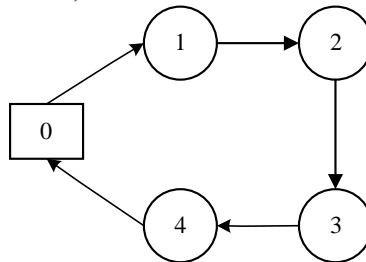


LAMPIRAN

Lampiran 1 (Rute Aktual Distribusi)



Gambar 0.1 Rute Aktual Pengiriman (Rute 1)

Tabel 0.1 Jarak Rute Aktual Pengiriman (Rute 1)

No	Ritel	Jarak (km)	Tujuan
0	Gudang	8.9	CFC Transmart Rungkut
1	CFC Transmart Rungkut	6.8	Maspion Square
2	Maspion Square	6.2	CFC Bungurasih
3	CFC Bungurasih	12.4	Transmart Sidoarjo (Pagerwojo)
4	Transmart Sidoarjo (Pagerwojo)	12.3	Gudang
Total jarak		46.6	

Total Kunjungan = 5

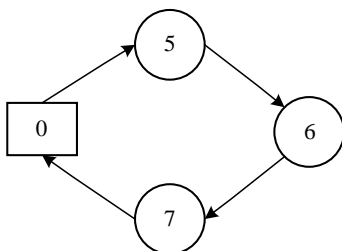
Total Supir = 2

Tabel 0.2 Waktu Rute Aktual Pengiriman (Rute 1)

Waktu Rute 1		Rumus
Durasi pengiriman (menit)	55.92	(total jarak/50)*60
Waktu Loading dan unloading (30 menit/kunjungan)	150	30*total kunjungan
Total waktu (menit)	205.92	
	2	
Total waktu (jam)	3.43	
Total hari	1.00	1 hari =12 jam

Tabel 0.3 Biaya Rute Aktual Pengiriman (Rute 1)

	Biaya	Rumus
BBM (Solar)	Rp60,021	Total jarak*biaya BBM
Uang Makan	Rp120,000	Jumlah supir*uang makan*Total hari
Hotel	Rp0	Biaya hotel*jumlah supir
Parkir	Rp25,000	Biaya parkir*total ritel
Toll dan lain - lain	Rp250,000	biaya toll dll*total ritel
Total	Rp455,021	



Gambar 0.2 Rute Aktual Pengiriman (Rute 2)

Tabel 0.4 Jarak Rute Aktual Pengiriman (Rute 2)

No	Ritel	Jarak (km)	Tujuan
0	Gudang	19.7	CFC Tidar
5	CFC Tidar	20.9	CFC Icon Mall Gresik
6	CFC Icon Mall Gresik	7.5	CFC Ramayana Gresik
7	CFC Ramayana Gresik	39.6	Gudang
	Total jarak	87.7	

Total Kunjungan = 4

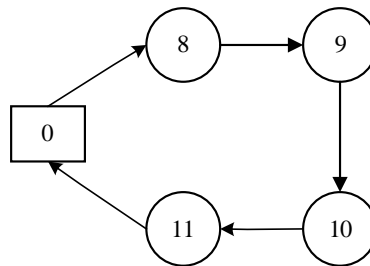
Total Supir = 2

Tabel 0.5 Waktu Rute Aktual Pengiriman (Rute 2)

Waktu Rute 2		Rumus
Durasi pengiriman (menit)	105.2 4	(total jarak/50)*60
Waktu Loading dan unloading (30 menit/kunjungan)	120	30*total kunjungan
Total waktu (menit)	225.2 4	
Total waktu (jam)	3.75	
Total hari	1.00	1 hari =12 jam

Tabel 0.6 Biaya Rute Aktual Pengiriman (Rute 2)

	Biaya	Rumus
BBM (Solar)	Rp112,958	Total jarak*biaya BBM
Uang Makan	Rp120,000	Jumlah supir*uang makan*Total hari
Hotel	Rp0	Biaya hotel*jumlah supir
Parkir	Rp20,000	Biaya parkir*total kunjungan
Toll dan lain - lain	Rp200,000	biaya toll dll*total kunjungan
Total	Rp452,958	



Gambar 0.3 Rute Aktual Pengiriman (Rute 3)

Tabel 0.7 Jarak Rute Aktual Pengiriman (Rute 3)

No	Ritel	Jarak (km)	Tujuan
0	Gudang	20.7	CFC Atom
8	CFC Atom	2.6	CFC Kaza City
9	CFC Kaza City	3.6	CFC WTC
10	CFC WTC	2.8	CFC Stasiun Gubeng
11	CFC Stasiun Gubeng	18.1	Gudang
	Total jarak	47.8	

Total Kunjungan = 5

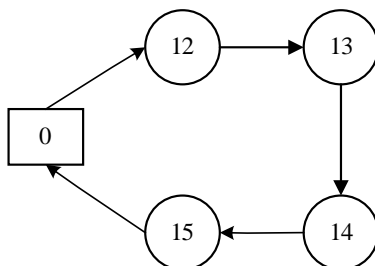
Total Supir = 2

Tabel 0.8 Waktu Rute Aktual Pengiriman (Rute 3)

Waktu Rute 3		Rumus
Durasi pengiriman (menit)	57.36	(total jarak/50)*60
Waktu Loading dan unloading (30 menit/kunjungan)	150	30*total kunjungan
Total waktu (menit)	207.36	
	6	
Total waktu (jam)	3.46	
Total hari	1.00	1 hari =12 jam

Tabel 0.9 Biaya Rute Aktual Pengiriman (Rute 3)

	Biaya	Rumus
BBM (Solar)	Rp61,566	Total jarak*biaya BBM
Uang Makan	Rp120,000	Jumlah supir*uang makan*Total hari
Hotel	Rp0	Biaya hotel*jumlah supir
Parkir	Rp25,000	Biaya parkir*total kunjungan
Toll dan lain - lain	Rp250,000	biaya toll dll*total kunjungan
Total	Rp456,566	



Gambar 0.4 Rute Aktual Pengiriman (Rute 4)
 Tabel 0.10 Jarak Rute Aktual Pengiriman (Rute 4)

No	Ritel	Jarak (km)	Tujuan
0	Gudang	146	CFC Lumajang
12	CFC Lumajang	63.4	Transmart Jember
13	Transmart Jember	3.2	CFC Lippo Plaza Jember
14	CFC Lippo Plaza Jember	2.9	Golden Market Jember
15	Golden Market Jember	194	Gudang
Total jarak		409.5	

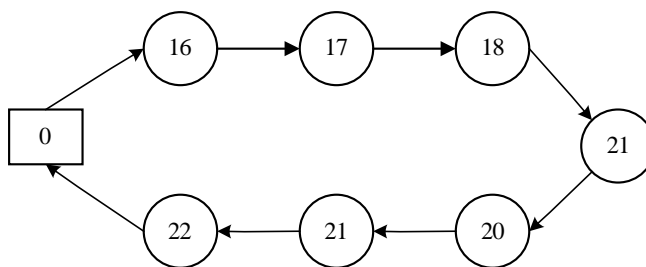
Total Kunjungi = 5
 Total Supir = 2

Tabel 0.11 Waktu Rute Aktual Pengiriman (Rute 4)

Waktu Rute 4		Rumus
Durasi pengiriman (menit)	491.4	(total jarak/50)*60
Waktu Loading dan unloading (30 menit/kunjungan)	150	30*total kunjungan
Total waktu (menit)	641.4	
Total waktu (jam)	10.69	
Total hari	1.00	1 hari =12 jam

Tabel 0.12 Biaya Rute Aktual Pengiriman (Rute 4)

	Biaya	Rumus
BBM (Solar)	Rp527,436	Total jarak*biaya BBM
Uang Makan	Rp120,000	Jumlah supir*uang makan*Total hari
Hotel	Rp0	Biaya hotel*jumlah supir
Parkir	Rp25,000	Biaya parkir*total kunjungan
Toll dan lain - lain	Rp250,000	biaya toll dll*total kunjungan
Total	Rp922,436	



Gambar 0.5 Rute Aktual Pengiriman (Rute 5)
Tabel 0.13 Jarak Rute Aktual Pengiriman (Rute 5)

No	Ritel	Jarak (km)	Tujuan
0	Gudang	49.3	Sunrise Mall Mojokerto
16	Sunrise Mall Mojokerto	80.1	Kediri Town Square
17	Kediri Town Square	1.1	Stasiun Kediri
18	Stasiun Kediri	89	Plaza Madiun
19	Plaza Madiun	5.4	CFC SunCity Madiun
20	CFC SunCity Madiun	3.1	Stasiun Madiun
21	Stasiun Madiun	32.3	CFC Ponorogo City Center
22	CFC Ponorogo City Center	193	Gudang
	Total jarak	453.3	

Total Kunjungan = 8

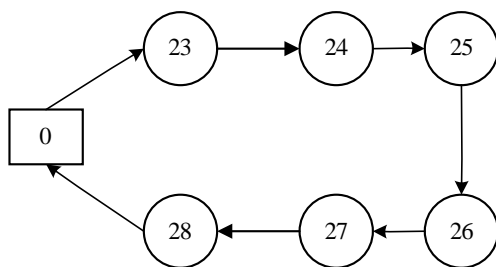
Total Supir = 2

Tabel 0.14 Waktu Rute Aktual Pengiriman (Rute 5)

Waktu Rute 5		Rumus
Durasi pengiriman (menit)	543.96	(total jarak/50)*60
Waktu Loading dan unloading (30 menit/ kunjungan)	240	30*total kunjungan
Total waktu (menit)	783.96	
Total waktu (jam)	13.07	
Total hari	2.00	1 hari =12 jam

Tabel 0.15 Biaya Rute Aktual Pengiriman (Rute 5)

	Biaya	Rumus
BBM (Solar)	Rp583,850	Total jarak*biaya BBM
Uang Makan	Rp240,000	Jumlah supir*uang makan*Total hari
Hotel	Rp300,000	Biaya hotel*jumlah supir
Parkir	Rp40,000	Biaya parkir*total kunjugan
Toll dan lain - lain	Rp400,000	biaya toll dll*total kunjungan
Total	Rp1,563,850	



Gambar 0.6 Rute Aktual Pengiriman (Rute 6)
Tabel 0.16 Jarak Rute Aktual Pengiriman (Rute 6)

No	Ritel	Jarak (km)	Tujuan
0	Gudang	102	CFC Jatimpark
23	CFC Jatimpark	14.9	Malang Town Square (Matos)
24	Malang Town Square (Matos)	3.6	Stasiun Malang
25	Stasiun Malang	3.1	Giant Sawojajar
26	Giant Sawojajar	4	Matahari Mitra Malang
27	Matahari Mitra Malang	74.3	CFC Blitar Square
28	CFC Blitar Square	166	Gudang
Total jarak		367.9	

Total Kunjungan = 7

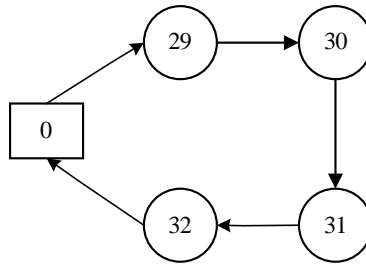
Total Supir = 2

Tabel 0.17 Waktu Rute Aktual Pengiriman (Rute 6)

Waktu Rute 6		Rumus
Durasi pengiriman (menit)	441.48	(total jarak/50)*60
Waktu Loading dan unloading (30 menit/ kunjungan)	210	30*total kunjungan
Total waktu (menit)	651.48	
Total waktu (jam)	10.86	
Total hari	1.00	1 hari =12 jam

Tabel 0.18 Biaya Rute Aktual Pengiriman (Rute 6)

	Biaya	Rumus
BBM (Solar)	Rp473,855	Total jarak*biaya BBM
Uang Makan	Rp120,000	Jumlah supir*uang makan*Total hari
Hotel	Rp300,000	Biaya hotel*jumlah supir
Parkir	Rp35,000	Biaya parkir*total kunjungan
Toll dan lain - lain	Rp350,000	biaya toll dll*total kunjungan
Total	Rp1,278,855	



Gambar 0.7 Rute Aktual Pengiriman (Rute 7)
Tabel 0.19 Jarak Rute Aktual Pengiriman (Rute 7)

No	Ritel	Jarak (km)	Tujuan
0	Gudang	235	CFC Cepu
29	CFC Cepu	85	CFC Purwodadi
30	CFC Purwodadi	48	CFC Pati
31	CFC Pati	28	CFC Kudus
32	CFC Kudus	330	Gudang
	Total jarak	726	

Total Kunjungan = 5

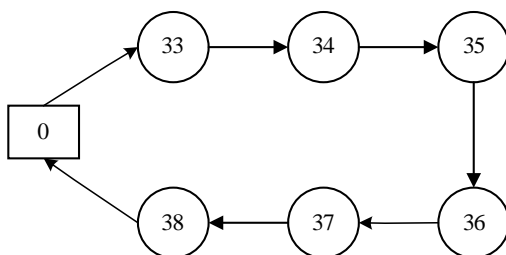
Total Supir = 2

Tabel 0.20 Waktu Rute Aktual Pengiriman (Rute 7)

Waktu Rute 7		Rumus
Durasi pengiriman (menit)	871.2	(total jarak/50)*60
Waktu Loading dan unloading (30 menit/kunjungan)	150	30*total kunjungan
Total waktu (menit)	1021.2	
Total waktu (jam)	17.02	
Total hari	2.00	1 hari =12 jam

Tabel 0.21 Biaya Rute Aktual Pengiriman (Rute 7)

	Biaya	Rumus
BBM (Solar)	Rp935,088	Total jarak*biaya BBM
Uang Makan	Rp240,000	Jumlah supir*uang makan*Total hari
Hotel	Rp300,000	Biaya hotel*jumlah supir
Parkir	Rp25,000	Biaya parkir*total kunjungan
Toll dan lain - lain	Rp250,000	biaya toll dll*total kunjungan
Total	Rp1,750,088	



Gambar 0.8 Rute Aktual Pengiriman (Rute 8)
Tabel 0.22 Jarak Rute Aktual Pengiriman (Rute 8)

No	Ritel	Jarak (km)	Tujuan
0	Gudang	260	Rest area KM 519 A SOKER
33	Rest area KM 519 A SOKER	20	Rest area KM 519 B Masaran
34	Rest area KM 519 B Masaran	24	Transmart Solo Pabelan
35	Transmart Solo Pabelan	7	Stasiun Solo Balapan
36	Stasiun Solo Balapan	3	Grandmall Solo
37	Grandmall Solo	7	CFC Hartono Mall Solo
38	CFC Hartono Mall Solo	259	Gudang
Total jarak		580	

Total Kunjungan = 7

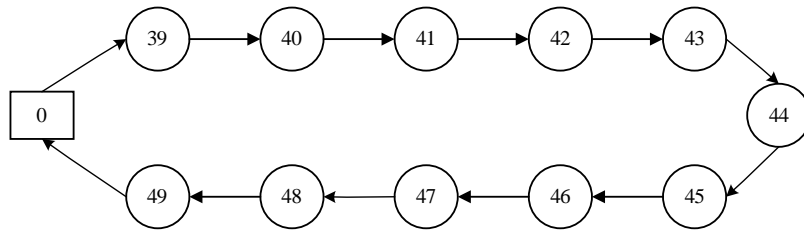
Total Supir = 2

Tabel 0.23 Waktu Rute Aktual Pengiriman (Rute 8)

Waktu Rute 8		Rumus
Durasi pengiriman (menit)	696	(total jarak/50)*60
Waktu Loading dan unloading (30 menit/kunjungan)	210	30*total kunjungan
Total waktu (menit)	906	
Total waktu (jam)	15.10	
Total hari	2.00	1 hari =12 jam

Tabel 0.24 Biaya Rute Aktual Pengiriman (Rute 8)

	Biaya	Rumus
BBM (Solar)	Rp747,040	Total jarak*biaya BBM
Uang Makan	Rp240,000	Jumlah supir*uang makan*Total hari
Hotel	Rp300,000	Biaya hotel*jumlah supir
Parkir	Rp35,000	Biaya parkir*total kunjungan
Toll dan lain - lain	Rp350,000	biaya toll dll*total kunjungan
Total	Rp1,672,040	



Gambar 0.9 Rute Aktual Pengiriman (Rute 9)
Tabel 0.25 Jarak Rute Aktual Pengiriman (Rute 9)

No	Ritel	Jarak (km)	Tujuan
0	Gudang	312	Bandara adisutjipto
39	Bandara adisutjipto	4	CFC Transmart Maguwo
40	CFC Transmart Maguwo	9.5	CFC Ramai Mall
41	CFC Ramai Mall	0.9	CFC Progo Jogja
42	CFC Progo Jogja	1.7	Stasiun Lempuyangan
43	Stasiun Lempuyangan	75.6	CFC Stasiun Kutoarjo
44	CFC Stasiun Kutoarjo	24.4	CFC Kebumen
45	CFC Kebumen	77.2	Rita Mall Purwokerto
46	Rita Mall Purwokerto	1.7	CFC Stasiun Purwokerto
47	CFC Stasiun Purwokerto	144	CFC Artos Mall
48	CFC Artos Mall	31.9	CFC Sleman City hall
49	CFC Sleman City hall	323	Gudang
	Total jarak	1005.9	

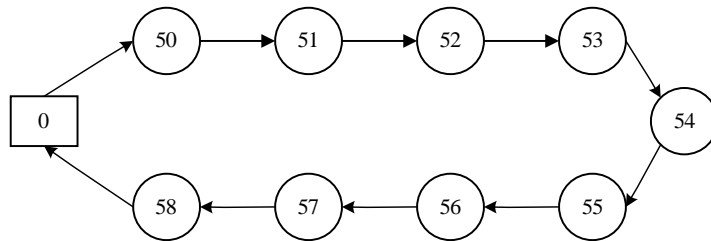
Total Kunjungan = 12
Total Supir = 2

Tabel 0.26 Waktu Rute Aktual Pengiriman (Rute 9)

Waktu Rute 9		Rumus
Durasi pengiriman (menit)	1207.08	(total jarak/50)*60
Waktu Loading dan unloading (30 menit/kunjungan)	360	30*total kunjungan
Total waktu (menit)	1567.08	
Total waktu (jam)	26.12	
Total hari	3.00	1 hari =12 jam

Tabel 0.27 Biaya Rute Aktual Pengiriman (Rute 9)

	Biaya	Rumus
BBM (Solar)	Rp1,295,599	Total jarak*biaya BBM
Uang Makan	Rp360,000	Jumlah supir*uang makan*Total hari
Hotel	Rp300,000	Biaya hotel*jumlah supir
Parkir	Rp60,000	Biaya parkir*total kunjungan
Toll dan lain - lain	Rp600,000	biaya toll dll*total kunjungan
Total	Rp2,615,599	



Gambar 0.10 Rute Aktual Pengiriman (Rute 10)

Tabel 0.28 Jarak Rute Aktual Pengiriman (Rute 10)

No	Ritel	Jarak (km)	Tujuan
0	Gudang	358	CFC Lawang sewu
50	CFC Lawang sewu	6.7	CFC Stasiun Poncol
51	CFC Stasiun Poncol	1.9	CFC Stasiun Tawang
52	CFC Stasiun Tawang	8.8	CFC Fatmawati
53	CFC Fatmawati	10.6	CFC Siliwangi
54	CFC Siliwangi	4.3	Plaza Simpang lima (Simpang lima)
55	Plaza Simpang lima (Simpang lima)	4.7	CFC Majapahit
56	CFC Majapahit	9.1	CFC Paragon Mall
57	CFC Paragon Mall	24.5	CFC Rest area KM 429 (Ungaran)
58	CFC Rest area KM 429 (Ungaran)	343	Gudang
	Total jarak	771.6	

Total Kunjungan = 10

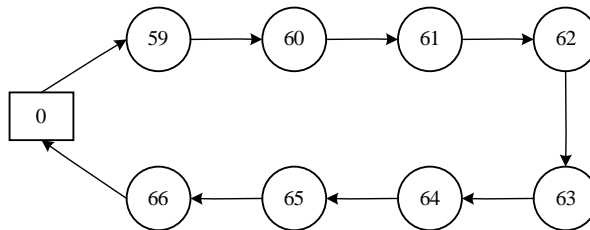
Total Supir = 2

Tabel 0.29 Waktu Rute Aktual Pengiriman (Rute 10)

Waktu Rute 10		Rumus
Durasi pengiriman (menit)	925.92	(total jarak/50)*60
Waktu Loading dan unloading (30 menit/kunjungan)	270	30*total kunjungan
Total waktu (menit)	1195.92	
Total waktu (jam)	19.93	
Total hari	2.00	1 hari =12 jam

Tabel 0.30 Biaya Rute Aktual Pengiriman (Rute 10)

	Biaya	Rumus
BBM (Solar)	Rp993,821	Total jarak*biaya BBM
Uang Makan	Rp240,000	Jumlah supir*uang makan*Total hari
Hotel	Rp300,000	Biaya hotel*jumlah supir
Parkir	Rp50,000	Biaya parkir*total kunjungan
Toll dan lain - lain	Rp500,000	biaya toll dll*total kunjungan
Total	Rp2,083,821	



Gambar 0.11 Rute Aktual Pengiriman (Rute 11)

Tabel 0.31 Jarak Rute Aktual Pengiriman (Rute 11)

No	Ritel	Jarak (km)	Tujuan
0	Gudang	433	Matahari Pekalongan
59	Matahari Pekalongan	2.4	CFC Stasiun Pekalongan
60	CFC Stasiun Pekalongan	32.5	CFC Pemalang
61	CFC Pemalang	31.5	CFC Stasiun Tegal
62	CFC Stasiun Tegal	3.4	Rita SuperMall Tegal
63	Rita SuperMall Tegal	78.6	CFC Rest area KM 294 B
64	CFC Rest area KM 294 B	34.7	CFC Rest area KM 260 PG
65	CFC Rest area KM 260 PG	10.9	CFC Toserba Yogya (Brebes)
66	CFC Toserba Yogya (Brebes)	23.8	CFC Slawi
67	CFC Slawi	495	Gudang
Total jarak		1145.8	

Total Kunjungan = 10

Total Supir = 2

Tabel 0.32 Waktu Rute Aktual Pengiriman (Rute 11)

Waktu Rute 11		Rumus
Durasi pengiriman (menit)	1374.96	(total jarak/50)*60
Waktu Loading dan unloading (30 menit/kunjungan)	300	30*total kunjungan
Total waktu (menit)	1674.96	
Total waktu (jam)	27.92	
Total hari	3.00	1 hari =12 jam

Tabel 0.33 Biaya Rute Aktual Pengiriman (Rute 11)

	Biaya	Rumus
BBM (Solar)	Rp1,475,790	Total jarak*biaya BBM
Uang Makan	Rp360,000	Jumlah supir*uang makan*Total hari
Hotel	Rp300,000	Biaya hotel*jumlah supir
Parkir	Rp50,000	Biaya parkir*total kunjungan
Toll dan lain - lain	Rp500,000	biaya toll dll*total kunjungan
Total	Rp2,685,790	

Lampiran 2 (Data Ukuran Dan Berat Barang Jenis Dry Dan Frozen)

Tabel 0.34 Data Ukuran Dan Berat Barang Jenis Dry Dan Klasifikasi Volume Dan Berat

NO.	ITEM NUMBER	NAMA BARANG	UNIT	KUBIKASI (m3)	BERAT (kg)
<i>I</i>	<i>1003.</i>	<i>BAHAN MAKANAN</i>			
1	1003.11.176	BD 1	KG	0.17*0.25*0.028	1
2	1003.11.190	BD 2	PK	0.17*0.1*0.05	0.2
3	1003.11.193	BD 3	PK	0.25*0.06*0.03	0.45
4	1003.11.177	BD 4	BL	0.5*0.37*0.16	25
5	1003.11.263	BD 5	PK	0.22*0.22*0.04	1
<i>II</i>	<i>1005.</i>	<i>BAHAN MINUMAN</i>			
6	1005.11.125	BD 6	PC	0.055*0.055*0.09	0.0017
7	1005.11.122	BD7	PK	0.22*0.16*0.05	0.95
8	1005.11.124	BD 8	PK	0.16*0.12*0.06	0.5
9	1005.11.076	BD 9	BX	0.15*0.3*0.4	4
10	1005.12.020	BD 10	PC	0.05*0.0375*0.2	0.19
11	1005.12.019	BD 11	BT	0.1*0.1*0.22	2.1
<i>III</i>	<i>1007.</i>	<i>BAHAN PELENGKAP</i>			
12	1007.11.213	BD 12	BOX	0.35*0.25*0.25	10
13	1007.11.192	BD 13	PC	0.1*0.1*0.035	0.2
14	1007.11.196	BD 14	PK	0.3*0.21*0.05	1
15	1005.11.159	BD 15	PC	0.15*0.06*0.02	0.06
16	1007.11.041	BD 16	PK	0.2*0.1*0.02	0.5
17	1007.11.199	BD 17	KG	0.2*0.2*0.04	2
18	1007.11.194	BD 18	BTL	0.1*0.1*0.31	2
19	1007.11.204	BD 19	KL	0.3*0.3*0.37	18
20	1007.11.382	BD 20	BX	0.2*0.3*0.5	25
21	1007.11.383	BD 21	BX	0.2*0.3*0.5	30
<i>IV</i>	<i>1008.</i>	<i>BAHAN PREMIK & BUMBU</i>			

NO.	ITEM NUMBER	NAMA BARANG	UNIT	KUBIKASI (m3)	BERAT (kg)
22	1008.11.045	BD 22	PK	0.17*0.13*0.02	0.5
23	1008.11.047	BD 23	PK	0.25*0.23*0.02	1.3
V	1009.	<i>BAHAN SAUCE & SAMBAL</i>			
24	1009.11.022	BD 24	PK	0.14*0.16*0.02	0.43
25	1009.11.012	BD 25	JR	0.24*0.27*0.42	18
26	1009.11.013	BD 26	BX	0.2*0.26*0.4	4
27	1009.11.015	BD 27	BX	0.42*0.35*0.14	4
VI	1010.	<i>BAHAN PEMBUNGKUS</i>			
28	1010.11.005	BD 28	PC	0.5*0.2*0.1	0.1
29	1010.11.181	BD 29	PC	0.004*0.12*0.12	0.025
30	1010.11.219	BD 30	PC	0.21*0.16*0.01	0.068
31	1010.11.182	BD 31	PC	0.13*0.1*0.006	0.034
32	1010.11.178	BD 32	PC	0.006*0.15*0.15	0.001
33	1010.11.016	BD 33	PC	0.01*0.1*0.1	0.008
34	1010.11.018	BD 34	PC	0.001*0.15*0.03	0.001
35	1010.11.025	BD 35	PC	0.12*0.1*0.001	0.0007
36	1010.11.183	BD 36	PC	0.13*0.14*0.001	0.0075
37	1010.11.188	BD 37	PC	0.16*0.02*0.01	0.003
38	1010.11.030	BD 38	KG	0.27*0.26*0.028	0.9
39	1010.11.031	BD 39	KG	0.2*0.22*0.028	0.83
40	1010.11.180	BD 40	PC	0.2*0.1*0.001	0.0062
41	1010.11.083	BD 41	PC	0.27*0.25*0.0001	0.001
42	1010.11.084	BD 42	PC	0.28*0.15*0.0001	0.0001
43	1010.11.202	BD 43	PK	0.13*0.09*0.09	0.5
44	1010.11.087	BD 44	PC	0.13*0.09*0.07	0.003
45	1010.11.187	BD 45	PC	0.23*0.02*0.002	0.003
46	1010.11.092	BD 46	PC	0.2*0.1*0.02	0.2
47	1010.11.093	BD 47	BX	0.49*0.3*0.32	2
48	1010.11.147	BD 48	PC	0.2*0.14*0.05	0.1
49	1010.11.098	BD 49	PC	0.32*0.31*0.0001	0.002
50	1010.11.099	BD 50	RL	0.3*0.12*0.12	2.4

NO.	ITEM NUMBER	NAMA BARANG	UNIT	KUBIKASI (m3)	BERAT (kg)
51	1010.11.104	BD 51	PK	0.15*0.1*0.1	0.26
52	1010.11.145	BD 52	PC	0.09*0.09*0.007	0.0002
53	1010.11.110	BD 53	PC	0.013*0.09*0.09	0.016
54	1010.11.112	BD 54	PC	0.012*0.07*0.07	0.016
55	1010.11.020	BD 55	PK	0.09*0.09*0.007	0.003
56	1010.11.116	BD 56	RL	0.22*0.15*0.15	2
57	1010.11.125	BD 57	PC	0.09*0.09*0.003	0.007
58	1010.11.046	BD 58	PC	0.1*0.1*0.006	0.0002
59	1010.11.131	BD 59	PC	0.09*0.09*0.012	0.003
60	1010.11.132	BD 60	PC	0.09*0.09*0.007	0.0002
61	1010.11.229	BD 61	RIM	0.36*0.25*0.05	3
62	1010.11.195	BD 62	PC	0.08*0.08*0.009	0.003
63	1010.11.137	BD 63	PC	0.08*0.08*0.009	0.003
64	1010.11.122	BD 64	PK	0.18*0.14*0.08	0.14
65	1010.11.196	BD 65	PC	0.13*0.13*0.0032	0.003
66	1010.11.197	BD 66	PC	0.13*0.13*0.0033	0.003
<i>VII</i>	<i>1010.</i>	<i>BAHAN PEBERSIH</i>			
67	2002.11.001	BD 67	JR	0.13*0.18*0.4	1
68	2002.11.003	BD 68	JR	0.32*0.17*0.1	5
69	2002.11.004	BD 69	KG	0.34*0.4*0.39	1
70	2002.11.005	BD 70	JR	0.32*0.17*0.1	5
71	2002.11.007	BD 71	PC	0.465*0.42*0.0045	0.03
72	2002.11.008	BD 72	PC	0.07*0.07*0.4	0.03
73	2002.11.027	BD 73	PC	0.7*0.5*0.07	0.355
74	2002.11.010	BD 74	JR	0.32*0.17*0.1	5
75	2006.11.091	BD 75	PC	0.35*0.19*0.09	0.5
76	2002.11.025	BD 76	PC	0.42*0.06*0.06	0.03
77	2002.11.026	BD 77	PC	0.51*0.33*0.0045	0.03
78	1010.11.203	BD 78	PC	0.33*0.15*0.00006	0.0017
<i>138</i>	<i>2003.</i>	<i>KANTOR</i>			
79	2003.14.006	BD 79	RL	0.05*0.05*0.06	0.09
80	2003.14.004	BD 80	RL	0.08*0.08*0.05	0.17

NO.	ITEM NUMBER	NAMA BARANG	UNIT	KUBIKASI (m3)	BERAT (kg)
<i>IX</i>	<i>2004.</i>	<i>UTENSIL</i>			
81	2003.14.010	BD 81	RL	0.05*0.05*0.08	0.12
82	2004.13.099	BD 82	PC	0.28*0.05*0.02	0.002
83	2004.13.100	BD 83	PC	0.28*0.05*0.02	0.002
84	2004.13.101	BD 84	PC	0.28*0.05*0.02	0.002
85	2004.13.336	BD 85	ST	0.3*0.16*0.01	0.23
86	2004.13.339	BD 86	PC	0.28*0.15*0.02	0.06
87	2004.13.344	BD 87	ST	0.3*0.16*0.01	0.09
<i>X</i>	<i>2006.</i>	<i>SOUVENIR</i>			
88	2006.11.046	BD 88	PC	0.36*0.28*0.02	0.23
89	2006.11.047	BD 89	PC	0.7*0.13*0.05	0.7
90	2006.11.048	BD 90	PC	0.14*0.14*0.03	2.5
91	2006.11.067	BD 91	PC	0.84*0.05*0.05	0.55
92	2006.11.106	BD 92	PC	0.13*0.13*0.012	0.05

Tabel 00.35 Data Ukuran Dan Berat Barang Jenis Frozen Dan Klasifikasi Volume Dan Berat

N O	ITEM NUMBER	NAMA BARANG	UNI T	KUBIKASI (m3)	BERAT (kg)
<i>I</i>	<i>1002.</i>	<i>BAHAN AYAM</i>			
1	1002.12.01 2	BF 1	EK	0.1*0.3*0.1	1
2	1002.12.01 3	BF 2	PK	0.1*0.3*0.15	1
<i>II</i>	<i>1003</i>	<i>BAHAN MAKANAN</i>			
3	1003.12.14 9	BF 3	PK	0.15*0.1*0.11	1
4	1003.12.12 2	BF 4	PK	0.3*0.46*0.24	9
5	1003.11.17 8	BF 5	PK	0.12*0.05*0.1 3	0.17
6	1003.12.13 3	BF 6	PC		0.07
7	1003.11.22 3	BF 7	KL	0.4*0.3*0.11	1
8	1003.12.11 9	BF 8	BX	0.31*0.29*0.2	6
9	1003.12.12 1	BF 9	KG	0.2*0.2*0.09	1
10	1003.12.13 5	BF 10	KG	0.15*0.1*0.2	1
<i>III</i>	<i>1005</i>	<i>BAHAN MINUMAN</i>			
11	1007.11.21 0	BF 11	PK	0.15*0.03*0.2 4	0.3
12	1003.12.14 5	BF 12	PK	0.15*0.05*0.2 4	0.69
13	1005.12.00 6	BF 13	PL	0.2*0.2*0.3	8
14	1005.12.00 7	BF 14	PL	0.2*0.2*0.3	8
15	1005.12.00 8	BF 15	PL	0.2*0.2*0.3	8

N O	ITEM NUMBER	NAMA BARANG	UNI T	KUBIKASI (m3)	BERAT (kg)
<i>IV</i>	<i>1007</i>	<i>BAHAN PELENGKAP</i>			
16	1007.12.01 0	BF 16	PK	0.15*0.2*0.1	1
17	1007.11.36 9	BF 17	PK	0.15*0.2*0.1	1
<i>V</i>	<i>1008</i>	<i>BAHAN PREMİK & BUMBU</i>			
18	1008.12.08 1	BF 18	PK	0.25*0.25*0.5	1
19	1008.12.07 4	BF 19	PK	0.1*0.15*0.05	0.3
20	1008.12.07 5	BF 20	PK	0.25*0.25*0.5	1
21	1008.12.04 5	BF 21	PK	0.25*0.15*0.1	0.3
22	1008.12.04 6	BF 22	PK	0.1*0.15*0.05	0.5
23	1008.12.07 8	BF 23	PK	0.1*0.15*0.05	0.3

Lampiran 3 (Data Alamat Ritel)

Tabel 00.36 Data Alamat Ritel

No.	Ritel	Alamat
0	Gudang CFC Surabaya	Jl. Bypass Juanda Baru, Pergudangan Ramajaya no 10-11, Kab. Sidoarjo
1	CFC Transmart Rungkut	Jl. Raya Rungkut No.25, Kali Rungkut, Kec. Rungkut, Kota SBY
2	Maspion Square	Jl. Ahmad Yani No.73, Dukuh Menanggal, Kec. Gayungan, Kota SBY
3	CFC Bungurasih	Jl. Kasian, Bungurasih, Kec. Waru, Kabupaten Sidoarjo
4	Transmart Sidoarjo (Pagerwojo)	Jl KH. Ali Masud, Nggrekmas, Pagerwojo, Kabupaten Sidoarjo
5	CFC Tidar	Jl. Tidar No.99, Surabaya
6	CFC Icon Mall Gresik	Jl. Dr. Wahidin S.H. No. 788, Krembangan, Gresik
7	CFC Ramayana Gresik	Jl. Gubernur Suryo No. 31, Karangturi, Gresik
8	CFC Atom	Mall Ps. Atum, Jl. Bunguran No.45, Bongkaran, Pabean Cantian, Surabaya
9	CFC Kaza City	Kaza Mall Jl. Kapas Krampung No. 45, Surabaya
10	CFC WTC	Jl. Plaza Boulevard-Wtc, Embong Kaliasin, Kec. Genteng, Kota SBY
11	CFC Stasiun Gubeng	Jl. Gubeng Masjid No. 35, Surabaya
12	CFC Lumajang	Jurang Mangu, Labruk Lor, Lumajang,
13	Transmart Jember	Jl. Hayam Wuruk No.71, Gerdu, Kabupaten Jember,
14	CFC Lippo Plaza Jember	Ledok, Jember Kidul, Kec. Kaliwates, Kabupaten Jember,
15	Golden Market Jember	Jl. Trunojoyo No. 42, Jember
16	Sunrise Mall Mojokerto	Jl. Benteng Pancasila, Mojokerto
17	Kediri Town Square	Jl. Hasanuddin No. 2, Kediri
18	Stasiun Kediri	Jl. Stasiun, Balowerti, Kota Kediri
19	Plaza Madiun	Jl. Pahlawan No. 38-40, Madiun
20	CFC SunCity Madiun	Jl. Letjend. S. Parman No.8, Madiun
21	Stasiun Madiun	Jl. Kompol Sunaryo No. 6A, Madiun

No.	Ritel	Alamat
22	CFC Ponorogo City Center	Jl. Ir. Juanda No. 12-21, Ponorogo
23	CFC Jatimpark	Jl. Oro-oro Ombo No. 9, Batu
24	Malang Town Square (Matos)	Jl. Veteran No. 2, Malang
25	Stasiun Malang	Jl. Trunojoyo No.10
26	Giant Sawojajar	Jl. Danau Toba Giant Extra, Malang
27	Matahari Mitra Malang	l. KH. Agus Salim no 10-16, Sukoharjo, Klojen, Malang
28	CFC Blitar Square	Jl. Merdeka, Kepanjen Lor, Blitar
29	CFC Cepu	Jl. Randu Blatung No. 8, Blora
30	CFC Purwodadi	Jl. R. Soeprapto 93 B, Purwodadi
31	CFC Pati	Jl. Ki Juru Mertani, Cengkok, Sidoharjo Pati
32	CFC Kudus	Jl. Jepara No. 806, Kudus
33	Rest area KM 519 A SOKER	Dusun II, Karang Malang, Kec. Masaran, Kabupaten Sragen
34	Rest area KM 519 B Masaran	Jl Tol Solo Kertosono KM 519 B, Dusun II, Karang Malang, Masaran
35	Transmart Solo Pabelan	Jl. A. Yani No.234, Sukoharjo
36	Stasiun Solo Balapan	Jl. Wolter Monginsidi No.112, Surakarta
37	Grandmall Solo	Jl. Slamet Riyadi, Surakarta
38	CFC Hartono Mall Solo	Jl. Ir. Soekarno Madegondo Grogol, Sukoharjo
39	Bandara adisutjipto	Jl. Raya Solo KM.9, Maguwoharjo, Kabupaten Sleman, Yogyakarta
40	CFC Transmart Maguwo	Jl. Raya Solo KM 8 No.234, Yogyakarta
41	CFC Ramai Mall	Jl. Jend A. Yani 73, Yogyakarta
42	CFC Progo Jogja	Jl. Suryotomo No. 29 Ngupasan Ngondomanan
43	Stasiun Lempuyangan	Jl. Lempuyangan, Yogyakarta
44	CFC Stasiun Kutoarjo	Jl. Merpati, Kutoarjo, Purworejo
45	CFC Kebumen	Jl. Raya Kutoarjo KM 06, Kebumen
46	Rita Mall Purwokerto	Jl. Jend Sudirman No.296, Purwokerto

No.	Ritel	Alamat
47	CFC Stasiun Purwokerto	Jl. ST., Kober, Purwokerto Barat, Kab. Banyumas
48	CFC Artos Mall	Jl. Mayjen Bambang Soegeng No.1, Magelang
49	CFC Sleman City hall	Jl. Magelang KM 9,6 No 18, Sleman
50	CFC Lawang sewu	Jl. Pemuda, sekayu, semarang
51	CFC Stasiun Poncol	Jl. Imam Bonjol No. 155, Semarang
52	CFC Stasiun Tawang	Jl. Taman Tawang No. 1, Semarang
53	CFC Fatmawati	Jl. Fatmawati No.15, Semarang
54	CFC Siliwangi	Jl. M.G.R. Sugiopranoto No. 28-60, Semarang
55	Plaza Simpang lima (Simpang lima)	Jl. Achmad Yani No.1, Semarang
56	CFC Majapahit	Jl. Majapahit No. 236
57	CFC Paragon Mall	Jl. Pemuda No.118, Semarang
58	CFC Rest area KM 429 (Ungaran)	Jl Tol Semarang - Solo KM 22, Susukan, Ungaran Timur, Semarang
59	Matahari Pekalongan	Jl. Nusantara No. 5, Pekalongan
60	CFC Stasiun Pekalongan	Jl. Gajah mada Bar. No. 5, Pekalongan
61	CFC Pemalang	Jl. Jend. Sudirman No. 167, Pemalang
62	CFC Stasiun Tegal	Jl. Semeru No. 1, Tegal
63	Rita SuperMall Tegal	Jl. Kolonel Sugiono No.155 Tegal
64	CFC Rest area KM 294 B	Jl. Tol Pejagan - Pemalang, Suradadi, Kec. Suradadi, Tegal
65	CFC Rest area KM 260 PG	Cipugur, Banjartama, Kec. Bulakamba, Kabupaten Brebes
66	CFC Toserba Yogya (Brebes)	Jl. Jend Sudirman 109, Brebes
67	CFC Slawi	Jl. Jenderal Ahmad Yani No.18, Slawi, Tegal

Lampiran 4 (Matriks Jarak Antar Gudang Dan Tiap Ritel (km))

Tabel 00.37 Matriks Jarak Antar Gudang Dan Tiap Ritel (km)

	0	1	2	3	4	5	6	7	8	9	10
0	0	8.9	13.6	8.3	12.3	19.7	41.1	39.6	20.7	21.5	19.2
1	8.9	0	6.8	11.2	24	13.3	40.7	39.1	14.6	13.1	10.9
2	14	6.8	0	6.2	14.8	7.9	28.6	27	10.3	10.5	8.1
3	8.3	11.2	6.2	0	12.4	12.2	24.4	33	14.5	14.8	12.4
4	12	24	14.8	12.4	0	23.2	46.3	44.7	25.5	25.7	23.3
5	20	13.3	7.9	12.2	23.2	0	20.9	19.6	3.9	4.6	4.6
6	41	40.7	28.6	24.4	46.3	20.9	0	7.5	24.5	26.2	27.2
7	40	39.1	27	33	44.7	19.6	7.5	0	21.3	23	24
8	21	14.6	10.3	14.5	25.5	3.9	24.5	21.3	0	2.6	5.4
9	22	13.1	10.5	14.8	25.7	4.6	26.2	23	2.6	0	3.6
10	19	10.9	8.1	12.4	23.3	4.6	27.2	24	5.4	3.6	0
11	18	8.7	9.4	11.3	29.8	5.6	27.1	23.9	3.4	2.5	2.8
12	146	145	142	139	128	152	170	167	154	156	150
13	190	189	186	183	172	196	214	211	198	200	196
14	192	191	188	185	174	198	216	213	200	202	198
15	194	194	191	188	177	201	219	215	203	205	201
16	49	48.1	44.9	41.8	54	55.2	73	69.8	57	54.2	52.1
17	115	114	111	108	120	121	139	136	123	120	118
18	115	115	112	109	121	122	140	137	124	121	119
19	161	160	157	154	166	167	185	182	169	166	164
20	160	160	156	153	165	167	184	181	169	166	164
21	160	159	156	153	165	167	184	181	168	165	163
22	193	192	189	186	198	199	217	213	201	198	196
23	102	101	97.4	94.2	83.1	107	125	122	109	111	107
24	93	92.5	89.3	86.2	75.1	99.3	117	114	101	103	96.5
25	92	91.7	88.6	85.4	74.3	98.5	116	113	100	102	95.8
26	94	93.4	90.2	87.1	76	100	118	115	102	104	100
27	93	925	89.4	86.2	75.1	99.3	117	114	101	103	99.2
28	157	157	153	150	148	152	170	178	166	163	161
29	227	226	223	220	232	233	127	133	235	232	230
30	275	275	272	268	281	279	300	297	284	281	278

	0	1	2	3	4	5	6	7	8	9	10
31	324	323	320	317	329	226	208	215	228	230	230
32	322	324	321	315	327	325	238	343	330	327	325
33	252	251	248	245	257	256	276	273	260	258	255
34	234	234	230	228	240	238	259	255	242	240	237
35	258	257	254	251	263	261	282	279	266	263	261
36	254	253	250	247	259	257	278	275	262	259	256
37	256	255	252	249	261	260	281	277	264	262	259
38	259	259	255	252	265	263	284	280	268	265	263
39	312	311	308	305	317	315	336	333	320	317	315
40	316	315	312	309	321	319	340	337	324	321	319
41	321	321	318	314	327	325	346	342	330	327	324
42	321	321	318	315	327	325	346	343	330	327	325
43	320	319	316	313	325	323	344	341	328	325	323
44	398	398	395	392	404	402	423	420	407	404	401
45	422	422	418	415	427	426	447	443	430	428	425
46	548	548	545	542	554	552	573	570	557	554	551
47	548	547	544	541	553	552	573	569	556	554	551
48	341	341	337	334	347	345	366	362	350	347	344
49	323	323	320	317	329	327	348	345	332	329	326
50	353	352	349	346	358	359	377	374	361	363	356
51	353	352	349	346	358	356	377	374	361	358	356
52	351	351	348	344	357	355	376	372	360	357	354
53	348	347	344	341	353	352	372	369	356	354	351
54	347	347	344	341	353	351	372	369	356	353	350
55	347	346	343	340	353	351	372	368	356	353	350
56	345	345	342	339	351	349	370	367	354	351	348
57	353	353	350	347	359	357	378	375	362	359	356
58	343	343	339	336	349	347	368	364	352	349	346
59	433	433	430	426	439	437	458	454	442	439	436
60	435	434	431	428	440	438	459	456	443	440	438

	0	1	2	3	4	5	6	7	8	9	10
61	464	464	461	457	470	468	489	485	473	470	467
62	510	509	506	503	515	517	534	531	518	521	513
63	508	507	503	500	512	514	532	528	515	518	511
64	472	472	469	466	478	476	497	494	481	478	476
65	507	507	504	500	513	511	532	528	516	513	510
66	503	503	499	496	509	507	528	524	512	509	506
67	495	494	491	488	500	498	519	516	503	500	498

	11	12	13	14	15	16	17	18	19	20
0	18.1	146	190	192	194	49.3	115	115	161	160
1	8.7	145	189	191	194	48.1	114	115	160	160
2	9.4	142	186	188	191	44.9	111	112	157	156
3	11.3	139	183	185	188	41.8	108	109	154	153
4	29.8	128	172	174	177	54	120	121	166	165
5	5.6	152	196	198	201	55.2	121	122	167	167
6	27.1	170	214	216	219	73	139	140	185	184
7	23.9	167	211	213	215	69.8	136	137	182	181
8	3.4	154	198	200	203	57	123	124	169	169
9	2.5	156	200	202	205	54.2	120	121	166	166
10	2.8	150	196	198	201	52.1	118	119	164	164
11	0	149	193	195	198	52.1	118	119	164	163
12	149	0	63.4	64.1	66.9	176	242	242	288	287
13	193	63.4	0	3.2	5.9	218	284	285	330	330
14	195	64.1	3.2	0	2.9	222	288	288	334	333
15	198	66.9	5.9	2.9	0	223	289	289	335	334
16	52.1	176	218	222	223	0	80.1	80.8	126	125
17	118	242	284	288	289	80.1	0	1.1	89.4	88.7
18	119	242	285	288	289	80.8	1.1	0	89	88.1
19	164	288	330	334	335	126	89.4	89	0	5.4
20	163	287	330	333	334	125	88.7	88.1	5.4	0
21	163	287	330	333	334	125	88.5	88	1.7	3.1
22	196	319	362	365	366	158	96.1	95	32.5	32.6
23	105	166	209	212	213	63.3	83	84.5	164	162
24	96.5	158	201	204	205	124	96.4	97.8	236	235
25	95.7	157	200	203	204	123	99.9	189	236	234
26	97.4	159	201	205	206	124	191	191	237	235
27	96.5	158	201	204	205	124	100	190	236	235
28	161	158	274	277	278	122	45.8	46	135	133
29	230	354	396	400	401	192	155	155	86	84
30	279	402	445	448	449	241	204	203	134	133

	11	12	13	14	15	16	17	18	19	20
31	327	451	493	497	498	289	252	252	183	181
32	402	449	491	495	498	364	253	252	181	179
33	255	379	422	425	426	217	181	180	111	110
34	238	361	404	407	408	200	163	162	94	92
35	261	385	427	431	432	223	186	186	117	115
36	257	380	423	426	427	219	182	182	113	111
37	260	382	425	428	429	221	184	184	115	114
38	264	387	430	433	434	225	189	188	119	118
39	315	439	481	485	486	277	240	240	171	169
40	319	442	485	489	489	281	244	244	175	173
41	325	448	491	494	495	287	250	249	180	179
42	325	448	491	494	495	287	250	250	181	179
43	323	447	489	493	494	285	249	248	179	177
44	402	525	568	571	572	364	327	326	258	256
45	426	549	592	595	596	387	351	350	281	280
46	484	607	650	653	654	445	409	476	408	406
47	485	609	651	655	656	447	410	476	407	406
48	345	468	511	514	515	306	270	269	200	199
49	327	450	493	496	497	289	252	252	182	180
50	356	480	522	526	527	318	281	281	212	210
51	356	480	522	526	527	318	281	281	212	210
52	355	478	521	524	525	317	280	279	210	209
53	351	475	517	521	522	313	277	276	207	205
54	351	474	517	520	521	313	276	275	207	205
55	351	474	517	520	521	312	276	275	206	205
56	349	472	515	518	519	311	274	273	205	203
57	357	480	523	526	527	319	282	281	213	211
58	347	470	513	516	517	309	272	271	202	201
59	437	560	603	606	607	399	362	361	292	291
60	438	562	604	608	609	400	363	363	294	292

	11	12	13	14	15	16	17	18	19	20
61	468	591	634	637	638	430	393	392	323	322
62	514	637	680	683	684	475	439	438	369	368
63	510	634	677	680	681	472	436	435	366	365
64	476	599	642	645	646	438	401	401	332	330
65	511	634	677	680	681	473	436	435	366	365
66	507	630	673	676	677	469	432	431	362	361
67	498	622	664	668	669	460	423	423	354	352

	21	22	23	24	25	26	27	28	29	30
0	160	193	102	93	92.2	93.8	93	157	227	275
1	159	192	101	92.5	91.7	93.4	925	157	226	275
2	156	189	97.4	89.3	88.6	90.2	89.4	153	223	272
3	153	186	94.2	86.2	85.4	87.1	86.2	150	220	268
4	165	198	83.1	75.1	74.3	76	75.1	148	232	281
5	167	199	107	99.3	98.5	100	99.3	152	233	279
6	184	217	125	117	116	118	117	170	127	300
7	181	213	122	114	113	115	114	178	133	297
8	168	201	109	101	100	102	101	166	235	284
9	165	198	111	103	102	104	103	163	232	281
10	163	196	107	96.5	95.8	100	99.2	161	230	278
11	163	196	105	96.5	95.7	97.4	96.5	161	230	279
12	287	319	166	158	157	159	158	158	354	402
13	330	362	209	201	200	201	201	274	396	445
14	333	365	212	204	203	205	204	277	400	448
15	334	366	213	205	204	206	205	278	401	449
16	125	158	63.3	124	123	124	124	122	192	241
17	88.5	96.1	83	96.4	99.9	191	100	45.8	155	204
18	88	95	84.5	97.8	189	191	190	46	155	203
19	1.7	32.5	164	236	236	237	236	135	86	134
20	3.1	32.6	162	235	234	235	235	133	84	133
21	0	32.3	163	236	235	237	236	135	84	133
22	32.3	0	194	266	265	267	175	103	115	164
23	163	194	0	14.9	18.6	21.5	18.7	75.3	230	278
24	236	266	14.9	0	3.6	6.6	3.8	76.6	301	349
25	235	265	18.6	3.6	0	3.1	1.4	74.4	299	348
26	237	267	21.5	6.6	3.1	0	4	74.6	302	351
27	236	175	18.7	3.8	1.4	4	0	74.3	301	349
28	135	103	75.3	76.6	74.4	74.6	74.3	0	199	247
29	84	115	230	301	299	302	301	199	0	85
30	133	164	278	349	348	351	349	247	85	0

	21	22	23	24	25	26	27	28	29	30
31	181	212	327	398	396	399	398	296	102	48
32	179	210	325	396	394	397	396	294	134	50
33	110	140	255	326	325	328	326	224	129	72
34	92	123	237	309	307	310	308	206	111	62
35	115	146	261	332	331	333	332	230	135	66
36	111	142	256	328	326	329	328	225	130	62
37	114	144	259	330	329	332	330	228	133	65
38	118	147	262	333	332	335	333	231	136	68
39	169	200	315	386	384	387	386	284	189	123
40	173	204	319	390	388	391	390	287	192	126
41	179	209	324	395	394	397	395	293	198	132
42	179	210	324	396	394	397	396	293	198	132
43	177	208	323	394	393	395	394	292	197	131
44	256	287	425	473	471	474	472	370	275	174
45	280	310	425	496	495	498	496	394	299	198
46	406	436	551	623	621	624	622	520	425	279
47	406	436	551	622	621	624	622	520	425	279
48	199	229	344	415	414	417	415	313	218	117
49	180	212	326	398	396	399	398	295	200	134
50	210	242	356	427	426	428	427	325	230	71
51	210	241	356	427	425	428	427	325	230	65
52	209	240	354	425	424	427	425	323	228	64
53	205	238	351	422	421	423	422	320	225	55
54	205	236	350	422	420	423	422	319	224	71
55	205	235	350	421	420	423	421	319	224	69
56	203	234	348	420	418	421	419	317	222	56
57	211	242	356	427	426	429	427	325	230	66
58	201	231	346	417	416	419	417	315	220	82
59	291	321	436	507	506	509	507	405	310	164
60	292	323	438	509	508	510	509	407	312	166

	21	22	23	24	25	26	27	28	29	30
61	322	353	467	538	537	540	538	436	341	195
62	368	398	513	584	583	586	584	482	387	241
63	366	395	510	581	583	581	584	479	384	238
64	330	361	475	547	545	548	547	444	349	204
65	365	395	510	581	580	583	581	479	384	238
66	361	391	506	577	576	579	577	475	380	234
67	352	383	498	569	567	570	569	467	372	226

	31	32	33	34	35	36	37	38	39	40
0	324	322	252	234	258	254	256	259	312	316
1	323	324	251	234	257	253	255	259	311	315
2	320	321	248	230	254	250	252	255	308	312
3	317	315	245	228	251	247	249	252	305	309
4	329	327	257	240	263	259	261	265	317	321
5	226	325	256	238	261	257	260	263	315	319
6	208	238	276	259	282	278	281	284	336	340
7	215	343	273	255	279	275	277	280	333	337
8	228	330	260	242	266	262	264	268	320	324
9	230	327	258	240	263	259	262	265	317	321
10	230	325	255	237	261	256	259	263	315	319
11	327	402	255	238	261	257	260	264	315	319
12	451	449	379	361	385	380	382	387	439	442
13	493	491	422	404	427	423	425	430	481	485
14	497	495	425	407	431	426	428	433	485	489
15	498	498	426	408	432	427	429	434	486	489
16	289	364	217	200	223	219	221	225	277	281
17	252	253	181	163	186	182	184	189	240	244
18	252	252	180	162	186	182	184	188	240	244
19	183	181	111	94	117	113	115	119	171	175
20	181	179	110	92	115	111	114	118	169	173
21	181	179	110	92	115	111	114	118	169	173
22	212	210	140	123	146	142	144	147	200	204
23	327	325	255	237	261	256	259	262	315	319
24	398	396	326	309	332	328	330	333	386	390
25	396	394	325	307	331	326	329	332	384	388
26	399	397	328	310	333	329	332	335	387	391
27	398	396	326	308	332	328	330	333	386	390
28	296	294	224	206	230	225	228	231	284	287
29	102	134	129	111	135	130	133	136	189	192
30	48	50	72	62	66	62	65	68	123	126

	31	32	33	34	35	36	37	38	39	40
31	0	28	120	109	114	110	112	115	199	202
32	28	0	164	106	145	156	149	153	173	176
33	120	164	0	20	44	39	42	46	98	101
34	109	106	20	0	24	20	23	25	78	81
35	114	145	44	24	0	7	6	9	49	53
36	110	156	39	20	7	0	3	6	57	61
37	112	149	42	23	6	3	0	7	57	60
38	115	153	46	25	9	6	7	0	52	56
39	199	173	98	78	49	57	57	52	0	4
40	202	176	101	81	53	61	60	56	4	0
41	208	182	107	87	59	66	66	62	10	9.5
42	208	182	107	87	59	67	66	62	10	9.8
43	207	181	106	86	58	65	65	61	9	8.1
44	219	193	184	164	138	156	156	141	89	82
45	242	216	208	188	158	166	164	161	109	101
46	296	270	334	314	295	306	305	306	186	179
47	295	269	334	314	295	306	305	306	187	180
48	161	135	127	107	88	99	98	99	45	43.7
49	193	167	109	89	61	69	68	64	14	13.2
50	87	61	139	119	100	111	110	111	128	130
51	81	55	138	119	100	111	110	111	128	130
52	80	54	137	117	98	109	109	109	127	129
53	81	55	134	114	95	106	106	106	124	126
54	87	61	133	113	94	106	105	105	123	125
55	85	59	133	113	94	105	104	105	123	125
56	84	58	131	111	92	103	103	103	121	123
57	82	56	139	119	100	111	111	111	129	131
58	98	72	129	109	90	101	100	101	119	121
59	180	154	219	199	180	191	190	191	209	211
60	182	156	221	201	182	193	192	193	210	212

	31	32	33	34	35	36	37	38	39	40
61	211	185	250	230	211	222	222	222	240	242
62	257	231	296	276	257	268	267	268	286	288
63	254	228	293	273	254	265	264	265	283	285
64	220	194	258	238	219	231	230	230	248	250
65	254	228	293	273	254	265	264	265	283	285
66	250	224	289	269	250	261	260	261	279	281
67	242	216	280	261	242	253	252	253	270	272

	41	42	43	44	45	46	47	48	49	50
0	321	321	320	398	422	548	548	341	323	353
1	321	321	319	398	422	548	547	341	323	352
2	318	318	316	395	418	545	544	337	320	349
3	314	315	313	392	415	542	541	334	317	346
4	327	327	325	404	427	554	553	347	329	358
5	325	325	323	402	426	552	552	345	327	359
6	346	346	344	423	447	573	573	366	348	377
7	342	343	341	420	443	570	569	362	345	374
8	330	330	328	407	430	557	556	350	332	361
9	327	327	325	404	428	554	554	347	329	363
10	324	325	323	401	425	551	551	344	326	356
11	325	325	323	402	426	484	485	345	327	356
12	448	448	447	525	549	607	609	468	450	480
13	491	491	489	568	592	650	651	511	493	522
14	494	494	493	571	595	653	655	514	496	526
15	495	495	494	572	596	654	656	515	497	527
16	287	287	285	364	387	445	447	306	289	318
17	250	250	249	327	351	409	410	270	252	281
18	249	250	248	326	350	476	476	269	252	281
19	180	181	179	258	281	408	407	200	182	212
20	179	179	177	256	280	406	406	199	180	210
21	179	179	177	256	280	406	406	199	180	210
22	209	210	208	287	310	436	436	229	212	242
23	324	324	323	425	425	551	551	344	326	356
24	395	396	394	473	496	623	622	415	398	427
25	394	394	393	471	495	621	621	414	396	426
26	397	397	395	474	498	624	624	417	399	428
27	395	396	394	472	496	622	622	415	398	427
28	293	293	292	370	394	520	520	313	295	325
29	198	198	197	275	299	425	425	218	200	230
30	132	132	131	174	198	279	279	117	134	71

	41	42	43	44	45	46	47	48	49	50
31	208	208	207	219	242	296	295	161	193	87
32	182	182	181	193	216	270	269	135	167	61
33	107	107	106	184	208	334	334	127	109	139
34	87	87	86	164	188	314	314	107	89	119
35	59	59	58	138	158	295	295	88	61	100
36	66	67	65	156	166	306	306	99	69	111
37	66	66	65	156	164	305	305	98	68	110
38	62	62	61	141	161	306	306	99	64	111
39	10	10	9	89	109	186	187	45	14	128
40	9.5	9.8	8.1	82	101	179	180	43.7	13.2	130
41	0	0.9	1.9	73.1	93.7	170	171	40	9.5	138
42	0.9	0	1.7	73.3	93.8	170	171	40.8	10.3	132
43	1.9	1.7	0	75.6	96.1	173	174	41.6	11.1	131
44	73.1	73.3	75.6	0	24.4	102	102	57.5	80.6	138
45	93.7	93.8	96.1	24.4	0	77.2	78	80.9	101	162
46	170	170	173	102	77.2	0	1.7	145	178	208
47	171	171	174	102	78	1.7	0	144	179	207
48	40	40.8	41.6	57.5	80.9	145	144	0	31.9	83.2
49	9.5	10.3	11.1	80.6	101	178	179	31.9	0	114
50	138	132	131	138	162	208	207	83.2	114	0
51	138	137	137	144	167	209	208	88.8	120	6.7
52	136	136	135	143	166	211	210	87.4	118	5.9
53	133	133	132	139	163	220	219	84	115	10
54	132	132	132	139	162	209	208	83.7	114	4.8
55	132	132	131	138	162	215	214	83.4	114	4.3
56	130	130	129	137	160	218	217	81.7	112	7.6
57	138	138	137	145	168	209	209	89.7	120	7.4
58	128	128	127	135	158	225	224	79.5	110	24.8
59	218	218	217	225	141	132	131	170	200	96.6
60	220	220	219	226	140	119	118	171	202	98.2

	41	42	43	44	45	46	47	48	49	50
61	249	249	248	162	137	86.4	86	201	231	128
62	295	295	294	191	166	102	104	246	277	173
63	292	292	291	192	168	99.5	103	243	274	170
64	257	257	257	264	164	113	112	209	239	136
65	292	292	291	191	167	90.2	91	244	274	171
66	288	288	287	195	171	94.3	95	239	270	167
67	280	279	279	163	139	89.9	91	231	262	158

	51	52	53	54	55	56	57	58	59	60
0	353	351	348	347	347	345	353	343	433	435
1	352	351	347	347	346	345	353	343	433	434
2	349	348	344	344	343	342	350	339	430	431
3	346	344	341	341	340	339	347	336	426	428
4	358	357	353	353	353	351	359	349	439	440
5	356	355	352	351	351	349	357	347	437	438
6	377	376	372	372	372	370	378	368	458	459
7	374	372	369	369	368	367	375	364	454	456
8	361	360	356	356	356	354	362	352	442	443
9	358	357	354	353	353	351	359	349	439	440
10	356	354	351	350	350	348	356	346	436	438
11	356	355	351	351	351	349	357	347	437	438
12	480	478	475	474	474	472	480	470	560	562
13	522	521	517	517	517	515	523	513	603	604
14	526	524	521	520	520	518	526	516	606	608
15	527	525	522	521	521	519	527	517	607	609
16	318	317	313	313	312	311	319	309	399	400
17	281	280	277	276	276	274	282	272	362	363
18	281	279	276	275	275	273	281	271	361	363
19	212	210	207	207	206	205	213	202	292	294
20	210	209	205	205	205	203	211	201	291	292
21	210	209	205	205	205	203	211	201	291	292
22	241	240	238	236	235	234	242	231	321	323
23	356	354	351	350	350	348	356	346	436	438
24	427	425	422	422	421	420	427	417	507	509
25	425	424	421	420	420	418	426	416	506	508
26	428	427	423	423	423	421	429	419	509	510
27	427	425	422	422	421	419	427	417	507	509
28	325	323	320	319	319	317	325	315	405	407
29	230	228	225	224	224	222	230	220	310	312
30	65	64	55	71	69	56	66	82	164	166

	51	52	53	54	55	56	57	58	59	60
31	81	80	81	87	85	84	82	98	180	182
32	55	54	55	61	59	58	56	72	154	156
33	138	137	134	133	133	131	139	129	219	221
34	119	117	114	113	113	111	119	109	199	201
35	100	98	95	94	94	92	100	90	180	182
36	111	109	106	106	105	103	111	101	191	193
37	110	109	106	105	104	103	111	100	190	192
38	111	109	106	105	105	103	111	101	191	193
39	128	127	124	123	123	121	129	119	209	210
40	130	129	126	125	125	123	131	121	211	212
41	138	136	133	132	132	130	138	128	218	220
42	137	136	133	132	132	130	138	128	218	220
43	137	135	132	132	131	129	137	127	217	219
44	144	143	139	139	138	137	145	135	225	226
45	167	166	163	162	162	160	168	158	141	140
46	209	211	220	209	215	218	209	225	132	119
47	208	210	219	208	214	217	209	224	131	118
48	88.8	87.4	84	83.7	83.4	81.7	89.7	79.5	170	171
49	120	118	115	114	114	112	120	110	200	202
50	6.7	5.9	10	4.8	4.3	7.6	7.4	24.8	96.6	98.2
51	0	1.9	10.3	5.9	4.8	8.7	1.8	28.6	96	97.5
52	1.9	0	8.8	9.8	5.3	7.3	3.4	26.2	98.6	100
53	10.3	8.8	0	10.6	6.2	1.7	10.7	21.8	104	105
54	5.9	9.8	10.6	0	4.3	9.8	3.5	27.3	91.9	93.4
55	4.8	5.3	6.2	4.3	0	4.7	6.3	21.9	99.7	101
56	8.7	7.3	1.7	9.8	4.7	0	9.1	20.2	102	104
57	1.8	3.4	10.7	3.5	6.3	9.1	0	24.5	96.3	97.9
58	28.6	26.2	21.8	27.3	21.9	20.2	24.5	0	114	116
59	96	98.6	104	91.9	99.7	102	96.3	114	0	2.4
60	97.5	100	105	93.4	101	104	97.9	116	2.4	0

	51	52	53	54	55	56	57	58	59	60
61	127	130	135	123	131	133	127	145	48.4	32.5
62	173	175	181	169	177	179	173	191	94.1	62.7
63	170	172	178	166	174	176	170	188	91.2	93.3
64	135	138	143	131	139	142	136	153	56.6	58.7
65	170	173	178	166	174	176	170	188	91.3	93.4
66	166	169	174	162	170	172	166	184	87.3	89.4
67	157	160	165	153	161	164	158	175	78.7	80.9

	61	62	63	64	65	66	67
0	464	510	508	472	507	503	495
1	464	509	507	472	507	503	494
2	461	506	503	469	504	499	491
3	457	503	500	466	500	496	488
4	470	515	512	478	513	509	500
5	468	517	514	476	511	507	498
6	489	534	532	497	532	528	519
7	485	531	528	494	528	524	516
8	473	518	515	481	516	512	503
9	470	521	518	478	513	509	500
10	467	513	511	476	510	506	498
11	468	514	510	476	511	507	498
12	591	637	634	599	634	630	622
13	634	680	677	642	677	673	664
14	637	683	680	645	680	676	668
15	638	684	681	646	681	677	669
16	430	475	472	438	473	469	460
17	393	439	436	401	436	432	423
18	392	438	435	401	435	431	423
19	323	369	366	332	366	362	354
20	322	368	365	330	365	361	352
21	322	368	366	330	365	361	352
22	353	398	395	361	395	391	383
23	467	513	510	475	510	506	498
24	538	584	581	547	581	577	569
25	537	583	583	545	580	576	567
26	540	586	581	548	583	579	570
27	538	584	584	547	581	577	569
28	436	482	479	444	479	475	467
29	341	387	384	349	384	380	372
30	195	241	238	204	238	234	226

	61	62	63	64	65	66	67
31	211	257	254	220	254	250	242
32	185	231	228	194	228	224	216
33	250	296	293	258	293	289	280
34	230	276	273	238	273	269	261
35	211	257	254	219	254	250	242
36	222	268	265	231	265	261	253
37	222	267	264	230	264	260	252
38	222	268	265	230	265	261	253
39	240	286	283	248	283	279	270
40	242	288	285	250	285	281	272
41	249	295	292	257	292	288	280
42	249	295	292	257	292	288	279
43	248	294	291	257	291	287	279
44	162	191	192	264	191	195	163
45	137	166	168	164	167	171	139
46	86.4	102	99.5	113	90.2	94.3	89.9
47	85.6	104	103	112	91.4	95.2	90.7
48	201	246	243	209	244	239	231
49	231	277	274	239	274	270	262
50	128	173	170	136	171	167	158
51	127	173	170	135	170	166	157
52	130	175	172	138	173	169	160
53	135	181	178	143	178	174	165
54	123	169	166	131	166	162	153
55	131	177	174	139	174	170	161
56	133	179	176	142	176	172	164
57	127	173	170	136	170	166	158
58	145	191	188	153	188	184	175
59	48.4	94.1	91.2	56.6	91.3	87.3	78.7
60	32.5	62.7	93.3	58.7	93.4	89.4	80.9

	61	62	63	64	65	66	67
61	0	31.5	33.1	27.2	61.9	57.9	49.3
62	31.5	0	3.4	58.4	21.5	12.1	16.2
63	33.1	3.4	0	78.6	18.1	8.8	14.5
64	27.2	58.4	78.6	0	34.7	30.7	22.1
65	61.9	21.5	18.1	34.7	0	10.9	35.6
66	57.9	12.1	8.8	30.7	10.9	0	23.8
67	49.3	16.2	14.5	22.1	35.6	23.8	0

Lampiran 5 (Data Total Kubikasi Barang Dry Tiap Ritel)

Tabel 0.38 Data Total Kubikasi Barang Dry Tiap Ritel Periode Agustus – Desember 2019 (m3)

Ritel	Agustus				September				Oktober				November				Desember
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
1	0.37	0.18	0.68	0.74	0.37	0.37	0.71	1.46	1.53	1	1.54	1.31	1.22	1.08	1.46	0.34	1.650816
2	0.42	1.17	2.26	1.95	0.2	0.29	0.1	0.37	0.47	1.91	0.51	0.98	1.06	0.89	0.6	2.65	0.8321566
3	0	0	0.28	0	0.29	0	0.19	0.16	0	0.06	0.21	0	0.22	0	0.77	0.88	0.03079
4	0.38	0	0.79	0.73	0.81	0.39	0.96	0.76	0.26	0.72	3.38	0.36	0.34	0.97	3.39	1.39	0.871055
5	0.7	1.51	0.72	0.53	2.86	1.41	1.33	0.64	0.22	1.94	0.67	0.44	0.45	0.44	3.35	1.31	5.2911356
6	0.43	1.13	0.62	0.75	0.84	0.46	0.2	1.31	0.55	1.37	1.06	0.79	0.12	0.81	1	3.02	4.4488706
7	0.29	0.23	0.41	1.22	0.3	0.23	0.29	0.85	0.96	0.33	0.74	0.43	0.78	0.68	0.97	0.61	1.032949
8	0.34	0.37	0.46	0.38	1.3	0.27	0.32	0.83	0.62	0.17	0.95	0.53	0.8	0.57	0.93	1.47	2.7416716
9	1.06	2.23	2.45	1.91	0.69	0.79	0.45	1.21	2.02	0.71	1.02	0.65	1.08	3.27	3.33	0.81	1.961159
10	0.36	1.04	0.49	0.42	0.29	1.24	0.67	1.01	0.98	1.63	1.01	1.42	1.55	0.47	0.53	1.33	1.961159
11	1.37	2.75	2.65	0.33	1.81	1.87	2.2	2.46	2.41	1.88	1.69	1.84	1.91	2	1.49	2.05	2.266304

Rite 1	Agustus				September				Oktober				November				Desembe r
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
24	0.9 1	0.7	0.4 3	0.8 9	0.4 8	0	0	0.9 3	0.8	0.7 7	0.6 2	0.9 2	4.4 9	0.6 6	0.6 6	0.8	0.882636 2
25	1.2 5	1.5 5	0.8 5	1.2 9	1.4	0	0	1.3 3	0.4 9	0.7 6	0.9 3	1.3 4	1.2 4	1.4 3	1.3 1	1.4 9	1.854699 2
26	0.6 3	0.5 6	0	0.4 8	0.3 7	0	0	0.6 4	0.3 4	0.2 9	0.7 2	0.7 5	0.3 1	0.4 3	0.4 5	0.6 7	0.187598
27	1.1	0.8 2	0.7 5	1.4 1	0.6 6	0	0	0.5 4	0.7 2	1.6 2	0.8 6	1.0 5	1.4 2	1.7 6	0.7 6	0.7 1	0.940796 6
28	0.4 2	1.2 1	1.2 6	1.9 1	1.6	0	0	0.5	1.3 1	0.6 4	1.6 4	0.5 4	1.1 4	1.0 7	0.6 1	0.6 8	1.115131
29	1.0 9	0	1.3 9	0	1.1 0	0	1.1 3	0	0	0	0.7 6	0	0.8 5	0	1.4 1	0	1.36
30	0.5 8	0	0.4 9	0	0.6 8	0	0.8 2	0	0	0	1.4 0	0	1.0 5	0	1.0 3	0	1.19
31	0	1.2 0	0	1.6 0	0	1.3 9	0	1.4 1	0	1.0 4	0	0.9 5	0	2.3 5	0	1.9 0	0
32	0	1.4 7	0	1.9 8	0	2.2 4	0	1.3 3	0	1.5 9	0	1.9 0	0	2.6 9	0	1.9 4	0
33	0.1 8	0.0 4	0.7 2	0.3 3	0.5 2	0.3 4	0.1 5	0.3 3	0.3 6	0.3 5	0.6 3	0.8 1	0.4 1	0.5 9	0.9 9	0.6 4	0.939769 4
34	0.0 3	0.0 9	0.8	0	0.1 5	0.3 7	0.0 3	0	0	0.2 9	2.2 3	0.1 7	0.7 2	0.1 9	1.1 7	1.0 7	0.601347 7
35	2.8 7	0	1.7 2	0	3.7 5	0	4.0 8	0	3.7 1	0	2.2 3	0	4.2 6	0	1.7 2	0	4.679458 2

Rite I	Agustus				September				Oktober				November				Desembe r
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
36	0.7 5	0	0.9 3	0	1.1 6	0	0.9 0	0	0.8 5	0	1.1 9	0	1.6 7	0	1.5 2	0	1.49
37	0.2 4	0	1.2 8	0	0.3 3	0	1.5 5	0	0.6 8	0	1.1 4	0	0.8 1	0	0.9 0	0	1.67
38	0.6 8	0	0.7 3	0	0.0 5	0	0.9 2	0	2.5 8	0	0.4 2	0	1.9 1	0	0.9 3	0	3.86757
39	0.6 9	0	0.6 3	0	0.4 6	0	2.0 7	0	1.3 7	0	0.8 1	0	1.1 6	0	1.4 8	0	2.416928
40	0.9 2	0	1.1 1	0	1.2 5	0	1.1 2	0	0.2 2	0	1.2 3	0	1.7 5	0	1.3 2	0	0.542623 8
41	0.2 5	0	0.4 8	0	0.3 3	0	1.0 6	0	0.8 6	0	2.2 2	0	1.1	0	1.4	0	1.420278 2
42	0.5 1	0	0.9 5	0	0.6 3	0	0.6 9	0	1.1 5	0	0.6 3	0	0.4 5	0	0.9 1	0	0.814795 6
43	0.5 2	0	0.6 5	0	1.1 8	0	1.0 3	0	0.9	0	0.9 2	0	0.7 6	0	1.1 8	0	1.023518
44	0.3 9	0	0.4 6	0	0.1 1	0	0.1 5	0	1.1 5	0	0.6 9	0	0.4 3	0	0.6 9	0	0.598778 2
45	0.9 4	0	0.3 9	0	0.4 1	0	0.4 8	0	0.4 2	0	0.7 3	0	0.5 5	0	0.5 1	0	0.760748 5
46	2.5 7	0	0.3 2	0	1.2 5	0	1.9 2	0	1.8 1	0	1.9 9	0	1.4 6	0	1.4	0	2.030553
47	2.1	0	1.8 7	0	1.0 3	0	0.9 9	0	1.4 9	0	1.9 7	0	2.7 5	0	2.7 7	0	4.635267 6

Rite l	Agustus				September				Oktober				November				Desembe r
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
48	0.6 6	0	1.3 2	0	0.8	0	0.6 2	0	0.9 8	0	3.5 6	0	1.9 9	0	1.4 2	0	2.035804 3
49	0.0 6	0	1.7 1	0	1.3 7	0	1.3 4	0	0.3 7	0	0.5 9	0	0.4 8	0	0.3 7	0	2.472786 6
50	0.7 1	0	1.0 3	0	0.8 6	0	0.9 7	0	0.9	0	1.4 5	0	1.2 7	0	1.2 6	0	1.874331 5
51	1.0 8	0	0.9 4	0	1.3 5	0	1.6 1	0	0.7 4	0	0.8 6	0	1.5 6	0	1.0 4	0	1.865962
52	1.4 1	0	1.5 5	0	1.4 2	0	1.6 5	0	1.4 2	0	1.7 4	0	1.7 7	0	1.7 7	0	2.073091 4
53	0.9 4	0	0.2 5	0	0.0 5	0	0.6	0	0.1 1	0	0.5 5	0	0.1 9	0	0.1 7	0	0.531597 2
54	0.5 4	0	1.0 6	0	0.3 4	0	2.2 9	0	1.6 7	0	2.6 8	0	2.3 9	0	3	0	1.926827 8
55	0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	0.9 2	0	1.2 8	0	0.8 3	0	0.5	0	0.4 8	0	1.0 8	0	0.8 6	0	1.6 5	0	2.020473 2
57	0.2 4	0	0.1 8	0	0.2 4	0	0.6 8	0	0.8 4	0	0.5 4	0	0.5 2	0	0.5 1	0	0.744501
58	0.6 6	0	0.9 3	0	0.3 9	0	0.4 1	0	0.4 8	0	1.3 2	0	0.6 1	0	1.5 6	0	1.741052 6
59	0	2.8 1	0	1.3 6	0	1.1 4	0	2.4 7	0	2.4 9	0	2.5 5	0	1.6 9	0	2.8 3	0
60	0	0	0	0.7 9	0	0.5 5	0	0.6 3	0	0.8 3	0	1.0 8	0	1.4	0	2.0 4	0

Rite I	Agustus				September				Oktober				November				Desembe r
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
61	0	1.5 2	0	1.3 8	0	1.5 6	0	2.3 3	0	1.6	0	1.4 6	0	1.1 9	0	1.2	0
62	0	0.4 9	0	1.2 5	0	0.7 2	0	1.0 1	0	1.0 4	0	3.1 8	0	0.5 8	0	1.1 5	0
63	0	0.5 9	0	0.5 7	0	0.4 7	0	0.8 4	0	1.9 4	0	1.4 5	0	1.8 7	0	1.7 3	0
64	0	2.0 6	0	1.8 6	0	0.8 4	0	0.8 2	0	0.6 2	0	1.5 3	0	1.3 3	0	2.0 4	0
65	0	1.6 2	0	1.5 4	0	1.1 3	0	0.6 1	0	3.3 7	0	0.5 3	0	0.4 9	0	2.3 3	0
66	0	0.8 6	0	0.8 9	0	0.7 3	0	0.5 9	0	0.6 1	0	0.4 9	0	0.9 9	0	1.4 2	0
67	0	1.2 3	0	1.0 5	0	1.8 2	0	1.7	0	1.9 4	0	1.3 6	0	1.9 6	0	2.2 3	0

Lampiran 6 (Data Total Berat Barang Dry Tiap Ritel)

Tabel 0.39 Data Total Berat Barang Dry Tiap Ritel Periode Agustus – Desember 2019 (Kg)

Ri tel	Agustus				September				Oktober				November				Dese mber
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
1	260	114	283	287	214	242	381	522	260	373	335	325	306	367	711	222	376.5 4
2	191	287	369	213	140	102	52.9	176	178	867	230	252	356	362	299	209 7	348.0 2
3	0	0	125 .89	0	56.8	0	112	104	0	50	112	0	77. 1	0	650	653	26
4	155 .09	0	286	196 .2	215. 55	166 .91	268. 42	224 .22	134. 69	159 .56	2690 .4	186 .34	118 .52	277. 81	221 1.3	576 .49	189.8 5
5	295 .86	461 .12	211 .71	199 .5	845. 95	363 .13	817. 19	243 .07	147	259 .16	250. 97	232 .56	263 .91	238. 5	194 5.6	816 .47	3397. 53
6	181 .05	419 .06	146 .07	192 .3	180. 52	268 .68	108. 48	408 .28	210. 78	327 .93	376. 84	280 .85	94. 68	364. 8	318 .2	206 8.1	3045. 3
7	163 .55	142 .25	148 .06	353 .28	117. 46	145 .93	139. 15	266 .35	237. 66	171 .87	316. 05	222 .02	274 .95	259. 87	296 .27	174 .88	240.1 6
8	195 .4	186 .7	150 .26	166 .66	335. 9	121 .14	162. 98	342 .01	306. 66	89. 44	257. 9	201 .15	425	202. 53	281 .4	361 .1	1417. 56
9	487 .27	353 .2	411 .61	250 .32	335. 23	338 .55	338. 14	101 5.5	565. 32	213 .48	448. 32	449 .37	565 .13	769. 95	757 .74	356 .48	498.8 62
10	240 .31	359 .23	243 .2	199 .88	186. 24	473 .65	241. 26	356 .34	222. 92	545 .25	290. 9	421 .01	324 .98	232. 51	248 .3	264 .08	498.8 62
11	757 .17	638 .47	608 .25	275	551. 91	593 .21	723. 53	851 .83	856. 33	644 .64	627. 01	635 .04	684 .26	682. 44	609 .64	800 .53	782.4 7

Ri tel	Agustus				September				Oktober				November				Dese mber
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
24	389 .69	348 .41	210 .34	349 .49	194. 95	0	0	331 .76	305. 54	312 .25	275. 9	327 .62	340 7.3	300. 7	337 .34	398 .01	419.2 3
25	649 .07	623 .34	406 .15	547 .04	538. 73	0	0	565 .72	242. 37	441 .89	433. 98	651 .95	563 .66	456. 13	385 .8	435 .52	731.0 2
26	250 .38	199 .86	0	148 .44	92.2 1	0	0	161 .23	85.2 9	170 .74	412. 88	457 .04	179 .4	141	155 .22	255 .59	113.2 9
27	551 .56	262 .87	287 .82	445 .32	344. 66	0	0	310 .02	359. 07	435 .61	398. 14	406 .24	446 .83	600. 36	423 .36	317 .81	355.8 2
28	175 .34	259 .76	278 .7	260 .25	403. 75	0	0	274 .75	355. 95	370 .75	1370 .9	258 .14	218 .5	357. 41	320 .63	292 .86	351.5 8
29	410 .1	0	443 .16	0	397. 51	0	401. 43	0	0	0	319. 34	0	362 .25	0	528 .93	0	516.8 4
30	263 .58	0	204 .39	0	329. 7	0	330. 22	0	0	0	532. 692	0	387 .75	0	415 .81	0	465.8 2
31	0	508 .86	0	600 .01	0	728 .67	0	683 .49	0	496 .09	0	271 .94	0	758. 49	0	577 .1	0
32	0	417 .15	0	534 .38	0	644 .25	0	592 .04	0	527 .03	0	602 .55	0	770. 052	0	723 .59	0
33	150	27. 5	316 .2	76. 01	333. 01	152 .7	16.3 12	76. 01	204. 51	151 .11	282. 1	406 .78	125 .76	174. 72	412 .77	276 .43	299.7 194
34	13	5	527 .87	0	127. 15	163 .5	6.8	0	4.2	183	1876 .9	141 .46	274 .82	127. 27	369 .42	416 .93	195.1 93
35	296 .54	0	278 .12	0	298. 26	0	339. 54	0	170. 28	0	294. 21	0	402 .56	0	154 .17	0	661.2

Ri tel	Agustus				September				Oktober				November				Dese mber
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
36	231 .41	0	206 .93	0	239. 172	0	267. 13	0	190. 532	0	290. 94	0	365 .04	0	309 .56	0	265.2 2
37	110 .79	0	262 .12	0	44.9 7	0	304. 828	0	235. 53	0	265. 24	0	193 .9	0	238 .34	0	238.0 3
38	281 .3	0	254 .5	0	24.2	0	73.1 3	0	278. 54	0	251. 03	0	448 .73	0	155 .16	0	890.4 24
39	228 .81	0	211 .65	0	232. 22	0	373. 5	0	280. 25	0	246. 65	0	343 .11	0	335 .21	0	473.9
40	191 .9	0	149 .74	0	240. 64	0	130. 37	0	120. 72	0	219. 92	0	229 .71	0	148 .58	0	189.1 2
41	103 .97	0	144 .78	0	143. 92	0	330. 32	0	243. 06	0	334. 79	0	238 .63	0	316 .82	0	343.1 1
42	171 .41	0	182 .64	0	114. 43	0	173. 62	0	270. 1	0	112. 26	0	123 .99	0	186 .24	0	180.0 12
43	155 .55	0	217 .32	0	282. 25	0	229. 71	0	185. 86	0	202. 59	0	151 .89	0	237 .65	0	231.9 6
44	106 .51	0	183 .19	0	75.0 1	0	98.7 4	0	720. 15	0	378. 69	0	203 .19	0	362 .32	0	308.7 92
45	324 .3	0	200 .55	0	278. 37	0	324. 24	0	96.0 3	0	331. 73	0	213 .26	0	327 .3	0	378.6 7
46	523 .73	0	72. 46	0	598. 79	0	853. 43	0	736. 74	0	414. 18	0	339 .51	0	545 .85	0	462.1 22
47	127 5.4	0	841 .54	0	644. 54	0	647. 56	0	734. 75	0	1014 .1	0	125 6.4	0	128 2.8	0	2256. 152

Ri tel	Agustus				September				Oktober				November				Dese mber
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
48	271 .35	0	258 .06	0	398. 64	0	376. 6	0	331. 08	0	2746 .5	0	145 6.1	0	380 .48	0	659.1 7
49	21. 62	0	324 .07	0	172. 47	0	187. 6	0	71.9	0	105. 83	0	153 .04	0	123 .64	0	353.3 54
50	263 .32	0	244 .27	0	235. 69	0	180. 88	0	217. 21	0	270. 36	0	505 .84	0	276 .34	0	432.5 9
51	392 .46	0	197 .56	0	395. 55	0	223. 54	0	296. 57	0	340. 62	0	434 .16	0	395 .82	0	485.2 1
52	419 .47	0	493 .1	0	407. 36	0	547. 48	0	431. 02	0	514. 3	0	527 .37	0	527 .37	0	572.1 66
53	281 .51	0	93. 81	0	17.6 8	0	147. 23	0	36.6 8	0	135. 68	0	46. 83	0	67. 45	0	168.6 7
54	181 .73	0	178 .47	0	154. 7	0	571. 21	0	307. 33	0	475. 05	0	671 .98	0	809 .37	0	489.9 3
55	35. 788	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	233 .5	0	324 .76	0	243. 29	0	127. 55	0	160. 36	0	284. 2	0	181 .56	0	312 .25	0	341.1 2
57	120 .56	0	70. 7	0	130. 2	0	212. 36	0	343. 33	0	117. 76	0	106 .32	0	105 .45	0	286.3 8
58	222 .1	0	159 .47	0	135. 08	0	141. 14	0	161. 92	0	443. 31	0	176 .79	0	287 .02	0	367.6 7
59	0	151 5	0	578 .46	0	386 .94	0	946 .88	0	102 4.2	0	671 .56	0	604. 42	0	893 .1	0

Ri tel	Agustus				September				Oktober				November				Dese mber
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
60	0	0	0	556 .7	0	153 .31	0	421 .75	0	252 .93	0	507 .83	0	569. 01	0	791 .37	0
61	0	476 .62	0	414 .86	0	501 .37	0	627 .16	0	509 .33	0	452 .31	0	470. 45	0	472 .23	0
62	0	375 .19	0	410 .9	0	326 .65	0	382 .83	0	357 .19	0	219 7.9	0	395. 6	0	546 .79	0
63	0	428 .5	0	154 .82	0	284 .8	0	372 .07	0	522 .24	0	543 .22	0	717. 81	0	618 .31	0
64	0	838 .46	0	808	0	487 .95	0	600 .17	0	223 .24	0	460 .37	0	660. 03	0	790 .76	0
65	0	660 .76	0	739 .2	0	571 .16	0	314 .72	0	210 1.6	0	304 .84	0	257. 52	0	804 .68	0
66	0	327 .59	0	288 .87	0	231 .94	0	149 .32	0	177 .16	0	95. 97	0	320. 09	0	315 .77	0
67	0	577 .56	0	388 .24	0	634 .51	0	500 .01	0	568 .01	0	435 .6	0	634. 52	0	644 .74	0

Lampiran 7 (Data Total Kubikasi Barang Frozen Tiap Ritel)

Tabel 0.40 Data Total Kubikasi Barang Frozen Tiap Ritel Periode Agustus – Desember 2019 (m3)

Ritel	Agustus				September				Oktober				November				Desember
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
1	0.409	0.063	0.825	0.126	0.366	0.794	0.64	0.66	0.175	0.555	0.468	0.523	0.562	0.919	0.855	0.548	0.146496
2	0.122	0.34	0.256	0.242	0.13	0.189	0.217	0.37	0.893	0.067	0.283	0.227	0.139	0.124	0.122	0.09	0.113676
3	0	0	0.206	0	0.125	0	0.18	0.102	0	0.065	0.093	0.144	0.026	0	0.18	0.06	0.0954
4	0.42	0	0.349	0.339	0.384	0.336	0.273	0.402	0.378	0.325	0.373	0.314	0.378	0.433	0.65	0.432	0.402252
5	0.502	0.226	0.216	0.341	0.228	0.491	0.51	0.551	0.295	0.423	0.455	0.484	0.296	0.494	0.789	0.345	0.513626
6	0.535	0.338	0.443	0.233	0.222	0.441	0.471	0.738	0.298	0.425	0.427	0.447	0.305	0.473	0.549	0.599	0.568896
7	0.574	0.29	0.488	0.373	0.37	0.22	0.247	0.492	0.377	0.295	0.326	0.481	0.467	0.491	0.533	0.48	0.34925
8	0.423	0.088	0.419	0.38	0.369	0.433	0.321	0.386	2.409	0.115	0.095	0.229	0.158	0.217	0.093	0.139	0.132696
9	0.787	1.175	0.715	0.781	0.483	0.758	0.594	1.362	0.799	0.645	0.824	0.661	0.734	0.761	0.806	0.192	0.200512
10	0.72	0.623	0.602	0.397	0.391	0.595	0.448	0.616	0.347	0.669	0.501	0.693	0.738	0.737	0.703	0.609	0.707766
11	1.142	1.234	0.872	1.45	1.299	1.019	1.249	1.66	1.647	1.022	0.662	0.502	0.533	0.533	0.431	0.579	0.535768

Rit el	Agustus				September				Oktober				November				Desem ber
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
24	0.55 2	0.65 1	0.60 4	0.38 3	0.43	0.57 8	0.62 8	0.63 6	0.58 6	0.69 8	0.40 7	0.61 1	0.15 6	0.98 9	0.70 9	0.76	0.61168 6
25	1.23 1	1.00 9	1.23 6	1.06 5	1.02 8	0.99 7	0.87 9	0.84 7	0.92 9	0.87 3	0.89 7	1.11 7	0.36 3	0.38 2	0.35 1	0.30 5	1.24256 8
26	0.45 4	0.37 9	0	0.39 3	0.13 8	0.24 4	0.39 9	0.21	0.30 2	0.31 5	0.14 9	0.22 2	0.25 1	0.27 1	0.27 4	0.54 8	0.12
27	0.53 6	0.88 3	0.71 2	0.49 6	0.78 9	0.61 8	0.85 2	0.53 1	1.13 1	1.17 4	1.18 1	0.69	1.51 2	1.29 6	1.04 9	1.10 9	1.39621 8
28	0.95 3	0.34 1	0.41 6	0.15 6	0.17 1	0.63 9	0.75 8	0.65 9	0.64 9	0.59 1	0.25 6	0.42 5	0.44 8	0.76 4	0.66 9	2.01 2	0.55073 2
29	0	1.03 9	0	0.55 3	0	0.50 7	0	0.65 4	0	0.84 4	0	0.32	0	0.32 9	0	0.36 4	0
30	0	0.63 7	0	0.83 8	0	0.8	0	0.84 1	0	1.01 7	0	0.72 2	0	0.76 1	0	1.04 2	0
31	0.70 6	0	0.93 2	0	1.02 6	0	1.17 1	0	1.10 3	0	0.36 8	0	0.40 8	0	0.26 3	0	0.41755 6
32	1.54 2	0	1.65	0	1.40 4	0	1.55 2	0	1.95 2	0	0.82 5	0	0.83 1	0	0.51 4	0	0.77907 2
33	0.43 9	0	0.54 9	0.08 3	1.10 8	0.34 6	0.50 1	0.19 1	0.44 7	0.14 2	0.88 4	0.96	0.35 9	0.35 9	1.16 9	0.95 6	0.78860 32
34	0.06 3	0	0.51 8	0.72 7	0	0.93 3	0.39 4	0.35 6	0	0.18	0.09 4	0.12 6	0.39 6	0.66 9	0.99	0.72 6	0.55762 6
35	0	0.22 9	0	0.23 4	0	0.24 4	0	0.47 4	0	0.22 2	0	0.06 7	0	0.05 3	0	0.03 6	0

Rit el	Agustus				September				Oktober				November				Desem ber
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
36	0	0.72 7	0	1.43 3	0	0.79 7	0	0.45 2	0	0.76 7	0	0.77 6	0	1.47 4	0	0.82 7	0
37	0	0.81 9	0	0.09 9	0	0.82 7	0	0.64 4	0	0.79 9	0	0.15 9	0	0.12 9	0	0.22 6	0
38	0	0.35 8	0	0.25 8	0	0.23 6	0	0.24 2	0	0.12 7	0	0.17 3	0	0.00 7	0	0.16	0
39	0	1.16 2	0	1.21 8	0	1.25 7	0	1.46 7	0	1.27 6	0	1.33 2	0	1.45	0	1.37 1	0
40	0	0.25 6	0	1.03 8	0	0.08 7	0	0.72 7	0	0.07 7	0	0.85 9	0	0.07 4	0	1.36 1	0
41	0	0.41 8	0	0.43 9	0	0.55 1	0	0.75 1	0	0.66 5	0	0.61 6	0	0.75 5	0	1.57 9	0
42	0	0.72	0	0.57 5	0	0.36 6	0	0.63 7	0	0.35 5	0	0.46 1	0	0.61 1	0	0.92 9	0
43	0	1.47 1	0	0.91 3	0	0.90 7	0	1.12 7	0	0.79 9	0	0.13	0	0.15	0	0.13 4	0
44	0	0.74 5	0	0.29 7	0	0.06 2	0	0.92 8	0	0.70 7	0	0.14 6	0	0.06 7	0	0.34 6	0
45	0	0.40 9	0	0.69 8	0	0.50 2	0	0.39	0	0.50 5	0	0.19 7	0	0.35 9	0	0.02 8	0
46	0	0.79 4	0	0.84 2	0	0.87 2	0	1.44 2	0	0.87 5	0	0.61	0	0.65	0	0.94	0
47	0	2.23 2	0	1.11 7	0	1.44 2	0	1.21 5	0	1.10 2	0	3.09 2	0	2.24 7	0	2.28 8	0

Rit el	Agustus				September				Oktober				November				Desem ber
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
48	0	0.62 1	0	0.72 9	0	0.49 8	0	0.60 5	0	0.51 6	0	0.12 9	0	0.13 5	0	0.22 1	0
49	0	0.40 7	0	0	0	0.73 6	0	0	0	0.06 1	0	1.49 2	0	1.00 6	0	0.47 8	0
50	0	1.17 2	0	0.78	0	0.34 1	0	0.41 9	0	0.86	0	0.97 8	0	0.74 9	0	0.74 9	0
51	0	1.12 3	0	2.56 6	0	0.97 7	0	1.13 8	0	1.01 3	0	0.48 6	0	0.35 9	0	0.44 8	0
52	0	2.37 9	0	2.08	0	2.07 4	0	2.10 5	0	1.77 8	0	0.30 5	0	0.30 3	0	0.32 8	0
53	0	0.34 1	0	0.45 1	0	0.53 1	0	0.32 6	0	0.38 7	0	0.46 5	0	0.33 6	0	0.62 8	0
54	0	0.85 1	0	0.55 3	0	0.87 1	0	1.72 2	0	0.94 7	0	1.25 4	0	1.18 6	0	0.68	0
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	0	0.91 9	0	0.54 5	0	0.79 6	0	0.92 5	0	0.74 3	0	0.82 3	0	0.82 5	0	1.17 6	0
57	0	0.31	0	0.28 4	0	0.34	0	0.37 5	0	0.42	0	0.44 7	0	0.35 3	0	0.41 3	0
58	0	0.72 9	0	0.08 9	0	0.15 6	0	0.24 8	0	0.23 3	0	1.12 8	0	1.27 2	0	2.04 9	0
60	0.64 7	0	0.85 6	0	0.70 1	0	0.60 2	0	0.86 4	0	1.00 6	0	0.74 7	0	0.90 4	0	1.30826 8
61	1.00 4	0	1.41 3	0	1.07 7	0	1.07 7	0	1.49 1	0	0.93 6	0	0.92 6	0	0.88 6	0	1.07734 6

Rit el	Agustus				September				Oktober				November				Desem ber
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
62	1.06 7	0	0.74 7	0	0.59 8	0	0.78 3	0	0.85 1	0	1.26 8	0	1.26 8	0	1.03 6	0	0.74087 2
63	1.16 1	0	0.34	0	0.70 7	0	0.62 4	0	0.64 4	0	1.37 6	0	0.87 5	0	1.09 4	0	0.29204 6
64	0.50 3	0	2.32 7	0	2.29 7	0	0.25 8	0	0.84 8	0	0.33 7	0	0.79	0	0.24 7	0	0.53796 2
65	1.52 5	0	0.95 9	0	1.68 3	0	0.68 3	0	0.88	0	0.14 1	0	0.28 6	0	0.13 6	0	1.96224 4
66	0.80 7	0	0.52 9	0	0.71 9	0	0.39 1	0	0.33 8	0	0.35 6	0	0.35 1	0	0.62 6	0	0.58284 6
67	1.04 3	0	0.48 9	0	1.28	0	1.37	0	0.95 9	0	1.61 7	0	0.55 2	0	0.98 9	0	0.98694 2

Lampiran 8 (Data Total Berat Barang Frozen Tiap Ritel)

Tabel 0.41 Data Total Berat Barang Frozen Tiap Ritel Periode Agustus – Desember 2019 (Kg)

Ri tel	Agustus				September				Oktober				November				Dese mber
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
1	137. 31	20	272 .9	36.1 6	125 .19	259 .59	210 .45	208 .14	62.1 9	182. 24	161 .01	171. 04	194. 04	316. 22	286. 88	181. 01	39.84
2	40.9	111. 52	87. 84	85.2 4	42. 64	62. 74	67. 46	124 .45	107. 4	23.3	101 .65	72.5 9	58.1 7	44.3 1	43.8 1	29.6 6	37.39
3	0	0	70. 1	0	40. 84	0	56. 7	42	0	20.8 4	35	56	7.26	0	60	20	34.84
4	146. 36	0	125 .5	121. 95	129 .2	106 .8	99. 79	135 .85	122. 96	111. 08	116 .41	109. 5	125. 5	143. 04	216. 66	156. 53	131.5 4
5	142. 18	74.7 6	72. 43	114. 2	81. 83	161 .19	172 .32	185 .82	97.6 7	137. 65	155 .36	160. 32	102. 49	166. 36	249. 8	116. 44	159.8 5
6	176. 86	123	143 .46	84.4 4	86. 74	136 .44	146 .18	248 .94	111. 48	137. 3	121 .76	153. 26	103. 6	149. 32	191. 32	193. 75	183.8 6
7	178. 7	95.2	151 .2	103. 1	109 .56	67. 2	77. 84	157 .84	103. 83	101. 81	102 .64	153. 94	142. 48	156. 73	172. 8	160. 06	110.3 2
8	136. 96	15.6 1	120	123. 74	129 .34	138 .86	91. 94	128 .26	772. 3	30.3 6	33. 68	74.8 6	27.6	63.0 8	26.8 4	49.0 2	34.04
9	256. 84	390. 55	231 .96	253. 92	152 .37	237 .92	201 .55	443 .47	264. 55	212. 1	273 .3	210. 62	235. 88	255. 55	271. 45	53.0 1	67.42
10	245. 32	191. 02	182 .36	134. 66	110 .52	182 .86	136 .1	188 .4	114. 3	221. 06	166 .42	208. 84	234. 52	229. 86	238. 06	200. 29	234.2 6
11	316. 96	413. 74	282 .56	517. 59	485 .29	367 .56	400 .54	576 .14	588. 32	388. 22	263 .32	223. 54	197. 18	185. 36	165. 93	194. 26	199.7 7

Ri tel	Agustus				September				Oktober				November				Dese mber
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
24	168. 88	207. 35	200 .34	114. 34	144 .04	183 .57	216 .8	208 .26	197. 86	232. 94	147 .43	207. 34	51.9	323. 15	229. 4	236. 6	197.9
25	382. 82	309. 56	406 .97	346. 12	346 .12	331 .12	283 .53	279 .53	322. 12	293. 12	306 .76	369. 24	115. 82	126. 16	118. 06	98.7 4	404.0 8
26	147. 95	120. 84	0	129. 36	46	82. 5	127 .46	69	102. 81	105. 76	51. 6	69.9 6	78.4 7	90.1 7	89.4	168. 46	40
27	152. 96	305. 42	269 .37	181. 74	258 .06	201 .06	252 .57	192 .56	384. 32	409. 63	399 .96	261. 92	516. 62	470. 4	372. 92	361. 98	453.4 8
28	285. 92	108. 9	140 .79	50.5 7	55	207 .5	247 .72	207 .69	201. 69	188. 96	79. 6	121. 22	148. 92	249. 67	197. 79	661. 77	175.5 2
29	0	333. 31	0	175. 9	0	164 .9	0	207 .25	0	263. 66	0	77.6 1	0	100. 054	0	102. 174	0
30	0	182. 75	0	261. 37	0	244 .05	0	252 .95	0	311. 83	0	217. 5	0	217. 86	0	344. 44	0
31	227. 14	0	289 .01	0	322 .31	0	344 .13	0	337. 93	0	83. 78	0	105. 65	0	79.0 1	0	111.6 4
32	484. 82	0	530 .96	0	523 .71	0	513 .47	0	673. 43	0	304 .97	0	296. 05	0	146. 59	0	279.4 9
33	144. 08	0	173 .46	12	316 .28	110 .58	115	52. 22	144. 2	10.2	260 .92	288. 82	116. 362	116. 362	370. 244	247. 262	232.6 82
34	2	0	153 .5	218. 28	0	188 .53	103	71. 69	0	60	21. 31	29.4 43	122	185. 18	292. 28	228. 862	147.9 7
35	0	73.4 7	0	74.5 6	0	74. 44	0	157 .17	0	74.6 7	0	18.4 1	0	14.6 1	0	10.0 4	0

Ri tel	Agustus				September				Oktober				November				Dese mber
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
36	0	233. 6	0	458. 98	0	247 .9	0	146 .3	0	242. 1	0	245. 7	0	469. 39	0	257. 44	0
37	0	254	0	22.4	0	255 .32	0	189 .73	0	257. 98	0	40.6 5	0	30.8 5	0	61.8 7	0
38	0	108. 64	0	76.1 4	0	68. 44	0	70. 38	0	43.3 9	0	43.5 8	0	2.98	0	44.6 4	0
39	0	356. 33	0	343. 09	0	398 .36	0	446 .65	0	421. 75	0	409. 45	0	448. 64	0	449. 74	0
40	0	82.1 9	0	339. 49	0	25	0	236 .38	0	21.9 4	0	282. 49	0	23.5 7	0	445. 94	0
41	0	127. 24	0	126. 19	0	146 .1	0	203 .69	0	195. 4	0	176	0	221. 34	0	476. 76	0
42	0	210. 88	0	178. 4	0	119 .5	0	197 .59	0	103	0	153. 97	0	193. 8	0	283. 74	0
43	0	481. 402	0	294. 362	0	292 .04	0	363 .46	0	266. 2	0	34.4	0	41.1	0	36.5 6	0
44	0	237. 5	0	95	0	17. 36	0	309 .68	0	223. 55	0	38.6 6	0	18.9 8	0	93.2 2	0
45	0	129. 38	0	233. 43	0	150 .26	0	129 .52	0	144. 24	0	52.5 4	0	64.8 8	0	10.3 8	0
46	0	257. 7	0	278. 93	0	291 .25	0	471 .96	0	280. 64	0	194. 02	0	210. 6	0	306. 75	0
47	0	748. 78	0	379. 22	0	477 .06	0	418 .01	0	385. 33	0	104 2.4	0	751. 07	0	775. 06	0

Ri tel	Agustus				September				Oktober				November				Dese mber
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
48	0	220. 2	0	263. 34	0	170 .7	0	205 .52	0	176	0	48.8 1	0	49.5 8	0	75.2 6	0
49	0	134. 69	0	0	0	241 .15	0	0	0	21.8 8	0	496. 58	0	339. 16	0	159. 28	0
50	0	361. 37	0	244. 14	0	94	0	152 .27	0	283. 39	0	298. 18	0	234. 11	0	234. 11	0
51	0	357. 164	0	864. 36	0	322 .36	0	396 .48	0	334. 362	0	166. 562	0	123. 22	0	144. 8	0
52	0	790. 5	0	711. 44	0	704 .64	0	707 .92	0	620. 34	0	124. 34	0	121. 64	0	122. 44	0
53	0	109. 142	0	147. 57	0	172 .86	0	107 .62	0	124. 552	0	147. 092	0	107. 262	0	203. 162	0
54	0	292. 3	0	189. 7	0	300 .1	0	566 .5	0	328. 65	0	430. 7	0	414. 51	0	236. 85	0
55	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
56	0	286. 34	0	168. 33	0	249 .54	0	273 .7	0	231. 7	0	248. 4	0	245. 1	0	378. 11	0
57	0	102. 9	0	94.9	0	103 .94	0	108 .96	0	125. 1	0	133. 18	0	111. 1	0	132. 72	0
58	0	205. 24	0	24.5	0	59. 83	0	74	0	75.8 4	0	385. 85	0	435. 32	0	693. 42	0
59	362. 14	0	590 .58	0	394 .69	0	367 .01	0	585. 65	0	555 .97	0	491. 31	0	444. 66	0	738.6 8
60	203. 2	0	278 .72	0	224 .62	0	190 .14	0	280. 14	0	325 .92	0	258. 22	0	308. 78	0	424.7 7

Ri tel	Agustus				September				Oktober				November				Dese mber
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
61	324. 01	0	421 .41	0	361 .54	0	361 .54	0	384. 78	0	286 .4	0	299. 78	0	275. 28	0	346.5 4
62	344. 36	0	244 .2	0	174 .72	0	239 .02	0	262. 36	0	386 .56	0	386. 56	0	330. 72	0	227.8 2
63	366. 18	0	105 .86	0	224 .24	0	213 .6	0	178. 79	0	397 .72	0	292. 4	0	369. 9	0	78.21
64	171. 46	0	788 .6	0	758 .02	0	88. 4	0	258. 96	0	119 .92	0	251. 51	0	94.1 4	0	140.8 6
65	488. 642	0	328 .92	0	563 .86	0	224 .36	0	282. 78	0	35. 5	0	102. 5	0	38.7 2	0	268.6 2
66	231. 82	0	161 .86	0	203 .21	0	122 .86	0	104. 14	0	111 .04	0	103	0	186. 53	0	175.0 7
67	314. 38	0	159 .99	0	410 .17	0	418 .86	0	297. 02	0	503 .43	0	173. 45	0	311. 85	0	311.7 8

Lampiran 9 (Matriks Durasi Antar Gudang Dan Tiap Ritel (menit))

Tabel 0.42 Matriks Durasi Antar Gudang Dan Tiap Ritel (Menit)

	0	1	2	3	4	5	6	7	8	9	10
0	0	10.6 8	16.3 2	9.96	14. 76	23.6 4	49. 32	47. 52	24. 84	25. 8	23.0 4
1	10.6 8	0	8.16	13.4 4	28. 8	15.9 6	48. 84	46. 92	17. 52	15. 72	13.0 8
2	16.3 2	8.16	0	7.44	17. 76	9.48	34. 32	32. 4	12. 36	12. 6	9.72
3	9.96	13.4 4	7.44	0	14. 88	14.6 4	29. 28	39. 6	17. 4	17. 76	14.8 8
4	14.7 6	28.8	17.7 6	14.8 8	0	27.8 4	55. 56	53. 64	30. 6	30. 84	27.9 6
5	23.6 4	15.9 6	9.48	14.6 4	27. 84	0	25. 08	23. 52	4.6 8	5.5 2	5.52
6	49.3 2	48.8 4	34.3 2	29.2 8	55. 56	25.0 8	0	9	29. 4	31. 44	32.6 4
7	47.5 2	46.9 2	32.4	39.6	53. 64	23.5 2	9	0	25. 56	27. 6	28.8
8	24.8 4	17.5 2	12.3 6	17.4	30. 6	4.68	29. 4	25. 56	0	3.1 2	6.48
9	25.8	15.7 2	12.6	17.7 6	30. 84	5.52	31. 44	27. 6	3.1 2	0	4.32
10	23.0 4	13.0 8	9.72	14.8 8	27. 96	5.52	32. 64	28. 8	6.4 8	4.3 2	0
11	21.7 2	10.4 4	11.2 8	13.5 6	35. 76	6.72	32. 52	28. 68	4.0 8	3	3.36
12	175. 2	174	170. 4	166. 8	153 .6	182. 4	204	200 .4	184 .8	187 .2	180
13	228	226. 8	223. 2	219. 6	206 .4	235. 2	256 .8	253 .2	237 .6	240	235. 2
14	230. 4	229. 2	225. 6	222	208 .8	237. 6	259 .2	255 .6	240	242 .4	237. 6
15	232. 8	232. 8	229. 2	225. 6	212 .4	241. 2	262 .8	258	243 .6	246	241. 2
16	59.1 6	57.7 2	53.8 8	50.1 6	64. 8	66.2 4	87. 6	83. 76	68. 4	65. 04	62.5 2
17	138	136. 8	133. 2	129. 6	144	145. 2	166 .8	163 .2	147 .6	144	141. 6
18	138	138	134. 4	130. 8	145 .2	146. 4	168	164 .4	148 .8	145 .2	142. 8

	0	1	2	3	4	5	6	7	8	9	10
1 9	193. 2	192	188. 4	184. 8	199 .2	200. 4	222	218 .4	202 .8	199 .2	196. 8
2 0	192	192	187. 2	183. 6	198	200. 4	220 .8	217 .2	202 .8	199 .2	196. 8
2 1	192	190. 8	187. 2	183. 6	198	200. 4	220 .8	217 .2	201 .6	198	195. 6
2 2	231. 6	230. 4	226. 8	223. 2	237 .6	238. 8	260 .4	255 .6	241 .2	237 .6	235. 2
2 3	122. 4	121. 2	116. 88	113. 04	99. 72	128. 4	150	146 .4	130 .8	133 .2	128. 4
2 4	111. 6	111	107. 16	103. 44	90. 12	119. 16	140 .4	136 .8	121 .2	123 .6	115. 8
2 5	110. 64	110. 04	106. 32	102. 48	89. 16	118. 2	139 .2	135 .6	120	122 .4	114. 96
2 6	112. 56	112. 08	108. 24	104. 52	91. 2	120	141 .6	138	122 .4	124 .8	120
2 7	111. 6	1110	107. 28	103. 44	90. 12	119. 16	140 .4	136 .8	121 .2	123 .6	119. 04
2 8	188. 4	188. 4	183. 6	180	177 .6	182. 4	204	213 .6	199 .2	195 .6	193. 2
2 9	272. 4	271. 2	267. 6	264	278 .4	279. 6	152 .4	159 .6	282	278 .4	276
3 0	330	330	326. 4	321. 6	337 .2	334. 8	360	356 .4	340 .8	337 .2	333. 6
3 1	388. 8	387. 6	384	380. 4	394 .8	271. 2	249 .6	258	273 .6	276	276
3 2	386. 4	388. 8	385. 2	378	392 .4	390	285 .6	411 .6	396	392 .4	390
3 3	302. 4	301. 2	297. 6	294	308 .4	307. 2	331 .2	327 .6	312	309 .6	306
3 4	280. 8	280. 8	276	273. 6	288	285. 6	310 .8	306	290 .4	288	284. 4
3 5	309. 6	308. 4	304. 8	301. 2	315 .6	313. 2	338 .4	334 .8	319 .2	315 .6	313. 2
3 6	304. 8	303. 6	300	296. 4	310 .8	308. 4	333 .6	330	314 .4	310 .8	307. 2
3 7	307. 2	306	302. 4	298. 8	313 .2	312	337 .2	332 .4	316 .8	314 .4	310. 8
3 8	310. 8	310. 8	306	302. 4	318	315. 6	340 .8	336	321 .6	318	315. 6
3 9	374. 4	373. 2	369. 6	366	380 .4	378	403 .2	399 .6	384	380 .4	378

	0	1	2	3	4	5	6	7	8	9	10
40	379. 2	378	374. 4	370. 8	385. .2	382. 8	408	404. .4	388. .8	385. .2	382. 8
41	385. 2	385. 2	381. 6	376. 8	392. .4	390	415. .2	410. .4	396	392. .4	388. 8
42	385. 2	385. 2	381. 6	378	392. .4	390	415. .2	411. .6	396	392. .4	390
43	384	382. 8	379. 2	375. 6	390	387. 6	412. .8	409. .2	393. .6	390	387. 6
44	477. 6	477. 6	474	470. 4	484. .8	482. 4	507. .6	504	488. .4	484. .8	481. 2
45	506. 4	506. 4	501. 6	498	512. .4	511. 2	536. .4	531. .6	516	513. .6	510
46	657. 6	657. 6	654	650. 4	664. .8	662. 4	687. .6	684	668. .4	664. .8	661. 2
47	657. 6	656. 4	652. 8	649. 2	663. .6	662. 4	687. .6	682. .8	667. .2	664. .8	661. 2
48	409. 2	409. 2	404. 4	400. 8	416. .4	414	439. .2	434. .4	420	416. .4	412. 8
49	387. 6	387. 6	384	380. 4	394. .8	392. 4	417. .6	414	398. .4	394. .8	391. 2
50	423. 6	422. 4	418. 8	415. 2	429. .6	430. 8	452. .4	448. .8	433. .2	435. .6	427. 2
51	423. 6	422. 4	418. 8	415. 2	429. .6	427. 2	452. .4	448. .8	433. .2	429. .6	427. 2
52	421. 2	421. 2	417. 6	412. 8	428. .4	426	451. .2	446. .4	432	428. .4	424. 8
53	417. 6	416. 4	412. 8	409. 2	423. .6	422. 4	446. .4	442. .8	427. .2	424. .8	421. 2
54	416. 4	416. 4	412. 8	409. 2	423. .6	421. 2	446. .4	442. .8	427. .2	423. .6	420
55	416. 4	415. 2	411. 6	408	423. .6	421. 2	446. .4	441. .6	427. .2	423. .6	420
56	414	414	410. 4	406. 8	421. .2	418. 8	444	440. .4	424. .8	421. .2	417. 6
57	423. 6	423. 6	420	416. 4	430. .8	428. 4	453. .6	450	434. .4	430. .8	427. 2
58	411. 6	411. 6	406. 8	403. 2	418. .8	416. 4	441. .6	436. .8	422. .4	418. .8	415. 2
59	519. 6	519. 6	516	511. 2	526. .8	524. 4	549. .6	544. .8	530. .4	526. .8	523. 2
60	522	520. 8	517. 2	513. 6	528	525. 6	550. .8	547. .2	531. .6	528	525. 6

	0	1	2	3	4	5	6	7	8	9	10
6 1	556. 8	556. 8	553. 2	548. 4	564	561. 6	586 .8	582	567 .6	564	560. 4
6 2	612	610. 8	607. 2	603. 6	618	620. 4	640 .8	637 .2	621 .6	625 .2	615. 6
6 3	609. 6	608. 4	603. 6	600	614 .4	616. 8	638 .4	633 .6	618	621 .6	613. 2
6 4	566. 4	566. 4	562. 8	559. 2	573 .6	571. 2	596 .4	592 .8	577 .2	573 .6	571. 2
6 5	608. 4	608. 4	604. 8	600	615 .6	613. 2	638 .4	633 .6	619 .2	615 .6	612
6 6	603. 6	603. 6	598. 8	595. 2	610 .8	608. 4	633 .6	628 .8	614 .4	610 .8	607. 2
6 7	594	592. 8	589. 2	585. 6	600	597. 6	622 .8	619 .2	603 .6	600	597. 6

	11	12	13	14	15	16	17	18	19	20
0	21.72	175. 2	228	230. 4	232. 8	59.1 6	138	138	193.2	192
1	10.44	174	226. 8	229. 2	232. 8	57.7 2	136.8	138	192	192
2	11.28	170. 4	223. 2	225. 6	229. 2	53.8 8	133.2	134.4	188.4	187.2
3	13.56	166. 8	219. 6	222	225. 6	50.1 6	129.6	130.8	184.8	183.6
4	35.76	153. 6	206. 4	208. 8	212. 4	64.8	144	145.2	199.2	198
5	6.72	182. 4	235. 2	237. 6	241. 2	66.2 4	145.2	146.4	200.4	200.4
6	32.52	204	256. 8	259. 2	262. 8	87.6	166.8	168	222	220.8
7	28.68	200. 4	253. 2	255. 6	258	83.7 6	163.2	164.4	218.4	217.2
8	4.08	184. 8	237. 6	240	243. 6	68.4	147.6	148.8	202.8	202.8
9	3	187. 2	240	242. 4	246	65.0 4	144	145.2	199.2	199.2
10	3.36	180	235. 2	237. 6	241. 2	62.5 2	141.6	142.8	196.8	196.8
11	0	178. 8	231. 6	234	237. 6	62.5 2	141.6	142.8	196.8	195.6
12	178.8	0	76.0 8	76.9 2	80.2 8	211. 2	290.4	290.4	345.6	344.4
13	231.6	76.0 8	0	3.84	7.08	261. 6	340.8	342	396	396
14	234	76.9 2	3.84	0	3.48	266. 4	345.6	345.6	400.8	399.6
15	237.6	80.2 8	7.08	3.48	0	267. 6	346.8	346.8	402	400.8
16	62.52	211. 2	261. 6	266. 4	267. 6	0	96.12	96.96	151.2	150
17	141.6	290. 4	340. 8	345. 6	346. 8	96.1 2	0	1.32	107.2 8	106.4 4
18	142.8	290. 4	342	345. 6	346. 8	96.9 6	1.32	0	106.8	105.7 2
19	196.8	345. 6	396	400. 8	402	151. 2	107.2 8	106.8	0	6.48
20	195.6	344. 4	396	399. 6	400. 8	150	106.4 4	105.7 2	6.48	0

	11	12	13	14	15	16	17	18	19	20
2 1	195.6	344. 4	396	399. 6	400. 8	150	106.2	105.6	2.04	3.72
2 2	235.2	382. 8	434. 4	438	439. 2	189. 6	115.3 2	114	39	39.12
2 3	126	199. 2	250. 8	254. 4	255. 6	75.9 6	99.6	101.4	196.8	194.4
2 4	115.8	189. 6	241. 2	244. 8	246	148. 8	115.6 8	117.3 6	283.2	282
2 5	114.8 4	188. 4	240	243. 6	244. 8	147. 6	119.8 8	226.8	283.2	280.8
2 6	116.8 8	190. 8	241. 2	246	247. 2	148. 8	229.2	229.2	284.4	282
2 7	115.8	189. 6	241. 2	244. 8	246	148. 8	120	228	283.2	282
2 8	193.2	189. 6	328. 8	332. 4	333. 6	146. 4	54.96	55.2	162	159.6
2 9	276	424. 8	475. 2	480	481. 2	230. 4	186	186	103.2	100.8
3 0	334.8	482. 4	534	537. 6	538. 8	289. 2	244.8	243.6	160.8	159.6
3 1	392.4	541. 2	591. 6	596. 4	597. 6	346. 8	302.4	302.4	219.6	217.2
3 2	482.4	538. 8	589. 2	594	597. 6	436. 8	303.6	302.4	217.2	214.8
3 3	306	454. 8	506. 4	510	511. 2	260. 4	217.2	216	133.2	132
3 4	285.6	433. 2	484. 8	488. 4	489. 6	240	195.6	194.4	112.8	110.4
3 5	313.2	462	512. 4	517. 2	518. 4	267. 6	223.2	223.2	140.4	138
3 6	308.4	456	507. 6	511. 2	512. 4	262. 8	218.4	218.4	135.6	133.2
3 7	312	458. 4	510	513. 6	514. 8	265. 2	220.8	220.8	138	136.8
3 8	316.8	464. 4	516	519. 6	520. 8	270	226.8	225.6	142.8	141.6
3 9	378	526. 8	577. 2	582	583. 2	332. 4	288	288	205.2	202.8
4 0	382.8	530. 4	582	586. 8	586. 8	337. 2	292.8	292.8	210	207.6
4 1	390	537. 6	589. 2	592. 8	594	344. 4	300	298.8	216	214.8

	11	12	13	14	15	16	17	18	19	20
4 2	390	537. 6	589. 2	592. 8	594	344. 4	300	300	217.2	214.8
4 3	387.6	536. 4	586. 8	591. 6	592. 8	342	298.8	297.6	214.8	212.4
4 4	482.4	630	681. 6	685. 2	686. 4	436. 8	392.4	391.2	309.6	307.2
4 5	511.2	658. 8	710. 4	714	715. 2	464. 4	421.2	420	337.2	336
4 6	580.8	728. 4	780	783. 6	784. 8	534	490.8	571.2	489.6	487.2
4 7	582	730. 8	781. 2	786	787. 2	536. 4	492	571.2	488.4	487.2
4 8	414	561. 6	613. 2	616. 8	618	367. 2	324	322.8	240	238.8
4 9	392.4	540	591. 6	595. 2	596. 4	346. 8	302.4	302.4	218.4	216
5 0	427.2	576	626. 4	631. 2	632. 4	381. 6	337.2	337.2	254.4	252
5 1	427.2	576	626. 4	631. 2	632. 4	381. 6	337.2	337.2	254.4	252
5 2	426	573. 6	625. 2	628. 8	630	380. 4	336	334.8	252	250.8
5 3	421.2	570	620. 4	625. 2	626. 4	375. 6	332.4	331.2	248.4	246
5 4	421.2	568. 8	620. 4	624	625. 2	375. 6	331.2	330	248.4	246
5 5	421.2	568. 8	620. 4	624	625. 2	374. 4	331.2	330	247.2	246
5 6	418.8	566. 4	618	621. 6	622. 8	373. 2	328.8	327.6	246	243.6
5 7	428.4	576	627. 6	631. 2	632. 4	382. 8	338.4	337.2	255.6	253.2
5 8	416.4	564	615. 6	619. 2	620. 4	370. 8	326.4	325.2	242.4	241.2
5 9	524.4	672	723. 6	727. 2	728. 4	478. 8	434.4	433.2	350.4	349.2
6 0	525.6	674. 4	724. 8	729. 6	730. 8	480	435.6	435.6	352.8	350.4
6 1	561.6	709. 2	760. 8	764. 4	765. 6	516	471.6	470.4	387.6	386.4
6 2	616.8	764. 4	816	819. 6	820. 8	570	526.8	525.6	442.8	441.6

	11	12	13	14	15	16	17	18	19	20
6 3	612	760. 8	812. 4	816	817. 2	566. 4	523.2	522	439.2	438
6 4	571.2	718. 8	770. 4	774	775. 2	525. 6	481.2	481.2	398.4	396
6 5	613.2	760. 8	812. 4	816	817. 2	567. 6	523.2	522	439.2	438
6 6	608.4	756	807. 6	811. 2	812. 4	562. 8	518.4	517.2	434.4	433.2
6 7	597.6	746. 4	796. 8	801. 6	802. 8	552	507.6	507.6	424.8	422.4

	21	22	23	24	25	26	27	28	29	30
0	192	231.6	122.4	111.6	110.6 4	112.5 6	111.6	188. 4	272. 4	330
1	190. 8	230.4	121.2	111	110.0 4	112.0 8	1110	188. 4	271. 2	330
2	187. 2	226.8	116.8 8	107.1 6	106.3 2	108.2 4	107.2 8	183. 6	267. 6	326. 4
3	183. 6	223.2	113.0 4	103.4 4	102.4 8	104.5 2	103.4 4	180	264	321. 6
4	198	237.6	99.72	90.12	89.16	91.2	90.12	177. 6	278. 4	337. 2
5	200. 4	238.8	128.4	119.1 6	118.2	120	119.1 6	182. 4	279. 6	334. 8
6	220. 8	260.4	150	140.4	139.2	141.6	140.4	204	152. 4	360
7	217. 2	255.6	146.4	136.8	135.6	138	136.8	213. 6	159. 6	356. 4
8	201. 6	241.2	130.8	121.2	120	122.4	121.2	199. 2	282	340. 8
9	198	237.6	133.2	123.6	122.4	124.8	123.6	195. 6	278. 4	337. 2
10	195. 6	235.2	128.4	115.8	114.9 6	120	119.0 4	193. 2	276	333. 6
11	195. 6	235.2	126	115.8	114.8 4	116.8 8	115.8	193. 2	276	334. 8
12	344. 4	382.8	199.2	189.6	188.4	190.8	189.6	189. 6	424. 8	482. 4
13	396	434.4	250.8	241.2	240	241.2	241.2	328. 8	475. 2	534
14	399. 6	438	254.4	244.8	243.6	246	244.8	332. 4	480	537. 6
15	400. 8	439.2	255.6	246	244.8	247.2	246	333. 6	481. 2	538. 8
16	150	189.6	75.96	148.8	147.6	148.8	148.8	146. 4	230. 4	289. 2
17	106. 2	115.3 2	99.6	115.6 8	119.8 8	229.2	120	54.9 6	186	244. 8
18	105. 6	114	101.4	117.3 6	226.8	229.2	228	55.2	186	243. 6
19	2.04	39	196.8	283.2	283.2	284.4	283.2	162	103. 2	160. 8
20	3.72	39.12	194.4	282	280.8	282	282	159. 6	100. 8	159. 6

	21	22	23	24	25	26	27	28	29	30
2 1	0	38.76	195.6	283.2	282	284.4	283.2	162	100. 8	159. 6
2 2	38.7 6	0	232.8	319.2	318	320.4	210	123. 6	138	196. 8
2 3	195. 6	232.8	0	17.88	22.32	25.8	22.44	90.3 6	276	333. 6
2 4	283. 2	319.2	17.88	0	4.32	7.92	4.56	91.9 2	361. 2	418. 8
2 5	282	318	22.32	4.32	0	3.72	1.68	89.2 8	358. 8	417. 6
2 6	284. 4	320.4	25.8	7.92	3.72	0	4.8	89.5 2	362. 4	421. 2
2 7	283. 2	210	22.44	4.56	1.68	4.8	0	89.1 6	361. 2	418. 8
2 8	162	123.6	90.36	91.92	89.28	89.52	89.16	0	238. 8	296. 4
2 9	100. 8	138	276	361.2	358.8	362.4	361.2	238. 8	0	102
3 0	159. 6	196.8	333.6	418.8	417.6	421.2	418.8	296. 4	102	0
3 1	217. 2	254.4	392.4	477.6	475.2	478.8	477.6	355. 2	122. 4	57.6
3 2	214. 8	252	390	475.2	472.8	476.4	475.2	352. 8	160. 8	60
3 3	132	168	306	391.2	390	393.6	391.2	268. 8	154. 8	86.4
3 4	110. 4	147.6	284.4	370.8	368.4	372	369.6	247. 2	133. 2	74.4
3 5	138	175.2	313.2	398.4	397.2	399.6	398.4	276	162	79.2
3 6	133. 2	170.4	307.2	393.6	391.2	394.8	393.6	270	156	74.4
3 7	136. 8	172.8	310.8	396	394.8	398.4	396	273. 6	159. 6	78
3 8	141. 6	176.4	314.4	399.6	398.4	402	399.6	277. 2	163. 2	81.6
3 9	202. 8	240	378	463.2	460.8	464.4	463.2	340. 8	226. 8	147. 6
4 0	207. 6	244.8	382.8	468	465.6	469.2	468	344. 4	230. 4	151. 2
4 1	214. 8	250.8	388.8	474	472.8	476.4	474	351. 6	237. 6	158. 4

	21	22	23	24	25	26	27	28	29	30
4 2	214. 8	252	388.8	475.2	472.8	476.4	475.2	351. 6	237. 6	158. 4
4 3	212. 4	249.6	387.6	472.8	471.6	474	472.8	350. 4	236. 4	157. 2
4 4	307. 2	344.4	510	567.6	565.2	568.8	566.4	444	330	208. 8
4 5	336	372	510	595.2	594	597.6	595.2	472. 8	358. 8	237. 6
4 6	487. 2	523.2	661.2	747.6	745.2	748.8	746.4	624	510	334. 8
4 7	487. 2	523.2	661.2	746.4	745.2	748.8	746.4	624	510	334. 8
4 8	238. 8	274.8	412.8	498	496.8	500.4	498	375. 6	261. 6	140. 4
4 9	216	254.4	391.2	477.6	475.2	478.8	477.6	354	240	160. 8
5 0	252	290.4	427.2	512.4	511.2	513.6	512.4	390	276	85.2
5 1	252	289.2	427.2	512.4	510	513.6	512.4	390	276	78
5 2	250. 8	288	424.8	510	508.8	512.4	510	387. 6	273. 6	76.8
5 3	246	285.6	421.2	506.4	505.2	507.6	506.4	384	270	66
5 4	246	283.2	420	506.4	504	507.6	506.4	382. 8	268. 8	85.2
5 5	246	282	420	505.2	504	507.6	505.2	382. 8	268. 8	82.8
5 6	243. 6	280.8	417.6	504	501.6	505.2	502.8	380. 4	266. 4	67.2
5 7	253. 2	290.4	427.2	512.4	511.2	514.8	512.4	390	276	79.2
5 8	241. 2	277.2	415.2	500.4	499.2	502.8	500.4	378	264	98.4
5 9	349. 2	385.2	523.2	608.4	607.2	610.8	608.4	486	372	196. 8
6 0	350. 4	387.6	525.6	610.8	609.6	612	610.8	488. 4	374. 4	199. 2
6 1	386. 4	423.6	560.4	645.6	644.4	648	645.6	523. 2	409. 2	234
6 2	441. 6	477.6	615.6	700.8	699.6	703.2	700.8	578. 4	464. 4	289. 2

	21	22	23	24	25	26	27	28	29	30
6 3	439. 2	474	612	697.2	699.6	697.2	700.8	574. 8	460. 8	285. 6
6 4	396	433.2	570	656.4	654	657.6	656.4	532. 8	418. 8	244. 8
6 5	438	474	612	697.2	696	699.6	697.2	574. 8	460. 8	285. 6
6 6	433. 2	469.2	607.2	692.4	691.2	694.8	692.4	570	456	280. 8
6 7	422. 4	459.6	597.6	682.8	680.4	684	682.8	560. 4	446. 4	271. 2

	31	32	33	34	35	36	37	38	39	40
0	388. 8	386. 4	302. 4	280. 8	309. 6	304. 8	307. 2	310. 8	374. 4	379. 2
1	387. 6	388. 8	301. 2	280. 8	308. 4	303. 6	306	310. 8	373. 2	378
2	384	385. 2	297. 6	276	304. 8	300	302. 4	306	369. 6	374. 4
3	380. 4	378	294	273. 6	301. 2	296. 4	298. 8	302. 4	366	370. 8
4	394. 8	392. 4	308. 4	288	315. 6	310. 8	313. 2	318	380. 4	385. 2
5	271. 2	390	307. 2	285. 6	313. 2	308. 4	312	315. 6	378	382. 8
6	249. 6	285. 6	331. 2	310. 8	338. 4	333. 6	337. 2	340. 8	403. 2	408
7	258	411. 6	327. 6	306	334. 8	330	332. 4	336	399. 6	404. 4
8	273. 6	396	312	290. 4	319. 2	314. 4	316. 8	321. 6	384	388. 8
9	276	392. 4	309. 6	288	315. 6	310. 8	314. 4	318	380. 4	385. 2
10	276	390	306	284. 4	313. 2	307. 2	310. 8	315. 6	378	382. 8
11	392. 4	482. 4	306	285. 6	313. 2	308. 4	312	316. 8	378	382. 8
12	541. 2	538. 8	454. 8	433. 2	462	456	458. 4	464. 4	526. 8	530. 4
13	591. 6	589. 2	506. 4	484. 8	512. 4	507. 6	510	516	577. 2	582
14	596. 4	594	510	488. 4	517. 2	511. 2	513. 6	519. 6	582	586. 8
15	597. 6	597. 6	511. 2	489. 6	518. 4	512. 4	514. 8	520. 8	583. 2	586. 8
16	346. 8	436. 8	260. 4	240	267. 6	262. 8	265. 2	270	332. 4	337. 2
17	302. 4	303. 6	217. 2	195. 6	223. 2	218. 4	220. 8	226. 8	288	292. 8
18	302. 4	302. 4	216	194. 4	223. 2	218. 4	220. 8	225. 6	288	292. 8
19	219. 6	217. 2	133. 2	112. 8	140. 4	135. 6	138	142. 8	205. 2	210
20	217. 2	214. 8	132	110. 4	138	133. 2	136. 8	141. 6	202. 8	207. 6

	31	32	33	34	35	36	37	38	39	40
2 1	217. 2	214. 8	132	110. 4	138	133. 2	136. 8	141. 6	202. 8	207. 6
2 2	254. 4	252	168	147. 6	175. 2	170. 4	172. 8	176. 4	240	244. 8
2 3	392. 4	390	306	284. 4	313. 2	307. 2	310. 8	314. 4	378	382. 8
2 4	477. 6	475. 2	391. 2	370. 8	398. 4	393. 6	396	399. 6	463. 2	468
2 5	475. 2	472. 8	390	368. 4	397. 2	391. 2	394. 8	398. 4	460. 8	465. 6
2 6	478. 8	476. 4	393. 6	372	399. 6	394. 8	398. 4	402	464. 4	469. 2
2 7	477. 6	475. 2	391. 2	369. 6	398. 4	393. 6	396	399. 6	463. 2	468
2 8	355. 2	352. 8	268. 8	247. 2	276	270	273. 6	277. 2	340. 8	344. 4
2 9	122. 4	160. 8	154. 8	133. 2	162	156	159. 6	163. 2	226. 8	230. 4
3 0	57.6	60	86.4	74.4	79.2	74.4	78	81.6	147. 6	151. 2
3 1	0	33.6	144	130. 8	136. 8	132	134. 4	138	238. 8	242. 4
3 2	33.6	0	196. 8	127. 2	174	187. 2	178. 8	183. 6	207. 6	211. 2
3 3	144	196. 8	0	24	52.8	46.8	50.4	55.2	117. 6	121. 2
3 4	130. 8	127. 2	24	0	28.8	24	27.6	30	93.6	97.2
3 5	136. 8	174	52.8	28.8	0	8.4	7.2	10.8	58.8	63.6
3 6	132	187. 2	46.8	24	8.4	0	3.6	7.2	68.4	73.2
3 7	134. 4	178. 8	50.4	27.6	7.2	3.6	0	8.4	68.4	72
3 8	138	183. 6	55.2	30	10.8	7.2	8.4	0	62.4	67.2
3 9	238. 8	207. 6	117. 6	93.6	58.8	68.4	68.4	62.4	0	4.8
4 0	242. 4	211. 2	121. 2	97.2	63.6	73.2	72	67.2	4.8	0
4 1	249. 6	218. 4	128. 4	104. 4	70.8	79.2	79.2	74.4	12	11.4

	31	32	33	34	35	36	37	38	39	40
4 2	249. 6	218. 4	128. 4	104. 4	70.8	80.4	79.2	74.4	12	11.7 6
4 3	248. 4	217. 2	127. 2	103. 2	69.6	78	78	73.2	10.8	9.72
4 4	262. 8	231. 6	220. 8	196. 8	165. 6	187. 2	187. 2	169. 2	106. 8	98.4
4 5	290. 4	259. 2	249. 6	225. 6	189. 6	199. 2	196. 8	193. 2	130. 8	121. 2
4 6	355. 2	324	400. 8	376. 8	354	367. 2	366	367. 2	223. 2	214. 8
4 7	354	322. 8	400. 8	376. 8	354	367. 2	366	367. 2	224. 4	216
4 8	193. 2	162	152. 4	128. 4	105. 6	118. 8	117. 6	118. 8	54	52.4 4
4 9	231. 6	200. 4	130. 8	106. 8	73.2	82.8	81.6	76.8	16.8	15.8 4
5 0	104. 4	73.2	166. 8	142. 8	120	133. 2	132	133. 2	153. 6	156
5 1	97.2	66	165. 6	142. 8	120	133. 2	132	133. 2	153. 6	156
5 2	96	64.8	164. 4	140. 4	117. 6	130. 8	130. 8	130. 8	152. 4	154. 8
5 3	97.2	66	160. 8	136. 8	114	127. 2	127. 2	127. 2	148. 8	151. 2
5 4	104. 4	73.2	159. 6	135. 6	112. 8	127. 2	126	126	147. 6	150
5 5	102	70.8	159. 6	135. 6	112. 8	126	124. 8	126	147. 6	150
5 6	100. 8	69.6	157. 2	133. 2	110. 4	123. 6	123. 6	123. 6	145. 2	147. 6
5 7	98.4	67.2	166. 8	142. 8	120	133. 2	133. 2	133. 2	154. 8	157. 2
5 8	117. 6	86.4	154. 8	130. 8	108	121. 2	120	121. 2	142. 8	145. 2
5 9	216	184. 8	262. 8	238. 8	216	229. 2	228	229. 2	250. 8	253. 2
6 0	218. 4	187. 2	265. 2	241. 2	218. 4	231. 6	230. 4	231. 6	252	254. 4
6 1	253. 2	222	300	276	253. 2	266. 4	266. 4	266. 4	288	290. 4
6 2	308. 4	277. 2	355. 2	331. 2	308. 4	321. 6	320. 4	321. 6	343. 2	345. 6

	31	32	33	34	35	36	37	38	39	40
6 3	304. 8	273. 6	351. 6	327. 6	304. 8	318	316. 8	318	339. 6	342
6 4	264	232. 8	309. 6	285. 6	262. 8	277. 2	276	276	297. 6	300
6 5	304. 8	273. 6	351. 6	327. 6	304. 8	318	316. 8	318	339. 6	342
6 6	300	268. 8	346. 8	322. 8	300	313. 2	312	313. 2	334. 8	337. 2
6 7	290. 4	259. 2	336	313. 2	290. 4	303. 6	302. 4	303. 6	324	326. 4

	41	42	43	44	45	46	47	48	49	50
0	385.2	385.2	384	477. 6	506.4	657.6	657.6	409.2	387. 6	423.6
1	385.2	385.2	382.8	477. 6	506.4	657.6	656.4	409.2	387. 6	422.4
2	381.6	381.6	379.2	474	501.6	654	652.8	404.4	384	418.8
3	376.8	378	375.6	470. 4	498	650.4	649.2	400.8	380. 4	415.2
4	392.4	392.4	390	484. 8	512.4	664.8	663.6	416.4	394. 8	429.6
5	390	390	387.6	482. 4	511.2	662.4	662.4	414	392. 4	430.8
6	415.2	415.2	412.8	507. 6	536.4	687.6	687.6	439.2	417. 6	452.4
7	410.4	411.6	409.2	504	531.6	684	682.8	434.4	414	448.8
8	396	396	393.6	488. 4	516	668.4	667.2	420	398. 4	433.2
9	392.4	392.4	390	484. 8	513.6	664.8	664.8	416.4	394. 8	435.6
10	388.8	390	387.6	481. 2	510	661.2	661.2	412.8	391. 2	427.2
11	390	390	387.6	482. 4	511.2	580.8	582	414	392. 4	427.2
12	537.6	537.6	536.4	630	658.8	728.4	730.8	561.6	540	576
13	589.2	589.2	586.8	681. 6	710.4	780	781.2	613.2	591. 6	626.4
14	592.8	592.8	591.6	685. 2	714	783.6	786	616.8	595. 2	631.2
15	594	594	592.8	686. 4	715.2	784.8	787.2	618	596. 4	632.4
16	344.4	344.4	342	436. 8	464.4	534	536.4	367.2	346. 8	381.6
17	300	300	298.8	392. 4	421.2	490.8	492	324	302. 4	337.2
18	298.8	300	297.6	391. 2	420	571.2	571.2	322.8	302. 4	337.2
19	216	217.2	214.8	309. 6	337.2	489.6	488.4	240	218. 4	254.4
20	214.8	214.8	212.4	307. 2	336	487.2	487.2	238.8	216	252

	41	42	43	44	45	46	47	48	49	50
2 1	214.8	214.8	212.4	307. 2	336	487.2	487.2	238.8	216	252
2 2	250.8	252	249.6	344. 4	372	523.2	523.2	274.8	254. 4	290.4
2 3	388.8	388.8	387.6	510	510	661.2	661.2	412.8	391. 2	427.2
2 4	474	475.2	472.8	567. 6	595.2	747.6	746.4	498	477. 6	512.4
2 5	472.8	472.8	471.6	565. 2	594	745.2	745.2	496.8	475. 2	511.2
2 6	476.4	476.4	474	568. 8	597.6	748.8	748.8	500.4	478. 8	513.6
2 7	474	475.2	472.8	566. 4	595.2	746.4	746.4	498	477. 6	512.4
2 8	351.6	351.6	350.4	444	472.8	624	624	375.6	354	390
2 9	237.6	237.6	236.4	330	358.8	510	510	261.6	240	276
3 0	158.4	158.4	157.2	208. 8	237.6	334.8	334.8	140.4	160. 8	85.2
3 1	249.6	249.6	248.4	262. 8	290.4	355.2	354	193.2	231. 6	104.4
3 2	218.4	218.4	217.2	231. 6	259.2	324	322.8	162	200. 4	73.2
3 3	128.4	128.4	127.2	220. 8	249.6	400.8	400.8	152.4	130. 8	166.8
3 4	104.4	104.4	103.2	196. 8	225.6	376.8	376.8	128.4	106. 8	142.8
3 5	70.8	70.8	69.6	165. 6	189.6	354	354	105.6	73.2	120
3 6	79.2	80.4	78	187. 2	199.2	367.2	367.2	118.8	82.8	133.2
3 7	79.2	79.2	78	187. 2	196.8	366	366	117.6	81.6	132
3 8	74.4	74.4	73.2	169. 2	193.2	367.2	367.2	118.8	76.8	133.2
3 9	12	12	10.8	106. 8	130.8	223.2	224.4	54	16.8	153.6
4 0	11.4	11.76	9.72	98.4	121.2	214.8	216	52.44	15.8 4	156
4 1	0	1.08	2.28	87.7 2	112.4 4	204	205.2	48	11.4	165.6

	41	42	43	44	45	46	47	48	49	50
4 2	1.08	0	2.04	87.9 6	112.5 6	204	205.2	48.96	12.3 6	158.4
4 3	2.28	2.04	0	90.7 2	115.3 2	207.6	208.8	49.92	13.3 2	157.2
4 4	87.72	87.96	90.72	0	29.28	122.4	122.4	69	96.7 2	165.6
4 5	112.4 4	112.5 6	115.3 2	29.2 8	0	92.64	93.6	97.08	121. 2	194.4
4 6	204	204	207.6	122. 4	92.64	0	2.04	174	213. 6	249.6
4 7	205.2	205.2	208.8	122. 4	93.6	2.04	0	172.8	214. 8	248.4
4 8	48	48.96	49.92	69	97.08	174	172.8	0	38.2 8	99.84
4 9	11.4	12.36	13.32	96.7 2	121.2	213.6	214.8	38.28	0	136.8
5 0	165.6	158.4	157.2	165. 6	194.4	249.6	248.4	99.84	136. 8	0
5 1	165.6	164.4	164.4	172. 8	200.4	250.8	249.6	106.5 6	144	8.04
5 2	163.2	163.2	162	171. 6	199.2	253.2	252	104.8 8	141. 6	7.08
5 3	159.6	159.6	158.4	166. 8	195.6	264	262.8	100.8	138	12
5 4	158.4	158.4	158.4	166. 8	194.4	250.8	249.6	100.4 4	136. 8	5.76
5 5	158.4	158.4	157.2	165. 6	194.4	258	256.8	100.0 8	136. 8	5.16
5 6	156	156	154.8	164. 4	192	261.6	260.4	98.04	134. 4	9.12
5 7	165.6	165.6	164.4	174	201.6	250.8	250.8	107.6 4	144	8.88
5 8	153.6	153.6	152.4	162	189.6	270	268.8	95.4	132	29.76
5 9	261.6	261.6	260.4	270	169.2	158.4	157.2	204	240	115.9 2
6 0	264	264	262.8	271. 2	168	142.8	141.6	205.2	242. 4	117.8 4
6 1	298.8	298.8	297.6	194. 4	164.4	103.6 8	102.7 2	241.2	277. 2	153.6
6 2	354	354	352.8	229. 2	199.2	122.4	124.8	295.2	332. 4	207.6

	41	42	43	44	45	46	47	48	49	50
6 3	350.4	350.4	349.2	230. 4	201.6	119.4	123.6	291.6	328. 8	204
6 4	308.4	308.4	308.4	316. 8	196.8	135.6	134.4	250.8	286. 8	163.2
6 5	350.4	350.4	349.2	229. 2	200.4	108.2 4	109.6 8	292.8	328. 8	205.2
6 6	345.6	345.6	344.4	234	205.2	113.1 6	114.2 4	286.8	324	200.4
6 7	336	334.8	334.8	195. 6	166.8	107.8 8	108.8 4	277.2	314. 4	189.6

	51	52	53	54	55	56	57	58	59	60
0	423.6	421.2	417. 6	416.4	416.4	414	423.6	411. 6	519.6	522
1	422.4	421.2	416. 4	416.4	415.2	414	423.6	411. 6	519.6	520.8
2	418.8	417.6	412. 8	412.8	411.6	410. 4	420	406. 8	516	517.2
3	415.2	412.8	409. 2	409.2	408	406. 8	416.4	403. 2	511.2	513.6
4	429.6	428.4	423. 6	423.6	423.6	421. 2	430.8	418. 8	526.8	528
5	427.2	426	422. 4	421.2	421.2	418. 8	428.4	416. 4	524.4	525.6
6	452.4	451.2	446. 4	446.4	446.4	444	453.6	441. 6	549.6	550.8
7	448.8	446.4	442. 8	442.8	441.6	440. 4	450	436. 8	544.8	547.2
8	433.2	432	427. 2	427.2	427.2	424. 8	434.4	422. 4	530.4	531.6
9	429.6	428.4	424. 8	423.6	423.6	421. 2	430.8	418. 8	526.8	528
10	427.2	424.8	421. 2	420	420	417. 6	427.2	415. 2	523.2	525.6
11	427.2	426	421. 2	421.2	421.2	418. 8	428.4	416. 4	524.4	525.6
12	576	573.6	570	568.8	568.8	566. 4	576	564	672	674.4
13	626.4	625.2	620. 4	620.4	620.4	618	627.6	615. 6	723.6	724.8
14	631.2	628.8	625. 2	624	624	621. 6	631.2	619. 2	727.2	729.6
15	632.4	630	626. 4	625.2	625.2	622. 8	632.4	620. 4	728.4	730.8
16	381.6	380.4	375. 6	375.6	374.4	373. 2	382.8	370. 8	478.8	480
17	337.2	336	332. 4	331.2	331.2	328. 8	338.4	326. 4	434.4	435.6
18	337.2	334.8	331. 2	330	330	327. 6	337.2	325. 2	433.2	435.6
19	254.4	252	248. 4	248.4	247.2	246	255.6	242. 4	350.4	352.8
20	252	250.8	246	246	246	243. 6	253.2	241. 2	349.2	350.4

	51	52	53	54	55	56	57	58	59	60
2 1	252	250.8	246	246	246	243. 6	253.2	241. 2	349.2	350.4
2 2	289.2	288	285. 6	283.2	282	280. 8	290.4	277. 2	385.2	387.6
2 3	427.2	424.8	421. 2	420	420	417. 6	427.2	415. 2	523.2	525.6
2 4	512.4	510	506. 4	506.4	505.2	504	512.4	500. 4	608.4	610.8
2 5	510	508.8	505. 2	504	504	501. 6	511.2	499. 2	607.2	609.6
2 6	513.6	512.4	507. 6	507.6	507.6	505. 2	514.8	502. 8	610.8	612
2 7	512.4	510	506. 4	506.4	505.2	502. 8	512.4	500. 4	608.4	610.8
2 8	390	387.6	384	382.8	382.8	380. 4	390	378	486	488.4
2 9	276	273.6	270	268.8	268.8	266. 4	276	264	372	374.4
3 0	78	76.8	66	85.2	82.8	67.2	79.2	98.4	196.8	199.2
3 1	97.2	96	97.2	104.4	102	100. 8	98.4	117. 6	216	218.4
3 2	66	64.8	66	73.2	70.8	69.6	67.2	86.4	184.8	187.2
3 3	165.6	164.4	160. 8	159.6	159.6	157. 2	166.8	154. 8	262.8	265.2
3 4	142.8	140.4	136. 8	135.6	135.6	133. 2	142.8	130. 8	238.8	241.2
3 5	120	117.6	114	112.8	112.8	110. 4	120	108	216	218.4
3 6	133.2	130.8	127. 2	127.2	126	123. 6	133.2	121. 2	229.2	231.6
3 7	132	130.8	127. 2	126	124.8	123. 6	133.2	120	228	230.4
3 8	133.2	130.8	127. 2	126	126	123. 6	133.2	121. 2	229.2	231.6
3 9	153.6	152.4	148. 8	147.6	147.6	145. 2	154.8	142. 8	250.8	252
4 0	156	154.8	151. 2	150	150	147. 6	157.2	145. 2	253.2	254.4
4 1	165.6	163.2	159. 6	158.4	158.4	156	165.6	153. 6	261.6	264

	51	52	53	54	55	56	57	58	59	60
4 2	164.4	163.2	159. 6	158.4	158.4	156	165.6	153. 6	261.6	264
4 3	164.4	162	158. 4	158.4	157.2	154. 8	164.4	152. 4	260.4	262.8
4 4	172.8	171.6	166. 8	166.8	165.6	164. 4	174	162	270	271.2
4 5	200.4	199.2	195. 6	194.4	194.4	192	201.6	189. 6	169.2	168
4 6	250.8	253.2	264	250.8	258	261. 6	250.8	270	158.4	142.8
4 7	249.6	252	262. 8	249.6	256.8	260. 4	250.8	268. 8	157.2	141.6
4 8	106.5 6	104.8 8	100. 8	100.4 4	100.0 8	98.0 4	107.6 4	95.4	204	205.2
4 9	144	141.6	138	136.8	136.8	134. 4	144	132	240	242.4
5 0	8.04	7.08	12	5.76	5.16	9.12	8.88	29.7 6	115.9 2	117.8 4
5 1	0	2.28	12.3 6	7.08	5.76	10.4 4	2.16	34.3 2	115.2	117
5 2	2.28	0	10.5 6	11.76	6.36	8.76	4.08	31.4 4	118.3 2	120
5 3	12.36	10.56	0	12.72	7.44	2.04	12.84	26.1 6	124.8	126
5 4	7.08	11.76	12.7 2	0	5.16	11.7 6	4.2	32.7 6	110.2 8	112.0 8
5 5	5.76	6.36	7.44	5.16	0	5.64	7.56	26.2 8	119.6 4	121.2
5 6	10.44	8.76	2.04	11.76	5.64	0	10.92	24.2 4	122.4	124.8
5 7	2.16	4.08	12.8 4	4.2	7.56	10.9 2	0	29.4	115.5 6	117.4 8
5 8	34.32	31.44	26.1 6	32.76	26.28	24.2 4	29.4	0	136.8	139.2
5 9	115.2	118.3 2	124. 8	110.2 8	119.6 4	122. 4	115.5 6	136. 8	0	2.88
6 0	117	120	126	112.0 8	121.2	124. 8	117.4 8	139. 2	2.88	0
6 1	152.4	156	162	147.6	157.2	159. 6	152.4	174	58.08	39
6 2	207.6	210	217. 2	202.8	212.4	214. 8	207.6	229. 2	112.9 2	75.24

	51	52	53	54	55	56	57	58	59	60
6 3	204	206.4	213. 6	199.2	208.8	211. 2	204	225. 6	109.4 4	111.9 6
6 4	162	165.6	171. 6	157.2	166.8	170. 4	163.2	183. 6	67.92	70.44
6 5	204	207.6	213. 6	199.2	208.8	211. 2	204	225. 6	109.5 6	112.0 8
6 6	199.2	202.8	208. 8	194.4	204	206. 4	199.2	220. 8	104.7 6	107.2 8
6 7	188.4	192	198	183.6	193.2	196. 8	189.6	210	94.44	97.08

	61	62	63	64	65	66	67
0	556.8	612	609.6	566.4	608.4	603.6	594
1	556.8	610.8	608.4	566.4	608.4	603.6	592.8
2	553.2	607.2	603.6	562.8	604.8	598.8	589.2
3	548.4	603.6	600	559.2	600	595.2	585.6
4	564	618	614.4	573.6	615.6	610.8	600
5	561.6	620.4	616.8	571.2	613.2	608.4	597.6
6	586.8	640.8	638.4	596.4	638.4	633.6	622.8
7	582	637.2	633.6	592.8	633.6	628.8	619.2
8	567.6	621.6	618	577.2	619.2	614.4	603.6
9	564	625.2	621.6	573.6	615.6	610.8	600
10	560.4	615.6	613.2	571.2	612	607.2	597.6
11	561.6	616.8	612	571.2	613.2	608.4	597.6
12	709.2	764.4	760.8	718.8	760.8	756	746.4
13	760.8	816	812.4	770.4	812.4	807.6	796.8
14	764.4	819.6	816	774	816	811.2	801.6
15	765.6	820.8	817.2	775.2	817.2	812.4	802.8
16	516	570	566.4	525.6	567.6	562.8	552
17	471.6	526.8	523.2	481.2	523.2	518.4	507.6
18	470.4	525.6	522	481.2	522	517.2	507.6
19	387.6	442.8	439.2	398.4	439.2	434.4	424.8
20	386.4	441.6	438	396	438	433.2	422.4
21	386.4	441.6	439.2	396	438	433.2	422.4
22	423.6	477.6	474	433.2	474	469.2	459.6
23	560.4	615.6	612	570	612	607.2	597.6
24	645.6	700.8	697.2	656.4	697.2	692.4	682.8
25	644.4	699.6	699.6	654	696	691.2	680.4
26	648	703.2	697.2	657.6	699.6	694.8	684
27	645.6	700.8	700.8	656.4	697.2	692.4	682.8
28	523.2	578.4	574.8	532.8	574.8	570	560.4
29	409.2	464.4	460.8	418.8	460.8	456	446.4
30	234	289.2	285.6	244.8	285.6	280.8	271.2
31	253.2	308.4	304.8	264	304.8	300	290.4
32	222	277.2	273.6	232.8	273.6	268.8	259.2
33	300	355.2	351.6	309.6	351.6	346.8	336

	61	62	63	64	65	66	67
34	276	331.2	327.6	285.6	327.6	322.8	313.2
35	253.2	308.4	304.8	262.8	304.8	300	290.4
36	266.4	321.6	318	277.2	318	313.2	303.6
37	266.4	320.4	316.8	276	316.8	312	302.4
38	266.4	321.6	318	276	318	313.2	303.6
39	288	343.2	339.6	297.6	339.6	334.8	324
40	290.4	345.6	342	300	342	337.2	326.4
41	298.8	354	350.4	308.4	350.4	345.6	336
42	298.8	354	350.4	308.4	350.4	345.6	334.8
43	297.6	352.8	349.2	308.4	349.2	344.4	334.8
44	194.4	229.2	230.4	316.8	229.2	234	195.6
45	164.4	199.2	201.6	196.8	200.4	205.2	166.8
46	103.68	122.4	119.4	135.6	108.24	113.16	107.88
47	102.72	124.8	123.6	134.4	109.68	114.24	108.84
48	241.2	295.2	291.6	250.8	292.8	286.8	277.2
49	277.2	332.4	328.8	286.8	328.8	324	314.4
50	153.6	207.6	204	163.2	205.2	200.4	189.6
51	152.4	207.6	204	162	204	199.2	188.4
52	156	210	206.4	165.6	207.6	202.8	192
53	162	217.2	213.6	171.6	213.6	208.8	198
54	147.6	202.8	199.2	157.2	199.2	194.4	183.6
55	157.2	212.4	208.8	166.8	208.8	204	193.2
56	159.6	214.8	211.2	170.4	211.2	206.4	196.8
57	152.4	207.6	204	163.2	204	199.2	189.6
58	174	229.2	225.6	183.6	225.6	220.8	210
59	58.08	112.92	109.44	67.92	109.56	104.76	94.44
60	39	75.24	111.96	70.44	112.08	107.28	97.08
61	0	37.8	39.72	32.64	74.28	69.48	59.16
62	37.8	0	4.08	70.08	25.8	14.52	19.44
63	39.72	4.08	0	94.32	21.72	10.56	17.4
64	32.64	70.08	94.32	0	41.64	36.84	26.52
65	74.28	25.8	21.72	41.64	0	13.08	42.72
66	69.48	14.52	10.56	36.84	13.08	0	28.56
67	59.16	19.44	17.4	26.52	42.72	28.56	0

Lampiran 10 (Penentuan Rute / *Running Model Menggunakan Software Lingo*)➤ Hasil dari *solution report* pada *cluster 1*

Global optimal solution found.

Objective value:	52.00000
Objective bound:	52.00000
Infeasibilities:	0.000000
Extended solver steps:	562
Total solver iterations:	9462
Elapsed runtime seconds:	0.74

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 3 sebesar 13.6 km

rute pengiriman dari ritel 2 ke ritel 1 sebesar 8.9 km

rute pengiriman dari ritel 3 ke ritel 4 sebesar 7.9 km

rute pengiriman dari ritel 4 ke ritel 5 sebesar 3.9 km

rute pengiriman dari ritel 5 ke ritel 6 sebesar 2.6 km

rute pengiriman dari ritel 6 ke ritel 7 sebesar 3.6 km

rute pengiriman dari ritel 7 ke ritel 8 sebesar 2.8 km

rute pengiriman dari ritel 8 ke ritel 2 sebesar 8.7 km

Model Class: MILP

Total variables:	72
Nonlinear variables:	0
Integer variables:	64
Total constraints:	88
Nonlinear constraints:	0
Total nonzeros:	399
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000

BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
T(1)	1285.800	0.000000
T(2)	755.4000	0.000000
T(3)	540.0000	0.000000
T(4)	579.4800	0.000000
T(5)	614.1600	0.000000
T(6)	647.2800	0.000000
T(7)	681.6000	0.000000
T(8)	714.9600	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	0.000000	8.900000
X(1, 3)	1.000000	13.60000
X(1, 4)	0.000000	19.70000
X(1, 5)	0.000000	20.70000
X(1, 6)	0.000000	21.50000
X(1, 7)	0.000000	19.20000
X(1, 8)	0.000000	18.10000
X(2, 1)	1.000000	8.900000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	6.800000
X(2, 4)	0.000000	13.30000
X(2, 5)	0.000000	14.60000
X(2, 6)	0.000000	13.10000
X(2, 7)	0.000000	10.90000
X(2, 8)	0.000000	8.700000
X(3, 1)	0.000000	13.60000

X(3, 2)	0.000000	6.800000
X(3, 3)	0.000000	0.000000
X(3, 4)	1.000000	7.900000
X(3, 5)	0.000000	10.30000
X(3, 6)	0.000000	10.50000
X(3, 7)	0.000000	8.100000
X(3, 8)	0.000000	9.400000
X(4, 1)	0.000000	19.70000
X(4, 2)	0.000000	13.30000
X(4, 3)	0.000000	7.900000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	3.900000
X(4, 6)	0.000000	4.600000
X(4, 7)	0.000000	4.600000
X(4, 8)	0.000000	5.600000
X(5, 1)	0.000000	20.70000
X(5, 2)	0.000000	14.60000
X(5, 3)	0.000000	10.30000
X(5, 4)	0.000000	3.900000
X(5, 5)	0.000000	0.000000
X(5, 6)	1.000000	2.600000
X(5, 7)	0.000000	5.400000
X(5, 8)	0.000000	3.400000
X(6, 1)	0.000000	21.50000
X(6, 2)	0.000000	13.10000
X(6, 3)	0.000000	10.50000
X(6, 4)	0.000000	4.600000
X(6, 5)	0.000000	2.600000
X(6, 6)	0.000000	0.000000
X(6, 7)	1.000000	3.600000
X(6, 8)	0.000000	2.500000
X(7, 1)	0.000000	19.20000
X(7, 2)	0.000000	10.90000
X(7, 3)	0.000000	8.100000
X(7, 4)	0.000000	4.600000
X(7, 5)	0.000000	5.400000
X(7, 6)	0.000000	3.600000
X(7, 7)	0.000000	0.000000
X(7, 8)	1.000000	2.800000
X(8, 1)	0.000000	18.10000
X(8, 2)	1.000000	8.700000
X(8, 3)	0.000000	9.400000
X(8, 4)	0.000000	5.600000
X(8, 5)	0.000000	3.400000

X(8, 6)	0.000000	2.500000
X(8, 7)	0.000000	2.800000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	8.900000	0.000000
D(1, 3)	13.60000	0.000000
D(1, 4)	19.70000	0.000000
D(1, 5)	20.70000	0.000000
D(1, 6)	21.50000	0.000000
D(1, 7)	19.20000	0.000000
D(1, 8)	18.10000	0.000000
D(2, 1)	8.900000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	6.800000	0.000000
D(2, 4)	13.30000	0.000000
D(2, 5)	14.60000	0.000000
D(2, 6)	13.10000	0.000000
D(2, 7)	10.90000	0.000000
D(2, 8)	8.700000	0.000000
D(3, 1)	13.60000	0.000000
D(3, 2)	6.800000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	7.900000	0.000000
D(3, 5)	10.30000	0.000000
D(3, 6)	10.50000	0.000000
D(3, 7)	8.100000	0.000000
D(3, 8)	9.400000	0.000000
D(4, 1)	19.70000	0.000000
D(4, 2)	13.30000	0.000000
D(4, 3)	7.900000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	3.900000	0.000000
D(4, 6)	4.600000	0.000000
D(4, 7)	4.600000	0.000000
D(4, 8)	5.600000	0.000000
D(5, 1)	20.70000	0.000000
D(5, 2)	14.60000	0.000000
D(5, 3)	10.30000	0.000000
D(5, 4)	3.900000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	2.600000	0.000000
D(5, 7)	5.400000	0.000000
D(5, 8)	3.400000	0.000000
D(6, 1)	21.50000	0.000000

D(6, 2)	13.10000	0.000000
D(6, 3)	10.50000	0.000000
D(6, 4)	4.600000	0.000000
D(6, 5)	2.600000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.600000	0.000000
D(6, 8)	2.500000	0.000000
D(7, 1)	19.20000	0.000000
D(7, 2)	10.90000	0.000000
D(7, 3)	8.100000	0.000000
D(7, 4)	4.600000	0.000000
D(7, 5)	5.400000	0.000000
D(7, 6)	3.600000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	2.800000	0.000000
D(8, 1)	18.10000	0.000000
D(8, 2)	8.700000	0.000000
D(8, 3)	9.400000	0.000000
D(8, 4)	5.600000	0.000000
D(8, 5)	3.400000	0.000000
D(8, 6)	2.500000	0.000000
D(8, 7)	2.800000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	10.68000	0.000000
DURASI(1, 3)	16.32000	0.000000
DURASI(1, 4)	23.64000	0.000000
DURASI(1, 5)	24.84000	0.000000
DURASI(1, 6)	25.80000	0.000000
DURASI(1, 7)	23.04000	0.000000
DURASI(1, 8)	21.72000	0.000000
DURASI(2, 1)	10.68000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	8.160000	0.000000
DURASI(2, 4)	15.96000	0.000000
DURASI(2, 5)	17.52000	0.000000
DURASI(2, 6)	15.72000	0.000000
DURASI(2, 7)	13.08000	0.000000
DURASI(2, 8)	10.44000	0.000000
DURASI(3, 1)	16.32000	0.000000
DURASI(3, 2)	8.160000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	9.480000	0.000000
DURASI(3, 5)	12.36000	0.000000

DURASI(3, 6)	12.60000	0.000000
DURASI(3, 7)	9.720000	0.000000
DURASI(3, 8)	11.28000	0.000000
DURASI(4, 1)	23.64000	0.000000
DURASI(4, 2)	15.96000	0.000000
DURASI(4, 3)	9.480000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	4.680000	0.000000
DURASI(4, 6)	5.520000	0.000000
DURASI(4, 7)	5.520000	0.000000
DURASI(4, 8)	6.720000	0.000000
DURASI(5, 1)	24.84000	0.000000
DURASI(5, 2)	17.52000	0.000000
DURASI(5, 3)	12.36000	0.000000
DURASI(5, 4)	4.680000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	3.120000	0.000000
DURASI(5, 7)	6.480000	0.000000
DURASI(5, 8)	4.080000	0.000000
DURASI(6, 1)	25.80000	0.000000
DURASI(6, 2)	15.72000	0.000000
DURASI(6, 3)	12.60000	0.000000
DURASI(6, 4)	5.520000	0.000000
DURASI(6, 5)	3.120000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.320000	0.000000
DURASI(6, 8)	3.000000	0.000000
DURASI(7, 1)	23.04000	0.000000
DURASI(7, 2)	13.08000	0.000000
DURASI(7, 3)	9.720000	0.000000
DURASI(7, 4)	5.520000	0.000000
DURASI(7, 5)	6.480000	0.000000
DURASI(7, 6)	4.320000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	3.360000	0.000000
DURASI(8, 1)	21.72000	0.000000
DURASI(8, 2)	10.44000	0.000000
DURASI(8, 3)	11.28000	0.000000
DURASI(8, 4)	6.720000	0.000000
DURASI(8, 5)	4.080000	0.000000
DURASI(8, 6)	3.000000	0.000000
DURASI(8, 7)	3.360000	0.000000
DURASI(8, 8)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 2*

model:

```
!parameter model:
    Buka           = waktu buka ritel
    Tutup          = waktu tutup ritel
    Bongkar        = waktu loading/unloading di ritel
    D              = jarak antar ritel
    T              = waktu memulai pelayanan pada ritel
    Durasi         = Durasi pengiriman
    R              = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..16/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 540 540 540 540 540 540 540 540 540
540 540;
tutup = 1020 1260 1260 1260 1260 1260 1260 1260 1260 1260 1260 1260
1260 1260 1260 1260 1260;
```

D =

```
!ritel
1    2    3    4    5    6    7    8    9    10   11
    12   13   14   15   16
!0   3    6    7    29   30   31   32   50   51   52
    53   54   55   57   60;
0    8.3  41.1  39.6  227  275  324  322  353  353
    351  348  347  347  353  435  !0;
8.3  0    24.4  33   220  268  317  315  346  346
    344  341  341  340  347  428  !3;
41.1 24.4  0    7.5  127  300  208  238  377  377
    376  372  372  372  378  459  !6;
```

39.6	33	7.5	0	133	297	215	343	374	374	
	372	369	369	368	375	456	!7;			
227	220	127	133	0	85	102	134	230	230	
	228	225	224	224	230	312	!29;			
275	268	300	297	85	0	48	50	71	65	64
	55	71	69	66	166	!30;				
324	317	208	215	102	48	0	28	87	81	80
	81	87	85	82	182	!31;				
322	315	238	343	134	50	28	0	61	55	54
	55	61	59	56	156	!32;				
353	346	377	374	230	71	87	61	0	6.7	5.9
	10	4.8	4.3	7.4	98.2	!50;				
353	346	377	374	230	65	81	55	6.7	0	1.9
	10.3	5.9	4.8	1.8	97.5	!51;				
351	344	376	372	228	64	80	54	5.9	1.9	0
	8.8	9.8	5.3	3.4	100	!52;				
348	341	372	369	225	55	81	55	10	10.3	8.8
	0	10.6	6.2	10.7	105	!53;				
347	341	372	369	224	71	87	61	4.8	5.9	9.8
	10.6	0	4.3	3.5	93.4	!54;				
347	340	372	368	224	69	85	59	4.3	4.8	5.3
	6.2	4.3	0	6.3	101	!55;				
353	347	378	375	230	66	82	56	7.4	1.8	3.4
	10.7	3.5	6.3	0	97.9	!57;				
435	428	459	456	312	166	182	156	98.2	97.5	
	100	105	93.4	101	97.9	0;	!60;			

durasi =

0	9.96	49.32	47.52	272.4	330	388.8	386.4	423.6	423.6	
	421.2	417.6	416.4	416.4	423.6	522				
9.96	0	29.28	39.6	264	321.6	380.4	378	415.2	415.2	
	412.8	409.2	409.2	408	416.4	513.6				
49.32	29.28	0	9	152.4	360	249.6	285.6	452.4	452.4	
	451.2	446.4	446.4	446.4	453.6	550.8				
47.52	39.6	9	0	159.6	356.4	258	411.6	448.8	448.8	
	446.4	442.8	442.8	441.6	450	547.2				
272.4	264	152.4	159.6	0	102	122.4	160.8	276	276	
	273.6	270	268.8	268.8	276	374.4				
330	321.6	360	356.4	102	0	57.6	60	85.2	78	
	76.8	66	85.2	82.8	79.2	199.2				
388.8	380.4	249.6	258	122.4	57.6	0	33.6	104.4	97.2	96
	97.2	104.4	102	98.4	218.4					
386.4	378	285.6	411.6	160.8	60	33.6	0	73.2	66	
	64.8	66	73.2	70.8	67.2	187.2				

```

423.6 415.2 452.4 448.8 276 85.2 104.4 73.2 0 8.04
      7.08 12 5.76 5.16 8.88 117.84
423.6 415.2 452.4 448.8 276 78 97.2 66 8.04 0
      2.28 12.36 7.08 5.76 2.16 117
421.2 412.8 451.2 446.4 273.6 76.8 96 64.8 7.08 2.28 0
      10.56 11.76 6.36 4.08 120
417.6 409.2 446.4 442.8 270 66 97.2 66 12 12.36
      10.56 0 12.72 7.44 12.84 126
416.4 409.2 446.4 442.8 268.8 85.2 104.4 73.2 5.76 7.08
      11.76 12.72 0 5.16 4.2 112.08
416.4 408 446.4 441.6 268.8 82.8 102 70.8 5.16 5.76
      6.36 7.44 5.16 0 7.56 121.2
423.6 416.4 453.6 450 276 79.2 98.4 67.2 8.88 2.16
      4.08 12.84 4.2 7.56 0 117.48
522 513.6 550.8 547.2 374.4 199.2 218.4 187.2 117.84
      117 120 126 112.08 121.2 117.48 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =

```

```

    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

```

```

!Fungsi batasan;

```

```

!setiap ritel dikunjungi satu kali;

```

```

@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

```

```

!perjalanan diawali dari depot;

```

```

@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

```

```

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!route;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 2*

Feasible solution found.	
Objective value:	844.6000
Objective bound:	637.8000
Infeasibilities:	0.000000
Extended solver steps:	8046641
Total solver iterations:	172393034
Elapsed runtime seconds:	25926.51

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 4 sebesar 39.6 km
 rute pengiriman dari ritel 2 ke ritel 1 sebesar 8.3000000000000001 km
 rute pengiriman dari ritel 3 ke ritel 2 sebesar 24.4 km
 rute pengiriman dari ritel 4 ke ritel 5 sebesar 133 km
 rute pengiriman dari ritel 5 ke ritel 6 sebesar 85 km
 rute pengiriman dari ritel 6 ke ritel 12 sebesar 55 km
 rute pengiriman dari ritel 7 ke ritel 3 sebesar 208 km
 rute pengiriman dari ritel 8 ke ritel 7 sebesar 28 km
 rute pengiriman dari ritel 9 ke ritel 16 sebesar 98.2 km
 rute pengiriman dari ritel 10 ke ritel 11 sebesar 1.9 km
 rute pengiriman dari ritel 11 ke ritel 8 sebesar 54 km
 rute pengiriman dari ritel 12 ke ritel 14 sebesar 6.2 km
 rute pengiriman dari ritel 13 ke ritel 15 sebesar 3.5 km
 rute pengiriman dari ritel 14 ke ritel 9 sebesar 4.3 km
 rute pengiriman dari ritel 15 ke ritel 10 sebesar 1.8 km
 rute pengiriman dari ritel 16 ke ritel 13 sebesar 93.40000000000001 km

Model Class: MILP

Total variables:	272
Nonlinear variables:	0
Integer variables:	256
Total constraints:	304
Nonlinear constraints:	0
Total nonzeros:	1695
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BONGKAR(12)	30.00000	0.000000
BONGKAR(13)	30.00000	0.000000
BONGKAR(14)	30.00000	0.000000

BONGKAR(15)	30.00000	0.000000
BONGKAR(16)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
BUKA(12)	540.0000	0.000000
BUKA(13)	540.0000	0.000000
BUKA(14)	540.0000	0.000000
BUKA(15)	540.0000	0.000000
BUKA(16)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
TUTUP(12)	1260.000	0.000000
TUTUP(13)	1260.000	0.000000
TUTUP(14)	1260.000	0.000000
TUTUP(15)	1260.000	0.000000
TUTUP(16)	1260.000	0.000000
T(1)	1260.000	0.000000
T(2)	1230.000	0.000000
T(3)	570.0000	0.000000
T(4)	1200.000	0.000000
T(5)	930.0000	0.000000
T(6)	900.0000	0.000000
T(7)	600.0000	0.000000
T(8)	630.0000	0.000000
T(9)	720.0000	0.000000
T(10)	840.0000	0.000000

T(11)	870.0000	0.000000
T(12)	660.0000	0.000000
T(13)	810.0000	0.000000
T(14)	690.0000	0.000000
T(15)	750.0000	0.000000
T(16)	780.0000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	0.000000	8.300000
X(1, 3)	0.000000	41.10000
X(1, 4)	1.000000	39.60000
X(1, 5)	0.000000	227.0000
X(1, 6)	0.000000	275.0000
X(1, 7)	0.000000	324.0000
X(1, 8)	0.000000	322.0000
X(1, 9)	0.000000	353.0000
X(1, 10)	0.000000	353.0000
X(1, 11)	0.000000	351.0000
X(1, 12)	0.000000	348.0000
X(1, 13)	0.000000	347.0000
X(1, 14)	0.000000	347.0000
X(1, 15)	0.000000	353.0000
X(1, 16)	0.000000	435.0000
X(2, 1)	1.000000	8.300000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	24.40000
X(2, 4)	0.000000	33.00000
X(2, 5)	0.000000	220.0000
X(2, 6)	0.000000	268.0000
X(2, 7)	0.000000	317.0000
X(2, 8)	0.000000	315.0000
X(2, 9)	0.000000	346.0000
X(2, 10)	0.000000	346.0000
X(2, 11)	0.000000	344.0000
X(2, 12)	0.000000	341.0000
X(2, 13)	0.000000	341.0000
X(2, 14)	0.000000	340.0000
X(2, 15)	0.000000	347.0000
X(2, 16)	0.000000	428.0000
X(3, 1)	0.000000	41.10000
X(3, 2)	1.000000	24.40000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	7.500000
X(3, 5)	0.000000	127.0000
X(3, 6)	0.000000	300.0000

X(3, 7)	0.000000	208.0000
X(3, 8)	0.000000	238.0000
X(3, 9)	0.000000	377.0000
X(3, 10)	0.000000	377.0000
X(3, 11)	0.000000	376.0000
X(3, 12)	0.000000	372.0000
X(3, 13)	0.000000	372.0000
X(3, 14)	0.000000	372.0000
X(3, 15)	0.000000	378.0000
X(3, 16)	0.000000	459.0000
X(4, 1)	0.000000	39.60000
X(4, 2)	0.000000	33.00000
X(4, 3)	0.000000	7.500000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	133.0000
X(4, 6)	0.000000	297.0000
X(4, 7)	0.000000	215.0000
X(4, 8)	0.000000	343.0000
X(4, 9)	0.000000	374.0000
X(4, 10)	0.000000	374.0000
X(4, 11)	0.000000	372.0000
X(4, 12)	0.000000	369.0000
X(4, 13)	0.000000	369.0000
X(4, 14)	0.000000	368.0000
X(4, 15)	0.000000	375.0000
X(4, 16)	0.000000	456.0000
X(5, 1)	0.000000	227.0000
X(5, 2)	0.000000	220.0000
X(5, 3)	0.000000	127.0000
X(5, 4)	0.000000	133.0000
X(5, 5)	0.000000	0.000000
X(5, 6)	1.000000	85.00000
X(5, 7)	0.000000	102.0000
X(5, 8)	0.000000	134.0000
X(5, 9)	0.000000	230.0000
X(5, 10)	0.000000	230.0000
X(5, 11)	0.000000	228.0000
X(5, 12)	0.000000	225.0000
X(5, 13)	0.000000	224.0000
X(5, 14)	0.000000	224.0000
X(5, 15)	0.000000	230.0000
X(5, 16)	0.000000	312.0000
X(6, 1)	0.000000	275.0000
X(6, 2)	0.000000	268.0000

X(6, 3)	0.000000	300.0000
X(6, 4)	0.000000	297.0000
X(6, 5)	0.000000	85.00000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	48.00000
X(6, 8)	0.000000	50.00000
X(6, 9)	0.000000	71.00000
X(6, 10)	0.000000	65.00000
X(6, 11)	0.000000	64.00000
X(6, 12)	1.000000	55.00000
X(6, 13)	0.000000	71.00000
X(6, 14)	0.000000	69.00000
X(6, 15)	0.000000	66.00000
X(6, 16)	0.000000	166.0000
X(7, 1)	0.000000	324.0000
X(7, 2)	0.000000	317.0000
X(7, 3)	1.000000	208.0000
X(7, 4)	0.000000	215.0000
X(7, 5)	0.000000	102.0000
X(7, 6)	0.000000	48.00000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	28.00000
X(7, 9)	0.000000	87.00000
X(7, 10)	0.000000	81.00000
X(7, 11)	0.000000	80.00000
X(7, 12)	0.000000	81.00000
X(7, 13)	0.000000	87.00000
X(7, 14)	0.000000	85.00000
X(7, 15)	0.000000	82.00000
X(7, 16)	0.000000	182.0000
X(8, 1)	0.000000	322.0000
X(8, 2)	0.000000	315.0000
X(8, 3)	0.000000	238.0000
X(8, 4)	0.000000	343.0000
X(8, 5)	0.000000	134.0000
X(8, 6)	0.000000	50.00000
X(8, 7)	1.000000	28.00000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	61.00000
X(8, 10)	0.000000	55.00000
X(8, 11)	0.000000	54.00000
X(8, 12)	0.000000	55.00000
X(8, 13)	0.000000	61.00000
X(8, 14)	0.000000	59.00000

X(8, 15)	0.000000	56.00000
X(8, 16)	0.000000	156.0000
X(9, 1)	0.000000	353.0000
X(9, 2)	0.000000	346.0000
X(9, 3)	0.000000	377.0000
X(9, 4)	0.000000	374.0000
X(9, 5)	0.000000	230.0000
X(9, 6)	0.000000	71.00000
X(9, 7)	0.000000	87.00000
X(9, 8)	0.000000	61.00000
X(9, 9)	0.000000	0.000000
X(9, 10)	0.000000	6.700000
X(9, 11)	0.000000	5.900000
X(9, 12)	0.000000	10.00000
X(9, 13)	0.000000	4.800000
X(9, 14)	0.000000	4.300000
X(9, 15)	0.000000	7.400000
X(9, 16)	1.000000	98.20000
X(10, 1)	0.000000	353.0000
X(10, 2)	0.000000	346.0000
X(10, 3)	0.000000	377.0000
X(10, 4)	0.000000	374.0000
X(10, 5)	0.000000	230.0000
X(10, 6)	0.000000	65.00000
X(10, 7)	0.000000	81.00000
X(10, 8)	0.000000	55.00000
X(10, 9)	0.000000	6.700000
X(10, 10)	0.000000	0.000000
X(10, 11)	1.000000	1.900000
X(10, 12)	0.000000	10.30000
X(10, 13)	0.000000	5.900000
X(10, 14)	0.000000	4.800000
X(10, 15)	0.000000	1.800000
X(10, 16)	0.000000	97.50000
X(11, 1)	0.000000	351.0000
X(11, 2)	0.000000	344.0000
X(11, 3)	0.000000	376.0000
X(11, 4)	0.000000	372.0000
X(11, 5)	0.000000	228.0000
X(11, 6)	0.000000	64.00000
X(11, 7)	0.000000	80.00000
X(11, 8)	1.000000	54.00000
X(11, 9)	0.000000	5.900000
X(11, 10)	0.000000	1.900000

X(11, 11)	0.000000	0.000000
X(11, 12)	0.000000	8.800000
X(11, 13)	0.000000	9.800000
X(11, 14)	0.000000	5.300000
X(11, 15)	0.000000	3.400000
X(11, 16)	0.000000	100.0000
X(12, 1)	0.000000	348.0000
X(12, 2)	0.000000	341.0000
X(12, 3)	0.000000	372.0000
X(12, 4)	0.000000	369.0000
X(12, 5)	0.000000	225.0000
X(12, 6)	0.000000	55.00000
X(12, 7)	0.000000	81.00000
X(12, 8)	0.000000	55.00000
X(12, 9)	0.000000	10.00000
X(12, 10)	0.000000	10.30000
X(12, 11)	0.000000	8.800000
X(12, 12)	0.000000	0.000000
X(12, 13)	0.000000	10.60000
X(12, 14)	1.000000	6.200000
X(12, 15)	0.000000	10.70000
X(12, 16)	0.000000	105.0000
X(13, 1)	0.000000	347.0000
X(13, 2)	0.000000	341.0000
X(13, 3)	0.000000	372.0000
X(13, 4)	0.000000	369.0000
X(13, 5)	0.000000	224.0000
X(13, 6)	0.000000	71.00000
X(13, 7)	0.000000	87.00000
X(13, 8)	0.000000	61.00000
X(13, 9)	0.000000	4.800000
X(13, 10)	0.000000	5.900000
X(13, 11)	0.000000	9.800000
X(13, 12)	0.000000	10.60000
X(13, 13)	0.000000	0.000000
X(13, 14)	0.000000	4.300000
X(13, 15)	1.000000	3.500000
X(13, 16)	0.000000	93.40000
X(14, 1)	0.000000	347.0000
X(14, 2)	0.000000	340.0000
X(14, 3)	0.000000	372.0000
X(14, 4)	0.000000	368.0000
X(14, 5)	0.000000	224.0000
X(14, 6)	0.000000	69.00000

X(14, 7)	0.000000	85.00000
X(14, 8)	0.000000	59.00000
X(14, 9)	1.000000	4.300000
X(14, 10)	0.000000	4.800000
X(14, 11)	0.000000	5.300000
X(14, 12)	0.000000	6.200000
X(14, 13)	0.000000	4.300000
X(14, 14)	0.000000	0.000000
X(14, 15)	0.000000	6.300000
X(14, 16)	0.000000	101.0000
X(15, 1)	0.000000	353.0000
X(15, 2)	0.000000	347.0000
X(15, 3)	0.000000	378.0000
X(15, 4)	0.000000	375.0000
X(15, 5)	0.000000	230.0000
X(15, 6)	0.000000	66.00000
X(15, 7)	0.000000	82.00000
X(15, 8)	0.000000	56.00000
X(15, 9)	0.000000	7.400000
X(15, 10)	1.000000	1.800000
X(15, 11)	0.000000	3.400000
X(15, 12)	0.000000	10.70000
X(15, 13)	0.000000	3.500000
X(15, 14)	0.000000	6.300000
X(15, 15)	0.000000	0.000000
X(15, 16)	0.000000	97.90000
X(16, 1)	0.000000	435.0000
X(16, 2)	0.000000	428.0000
X(16, 3)	0.000000	459.0000
X(16, 4)	0.000000	456.0000
X(16, 5)	0.000000	312.0000
X(16, 6)	0.000000	166.0000
X(16, 7)	0.000000	182.0000
X(16, 8)	0.000000	156.0000
X(16, 9)	0.000000	98.20000
X(16, 10)	0.000000	97.50000
X(16, 11)	0.000000	100.0000
X(16, 12)	0.000000	105.0000
X(16, 13)	1.000000	93.40000
X(16, 14)	0.000000	101.0000
X(16, 15)	0.000000	97.90000
X(16, 16)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	8.300000	0.000000

D(1, 3)	41.10000	0.000000
D(1, 4)	39.60000	0.000000
D(1, 5)	227.0000	0.000000
D(1, 6)	275.0000	0.000000
D(1, 7)	324.0000	0.000000
D(1, 8)	322.0000	0.000000
D(1, 9)	353.0000	0.000000
D(1, 10)	353.0000	0.000000
D(1, 11)	351.0000	0.000000
D(1, 12)	348.0000	0.000000
D(1, 13)	347.0000	0.000000
D(1, 14)	347.0000	0.000000
D(1, 15)	353.0000	0.000000
D(1, 16)	435.0000	0.000000
D(2, 1)	8.300000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	24.40000	0.000000
D(2, 4)	33.00000	0.000000
D(2, 5)	220.0000	0.000000
D(2, 6)	268.0000	0.000000
D(2, 7)	317.0000	0.000000
D(2, 8)	315.0000	0.000000
D(2, 9)	346.0000	0.000000
D(2, 10)	346.0000	0.000000
D(2, 11)	344.0000	0.000000
D(2, 12)	341.0000	0.000000
D(2, 13)	341.0000	0.000000
D(2, 14)	340.0000	0.000000
D(2, 15)	347.0000	0.000000
D(2, 16)	428.0000	0.000000
D(3, 1)	41.10000	0.000000
D(3, 2)	24.40000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	7.500000	0.000000
D(3, 5)	127.0000	0.000000
D(3, 6)	300.0000	0.000000
D(3, 7)	208.0000	0.000000
D(3, 8)	238.0000	0.000000
D(3, 9)	377.0000	0.000000
D(3, 10)	377.0000	0.000000
D(3, 11)	376.0000	0.000000
D(3, 12)	372.0000	0.000000
D(3, 13)	372.0000	0.000000
D(3, 14)	372.0000	0.000000

D(3, 15)	378.0000	0.000000
D(3, 16)	459.0000	0.000000
D(4, 1)	39.60000	0.000000
D(4, 2)	33.00000	0.000000
D(4, 3)	7.500000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	133.0000	0.000000
D(4, 6)	297.0000	0.000000
D(4, 7)	215.0000	0.000000
D(4, 8)	343.0000	0.000000
D(4, 9)	374.0000	0.000000
D(4, 10)	374.0000	0.000000
D(4, 11)	372.0000	0.000000
D(4, 12)	369.0000	0.000000
D(4, 13)	369.0000	0.000000
D(4, 14)	368.0000	0.000000
D(4, 15)	375.0000	0.000000
D(4, 16)	456.0000	0.000000
D(5, 1)	227.0000	0.000000
D(5, 2)	220.0000	0.000000
D(5, 3)	127.0000	0.000000
D(5, 4)	133.0000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	85.00000	0.000000
D(5, 7)	102.0000	0.000000
D(5, 8)	134.0000	0.000000
D(5, 9)	230.0000	0.000000
D(5, 10)	230.0000	0.000000
D(5, 11)	228.0000	0.000000
D(5, 12)	225.0000	0.000000
D(5, 13)	224.0000	0.000000
D(5, 14)	224.0000	0.000000
D(5, 15)	230.0000	0.000000
D(5, 16)	312.0000	0.000000
D(6, 1)	275.0000	0.000000
D(6, 2)	268.0000	0.000000
D(6, 3)	300.0000	0.000000
D(6, 4)	297.0000	0.000000
D(6, 5)	85.00000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	48.00000	0.000000
D(6, 8)	50.00000	0.000000
D(6, 9)	71.00000	0.000000
D(6, 10)	65.00000	0.000000

D(6, 11)	64.00000	0.000000
D(6, 12)	55.00000	0.000000
D(6, 13)	71.00000	0.000000
D(6, 14)	69.00000	0.000000
D(6, 15)	66.00000	0.000000
D(6, 16)	166.0000	0.000000
D(7, 1)	324.0000	0.000000
D(7, 2)	317.0000	0.000000
D(7, 3)	208.0000	0.000000
D(7, 4)	215.0000	0.000000
D(7, 5)	102.0000	0.000000
D(7, 6)	48.00000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	28.00000	0.000000
D(7, 9)	87.00000	0.000000
D(7, 10)	81.00000	0.000000
D(7, 11)	80.00000	0.000000
D(7, 12)	81.00000	0.000000
D(7, 13)	87.00000	0.000000
D(7, 14)	85.00000	0.000000
D(7, 15)	82.00000	0.000000
D(7, 16)	182.0000	0.000000
D(8, 1)	322.0000	0.000000
D(8, 2)	315.0000	0.000000
D(8, 3)	238.0000	0.000000
D(8, 4)	343.0000	0.000000
D(8, 5)	134.0000	0.000000
D(8, 6)	50.00000	0.000000
D(8, 7)	28.00000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	61.00000	0.000000
D(8, 10)	55.00000	0.000000
D(8, 11)	54.00000	0.000000
D(8, 12)	55.00000	0.000000
D(8, 13)	61.00000	0.000000
D(8, 14)	59.00000	0.000000
D(8, 15)	56.00000	0.000000
D(8, 16)	156.0000	0.000000
D(9, 1)	353.0000	0.000000
D(9, 2)	346.0000	0.000000
D(9, 3)	377.0000	0.000000
D(9, 4)	374.0000	0.000000
D(9, 5)	230.0000	0.000000
D(9, 6)	71.00000	0.000000

D(9, 7)	87.00000	0.000000
D(9, 8)	61.00000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	6.700000	0.000000
D(9, 11)	5.900000	0.000000
D(9, 12)	10.00000	0.000000
D(9, 13)	4.800000	0.000000
D(9, 14)	4.300000	0.000000
D(9, 15)	7.400000	0.000000
D(9, 16)	98.20000	0.000000
D(10, 1)	353.0000	0.000000
D(10, 2)	346.0000	0.000000
D(10, 3)	377.0000	0.000000
D(10, 4)	374.0000	0.000000
D(10, 5)	230.0000	0.000000
D(10, 6)	65.00000	0.000000
D(10, 7)	81.00000	0.000000
D(10, 8)	55.00000	0.000000
D(10, 9)	6.700000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	1.900000	0.000000
D(10, 12)	10.30000	0.000000
D(10, 13)	5.900000	0.000000
D(10, 14)	4.800000	0.000000
D(10, 15)	1.800000	0.000000
D(10, 16)	97.50000	0.000000
D(11, 1)	351.0000	0.000000
D(11, 2)	344.0000	0.000000
D(11, 3)	376.0000	0.000000
D(11, 4)	372.0000	0.000000
D(11, 5)	228.0000	0.000000
D(11, 6)	64.00000	0.000000
D(11, 7)	80.00000	0.000000
D(11, 8)	54.00000	0.000000
D(11, 9)	5.900000	0.000000
D(11, 10)	1.900000	0.000000
D(11, 11)	0.000000	0.000000
D(11, 12)	8.800000	0.000000
D(11, 13)	9.800000	0.000000
D(11, 14)	5.300000	0.000000
D(11, 15)	3.400000	0.000000
D(11, 16)	100.0000	0.000000
D(12, 1)	348.0000	0.000000
D(12, 2)	341.0000	0.000000

D(12, 3)	372.0000	0.000000
D(12, 4)	369.0000	0.000000
D(12, 5)	225.0000	0.000000
D(12, 6)	55.00000	0.000000
D(12, 7)	81.00000	0.000000
D(12, 8)	55.00000	0.000000
D(12, 9)	10.00000	0.000000
D(12, 10)	10.30000	0.000000
D(12, 11)	8.800000	0.000000
D(12, 12)	0.000000	0.000000
D(12, 13)	10.60000	0.000000
D(12, 14)	6.200000	0.000000
D(12, 15)	10.70000	0.000000
D(12, 16)	105.0000	0.000000
D(13, 1)	347.0000	0.000000
D(13, 2)	341.0000	0.000000
D(13, 3)	372.0000	0.000000
D(13, 4)	369.0000	0.000000
D(13, 5)	224.0000	0.000000
D(13, 6)	71.00000	0.000000
D(13, 7)	87.00000	0.000000
D(13, 8)	61.00000	0.000000
D(13, 9)	4.800000	0.000000
D(13, 10)	5.900000	0.000000
D(13, 11)	9.800000	0.000000
D(13, 12)	10.60000	0.000000
D(13, 13)	0.000000	0.000000
D(13, 14)	4.300000	0.000000
D(13, 15)	3.500000	0.000000
D(13, 16)	93.40000	0.000000
D(14, 1)	347.0000	0.000000
D(14, 2)	340.0000	0.000000
D(14, 3)	372.0000	0.000000
D(14, 4)	368.0000	0.000000
D(14, 5)	224.0000	0.000000
D(14, 6)	69.00000	0.000000
D(14, 7)	85.00000	0.000000
D(14, 8)	59.00000	0.000000
D(14, 9)	4.300000	0.000000
D(14, 10)	4.800000	0.000000
D(14, 11)	5.300000	0.000000
D(14, 12)	6.200000	0.000000
D(14, 13)	4.300000	0.000000
D(14, 14)	0.000000	0.000000

D(14, 15)	6.300000	0.000000
D(14, 16)	101.0000	0.000000
D(15, 1)	353.0000	0.000000
D(15, 2)	347.0000	0.000000
D(15, 3)	378.0000	0.000000
D(15, 4)	375.0000	0.000000
D(15, 5)	230.0000	0.000000
D(15, 6)	66.00000	0.000000
D(15, 7)	82.00000	0.000000
D(15, 8)	56.00000	0.000000
D(15, 9)	7.400000	0.000000
D(15, 10)	1.800000	0.000000
D(15, 11)	3.400000	0.000000
D(15, 12)	10.70000	0.000000
D(15, 13)	3.500000	0.000000
D(15, 14)	6.300000	0.000000
D(15, 15)	0.000000	0.000000
D(15, 16)	97.90000	0.000000
D(16, 1)	435.0000	0.000000
D(16, 2)	428.0000	0.000000
D(16, 3)	459.0000	0.000000
D(16, 4)	456.0000	0.000000
D(16, 5)	312.0000	0.000000
D(16, 6)	166.0000	0.000000
D(16, 7)	182.0000	0.000000
D(16, 8)	156.0000	0.000000
D(16, 9)	98.20000	0.000000
D(16, 10)	97.50000	0.000000
D(16, 11)	100.0000	0.000000
D(16, 12)	105.0000	0.000000
D(16, 13)	93.40000	0.000000
D(16, 14)	101.0000	0.000000
D(16, 15)	97.90000	0.000000
D(16, 16)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	9.960000	0.000000
DURASI(1, 3)	49.32000	0.000000
DURASI(1, 4)	47.52000	0.000000
DURASI(1, 5)	272.4000	0.000000
DURASI(1, 6)	330.0000	0.000000
DURASI(1, 7)	388.8000	0.000000
DURASI(1, 8)	386.4000	0.000000
DURASI(1, 9)	423.6000	0.000000
DURASI(1, 10)	423.6000	0.000000

DURASI(1, 11)	421.2000	0.000000
DURASI(1, 12)	417.6000	0.000000
DURASI(1, 13)	416.4000	0.000000
DURASI(1, 14)	416.4000	0.000000
DURASI(1, 15)	423.6000	0.000000
DURASI(1, 16)	522.0000	0.000000
DURASI(2, 1)	9.960000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	29.28000	0.000000
DURASI(2, 4)	39.60000	0.000000
DURASI(2, 5)	264.0000	0.000000
DURASI(2, 6)	321.6000	0.000000
DURASI(2, 7)	380.4000	0.000000
DURASI(2, 8)	378.0000	0.000000
DURASI(2, 9)	415.2000	0.000000
DURASI(2, 10)	415.2000	0.000000
DURASI(2, 11)	412.8000	0.000000
DURASI(2, 12)	409.2000	0.000000
DURASI(2, 13)	409.2000	0.000000
DURASI(2, 14)	408.0000	0.000000
DURASI(2, 15)	416.4000	0.000000
DURASI(2, 16)	513.6000	0.000000
DURASI(3, 1)	49.32000	0.000000
DURASI(3, 2)	29.28000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	9.000000	0.000000
DURASI(3, 5)	152.4000	0.000000
DURASI(3, 6)	360.0000	0.000000
DURASI(3, 7)	249.6000	0.000000
DURASI(3, 8)	285.6000	0.000000
DURASI(3, 9)	452.4000	0.000000
DURASI(3, 10)	452.4000	0.000000
DURASI(3, 11)	451.2000	0.000000
DURASI(3, 12)	446.4000	0.000000
DURASI(3, 13)	446.4000	0.000000
DURASI(3, 14)	446.4000	0.000000
DURASI(3, 15)	453.6000	0.000000
DURASI(3, 16)	550.8000	0.000000
DURASI(4, 1)	47.52000	0.000000
DURASI(4, 2)	39.60000	0.000000
DURASI(4, 3)	9.000000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	159.6000	0.000000
DURASI(4, 6)	356.4000	0.000000

DURASI(4, 7)	258.0000	0.000000
DURASI(4, 8)	411.6000	0.000000
DURASI(4, 9)	448.8000	0.000000
DURASI(4, 10)	448.8000	0.000000
DURASI(4, 11)	446.4000	0.000000
DURASI(4, 12)	442.8000	0.000000
DURASI(4, 13)	442.8000	0.000000
DURASI(4, 14)	441.6000	0.000000
DURASI(4, 15)	450.0000	0.000000
DURASI(4, 16)	547.2000	0.000000
DURASI(5, 1)	272.4000	0.000000
DURASI(5, 2)	264.0000	0.000000
DURASI(5, 3)	152.4000	0.000000
DURASI(5, 4)	159.6000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	102.0000	0.000000
DURASI(5, 7)	122.4000	0.000000
DURASI(5, 8)	160.8000	0.000000
DURASI(5, 9)	276.0000	0.000000
DURASI(5, 10)	276.0000	0.000000
DURASI(5, 11)	273.6000	0.000000
DURASI(5, 12)	270.0000	0.000000
DURASI(5, 13)	268.8000	0.000000
DURASI(5, 14)	268.8000	0.000000
DURASI(5, 15)	276.0000	0.000000
DURASI(5, 16)	374.4000	0.000000
DURASI(6, 1)	330.0000	0.000000
DURASI(6, 2)	321.6000	0.000000
DURASI(6, 3)	360.0000	0.000000
DURASI(6, 4)	356.4000	0.000000
DURASI(6, 5)	102.0000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	57.60000	0.000000
DURASI(6, 8)	60.00000	0.000000
DURASI(6, 9)	85.20000	0.000000
DURASI(6, 10)	78.00000	0.000000
DURASI(6, 11)	76.80000	0.000000
DURASI(6, 12)	66.00000	0.000000
DURASI(6, 13)	85.20000	0.000000
DURASI(6, 14)	82.80000	0.000000
DURASI(6, 15)	79.20000	0.000000
DURASI(6, 16)	199.2000	0.000000
DURASI(7, 1)	388.8000	0.000000
DURASI(7, 2)	380.4000	0.000000

DURASI(7, 3)	249.6000	0.000000
DURASI(7, 4)	258.0000	0.000000
DURASI(7, 5)	122.4000	0.000000
DURASI(7, 6)	57.60000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	33.60000	0.000000
DURASI(7, 9)	104.4000	0.000000
DURASI(7, 10)	97.20000	0.000000
DURASI(7, 11)	96.00000	0.000000
DURASI(7, 12)	97.20000	0.000000
DURASI(7, 13)	104.4000	0.000000
DURASI(7, 14)	102.0000	0.000000
DURASI(7, 15)	98.40000	0.000000
DURASI(7, 16)	218.4000	0.000000
DURASI(8, 1)	386.4000	0.000000
DURASI(8, 2)	378.0000	0.000000
DURASI(8, 3)	285.6000	0.000000
DURASI(8, 4)	411.6000	0.000000
DURASI(8, 5)	160.8000	0.000000
DURASI(8, 6)	60.00000	0.000000
DURASI(8, 7)	33.60000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	73.20000	0.000000
DURASI(8, 10)	66.00000	0.000000
DURASI(8, 11)	64.80000	0.000000
DURASI(8, 12)	66.00000	0.000000
DURASI(8, 13)	73.20000	0.000000
DURASI(8, 14)	70.80000	0.000000
DURASI(8, 15)	67.20000	0.000000
DURASI(8, 16)	187.2000	0.000000
DURASI(9, 1)	423.6000	0.000000
DURASI(9, 2)	415.2000	0.000000
DURASI(9, 3)	452.4000	0.000000
DURASI(9, 4)	448.8000	0.000000
DURASI(9, 5)	276.0000	0.000000
DURASI(9, 6)	85.20000	0.000000
DURASI(9, 7)	104.4000	0.000000
DURASI(9, 8)	73.20000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	8.040000	0.000000
DURASI(9, 11)	7.080000	0.000000
DURASI(9, 12)	12.00000	0.000000
DURASI(9, 13)	5.760000	0.000000
DURASI(9, 14)	5.160000	0.000000

DURASI(9, 15)	8.880000	0.000000
DURASI(9, 16)	117.8400	0.000000
DURASI(10, 1)	423.6000	0.000000
DURASI(10, 2)	415.2000	0.000000
DURASI(10, 3)	452.4000	0.000000
DURASI(10, 4)	448.8000	0.000000
DURASI(10, 5)	276.0000	0.000000
DURASI(10, 6)	78.00000	0.000000
DURASI(10, 7)	97.20000	0.000000
DURASI(10, 8)	66.00000	0.000000
DURASI(10, 9)	8.040000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	2.280000	0.000000
DURASI(10, 12)	12.36000	0.000000
DURASI(10, 13)	7.080000	0.000000
DURASI(10, 14)	5.760000	0.000000
DURASI(10, 15)	2.160000	0.000000
DURASI(10, 16)	117.0000	0.000000
DURASI(11, 1)	421.2000	0.000000
DURASI(11, 2)	412.8000	0.000000
DURASI(11, 3)	451.2000	0.000000
DURASI(11, 4)	446.4000	0.000000
DURASI(11, 5)	273.6000	0.000000
DURASI(11, 6)	76.80000	0.000000
DURASI(11, 7)	96.00000	0.000000
DURASI(11, 8)	64.80000	0.000000
DURASI(11, 9)	7.080000	0.000000
DURASI(11, 10)	2.280000	0.000000
DURASI(11, 11)	0.000000	0.000000
DURASI(11, 12)	10.56000	0.000000
DURASI(11, 13)	11.76000	0.000000
DURASI(11, 14)	6.360000	0.000000
DURASI(11, 15)	4.080000	0.000000
DURASI(11, 16)	120.0000	0.000000
DURASI(12, 1)	417.6000	0.000000
DURASI(12, 2)	409.2000	0.000000
DURASI(12, 3)	446.4000	0.000000
DURASI(12, 4)	442.8000	0.000000
DURASI(12, 5)	270.0000	0.000000
DURASI(12, 6)	66.00000	0.000000
DURASI(12, 7)	97.20000	0.000000
DURASI(12, 8)	66.00000	0.000000
DURASI(12, 9)	12.00000	0.000000
DURASI(12, 10)	12.36000	0.000000

DURASI(12, 11)	10.56000	0.000000
DURASI(12, 12)	0.000000	0.000000
DURASI(12, 13)	12.72000	0.000000
DURASI(12, 14)	7.440000	0.000000
DURASI(12, 15)	12.84000	0.000000
DURASI(12, 16)	126.0000	0.000000
DURASI(13, 1)	416.4000	0.000000
DURASI(13, 2)	409.2000	0.000000
DURASI(13, 3)	446.4000	0.000000
DURASI(13, 4)	442.8000	0.000000
DURASI(13, 5)	268.8000	0.000000
DURASI(13, 6)	85.20000	0.000000
DURASI(13, 7)	104.4000	0.000000
DURASI(13, 8)	73.20000	0.000000
DURASI(13, 9)	5.760000	0.000000
DURASI(13, 10)	7.080000	0.000000
DURASI(13, 11)	11.76000	0.000000
DURASI(13, 12)	12.72000	0.000000
DURASI(13, 13)	0.000000	0.000000
DURASI(13, 14)	5.160000	0.000000
DURASI(13, 15)	4.200000	0.000000
DURASI(13, 16)	112.0800	0.000000
DURASI(14, 1)	416.4000	0.000000
DURASI(14, 2)	408.0000	0.000000
DURASI(14, 3)	446.4000	0.000000
DURASI(14, 4)	441.6000	0.000000
DURASI(14, 5)	268.8000	0.000000
DURASI(14, 6)	82.80000	0.000000
DURASI(14, 7)	102.0000	0.000000
DURASI(14, 8)	70.80000	0.000000
DURASI(14, 9)	5.160000	0.000000
DURASI(14, 10)	5.760000	0.000000
DURASI(14, 11)	6.360000	0.000000
DURASI(14, 12)	7.440000	0.000000
DURASI(14, 13)	5.160000	0.000000
DURASI(14, 14)	0.000000	0.000000
DURASI(14, 15)	7.560000	0.000000
DURASI(14, 16)	121.2000	0.000000
DURASI(15, 1)	423.6000	0.000000
DURASI(15, 2)	416.4000	0.000000
DURASI(15, 3)	453.6000	0.000000
DURASI(15, 4)	450.0000	0.000000
DURASI(15, 5)	276.0000	0.000000
DURASI(15, 6)	79.20000	0.000000

DURASI(15, 7)	98.40000	0.000000
DURASI(15, 8)	67.20000	0.000000
DURASI(15, 9)	8.880000	0.000000
DURASI(15, 10)	2.160000	0.000000
DURASI(15, 11)	4.080000	0.000000
DURASI(15, 12)	12.84000	0.000000
DURASI(15, 13)	4.200000	0.000000
DURASI(15, 14)	7.560000	0.000000
DURASI(15, 15)	0.000000	0.000000
DURASI(15, 16)	117.4800	0.000000
DURASI(16, 1)	522.0000	0.000000
DURASI(16, 2)	513.6000	0.000000
DURASI(16, 3)	550.8000	0.000000
DURASI(16, 4)	547.2000	0.000000
DURASI(16, 5)	374.4000	0.000000
DURASI(16, 6)	199.2000	0.000000
DURASI(16, 7)	218.4000	0.000000
DURASI(16, 8)	187.2000	0.000000
DURASI(16, 9)	117.8400	0.000000
DURASI(16, 10)	117.0000	0.000000
DURASI(16, 11)	120.0000	0.000000
DURASI(16, 12)	126.0000	0.000000
DURASI(16, 13)	112.0800	0.000000
DURASI(16, 14)	121.2000	0.000000
DURASI(16, 15)	117.4800	0.000000
DURASI(16, 16)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster* 3

model:

```
!parameter model:
    Buka           = waktu buka ritel
    Tutup          = waktu tutup ritel
    Bongkar        = waktu loading/unloading di ritel
    D              = jarak antar ritel
    T              = waktu memulai pelayanan pada ritel
    Durasi         = Durasi pengiriman
    R              = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i,j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..11/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 540 540 540 540 540 540;
tutup = 1020 1260 1260 1260 1260 1260 1260 1260 1260 1260 1260;
D =
!ritel
!0   56   58   59   61   62   63   64   65   66
    67;
0    345  343  433  464  510  508  472  507  503
    495  !0;
345  0    20.2  102  133  179  176  142  176  172
    164  !56;
343  20.2  0    114  145  191  188  153  188  184
    175  !58;
433  102  114  0    48.4  94.1  91.2  56.6  91.3  87.3
    78.7 !59;
464  133  145  48.4  0    31.5  33.1  27.2  61.9  57.9
    49.3 !61;
510  179  191  94.1  31.5  0    3.4  58.4  21.5  12.1
    16.2 !62;
```

508	176	188	91.2	33.1	3.4	0	78.6	18.1	8.8	
	14.5	!63;								
472	142	153	56.6	27.2	58.4	78.6	0	34.7	30.7	
	22.1	!64;								
507	176	188	91.3	61.9	21.5	18.1	34.7	0	10.9	
	35.6	!65;								
503	172	184	87.3	57.9	12.1	8.8	30.7	10.9	0	
	23.8	!66;								
495	164	175	78.7	49.3	16.2	14.5	22.1	35.6	23.8	0;
	!67;									

```

durasi =
0      414      411.6  519.6  556.8  612      609.6  566.4  608.4  603.6
      594
414    0        24.24  122.4  159.6  214.8  211.2  170.4  211.2  206.4
      196.8
411.6  24.24  0        136.8  174     229.2  225.6  183.6  225.6  220.8
      210
519.6  122.4  136.8  0        58.08  112.92      109.44      67.92
      109.56      104.76      94.44
556.8  159.6  174     58.08  0        37.8   39.72  32.64  74.28  69.48
      59.16
612    214.8  229.2  112.92      37.8   0        4.08   70.08  25.8
      14.52  19.44
609.6  211.2  225.6  109.44      39.72  4.08   0        94.32  21.72
      10.56  17.4
566.4  170.4  183.6  67.92  32.64  70.08  94.32  0        41.64  36.84
      26.52
608.4  211.2  225.6  109.56      74.28  25.8   21.72  41.64  0
      13.08  42.72
603.6  206.4  220.8  104.76      69.48  14.52  10.56  36.84  13.08  0
      28.56
594    196.8  210     94.44  59.16  19.44  17.4   26.52  42.72  28.56  0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
    );

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

```

End

➤ Hasil dari *solution report* pada *cluster 3*

Global optimal solution found.

Objective value:	1094.800
Objective bound:	1094.800
Infeasibilities:	0.000000
Extended solver steps:	20637
Total solver iterations:	198019
Elapsed runtime seconds:	15.56

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 3 sebesar 343 km
 rute pengiriman dari ritel 2 ke ritel 4 sebesar 102 km
 rute pengiriman dari ritel 3 ke ritel 2 sebesar 20.2 km
 rute pengiriman dari ritel 4 ke ritel 5 sebesar 48.4 km
 rute pengiriman dari ritel 5 ke ritel 6 sebesar 31.5 km
 rute pengiriman dari ritel 6 ke ritel 10 sebesar 12.1 km
 rute pengiriman dari ritel 7 ke ritel 11 sebesar 14.5 km
 rute pengiriman dari ritel 8 ke ritel 1 sebesar 472 km
 rute pengiriman dari ritel 9 ke ritel 7 sebesar 18.1 km
 rute pengiriman dari ritel 10 ke ritel 9 sebesar 10.9 km
 rute pengiriman dari ritel 11 ke ritel 8 sebesar 22.1 km

Model Class: MILP

Total variables:	132
Nonlinear variables:	0
Integer variables:	121

Total constraints:	154
Nonlinear constraints:	0

Total nonzeros:	780
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000

BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
T(1)	1872.000	0.000000
T(2)	594.2400	0.000000
T(3)	540.0000	0.000000
T(4)	746.6400	0.000000
T(5)	834.7200	0.000000
T(6)	902.5200	0.000000
T(7)	1041.840	0.000000
T(8)	1230.000	0.000000
T(9)	990.1200	0.000000
T(10)	947.0400	0.000000
T(11)	1173.480	0.000000

X(1, 1)	0.000000	0.000000
X(1, 2)	0.000000	345.0000
X(1, 3)	1.000000	343.0000
X(1, 4)	0.000000	433.0000
X(1, 5)	0.000000	464.0000
X(1, 6)	0.000000	510.0000
X(1, 7)	0.000000	508.0000
X(1, 8)	0.000000	472.0000
X(1, 9)	0.000000	507.0000
X(1, 10)	0.000000	503.0000
X(1, 11)	0.000000	495.0000
X(2, 1)	0.000000	345.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	20.20000
X(2, 4)	1.000000	102.0000
X(2, 5)	0.000000	133.0000
X(2, 6)	0.000000	179.0000
X(2, 7)	0.000000	176.0000
X(2, 8)	0.000000	142.0000
X(2, 9)	0.000000	176.0000
X(2, 10)	0.000000	172.0000
X(2, 11)	0.000000	164.0000
X(3, 1)	0.000000	343.0000
X(3, 2)	1.000000	20.20000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	114.0000
X(3, 5)	0.000000	145.0000
X(3, 6)	0.000000	191.0000
X(3, 7)	0.000000	188.0000
X(3, 8)	0.000000	153.0000
X(3, 9)	0.000000	188.0000
X(3, 10)	0.000000	184.0000
X(3, 11)	0.000000	175.0000
X(4, 1)	0.000000	433.0000
X(4, 2)	0.000000	102.0000
X(4, 3)	0.000000	114.0000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	48.40000
X(4, 6)	0.000000	94.10000
X(4, 7)	0.000000	91.20000
X(4, 8)	0.000000	56.60000
X(4, 9)	0.000000	91.30000
X(4, 10)	0.000000	87.30000
X(4, 11)	0.000000	78.70000

X(5, 1)	0.000000	464.0000
X(5, 2)	0.000000	133.0000
X(5, 3)	0.000000	145.0000
X(5, 4)	0.000000	48.40000
X(5, 5)	0.000000	0.000000
X(5, 6)	1.000000	31.50000
X(5, 7)	0.000000	33.10000
X(5, 8)	0.000000	27.20000
X(5, 9)	0.000000	61.90000
X(5, 10)	0.000000	57.90000
X(5, 11)	0.000000	49.30000
X(6, 1)	0.000000	510.0000
X(6, 2)	0.000000	179.0000
X(6, 3)	0.000000	191.0000
X(6, 4)	0.000000	94.10000
X(6, 5)	0.000000	31.50000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.400000
X(6, 8)	0.000000	58.40000
X(6, 9)	0.000000	21.50000
X(6, 10)	1.000000	12.10000
X(6, 11)	0.000000	16.20000
X(7, 1)	0.000000	508.0000
X(7, 2)	0.000000	176.0000
X(7, 3)	0.000000	188.0000
X(7, 4)	0.000000	91.20000
X(7, 5)	0.000000	33.10000
X(7, 6)	0.000000	3.400000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	78.60000
X(7, 9)	0.000000	18.10000
X(7, 10)	0.000000	8.800000
X(7, 11)	1.000000	14.50000
X(8, 1)	1.000000	472.0000
X(8, 2)	0.000000	142.0000
X(8, 3)	0.000000	153.0000
X(8, 4)	0.000000	56.60000
X(8, 5)	0.000000	27.20000
X(8, 6)	0.000000	58.40000
X(8, 7)	0.000000	78.60000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	34.70000
X(8, 10)	0.000000	30.70000
X(8, 11)	0.000000	22.10000

X(9, 1)	0.000000	507.0000
X(9, 2)	0.000000	176.0000
X(9, 3)	0.000000	188.0000
X(9, 4)	0.000000	91.30000
X(9, 5)	0.000000	61.90000
X(9, 6)	0.000000	21.50000
X(9, 7)	1.000000	18.10000
X(9, 8)	0.000000	34.70000
X(9, 9)	0.000000	0.000000
X(9, 10)	0.000000	10.90000
X(9, 11)	0.000000	35.60000
X(10, 1)	0.000000	503.0000
X(10, 2)	0.000000	172.0000
X(10, 3)	0.000000	184.0000
X(10, 4)	0.000000	87.30000
X(10, 5)	0.000000	57.90000
X(10, 6)	0.000000	12.10000
X(10, 7)	0.000000	8.800000
X(10, 8)	0.000000	30.70000
X(10, 9)	1.000000	10.90000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	23.80000
X(11, 1)	0.000000	495.0000
X(11, 2)	0.000000	164.0000
X(11, 3)	0.000000	175.0000
X(11, 4)	0.000000	78.70000
X(11, 5)	0.000000	49.30000
X(11, 6)	0.000000	16.20000
X(11, 7)	0.000000	14.50000
X(11, 8)	1.000000	22.10000
X(11, 9)	0.000000	35.60000
X(11, 10)	0.000000	23.80000
X(11, 11)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	345.0000	0.000000
D(1, 3)	343.0000	0.000000
D(1, 4)	433.0000	0.000000
D(1, 5)	464.0000	0.000000
D(1, 6)	510.0000	0.000000
D(1, 7)	508.0000	0.000000
D(1, 8)	472.0000	0.000000
D(1, 9)	507.0000	0.000000
D(1, 10)	503.0000	0.000000
D(1, 11)	495.0000	0.000000

D(2, 1)	345.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	20.20000	0.000000
D(2, 4)	102.0000	0.000000
D(2, 5)	133.0000	0.000000
D(2, 6)	179.0000	0.000000
D(2, 7)	176.0000	0.000000
D(2, 8)	142.0000	0.000000
D(2, 9)	176.0000	0.000000
D(2, 10)	172.0000	0.000000
D(2, 11)	164.0000	0.000000
D(3, 1)	343.0000	0.000000
D(3, 2)	20.20000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	114.0000	0.000000
D(3, 5)	145.0000	0.000000
D(3, 6)	191.0000	0.000000
D(3, 7)	188.0000	0.000000
D(3, 8)	153.0000	0.000000
D(3, 9)	188.0000	0.000000
D(3, 10)	184.0000	0.000000
D(3, 11)	175.0000	0.000000
D(4, 1)	433.0000	0.000000
D(4, 2)	102.0000	0.000000
D(4, 3)	114.0000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	48.40000	0.000000
D(4, 6)	94.10000	0.000000
D(4, 7)	91.20000	0.000000
D(4, 8)	56.60000	0.000000
D(4, 9)	91.30000	0.000000
D(4, 10)	87.30000	0.000000
D(4, 11)	78.70000	0.000000
D(5, 1)	464.0000	0.000000
D(5, 2)	133.0000	0.000000
D(5, 3)	145.0000	0.000000
D(5, 4)	48.40000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	31.50000	0.000000
D(5, 7)	33.10000	0.000000
D(5, 8)	27.20000	0.000000
D(5, 9)	61.90000	0.000000
D(5, 10)	57.90000	0.000000
D(5, 11)	49.30000	0.000000

D(6, 1)	510.0000	0.000000
D(6, 2)	179.0000	0.000000
D(6, 3)	191.0000	0.000000
D(6, 4)	94.10000	0.000000
D(6, 5)	31.50000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.400000	0.000000
D(6, 8)	58.40000	0.000000
D(6, 9)	21.50000	0.000000
D(6, 10)	12.10000	0.000000
D(6, 11)	16.20000	0.000000
D(7, 1)	508.0000	0.000000
D(7, 2)	176.0000	0.000000
D(7, 3)	188.0000	0.000000
D(7, 4)	91.20000	0.000000
D(7, 5)	33.10000	0.000000
D(7, 6)	3.400000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	78.60000	0.000000
D(7, 9)	18.10000	0.000000
D(7, 10)	8.800000	0.000000
D(7, 11)	14.50000	0.000000
D(8, 1)	472.0000	0.000000
D(8, 2)	142.0000	0.000000
D(8, 3)	153.0000	0.000000
D(8, 4)	56.60000	0.000000
D(8, 5)	27.20000	0.000000
D(8, 6)	58.40000	0.000000
D(8, 7)	78.60000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	34.70000	0.000000
D(8, 10)	30.70000	0.000000
D(8, 11)	22.10000	0.000000
D(9, 1)	507.0000	0.000000
D(9, 2)	176.0000	0.000000
D(9, 3)	188.0000	0.000000
D(9, 4)	91.30000	0.000000
D(9, 5)	61.90000	0.000000
D(9, 6)	21.50000	0.000000
D(9, 7)	18.10000	0.000000
D(9, 8)	34.70000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	10.90000	0.000000
D(9, 11)	35.60000	0.000000

D(10, 1)	503.0000	0.000000
D(10, 2)	172.0000	0.000000
D(10, 3)	184.0000	0.000000
D(10, 4)	87.30000	0.000000
D(10, 5)	57.90000	0.000000
D(10, 6)	12.10000	0.000000
D(10, 7)	8.800000	0.000000
D(10, 8)	30.70000	0.000000
D(10, 9)	10.90000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	23.80000	0.000000
D(11, 1)	495.0000	0.000000
D(11, 2)	164.0000	0.000000
D(11, 3)	175.0000	0.000000
D(11, 4)	78.70000	0.000000
D(11, 5)	49.30000	0.000000
D(11, 6)	16.20000	0.000000
D(11, 7)	14.50000	0.000000
D(11, 8)	22.10000	0.000000
D(11, 9)	35.60000	0.000000
D(11, 10)	23.80000	0.000000
D(11, 11)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	414.0000	0.000000
DURASI(1, 3)	411.6000	0.000000
DURASI(1, 4)	519.6000	0.000000
DURASI(1, 5)	556.8000	0.000000
DURASI(1, 6)	612.0000	0.000000
DURASI(1, 7)	609.6000	0.000000
DURASI(1, 8)	566.4000	0.000000
DURASI(1, 9)	608.4000	0.000000
DURASI(1, 10)	603.6000	0.000000
DURASI(1, 11)	594.0000	0.000000
DURASI(2, 1)	414.0000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	24.24000	0.000000
DURASI(2, 4)	122.4000	0.000000
DURASI(2, 5)	159.6000	0.000000
DURASI(2, 6)	214.8000	0.000000
DURASI(2, 7)	211.2000	0.000000
DURASI(2, 8)	170.4000	0.000000
DURASI(2, 9)	211.2000	0.000000
DURASI(2, 10)	206.4000	0.000000
DURASI(2, 11)	196.8000	0.000000

DURASI(3, 1)	411.6000	0.000000
DURASI(3, 2)	24.24000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	136.8000	0.000000
DURASI(3, 5)	174.0000	0.000000
DURASI(3, 6)	229.2000	0.000000
DURASI(3, 7)	225.6000	0.000000
DURASI(3, 8)	183.6000	0.000000
DURASI(3, 9)	225.6000	0.000000
DURASI(3, 10)	220.8000	0.000000
DURASI(3, 11)	210.0000	0.000000
DURASI(4, 1)	519.6000	0.000000
DURASI(4, 2)	122.4000	0.000000
DURASI(4, 3)	136.8000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	58.08000	0.000000
DURASI(4, 6)	112.9200	0.000000
DURASI(4, 7)	109.4400	0.000000
DURASI(4, 8)	67.92000	0.000000
DURASI(4, 9)	109.5600	0.000000
DURASI(4, 10)	104.7600	0.000000
DURASI(4, 11)	94.44000	0.000000
DURASI(5, 1)	556.8000	0.000000
DURASI(5, 2)	159.6000	0.000000
DURASI(5, 3)	174.0000	0.000000
DURASI(5, 4)	58.08000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	37.80000	0.000000
DURASI(5, 7)	39.72000	0.000000
DURASI(5, 8)	32.64000	0.000000
DURASI(5, 9)	74.28000	0.000000
DURASI(5, 10)	69.48000	0.000000
DURASI(5, 11)	59.16000	0.000000
DURASI(6, 1)	612.0000	0.000000
DURASI(6, 2)	214.8000	0.000000
DURASI(6, 3)	229.2000	0.000000
DURASI(6, 4)	112.9200	0.000000
DURASI(6, 5)	37.80000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.080000	0.000000
DURASI(6, 8)	70.08000	0.000000
DURASI(6, 9)	25.80000	0.000000
DURASI(6, 10)	14.52000	0.000000
DURASI(6, 11)	19.44000	0.000000

DURASI(7, 1)	609.6000	0.000000
DURASI(7, 2)	211.2000	0.000000
DURASI(7, 3)	225.6000	0.000000
DURASI(7, 4)	109.4400	0.000000
DURASI(7, 5)	39.72000	0.000000
DURASI(7, 6)	4.080000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	94.32000	0.000000
DURASI(7, 9)	21.72000	0.000000
DURASI(7, 10)	10.56000	0.000000
DURASI(7, 11)	17.40000	0.000000
DURASI(8, 1)	566.4000	0.000000
DURASI(8, 2)	170.4000	0.000000
DURASI(8, 3)	183.6000	0.000000
DURASI(8, 4)	67.92000	0.000000
DURASI(8, 5)	32.64000	0.000000
DURASI(8, 6)	70.08000	0.000000
DURASI(8, 7)	94.32000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	41.64000	0.000000
DURASI(8, 10)	36.84000	0.000000
DURASI(8, 11)	26.52000	0.000000
DURASI(9, 1)	608.4000	0.000000
DURASI(9, 2)	211.2000	0.000000
DURASI(9, 3)	225.6000	0.000000
DURASI(9, 4)	109.5600	0.000000
DURASI(9, 5)	74.28000	0.000000
DURASI(9, 6)	25.80000	0.000000
DURASI(9, 7)	21.72000	0.000000
DURASI(9, 8)	41.64000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	13.08000	0.000000
DURASI(9, 11)	42.72000	0.000000
DURASI(10, 1)	603.6000	0.000000
DURASI(10, 2)	206.4000	0.000000
DURASI(10, 3)	220.8000	0.000000
DURASI(10, 4)	104.7600	0.000000
DURASI(10, 5)	69.48000	0.000000
DURASI(10, 6)	14.52000	0.000000
DURASI(10, 7)	10.56000	0.000000
DURASI(10, 8)	36.84000	0.000000
DURASI(10, 9)	13.08000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	28.56000	0.000000

DURASI(11, 1)	594.0000	0.000000
DURASI(11, 2)	196.8000	0.000000
DURASI(11, 3)	210.0000	0.000000
DURASI(11, 4)	94.44000	0.000000
DURASI(11, 5)	59.16000	0.000000
DURASI(11, 6)	19.44000	0.000000
DURASI(11, 7)	17.40000	0.000000
DURASI(11, 8)	26.52000	0.000000
DURASI(11, 9)	42.72000	0.000000
DURASI(11, 10)	28.56000	0.000000
DURASI(11, 11)	0.000000	0.000000

Row Slack or Surplus Dual Price

➤ Pemrograman Lingo untuk *cluster 4*

model:

```
!parameter model:
    Buka          = waktu buka ritel
    Tutup         = waktu tutup ritel
    Bongkar       = waktu loading/unloading di ritel
    D             = jarak antar ritel
    T            = waktu memulai pelayanan pada ritel
    Durasi        = Durasi pengiriman
    R            = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i,j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..12/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 540 540 540 540 540 540 540;
tutup = 1020 1260 1260 1260 1260 1260 1260 1260 1260 1260 1260 1260;
1260;
```

D =

```
!ritel
!0   33   34   35   36   37   38   44   45   46   47
     48;
0    252  234  258  254  256  259  398  422  548
     548  341  !0;
252  0    20   44   39   42   46   184  208  334
     334  127  !33;
234  20   0    24   20   23   25   164  188  314
     314  107  !34;
258  44   24   0    7    6    9    138  158  295
     295  88   !35;
254  39   20   7    0    3    6    156  166  306
     306  99   !36;
256  42   23   6    3    0    7    156  164  305
     305  98   !37;
```

259	46	25	9	6	7	0	141	161	306	
	306	99	!38;							
398	184	164	138	156	156	141	0	24.4	102	
	102	57.5	!44;							
422	208	188	158	166	164	161	24.4	0	77.2	78
	80.9	!45;								
548	334	314	295	306	305	306	102	77.2	0	1.7
	145	!46;								
548	334	314	295	306	305	306	102	78	1.7	0
	144	!47;								
341	127	107	88	99	98	99	57.5	80.9	145	
	144	0;	!48;							

```

durasi =
0      302.4 280.8 309.6 304.8 307.2 310.8 477.6 506.4 657.6
      657.6 409.2
302.4 0      24      52.8 46.8 50.4 55.2 220.8 249.6 400.8
      400.8 152.4
280.8 24      0      28.8 24      27.6 30      196.8 225.6 376.8
      376.8 128.4
309.6 52.8 28.8 0      8.4 7.2 10.8 165.6 189.6 354
      354 105.6
304.8 46.8 24      8.4 0      3.6 7.2 187.2 199.2 367.2
      367.2 118.8
307.2 50.4 27.6 7.2 3.6 0      8.4 187.2 196.8 366
      366 117.6
310.8 55.2 30      10.8 7.2 8.4 0      169.2 193.2 367.2
      367.2 118.8
477.6 220.8 196.8 165.6 187.2 187.2 169.2 0      29.28 122.4
      122.4 69
506.4 249.6 225.6 189.6 199.2 196.8 193.2 29.28 0      92.64
      93.6 97.08
657.6 400.8 376.8 354 367.2 366 367.2 122.4 92.64 0
      2.04 174
657.6 400.8 376.8 354 367.2 366 367.2 122.4 93.6 2.04 0
      172.8
409.2 152.4 128.4 105.6 118.8 117.6 118.8 69 97.08 174
      172.8 0;

```

```

Bongkar = 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

```

```

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 4*

```

Global optimal solution found.
Objective value:           1035.300
Objective bound:          1035.300
Infeasibilities:          0.000000
Extended solver steps:    1079
Total solver iterations:  25635
Elapsed runtime seconds:  2.26

```

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 252 km
 rute pengiriman dari ritel 2 ke ritel 5 sebesar 39 km
 rute pengiriman dari ritel 3 ke ritel 1 sebesar 234 km
 rute pengiriman dari ritel 4 ke ritel 12 sebesar 88 km
 rute pengiriman dari ritel 5 ke ritel 6 sebesar 3 km
 rute pengiriman dari ritel 6 ke ritel 4 sebesar 6 km
 rute pengiriman dari ritel 7 ke ritel 3 sebesar 25 km
 rute pengiriman dari ritel 8 ke ritel 7 sebesar 141 km
 rute pengiriman dari ritel 9 ke ritel 8 sebesar 24.4 km
 rute pengiriman dari ritel 10 ke ritel 9 sebesar 77.2 km
 rute pengiriman dari ritel 11 ke ritel 10 sebesar 1.7 km
 rute pengiriman dari ritel 12 ke ritel 11 sebesar 144 km

Model Class: MILP

```

Total variables:          156
Nonlinear variables:      0
Integer variables:        144

Total constraints:        180
Nonlinear constraints:    0

Total nonzeros:           935

```

Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	0.3000000	0.000000
BONGKAR(2)	0.3000000	0.000000
BONGKAR(3)	0.3000000	0.000000
BONGKAR(4)	0.3000000	0.000000
BONGKAR(5)	0.3000000	0.000000
BONGKAR(6)	0.3000000	0.000000
BONGKAR(7)	0.3000000	0.000000
BONGKAR(8)	0.3000000	0.000000
BONGKAR(9)	0.3000000	0.000000
BONGKAR(10)	0.3000000	0.000000
BONGKAR(11)	0.3000000	0.000000
BONGKAR(12)	0.3000000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
BUKA(12)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
TUTUP(12)	1260.000	0.000000
T(1)	1917.600	0.000000
T(2)	540.0000	0.000000

T(3)	1259.700	0.000000
T(4)	598.5000	0.000000
T(5)	587.1000	0.000000
T(6)	591.0000	0.000000
T(7)	1229.400	0.000000
T(8)	1059.900	0.000000
T(9)	1030.320	0.000000
T(10)	879.8400	0.000000
T(11)	877.5000	0.000000
T(12)	704.4000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	252.0000
X(1, 3)	0.000000	234.0000
X(1, 4)	0.000000	258.0000
X(1, 5)	0.000000	254.0000
X(1, 6)	0.000000	256.0000
X(1, 7)	0.000000	259.0000
X(1, 8)	0.000000	398.0000
X(1, 9)	0.000000	422.0000
X(1, 10)	0.000000	548.0000
X(1, 11)	0.000000	548.0000
X(1, 12)	0.000000	341.0000
X(2, 1)	0.000000	252.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	20.00000
X(2, 4)	0.000000	44.00000
X(2, 5)	1.000000	39.00000
X(2, 6)	0.000000	42.00000
X(2, 7)	0.000000	46.00000
X(2, 8)	0.000000	184.0000
X(2, 9)	0.000000	208.0000
X(2, 10)	0.000000	334.0000
X(2, 11)	0.000000	334.0000
X(2, 12)	0.000000	127.0000
X(3, 1)	1.000000	234.0000
X(3, 2)	0.000000	20.00000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	24.00000
X(3, 5)	0.000000	20.00000
X(3, 6)	0.000000	23.00000
X(3, 7)	0.000000	25.00000
X(3, 8)	0.000000	164.0000
X(3, 9)	0.000000	188.0000
X(3, 10)	0.000000	314.0000

X(3, 11)	0.000000	314.0000
X(3, 12)	0.000000	107.0000
X(4, 1)	0.000000	258.0000
X(4, 2)	0.000000	44.00000
X(4, 3)	0.000000	24.00000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	7.000000
X(4, 6)	0.000000	6.000000
X(4, 7)	0.000000	9.000000
X(4, 8)	0.000000	138.0000
X(4, 9)	0.000000	158.0000
X(4, 10)	0.000000	295.0000
X(4, 11)	0.000000	295.0000
X(4, 12)	1.000000	88.00000
X(5, 1)	0.000000	254.0000
X(5, 2)	0.000000	39.00000
X(5, 3)	0.000000	20.00000
X(5, 4)	0.000000	7.000000
X(5, 5)	0.000000	0.000000
X(5, 6)	1.000000	3.000000
X(5, 7)	0.000000	6.000000
X(5, 8)	0.000000	156.0000
X(5, 9)	0.000000	166.0000
X(5, 10)	0.000000	306.0000
X(5, 11)	0.000000	306.0000
X(5, 12)	0.000000	99.00000
X(6, 1)	0.000000	256.0000
X(6, 2)	0.000000	42.00000
X(6, 3)	0.000000	23.00000
X(6, 4)	1.000000	6.000000
X(6, 5)	0.000000	3.000000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	7.000000
X(6, 8)	0.000000	156.0000
X(6, 9)	0.000000	164.0000
X(6, 10)	0.000000	305.0000
X(6, 11)	0.000000	305.0000
X(6, 12)	0.000000	98.00000
X(7, 1)	0.000000	259.0000
X(7, 2)	0.000000	46.00000
X(7, 3)	1.000000	25.00000
X(7, 4)	0.000000	9.000000
X(7, 5)	0.000000	6.000000
X(7, 6)	0.000000	7.000000

X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	141.0000
X(7, 9)	0.000000	161.0000
X(7, 10)	0.000000	306.0000
X(7, 11)	0.000000	306.0000
X(7, 12)	0.000000	99.000000
X(8, 1)	0.000000	398.0000
X(8, 2)	0.000000	184.0000
X(8, 3)	0.000000	164.0000
X(8, 4)	0.000000	138.0000
X(8, 5)	0.000000	156.0000
X(8, 6)	0.000000	156.0000
X(8, 7)	1.000000	141.0000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	24.40000
X(8, 10)	0.000000	102.0000
X(8, 11)	0.000000	102.0000
X(8, 12)	0.000000	57.50000
X(9, 1)	0.000000	422.0000
X(9, 2)	0.000000	208.0000
X(9, 3)	0.000000	188.0000
X(9, 4)	0.000000	158.0000
X(9, 5)	0.000000	166.0000
X(9, 6)	0.000000	164.0000
X(9, 7)	0.000000	161.0000
X(9, 8)	1.000000	24.40000
X(9, 9)	0.000000	0.000000
X(9, 10)	0.000000	77.20000
X(9, 11)	0.000000	78.00000
X(9, 12)	0.000000	80.90000
X(10, 1)	0.000000	548.0000
X(10, 2)	0.000000	334.0000
X(10, 3)	0.000000	314.0000
X(10, 4)	0.000000	295.0000
X(10, 5)	0.000000	306.0000
X(10, 6)	0.000000	305.0000
X(10, 7)	0.000000	306.0000
X(10, 8)	0.000000	102.0000
X(10, 9)	1.000000	77.20000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	1.700000
X(10, 12)	0.000000	145.0000
X(11, 1)	0.000000	548.0000
X(11, 2)	0.000000	334.0000

X(11, 3)	0.000000	314.0000
X(11, 4)	0.000000	295.0000
X(11, 5)	0.000000	306.0000
X(11, 6)	0.000000	305.0000
X(11, 7)	0.000000	306.0000
X(11, 8)	0.000000	102.0000
X(11, 9)	0.000000	78.00000
X(11, 10)	1.000000	1.700000
X(11, 11)	0.000000	0.000000
X(11, 12)	0.000000	144.0000
X(12, 1)	0.000000	341.0000
X(12, 2)	0.000000	127.0000
X(12, 3)	0.000000	107.0000
X(12, 4)	0.000000	88.00000
X(12, 5)	0.000000	99.00000
X(12, 6)	0.000000	98.00000
X(12, 7)	0.000000	99.00000
X(12, 8)	0.000000	57.50000
X(12, 9)	0.000000	80.90000
X(12, 10)	0.000000	145.0000
X(12, 11)	1.000000	144.0000
X(12, 12)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	252.0000	0.000000
D(1, 3)	234.0000	0.000000
D(1, 4)	258.0000	0.000000
D(1, 5)	254.0000	0.000000
D(1, 6)	256.0000	0.000000
D(1, 7)	259.0000	0.000000
D(1, 8)	398.0000	0.000000
D(1, 9)	422.0000	0.000000
D(1, 10)	548.0000	0.000000
D(1, 11)	548.0000	0.000000
D(1, 12)	341.0000	0.000000
D(2, 1)	252.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	20.00000	0.000000
D(2, 4)	44.00000	0.000000
D(2, 5)	39.00000	0.000000
D(2, 6)	42.00000	0.000000
D(2, 7)	46.00000	0.000000
D(2, 8)	184.0000	0.000000
D(2, 9)	208.0000	0.000000
D(2, 10)	334.0000	0.000000

D(2, 11)	334.0000	0.000000
D(2, 12)	127.0000	0.000000
D(3, 1)	234.0000	0.000000
D(3, 2)	20.00000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	24.00000	0.000000
D(3, 5)	20.00000	0.000000
D(3, 6)	23.00000	0.000000
D(3, 7)	25.00000	0.000000
D(3, 8)	164.0000	0.000000
D(3, 9)	188.0000	0.000000
D(3, 10)	314.0000	0.000000
D(3, 11)	314.0000	0.000000
D(3, 12)	107.0000	0.000000
D(4, 1)	258.0000	0.000000
D(4, 2)	44.00000	0.000000
D(4, 3)	24.00000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	7.000000	0.000000
D(4, 6)	6.000000	0.000000
D(4, 7)	9.000000	0.000000
D(4, 8)	138.0000	0.000000
D(4, 9)	158.0000	0.000000
D(4, 10)	295.0000	0.000000
D(4, 11)	295.0000	0.000000
D(4, 12)	88.00000	0.000000
D(5, 1)	254.0000	0.000000
D(5, 2)	39.00000	0.000000
D(5, 3)	20.00000	0.000000
D(5, 4)	7.000000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	3.000000	0.000000
D(5, 7)	6.000000	0.000000
D(5, 8)	156.0000	0.000000
D(5, 9)	166.0000	0.000000
D(5, 10)	306.0000	0.000000
D(5, 11)	306.0000	0.000000
D(5, 12)	99.00000	0.000000
D(6, 1)	256.0000	0.000000
D(6, 2)	42.00000	0.000000
D(6, 3)	23.00000	0.000000
D(6, 4)	6.000000	0.000000
D(6, 5)	3.000000	0.000000
D(6, 6)	0.000000	0.000000

D(6, 7)	7.000000	0.000000
D(6, 8)	156.0000	0.000000
D(6, 9)	164.0000	0.000000
D(6, 10)	305.0000	0.000000
D(6, 11)	305.0000	0.000000
D(6, 12)	98.00000	0.000000
D(7, 1)	259.0000	0.000000
D(7, 2)	46.00000	0.000000
D(7, 3)	25.00000	0.000000
D(7, 4)	9.000000	0.000000
D(7, 5)	6.000000	0.000000
D(7, 6)	7.000000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	141.0000	0.000000
D(7, 9)	161.0000	0.000000
D(7, 10)	306.0000	0.000000
D(7, 11)	306.0000	0.000000
D(7, 12)	99.00000	0.000000
D(8, 1)	398.0000	0.000000
D(8, 2)	184.0000	0.000000
D(8, 3)	164.0000	0.000000
D(8, 4)	138.0000	0.000000
D(8, 5)	156.0000	0.000000
D(8, 6)	156.0000	0.000000
D(8, 7)	141.0000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	24.40000	0.000000
D(8, 10)	102.0000	0.000000
D(8, 11)	102.0000	0.000000
D(8, 12)	57.50000	0.000000
D(9, 1)	422.0000	0.000000
D(9, 2)	208.0000	0.000000
D(9, 3)	188.0000	0.000000
D(9, 4)	158.0000	0.000000
D(9, 5)	166.0000	0.000000
D(9, 6)	164.0000	0.000000
D(9, 7)	161.0000	0.000000
D(9, 8)	24.40000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	77.20000	0.000000
D(9, 11)	78.00000	0.000000
D(9, 12)	80.90000	0.000000
D(10, 1)	548.0000	0.000000
D(10, 2)	334.0000	0.000000

D(10, 3)	314.0000	0.000000
D(10, 4)	295.0000	0.000000
D(10, 5)	306.0000	0.000000
D(10, 6)	305.0000	0.000000
D(10, 7)	306.0000	0.000000
D(10, 8)	102.0000	0.000000
D(10, 9)	77.20000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	1.700000	0.000000
D(10, 12)	145.0000	0.000000
D(11, 1)	548.0000	0.000000
D(11, 2)	334.0000	0.000000
D(11, 3)	314.0000	0.000000
D(11, 4)	295.0000	0.000000
D(11, 5)	306.0000	0.000000
D(11, 6)	305.0000	0.000000
D(11, 7)	306.0000	0.000000
D(11, 8)	102.0000	0.000000
D(11, 9)	78.00000	0.000000
D(11, 10)	1.700000	0.000000
D(11, 11)	0.000000	0.000000
D(11, 12)	144.0000	0.000000
D(12, 1)	341.0000	0.000000
D(12, 2)	127.0000	0.000000
D(12, 3)	107.0000	0.000000
D(12, 4)	88.00000	0.000000
D(12, 5)	99.00000	0.000000
D(12, 6)	98.00000	0.000000
D(12, 7)	99.00000	0.000000
D(12, 8)	57.50000	0.000000
D(12, 9)	80.90000	0.000000
D(12, 10)	145.0000	0.000000
D(12, 11)	144.0000	0.000000
D(12, 12)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	302.4000	0.000000
DURASI(1, 3)	280.8000	0.000000
DURASI(1, 4)	309.6000	0.000000
DURASI(1, 5)	304.8000	0.000000
DURASI(1, 6)	307.2000	0.000000
DURASI(1, 7)	310.8000	0.000000
DURASI(1, 8)	477.6000	0.000000
DURASI(1, 9)	506.4000	0.000000
DURASI(1, 10)	657.6000	0.000000

DURASI(1, 11)	657.6000	0.000000
DURASI(1, 12)	409.2000	0.000000
DURASI(2, 1)	302.4000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	24.00000	0.000000
DURASI(2, 4)	52.80000	0.000000
DURASI(2, 5)	46.80000	0.000000
DURASI(2, 6)	50.40000	0.000000
DURASI(2, 7)	55.20000	0.000000
DURASI(2, 8)	220.8000	0.000000
DURASI(2, 9)	249.6000	0.000000
DURASI(2, 10)	400.8000	0.000000
DURASI(2, 11)	400.8000	0.000000
DURASI(2, 12)	152.4000	0.000000
DURASI(3, 1)	280.8000	0.000000
DURASI(3, 2)	24.00000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	28.80000	0.000000
DURASI(3, 5)	24.00000	0.000000
DURASI(3, 6)	27.60000	0.000000
DURASI(3, 7)	30.00000	0.000000
DURASI(3, 8)	196.8000	0.000000
DURASI(3, 9)	225.6000	0.000000
DURASI(3, 10)	376.8000	0.000000
DURASI(3, 11)	376.8000	0.000000
DURASI(3, 12)	128.4000	0.000000
DURASI(4, 1)	309.6000	0.000000
DURASI(4, 2)	52.80000	0.000000
DURASI(4, 3)	28.80000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	8.400000	0.000000
DURASI(4, 6)	7.200000	0.000000
DURASI(4, 7)	10.80000	0.000000
DURASI(4, 8)	165.6000	0.000000
DURASI(4, 9)	189.6000	0.000000
DURASI(4, 10)	354.0000	0.000000
DURASI(4, 11)	354.0000	0.000000
DURASI(4, 12)	105.6000	0.000000
DURASI(5, 1)	304.8000	0.000000
DURASI(5, 2)	46.80000	0.000000
DURASI(5, 3)	24.00000	0.000000
DURASI(5, 4)	8.400000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	3.600000	0.000000

DURASI(5, 7)	7.200000	0.000000
DURASI(5, 8)	187.2000	0.000000
DURASI(5, 9)	199.2000	0.000000
DURASI(5, 10)	367.2000	0.000000
DURASI(5, 11)	367.2000	0.000000
DURASI(5, 12)	118.8000	0.000000
DURASI(6, 1)	307.2000	0.000000
DURASI(6, 2)	50.40000	0.000000
DURASI(6, 3)	27.60000	0.000000
DURASI(6, 4)	7.200000	0.000000
DURASI(6, 5)	3.600000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	8.400000	0.000000
DURASI(6, 8)	187.2000	0.000000
DURASI(6, 9)	196.8000	0.000000
DURASI(6, 10)	366.0000	0.000000
DURASI(6, 11)	366.0000	0.000000
DURASI(6, 12)	117.6000	0.000000
DURASI(7, 1)	310.8000	0.000000
DURASI(7, 2)	55.20000	0.000000
DURASI(7, 3)	30.00000	0.000000
DURASI(7, 4)	10.80000	0.000000
DURASI(7, 5)	7.200000	0.000000
DURASI(7, 6)	8.400000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	169.2000	0.000000
DURASI(7, 9)	193.2000	0.000000
DURASI(7, 10)	367.2000	0.000000
DURASI(7, 11)	367.2000	0.000000
DURASI(7, 12)	118.8000	0.000000
DURASI(8, 1)	477.6000	0.000000
DURASI(8, 2)	220.8000	0.000000
DURASI(8, 3)	196.8000	0.000000
DURASI(8, 4)	165.6000	0.000000
DURASI(8, 5)	187.2000	0.000000
DURASI(8, 6)	187.2000	0.000000
DURASI(8, 7)	169.2000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	29.28000	0.000000
DURASI(8, 10)	122.4000	0.000000
DURASI(8, 11)	122.4000	0.000000
DURASI(8, 12)	69.00000	0.000000
DURASI(9, 1)	506.4000	0.000000
DURASI(9, 2)	249.6000	0.000000

DURASI(9, 3)	225.6000	0.000000
DURASI(9, 4)	189.6000	0.000000
DURASI(9, 5)	199.2000	0.000000
DURASI(9, 6)	196.8000	0.000000
DURASI(9, 7)	193.2000	0.000000
DURASI(9, 8)	29.28000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	92.64000	0.000000
DURASI(9, 11)	93.60000	0.000000
DURASI(9, 12)	97.08000	0.000000
DURASI(10, 1)	657.6000	0.000000
DURASI(10, 2)	400.8000	0.000000
DURASI(10, 3)	376.8000	0.000000
DURASI(10, 4)	354.0000	0.000000
DURASI(10, 5)	367.2000	0.000000
DURASI(10, 6)	366.0000	0.000000
DURASI(10, 7)	367.2000	0.000000
DURASI(10, 8)	122.4000	0.000000
DURASI(10, 9)	92.64000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	2.040000	0.000000
DURASI(10, 12)	174.0000	0.000000
DURASI(11, 1)	657.6000	0.000000
DURASI(11, 2)	400.8000	0.000000
DURASI(11, 3)	376.8000	0.000000
DURASI(11, 4)	354.0000	0.000000
DURASI(11, 5)	367.2000	0.000000
DURASI(11, 6)	366.0000	0.000000
DURASI(11, 7)	367.2000	0.000000
DURASI(11, 8)	122.4000	0.000000
DURASI(11, 9)	93.60000	0.000000
DURASI(11, 10)	2.040000	0.000000
DURASI(11, 11)	0.000000	0.000000
DURASI(11, 12)	172.8000	0.000000
DURASI(12, 1)	409.2000	0.000000
DURASI(12, 2)	152.4000	0.000000
DURASI(12, 3)	128.4000	0.000000
DURASI(12, 4)	105.6000	0.000000
DURASI(12, 5)	118.8000	0.000000
DURASI(12, 6)	117.6000	0.000000
DURASI(12, 7)	118.8000	0.000000
DURASI(12, 8)	69.00000	0.000000
DURASI(12, 9)	97.08000	0.000000
DURASI(12, 10)	174.0000	0.000000

DURASI(12, 11)	172.8000	0.000000
DURASI(12, 12)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 5*

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;

sets:
ritel/1..11/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 540 540 540 540 540 540;
tutup = 1020 1260 1260 1260 1260 1260 1260 1260 1260 1260 1260;
1260;

D =
!ritel
!0    16    19    20    21    39    40    41    42    43
    49;
0     49.3  161   160   160   312   316   321   321   320
    323  !0;
49.3  0     126   125   125   277   281   287   287   285
    289  !16;
161   126   0     5.4   1.7   171   175   180   181   179
    182  !19;
160   125   5.4   0     3.1   169   173   179   179   177
    180  !20;
160   125   1.7   3.1   0     169   173   179   179   177
    180  !21;
312   277   171   169   169   0     4     10    10    9    14
    !39;
316   281   175   173   173   4     0     9.5   9.8   8.1
    13.2 !40;
```

```

321  287  180  179  179  10  9.5  0  0.9  1.9  9.5
      !41;
321  287  181  179  179  10  9.8  0.9  0  1.7
      10.3  !42;
320  285  179  177  177  9  8.1  1.9  1.7  0
      11.1  !43;
323  289  182  180  180  14  13.2  9.5  10.3  11.1  0;
      !49;

```

```

durasi =
0      59.16 193.2 192  192  374.4 379.2 385.2 385.2 384
      387.6
59.16 0      151.2 150  150  332.4 337.2 344.4 344.4 342
      346.8
193.2 151.2 0      6.48 2.04 205.2 210  216  217.2 214.8
      218.4
192   150  6.48 0      3.72 202.8 207.6 214.8 214.8 212.4
      216
192   150  2.04 3.72 0      202.8 207.6 214.8 214.8 212.4
      216
374.4 332.4 205.2 202.8 202.8 0  4.8  12  12  10.8
      16.8
379.2 337.2 210  207.6 207.6 4.8  0  11.4 11.76 9.72
      15.84
385.2 344.4 216  214.8 214.8 12  11.4 0  1.08 2.28
      11.4
385.2 344.4 217.2 214.8 214.8 12  11.76 1.08 0  2.04
      12.36
384   342  214.8 212.4 212.4 10.8  9.72 2.28 2.04 0
      13.32
387.6 346.8 218.4 216  216  16.8 15.84 11.4 12.36 13.32 0;

```

```

Bongkar= 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;
MIN =

```

```

    @SUM (ritel(i) :
          @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 5*

Global optimal solution found.

Objective value:	696.3000
Objective bound:	696.3000
Infeasibilities:	0.000000
Extended solver steps:	47278
Total solver iterations:	430928
Elapsed runtime seconds:	33.73

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 11 sebesar 323 km
 rute pengiriman dari ritel 2 ke ritel 1 sebesar 49.3 km
 rute pengiriman dari ritel 3 ke ritel 2 sebesar 126 km
 rute pengiriman dari ritel 4 ke ritel 5 sebesar 3.1 km
 rute pengiriman dari ritel 5 ke ritel 3 sebesar 1.7 km
 rute pengiriman dari ritel 6 ke ritel 4 sebesar 169 km
 rute pengiriman dari ritel 7 ke ritel 6 sebesar 4 km
 rute pengiriman dari ritel 8 ke ritel 9 sebesar 0.9 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 1.7 km
 rute pengiriman dari ritel 10 ke ritel 7 sebesar 8.1 km
 rute pengiriman dari ritel 11 ke ritel 8 sebesar 9.5 km

Model Class: MILP

Total variables:	132
Nonlinear variables:	0
Integer variables:	121
Total constraints:	154
Nonlinear constraints:	0
Total nonzeros:	780
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000

BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
T(1)	1647.600	0.000000
T(2)	1230.000	0.000000
T(3)	1048.800	0.000000
T(4)	983.0400	0.000000
T(5)	1016.760	0.000000
T(6)	750.2400	0.000000
T(7)	715.4400	0.000000
T(8)	581.4000	0.000000
T(9)	612.4800	0.000000
T(10)	675.7200	0.000000
T(11)	540.0000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	0.000000	49.30000
X(1, 3)	0.000000	161.0000
X(1, 4)	0.000000	160.0000

X(1, 5)	0.000000	160.0000
X(1, 6)	0.000000	312.0000
X(1, 7)	0.000000	316.0000
X(1, 8)	0.000000	321.0000
X(1, 9)	0.000000	321.0000
X(1, 10)	0.000000	320.0000
X(1, 11)	1.000000	323.0000
X(2, 1)	1.000000	49.30000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	126.0000
X(2, 4)	0.000000	125.0000
X(2, 5)	0.000000	125.0000
X(2, 6)	0.000000	277.0000
X(2, 7)	0.000000	281.0000
X(2, 8)	0.000000	287.0000
X(2, 9)	0.000000	287.0000
X(2, 10)	0.000000	285.0000
X(2, 11)	0.000000	289.0000
X(3, 1)	0.000000	161.0000
X(3, 2)	1.000000	126.0000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	5.400000
X(3, 5)	0.000000	1.700000
X(3, 6)	0.000000	171.0000
X(3, 7)	0.000000	175.0000
X(3, 8)	0.000000	180.0000
X(3, 9)	0.000000	181.0000
X(3, 10)	0.000000	179.0000
X(3, 11)	0.000000	182.0000
X(4, 1)	0.000000	160.0000
X(4, 2)	0.000000	125.0000
X(4, 3)	0.000000	5.400000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	3.100000
X(4, 6)	0.000000	169.0000
X(4, 7)	0.000000	173.0000
X(4, 8)	0.000000	179.0000
X(4, 9)	0.000000	179.0000
X(4, 10)	0.000000	177.0000
X(4, 11)	0.000000	180.0000
X(5, 1)	0.000000	160.0000
X(5, 2)	0.000000	125.0000
X(5, 3)	1.000000	1.700000
X(5, 4)	0.000000	3.100000

X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	169.0000
X(5, 7)	0.000000	173.0000
X(5, 8)	0.000000	179.0000
X(5, 9)	0.000000	179.0000
X(5, 10)	0.000000	177.0000
X(5, 11)	0.000000	180.0000
X(6, 1)	0.000000	312.0000
X(6, 2)	0.000000	277.0000
X(6, 3)	0.000000	171.0000
X(6, 4)	1.000000	169.0000
X(6, 5)	0.000000	169.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	4.000000
X(6, 8)	0.000000	10.00000
X(6, 9)	0.000000	10.00000
X(6, 10)	0.000000	9.000000
X(6, 11)	0.000000	14.00000
X(7, 1)	0.000000	316.0000
X(7, 2)	0.000000	281.0000
X(7, 3)	0.000000	175.0000
X(7, 4)	0.000000	173.0000
X(7, 5)	0.000000	173.0000
X(7, 6)	1.000000	4.000000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	9.500000
X(7, 9)	0.000000	9.800000
X(7, 10)	0.000000	8.100000
X(7, 11)	0.000000	13.20000
X(8, 1)	0.000000	321.0000
X(8, 2)	0.000000	287.0000
X(8, 3)	0.000000	180.0000
X(8, 4)	0.000000	179.0000
X(8, 5)	0.000000	179.0000
X(8, 6)	0.000000	10.00000
X(8, 7)	0.000000	9.500000
X(8, 8)	0.000000	0.000000
X(8, 9)	1.000000	0.9000000
X(8, 10)	0.000000	1.900000
X(8, 11)	0.000000	9.500000
X(9, 1)	0.000000	321.0000
X(9, 2)	0.000000	287.0000
X(9, 3)	0.000000	181.0000
X(9, 4)	0.000000	179.0000

X(9, 5)	0.000000	179.0000
X(9, 6)	0.000000	10.00000
X(9, 7)	0.000000	9.800000
X(9, 8)	0.000000	0.9000000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	1.700000
X(9, 11)	0.000000	10.30000
X(10, 1)	0.000000	320.0000
X(10, 2)	0.000000	285.0000
X(10, 3)	0.000000	179.0000
X(10, 4)	0.000000	177.0000
X(10, 5)	0.000000	177.0000
X(10, 6)	0.000000	9.000000
X(10, 7)	1.000000	8.100000
X(10, 8)	0.000000	1.900000
X(10, 9)	0.000000	1.700000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	11.10000
X(11, 1)	0.000000	323.0000
X(11, 2)	0.000000	289.0000
X(11, 3)	0.000000	182.0000
X(11, 4)	0.000000	180.0000
X(11, 5)	0.000000	180.0000
X(11, 6)	0.000000	14.00000
X(11, 7)	0.000000	13.20000
X(11, 8)	1.000000	9.500000
X(11, 9)	0.000000	10.30000
X(11, 10)	0.000000	11.10000
X(11, 11)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	49.30000	0.000000
D(1, 3)	161.0000	0.000000
D(1, 4)	160.0000	0.000000
D(1, 5)	160.0000	0.000000
D(1, 6)	312.0000	0.000000
D(1, 7)	316.0000	0.000000
D(1, 8)	321.0000	0.000000
D(1, 9)	321.0000	0.000000
D(1, 10)	320.0000	0.000000
D(1, 11)	323.0000	0.000000
D(2, 1)	49.30000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	126.0000	0.000000
D(2, 4)	125.0000	0.000000

D(2, 5)	125.0000	0.000000
D(2, 6)	277.0000	0.000000
D(2, 7)	281.0000	0.000000
D(2, 8)	287.0000	0.000000
D(2, 9)	287.0000	0.000000
D(2, 10)	285.0000	0.000000
D(2, 11)	289.0000	0.000000
D(3, 1)	161.0000	0.000000
D(3, 2)	126.0000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	5.400000	0.000000
D(3, 5)	1.700000	0.000000
D(3, 6)	171.0000	0.000000
D(3, 7)	175.0000	0.000000
D(3, 8)	180.0000	0.000000
D(3, 9)	181.0000	0.000000
D(3, 10)	179.0000	0.000000
D(3, 11)	182.0000	0.000000
D(4, 1)	160.0000	0.000000
D(4, 2)	125.0000	0.000000
D(4, 3)	5.400000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	3.100000	0.000000
D(4, 6)	169.0000	0.000000
D(4, 7)	173.0000	0.000000
D(4, 8)	179.0000	0.000000
D(4, 9)	179.0000	0.000000
D(4, 10)	177.0000	0.000000
D(4, 11)	180.0000	0.000000
D(5, 1)	160.0000	0.000000
D(5, 2)	125.0000	0.000000
D(5, 3)	1.700000	0.000000
D(5, 4)	3.100000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	169.0000	0.000000
D(5, 7)	173.0000	0.000000
D(5, 8)	179.0000	0.000000
D(5, 9)	179.0000	0.000000
D(5, 10)	177.0000	0.000000
D(5, 11)	180.0000	0.000000
D(6, 1)	312.0000	0.000000
D(6, 2)	277.0000	0.000000
D(6, 3)	171.0000	0.000000
D(6, 4)	169.0000	0.000000

D(6, 5)	169.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	4.000000	0.000000
D(6, 8)	10.00000	0.000000
D(6, 9)	10.00000	0.000000
D(6, 10)	9.000000	0.000000
D(6, 11)	14.00000	0.000000
D(7, 1)	316.0000	0.000000
D(7, 2)	281.0000	0.000000
D(7, 3)	175.0000	0.000000
D(7, 4)	173.0000	0.000000
D(7, 5)	173.0000	0.000000
D(7, 6)	4.000000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	9.500000	0.000000
D(7, 9)	9.800000	0.000000
D(7, 10)	8.100000	0.000000
D(7, 11)	13.20000	0.000000
D(8, 1)	321.0000	0.000000
D(8, 2)	287.0000	0.000000
D(8, 3)	180.0000	0.000000
D(8, 4)	179.0000	0.000000
D(8, 5)	179.0000	0.000000
D(8, 6)	10.00000	0.000000
D(8, 7)	9.500000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	0.9000000	0.000000
D(8, 10)	1.900000	0.000000
D(8, 11)	9.500000	0.000000
D(9, 1)	321.0000	0.000000
D(9, 2)	287.0000	0.000000
D(9, 3)	181.0000	0.000000
D(9, 4)	179.0000	0.000000
D(9, 5)	179.0000	0.000000
D(9, 6)	10.00000	0.000000
D(9, 7)	9.800000	0.000000
D(9, 8)	0.9000000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	1.700000	0.000000
D(9, 11)	10.30000	0.000000
D(10, 1)	320.0000	0.000000
D(10, 2)	285.0000	0.000000
D(10, 3)	179.0000	0.000000
D(10, 4)	177.0000	0.000000

D(10, 5)	177.0000	0.000000
D(10, 6)	9.000000	0.000000
D(10, 7)	8.100000	0.000000
D(10, 8)	1.900000	0.000000
D(10, 9)	1.700000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	11.10000	0.000000
D(11, 1)	323.0000	0.000000
D(11, 2)	289.0000	0.000000
D(11, 3)	182.0000	0.000000
D(11, 4)	180.0000	0.000000
D(11, 5)	180.0000	0.000000
D(11, 6)	14.00000	0.000000
D(11, 7)	13.20000	0.000000
D(11, 8)	9.500000	0.000000
D(11, 9)	10.30000	0.000000
D(11, 10)	11.10000	0.000000
D(11, 11)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	59.16000	0.000000
DURASI(1, 3)	193.2000	0.000000
DURASI(1, 4)	192.0000	0.000000
DURASI(1, 5)	192.0000	0.000000
DURASI(1, 6)	374.4000	0.000000
DURASI(1, 7)	379.2000	0.000000
DURASI(1, 8)	385.2000	0.000000
DURASI(1, 9)	385.2000	0.000000
DURASI(1, 10)	384.0000	0.000000
DURASI(1, 11)	387.6000	0.000000
DURASI(2, 1)	59.16000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	151.2000	0.000000
DURASI(2, 4)	150.0000	0.000000
DURASI(2, 5)	150.0000	0.000000
DURASI(2, 6)	332.4000	0.000000
DURASI(2, 7)	337.2000	0.000000
DURASI(2, 8)	344.4000	0.000000
DURASI(2, 9)	344.4000	0.000000
DURASI(2, 10)	342.0000	0.000000
DURASI(2, 11)	346.8000	0.000000
DURASI(3, 1)	193.2000	0.000000
DURASI(3, 2)	151.2000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	6.480000	0.000000

DURASI(3, 5)	2.040000	0.000000
DURASI(3, 6)	205.2000	0.000000
DURASI(3, 7)	210.0000	0.000000
DURASI(3, 8)	216.0000	0.000000
DURASI(3, 9)	217.2000	0.000000
DURASI(3, 10)	214.8000	0.000000
DURASI(3, 11)	218.4000	0.000000
DURASI(4, 1)	192.0000	0.000000
DURASI(4, 2)	150.0000	0.000000
DURASI(4, 3)	6.480000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	3.720000	0.000000
DURASI(4, 6)	202.8000	0.000000
DURASI(4, 7)	207.6000	0.000000
DURASI(4, 8)	214.8000	0.000000
DURASI(4, 9)	214.8000	0.000000
DURASI(4, 10)	212.4000	0.000000
DURASI(4, 11)	216.0000	0.000000
DURASI(5, 1)	192.0000	0.000000
DURASI(5, 2)	150.0000	0.000000
DURASI(5, 3)	2.040000	0.000000
DURASI(5, 4)	3.720000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	202.8000	0.000000
DURASI(5, 7)	207.6000	0.000000
DURASI(5, 8)	214.8000	0.000000
DURASI(5, 9)	214.8000	0.000000
DURASI(5, 10)	212.4000	0.000000
DURASI(5, 11)	216.0000	0.000000
DURASI(6, 1)	374.4000	0.000000
DURASI(6, 2)	332.4000	0.000000
DURASI(6, 3)	205.2000	0.000000
DURASI(6, 4)	202.8000	0.000000
DURASI(6, 5)	202.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.800000	0.000000
DURASI(6, 8)	12.00000	0.000000
DURASI(6, 9)	12.00000	0.000000
DURASI(6, 10)	10.80000	0.000000
DURASI(6, 11)	16.80000	0.000000
DURASI(7, 1)	379.2000	0.000000
DURASI(7, 2)	337.2000	0.000000
DURASI(7, 3)	210.0000	0.000000
DURASI(7, 4)	207.6000	0.000000

DURASI(7, 5)	207.6000	0.000000
DURASI(7, 6)	4.800000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	11.40000	0.000000
DURASI(7, 9)	11.76000	0.000000
DURASI(7, 10)	9.720000	0.000000
DURASI(7, 11)	15.84000	0.000000
DURASI(8, 1)	385.2000	0.000000
DURASI(8, 2)	344.4000	0.000000
DURASI(8, 3)	216.0000	0.000000
DURASI(8, 4)	214.8000	0.000000
DURASI(8, 5)	214.8000	0.000000
DURASI(8, 6)	12.00000	0.000000
DURASI(8, 7)	11.40000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	1.080000	0.000000
DURASI(8, 10)	2.280000	0.000000
DURASI(8, 11)	11.40000	0.000000
DURASI(9, 1)	385.2000	0.000000
DURASI(9, 2)	344.4000	0.000000
DURASI(9, 3)	217.2000	0.000000
DURASI(9, 4)	214.8000	0.000000
DURASI(9, 5)	214.8000	0.000000
DURASI(9, 6)	12.00000	0.000000
DURASI(9, 7)	11.76000	0.000000
DURASI(9, 8)	1.080000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	2.040000	0.000000
DURASI(9, 11)	12.36000	0.000000
DURASI(10, 1)	384.0000	0.000000
DURASI(10, 2)	342.0000	0.000000
DURASI(10, 3)	214.8000	0.000000
DURASI(10, 4)	212.4000	0.000000
DURASI(10, 5)	212.4000	0.000000
DURASI(10, 6)	10.80000	0.000000
DURASI(10, 7)	9.720000	0.000000
DURASI(10, 8)	2.280000	0.000000
DURASI(10, 9)	2.040000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	13.32000	0.000000
DURASI(11, 1)	387.6000	0.000000
DURASI(11, 2)	346.8000	0.000000
DURASI(11, 3)	218.4000	0.000000
DURASI(11, 4)	216.0000	0.000000

DURASI(11, 5)	216.0000	0.000000
DURASI(11, 6)	16.80000	0.000000
DURASI(11, 7)	15.84000	0.000000
DURASI(11, 8)	11.40000	0.000000
DURASI(11, 9)	12.36000	0.000000
DURASI(11, 10)	13.32000	0.000000
DURASI(11, 11)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster* 6

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..8/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 540 540 540;
tutup = 1020 1260 1260 1260 1260 1260 1260 1260;
```

D =

```
!ritel
!0   4   17   18   22   23   24   28;
0    12.3 115 115 193 102 93 157 !0;
12.3 0    120 121 198 83.1 75.1 148 !4;
115 120 0    1.1 96.1 83 96.4 45.8 !17;
115 121 1.1 0    95 84.5 97.8 46 !18;
193 198 96.1 95 0    194 266 103 !22;
102 83.1 83 84.5 194 0    14.9 75.3 !23;
93 75.1 96.4 97.8 266 14.9 0    76.6 !24;
157 148 45.8 46 103 75.3 76.6 0; !28;
```

durasi =

```
0    14.76 138 138 231.6 122.4 111.6 188.4
14.76 0    144 145.2 237.6 99.72 90.12 177.6
138 144 0    1.32 115.32 99.6 115.68 54.96
138 145.2 1.32 0    114 101.4 117.36 55.2
```

```

231.6 237.6 115.32      114    0      232.8 319.2 123.6
122.4 99.72 99.6  101.4 232.8 0      17.88 90.36
111.6 90.12 115.68      117.36      319.2 17.88 0      91.92
188.4 177.6 54.96 55.2  123.6 90.36 91.92 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

```

```

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 6*

Global optimal solution found.
Objective value: 491.7000
Objective bound: 491.7000
Infeasibilities: 0.000000
Extended solver steps: 218
Total solver iterations: 6348
Elapsed runtime seconds: 0.61

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 3 sebesar 115 km
rute pengiriman dari ritel 2 ke ritel 1 sebesar 12.3 km
rute pengiriman dari ritel 3 ke ritel 4 sebesar 1.1 km
rute pengiriman dari ritel 4 ke ritel 5 sebesar 95 km
rute pengiriman dari ritel 5 ke ritel 8 sebesar 103 km
rute pengiriman dari ritel 6 ke ritel 7 sebesar 14.9 km
rute pengiriman dari ritel 7 ke ritel 2 sebesar 75.09999999999999 km
rute pengiriman dari ritel 8 ke ritel 6 sebesar 75.3 km
Model Class: MILP

Total variables: 72
Nonlinear variables: 0

Integer variables: 64
 Total constraints: 88
 Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
T(1)	1491.600	0.000000
T(2)	1230.000	0.000000
T(3)	540.0000	0.000000
T(4)	571.3200	0.000000
T(5)	715.3200	0.000000
T(6)	989.2800	0.000000
T(7)	1109.880	0.000000
T(8)	868.9200	0.000000

X(1, 1)	0.000000	0.000000
X(1, 2)	0.000000	12.30000
X(1, 3)	1.000000	115.0000
X(1, 4)	0.000000	115.0000
X(1, 5)	0.000000	193.0000
X(1, 6)	0.000000	102.0000
X(1, 7)	0.000000	93.00000
X(1, 8)	0.000000	157.0000
X(2, 1)	1.000000	12.30000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	120.0000
X(2, 4)	0.000000	121.0000
X(2, 5)	0.000000	198.0000
X(2, 6)	0.000000	83.10000
X(2, 7)	0.000000	75.10000
X(2, 8)	0.000000	148.0000
X(3, 1)	0.000000	115.0000
X(3, 2)	0.000000	120.0000
X(3, 3)	0.000000	0.000000
X(3, 4)	1.000000	1.100000
X(3, 5)	0.000000	96.10000
X(3, 6)	0.000000	83.00000
X(3, 7)	0.000000	96.40000
X(3, 8)	0.000000	45.80000
X(4, 1)	0.000000	115.0000
X(4, 2)	0.000000	121.0000
X(4, 3)	0.000000	1.100000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	95.00000
X(4, 6)	0.000000	84.50000
X(4, 7)	0.000000	97.80000
X(4, 8)	0.000000	46.00000
X(5, 1)	0.000000	193.0000
X(5, 2)	0.000000	198.0000
X(5, 3)	0.000000	96.10000
X(5, 4)	0.000000	95.00000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	194.0000
X(5, 7)	0.000000	266.0000
X(5, 8)	1.000000	103.0000
X(6, 1)	0.000000	102.0000
X(6, 2)	0.000000	83.10000
X(6, 3)	0.000000	83.00000
X(6, 4)	0.000000	84.50000

X(6, 5)	0.000000	194.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	1.000000	14.90000
X(6, 8)	0.000000	75.30000
X(7, 1)	0.000000	93.00000
X(7, 2)	1.000000	75.10000
X(7, 3)	0.000000	96.40000
X(7, 4)	0.000000	97.80000
X(7, 5)	0.000000	266.0000
X(7, 6)	0.000000	14.90000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	76.60000
X(8, 1)	0.000000	157.0000
X(8, 2)	0.000000	148.0000
X(8, 3)	0.000000	45.80000
X(8, 4)	0.000000	46.00000
X(8, 5)	0.000000	103.0000
X(8, 6)	1.000000	75.30000
X(8, 7)	0.000000	76.60000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	12.30000	0.000000
D(1, 3)	115.0000	0.000000
D(1, 4)	115.0000	0.000000
D(1, 5)	193.0000	0.000000
D(1, 6)	102.0000	0.000000
D(1, 7)	93.00000	0.000000
D(1, 8)	157.0000	0.000000
D(2, 1)	12.30000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	120.0000	0.000000
D(2, 4)	121.0000	0.000000
D(2, 5)	198.0000	0.000000
D(2, 6)	83.10000	0.000000
D(2, 7)	75.10000	0.000000
D(2, 8)	148.0000	0.000000
D(3, 1)	115.0000	0.000000
D(3, 2)	120.0000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	1.100000	0.000000
D(3, 5)	96.10000	0.000000
D(3, 6)	83.00000	0.000000
D(3, 7)	96.40000	0.000000
D(3, 8)	45.80000	0.000000

D(4, 1)	115.0000	0.000000
D(4, 2)	121.0000	0.000000
D(4, 3)	1.100000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	95.00000	0.000000
D(4, 6)	84.50000	0.000000
D(4, 7)	97.80000	0.000000
D(4, 8)	46.00000	0.000000
D(5, 1)	193.0000	0.000000
D(5, 2)	198.0000	0.000000
D(5, 3)	96.10000	0.000000
D(5, 4)	95.00000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	194.0000	0.000000
D(5, 7)	266.0000	0.000000
D(5, 8)	103.0000	0.000000
D(6, 1)	102.0000	0.000000
D(6, 2)	83.10000	0.000000
D(6, 3)	83.00000	0.000000
D(6, 4)	84.50000	0.000000
D(6, 5)	194.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	14.90000	0.000000
D(6, 8)	75.30000	0.000000
D(7, 1)	93.00000	0.000000
D(7, 2)	75.10000	0.000000
D(7, 3)	96.40000	0.000000
D(7, 4)	97.80000	0.000000
D(7, 5)	266.0000	0.000000
D(7, 6)	14.90000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	76.60000	0.000000
D(8, 1)	157.0000	0.000000
D(8, 2)	148.0000	0.000000
D(8, 3)	45.80000	0.000000
D(8, 4)	46.00000	0.000000
D(8, 5)	103.0000	0.000000
D(8, 6)	75.30000	0.000000
D(8, 7)	76.60000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	14.76000	0.000000
DURASI(1, 3)	138.0000	0.000000
DURASI(1, 4)	138.0000	0.000000

DURASI(1, 5)	231.6000	0.000000
DURASI(1, 6)	122.4000	0.000000
DURASI(1, 7)	111.6000	0.000000
DURASI(1, 8)	188.4000	0.000000
DURASI(2, 1)	14.76000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	144.0000	0.000000
DURASI(2, 4)	145.2000	0.000000
DURASI(2, 5)	237.6000	0.000000
DURASI(2, 6)	99.72000	0.000000
DURASI(2, 7)	90.12000	0.000000
DURASI(2, 8)	177.6000	0.000000
DURASI(3, 1)	138.0000	0.000000
DURASI(3, 2)	144.0000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	1.320000	0.000000
DURASI(3, 5)	115.3200	0.000000
DURASI(3, 6)	99.60000	0.000000
DURASI(3, 7)	115.6800	0.000000
DURASI(3, 8)	54.96000	0.000000
DURASI(4, 1)	138.0000	0.000000
DURASI(4, 2)	145.2000	0.000000
DURASI(4, 3)	1.320000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	114.0000	0.000000
DURASI(4, 6)	101.4000	0.000000
DURASI(4, 7)	117.3600	0.000000
DURASI(4, 8)	55.20000	0.000000
DURASI(5, 1)	231.6000	0.000000
DURASI(5, 2)	237.6000	0.000000
DURASI(5, 3)	115.3200	0.000000
DURASI(5, 4)	114.0000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	232.8000	0.000000
DURASI(5, 7)	319.2000	0.000000
DURASI(5, 8)	123.6000	0.000000
DURASI(6, 1)	122.4000	0.000000
DURASI(6, 2)	99.72000	0.000000
DURASI(6, 3)	99.60000	0.000000
DURASI(6, 4)	101.4000	0.000000
DURASI(6, 5)	232.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	17.88000	0.000000
DURASI(6, 8)	90.36000	0.000000

DURASI(7, 1)	111.6000	0.000000
DURASI(7, 2)	90.12000	0.000000
DURASI(7, 3)	115.6800	0.000000
DURASI(7, 4)	117.3600	0.000000
DURASI(7, 5)	319.2000	0.000000
DURASI(7, 6)	17.88000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	91.92000	0.000000
DURASI(8, 1)	188.4000	0.000000
DURASI(8, 2)	177.6000	0.000000
DURASI(8, 3)	54.96000	0.000000
DURASI(8, 4)	55.20000	0.000000
DURASI(8, 5)	123.6000	0.000000
DURASI(8, 6)	90.36000	0.000000
DURASI(8, 7)	91.92000	0.000000
DURASI(8, 8)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 7*

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..8/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 540 540 540;
tutup = 1020 1260 1260 1260 1260 1260 1260 1260;
```

D =

```
!ritel
!0    12    13    14    15    25    26    27;
0     146   190   192   194   92.2  93.8  93    !0;
146   0     63.4  64.1  66.9  157   159   158   !12;
190   63.4  0     3.2   5.9   200   201   201   !13;
192   64.1  3.2   0     2.9   203   205   204   !14;
194   66.9  5.9   2.9   0     204   206   205   !15;
92.2  157    200   203   204   0     3.1   1.4   !25;
93.8  159    201   205   206   3.1   0     4     !26;
93    158    201   204   205   1.4   4     0;    !27;
```

durasi =

```
0     175.2  228   230.4  232.8  110.64  112.56  111.6
175.2 0     76.08  76.92  80.28  188.4  190.8  189.6
228   76.08 0     3.84   7.08  240   241.2  241.2
230.4 76.92 3.84  0     3.48  243.6  246   244.8
232.8 80.28 7.08  3.48  0     244.8  247.2  246
```

```

110.64      188.4 240   243.6 244.8 0      3.72  1.68
112.56      190.8 241.2 246   247.2 3.72  0      4.8
111.6 189.6 241.2 244.8 246   1.68  4.8   0;

```

```

Bongkar = 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

```

```

!Fungsi batasan;

```

```

!setiap ritel dikunjungi satu kali;

```

```

@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

```

```

!perjalanan diawali dari depot;

```

```

@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

```

```

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

```

```

!pelaksanaan;

```

```

@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

```

```

!rute;

```

```

@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 7*

Global optimal solution found.

Objective value:	517.4000
Objective bound:	517.4000
Infeasibilities:	0.000000
Extended solver steps:	316
Total solver iterations:	1803
Elapsed runtime seconds:	0.41

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 8 sebesar 93 km
rute pengiriman dari ritel 2 ke ritel 1 sebesar 146 km
rute pengiriman dari ritel 3 ke ritel 5 sebesar 5.9 km
rute pengiriman dari ritel 4 ke ritel 2 sebesar 64.099999999999999 km
rute pengiriman dari ritel 5 ke ritel 4 sebesar 2.9 km
rute pengiriman dari ritel 6 ke ritel 7 sebesar 3.1 km
rute pengiriman dari ritel 7 ke ritel 3 sebesar 201 km
rute pengiriman dari ritel 8 ke ritel 6 sebesar 1.4 km
Model Class: MILP

Total variables: 72

Nonlinear variables: 0
 Integer variables: 64

 Total constraints: 88
 Nonlinear constraints: 0

 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
T(1)	1492.800	0.000000
T(2)	1230.000	0.000000
T(3)	876.6000	0.000000
T(4)	1123.080	0.000000
T(5)	1089.600	0.000000
T(6)	571.6800	0.000000
T(7)	605.4000	0.000000

T (8)	540.0000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	0.000000	146.0000
X(1, 3)	0.000000	190.0000
X(1, 4)	0.000000	192.0000
X(1, 5)	0.000000	194.0000
X(1, 6)	0.000000	92.20000
X(1, 7)	0.000000	93.80000
X(1, 8)	1.000000	93.00000
X(2, 1)	1.000000	146.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	63.40000
X(2, 4)	0.000000	64.10000
X(2, 5)	0.000000	66.90000
X(2, 6)	0.000000	157.0000
X(2, 7)	0.000000	159.0000
X(2, 8)	0.000000	158.0000
X(3, 1)	0.000000	190.0000
X(3, 2)	0.000000	63.40000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	3.200000
X(3, 5)	1.000000	5.900000
X(3, 6)	0.000000	200.0000
X(3, 7)	0.000000	201.0000
X(3, 8)	0.000000	201.0000
X(4, 1)	0.000000	192.0000
X(4, 2)	1.000000	64.10000
X(4, 3)	0.000000	3.200000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	2.900000
X(4, 6)	0.000000	203.0000
X(4, 7)	0.000000	205.0000
X(4, 8)	0.000000	204.0000
X(5, 1)	0.000000	194.0000
X(5, 2)	0.000000	66.90000
X(5, 3)	0.000000	5.900000
X(5, 4)	1.000000	2.900000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	204.0000
X(5, 7)	0.000000	206.0000
X(5, 8)	0.000000	205.0000
X(6, 1)	0.000000	92.20000
X(6, 2)	0.000000	157.0000
X(6, 3)	0.000000	200.0000

X(6, 4)	0.000000	203.0000
X(6, 5)	0.000000	204.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	1.000000	3.100000
X(6, 8)	0.000000	1.400000
X(7, 1)	0.000000	93.80000
X(7, 2)	0.000000	159.0000
X(7, 3)	1.000000	201.0000
X(7, 4)	0.000000	205.0000
X(7, 5)	0.000000	206.0000
X(7, 6)	0.000000	3.100000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	4.000000
X(8, 1)	0.000000	93.00000
X(8, 2)	0.000000	158.0000
X(8, 3)	0.000000	201.0000
X(8, 4)	0.000000	204.0000
X(8, 5)	0.000000	205.0000
X(8, 6)	1.000000	1.400000
X(8, 7)	0.000000	4.000000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	146.0000	0.000000
D(1, 3)	190.0000	0.000000
D(1, 4)	192.0000	0.000000
D(1, 5)	194.0000	0.000000
D(1, 6)	92.20000	0.000000
D(1, 7)	93.80000	0.000000
D(1, 8)	93.00000	0.000000
D(2, 1)	146.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	63.40000	0.000000
D(2, 4)	64.10000	0.000000
D(2, 5)	66.90000	0.000000
D(2, 6)	157.0000	0.000000
D(2, 7)	159.0000	0.000000
D(2, 8)	158.0000	0.000000
D(3, 1)	190.0000	0.000000
D(3, 2)	63.40000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	3.200000	0.000000
D(3, 5)	5.900000	0.000000
D(3, 6)	200.0000	0.000000
D(3, 7)	201.0000	0.000000

D(3, 8)	201.0000	0.000000
D(4, 1)	192.0000	0.000000
D(4, 2)	64.10000	0.000000
D(4, 3)	3.200000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	2.900000	0.000000
D(4, 6)	203.0000	0.000000
D(4, 7)	205.0000	0.000000
D(4, 8)	204.0000	0.000000
D(5, 1)	194.0000	0.000000
D(5, 2)	66.90000	0.000000
D(5, 3)	5.900000	0.000000
D(5, 4)	2.900000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	204.0000	0.000000
D(5, 7)	206.0000	0.000000
D(5, 8)	205.0000	0.000000
D(6, 1)	92.20000	0.000000
D(6, 2)	157.0000	0.000000
D(6, 3)	200.0000	0.000000
D(6, 4)	203.0000	0.000000
D(6, 5)	204.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.100000	0.000000
D(6, 8)	1.400000	0.000000
D(7, 1)	93.80000	0.000000
D(7, 2)	159.0000	0.000000
D(7, 3)	201.0000	0.000000
D(7, 4)	205.0000	0.000000
D(7, 5)	206.0000	0.000000
D(7, 6)	3.100000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	4.000000	0.000000
D(8, 1)	93.00000	0.000000
D(8, 2)	158.0000	0.000000
D(8, 3)	201.0000	0.000000
D(8, 4)	204.0000	0.000000
D(8, 5)	205.0000	0.000000
D(8, 6)	1.400000	0.000000
D(8, 7)	4.000000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	175.2000	0.000000
DURASI(1, 3)	228.0000	0.000000

DURASI(1, 4)	230.4000	0.000000
DURASI(1, 5)	232.8000	0.000000
DURASI(1, 6)	110.6400	0.000000
DURASI(1, 7)	112.5600	0.000000
DURASI(1, 8)	111.6000	0.000000
DURASI(2, 1)	175.2000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	76.08000	0.000000
DURASI(2, 4)	76.92000	0.000000
DURASI(2, 5)	80.28000	0.000000
DURASI(2, 6)	188.4000	0.000000
DURASI(2, 7)	190.8000	0.000000
DURASI(2, 8)	189.6000	0.000000
DURASI(3, 1)	228.0000	0.000000
DURASI(3, 2)	76.08000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	3.840000	0.000000
DURASI(3, 5)	7.080000	0.000000
DURASI(3, 6)	240.0000	0.000000
DURASI(3, 7)	241.2000	0.000000
DURASI(3, 8)	241.2000	0.000000
DURASI(4, 1)	230.4000	0.000000
DURASI(4, 2)	76.92000	0.000000
DURASI(4, 3)	3.840000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	3.480000	0.000000
DURASI(4, 6)	243.6000	0.000000
DURASI(4, 7)	246.0000	0.000000
DURASI(4, 8)	244.8000	0.000000
DURASI(5, 1)	232.8000	0.000000
DURASI(5, 2)	80.28000	0.000000
DURASI(5, 3)	7.080000	0.000000
DURASI(5, 4)	3.480000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	244.8000	0.000000
DURASI(5, 7)	247.2000	0.000000
DURASI(5, 8)	246.0000	0.000000
DURASI(6, 1)	110.6400	0.000000
DURASI(6, 2)	188.4000	0.000000
DURASI(6, 3)	240.0000	0.000000
DURASI(6, 4)	243.6000	0.000000
DURASI(6, 5)	244.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	3.720000	0.000000

DURASI(6, 8)	1.680000	0.000000
DURASI(7, 1)	112.5600	0.000000
DURASI(7, 2)	190.8000	0.000000
DURASI(7, 3)	241.2000	0.000000
DURASI(7, 4)	246.0000	0.000000
DURASI(7, 5)	247.2000	0.000000
DURASI(7, 6)	3.720000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	4.800000	0.000000
DURASI(8, 1)	111.6000	0.000000
DURASI(8, 2)	189.6000	0.000000
DURASI(8, 3)	241.2000	0.000000
DURASI(8, 4)	244.8000	0.000000
DURASI(8, 5)	246.0000	0.000000
DURASI(8, 6)	1.680000	0.000000
DURASI(8, 7)	4.800000	0.000000
DURASI(8, 8)	0.000000	0.000000

Lampiran 11 (Pemrograman Lingo Untuk Analisis Sensitivitas Skenario 1)

- Hasil dari *solution report* pada *cluster 1* analisis sensitivitas skenario 1

Hasil *reporting solution* sebagai berikut :

Global optimal solution found.
 Objective value: 52.00000
 Objective bound: 52.00000
 Infeasibilities: 0.000000
 Extended solver steps: 636
 Total solver iterations: 10469
 Elapsed runtime seconds: 0.86

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 8.9 km
 rute pengiriman dari ritel 2 ke ritel 8 sebesar 8.7 km
 rute pengiriman dari ritel 3 ke ritel 1 sebesar 13.6 km
 rute pengiriman dari ritel 4 ke ritel 3 sebesar 7.9 km
 rute pengiriman dari ritel 5 ke ritel 4 sebesar 3.9 km
 rute pengiriman dari ritel 6 ke ritel 5 sebesar 2.6 km
 rute pengiriman dari ritel 7 ke ritel 6 sebesar 3.6 km
 rute pengiriman dari ritel 8 ke ritel 7 sebesar 2.8 km
 Model Class: MILP

Total variables: 72
 Nonlinear variables: 0
 Integer variables: 64
 Total constraints: 88
 Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000

BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
T(1)	1285.800	0.000000
T(2)	540.0000	0.000000
T(3)	755.4000	0.000000
T(4)	715.9200	0.000000
T(5)	681.2400	0.000000
T(6)	648.1200	0.000000
T(7)	613.8000	0.000000
T(8)	580.4400	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	8.900000
X(1, 3)	0.000000	13.60000
X(1, 4)	0.000000	19.70000
X(1, 5)	0.000000	20.70000
X(1, 6)	0.000000	21.50000
X(1, 7)	0.000000	19.20000
X(1, 8)	0.000000	18.10000
X(2, 1)	0.000000	8.900000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	6.800000
X(2, 4)	0.000000	13.30000
X(2, 5)	0.000000	14.60000
X(2, 6)	0.000000	13.10000
X(2, 7)	0.000000	10.90000
X(2, 8)	1.000000	8.700000

X(3, 1)	1.000000	13.60000
X(3, 2)	0.000000	6.800000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	7.900000
X(3, 5)	0.000000	10.30000
X(3, 6)	0.000000	10.50000
X(3, 7)	0.000000	8.100000
X(3, 8)	0.000000	9.400000
X(4, 1)	0.000000	19.70000
X(4, 2)	0.000000	13.30000
X(4, 3)	1.000000	7.900000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	3.900000
X(4, 6)	0.000000	4.600000
X(4, 7)	0.000000	4.600000
X(4, 8)	0.000000	5.600000
X(5, 1)	0.000000	20.70000
X(5, 2)	0.000000	14.60000
X(5, 3)	0.000000	10.30000
X(5, 4)	1.000000	3.900000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	2.600000
X(5, 7)	0.000000	5.400000
X(5, 8)	0.000000	3.400000
X(6, 1)	0.000000	21.50000
X(6, 2)	0.000000	13.10000
X(6, 3)	0.000000	10.50000
X(6, 4)	0.000000	4.600000
X(6, 5)	1.000000	2.600000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.600000
X(6, 8)	0.000000	2.500000
X(7, 1)	0.000000	19.20000
X(7, 2)	0.000000	10.90000
X(7, 3)	0.000000	8.100000
X(7, 4)	0.000000	4.600000
X(7, 5)	0.000000	5.400000
X(7, 6)	1.000000	3.600000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	2.800000
X(8, 1)	0.000000	18.10000
X(8, 2)	0.000000	8.700000
X(8, 3)	0.000000	9.400000
X(8, 4)	0.000000	5.600000

X(8, 5)	0.000000	3.400000
X(8, 6)	0.000000	2.500000
X(8, 7)	1.000000	2.800000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	8.900000	0.000000
D(1, 3)	13.60000	0.000000
D(1, 4)	19.70000	0.000000
D(1, 5)	20.70000	0.000000
D(1, 6)	21.50000	0.000000
D(1, 7)	19.20000	0.000000
D(1, 8)	18.10000	0.000000
D(2, 1)	8.900000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	6.800000	0.000000
D(2, 4)	13.30000	0.000000
D(2, 5)	14.60000	0.000000
D(2, 6)	13.10000	0.000000
D(2, 7)	10.90000	0.000000
D(2, 8)	8.700000	0.000000
D(3, 1)	13.60000	0.000000
D(3, 2)	6.800000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	7.900000	0.000000
D(3, 5)	10.30000	0.000000
D(3, 6)	10.50000	0.000000
D(3, 7)	8.100000	0.000000
D(3, 8)	9.400000	0.000000
D(4, 1)	19.70000	0.000000
D(4, 2)	13.30000	0.000000
D(4, 3)	7.900000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	3.900000	0.000000
D(4, 6)	4.600000	0.000000
D(4, 7)	4.600000	0.000000
D(4, 8)	5.600000	0.000000
D(5, 1)	20.70000	0.000000
D(5, 2)	14.60000	0.000000
D(5, 3)	10.30000	0.000000
D(5, 4)	3.900000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	2.600000	0.000000
D(5, 7)	5.400000	0.000000
D(5, 8)	3.400000	0.000000

D(6, 1)	21.50000	0.000000
D(6, 2)	13.10000	0.000000
D(6, 3)	10.50000	0.000000
D(6, 4)	4.600000	0.000000
D(6, 5)	2.600000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.600000	0.000000
D(6, 8)	2.500000	0.000000
D(7, 1)	19.20000	0.000000
D(7, 2)	10.90000	0.000000
D(7, 3)	8.100000	0.000000
D(7, 4)	4.600000	0.000000
D(7, 5)	5.400000	0.000000
D(7, 6)	3.600000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	2.800000	0.000000
D(8, 1)	18.10000	0.000000
D(8, 2)	8.700000	0.000000
D(8, 3)	9.400000	0.000000
D(8, 4)	5.600000	0.000000
D(8, 5)	3.400000	0.000000
D(8, 6)	2.500000	0.000000
D(8, 7)	2.800000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	10.68000	0.000000
DURASI(1, 3)	16.32000	0.000000
DURASI(1, 4)	23.64000	0.000000
DURASI(1, 5)	24.84000	0.000000
DURASI(1, 6)	25.80000	0.000000
DURASI(1, 7)	23.04000	0.000000
DURASI(1, 8)	21.72000	0.000000
DURASI(2, 1)	10.68000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	8.160000	0.000000
DURASI(2, 4)	15.96000	0.000000
DURASI(2, 5)	17.52000	0.000000
DURASI(2, 6)	15.72000	0.000000
DURASI(2, 7)	13.08000	0.000000
DURASI(2, 8)	10.44000	0.000000
DURASI(3, 1)	16.32000	0.000000
DURASI(3, 2)	8.160000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	9.480000	0.000000

DURASI(3, 5)	12.36000	0.000000
DURASI(3, 6)	12.60000	0.000000
DURASI(3, 7)	9.720000	0.000000
DURASI(3, 8)	11.28000	0.000000
DURASI(4, 1)	23.64000	0.000000
DURASI(4, 2)	15.96000	0.000000
DURASI(4, 3)	9.480000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	4.680000	0.000000
DURASI(4, 6)	5.520000	0.000000
DURASI(4, 7)	5.520000	0.000000
DURASI(4, 8)	6.720000	0.000000
DURASI(5, 1)	24.84000	0.000000
DURASI(5, 2)	17.52000	0.000000
DURASI(5, 3)	12.36000	0.000000
DURASI(5, 4)	4.680000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	3.120000	0.000000
DURASI(5, 7)	6.480000	0.000000
DURASI(5, 8)	4.080000	0.000000
DURASI(6, 1)	25.80000	0.000000
DURASI(6, 2)	15.72000	0.000000
DURASI(6, 3)	12.60000	0.000000
DURASI(6, 4)	5.520000	0.000000
DURASI(6, 5)	3.120000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.320000	0.000000
DURASI(6, 8)	3.000000	0.000000
DURASI(7, 1)	23.04000	0.000000
DURASI(7, 2)	13.08000	0.000000
DURASI(7, 3)	9.720000	0.000000
DURASI(7, 4)	5.520000	0.000000
DURASI(7, 5)	6.480000	0.000000
DURASI(7, 6)	4.320000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	3.360000	0.000000
DURASI(8, 1)	21.72000	0.000000
DURASI(8, 2)	10.44000	0.000000
DURASI(8, 3)	11.28000	0.000000
DURASI(8, 4)	6.720000	0.000000
DURASI(8, 5)	4.080000	0.000000
DURASI(8, 6)	3.000000	0.000000
DURASI(8, 7)	3.360000	0.000000
DURASI(8, 8)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster* 2 analisis sensitivitas skenario 1

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..16/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 540 540 540 540 540 540 540 540 540
540 540;
tutup = 1020 660 1260 1260 1260 1260 1260 1260 1260 1260 1260 1260
1260 1260 1260 1260 1260;
```

D =

```
!ritel
!0    3    6    7    29   30   31   32   50   51   52
      53   54   55   57   60;
0     8.3  41.1  39.6  227  275  324  322  353  353
      351  348  347  347  353  435  !0;
8.3   0    24.4  33    220  268  317  315  346  346
      344  341  341  340  347  428  !3;
41.1  24.4  0     7.5   127  300  208  238  377  377
      376  372  372  372  378  459  !6;
39.6  33    7.5   0     133  297  215  343  374  374
      372  369  369  368  375  456  !7;
```

227	220	127	133	0	85	102	134	230	230	
	228	225	224	224	230	312	!29;			
275	268	300	297	85	0	48	50	71	65	64
	55	71	69	66	166	!30;				
324	317	208	215	102	48	0	28	87	81	80
	81	87	85	82	182	!31;				
322	315	238	343	134	50	28	0	61	55	54
	55	61	59	56	156	!32;				
353	346	377	374	230	71	87	61	0	6.7	5.9
	10	4.8	4.3	7.4	98.2	!50;				
353	346	377	374	230	65	81	55	6.7	0	1.9
	10.3	5.9	4.8	1.8	97.5	!51;				
351	344	376	372	228	64	80	54	5.9	1.9	0
	8.8	9.8	5.3	3.4	100	!52;				
348	341	372	369	225	55	81	55	10	10.3	8.8
	0	10.6	6.2	10.7	105	!53;				
347	341	372	369	224	71	87	61	4.8	5.9	9.8
	10.6	0	4.3	3.5	93.4	!54;				
347	340	372	368	224	69	85	59	4.3	4.8	5.3
	6.2	4.3	0	6.3	101	!55;				
353	347	378	375	230	66	82	56	7.4	1.8	3.4
	10.7	3.5	6.3	0	97.9	!57;				
435	428	459	456	312	166	182	156	98.2	97.5	
	100	105	93.4	101	97.9	0;	!60;			

durasi =

0	9.96	49.32	47.52	272.4	330	388.8	386.4	423.6	423.6	
	421.2	417.6	416.4	416.4	423.6	522				
9.96	0	29.28	39.6	264	321.6	380.4	378	415.2	415.2	
	412.8	409.2	409.2	408	416.4	513.6				
49.32	29.28	0	9	152.4	360	249.6	285.6	452.4	452.4	
	451.2	446.4	446.4	446.4	453.6	550.8				
47.52	39.6	9	0	159.6	356.4	258	411.6	448.8	448.8	
	446.4	442.8	442.8	441.6	450	547.2				
272.4	264	152.4	159.6	0	102	122.4	160.8	276	276	
	273.6	270	268.8	268.8	276	374.4				
330	321.6	360	356.4	102	0	57.6	60	85.2	78	
	76.8	66	85.2	82.8	79.2	199.2				
388.8	380.4	249.6	258	122.4	57.6	0	33.6	104.4	97.2	96
	97.2	104.4	102	98.4	218.4					
386.4	378	285.6	411.6	160.8	60	33.6	0	73.2	66	
	64.8	66	73.2	70.8	67.2	187.2				
423.6	415.2	452.4	448.8	276	85.2	104.4	73.2	0	8.04	
	7.08	12	5.76	5.16	8.88	117.84				

```

423.6 415.2 452.4 448.8 276 78 97.2 66 8.04 0
      2.28 12.36 7.08 5.76 2.16 117
421.2 412.8 451.2 446.4 273.6 76.8 96 64.8 7.08 2.28 0
      10.56 11.76 6.36 4.08 120
417.6 409.2 446.4 442.8 270 66 97.2 66 12 12.36
      10.56 0 12.72 7.44 12.84 126
416.4 409.2 446.4 442.8 268.8 85.2 104.4 73.2 5.76 7.08
      11.76 12.72 0 5.16 4.2 112.08
416.4 408 446.4 441.6 268.8 82.8 102 70.8 5.16 5.76
      6.36 7.44 5.16 0 7.56 121.2
423.6 416.4 453.6 450 276 79.2 98.4 67.2 8.88 2.16
      4.08 12.84 4.2 7.56 0 117.48
522 513.6 550.8 547.2 374.4 199.2 218.4 187.2 117.84
      117 120 126 112.08 121.2 117.48 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 2* analisis sensitivitas

Feasible solution found.	
Objective value:	867.8000
Objective bound:	562.9000
Infeasibilities:	0.000000
Extended solver steps:	6609
Total solver iterations:	44707
Elapsed runtime seconds:	7.03

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 8.3 km
rute pengiriman dari ritel 2 ke ritel 3 sebesar 24.4 km
rute pengiriman dari ritel 3 ke ritel 7 sebesar 208 km
rute pengiriman dari ritel 4 ke ritel 1 sebesar 39.6 km

rute pengiriman dari ritel 5 ke ritel 4 sebesar 133 km
 rute pengiriman dari ritel 6 ke ritel 5 sebesar 85 km
 rute pengiriman dari ritel 7 ke ritel 8 sebesar 28 km
 rute pengiriman dari ritel 8 ke ritel 11 sebesar 54 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 6.7 km
 rute pengiriman dari ritel 10 ke ritel 6 sebesar 65 km
 rute pengiriman dari ritel 11 ke ritel 15 sebesar 3.4 km
 rute pengiriman dari ritel 12 ke ritel 14 sebesar 6.2 km
 rute pengiriman dari ritel 13 ke ritel 16 sebesar 93.4 km
 rute pengiriman dari ritel 14 ke ritel 9 sebesar 4.3 km
 rute pengiriman dari ritel 15 ke ritel 13 sebesar 3.5 km
 rute pengiriman dari ritel 16 ke ritel 12 sebesar 105 km

Model Class: MILP

Total variables:	272
Nonlinear variables:	0
Integer variables:	256
Total constraints:	304
Nonlinear constraints:	0
Total nonzeros:	1695
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BONGKAR(12)	30.00000	0.000000
BONGKAR(13)	30.00000	0.000000
BONGKAR(14)	30.00000	0.000000
BONGKAR(15)	30.00000	0.000000
BONGKAR(16)	30.00000	0.000000

BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
BUKA(12)	540.0000	0.000000
BUKA(13)	540.0000	0.000000
BUKA(14)	540.0000	0.000000
BUKA(15)	540.0000	0.000000
BUKA(16)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
TUTUP(12)	1260.000	0.000000
TUTUP(13)	1260.000	0.000000
TUTUP(14)	1260.000	0.000000
TUTUP(15)	1260.000	0.000000
TUTUP(16)	1260.000	0.000000
T(1)	1260.000	0.000000
T(2)	540.0000	0.000000
T(3)	570.0000	0.000000
T(4)	960.0000	0.000000
T(5)	930.0000	0.000000
T(6)	900.0000	0.000000
T(7)	600.0000	0.000000
T(8)	630.0000	0.000000
T(9)	840.0000	0.000000
T(10)	870.0000	0.000000
T(11)	660.0000	0.000000
T(12)	780.0000	0.000000

T(13)	720.0000	0.000000
T(14)	810.0000	0.000000
T(15)	690.0000	0.000000
T(16)	750.0000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	8.300000
X(1, 3)	0.000000	41.10000
X(1, 4)	0.000000	39.60000
X(1, 5)	0.000000	227.0000
X(1, 6)	0.000000	275.0000
X(1, 7)	0.000000	324.0000
X(1, 8)	0.000000	322.0000
X(1, 9)	0.000000	353.0000
X(1, 10)	0.000000	353.0000
X(1, 11)	0.000000	351.0000
X(1, 12)	0.000000	348.0000
X(1, 13)	0.000000	347.0000
X(1, 14)	0.000000	347.0000
X(1, 15)	0.000000	353.0000
X(1, 16)	0.000000	435.0000
X(2, 1)	0.000000	8.300000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	24.40000
X(2, 4)	0.000000	33.00000
X(2, 5)	0.000000	220.0000
X(2, 6)	0.000000	268.0000
X(2, 7)	0.000000	317.0000
X(2, 8)	0.000000	315.0000
X(2, 9)	0.000000	346.0000
X(2, 10)	0.000000	346.0000
X(2, 11)	0.000000	344.0000
X(2, 12)	0.000000	341.0000
X(2, 13)	0.000000	341.0000
X(2, 14)	0.000000	340.0000
X(2, 15)	0.000000	347.0000
X(2, 16)	0.000000	428.0000
X(3, 1)	0.000000	41.10000
X(3, 2)	0.000000	24.40000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	7.500000
X(3, 5)	0.000000	127.0000
X(3, 6)	0.000000	300.0000
X(3, 7)	1.000000	208.0000
X(3, 8)	0.000000	238.0000

X(3, 9)	0.000000	377.0000
X(3, 10)	0.000000	377.0000
X(3, 11)	0.000000	376.0000
X(3, 12)	0.000000	372.0000
X(3, 13)	0.000000	372.0000
X(3, 14)	0.000000	372.0000
X(3, 15)	0.000000	378.0000
X(3, 16)	0.000000	459.0000
X(4, 1)	1.000000	39.60000
X(4, 2)	0.000000	33.00000
X(4, 3)	0.000000	7.500000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	133.0000
X(4, 6)	0.000000	297.0000
X(4, 7)	0.000000	215.0000
X(4, 8)	0.000000	343.0000
X(4, 9)	0.000000	374.0000
X(4, 10)	0.000000	374.0000
X(4, 11)	0.000000	372.0000
X(4, 12)	0.000000	369.0000
X(4, 13)	0.000000	369.0000
X(4, 14)	0.000000	368.0000
X(4, 15)	0.000000	375.0000
X(4, 16)	0.000000	456.0000
X(5, 1)	0.000000	227.0000
X(5, 2)	0.000000	220.0000
X(5, 3)	0.000000	127.0000
X(5, 4)	1.000000	133.0000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	85.00000
X(5, 7)	0.000000	102.0000
X(5, 8)	0.000000	134.0000
X(5, 9)	0.000000	230.0000
X(5, 10)	0.000000	230.0000
X(5, 11)	0.000000	228.0000
X(5, 12)	0.000000	225.0000
X(5, 13)	0.000000	224.0000
X(5, 14)	0.000000	224.0000
X(5, 15)	0.000000	230.0000
X(5, 16)	0.000000	312.0000
X(6, 1)	0.000000	275.0000
X(6, 2)	0.000000	268.0000
X(6, 3)	0.000000	300.0000
X(6, 4)	0.000000	297.0000

X(6, 5)	1.000000	85.00000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	48.00000
X(6, 8)	0.000000	50.00000
X(6, 9)	0.000000	71.00000
X(6, 10)	0.000000	65.00000
X(6, 11)	0.000000	64.00000
X(6, 12)	0.000000	55.00000
X(6, 13)	0.000000	71.00000
X(6, 14)	0.000000	69.00000
X(6, 15)	0.000000	66.00000
X(6, 16)	0.000000	166.0000
X(7, 1)	0.000000	324.0000
X(7, 2)	0.000000	317.0000
X(7, 3)	0.000000	208.0000
X(7, 4)	0.000000	215.0000
X(7, 5)	0.000000	102.0000
X(7, 6)	0.000000	48.00000
X(7, 7)	0.000000	0.000000
X(7, 8)	1.000000	28.00000
X(7, 9)	0.000000	87.00000
X(7, 10)	0.000000	81.00000
X(7, 11)	0.000000	80.00000
X(7, 12)	0.000000	81.00000
X(7, 13)	0.000000	87.00000
X(7, 14)	0.000000	85.00000
X(7, 15)	0.000000	82.00000
X(7, 16)	0.000000	182.0000
X(8, 1)	0.000000	322.0000
X(8, 2)	0.000000	315.0000
X(8, 3)	0.000000	238.0000
X(8, 4)	0.000000	343.0000
X(8, 5)	0.000000	134.0000
X(8, 6)	0.000000	50.00000
X(8, 7)	0.000000	28.00000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	61.00000
X(8, 10)	0.000000	55.00000
X(8, 11)	1.000000	54.00000
X(8, 12)	0.000000	55.00000
X(8, 13)	0.000000	61.00000
X(8, 14)	0.000000	59.00000
X(8, 15)	0.000000	56.00000
X(8, 16)	0.000000	156.0000

X(9, 1)	0.000000	353.0000
X(9, 2)	0.000000	346.0000
X(9, 3)	0.000000	377.0000
X(9, 4)	0.000000	374.0000
X(9, 5)	0.000000	230.0000
X(9, 6)	0.000000	71.00000
X(9, 7)	0.000000	87.00000
X(9, 8)	0.000000	61.00000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	6.700000
X(9, 11)	0.000000	5.900000
X(9, 12)	0.000000	10.00000
X(9, 13)	0.000000	4.800000
X(9, 14)	0.000000	4.300000
X(9, 15)	0.000000	7.400000
X(9, 16)	0.000000	98.20000
X(10, 1)	0.000000	353.0000
X(10, 2)	0.000000	346.0000
X(10, 3)	0.000000	377.0000
X(10, 4)	0.000000	374.0000
X(10, 5)	0.000000	230.0000
X(10, 6)	1.000000	65.00000
X(10, 7)	0.000000	81.00000
X(10, 8)	0.000000	55.00000
X(10, 9)	0.000000	6.700000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	1.900000
X(10, 12)	0.000000	10.30000
X(10, 13)	0.000000	5.900000
X(10, 14)	0.000000	4.800000
X(10, 15)	0.000000	1.800000
X(10, 16)	0.000000	97.50000
X(11, 1)	0.000000	351.0000
X(11, 2)	0.000000	344.0000
X(11, 3)	0.000000	376.0000
X(11, 4)	0.000000	372.0000
X(11, 5)	0.000000	228.0000
X(11, 6)	0.000000	64.00000
X(11, 7)	0.000000	80.00000
X(11, 8)	0.000000	54.00000
X(11, 9)	0.000000	5.900000
X(11, 10)	0.000000	1.900000
X(11, 11)	0.000000	0.000000
X(11, 12)	0.000000	8.800000

X(11, 13)	0.000000	9.800000
X(11, 14)	0.000000	5.300000
X(11, 15)	1.000000	3.400000
X(11, 16)	0.000000	100.0000
X(12, 1)	0.000000	348.0000
X(12, 2)	0.000000	341.0000
X(12, 3)	0.000000	372.0000
X(12, 4)	0.000000	369.0000
X(12, 5)	0.000000	225.0000
X(12, 6)	0.000000	55.00000
X(12, 7)	0.000000	81.00000
X(12, 8)	0.000000	55.00000
X(12, 9)	0.000000	10.00000
X(12, 10)	0.000000	10.30000
X(12, 11)	0.000000	8.800000
X(12, 12)	0.000000	0.000000
X(12, 13)	0.000000	10.60000
X(12, 14)	1.000000	6.200000
X(12, 15)	0.000000	10.70000
X(12, 16)	0.000000	105.0000
X(13, 1)	0.000000	347.0000
X(13, 2)	0.000000	341.0000
X(13, 3)	0.000000	372.0000
X(13, 4)	0.000000	369.0000
X(13, 5)	0.000000	224.0000
X(13, 6)	0.000000	71.00000
X(13, 7)	0.000000	87.00000
X(13, 8)	0.000000	61.00000
X(13, 9)	0.000000	4.800000
X(13, 10)	0.000000	5.900000
X(13, 11)	0.000000	9.800000
X(13, 12)	0.000000	10.60000
X(13, 13)	0.000000	0.000000
X(13, 14)	0.000000	4.300000
X(13, 15)	0.000000	3.500000
X(13, 16)	1.000000	93.40000
X(14, 1)	0.000000	347.0000
X(14, 2)	0.000000	340.0000
X(14, 3)	0.000000	372.0000
X(14, 4)	0.000000	368.0000
X(14, 5)	0.000000	224.0000
X(14, 6)	0.000000	69.00000
X(14, 7)	0.000000	85.00000
X(14, 8)	0.000000	59.00000

X(14, 9)	1.000000	4.300000
X(14, 10)	0.000000	4.800000
X(14, 11)	0.000000	5.300000
X(14, 12)	0.000000	6.200000
X(14, 13)	0.000000	4.300000
X(14, 14)	0.000000	0.000000
X(14, 15)	0.000000	6.300000
X(14, 16)	0.000000	101.0000
X(15, 1)	0.000000	353.0000
X(15, 2)	0.000000	347.0000
X(15, 3)	0.000000	378.0000
X(15, 4)	0.000000	375.0000
X(15, 5)	0.000000	230.0000
X(15, 6)	0.000000	66.00000
X(15, 7)	0.000000	82.00000
X(15, 8)	0.000000	56.00000
X(15, 9)	0.000000	7.400000
X(15, 10)	0.000000	1.800000
X(15, 11)	0.000000	3.400000
X(15, 12)	0.000000	10.70000
X(15, 13)	1.000000	3.500000
X(15, 14)	0.000000	6.300000
X(15, 15)	0.000000	0.000000
X(15, 16)	0.000000	97.90000
X(16, 1)	0.000000	435.0000
X(16, 2)	0.000000	428.0000
X(16, 3)	0.000000	459.0000
X(16, 4)	0.000000	456.0000
X(16, 5)	0.000000	312.0000
X(16, 6)	0.000000	166.0000
X(16, 7)	0.000000	182.0000
X(16, 8)	0.000000	156.0000
X(16, 9)	0.000000	98.20000
X(16, 10)	0.000000	97.50000
X(16, 11)	0.000000	100.0000
X(16, 12)	1.000000	105.0000
X(16, 13)	0.000000	93.40000
X(16, 14)	0.000000	101.0000
X(16, 15)	0.000000	97.90000
X(16, 16)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	8.300000	0.000000
D(1, 3)	41.10000	0.000000
D(1, 4)	39.60000	0.000000

D(1, 5)	227.0000	0.000000
D(1, 6)	275.0000	0.000000
D(1, 7)	324.0000	0.000000
D(1, 8)	322.0000	0.000000
D(1, 9)	353.0000	0.000000
D(1, 10)	353.0000	0.000000
D(1, 11)	351.0000	0.000000
D(1, 12)	348.0000	0.000000
D(1, 13)	347.0000	0.000000
D(1, 14)	347.0000	0.000000
D(1, 15)	353.0000	0.000000
D(1, 16)	435.0000	0.000000
D(2, 1)	8.300000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	24.40000	0.000000
D(2, 4)	33.00000	0.000000
D(2, 5)	220.0000	0.000000
D(2, 6)	268.0000	0.000000
D(2, 7)	317.0000	0.000000
D(2, 8)	315.0000	0.000000
D(2, 9)	346.0000	0.000000
D(2, 10)	346.0000	0.000000
D(2, 11)	344.0000	0.000000
D(2, 12)	341.0000	0.000000
D(2, 13)	341.0000	0.000000
D(2, 14)	340.0000	0.000000
D(2, 15)	347.0000	0.000000
D(2, 16)	428.0000	0.000000
D(3, 1)	41.10000	0.000000
D(3, 2)	24.40000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	7.500000	0.000000
D(3, 5)	127.0000	0.000000
D(3, 6)	300.0000	0.000000
D(3, 7)	208.0000	0.000000
D(3, 8)	238.0000	0.000000
D(3, 9)	377.0000	0.000000
D(3, 10)	377.0000	0.000000
D(3, 11)	376.0000	0.000000
D(3, 12)	372.0000	0.000000
D(3, 13)	372.0000	0.000000
D(3, 14)	372.0000	0.000000
D(3, 15)	378.0000	0.000000
D(3, 16)	459.0000	0.000000

D(4, 1)	39.60000	0.000000
D(4, 2)	33.00000	0.000000
D(4, 3)	7.500000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	133.0000	0.000000
D(4, 6)	297.0000	0.000000
D(4, 7)	215.0000	0.000000
D(4, 8)	343.0000	0.000000
D(4, 9)	374.0000	0.000000
D(4, 10)	374.0000	0.000000
D(4, 11)	372.0000	0.000000
D(4, 12)	369.0000	0.000000
D(4, 13)	369.0000	0.000000
D(4, 14)	368.0000	0.000000
D(4, 15)	375.0000	0.000000
D(4, 16)	456.0000	0.000000
D(5, 1)	227.0000	0.000000
D(5, 2)	220.0000	0.000000
D(5, 3)	127.0000	0.000000
D(5, 4)	133.0000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	85.00000	0.000000
D(5, 7)	102.0000	0.000000
D(5, 8)	134.0000	0.000000
D(5, 9)	230.0000	0.000000
D(5, 10)	230.0000	0.000000
D(5, 11)	228.0000	0.000000
D(5, 12)	225.0000	0.000000
D(5, 13)	224.0000	0.000000
D(5, 14)	224.0000	0.000000
D(5, 15)	230.0000	0.000000
D(5, 16)	312.0000	0.000000
D(6, 1)	275.0000	0.000000
D(6, 2)	268.0000	0.000000
D(6, 3)	300.0000	0.000000
D(6, 4)	297.0000	0.000000
D(6, 5)	85.00000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	48.00000	0.000000
D(6, 8)	50.00000	0.000000
D(6, 9)	71.00000	0.000000
D(6, 10)	65.00000	0.000000
D(6, 11)	64.00000	0.000000
D(6, 12)	55.00000	0.000000

D(6, 13)	71.00000	0.000000
D(6, 14)	69.00000	0.000000
D(6, 15)	66.00000	0.000000
D(6, 16)	166.0000	0.000000
D(7, 1)	324.0000	0.000000
D(7, 2)	317.0000	0.000000
D(7, 3)	208.0000	0.000000
D(7, 4)	215.0000	0.000000
D(7, 5)	102.0000	0.000000
D(7, 6)	48.00000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	28.00000	0.000000
D(7, 9)	87.00000	0.000000
D(7, 10)	81.00000	0.000000
D(7, 11)	80.00000	0.000000
D(7, 12)	81.00000	0.000000
D(7, 13)	87.00000	0.000000
D(7, 14)	85.00000	0.000000
D(7, 15)	82.00000	0.000000
D(7, 16)	182.0000	0.000000
D(8, 1)	322.0000	0.000000
D(8, 2)	315.0000	0.000000
D(8, 3)	238.0000	0.000000
D(8, 4)	343.0000	0.000000
D(8, 5)	134.0000	0.000000
D(8, 6)	50.00000	0.000000
D(8, 7)	28.00000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	61.00000	0.000000
D(8, 10)	55.00000	0.000000
D(8, 11)	54.00000	0.000000
D(8, 12)	55.00000	0.000000
D(8, 13)	61.00000	0.000000
D(8, 14)	59.00000	0.000000
D(8, 15)	56.00000	0.000000
D(8, 16)	156.0000	0.000000
D(9, 1)	353.0000	0.000000
D(9, 2)	346.0000	0.000000
D(9, 3)	377.0000	0.000000
D(9, 4)	374.0000	0.000000
D(9, 5)	230.0000	0.000000
D(9, 6)	71.00000	0.000000
D(9, 7)	87.00000	0.000000
D(9, 8)	61.00000	0.000000

D(9, 9)	0.000000	0.000000
D(9, 10)	6.700000	0.000000
D(9, 11)	5.900000	0.000000
D(9, 12)	10.000000	0.000000
D(9, 13)	4.800000	0.000000
D(9, 14)	4.300000	0.000000
D(9, 15)	7.400000	0.000000
D(9, 16)	98.200000	0.000000
D(10, 1)	353.0000	0.000000
D(10, 2)	346.0000	0.000000
D(10, 3)	377.0000	0.000000
D(10, 4)	374.0000	0.000000
D(10, 5)	230.0000	0.000000
D(10, 6)	65.000000	0.000000
D(10, 7)	81.000000	0.000000
D(10, 8)	55.000000	0.000000
D(10, 9)	6.700000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	1.900000	0.000000
D(10, 12)	10.300000	0.000000
D(10, 13)	5.900000	0.000000
D(10, 14)	4.800000	0.000000
D(10, 15)	1.800000	0.000000
D(10, 16)	97.500000	0.000000
D(11, 1)	351.0000	0.000000
D(11, 2)	344.0000	0.000000
D(11, 3)	376.0000	0.000000
D(11, 4)	372.0000	0.000000
D(11, 5)	228.0000	0.000000
D(11, 6)	64.000000	0.000000
D(11, 7)	80.000000	0.000000
D(11, 8)	54.000000	0.000000
D(11, 9)	5.900000	0.000000
D(11, 10)	1.900000	0.000000
D(11, 11)	0.000000	0.000000
D(11, 12)	8.800000	0.000000
D(11, 13)	9.800000	0.000000
D(11, 14)	5.300000	0.000000
D(11, 15)	3.400000	0.000000
D(11, 16)	100.0000	0.000000
D(12, 1)	348.0000	0.000000
D(12, 2)	341.0000	0.000000
D(12, 3)	372.0000	0.000000
D(12, 4)	369.0000	0.000000

D(12, 5)	225.0000	0.000000
D(12, 6)	55.00000	0.000000
D(12, 7)	81.00000	0.000000
D(12, 8)	55.00000	0.000000
D(12, 9)	10.00000	0.000000
D(12, 10)	10.30000	0.000000
D(12, 11)	8.800000	0.000000
D(12, 12)	0.000000	0.000000
D(12, 13)	10.60000	0.000000
D(12, 14)	6.200000	0.000000
D(12, 15)	10.70000	0.000000
D(12, 16)	105.0000	0.000000
D(13, 1)	347.0000	0.000000
D(13, 2)	341.0000	0.000000
D(13, 3)	372.0000	0.000000
D(13, 4)	369.0000	0.000000
D(13, 5)	224.0000	0.000000
D(13, 6)	71.00000	0.000000
D(13, 7)	87.00000	0.000000
D(13, 8)	61.00000	0.000000
D(13, 9)	4.800000	0.000000
D(13, 10)	5.900000	0.000000
D(13, 11)	9.800000	0.000000
D(13, 12)	10.60000	0.000000
D(13, 13)	0.000000	0.000000
D(13, 14)	4.300000	0.000000
D(13, 15)	3.500000	0.000000
D(13, 16)	93.40000	0.000000
D(14, 1)	347.0000	0.000000
D(14, 2)	340.0000	0.000000
D(14, 3)	372.0000	0.000000
D(14, 4)	368.0000	0.000000
D(14, 5)	224.0000	0.000000
D(14, 6)	69.00000	0.000000
D(14, 7)	85.00000	0.000000
D(14, 8)	59.00000	0.000000
D(14, 9)	4.300000	0.000000
D(14, 10)	4.800000	0.000000
D(14, 11)	5.300000	0.000000
D(14, 12)	6.200000	0.000000
D(14, 13)	4.300000	0.000000
D(14, 14)	0.000000	0.000000
D(14, 15)	6.300000	0.000000
D(14, 16)	101.0000	0.000000

D(15, 1)	353.0000	0.000000
D(15, 2)	347.0000	0.000000
D(15, 3)	378.0000	0.000000
D(15, 4)	375.0000	0.000000
D(15, 5)	230.0000	0.000000
D(15, 6)	66.00000	0.000000
D(15, 7)	82.00000	0.000000
D(15, 8)	56.00000	0.000000
D(15, 9)	7.400000	0.000000
D(15, 10)	1.800000	0.000000
D(15, 11)	3.400000	0.000000
D(15, 12)	10.70000	0.000000
D(15, 13)	3.500000	0.000000
D(15, 14)	6.300000	0.000000
D(15, 15)	0.000000	0.000000
D(15, 16)	97.90000	0.000000
D(16, 1)	435.0000	0.000000
D(16, 2)	428.0000	0.000000
D(16, 3)	459.0000	0.000000
D(16, 4)	456.0000	0.000000
D(16, 5)	312.0000	0.000000
D(16, 6)	166.0000	0.000000
D(16, 7)	182.0000	0.000000
D(16, 8)	156.0000	0.000000
D(16, 9)	98.20000	0.000000
D(16, 10)	97.50000	0.000000
D(16, 11)	100.0000	0.000000
D(16, 12)	105.0000	0.000000
D(16, 13)	93.40000	0.000000
D(16, 14)	101.0000	0.000000
D(16, 15)	97.90000	0.000000
D(16, 16)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	9.960000	0.000000
DURASI(1, 3)	49.32000	0.000000
DURASI(1, 4)	47.52000	0.000000
DURASI(1, 5)	272.4000	0.000000
DURASI(1, 6)	330.0000	0.000000
DURASI(1, 7)	388.8000	0.000000
DURASI(1, 8)	386.4000	0.000000
DURASI(1, 9)	423.6000	0.000000
DURASI(1, 10)	423.6000	0.000000
DURASI(1, 11)	421.2000	0.000000
DURASI(1, 12)	417.6000	0.000000

DURASI(1, 13)	416.4000	0.000000
DURASI(1, 14)	416.4000	0.000000
DURASI(1, 15)	423.6000	0.000000
DURASI(1, 16)	522.0000	0.000000
DURASI(2, 1)	9.960000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	29.28000	0.000000
DURASI(2, 4)	39.60000	0.000000
DURASI(2, 5)	264.0000	0.000000
DURASI(2, 6)	321.6000	0.000000
DURASI(2, 7)	380.4000	0.000000
DURASI(2, 8)	378.0000	0.000000
DURASI(2, 9)	415.2000	0.000000
DURASI(2, 10)	415.2000	0.000000
DURASI(2, 11)	412.8000	0.000000
DURASI(2, 12)	409.2000	0.000000
DURASI(2, 13)	409.2000	0.000000
DURASI(2, 14)	408.0000	0.000000
DURASI(2, 15)	416.4000	0.000000
DURASI(2, 16)	513.6000	0.000000
DURASI(3, 1)	49.32000	0.000000
DURASI(3, 2)	29.28000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	9.000000	0.000000
DURASI(3, 5)	152.4000	0.000000
DURASI(3, 6)	360.0000	0.000000
DURASI(3, 7)	249.6000	0.000000
DURASI(3, 8)	285.6000	0.000000
DURASI(3, 9)	452.4000	0.000000
DURASI(3, 10)	452.4000	0.000000
DURASI(3, 11)	451.2000	0.000000
DURASI(3, 12)	446.4000	0.000000
DURASI(3, 13)	446.4000	0.000000
DURASI(3, 14)	446.4000	0.000000
DURASI(3, 15)	453.6000	0.000000
DURASI(3, 16)	550.8000	0.000000
DURASI(4, 1)	47.52000	0.000000
DURASI(4, 2)	39.60000	0.000000
DURASI(4, 3)	9.000000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	159.6000	0.000000
DURASI(4, 6)	356.4000	0.000000
DURASI(4, 7)	258.0000	0.000000
DURASI(4, 8)	411.6000	0.000000

DURASI(4, 9)	448.8000	0.000000
DURASI(4, 10)	448.8000	0.000000
DURASI(4, 11)	446.4000	0.000000
DURASI(4, 12)	442.8000	0.000000
DURASI(4, 13)	442.8000	0.000000
DURASI(4, 14)	441.6000	0.000000
DURASI(4, 15)	450.0000	0.000000
DURASI(4, 16)	547.2000	0.000000
DURASI(5, 1)	272.4000	0.000000
DURASI(5, 2)	264.0000	0.000000
DURASI(5, 3)	152.4000	0.000000
DURASI(5, 4)	159.6000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	102.0000	0.000000
DURASI(5, 7)	122.4000	0.000000
DURASI(5, 8)	160.8000	0.000000
DURASI(5, 9)	276.0000	0.000000
DURASI(5, 10)	276.0000	0.000000
DURASI(5, 11)	273.6000	0.000000
DURASI(5, 12)	270.0000	0.000000
DURASI(5, 13)	268.8000	0.000000
DURASI(5, 14)	268.8000	0.000000
DURASI(5, 15)	276.0000	0.000000
DURASI(5, 16)	374.4000	0.000000
DURASI(6, 1)	330.0000	0.000000
DURASI(6, 2)	321.6000	0.000000
DURASI(6, 3)	360.0000	0.000000
DURASI(6, 4)	356.4000	0.000000
DURASI(6, 5)	102.0000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	57.60000	0.000000
DURASI(6, 8)	60.00000	0.000000
DURASI(6, 9)	85.20000	0.000000
DURASI(6, 10)	78.00000	0.000000
DURASI(6, 11)	76.80000	0.000000
DURASI(6, 12)	66.00000	0.000000
DURASI(6, 13)	85.20000	0.000000
DURASI(6, 14)	82.80000	0.000000
DURASI(6, 15)	79.20000	0.000000
DURASI(6, 16)	199.2000	0.000000
DURASI(7, 1)	388.8000	0.000000
DURASI(7, 2)	380.4000	0.000000
DURASI(7, 3)	249.6000	0.000000
DURASI(7, 4)	258.0000	0.000000

DURASI(7, 5)	122.4000	0.000000
DURASI(7, 6)	57.60000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	33.60000	0.000000
DURASI(7, 9)	104.4000	0.000000
DURASI(7, 10)	97.20000	0.000000
DURASI(7, 11)	96.00000	0.000000
DURASI(7, 12)	97.20000	0.000000
DURASI(7, 13)	104.4000	0.000000
DURASI(7, 14)	102.0000	0.000000
DURASI(7, 15)	98.40000	0.000000
DURASI(7, 16)	218.4000	0.000000
DURASI(8, 1)	386.4000	0.000000
DURASI(8, 2)	378.0000	0.000000
DURASI(8, 3)	285.6000	0.000000
DURASI(8, 4)	411.6000	0.000000
DURASI(8, 5)	160.8000	0.000000
DURASI(8, 6)	60.00000	0.000000
DURASI(8, 7)	33.60000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	73.20000	0.000000
DURASI(8, 10)	66.00000	0.000000
DURASI(8, 11)	64.80000	0.000000
DURASI(8, 12)	66.00000	0.000000
DURASI(8, 13)	73.20000	0.000000
DURASI(8, 14)	70.80000	0.000000
DURASI(8, 15)	67.20000	0.000000
DURASI(8, 16)	187.2000	0.000000
DURASI(9, 1)	423.6000	0.000000
DURASI(9, 2)	415.2000	0.000000
DURASI(9, 3)	452.4000	0.000000
DURASI(9, 4)	448.8000	0.000000
DURASI(9, 5)	276.0000	0.000000
DURASI(9, 6)	85.20000	0.000000
DURASI(9, 7)	104.4000	0.000000
DURASI(9, 8)	73.20000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	8.040000	0.000000
DURASI(9, 11)	7.080000	0.000000
DURASI(9, 12)	12.00000	0.000000
DURASI(9, 13)	5.760000	0.000000
DURASI(9, 14)	5.160000	0.000000
DURASI(9, 15)	8.880000	0.000000
DURASI(9, 16)	117.8400	0.000000

DURASI(10, 1)	423.6000	0.000000
DURASI(10, 2)	415.2000	0.000000
DURASI(10, 3)	452.4000	0.000000
DURASI(10, 4)	448.8000	0.000000
DURASI(10, 5)	276.0000	0.000000
DURASI(10, 6)	78.00000	0.000000
DURASI(10, 7)	97.20000	0.000000
DURASI(10, 8)	66.00000	0.000000
DURASI(10, 9)	8.040000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	2.280000	0.000000
DURASI(10, 12)	12.36000	0.000000
DURASI(10, 13)	7.080000	0.000000
DURASI(10, 14)	5.760000	0.000000
DURASI(10, 15)	2.160000	0.000000
DURASI(10, 16)	117.0000	0.000000
DURASI(11, 1)	421.2000	0.000000
DURASI(11, 2)	412.8000	0.000000
DURASI(11, 3)	451.2000	0.000000
DURASI(11, 4)	446.4000	0.000000
DURASI(11, 5)	273.6000	0.000000
DURASI(11, 6)	76.80000	0.000000
DURASI(11, 7)	96.00000	0.000000
DURASI(11, 8)	64.80000	0.000000
DURASI(11, 9)	7.080000	0.000000
DURASI(11, 10)	2.280000	0.000000
DURASI(11, 11)	0.000000	0.000000
DURASI(11, 12)	10.56000	0.000000
DURASI(11, 13)	11.76000	0.000000
DURASI(11, 14)	6.360000	0.000000
DURASI(11, 15)	4.080000	0.000000
DURASI(11, 16)	120.0000	0.000000
DURASI(12, 1)	417.6000	0.000000
DURASI(12, 2)	409.2000	0.000000
DURASI(12, 3)	446.4000	0.000000
DURASI(12, 4)	442.8000	0.000000
DURASI(12, 5)	270.0000	0.000000
DURASI(12, 6)	66.00000	0.000000
DURASI(12, 7)	97.20000	0.000000
DURASI(12, 8)	66.00000	0.000000
DURASI(12, 9)	12.00000	0.000000
DURASI(12, 10)	12.36000	0.000000
DURASI(12, 11)	10.56000	0.000000
DURASI(12, 12)	0.000000	0.000000

DURASI(12, 13)	12.72000	0.000000
DURASI(12, 14)	7.440000	0.000000
DURASI(12, 15)	12.84000	0.000000
DURASI(12, 16)	126.0000	0.000000
DURASI(13, 1)	416.4000	0.000000
DURASI(13, 2)	409.2000	0.000000
DURASI(13, 3)	446.4000	0.000000
DURASI(13, 4)	442.8000	0.000000
DURASI(13, 5)	268.8000	0.000000
DURASI(13, 6)	85.20000	0.000000
DURASI(13, 7)	104.4000	0.000000
DURASI(13, 8)	73.20000	0.000000
DURASI(13, 9)	5.760000	0.000000
DURASI(13, 10)	7.080000	0.000000
DURASI(13, 11)	11.76000	0.000000
DURASI(13, 12)	12.72000	0.000000
DURASI(13, 13)	0.000000	0.000000
DURASI(13, 14)	5.160000	0.000000
DURASI(13, 15)	4.200000	0.000000
DURASI(13, 16)	112.0800	0.000000
DURASI(14, 1)	416.4000	0.000000
DURASI(14, 2)	408.0000	0.000000
DURASI(14, 3)	446.4000	0.000000
DURASI(14, 4)	441.6000	0.000000
DURASI(14, 5)	268.8000	0.000000
DURASI(14, 6)	82.80000	0.000000
DURASI(14, 7)	102.0000	0.000000
DURASI(14, 8)	70.80000	0.000000
DURASI(14, 9)	5.160000	0.000000
DURASI(14, 10)	5.760000	0.000000
DURASI(14, 11)	6.360000	0.000000
DURASI(14, 12)	7.440000	0.000000
DURASI(14, 13)	5.160000	0.000000
DURASI(14, 14)	0.000000	0.000000
DURASI(14, 15)	7.560000	0.000000
DURASI(14, 16)	121.2000	0.000000
DURASI(15, 1)	423.6000	0.000000
DURASI(15, 2)	416.4000	0.000000
DURASI(15, 3)	453.6000	0.000000
DURASI(15, 4)	450.0000	0.000000
DURASI(15, 5)	276.0000	0.000000
DURASI(15, 6)	79.20000	0.000000
DURASI(15, 7)	98.40000	0.000000
DURASI(15, 8)	67.20000	0.000000

DURASI(15, 9)	8.880000	0.000000
DURASI(15, 10)	2.160000	0.000000
DURASI(15, 11)	4.080000	0.000000
DURASI(15, 12)	12.84000	0.000000
DURASI(15, 13)	4.200000	0.000000
DURASI(15, 14)	7.560000	0.000000
DURASI(15, 15)	0.000000	0.000000
DURASI(15, 16)	117.4800	0.000000
DURASI(16, 1)	522.0000	0.000000
DURASI(16, 2)	513.6000	0.000000
DURASI(16, 3)	550.8000	0.000000
DURASI(16, 4)	547.2000	0.000000
DURASI(16, 5)	374.4000	0.000000
DURASI(16, 6)	199.2000	0.000000
DURASI(16, 7)	218.4000	0.000000
DURASI(16, 8)	187.2000	0.000000
DURASI(16, 9)	117.8400	0.000000
DURASI(16, 10)	117.0000	0.000000
DURASI(16, 11)	120.0000	0.000000
DURASI(16, 12)	126.0000	0.000000
DURASI(16, 13)	112.0800	0.000000
DURASI(16, 14)	121.2000	0.000000
DURASI(16, 15)	117.4800	0.000000
DURASI(16, 16)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster* 3 analisis sensitivitas skenario 1

model:

```

!parameter model:
    Buka           = waktu buka ritel
    Tutup          = waktu tutup ritel
    Bongkar        = waktu loading/unloading di ritel
    D              = jarak antar ritel
    T              = waktu memulai pelayanan pada ritel
    Durasi         = Durasi pengiriman
    R              = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i,j) = 1 jika kendaraan k beroperasi dari i ke j
;

sets:
ritel/1..11/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets

data:
buka = 480 540 540 540 540 540 540 540 540 540 540;
tutup = 1020 1260 1260 660 1260 1260 1260 1260 1260 1260 1260;

D =
!ritel
!0    56    58    59    61    62    63    64    65    66
      67;
0     345   343   433   464   510   508   472   507   503
      495   !0;
345   0     20.2  102   133   179   176   142   176   172
      164   !56;
343   20.2  0     114   145   191   188   153   188   184
      175   !58;
433   102   114   0     48.4  94.1  91.2  56.6  91.3  87.3
      78.7  !59;
464   133   145   48.4  0     31.5  33.1  27.2  61.9  57.9
      49.3  !61;
510   179   191   94.1  31.5  0     3.4   58.4  21.5  12.1
      16.2  !62;
508   176   188   91.2  33.1  3.4   0     78.6  18.1  8.8
      14.5  !63;

```

```

472  142  153  56.6  27.2  58.4  78.6  0    34.7  30.7
      22.1  !64;
507  176  188  91.3  61.9  21.5  18.1  34.7  0    10.9
      35.6  !65;
503  172  184  87.3  57.9  12.1  8.8   30.7  10.9  0
      23.8  !66;
495  164  175  78.7  49.3  16.2  14.5  22.1  35.6  23.8  0;
      !67;

```

```

durasi =
0      414  411.6  519.6  556.8  612   609.6  566.4  608.4  603.6
      594
414    0     24.24  122.4  159.6  214.8  211.2  170.4  211.2  206.4
      196.8
411.6  24.24  0     136.8  174   229.2  225.6  183.6  225.6  220.8
      210
519.6  122.4  136.8  0     58.08  112.92  109.44  67.92
      109.56  104.76  94.44
556.8  159.6  174   58.08  0     37.8   39.72  32.64  74.28  69.48
      59.16
612    214.8  229.2  112.92  37.8  0     4.08   70.08  25.8
      14.52  19.44
609.6  211.2  225.6  109.44  39.72  4.08  0     94.32  21.72
      10.56  17.4
566.4  170.4  183.6  67.92  32.64  70.08  94.32  0     41.64  36.84
      26.52
608.4  211.2  225.6  109.56  74.28  25.8  21.72  41.64  0
      13.08  42.72
603.6  206.4  220.8  104.76  69.48  14.52  10.56  36.84  13.08  0
      28.56
594    196.8  210   94.44  59.16  19.44  17.4   26.52  42.72  28.56  0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
            @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
    );

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 3* analisis sensitivitas

Global optimal solution found.

Objective value:	1095.000
Objective bound:	1095.000
Infeasibilities:	0.000000
Extended solver steps:	1474
Total solver iterations:	38956
Elapsed runtime seconds:	2.70

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 4 sebesar 433 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 20.2 km
 rute pengiriman dari ritel 3 ke ritel 1 sebesar 343 km
 rute pengiriman dari ritel 4 ke ritel 8 sebesar 56.6 km
 rute pengiriman dari ritel 5 ke ritel 2 sebesar 133 km
 rute pengiriman dari ritel 5 ke ritel 7 sebesar 33.1 km
 rute pengiriman dari ritel 6 ke ritel 5 sebesar 31.5 km
 rute pengiriman dari ritel 7 ke ritel 9 sebesar 18.1 km
 rute pengiriman dari ritel 7 ke ritel 10 sebesar 8.800000000000001 km
 rute pengiriman dari ritel 8 ke ritel 11 sebesar 22.1 km
 rute pengiriman dari ritel 9 ke ritel 7 sebesar 18.1 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 10.9 km
 rute pengiriman dari ritel 10 ke ritel 6 sebesar 12.1 km
 rute pengiriman dari ritel 11 ke ritel 7 sebesar 14.5 km

Model Class: MILP

Total variables:	132
Nonlinear variables:	0
Integer variables:	121
Total constraints:	154
Nonlinear constraints:	0
Total nonzeros:	780
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000

BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	660.0000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
T(1)	1872.000	0.000000
T(2)	1175.760	0.000000
T(3)	1230.000	0.000000
T(4)	540.0000	0.000000
T(5)	967.1954	0.000000
T(6)	899.3954	0.000000
T(7)	760.0754	0.000000
T(8)	656.1554	0.000000
T(9)	811.7954	0.000000
T(10)	854.8754	0.000000
T(11)	712.6754	0.000000

X(1, 1)	0.000000	0.000000
X(1, 2)	0.000000	345.0000
X(1, 3)	0.000000	343.0000
X(1, 4)	1.000000	433.0000
X(1, 5)	0.000000	464.0000
X(1, 6)	0.000000	510.0000
X(1, 7)	0.000000	508.0000
X(1, 8)	0.000000	472.0000
X(1, 9)	0.000000	507.0000
X(1, 10)	0.000000	503.0000
X(1, 11)	0.000000	495.0000
X(2, 1)	0.000000	345.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	20.20000
X(2, 4)	0.000000	102.0000
X(2, 5)	0.000000	133.0000
X(2, 6)	0.000000	179.0000
X(2, 7)	0.000000	176.0000
X(2, 8)	0.000000	142.0000
X(2, 9)	0.000000	176.0000
X(2, 10)	0.000000	172.0000
X(2, 11)	0.000000	164.0000
X(3, 1)	1.000000	343.0000
X(3, 2)	0.000000	20.20000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	114.0000
X(3, 5)	0.000000	145.0000
X(3, 6)	0.000000	191.0000
X(3, 7)	0.000000	188.0000
X(3, 8)	0.000000	153.0000
X(3, 9)	0.000000	188.0000
X(3, 10)	0.000000	184.0000
X(3, 11)	0.000000	175.0000
X(4, 1)	0.000000	433.0000
X(4, 2)	0.000000	102.0000
X(4, 3)	0.000000	114.0000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	48.40000
X(4, 6)	0.000000	94.10000
X(4, 7)	0.000000	91.20000
X(4, 8)	1.000000	56.60000
X(4, 9)	0.000000	91.30000
X(4, 10)	0.000000	87.30000
X(4, 11)	0.000000	78.70000

X(5, 1)	0.000000	464.0000
X(5, 2)	1.000000	133.0000
X(5, 3)	0.000000	145.0000
X(5, 4)	0.000000	48.40000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	31.50000
X(5, 7)	0.000000	33.10000
X(5, 8)	0.000000	27.20000
X(5, 9)	0.000000	61.90000
X(5, 10)	0.000000	57.90000
X(5, 11)	0.000000	49.30000
X(6, 1)	0.000000	510.0000
X(6, 2)	0.000000	179.0000
X(6, 3)	0.000000	191.0000
X(6, 4)	0.000000	94.10000
X(6, 5)	1.000000	31.50000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.400000
X(6, 8)	0.000000	58.40000
X(6, 9)	0.000000	21.50000
X(6, 10)	0.000000	12.10000
X(6, 11)	0.000000	16.20000
X(7, 1)	0.000000	508.0000
X(7, 2)	0.000000	176.0000
X(7, 3)	0.000000	188.0000
X(7, 4)	0.000000	91.20000
X(7, 5)	0.000000	33.10000
X(7, 6)	0.000000	3.400000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	78.60000
X(7, 9)	1.000000	18.10000
X(7, 10)	0.000000	8.800000
X(7, 11)	0.000000	14.50000
X(8, 1)	0.000000	472.0000
X(8, 2)	0.000000	142.0000
X(8, 3)	0.000000	153.0000
X(8, 4)	0.000000	56.60000
X(8, 5)	0.000000	27.20000
X(8, 6)	0.000000	58.40000
X(8, 7)	0.000000	78.60000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	34.70000
X(8, 10)	0.000000	30.70000
X(8, 11)	1.000000	22.10000

X(9, 1)	0.000000	507.0000
X(9, 2)	0.000000	176.0000
X(9, 3)	0.000000	188.0000
X(9, 4)	0.000000	91.30000
X(9, 5)	0.000000	61.90000
X(9, 6)	0.000000	21.50000
X(9, 7)	0.000000	18.10000
X(9, 8)	0.000000	34.70000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	10.90000
X(9, 11)	0.000000	35.60000
X(10, 1)	0.000000	503.0000
X(10, 2)	0.000000	172.0000
X(10, 3)	0.000000	184.0000
X(10, 4)	0.000000	87.30000
X(10, 5)	0.000000	57.90000
X(10, 6)	1.000000	12.10000
X(10, 7)	0.000000	8.800000
X(10, 8)	0.000000	30.70000
X(10, 9)	0.000000	10.90000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	23.80000
X(11, 1)	0.000000	495.0000
X(11, 2)	0.000000	164.0000
X(11, 3)	0.000000	175.0000
X(11, 4)	0.000000	78.70000
X(11, 5)	0.000000	49.30000
X(11, 6)	0.000000	16.20000
X(11, 7)	1.000000	14.50000
X(11, 8)	0.000000	22.10000
X(11, 9)	0.000000	35.60000
X(11, 10)	0.000000	23.80000
X(11, 11)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	345.0000	0.000000
D(1, 3)	343.0000	0.000000
D(1, 4)	433.0000	0.000000
D(1, 5)	464.0000	0.000000
D(1, 6)	510.0000	0.000000
D(1, 7)	508.0000	0.000000
D(1, 8)	472.0000	0.000000
D(1, 9)	507.0000	0.000000
D(1, 10)	503.0000	0.000000
D(1, 11)	495.0000	0.000000

D(2, 1)	345.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	20.20000	0.000000
D(2, 4)	102.0000	0.000000
D(2, 5)	133.0000	0.000000
D(2, 6)	179.0000	0.000000
D(2, 7)	176.0000	0.000000
D(2, 8)	142.0000	0.000000
D(2, 9)	176.0000	0.000000
D(2, 10)	172.0000	0.000000
D(2, 11)	164.0000	0.000000
D(3, 1)	343.0000	0.000000
D(3, 2)	20.20000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	114.0000	0.000000
D(3, 5)	145.0000	0.000000
D(3, 6)	191.0000	0.000000
D(3, 7)	188.0000	0.000000
D(3, 8)	153.0000	0.000000
D(3, 9)	188.0000	0.000000
D(3, 10)	184.0000	0.000000
D(3, 11)	175.0000	0.000000
D(4, 1)	433.0000	0.000000
D(4, 2)	102.0000	0.000000
D(4, 3)	114.0000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	48.40000	0.000000
D(4, 6)	94.10000	0.000000
D(4, 7)	91.20000	0.000000
D(4, 8)	56.60000	0.000000
D(4, 9)	91.30000	0.000000
D(4, 10)	87.30000	0.000000
D(4, 11)	78.70000	0.000000
D(5, 1)	464.0000	0.000000
D(5, 2)	133.0000	0.000000
D(5, 3)	145.0000	0.000000
D(5, 4)	48.40000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	31.50000	0.000000
D(5, 7)	33.10000	0.000000
D(5, 8)	27.20000	0.000000
D(5, 9)	61.90000	0.000000
D(5, 10)	57.90000	0.000000
D(5, 11)	49.30000	0.000000

D(6, 1)	510.0000	0.000000
D(6, 2)	179.0000	0.000000
D(6, 3)	191.0000	0.000000
D(6, 4)	94.10000	0.000000
D(6, 5)	31.50000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.400000	0.000000
D(6, 8)	58.40000	0.000000
D(6, 9)	21.50000	0.000000
D(6, 10)	12.10000	0.000000
D(6, 11)	16.20000	0.000000
D(7, 1)	508.0000	0.000000
D(7, 2)	176.0000	0.000000
D(7, 3)	188.0000	0.000000
D(7, 4)	91.20000	0.000000
D(7, 5)	33.10000	0.000000
D(7, 6)	3.400000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	78.60000	0.000000
D(7, 9)	18.10000	0.000000
D(7, 10)	8.800000	0.000000
D(7, 11)	14.50000	0.000000
D(8, 1)	472.0000	0.000000
D(8, 2)	142.0000	0.000000
D(8, 3)	153.0000	0.000000
D(8, 4)	56.60000	0.000000
D(8, 5)	27.20000	0.000000
D(8, 6)	58.40000	0.000000
D(8, 7)	78.60000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	34.70000	0.000000
D(8, 10)	30.70000	0.000000
D(8, 11)	22.10000	0.000000
D(9, 1)	507.0000	0.000000
D(9, 2)	176.0000	0.000000
D(9, 3)	188.0000	0.000000
D(9, 4)	91.30000	0.000000
D(9, 5)	61.90000	0.000000
D(9, 6)	21.50000	0.000000
D(9, 7)	18.10000	0.000000
D(9, 8)	34.70000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	10.90000	0.000000
D(9, 11)	35.60000	0.000000

D(10, 1)	503.0000	0.000000
D(10, 2)	172.0000	0.000000
D(10, 3)	184.0000	0.000000
D(10, 4)	87.30000	0.000000
D(10, 5)	57.90000	0.000000
D(10, 6)	12.10000	0.000000
D(10, 7)	8.800000	0.000000
D(10, 8)	30.70000	0.000000
D(10, 9)	10.90000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	23.80000	0.000000
D(11, 1)	495.0000	0.000000
D(11, 2)	164.0000	0.000000
D(11, 3)	175.0000	0.000000
D(11, 4)	78.70000	0.000000
D(11, 5)	49.30000	0.000000
D(11, 6)	16.20000	0.000000
D(11, 7)	14.50000	0.000000
D(11, 8)	22.10000	0.000000
D(11, 9)	35.60000	0.000000
D(11, 10)	23.80000	0.000000
D(11, 11)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	414.0000	0.000000
DURASI(1, 3)	411.6000	0.000000
DURASI(1, 4)	519.6000	0.000000
DURASI(1, 5)	556.8000	0.000000
DURASI(1, 6)	612.0000	0.000000
DURASI(1, 7)	609.6000	0.000000
DURASI(1, 8)	566.4000	0.000000
DURASI(1, 9)	608.4000	0.000000
DURASI(1, 10)	603.6000	0.000000
DURASI(1, 11)	594.0000	0.000000
DURASI(2, 1)	414.0000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	24.24000	0.000000
DURASI(2, 4)	122.4000	0.000000
DURASI(2, 5)	159.6000	0.000000
DURASI(2, 6)	214.8000	0.000000
DURASI(2, 7)	211.2000	0.000000
DURASI(2, 8)	170.4000	0.000000
DURASI(2, 9)	211.2000	0.000000
DURASI(2, 10)	206.4000	0.000000
DURASI(2, 11)	196.8000	0.000000

DURASI(3, 1)	411.6000	0.000000
DURASI(3, 2)	24.24000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	136.8000	0.000000
DURASI(3, 5)	174.0000	0.000000
DURASI(3, 6)	229.2000	0.000000
DURASI(3, 7)	225.6000	0.000000
DURASI(3, 8)	183.6000	0.000000
DURASI(3, 9)	225.6000	0.000000
DURASI(3, 10)	220.8000	0.000000
DURASI(3, 11)	210.0000	0.000000
DURASI(4, 1)	519.6000	0.000000
DURASI(4, 2)	122.4000	0.000000
DURASI(4, 3)	136.8000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	58.08000	0.000000
DURASI(4, 6)	112.9200	0.000000
DURASI(4, 7)	109.4400	0.000000
DURASI(4, 8)	67.92000	0.000000
DURASI(4, 9)	109.5600	0.000000
DURASI(4, 10)	104.7600	0.000000
DURASI(4, 11)	94.44000	0.000000
DURASI(5, 1)	556.8000	0.000000
DURASI(5, 2)	159.6000	0.000000
DURASI(5, 3)	174.0000	0.000000
DURASI(5, 4)	58.08000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	37.80000	0.000000
DURASI(5, 7)	39.72000	0.000000
DURASI(5, 8)	32.64000	0.000000
DURASI(5, 9)	74.28000	0.000000
DURASI(5, 10)	69.48000	0.000000
DURASI(5, 11)	59.16000	0.000000
DURASI(6, 1)	612.0000	0.000000
DURASI(6, 2)	214.8000	0.000000
DURASI(6, 3)	229.2000	0.000000
DURASI(6, 4)	112.9200	0.000000
DURASI(6, 5)	37.80000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.080000	0.000000
DURASI(6, 8)	70.08000	0.000000
DURASI(6, 9)	25.80000	0.000000
DURASI(6, 10)	14.52000	0.000000
DURASI(6, 11)	19.44000	0.000000

DURASI(7, 1)	609.6000	0.000000
DURASI(7, 2)	211.2000	0.000000
DURASI(7, 3)	225.6000	0.000000
DURASI(7, 4)	109.4400	0.000000
DURASI(7, 5)	39.72000	0.000000
DURASI(7, 6)	4.080000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	94.32000	0.000000
DURASI(7, 9)	21.72000	0.000000
DURASI(7, 10)	10.56000	0.000000
DURASI(7, 11)	17.40000	0.000000
DURASI(8, 1)	566.4000	0.000000
DURASI(8, 2)	170.4000	0.000000
DURASI(8, 3)	183.6000	0.000000
DURASI(8, 4)	67.92000	0.000000
DURASI(8, 5)	32.64000	0.000000
DURASI(8, 6)	70.08000	0.000000
DURASI(8, 7)	94.32000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	41.64000	0.000000
DURASI(8, 10)	36.84000	0.000000
DURASI(8, 11)	26.52000	0.000000
DURASI(9, 1)	608.4000	0.000000
DURASI(9, 2)	211.2000	0.000000
DURASI(9, 3)	225.6000	0.000000
DURASI(9, 4)	109.5600	0.000000
DURASI(9, 5)	74.28000	0.000000
DURASI(9, 6)	25.80000	0.000000
DURASI(9, 7)	21.72000	0.000000
DURASI(9, 8)	41.64000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	13.08000	0.000000
DURASI(9, 11)	42.72000	0.000000
DURASI(10, 1)	603.6000	0.000000
DURASI(10, 2)	206.4000	0.000000
DURASI(10, 3)	220.8000	0.000000
DURASI(10, 4)	104.7600	0.000000
DURASI(10, 5)	69.48000	0.000000
DURASI(10, 6)	14.52000	0.000000
DURASI(10, 7)	10.56000	0.000000
DURASI(10, 8)	36.84000	0.000000
DURASI(10, 9)	13.08000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	28.56000	0.000000

DURASI(11, 1)	594.0000	0.000000
DURASI(11, 2)	196.8000	0.000000
DURASI(11, 3)	210.0000	0.000000
DURASI(11, 4)	94.44000	0.000000
DURASI(11, 5)	59.16000	0.000000
DURASI(11, 6)	19.44000	0.000000
DURASI(11, 7)	17.40000	0.000000
DURASI(11, 8)	26.52000	0.000000
DURASI(11, 9)	42.72000	0.000000
DURASI(11, 10)	28.56000	0.000000
DURASI(11, 11)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 4* analisis sensitivitas skenario 1

model:

```
!parameter model:
    Buka           = waktu buka ritel
    Tutup          = waktu tutup ritel
    Bongkar        = waktu loading/unloading di ritel
    D              = jarak antar ritel
    T              = waktu memulai pelayanan pada ritel
    Durasi         = Durasi pengiriman
    R              = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i,j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..12/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 540 540 540 540 540 540 540;
tutup = 1020 1260 660 1260 1260 1260 1260 1260 1260 1260 1260 1260
1260;
```

D =

```
!ritel
!0    33    34    35    36    37    38    44    45    46    47
      48;
0     252   234   258   254   256   259   398   422   548
      548   341   !0;
252   0     20    44    39    42    46    184   208   334
      334   127   !33;
234   20    0     24    20    23    25    164   188   314
      314   107   !34;
258   44    24    0     7     6     9     138   158   295
      295   88    !35;
254   39    20    7     0     3     6     156   166   306
      306   99    !36;
256   42    23    6     3     0     7     156   164   305
      305   98    !37;
259   46    25    9     6     7     0     141   161   306
      306   99    !38;
```

398	184	164	138	156	156	141	0	24.4	102	
	102	57.5	!44;							
422	208	188	158	166	164	161	24.4	0	77.2	78
	80.9	!45;								
548	334	314	295	306	305	306	102	77.2	0	1.7
	145	!46;								
548	334	314	295	306	305	306	102	78	1.7	0
	144	!47;								
341	127	107	88	99	98	99	57.5	80.9	145	
	144	0;	!48;							

```

durasi =
0      302.4 280.8 309.6 304.8 307.2 310.8 477.6 506.4 657.6
      657.6 409.2
302.4  0      24    52.8  46.8  50.4  55.2  220.8 249.6 400.8
      400.8 152.4
280.8  24    0      28.8  24    27.6  30    196.8 225.6 376.8
      376.8 128.4
309.6  52.8  28.8  0      8.4   7.2   10.8  165.6 189.6 354
      354   105.6
304.8  46.8  24    8.4   0     3.6   7.2   187.2 199.2 367.2
      367.2 118.8
307.2  50.4  27.6  7.2   3.6   0     8.4   187.2 196.8 366
      366   117.6
310.8  55.2  30    10.8  7.2   8.4   0     169.2 193.2 367.2
      367.2 118.8
477.6  220.8 196.8 165.6 187.2 187.2 169.2 0      29.28 122.4
      122.4 69
506.4  249.6 225.6 189.6 199.2 196.8 193.2 29.28 0      92.64
      93.6  97.08
657.6  400.8 376.8 354   367.2 366   367.2 122.4 92.64 0
      2.04  174
657.6  400.8 376.8 354   367.2 366   367.2 122.4 93.6  2.04  0
      172.8
409.2  152.4 128.4 105.6 118.8 117.6 118.8 69    97.08 174
      172.8 0;

```

```

Bongkar = 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",

```



```

@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
    );

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;

```

```
@FOR (rute (i, j):
    @BIN(x(i, j)));
```

```
End
```

- Hasil dari *solution report* pada *cluster 4* analisis sensitivitas

Global optimal solution found.

Objective value:	1035.300
Objective bound:	1035.300
Infeasibilities:	0.000000
Extended solver steps:	832
Total solver iterations:	30251
Elapsed runtime seconds:	2.28

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 3 sebesar 234 km
 rute pengiriman dari ritel 2 ke ritel 1 sebesar 252 km
 rute pengiriman dari ritel 3 ke ritel 7 sebesar 25 km
 rute pengiriman dari ritel 4 ke ritel 6 sebesar 6 km
 rute pengiriman dari ritel 5 ke ritel 2 sebesar 39 km
 rute pengiriman dari ritel 6 ke ritel 5 sebesar 3 km
 rute pengiriman dari ritel 7 ke ritel 8 sebesar 141 km
 rute pengiriman dari ritel 8 ke ritel 9 sebesar 24.4 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 77.2 km
 rute pengiriman dari ritel 10 ke ritel 11 sebesar 1.7 km
 rute pengiriman dari ritel 11 ke ritel 12 sebesar 144 km
 rute pengiriman dari ritel 12 ke ritel 4 sebesar 88 km

Model Class: MILP

Total variables:	156
Nonlinear variables:	0
Integer variables:	144
Total constraints:	180
Nonlinear constraints:	0
Total nonzeros:	935
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000

BONGKAR(1)	0.3000000	0.000000
BONGKAR(2)	0.3000000	0.000000
BONGKAR(3)	0.3000000	0.000000
BONGKAR(4)	0.3000000	0.000000
BONGKAR(5)	0.3000000	0.000000
BONGKAR(6)	0.3000000	0.000000
BONGKAR(7)	0.3000000	0.000000
BONGKAR(8)	0.3000000	0.000000
BONGKAR(9)	0.3000000	0.000000
BONGKAR(10)	0.3000000	0.000000
BONGKAR(11)	0.3000000	0.000000
BONGKAR(12)	0.3000000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
BUKA(12)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	660.0000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
TUTUP(12)	1260.000	0.000000
T(1)	1917.600	0.000000
T(2)	1259.700	0.000000
T(3)	540.0000	0.000000
T(4)	1143.660	0.000000
T(5)	1212.600	0.000000
T(6)	1151.160	0.000000
T(7)	570.3000	0.000000
T(8)	739.8000	0.000000

T(9)	769.3800	0.000000
T(10)	862.3200	0.000000
T(11)	864.6600	0.000000
T(12)	1037.760	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	0.000000	252.0000
X(1, 3)	1.000000	234.0000
X(1, 4)	0.000000	258.0000
X(1, 5)	0.000000	254.0000
X(1, 6)	0.000000	256.0000
X(1, 7)	0.000000	259.0000
X(1, 8)	0.000000	398.0000
X(1, 9)	0.000000	422.0000
X(1, 10)	0.000000	548.0000
X(1, 11)	0.000000	548.0000
X(1, 12)	0.000000	341.0000
X(2, 1)	1.000000	252.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	20.00000
X(2, 4)	0.000000	44.00000
X(2, 5)	0.000000	39.00000
X(2, 6)	0.000000	42.00000
X(2, 7)	0.000000	46.00000
X(2, 8)	0.000000	184.0000
X(2, 9)	0.000000	208.0000
X(2, 10)	0.000000	334.0000
X(2, 11)	0.000000	334.0000
X(2, 12)	0.000000	127.0000
X(3, 1)	0.000000	234.0000
X(3, 2)	0.000000	20.00000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	24.00000
X(3, 5)	0.000000	20.00000
X(3, 6)	0.000000	23.00000
X(3, 7)	1.000000	25.00000
X(3, 8)	0.000000	164.0000
X(3, 9)	0.000000	188.0000
X(3, 10)	0.000000	314.0000
X(3, 11)	0.000000	314.0000
X(3, 12)	0.000000	107.0000
X(4, 1)	0.000000	258.0000
X(4, 2)	0.000000	44.00000
X(4, 3)	0.000000	24.00000
X(4, 4)	0.000000	0.000000

X(4, 5)	0.000000	7.000000
X(4, 6)	1.000000	6.000000
X(4, 7)	0.000000	9.000000
X(4, 8)	0.000000	138.0000
X(4, 9)	0.000000	158.0000
X(4, 10)	0.000000	295.0000
X(4, 11)	0.000000	295.0000
X(4, 12)	0.000000	88.00000
X(5, 1)	0.000000	254.0000
X(5, 2)	1.000000	39.00000
X(5, 3)	0.000000	20.00000
X(5, 4)	0.000000	7.000000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	3.000000
X(5, 7)	0.000000	6.000000
X(5, 8)	0.000000	156.0000
X(5, 9)	0.000000	166.0000
X(5, 10)	0.000000	306.0000
X(5, 11)	0.000000	306.0000
X(5, 12)	0.000000	99.00000
X(6, 1)	0.000000	256.0000
X(6, 2)	0.000000	42.00000
X(6, 3)	0.000000	23.00000
X(6, 4)	0.000000	6.000000
X(6, 5)	1.000000	3.000000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	7.000000
X(6, 8)	0.000000	156.0000
X(6, 9)	0.000000	164.0000
X(6, 10)	0.000000	305.0000
X(6, 11)	0.000000	305.0000
X(6, 12)	0.000000	98.00000
X(7, 1)	0.000000	259.0000
X(7, 2)	0.000000	46.00000
X(7, 3)	0.000000	25.00000
X(7, 4)	0.000000	9.000000
X(7, 5)	0.000000	6.000000
X(7, 6)	0.000000	7.000000
X(7, 7)	0.000000	0.000000
X(7, 8)	1.000000	141.0000
X(7, 9)	0.000000	161.0000
X(7, 10)	0.000000	306.0000
X(7, 11)	0.000000	306.0000
X(7, 12)	0.000000	99.00000

X(8, 1)	0.000000	398.0000
X(8, 2)	0.000000	184.0000
X(8, 3)	0.000000	164.0000
X(8, 4)	0.000000	138.0000
X(8, 5)	0.000000	156.0000
X(8, 6)	0.000000	156.0000
X(8, 7)	0.000000	141.0000
X(8, 8)	0.000000	0.000000
X(8, 9)	1.000000	24.40000
X(8, 10)	0.000000	102.0000
X(8, 11)	0.000000	102.0000
X(8, 12)	0.000000	57.50000
X(9, 1)	0.000000	422.0000
X(9, 2)	0.000000	208.0000
X(9, 3)	0.000000	188.0000
X(9, 4)	0.000000	158.0000
X(9, 5)	0.000000	166.0000
X(9, 6)	0.000000	164.0000
X(9, 7)	0.000000	161.0000
X(9, 8)	0.000000	24.40000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	77.20000
X(9, 11)	0.000000	78.00000
X(9, 12)	0.000000	80.90000
X(10, 1)	0.000000	548.0000
X(10, 2)	0.000000	334.0000
X(10, 3)	0.000000	314.0000
X(10, 4)	0.000000	295.0000
X(10, 5)	0.000000	306.0000
X(10, 6)	0.000000	305.0000
X(10, 7)	0.000000	306.0000
X(10, 8)	0.000000	102.0000
X(10, 9)	0.000000	77.20000
X(10, 10)	0.000000	0.000000
X(10, 11)	1.000000	1.700000
X(10, 12)	0.000000	145.0000
X(11, 1)	0.000000	548.0000
X(11, 2)	0.000000	334.0000
X(11, 3)	0.000000	314.0000
X(11, 4)	0.000000	295.0000
X(11, 5)	0.000000	306.0000
X(11, 6)	0.000000	305.0000
X(11, 7)	0.000000	306.0000
X(11, 8)	0.000000	102.0000

X(11, 9)	0.000000	78.00000
X(11, 10)	0.000000	1.700000
X(11, 11)	0.000000	0.000000
X(11, 12)	1.000000	144.0000
X(12, 1)	0.000000	341.0000
X(12, 2)	0.000000	127.0000
X(12, 3)	0.000000	107.0000
X(12, 4)	1.000000	88.00000
X(12, 5)	0.000000	99.00000
X(12, 6)	0.000000	98.00000
X(12, 7)	0.000000	99.00000
X(12, 8)	0.000000	57.50000
X(12, 9)	0.000000	80.90000
X(12, 10)	0.000000	145.0000
X(12, 11)	0.000000	144.0000
X(12, 12)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	252.0000	0.000000
D(1, 3)	234.0000	0.000000
D(1, 4)	258.0000	0.000000
D(1, 5)	254.0000	0.000000
D(1, 6)	256.0000	0.000000
D(1, 7)	259.0000	0.000000
D(1, 8)	398.0000	0.000000
D(1, 9)	422.0000	0.000000
D(1, 10)	548.0000	0.000000
D(1, 11)	548.0000	0.000000
D(1, 12)	341.0000	0.000000
D(2, 1)	252.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	20.00000	0.000000
D(2, 4)	44.00000	0.000000
D(2, 5)	39.00000	0.000000
D(2, 6)	42.00000	0.000000
D(2, 7)	46.00000	0.000000
D(2, 8)	184.0000	0.000000
D(2, 9)	208.0000	0.000000
D(2, 10)	334.0000	0.000000
D(2, 11)	334.0000	0.000000
D(2, 12)	127.0000	0.000000
D(3, 1)	234.0000	0.000000
D(3, 2)	20.00000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	24.00000	0.000000

D(3, 5)	20.00000	0.000000
D(3, 6)	23.00000	0.000000
D(3, 7)	25.00000	0.000000
D(3, 8)	164.0000	0.000000
D(3, 9)	188.0000	0.000000
D(3, 10)	314.0000	0.000000
D(3, 11)	314.0000	0.000000
D(3, 12)	107.0000	0.000000
D(4, 1)	258.0000	0.000000
D(4, 2)	44.00000	0.000000
D(4, 3)	24.00000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	7.000000	0.000000
D(4, 6)	6.000000	0.000000
D(4, 7)	9.000000	0.000000
D(4, 8)	138.0000	0.000000
D(4, 9)	158.0000	0.000000
D(4, 10)	295.0000	0.000000
D(4, 11)	295.0000	0.000000
D(4, 12)	88.00000	0.000000
D(5, 1)	254.0000	0.000000
D(5, 2)	39.00000	0.000000
D(5, 3)	20.00000	0.000000
D(5, 4)	7.000000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	3.000000	0.000000
D(5, 7)	6.000000	0.000000
D(5, 8)	156.0000	0.000000
D(5, 9)	166.0000	0.000000
D(5, 10)	306.0000	0.000000
D(5, 11)	306.0000	0.000000
D(5, 12)	99.00000	0.000000
D(6, 1)	256.0000	0.000000
D(6, 2)	42.00000	0.000000
D(6, 3)	23.00000	0.000000
D(6, 4)	6.000000	0.000000
D(6, 5)	3.000000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	7.000000	0.000000
D(6, 8)	156.0000	0.000000
D(6, 9)	164.0000	0.000000
D(6, 10)	305.0000	0.000000
D(6, 11)	305.0000	0.000000
D(6, 12)	98.00000	0.000000

D(7, 1)	259.0000	0.000000
D(7, 2)	46.00000	0.000000
D(7, 3)	25.00000	0.000000
D(7, 4)	9.000000	0.000000
D(7, 5)	6.000000	0.000000
D(7, 6)	7.000000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	141.0000	0.000000
D(7, 9)	161.0000	0.000000
D(7, 10)	306.0000	0.000000
D(7, 11)	306.0000	0.000000
D(7, 12)	99.00000	0.000000
D(8, 1)	398.0000	0.000000
D(8, 2)	184.0000	0.000000
D(8, 3)	164.0000	0.000000
D(8, 4)	138.0000	0.000000
D(8, 5)	156.0000	0.000000
D(8, 6)	156.0000	0.000000
D(8, 7)	141.0000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	24.40000	0.000000
D(8, 10)	102.0000	0.000000
D(8, 11)	102.0000	0.000000
D(8, 12)	57.50000	0.000000
D(9, 1)	422.0000	0.000000
D(9, 2)	208.0000	0.000000
D(9, 3)	188.0000	0.000000
D(9, 4)	158.0000	0.000000
D(9, 5)	166.0000	0.000000
D(9, 6)	164.0000	0.000000
D(9, 7)	161.0000	0.000000
D(9, 8)	24.40000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	77.20000	0.000000
D(9, 11)	78.00000	0.000000
D(9, 12)	80.90000	0.000000
D(10, 1)	548.0000	0.000000
D(10, 2)	334.0000	0.000000
D(10, 3)	314.0000	0.000000
D(10, 4)	295.0000	0.000000
D(10, 5)	306.0000	0.000000
D(10, 6)	305.0000	0.000000
D(10, 7)	306.0000	0.000000
D(10, 8)	102.0000	0.000000

D(10, 9)	77.20000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	1.700000	0.000000
D(10, 12)	145.0000	0.000000
D(11, 1)	548.0000	0.000000
D(11, 2)	334.0000	0.000000
D(11, 3)	314.0000	0.000000
D(11, 4)	295.0000	0.000000
D(11, 5)	306.0000	0.000000
D(11, 6)	305.0000	0.000000
D(11, 7)	306.0000	0.000000
D(11, 8)	102.0000	0.000000
D(11, 9)	78.00000	0.000000
D(11, 10)	1.700000	0.000000
D(11, 11)	0.000000	0.000000
D(11, 12)	144.0000	0.000000
D(12, 1)	341.0000	0.000000
D(12, 2)	127.0000	0.000000
D(12, 3)	107.0000	0.000000
D(12, 4)	88.00000	0.000000
D(12, 5)	99.00000	0.000000
D(12, 6)	98.00000	0.000000
D(12, 7)	99.00000	0.000000
D(12, 8)	57.50000	0.000000
D(12, 9)	80.90000	0.000000
D(12, 10)	145.0000	0.000000
D(12, 11)	144.0000	0.000000
D(12, 12)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	302.4000	0.000000
DURASI(1, 3)	280.8000	0.000000
DURASI(1, 4)	309.6000	0.000000
DURASI(1, 5)	304.8000	0.000000
DURASI(1, 6)	307.2000	0.000000
DURASI(1, 7)	310.8000	0.000000
DURASI(1, 8)	477.6000	0.000000
DURASI(1, 9)	506.4000	0.000000
DURASI(1, 10)	657.6000	0.000000
DURASI(1, 11)	657.6000	0.000000
DURASI(1, 12)	409.2000	0.000000
DURASI(2, 1)	302.4000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	24.00000	0.000000
DURASI(2, 4)	52.80000	0.000000

DURASI(2, 5)	46.80000	0.000000
DURASI(2, 6)	50.40000	0.000000
DURASI(2, 7)	55.20000	0.000000
DURASI(2, 8)	220.8000	0.000000
DURASI(2, 9)	249.6000	0.000000
DURASI(2, 10)	400.8000	0.000000
DURASI(2, 11)	400.8000	0.000000
DURASI(2, 12)	152.4000	0.000000
DURASI(3, 1)	280.8000	0.000000
DURASI(3, 2)	24.00000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	28.80000	0.000000
DURASI(3, 5)	24.00000	0.000000
DURASI(3, 6)	27.60000	0.000000
DURASI(3, 7)	30.00000	0.000000
DURASI(3, 8)	196.8000	0.000000
DURASI(3, 9)	225.6000	0.000000
DURASI(3, 10)	376.8000	0.000000
DURASI(3, 11)	376.8000	0.000000
DURASI(3, 12)	128.4000	0.000000
DURASI(4, 1)	309.6000	0.000000
DURASI(4, 2)	52.80000	0.000000
DURASI(4, 3)	28.80000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	8.400000	0.000000
DURASI(4, 6)	7.200000	0.000000
DURASI(4, 7)	10.80000	0.000000
DURASI(4, 8)	165.6000	0.000000
DURASI(4, 9)	189.6000	0.000000
DURASI(4, 10)	354.0000	0.000000
DURASI(4, 11)	354.0000	0.000000
DURASI(4, 12)	105.6000	0.000000
DURASI(5, 1)	304.8000	0.000000
DURASI(5, 2)	46.80000	0.000000
DURASI(5, 3)	24.00000	0.000000
DURASI(5, 4)	8.400000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	3.600000	0.000000
DURASI(5, 7)	7.200000	0.000000
DURASI(5, 8)	187.2000	0.000000
DURASI(5, 9)	199.2000	0.000000
DURASI(5, 10)	367.2000	0.000000
DURASI(5, 11)	367.2000	0.000000
DURASI(5, 12)	118.8000	0.000000

DURASI(6, 1)	307.2000	0.000000
DURASI(6, 2)	50.40000	0.000000
DURASI(6, 3)	27.60000	0.000000
DURASI(6, 4)	7.200000	0.000000
DURASI(6, 5)	3.600000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	8.400000	0.000000
DURASI(6, 8)	187.2000	0.000000
DURASI(6, 9)	196.8000	0.000000
DURASI(6, 10)	366.0000	0.000000
DURASI(6, 11)	366.0000	0.000000
DURASI(6, 12)	117.6000	0.000000
DURASI(7, 1)	310.8000	0.000000
DURASI(7, 2)	55.20000	0.000000
DURASI(7, 3)	30.00000	0.000000
DURASI(7, 4)	10.80000	0.000000
DURASI(7, 5)	7.200000	0.000000
DURASI(7, 6)	8.400000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	169.2000	0.000000
DURASI(7, 9)	193.2000	0.000000
DURASI(7, 10)	367.2000	0.000000
DURASI(7, 11)	367.2000	0.000000
DURASI(7, 12)	118.8000	0.000000
DURASI(8, 1)	477.6000	0.000000
DURASI(8, 2)	220.8000	0.000000
DURASI(8, 3)	196.8000	0.000000
DURASI(8, 4)	165.6000	0.000000
DURASI(8, 5)	187.2000	0.000000
DURASI(8, 6)	187.2000	0.000000
DURASI(8, 7)	169.2000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	29.28000	0.000000
DURASI(8, 10)	122.4000	0.000000
DURASI(8, 11)	122.4000	0.000000
DURASI(8, 12)	69.00000	0.000000
DURASI(9, 1)	506.4000	0.000000
DURASI(9, 2)	249.6000	0.000000
DURASI(9, 3)	225.6000	0.000000
DURASI(9, 4)	189.6000	0.000000
DURASI(9, 5)	199.2000	0.000000
DURASI(9, 6)	196.8000	0.000000
DURASI(9, 7)	193.2000	0.000000
DURASI(9, 8)	29.28000	0.000000

DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	92.64000	0.000000
DURASI(9, 11)	93.60000	0.000000
DURASI(9, 12)	97.08000	0.000000
DURASI(10, 1)	657.6000	0.000000
DURASI(10, 2)	400.8000	0.000000
DURASI(10, 3)	376.8000	0.000000
DURASI(10, 4)	354.0000	0.000000
DURASI(10, 5)	367.2000	0.000000
DURASI(10, 6)	366.0000	0.000000
DURASI(10, 7)	367.2000	0.000000
DURASI(10, 8)	122.4000	0.000000
DURASI(10, 9)	92.64000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	2.040000	0.000000
DURASI(10, 12)	174.0000	0.000000
DURASI(11, 1)	657.6000	0.000000
DURASI(11, 2)	400.8000	0.000000
DURASI(11, 3)	376.8000	0.000000
DURASI(11, 4)	354.0000	0.000000
DURASI(11, 5)	367.2000	0.000000
DURASI(11, 6)	366.0000	0.000000
DURASI(11, 7)	367.2000	0.000000
DURASI(11, 8)	122.4000	0.000000
DURASI(11, 9)	93.60000	0.000000
DURASI(11, 10)	2.040000	0.000000
DURASI(11, 11)	0.000000	0.000000
DURASI(11, 12)	172.8000	0.000000
DURASI(12, 1)	409.2000	0.000000
DURASI(12, 2)	152.4000	0.000000
DURASI(12, 3)	128.4000	0.000000
DURASI(12, 4)	105.6000	0.000000
DURASI(12, 5)	118.8000	0.000000
DURASI(12, 6)	117.6000	0.000000
DURASI(12, 7)	118.8000	0.000000
DURASI(12, 8)	69.00000	0.000000
DURASI(12, 9)	97.08000	0.000000
DURASI(12, 10)	174.0000	0.000000
DURASI(12, 11)	172.8000	0.000000
DURASI(12, 12)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 5* analisis sensitivitas skenario 1

model:

```
!parameter model:
    Buka           = waktu buka ritel
    Tutup          = waktu tutup ritel
    Bongkar        = waktu loading/unloading di ritel
    D              = jarak antar ritel
    T              = waktu memulai pelayanan pada ritel
    Durasi         = Durasi pengiriman
    R              = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..11/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 540 540 540 540 540 540;
tutup = 1020 660 1260 1260 1260 1260 1260 1260 1260 1260 1260;
```

D =

```
!ritel
!0    16    19    20    21    39    40    41    42    43
    49;
0     49.3  161   160   160   312   316   321   321   320
    323   !0;
49.3  0     126   125   125   277   281   287   287   285
    289   !16;
161   126   0     5.4   1.7   171   175   180   181   179
    182   !19;
160   125   5.4   0     3.1   169   173   179   179   177
    180   !20;
160   125   1.7   3.1   0     169   173   179   179   177
    180   !21;
312   277   171   169   169   0     4     10    10    9    14
    !39;
316   281   175   173   173   4     0     9.5   9.8   8.1
    13.2 !40;
```

```

321  287  180  179  179  10  9.5  0  0.9  1.9  9.5
      !41;
321  287  181  179  179  10  9.8  0.9  0  1.7
      10.3  !42;
320  285  179  177  177  9  8.1  1.9  1.7  0
      11.1  !43;
323  289  182  180  180  14  13.2  9.5  10.3  11.1  0;
      !49;

```

```

durasi =
0      59.16 193.2 192  192  374.4 379.2 385.2 385.2 384
      387.6
59.16 0      151.2 150  150  332.4 337.2 344.4 344.4 342
      346.8
193.2 151.2 0      6.48 2.04 205.2 210  216  217.2 214.8
      218.4
192  150  6.48 0      3.72 202.8 207.6 214.8 214.8 212.4
      216
192  150  2.04 3.72 0      202.8 207.6 214.8 214.8 212.4
      216
374.4 332.4 205.2 202.8 202.8 0      4.8  12  12  10.8
      16.8
379.2 337.2 210  207.6 207.6 4.8  0      11.4  11.76 9.72
      15.84
385.2 344.4 216  214.8 214.8 12  11.4  0  1.08 2.28
      11.4
385.2 344.4 217.2 214.8 214.8 12  11.76 1.08 0  2.04
      12.36
384  342  214.8 212.4 212.4 10.8  9.72 2.28 2.04 0
      13.32
387.6 346.8 218.4 216  216  16.8  15.84 11.4 12.36 13.32 0;

```

```

Bongkar= 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;
MIN =

```

```

    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```


➤ Hasil dari *solution report* pada *cluster 5* analisis sensitivitas

Global optimal solution found.

Objective value: 696.3000
 Objective bound: 696.3000
 Infeasibilities: 0.000000
 Extended solver steps: 43830
 Total solver iterations: 353562
 Elapsed runtime seconds: 33.80

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 49.3 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 126 km
 rute pengiriman dari ritel 3 ke ritel 5 sebesar 1.7 km
 rute pengiriman dari ritel 4 ke ritel 11 sebesar 180 km
 rute pengiriman dari ritel 5 ke ritel 4 sebesar 3.1 km
 rute pengiriman dari ritel 6 ke ritel 1 sebesar 312 km
 rute pengiriman dari ritel 7 ke ritel 6 sebesar 4 km
 rute pengiriman dari ritel 8 ke ritel 9 sebesar 0.9 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 1.7 km
 rute pengiriman dari ritel 10 ke ritel 7 sebesar 8.1 km
 rute pengiriman dari ritel 11 ke ritel 8 sebesar 9.5 km

Model Class: MILP

Total variables: 132
 Nonlinear variables: 0
 Integer variables: 121
 Total constraints: 154
 Nonlinear constraints: 0
 Total nonzeros: 780
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000

BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
T(1)	1647.600	0.000000
T(2)	540.0000	0.000000
T(3)	721.2000	0.000000
T(4)	786.9600	0.000000
T(5)	753.2400	0.000000
T(6)	1230.000	0.000000
T(7)	1195.200	0.000000
T(8)	1074.360	0.000000
T(9)	1123.440	0.000000
T(10)	1155.480	0.000000
T(11)	1032.960	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	49.30000
X(1, 3)	0.000000	161.0000
X(1, 4)	0.000000	160.0000
X(1, 5)	0.000000	160.0000

X(1, 6)	0.000000	312.0000
X(1, 7)	0.000000	316.0000
X(1, 8)	0.000000	321.0000
X(1, 9)	0.000000	321.0000
X(1, 10)	0.000000	320.0000
X(1, 11)	0.000000	323.0000
X(2, 1)	0.000000	49.30000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	126.0000
X(2, 4)	0.000000	125.0000
X(2, 5)	0.000000	125.0000
X(2, 6)	0.000000	277.0000
X(2, 7)	0.000000	281.0000
X(2, 8)	0.000000	287.0000
X(2, 9)	0.000000	287.0000
X(2, 10)	0.000000	285.0000
X(2, 11)	0.000000	289.0000
X(3, 1)	0.000000	161.0000
X(3, 2)	0.000000	126.0000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	5.400000
X(3, 5)	1.000000	1.700000
X(3, 6)	0.000000	171.0000
X(3, 7)	0.000000	175.0000
X(3, 8)	0.000000	180.0000
X(3, 9)	0.000000	181.0000
X(3, 10)	0.000000	179.0000
X(3, 11)	0.000000	182.0000
X(4, 1)	0.000000	160.0000
X(4, 2)	0.000000	125.0000
X(4, 3)	0.000000	5.400000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	3.100000
X(4, 6)	0.000000	169.0000
X(4, 7)	0.000000	173.0000
X(4, 8)	0.000000	179.0000
X(4, 9)	0.000000	179.0000
X(4, 10)	0.000000	177.0000
X(4, 11)	1.000000	180.0000
X(5, 1)	0.000000	160.0000
X(5, 2)	0.000000	125.0000
X(5, 3)	0.000000	1.700000
X(5, 4)	1.000000	3.100000
X(5, 5)	0.000000	0.000000

X(5, 6)	0.000000	169.0000
X(5, 7)	0.000000	173.0000
X(5, 8)	0.000000	179.0000
X(5, 9)	0.000000	179.0000
X(5, 10)	0.000000	177.0000
X(5, 11)	0.000000	180.0000
X(6, 1)	1.000000	312.0000
X(6, 2)	0.000000	277.0000
X(6, 3)	0.000000	171.0000
X(6, 4)	0.000000	169.0000
X(6, 5)	0.000000	169.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	4.000000
X(6, 8)	0.000000	10.00000
X(6, 9)	0.000000	10.00000
X(6, 10)	0.000000	9.000000
X(6, 11)	0.000000	14.00000
X(7, 1)	0.000000	316.0000
X(7, 2)	0.000000	281.0000
X(7, 3)	0.000000	175.0000
X(7, 4)	0.000000	173.0000
X(7, 5)	0.000000	173.0000
X(7, 6)	1.000000	4.000000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	9.500000
X(7, 9)	0.000000	9.800000
X(7, 10)	0.000000	8.100000
X(7, 11)	0.000000	13.20000
X(8, 1)	0.000000	321.0000
X(8, 2)	0.000000	287.0000
X(8, 3)	0.000000	180.0000
X(8, 4)	0.000000	179.0000
X(8, 5)	0.000000	179.0000
X(8, 6)	0.000000	10.00000
X(8, 7)	0.000000	9.500000
X(8, 8)	0.000000	0.000000
X(8, 9)	1.000000	0.9000000
X(8, 10)	0.000000	1.900000
X(8, 11)	0.000000	9.500000
X(9, 1)	0.000000	321.0000
X(9, 2)	0.000000	287.0000
X(9, 3)	0.000000	181.0000
X(9, 4)	0.000000	179.0000
X(9, 5)	0.000000	179.0000

X(9, 6)	0.000000	10.00000
X(9, 7)	0.000000	9.800000
X(9, 8)	0.000000	0.9000000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	1.700000
X(9, 11)	0.000000	10.30000
X(10, 1)	0.000000	320.0000
X(10, 2)	0.000000	285.0000
X(10, 3)	0.000000	179.0000
X(10, 4)	0.000000	177.0000
X(10, 5)	0.000000	177.0000
X(10, 6)	0.000000	9.000000
X(10, 7)	1.000000	8.100000
X(10, 8)	0.000000	1.900000
X(10, 9)	0.000000	1.700000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	11.10000
X(11, 1)	0.000000	323.0000
X(11, 2)	0.000000	289.0000
X(11, 3)	0.000000	182.0000
X(11, 4)	0.000000	180.0000
X(11, 5)	0.000000	180.0000
X(11, 6)	0.000000	14.00000
X(11, 7)	0.000000	13.20000
X(11, 8)	1.000000	9.500000
X(11, 9)	0.000000	10.30000
X(11, 10)	0.000000	11.10000
X(11, 11)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	49.30000	0.000000
D(1, 3)	161.0000	0.000000
D(1, 4)	160.0000	0.000000
D(1, 5)	160.0000	0.000000
D(1, 6)	312.0000	0.000000
D(1, 7)	316.0000	0.000000
D(1, 8)	321.0000	0.000000
D(1, 9)	321.0000	0.000000
D(1, 10)	320.0000	0.000000
D(1, 11)	323.0000	0.000000
D(2, 1)	49.30000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	126.0000	0.000000
D(2, 4)	125.0000	0.000000
D(2, 5)	125.0000	0.000000

D(2, 6)	277.0000	0.000000
D(2, 7)	281.0000	0.000000
D(2, 8)	287.0000	0.000000
D(2, 9)	287.0000	0.000000
D(2, 10)	285.0000	0.000000
D(2, 11)	289.0000	0.000000
D(3, 1)	161.0000	0.000000
D(3, 2)	126.0000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	5.400000	0.000000
D(3, 5)	1.700000	0.000000
D(3, 6)	171.0000	0.000000
D(3, 7)	175.0000	0.000000
D(3, 8)	180.0000	0.000000
D(3, 9)	181.0000	0.000000
D(3, 10)	179.0000	0.000000
D(3, 11)	182.0000	0.000000
D(4, 1)	160.0000	0.000000
D(4, 2)	125.0000	0.000000
D(4, 3)	5.400000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	3.100000	0.000000
D(4, 6)	169.0000	0.000000
D(4, 7)	173.0000	0.000000
D(4, 8)	179.0000	0.000000
D(4, 9)	179.0000	0.000000
D(4, 10)	177.0000	0.000000
D(4, 11)	180.0000	0.000000
D(5, 1)	160.0000	0.000000
D(5, 2)	125.0000	0.000000
D(5, 3)	1.700000	0.000000
D(5, 4)	3.100000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	169.0000	0.000000
D(5, 7)	173.0000	0.000000
D(5, 8)	179.0000	0.000000
D(5, 9)	179.0000	0.000000
D(5, 10)	177.0000	0.000000
D(5, 11)	180.0000	0.000000
D(6, 1)	312.0000	0.000000
D(6, 2)	277.0000	0.000000
D(6, 3)	171.0000	0.000000
D(6, 4)	169.0000	0.000000
D(6, 5)	169.0000	0.000000

D(6, 6)	0.000000	0.000000
D(6, 7)	4.000000	0.000000
D(6, 8)	10.00000	0.000000
D(6, 9)	10.00000	0.000000
D(6, 10)	9.000000	0.000000
D(6, 11)	14.00000	0.000000
D(7, 1)	316.0000	0.000000
D(7, 2)	281.0000	0.000000
D(7, 3)	175.0000	0.000000
D(7, 4)	173.0000	0.000000
D(7, 5)	173.0000	0.000000
D(7, 6)	4.000000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	9.500000	0.000000
D(7, 9)	9.800000	0.000000
D(7, 10)	8.100000	0.000000
D(7, 11)	13.20000	0.000000
D(8, 1)	321.0000	0.000000
D(8, 2)	287.0000	0.000000
D(8, 3)	180.0000	0.000000
D(8, 4)	179.0000	0.000000
D(8, 5)	179.0000	0.000000
D(8, 6)	10.00000	0.000000
D(8, 7)	9.500000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	0.9000000	0.000000
D(8, 10)	1.900000	0.000000
D(8, 11)	9.500000	0.000000
D(9, 1)	321.0000	0.000000
D(9, 2)	287.0000	0.000000
D(9, 3)	181.0000	0.000000
D(9, 4)	179.0000	0.000000
D(9, 5)	179.0000	0.000000
D(9, 6)	10.00000	0.000000
D(9, 7)	9.800000	0.000000
D(9, 8)	0.9000000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	1.700000	0.000000
D(9, 11)	10.30000	0.000000
D(10, 1)	320.0000	0.000000
D(10, 2)	285.0000	0.000000
D(10, 3)	179.0000	0.000000
D(10, 4)	177.0000	0.000000
D(10, 5)	177.0000	0.000000

D(10, 6)	9.000000	0.000000
D(10, 7)	8.100000	0.000000
D(10, 8)	1.900000	0.000000
D(10, 9)	1.700000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	11.10000	0.000000
D(11, 1)	323.0000	0.000000
D(11, 2)	289.0000	0.000000
D(11, 3)	182.0000	0.000000
D(11, 4)	180.0000	0.000000
D(11, 5)	180.0000	0.000000
D(11, 6)	14.00000	0.000000
D(11, 7)	13.20000	0.000000
D(11, 8)	9.500000	0.000000
D(11, 9)	10.30000	0.000000
D(11, 10)	11.10000	0.000000
D(11, 11)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	59.16000	0.000000
DURASI(1, 3)	193.2000	0.000000
DURASI(1, 4)	192.0000	0.000000
DURASI(1, 5)	192.0000	0.000000
DURASI(1, 6)	374.4000	0.000000
DURASI(1, 7)	379.2000	0.000000
DURASI(1, 8)	385.2000	0.000000
DURASI(1, 9)	385.2000	0.000000
DURASI(1, 10)	384.0000	0.000000
DURASI(1, 11)	387.6000	0.000000
DURASI(2, 1)	59.16000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	151.2000	0.000000
DURASI(2, 4)	150.0000	0.000000
DURASI(2, 5)	150.0000	0.000000
DURASI(2, 6)	332.4000	0.000000
DURASI(2, 7)	337.2000	0.000000
DURASI(2, 8)	344.4000	0.000000
DURASI(2, 9)	344.4000	0.000000
DURASI(2, 10)	342.0000	0.000000
DURASI(2, 11)	346.8000	0.000000
DURASI(3, 1)	193.2000	0.000000
DURASI(3, 2)	151.2000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	6.480000	0.000000
DURASI(3, 5)	2.040000	0.000000

DURASI(3, 6)	205.2000	0.000000
DURASI(3, 7)	210.0000	0.000000
DURASI(3, 8)	216.0000	0.000000
DURASI(3, 9)	217.2000	0.000000
DURASI(3, 10)	214.8000	0.000000
DURASI(3, 11)	218.4000	0.000000
DURASI(4, 1)	192.0000	0.000000
DURASI(4, 2)	150.0000	0.000000
DURASI(4, 3)	6.480000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	3.720000	0.000000
DURASI(4, 6)	202.8000	0.000000
DURASI(4, 7)	207.6000	0.000000
DURASI(4, 8)	214.8000	0.000000
DURASI(4, 9)	214.8000	0.000000
DURASI(4, 10)	212.4000	0.000000
DURASI(4, 11)	216.0000	0.000000
DURASI(5, 1)	192.0000	0.000000
DURASI(5, 2)	150.0000	0.000000
DURASI(5, 3)	2.040000	0.000000
DURASI(5, 4)	3.720000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	202.8000	0.000000
DURASI(5, 7)	207.6000	0.000000
DURASI(5, 8)	214.8000	0.000000
DURASI(5, 9)	214.8000	0.000000
DURASI(5, 10)	212.4000	0.000000
DURASI(5, 11)	216.0000	0.000000
DURASI(6, 1)	374.4000	0.000000
DURASI(6, 2)	332.4000	0.000000
DURASI(6, 3)	205.2000	0.000000
DURASI(6, 4)	202.8000	0.000000
DURASI(6, 5)	202.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.800000	0.000000
DURASI(6, 8)	12.00000	0.000000
DURASI(6, 9)	12.00000	0.000000
DURASI(6, 10)	10.80000	0.000000
DURASI(6, 11)	16.80000	0.000000
DURASI(7, 1)	379.2000	0.000000
DURASI(7, 2)	337.2000	0.000000
DURASI(7, 3)	210.0000	0.000000
DURASI(7, 4)	207.6000	0.000000
DURASI(7, 5)	207.6000	0.000000

DURASI(7, 6)	4.800000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	11.40000	0.000000
DURASI(7, 9)	11.76000	0.000000
DURASI(7, 10)	9.720000	0.000000
DURASI(7, 11)	15.84000	0.000000
DURASI(8, 1)	385.2000	0.000000
DURASI(8, 2)	344.4000	0.000000
DURASI(8, 3)	216.0000	0.000000
DURASI(8, 4)	214.8000	0.000000
DURASI(8, 5)	214.8000	0.000000
DURASI(8, 6)	12.00000	0.000000
DURASI(8, 7)	11.40000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	1.080000	0.000000
DURASI(8, 10)	2.280000	0.000000
DURASI(8, 11)	11.40000	0.000000
DURASI(9, 1)	385.2000	0.000000
DURASI(9, 2)	344.4000	0.000000
DURASI(9, 3)	217.2000	0.000000
DURASI(9, 4)	214.8000	0.000000
DURASI(9, 5)	214.8000	0.000000
DURASI(9, 6)	12.00000	0.000000
DURASI(9, 7)	11.76000	0.000000
DURASI(9, 8)	1.080000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	2.040000	0.000000
DURASI(9, 11)	12.36000	0.000000
DURASI(10, 1)	384.0000	0.000000
DURASI(10, 2)	342.0000	0.000000
DURASI(10, 3)	214.8000	0.000000
DURASI(10, 4)	212.4000	0.000000
DURASI(10, 5)	212.4000	0.000000
DURASI(10, 6)	10.80000	0.000000
DURASI(10, 7)	9.720000	0.000000
DURASI(10, 8)	2.280000	0.000000
DURASI(10, 9)	2.040000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	13.32000	0.000000
DURASI(11, 1)	387.6000	0.000000
DURASI(11, 2)	346.8000	0.000000
DURASI(11, 3)	218.4000	0.000000
DURASI(11, 4)	216.0000	0.000000
DURASI(11, 5)	216.0000	0.000000

DURASI(11, 6)	16.80000	0.000000
DURASI(11, 7)	15.84000	0.000000
DURASI(11, 8)	11.40000	0.000000
DURASI(11, 9)	12.36000	0.000000
DURASI(11, 10)	13.32000	0.000000
DURASI(11, 11)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 6* analisis sensitivitas skenario 1

model:

```
!parameter model:
    Buka           = waktu buka ritel
    Tutup          = waktu tutup ritel
    Bongkar        = waktu loading/unloading di ritel
    D              = jarak antar ritel
    T              = waktu memulai pelayanan pada ritel
    Durasi         = Durasi pengiriman
    R              = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..8/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 540 540 540;
tutup = 1020 660 1260 1260 1260 1260 1260 1260;
```

D =

```
!ritel
!0    4    17    18    22    23    24    28;
0     12.3  115   115   193   102   93    157   !0;
12.3  0     120   121   198   83.1  75.1  148   !4;
115   120   0     1.1   96.1  83    96.4  45.8  !17;
115   121   1.1   0     95    84.5  97.8  46    !18;
193   198   96.1  95    0     194   266   103   !22;
102   83.1  83    84.5  194   0     14.9  75.3  !23;
93    75.1  96.4  97.8  266   14.9  0     76.6  !24;
157   148   45.8  46    103   75.3  76.6  0;    !28;
```

durasi =

```
0     14.76  138   138   231.6  122.4  111.6  188.4
14.76 0     144   145.2  237.6  99.72  90.12  177.6
138   144   0     1.32  115.32  99.6   115.68  54.96
138   145.2  1.32  0     114    101.4  117.36  55.2
231.6 237.6  115.32  114   0     232.8  319.2  123.6
122.4 99.72  99.6   101.4  232.8  0     17.88  90.36
```

```

111.6 90.12 115.68      117.36      319.2 17.88 0      91.92
188.4 177.6 54.96 55.2  123.6 90.36 91.92 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

```

```

!Fungsi batasan;

```

```

!setiap ritel dikunjungi satu kali;

```

```

@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

```

```

!perjalanan diawali dari depot;

```

```

@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

```

```

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

```

```

!pelaksanaan;

```

```

@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

```

```

!rute;

```

```

@FOR (ritel (z) :

```

```

        @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
    );

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 6* analisis sensitivitas

Global optimal solution found.

Objective value:	491.7000
Objective bound:	491.7000
Infeasibilities:	0.000000
Extended solver steps:	183
Total solver iterations:	4359
Elapsed runtime seconds:	0.36

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 12.3 km
rute pengiriman dari ritel 2 ke ritel 7 sebesar 75.1 km
rute pengiriman dari ritel 3 ke ritel 1 sebesar 115 km
rute pengiriman dari ritel 4 ke ritel 3 sebesar 1.1 km
rute pengiriman dari ritel 5 ke ritel 4 sebesar 95 km
rute pengiriman dari ritel 6 ke ritel 8 sebesar 75.3 km
rute pengiriman dari ritel 7 ke ritel 6 sebesar 14.9 km
rute pengiriman dari ritel 8 ke ritel 5 sebesar 103 km

Model Class: MILP

Total variables:	72
Nonlinear variables:	0
Integer variables:	64

Total constraints:	88
--------------------	----

Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
T(1)	1491.600	0.000000
T(2)	540.0000	0.000000
T(3)	1230.000	0.000000
T(4)	1125.960	0.000000
T(5)	981.9600	0.000000
T(6)	708.0000	0.000000
T(7)	660.1200	0.000000
T(8)	828.3600	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	12.30000
X(1, 3)	0.000000	115.0000

X(1, 4)	0.000000	115.0000
X(1, 5)	0.000000	193.0000
X(1, 6)	0.000000	102.0000
X(1, 7)	0.000000	93.00000
X(1, 8)	0.000000	157.0000
X(2, 1)	0.000000	12.30000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	120.0000
X(2, 4)	0.000000	121.0000
X(2, 5)	0.000000	198.0000
X(2, 6)	0.000000	83.10000
X(2, 7)	1.000000	75.10000
X(2, 8)	0.000000	148.0000
X(3, 1)	1.000000	115.0000
X(3, 2)	0.000000	120.0000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	1.100000
X(3, 5)	0.000000	96.10000
X(3, 6)	0.000000	83.00000
X(3, 7)	0.000000	96.40000
X(3, 8)	0.000000	45.80000
X(4, 1)	0.000000	115.0000
X(4, 2)	0.000000	121.0000
X(4, 3)	1.000000	1.100000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	95.00000
X(4, 6)	0.000000	84.50000
X(4, 7)	0.000000	97.80000
X(4, 8)	0.000000	46.00000
X(5, 1)	0.000000	193.0000
X(5, 2)	0.000000	198.0000
X(5, 3)	0.000000	96.10000
X(5, 4)	1.000000	95.00000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	194.0000
X(5, 7)	0.000000	266.0000
X(5, 8)	0.000000	103.0000
X(6, 1)	0.000000	102.0000
X(6, 2)	0.000000	83.10000
X(6, 3)	0.000000	83.00000
X(6, 4)	0.000000	84.50000
X(6, 5)	0.000000	194.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	14.90000

X(6, 8)	1.000000	75.30000
X(7, 1)	0.000000	93.00000
X(7, 2)	0.000000	75.10000
X(7, 3)	0.000000	96.40000
X(7, 4)	0.000000	97.80000
X(7, 5)	0.000000	266.0000
X(7, 6)	1.000000	14.90000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	76.60000
X(8, 1)	0.000000	157.0000
X(8, 2)	0.000000	148.0000
X(8, 3)	0.000000	45.80000
X(8, 4)	0.000000	46.00000
X(8, 5)	1.000000	103.0000
X(8, 6)	0.000000	75.30000
X(8, 7)	0.000000	76.60000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	12.30000	0.000000
D(1, 3)	115.0000	0.000000
D(1, 4)	115.0000	0.000000
D(1, 5)	193.0000	0.000000
D(1, 6)	102.0000	0.000000
D(1, 7)	93.00000	0.000000
D(1, 8)	157.0000	0.000000
D(2, 1)	12.30000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	120.0000	0.000000
D(2, 4)	121.0000	0.000000
D(2, 5)	198.0000	0.000000
D(2, 6)	83.10000	0.000000
D(2, 7)	75.10000	0.000000
D(2, 8)	148.0000	0.000000
D(3, 1)	115.0000	0.000000
D(3, 2)	120.0000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	1.100000	0.000000
D(3, 5)	96.10000	0.000000
D(3, 6)	83.00000	0.000000
D(3, 7)	96.40000	0.000000
D(3, 8)	45.80000	0.000000
D(4, 1)	115.0000	0.000000
D(4, 2)	121.0000	0.000000
D(4, 3)	1.100000	0.000000

D(4, 4)	0.000000	0.000000
D(4, 5)	95.00000	0.000000
D(4, 6)	84.50000	0.000000
D(4, 7)	97.80000	0.000000
D(4, 8)	46.00000	0.000000
D(5, 1)	193.0000	0.000000
D(5, 2)	198.0000	0.000000
D(5, 3)	96.10000	0.000000
D(5, 4)	95.00000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	194.0000	0.000000
D(5, 7)	266.0000	0.000000
D(5, 8)	103.0000	0.000000
D(6, 1)	102.0000	0.000000
D(6, 2)	83.10000	0.000000
D(6, 3)	83.00000	0.000000
D(6, 4)	84.50000	0.000000
D(6, 5)	194.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	14.90000	0.000000
D(6, 8)	75.30000	0.000000
D(7, 1)	93.00000	0.000000
D(7, 2)	75.10000	0.000000
D(7, 3)	96.40000	0.000000
D(7, 4)	97.80000	0.000000
D(7, 5)	266.0000	0.000000
D(7, 6)	14.90000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	76.60000	0.000000
D(8, 1)	157.0000	0.000000
D(8, 2)	148.0000	0.000000
D(8, 3)	45.80000	0.000000
D(8, 4)	46.00000	0.000000
D(8, 5)	103.0000	0.000000
D(8, 6)	75.30000	0.000000
D(8, 7)	76.60000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	14.76000	0.000000
DURASI(1, 3)	138.0000	0.000000
DURASI(1, 4)	138.0000	0.000000
DURASI(1, 5)	231.6000	0.000000
DURASI(1, 6)	122.4000	0.000000
DURASI(1, 7)	111.6000	0.000000

DURASI(1, 8)	188.4000	0.000000
DURASI(2, 1)	14.76000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	144.0000	0.000000
DURASI(2, 4)	145.2000	0.000000
DURASI(2, 5)	237.6000	0.000000
DURASI(2, 6)	99.72000	0.000000
DURASI(2, 7)	90.12000	0.000000
DURASI(2, 8)	177.6000	0.000000
DURASI(3, 1)	138.0000	0.000000
DURASI(3, 2)	144.0000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	1.320000	0.000000
DURASI(3, 5)	115.3200	0.000000
DURASI(3, 6)	99.60000	0.000000
DURASI(3, 7)	115.6800	0.000000
DURASI(3, 8)	54.96000	0.000000
DURASI(4, 1)	138.0000	0.000000
DURASI(4, 2)	145.2000	0.000000
DURASI(4, 3)	1.320000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	114.0000	0.000000
DURASI(4, 6)	101.4000	0.000000
DURASI(4, 7)	117.3600	0.000000
DURASI(4, 8)	55.20000	0.000000
DURASI(5, 1)	231.6000	0.000000
DURASI(5, 2)	237.6000	0.000000
DURASI(5, 3)	115.3200	0.000000
DURASI(5, 4)	114.0000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	232.8000	0.000000
DURASI(5, 7)	319.2000	0.000000
DURASI(5, 8)	123.6000	0.000000
DURASI(6, 1)	122.4000	0.000000
DURASI(6, 2)	99.72000	0.000000
DURASI(6, 3)	99.60000	0.000000
DURASI(6, 4)	101.4000	0.000000
DURASI(6, 5)	232.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	17.88000	0.000000
DURASI(6, 8)	90.36000	0.000000
DURASI(7, 1)	111.6000	0.000000
DURASI(7, 2)	90.12000	0.000000
DURASI(7, 3)	115.6800	0.000000

DURASI(7, 4)	117.3600	0.000000
DURASI(7, 5)	319.2000	0.000000
DURASI(7, 6)	17.88000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	91.92000	0.000000
DURASI(8, 1)	188.4000	0.000000
DURASI(8, 2)	177.6000	0.000000
DURASI(8, 3)	54.96000	0.000000
DURASI(8, 4)	55.20000	0.000000
DURASI(8, 5)	123.6000	0.000000
DURASI(8, 6)	90.36000	0.000000
DURASI(8, 7)	91.92000	0.000000
DURASI(8, 8)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 7* analisis sensitivitas skenario 1

model:

```
!parameter model:
    Buka           = waktu buka ritel
    Tutup          = waktu tutup ritel
    Bongkar        = waktu loading/unloading di ritel
    D              = jarak antar ritel
    T              = waktu memulai pelayanan pada ritel
    Durasi         = Durasi pengiriman
    R              = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..8/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 540 540 540;
tutup = 1020 660 1260 1260 1260 1260 1260 1260;
```

D =

```
!ritel
!0    12    13    14    15    25    26    27;
0     146   190   192   194   92.2  93.8  93    !0;
146   0     63.4  64.1  66.9  157   159   158   !12;
190   63.4  0     3.2   5.9   200   201   201   !13;
192   64.1  3.2   0     2.9   203   205   204   !14;
194   66.9  5.9   2.9   0     204   206   205   !15;
92.2  157   200   203   204   0     3.1   1.4   !25;
93.8  159   201   205   206   3.1   0     4     !26;
93    158   201   204   205   1.4   4     0;    !27;
```

durasi =

```
0     175.2  228   230.4  232.8  110.64      112.56      111.6
175.2 0     76.08  76.92  80.28  188.4  190.8  189.6
228   76.08 0     3.84   7.08   240   241.2  241.2
230.4 76.92 3.84  0     3.48   243.6  246   244.8
232.8 80.28 7.08  3.48  0     244.8  247.2  246
110.64      188.4  240   243.6  244.8  0     3.72  1.68
```

```

112.56      190.8 241.2 246      247.2 3.72 0      4.8
111.6 189.6 241.2 244.8 246      1.68 4.8 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

```

```

!Fungsi batasan;

```

```

!setiap ritel dikunjungi satu kali;

```

```

@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

```

```

!perjalanan diawali dari depot;

```

```

@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

```

```

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

```

```

!pelaksanaan;

```

```

@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

```

```

!rute;

```

```

@FOR (ritel (z) :

```

```

        @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
    );

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

- Hasil dari *solution report* pada *cluster 7* analisis sensitivitas

Global optimal solution found.

Objective value:	517.4000
Objective bound:	517.4000
Infeasibilities:	0.000000
Extended solver steps:	45
Total solver iterations:	807
Elapsed runtime seconds:	0.14

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 146 km
rute pengiriman dari ritel 2 ke ritel 4 sebesar 64.09999999999999 km
rute pengiriman dari ritel 3 ke ritel 7 sebesar 201 km
rute pengiriman dari ritel 4 ke ritel 5 sebesar 2.9 km
rute pengiriman dari ritel 5 ke ritel 3 sebesar 5.9 km
rute pengiriman dari ritel 6 ke ritel 8 sebesar 1.4 km
rute pengiriman dari ritel 7 ke ritel 6 sebesar 3.1 km
rute pengiriman dari ritel 8 ke ritel 1 sebesar 93 km

Model Class: MILP

Total variables:	72
Nonlinear variables:	0
Integer variables:	64

Total constraints:	88
--------------------	----

Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
T(1)	1492.800	0.000000
T(2)	540.0000	0.000000
T(3)	717.4800	0.000000
T(4)	646.9200	0.000000
T(5)	680.4000	0.000000
T(6)	1198.320	0.000000
T(7)	988.6800	0.000000
T(8)	1230.000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	146.0000
X(1, 3)	0.000000	190.0000

X(1, 4)	0.000000	192.0000
X(1, 5)	0.000000	194.0000
X(1, 6)	0.000000	92.20000
X(1, 7)	0.000000	93.80000
X(1, 8)	0.000000	93.00000
X(2, 1)	0.000000	146.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	63.40000
X(2, 4)	1.000000	64.10000
X(2, 5)	0.000000	66.90000
X(2, 6)	0.000000	157.0000
X(2, 7)	0.000000	159.0000
X(2, 8)	0.000000	158.0000
X(3, 1)	0.000000	190.0000
X(3, 2)	0.000000	63.40000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	3.200000
X(3, 5)	0.000000	5.900000
X(3, 6)	0.000000	200.0000
X(3, 7)	1.000000	201.0000
X(3, 8)	0.000000	201.0000
X(4, 1)	0.000000	192.0000
X(4, 2)	0.000000	64.10000
X(4, 3)	0.000000	3.200000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	2.900000
X(4, 6)	0.000000	203.0000
X(4, 7)	0.000000	205.0000
X(4, 8)	0.000000	204.0000
X(5, 1)	0.000000	194.0000
X(5, 2)	0.000000	66.90000
X(5, 3)	1.000000	5.900000
X(5, 4)	0.000000	2.900000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	204.0000
X(5, 7)	0.000000	206.0000
X(5, 8)	0.000000	205.0000
X(6, 1)	0.000000	92.20000
X(6, 2)	0.000000	157.0000
X(6, 3)	0.000000	200.0000
X(6, 4)	0.000000	203.0000
X(6, 5)	0.000000	204.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.100000

X(6, 8)	1.000000	1.400000
X(7, 1)	0.000000	93.80000
X(7, 2)	0.000000	159.0000
X(7, 3)	0.000000	201.0000
X(7, 4)	0.000000	205.0000
X(7, 5)	0.000000	206.0000
X(7, 6)	1.000000	3.100000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	4.000000
X(8, 1)	1.000000	93.00000
X(8, 2)	0.000000	158.0000
X(8, 3)	0.000000	201.0000
X(8, 4)	0.000000	204.0000
X(8, 5)	0.000000	205.0000
X(8, 6)	0.000000	1.400000
X(8, 7)	0.000000	4.000000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	146.0000	0.000000
D(1, 3)	190.0000	0.000000
D(1, 4)	192.0000	0.000000
D(1, 5)	194.0000	0.000000
D(1, 6)	92.20000	0.000000
D(1, 7)	93.80000	0.000000
D(1, 8)	93.00000	0.000000
D(2, 1)	146.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	63.40000	0.000000
D(2, 4)	64.10000	0.000000
D(2, 5)	66.90000	0.000000
D(2, 6)	157.0000	0.000000
D(2, 7)	159.0000	0.000000
D(2, 8)	158.0000	0.000000
D(3, 1)	190.0000	0.000000
D(3, 2)	63.40000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	3.200000	0.000000
D(3, 5)	5.900000	0.000000
D(3, 6)	200.0000	0.000000
D(3, 7)	201.0000	0.000000
D(3, 8)	201.0000	0.000000
D(4, 1)	192.0000	0.000000
D(4, 2)	64.10000	0.000000
D(4, 3)	3.200000	0.000000

D(4, 4)	0.000000	0.000000
D(4, 5)	2.900000	0.000000
D(4, 6)	203.0000	0.000000
D(4, 7)	205.0000	0.000000
D(4, 8)	204.0000	0.000000
D(5, 1)	194.0000	0.000000
D(5, 2)	66.90000	0.000000
D(5, 3)	5.900000	0.000000
D(5, 4)	2.900000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	204.0000	0.000000
D(5, 7)	206.0000	0.000000
D(5, 8)	205.0000	0.000000
D(6, 1)	92.20000	0.000000
D(6, 2)	157.0000	0.000000
D(6, 3)	200.0000	0.000000
D(6, 4)	203.0000	0.000000
D(6, 5)	204.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.100000	0.000000
D(6, 8)	1.400000	0.000000
D(7, 1)	93.80000	0.000000
D(7, 2)	159.0000	0.000000
D(7, 3)	201.0000	0.000000
D(7, 4)	205.0000	0.000000
D(7, 5)	206.0000	0.000000
D(7, 6)	3.100000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	4.000000	0.000000
D(8, 1)	93.00000	0.000000
D(8, 2)	158.0000	0.000000
D(8, 3)	201.0000	0.000000
D(8, 4)	204.0000	0.000000
D(8, 5)	205.0000	0.000000
D(8, 6)	1.400000	0.000000
D(8, 7)	4.000000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	175.2000	0.000000
DURASI(1, 3)	228.0000	0.000000
DURASI(1, 4)	230.4000	0.000000
DURASI(1, 5)	232.8000	0.000000
DURASI(1, 6)	110.6400	0.000000
DURASI(1, 7)	112.5600	0.000000

DURASI(1, 8)	111.6000	0.000000
DURASI(2, 1)	175.2000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	76.08000	0.000000
DURASI(2, 4)	76.92000	0.000000
DURASI(2, 5)	80.28000	0.000000
DURASI(2, 6)	188.4000	0.000000
DURASI(2, 7)	190.8000	0.000000
DURASI(2, 8)	189.6000	0.000000
DURASI(3, 1)	228.0000	0.000000
DURASI(3, 2)	76.08000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	3.840000	0.000000
DURASI(3, 5)	7.080000	0.000000
DURASI(3, 6)	240.0000	0.000000
DURASI(3, 7)	241.2000	0.000000
DURASI(3, 8)	241.2000	0.000000
DURASI(4, 1)	230.4000	0.000000
DURASI(4, 2)	76.92000	0.000000
DURASI(4, 3)	3.840000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	3.480000	0.000000
DURASI(4, 6)	243.6000	0.000000
DURASI(4, 7)	246.0000	0.000000
DURASI(4, 8)	244.8000	0.000000
DURASI(5, 1)	232.8000	0.000000
DURASI(5, 2)	80.28000	0.000000
DURASI(5, 3)	7.080000	0.000000
DURASI(5, 4)	3.480000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	244.8000	0.000000
DURASI(5, 7)	247.2000	0.000000
DURASI(5, 8)	246.0000	0.000000
DURASI(6, 1)	110.6400	0.000000
DURASI(6, 2)	188.4000	0.000000
DURASI(6, 3)	240.0000	0.000000
DURASI(6, 4)	243.6000	0.000000
DURASI(6, 5)	244.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	3.720000	0.000000
DURASI(6, 8)	1.680000	0.000000
DURASI(7, 1)	112.5600	0.000000
DURASI(7, 2)	190.8000	0.000000
DURASI(7, 3)	241.2000	0.000000

DURASI(7, 4)	246.0000	0.000000
DURASI(7, 5)	247.2000	0.000000
DURASI(7, 6)	3.720000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	4.800000	0.000000
DURASI(8, 1)	111.6000	0.000000
DURASI(8, 2)	189.6000	0.000000
DURASI(8, 3)	241.2000	0.000000
DURASI(8, 4)	244.8000	0.000000
DURASI(8, 5)	246.0000	0.000000
DURASI(8, 6)	1.680000	0.000000
DURASI(8, 7)	4.800000	0.000000
DURASI(8, 8)	0.000000	0.000000

Lampiran 12 (Pemrograman Lingo Untuk Analisis Sensitivitas Skenario 2)

- Hasil dari *solution report* pada *cluster 1* analisis sensitivitas skenario 2

Global optimal solution found.

Objective value: 54.60000
 Objective bound: 54.60000
 Infeasibilities: 0.000000
 Extended solver steps: 564
 Total solver iterations: 8681
 Elapsed runtime seconds: 0.91

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 8.9 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 6.8 km
 rute pengiriman dari ritel 3 ke ritel 4 sebesar 7.9 km
 rute pengiriman dari ritel 4 ke ritel 5 sebesar 3.9 km
 rute pengiriman dari ritel 5 ke ritel 6 sebesar 2.6 km
 rute pengiriman dari ritel 6 ke ritel 8 sebesar 2.5 km
 rute pengiriman dari ritel 7 ke ritel 1 sebesar 19.2 km
 rute pengiriman dari ritel 8 ke ritel 7 sebesar 2.8 km

Model Class: MILP

Total variables: 72
 Nonlinear variables: 0
 Integer variables: 64
 Total constraints: 88
 Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000

BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	660.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	780.0000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
T(1)	1285.800	0.000000
T(2)	621.8400	0.000000
T(3)	660.0000	0.000000
T(4)	707.6400	0.000000
T(5)	742.3200	0.000000
T(6)	775.4400	0.000000
T(7)	1230.000	0.000000
T(8)	808.4400	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	8.900000
X(1, 3)	0.000000	13.60000
X(1, 4)	0.000000	19.70000
X(1, 5)	0.000000	20.70000
X(1, 6)	0.000000	21.50000
X(1, 7)	0.000000	19.20000
X(1, 8)	0.000000	18.10000
X(2, 1)	0.000000	8.900000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	6.800000
X(2, 4)	0.000000	13.30000
X(2, 5)	0.000000	14.60000
X(2, 6)	0.000000	13.10000
X(2, 7)	0.000000	10.90000
X(2, 8)	0.000000	8.700000
X(3, 1)	0.000000	13.60000
X(3, 2)	0.000000	6.800000

X(3, 3)	0.000000	0.000000
X(3, 4)	1.000000	7.900000
X(3, 5)	0.000000	10.30000
X(3, 6)	0.000000	10.50000
X(3, 7)	0.000000	8.100000
X(3, 8)	0.000000	9.400000
X(4, 1)	0.000000	19.70000
X(4, 2)	0.000000	13.30000
X(4, 3)	0.000000	7.900000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	3.900000
X(4, 6)	0.000000	4.600000
X(4, 7)	0.000000	4.600000
X(4, 8)	0.000000	5.600000
X(5, 1)	0.000000	20.70000
X(5, 2)	0.000000	14.60000
X(5, 3)	0.000000	10.30000
X(5, 4)	0.000000	3.900000
X(5, 5)	0.000000	0.000000
X(5, 6)	1.000000	2.600000
X(5, 7)	0.000000	5.400000
X(5, 8)	0.000000	3.400000
X(6, 1)	0.000000	21.50000
X(6, 2)	0.000000	13.10000
X(6, 3)	0.000000	10.50000
X(6, 4)	0.000000	4.600000
X(6, 5)	0.000000	2.600000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.600000
X(6, 8)	1.000000	2.500000
X(7, 1)	1.000000	19.20000
X(7, 2)	0.000000	10.90000
X(7, 3)	0.000000	8.100000
X(7, 4)	0.000000	4.600000
X(7, 5)	0.000000	5.400000
X(7, 6)	0.000000	3.600000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	2.800000
X(8, 1)	0.000000	18.10000
X(8, 2)	0.000000	8.700000
X(8, 3)	0.000000	9.400000
X(8, 4)	0.000000	5.600000
X(8, 5)	0.000000	3.400000
X(8, 6)	0.000000	2.500000

X(8, 7)	1.000000	2.800000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	8.900000	0.000000
D(1, 3)	13.60000	0.000000
D(1, 4)	19.70000	0.000000
D(1, 5)	20.70000	0.000000
D(1, 6)	21.50000	0.000000
D(1, 7)	19.20000	0.000000
D(1, 8)	18.10000	0.000000
D(2, 1)	8.900000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	6.800000	0.000000
D(2, 4)	13.30000	0.000000
D(2, 5)	14.60000	0.000000
D(2, 6)	13.10000	0.000000
D(2, 7)	10.90000	0.000000
D(2, 8)	8.700000	0.000000
D(3, 1)	13.60000	0.000000
D(3, 2)	6.800000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	7.900000	0.000000
D(3, 5)	10.30000	0.000000
D(3, 6)	10.50000	0.000000
D(3, 7)	8.100000	0.000000
D(3, 8)	9.400000	0.000000
D(4, 1)	19.70000	0.000000
D(4, 2)	13.30000	0.000000
D(4, 3)	7.900000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	3.900000	0.000000
D(4, 6)	4.600000	0.000000
D(4, 7)	4.600000	0.000000
D(4, 8)	5.600000	0.000000
D(5, 1)	20.70000	0.000000
D(5, 2)	14.60000	0.000000
D(5, 3)	10.30000	0.000000
D(5, 4)	3.900000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	2.600000	0.000000
D(5, 7)	5.400000	0.000000
D(5, 8)	3.400000	0.000000
D(6, 1)	21.50000	0.000000
D(6, 2)	13.10000	0.000000

D(6, 3)	10.50000	0.000000
D(6, 4)	4.600000	0.000000
D(6, 5)	2.600000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.600000	0.000000
D(6, 8)	2.500000	0.000000
D(7, 1)	19.20000	0.000000
D(7, 2)	10.90000	0.000000
D(7, 3)	8.100000	0.000000
D(7, 4)	4.600000	0.000000
D(7, 5)	5.400000	0.000000
D(7, 6)	3.600000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	2.800000	0.000000
D(8, 1)	18.10000	0.000000
D(8, 2)	8.700000	0.000000
D(8, 3)	9.400000	0.000000
D(8, 4)	5.600000	0.000000
D(8, 5)	3.400000	0.000000
D(8, 6)	2.500000	0.000000
D(8, 7)	2.800000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	10.68000	0.000000
DURASI(1, 3)	16.32000	0.000000
DURASI(1, 4)	23.64000	0.000000
DURASI(1, 5)	24.84000	0.000000
DURASI(1, 6)	25.80000	0.000000
DURASI(1, 7)	23.04000	0.000000
DURASI(1, 8)	21.72000	0.000000
DURASI(2, 1)	10.68000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	8.160000	0.000000
DURASI(2, 4)	15.96000	0.000000
DURASI(2, 5)	17.52000	0.000000
DURASI(2, 6)	15.72000	0.000000
DURASI(2, 7)	13.08000	0.000000
DURASI(2, 8)	10.44000	0.000000
DURASI(3, 1)	16.32000	0.000000
DURASI(3, 2)	8.160000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	9.480000	0.000000
DURASI(3, 5)	12.36000	0.000000
DURASI(3, 6)	12.60000	0.000000

DURASI(3, 7)	9.720000	0.000000
DURASI(3, 8)	11.28000	0.000000
DURASI(4, 1)	23.64000	0.000000
DURASI(4, 2)	15.96000	0.000000
DURASI(4, 3)	9.480000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	4.680000	0.000000
DURASI(4, 6)	5.520000	0.000000
DURASI(4, 7)	5.520000	0.000000
DURASI(4, 8)	6.720000	0.000000
DURASI(5, 1)	24.84000	0.000000
DURASI(5, 2)	17.52000	0.000000
DURASI(5, 3)	12.36000	0.000000
DURASI(5, 4)	4.680000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	3.120000	0.000000
DURASI(5, 7)	6.480000	0.000000
DURASI(5, 8)	4.080000	0.000000
DURASI(6, 1)	25.80000	0.000000
DURASI(6, 2)	15.72000	0.000000
DURASI(6, 3)	12.60000	0.000000
DURASI(6, 4)	5.520000	0.000000
DURASI(6, 5)	3.120000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.320000	0.000000
DURASI(6, 8)	3.000000	0.000000
DURASI(7, 1)	23.04000	0.000000
DURASI(7, 2)	13.08000	0.000000
DURASI(7, 3)	9.720000	0.000000
DURASI(7, 4)	5.520000	0.000000
DURASI(7, 5)	6.480000	0.000000
DURASI(7, 6)	4.320000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	3.360000	0.000000
DURASI(8, 1)	21.72000	0.000000
DURASI(8, 2)	10.44000	0.000000
DURASI(8, 3)	11.28000	0.000000
DURASI(8, 4)	6.720000	0.000000
DURASI(8, 5)	4.080000	0.000000
DURASI(8, 6)	3.000000	0.000000
DURASI(8, 7)	3.360000	0.000000
DURASI(8, 8)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 2* analisis sensitivitas skenario 2

model:

```
!parameter model:
    Buka           = waktu buka ritel
    Tutup          = waktu tutup ritel
    Bongkar        = waktu loading/unloading di ritel
    D              = jarak antar ritel
    T              = waktu memulai pelayanan pada ritel
    Durasi         = Durasi pengiriman
    R              = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..16/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 660 540 540 540 540 540 540 540 540 540 540
540 540;
tutup = 1020 660 1260 1260 780 1260 1260 1260 1260 1260 1260 1260
1260 1260 1260 1260 1260;
```

D =

```
!ritel
1      2      3      4      5      6      7      8      9      10     11
      12     13     14     15     16
!0     3      6      7      29     30     31     32     50     51     52
      53     54     55     57     60;
0      8.3    41.1   39.6   227    275    324    322    353    353
      351    348    347    347    353    435    !0;
8.3    0      24.4   33     220    268    317    315    346    346
      344    341    341    340    347    428    !3;
41.1   24.4   0      7.5    127    300    208    238    377    377
      376    372    372    372    378    459    !6;
39.6   33     7.5    0      133    297    215    343    374    374
      372    369    369    368    375    456    !7;
```

227	220	127	133	0	85	102	134	230	230	
	228	225	224	224	230	312	!29;			
275	268	300	297	85	0	48	50	71	65	64
	55	71	69	66	166	!30;				
324	317	208	215	102	48	0	28	87	81	80
	81	87	85	82	182	!31;				
322	315	238	343	134	50	28	0	61	55	54
	55	61	59	56	156	!32;				
353	346	377	374	230	71	87	61	0	6.7	5.9
	10	4.8	4.3	7.4	98.2	!50;				
353	346	377	374	230	65	81	55	6.7	0	1.9
	10.3	5.9	4.8	1.8	97.5	!51;				
351	344	376	372	228	64	80	54	5.9	1.9	0
	8.8	9.8	5.3	3.4	100	!52;				
348	341	372	369	225	55	81	55	10	10.3	8.8
	0	10.6	6.2	10.7	105	!53;				
347	341	372	369	224	71	87	61	4.8	5.9	9.8
	10.6	0	4.3	3.5	93.4	!54;				
347	340	372	368	224	69	85	59	4.3	4.8	5.3
	6.2	4.3	0	6.3	101	!55;				
353	347	378	375	230	66	82	56	7.4	1.8	3.4
	10.7	3.5	6.3	0	97.9	!57;				
435	428	459	456	312	166	182	156	98.2	97.5	
	100	105	93.4	101	97.9	0;	!60;			

durasi =

0	9.96	49.32	47.52	272.4	330	388.8	386.4	423.6	423.6	
	421.2	417.6	416.4	416.4	423.6	522				
9.96	0	29.28	39.6	264	321.6	380.4	378	415.2	415.2	
	412.8	409.2	409.2	408	416.4	513.6				
49.32	29.28	0	9	152.4	360	249.6	285.6	452.4	452.4	
	451.2	446.4	446.4	446.4	453.6	550.8				
47.52	39.6	9	0	159.6	356.4	258	411.6	448.8	448.8	
	446.4	442.8	442.8	441.6	450	547.2				
272.4	264	152.4	159.6	0	102	122.4	160.8	276	276	
	273.6	270	268.8	268.8	276	374.4				
330	321.6	360	356.4	102	0	57.6	60	85.2	78	
	76.8	66	85.2	82.8	79.2	199.2				
388.8	380.4	249.6	258	122.4	57.6	0	33.6	104.4	97.2	96
	97.2	104.4	102	98.4	218.4					
386.4	378	285.6	411.6	160.8	60	33.6	0	73.2	66	
	64.8	66	73.2	70.8	67.2	187.2				
423.6	415.2	452.4	448.8	276	85.2	104.4	73.2	0	8.04	
	7.08	12	5.76	5.16	8.88	117.84				

```

423.6 415.2 452.4 448.8 276 78 97.2 66 8.04 0
      2.28 12.36 7.08 5.76 2.16 117
421.2 412.8 451.2 446.4 273.6 76.8 96 64.8 7.08 2.28 0
      10.56 11.76 6.36 4.08 120
417.6 409.2 446.4 442.8 270 66 97.2 66 12 12.36
      10.56 0 12.72 7.44 12.84 126
416.4 409.2 446.4 442.8 268.8 85.2 104.4 73.2 5.76 7.08
      11.76 12.72 0 5.16 4.2 112.08
416.4 408 446.4 441.6 268.8 82.8 102 70.8 5.16 5.76
      6.36 7.44 5.16 0 7.56 121.2
423.6 416.4 453.6 450 276 79.2 98.4 67.2 8.88 2.16
      4.08 12.84 4.2 7.56 0 117.48
522 513.6 550.8 547.2 374.4 199.2 218.4 187.2 117.84
      117 120 126 112.08 121.2 117.48 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) - R * (1 -
x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 2* analisis sensitivitas skenario 2

Feasible solution found.	
Objective value:	997.2000
Objective bound:	579.4000
Infeasibilities:	0.000000
Extended solver steps:	8411
Total solver iterations:	79944
Elapsed runtime seconds:	10.59

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 8.300000000000001 km
rute pengiriman dari ritel 2 ke ritel 4 sebesar 33 km
rute pengiriman dari ritel 3 ke ritel 5 sebesar 127 km
rute pengiriman dari ritel 4 ke ritel 3 sebesar 7.5 km

rute pengiriman dari ritel 5 ke ritel 6 sebesar 85 km
 rute pengiriman dari ritel 6 ke ritel 8 sebesar 50 km
 rute pengiriman dari ritel 7 ke ritel 12 sebesar 81 km
 rute pengiriman dari ritel 8 ke ritel 7 sebesar 28 km
 rute pengiriman dari ritel 9 ke ritel 13 sebesar 4.8 km
 rute pengiriman dari ritel 10 ke ritel 15 sebesar 1.8 km
 rute pengiriman dari ritel 11 ke ritel 16 sebesar 100 km
 rute pengiriman dari ritel 12 ke ritel 14 sebesar 6.2 km
 rute pengiriman dari ritel 13 ke ritel 11 sebesar 9.8000000000000001 km
 rute pengiriman dari ritel 14 ke ritel 9 sebesar 4.3 km
 rute pengiriman dari ritel 15 ke ritel 1 sebesar 353 km
 rute pengiriman dari ritel 16 ke ritel 10 sebesar 97.5 km

Model Class: MILP

Total variables:	272
Nonlinear variables:	0
Integer variables:	256
Total constraints:	304
Nonlinear constraints:	0
Total nonzeros:	1695
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BONGKAR(12)	30.00000	0.000000
BONGKAR(13)	30.00000	0.000000
BONGKAR(14)	30.00000	0.000000
BONGKAR(15)	30.00000	0.000000
BONGKAR(16)	30.00000	0.000000

BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	660.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
BUKA(12)	540.0000	0.000000
BUKA(13)	540.0000	0.000000
BUKA(14)	540.0000	0.000000
BUKA(15)	540.0000	0.000000
BUKA(16)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	780.0000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
TUTUP(12)	1260.000	0.000000
TUTUP(13)	1260.000	0.000000
TUTUP(14)	1260.000	0.000000
TUTUP(15)	1260.000	0.000000
TUTUP(16)	1260.000	0.000000
T(1)	1260.000	0.000000
T(2)	540.0000	0.000000
T(3)	630.0000	0.000000
T(4)	600.0000	0.000000
T(5)	660.0000	0.000000
T(6)	690.0000	0.000000
T(7)	750.0000	0.000000
T(8)	720.0000	0.000000
T(9)	840.0000	0.000000
T(10)	960.0000	0.000000
T(11)	900.0000	0.000000
T(12)	780.0000	0.000000

T(13)	870.0000	0.000000
T(14)	810.0000	0.000000
T(15)	990.0000	0.000000
T(16)	930.0000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	8.300000
X(1, 3)	0.000000	41.10000
X(1, 4)	0.000000	39.60000
X(1, 5)	0.000000	227.0000
X(1, 6)	0.000000	275.0000
X(1, 7)	0.000000	324.0000
X(1, 8)	0.000000	322.0000
X(1, 9)	0.000000	353.0000
X(1, 10)	0.000000	353.0000
X(1, 11)	0.000000	351.0000
X(1, 12)	0.000000	348.0000
X(1, 13)	0.000000	347.0000
X(1, 14)	0.000000	347.0000
X(1, 15)	0.000000	353.0000
X(1, 16)	0.000000	435.0000
X(2, 1)	0.000000	8.300000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	24.40000
X(2, 4)	1.000000	33.00000
X(2, 5)	0.000000	220.0000
X(2, 6)	0.000000	268.0000
X(2, 7)	0.000000	317.0000
X(2, 8)	0.000000	315.0000
X(2, 9)	0.000000	346.0000
X(2, 10)	0.000000	346.0000
X(2, 11)	0.000000	344.0000
X(2, 12)	0.000000	341.0000
X(2, 13)	0.000000	341.0000
X(2, 14)	0.000000	340.0000
X(2, 15)	0.000000	347.0000
X(2, 16)	0.000000	428.0000
X(3, 1)	0.000000	41.10000
X(3, 2)	0.000000	24.40000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	7.500000
X(3, 5)	1.000000	127.0000
X(3, 6)	0.000000	300.0000
X(3, 7)	0.000000	208.0000
X(3, 8)	0.000000	238.0000

X(3, 9)	0.000000	377.0000
X(3, 10)	0.000000	377.0000
X(3, 11)	0.000000	376.0000
X(3, 12)	0.000000	372.0000
X(3, 13)	0.000000	372.0000
X(3, 14)	0.000000	372.0000
X(3, 15)	0.000000	378.0000
X(3, 16)	0.000000	459.0000
X(4, 1)	0.000000	39.60000
X(4, 2)	0.000000	33.00000
X(4, 3)	1.000000	7.500000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	133.0000
X(4, 6)	0.000000	297.0000
X(4, 7)	0.000000	215.0000
X(4, 8)	0.000000	343.0000
X(4, 9)	0.000000	374.0000
X(4, 10)	0.000000	374.0000
X(4, 11)	0.000000	372.0000
X(4, 12)	0.000000	369.0000
X(4, 13)	0.000000	369.0000
X(4, 14)	0.000000	368.0000
X(4, 15)	0.000000	375.0000
X(4, 16)	0.000000	456.0000
X(5, 1)	0.000000	227.0000
X(5, 2)	0.000000	220.0000
X(5, 3)	0.000000	127.0000
X(5, 4)	0.000000	133.0000
X(5, 5)	0.000000	0.000000
X(5, 6)	1.000000	85.00000
X(5, 7)	0.000000	102.0000
X(5, 8)	0.000000	134.0000
X(5, 9)	0.000000	230.0000
X(5, 10)	0.000000	230.0000
X(5, 11)	0.000000	228.0000
X(5, 12)	0.000000	225.0000
X(5, 13)	0.000000	224.0000
X(5, 14)	0.000000	224.0000
X(5, 15)	0.000000	230.0000
X(5, 16)	0.000000	312.0000
X(6, 1)	0.000000	275.0000
X(6, 2)	0.000000	268.0000
X(6, 3)	0.000000	300.0000
X(6, 4)	0.000000	297.0000

X(6, 5)	0.000000	85.00000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	48.00000
X(6, 8)	1.000000	50.00000
X(6, 9)	0.000000	71.00000
X(6, 10)	0.000000	65.00000
X(6, 11)	0.000000	64.00000
X(6, 12)	0.000000	55.00000
X(6, 13)	0.000000	71.00000
X(6, 14)	0.000000	69.00000
X(6, 15)	0.000000	66.00000
X(6, 16)	0.000000	166.0000
X(7, 1)	0.000000	324.0000
X(7, 2)	0.000000	317.0000
X(7, 3)	0.000000	208.0000
X(7, 4)	0.000000	215.0000
X(7, 5)	0.000000	102.0000
X(7, 6)	0.000000	48.00000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	28.00000
X(7, 9)	0.000000	87.00000
X(7, 10)	0.000000	81.00000
X(7, 11)	0.000000	80.00000
X(7, 12)	1.000000	81.00000
X(7, 13)	0.000000	87.00000
X(7, 14)	0.000000	85.00000
X(7, 15)	0.000000	82.00000
X(7, 16)	0.000000	182.0000
X(8, 1)	0.000000	322.0000
X(8, 2)	0.000000	315.0000
X(8, 3)	0.000000	238.0000
X(8, 4)	0.000000	343.0000
X(8, 5)	0.000000	134.0000
X(8, 6)	0.000000	50.00000
X(8, 7)	1.000000	28.00000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	61.00000
X(8, 10)	0.000000	55.00000
X(8, 11)	0.000000	54.00000
X(8, 12)	0.000000	55.00000
X(8, 13)	0.000000	61.00000
X(8, 14)	0.000000	59.00000
X(8, 15)	0.000000	56.00000
X(8, 16)	0.000000	156.0000

X(9, 1)	0.000000	353.0000
X(9, 2)	0.000000	346.0000
X(9, 3)	0.000000	377.0000
X(9, 4)	0.000000	374.0000
X(9, 5)	0.000000	230.0000
X(9, 6)	0.000000	71.00000
X(9, 7)	0.000000	87.00000
X(9, 8)	0.000000	61.00000
X(9, 9)	0.000000	0.000000
X(9, 10)	0.000000	6.700000
X(9, 11)	0.000000	5.900000
X(9, 12)	0.000000	10.00000
X(9, 13)	1.000000	4.800000
X(9, 14)	0.000000	4.300000
X(9, 15)	0.000000	7.400000
X(9, 16)	0.000000	98.20000
X(10, 1)	0.000000	353.0000
X(10, 2)	0.000000	346.0000
X(10, 3)	0.000000	377.0000
X(10, 4)	0.000000	374.0000
X(10, 5)	0.000000	230.0000
X(10, 6)	0.000000	65.00000
X(10, 7)	0.000000	81.00000
X(10, 8)	0.000000	55.00000
X(10, 9)	0.000000	6.700000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	1.900000
X(10, 12)	0.000000	10.30000
X(10, 13)	0.000000	5.900000
X(10, 14)	0.000000	4.800000
X(10, 15)	1.000000	1.800000
X(10, 16)	0.000000	97.50000
X(11, 1)	0.000000	351.0000
X(11, 2)	0.000000	344.0000
X(11, 3)	0.000000	376.0000
X(11, 4)	0.000000	372.0000
X(11, 5)	0.000000	228.0000
X(11, 6)	0.000000	64.00000
X(11, 7)	0.000000	80.00000
X(11, 8)	0.000000	54.00000
X(11, 9)	0.000000	5.900000
X(11, 10)	0.000000	1.900000
X(11, 11)	0.000000	0.000000
X(11, 12)	0.000000	8.800000

X(11, 13)	0.000000	9.800000
X(11, 14)	0.000000	5.300000
X(11, 15)	0.000000	3.400000
X(11, 16)	1.000000	100.0000
X(12, 1)	0.000000	348.0000
X(12, 2)	0.000000	341.0000
X(12, 3)	0.000000	372.0000
X(12, 4)	0.000000	369.0000
X(12, 5)	0.000000	225.0000
X(12, 6)	0.000000	55.00000
X(12, 7)	0.000000	81.00000
X(12, 8)	0.000000	55.00000
X(12, 9)	0.000000	10.00000
X(12, 10)	0.000000	10.30000
X(12, 11)	0.000000	8.800000
X(12, 12)	0.000000	0.000000
X(12, 13)	0.000000	10.60000
X(12, 14)	1.000000	6.200000
X(12, 15)	0.000000	10.70000
X(12, 16)	0.000000	105.0000
X(13, 1)	0.000000	347.0000
X(13, 2)	0.000000	341.0000
X(13, 3)	0.000000	372.0000
X(13, 4)	0.000000	369.0000
X(13, 5)	0.000000	224.0000
X(13, 6)	0.000000	71.00000
X(13, 7)	0.000000	87.00000
X(13, 8)	0.000000	61.00000
X(13, 9)	0.000000	4.800000
X(13, 10)	0.000000	5.900000
X(13, 11)	1.000000	9.800000
X(13, 12)	0.000000	10.60000
X(13, 13)	0.000000	0.000000
X(13, 14)	0.000000	4.300000
X(13, 15)	0.000000	3.500000
X(13, 16)	0.000000	93.40000
X(14, 1)	0.000000	347.0000
X(14, 2)	0.000000	340.0000
X(14, 3)	0.000000	372.0000
X(14, 4)	0.000000	368.0000
X(14, 5)	0.000000	224.0000
X(14, 6)	0.000000	69.00000
X(14, 7)	0.000000	85.00000
X(14, 8)	0.000000	59.00000

X(14, 9)	1.000000	4.300000
X(14, 10)	0.000000	4.800000
X(14, 11)	0.000000	5.300000
X(14, 12)	0.000000	6.200000
X(14, 13)	0.000000	4.300000
X(14, 14)	0.000000	0.000000
X(14, 15)	0.000000	6.300000
X(14, 16)	0.000000	101.0000
X(15, 1)	1.000000	353.0000
X(15, 2)	0.000000	347.0000
X(15, 3)	0.000000	378.0000
X(15, 4)	0.000000	375.0000
X(15, 5)	0.000000	230.0000
X(15, 6)	0.000000	66.00000
X(15, 7)	0.000000	82.00000
X(15, 8)	0.000000	56.00000
X(15, 9)	0.000000	7.400000
X(15, 10)	0.000000	1.800000
X(15, 11)	0.000000	3.400000
X(15, 12)	0.000000	10.70000
X(15, 13)	0.000000	3.500000
X(15, 14)	0.000000	6.300000
X(15, 15)	0.000000	0.000000
X(15, 16)	0.000000	97.90000
X(16, 1)	0.000000	435.0000
X(16, 2)	0.000000	428.0000
X(16, 3)	0.000000	459.0000
X(16, 4)	0.000000	456.0000
X(16, 5)	0.000000	312.0000
X(16, 6)	0.000000	166.0000
X(16, 7)	0.000000	182.0000
X(16, 8)	0.000000	156.0000
X(16, 9)	0.000000	98.20000
X(16, 10)	1.000000	97.50000
X(16, 11)	0.000000	100.0000
X(16, 12)	0.000000	105.0000
X(16, 13)	0.000000	93.40000
X(16, 14)	0.000000	101.0000
X(16, 15)	0.000000	97.90000
X(16, 16)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	8.300000	0.000000
D(1, 3)	41.10000	0.000000
D(1, 4)	39.60000	0.000000

D(1, 5)	227.0000	0.000000
D(1, 6)	275.0000	0.000000
D(1, 7)	324.0000	0.000000
D(1, 8)	322.0000	0.000000
D(1, 9)	353.0000	0.000000
D(1, 10)	353.0000	0.000000
D(1, 11)	351.0000	0.000000
D(1, 12)	348.0000	0.000000
D(1, 13)	347.0000	0.000000
D(1, 14)	347.0000	0.000000
D(1, 15)	353.0000	0.000000
D(1, 16)	435.0000	0.000000
D(2, 1)	8.300000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	24.40000	0.000000
D(2, 4)	33.00000	0.000000
D(2, 5)	220.0000	0.000000
D(2, 6)	268.0000	0.000000
D(2, 7)	317.0000	0.000000
D(2, 8)	315.0000	0.000000
D(2, 9)	346.0000	0.000000
D(2, 10)	346.0000	0.000000
D(2, 11)	344.0000	0.000000
D(2, 12)	341.0000	0.000000
D(2, 13)	341.0000	0.000000
D(2, 14)	340.0000	0.000000
D(2, 15)	347.0000	0.000000
D(2, 16)	428.0000	0.000000
D(3, 1)	41.10000	0.000000
D(3, 2)	24.40000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	7.500000	0.000000
D(3, 5)	127.0000	0.000000
D(3, 6)	300.0000	0.000000
D(3, 7)	208.0000	0.000000
D(3, 8)	238.0000	0.000000
D(3, 9)	377.0000	0.000000
D(3, 10)	377.0000	0.000000
D(3, 11)	376.0000	0.000000
D(3, 12)	372.0000	0.000000
D(3, 13)	372.0000	0.000000
D(3, 14)	372.0000	0.000000
D(3, 15)	378.0000	0.000000
D(3, 16)	459.0000	0.000000

D(4, 1)	39.60000	0.000000
D(4, 2)	33.00000	0.000000
D(4, 3)	7.500000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	133.0000	0.000000
D(4, 6)	297.0000	0.000000
D(4, 7)	215.0000	0.000000
D(4, 8)	343.0000	0.000000
D(4, 9)	374.0000	0.000000
D(4, 10)	374.0000	0.000000
D(4, 11)	372.0000	0.000000
D(4, 12)	369.0000	0.000000
D(4, 13)	369.0000	0.000000
D(4, 14)	368.0000	0.000000
D(4, 15)	375.0000	0.000000
D(4, 16)	456.0000	0.000000
D(5, 1)	227.0000	0.000000
D(5, 2)	220.0000	0.000000
D(5, 3)	127.0000	0.000000
D(5, 4)	133.0000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	85.00000	0.000000
D(5, 7)	102.0000	0.000000
D(5, 8)	134.0000	0.000000
D(5, 9)	230.0000	0.000000
D(5, 10)	230.0000	0.000000
D(5, 11)	228.0000	0.000000
D(5, 12)	225.0000	0.000000
D(5, 13)	224.0000	0.000000
D(5, 14)	224.0000	0.000000
D(5, 15)	230.0000	0.000000
D(5, 16)	312.0000	0.000000
D(6, 1)	275.0000	0.000000
D(6, 2)	268.0000	0.000000
D(6, 3)	300.0000	0.000000
D(6, 4)	297.0000	0.000000
D(6, 5)	85.00000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	48.00000	0.000000
D(6, 8)	50.00000	0.000000
D(6, 9)	71.00000	0.000000
D(6, 10)	65.00000	0.000000
D(6, 11)	64.00000	0.000000
D(6, 12)	55.00000	0.000000

D(6, 13)	71.00000	0.000000
D(6, 14)	69.00000	0.000000
D(6, 15)	66.00000	0.000000
D(6, 16)	166.0000	0.000000
D(7, 1)	324.0000	0.000000
D(7, 2)	317.0000	0.000000
D(7, 3)	208.0000	0.000000
D(7, 4)	215.0000	0.000000
D(7, 5)	102.0000	0.000000
D(7, 6)	48.00000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	28.00000	0.000000
D(7, 9)	87.00000	0.000000
D(7, 10)	81.00000	0.000000
D(7, 11)	80.00000	0.000000
D(7, 12)	81.00000	0.000000
D(7, 13)	87.00000	0.000000
D(7, 14)	85.00000	0.000000
D(7, 15)	82.00000	0.000000
D(7, 16)	182.0000	0.000000
D(8, 1)	322.0000	0.000000
D(8, 2)	315.0000	0.000000
D(8, 3)	238.0000	0.000000
D(8, 4)	343.0000	0.000000
D(8, 5)	134.0000	0.000000
D(8, 6)	50.00000	0.000000
D(8, 7)	28.00000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	61.00000	0.000000
D(8, 10)	55.00000	0.000000
D(8, 11)	54.00000	0.000000
D(8, 12)	55.00000	0.000000
D(8, 13)	61.00000	0.000000
D(8, 14)	59.00000	0.000000
D(8, 15)	56.00000	0.000000
D(8, 16)	156.0000	0.000000
D(9, 1)	353.0000	0.000000
D(9, 2)	346.0000	0.000000
D(9, 3)	377.0000	0.000000
D(9, 4)	374.0000	0.000000
D(9, 5)	230.0000	0.000000
D(9, 6)	71.00000	0.000000
D(9, 7)	87.00000	0.000000
D(9, 8)	61.00000	0.000000

D(9, 9)	0.000000	0.000000
D(9, 10)	6.700000	0.000000
D(9, 11)	5.900000	0.000000
D(9, 12)	10.000000	0.000000
D(9, 13)	4.800000	0.000000
D(9, 14)	4.300000	0.000000
D(9, 15)	7.400000	0.000000
D(9, 16)	98.200000	0.000000
D(10, 1)	353.0000	0.000000
D(10, 2)	346.0000	0.000000
D(10, 3)	377.0000	0.000000
D(10, 4)	374.0000	0.000000
D(10, 5)	230.0000	0.000000
D(10, 6)	65.000000	0.000000
D(10, 7)	81.000000	0.000000
D(10, 8)	55.000000	0.000000
D(10, 9)	6.700000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	1.900000	0.000000
D(10, 12)	10.300000	0.000000
D(10, 13)	5.900000	0.000000
D(10, 14)	4.800000	0.000000
D(10, 15)	1.800000	0.000000
D(10, 16)	97.500000	0.000000
D(11, 1)	351.0000	0.000000
D(11, 2)	344.0000	0.000000
D(11, 3)	376.0000	0.000000
D(11, 4)	372.0000	0.000000
D(11, 5)	228.0000	0.000000
D(11, 6)	64.000000	0.000000
D(11, 7)	80.000000	0.000000
D(11, 8)	54.000000	0.000000
D(11, 9)	5.900000	0.000000
D(11, 10)	1.900000	0.000000
D(11, 11)	0.000000	0.000000
D(11, 12)	8.800000	0.000000
D(11, 13)	9.800000	0.000000
D(11, 14)	5.300000	0.000000
D(11, 15)	3.400000	0.000000
D(11, 16)	100.0000	0.000000
D(12, 1)	348.0000	0.000000
D(12, 2)	341.0000	0.000000
D(12, 3)	372.0000	0.000000
D(12, 4)	369.0000	0.000000

D(12, 5)	225.0000	0.000000
D(12, 6)	55.00000	0.000000
D(12, 7)	81.00000	0.000000
D(12, 8)	55.00000	0.000000
D(12, 9)	10.00000	0.000000
D(12, 10)	10.30000	0.000000
D(12, 11)	8.800000	0.000000
D(12, 12)	0.000000	0.000000
D(12, 13)	10.60000	0.000000
D(12, 14)	6.200000	0.000000
D(12, 15)	10.70000	0.000000
D(12, 16)	105.0000	0.000000
D(13, 1)	347.0000	0.000000
D(13, 2)	341.0000	0.000000
D(13, 3)	372.0000	0.000000
D(13, 4)	369.0000	0.000000
D(13, 5)	224.0000	0.000000
D(13, 6)	71.00000	0.000000
D(13, 7)	87.00000	0.000000
D(13, 8)	61.00000	0.000000
D(13, 9)	4.800000	0.000000
D(13, 10)	5.900000	0.000000
D(13, 11)	9.800000	0.000000
D(13, 12)	10.60000	0.000000
D(13, 13)	0.000000	0.000000
D(13, 14)	4.300000	0.000000
D(13, 15)	3.500000	0.000000
D(13, 16)	93.40000	0.000000
D(14, 1)	347.0000	0.000000
D(14, 2)	340.0000	0.000000
D(14, 3)	372.0000	0.000000
D(14, 4)	368.0000	0.000000
D(14, 5)	224.0000	0.000000
D(14, 6)	69.00000	0.000000
D(14, 7)	85.00000	0.000000
D(14, 8)	59.00000	0.000000
D(14, 9)	4.300000	0.000000
D(14, 10)	4.800000	0.000000
D(14, 11)	5.300000	0.000000
D(14, 12)	6.200000	0.000000
D(14, 13)	4.300000	0.000000
D(14, 14)	0.000000	0.000000
D(14, 15)	6.300000	0.000000
D(14, 16)	101.0000	0.000000

D(15, 1)	353.0000	0.000000
D(15, 2)	347.0000	0.000000
D(15, 3)	378.0000	0.000000
D(15, 4)	375.0000	0.000000
D(15, 5)	230.0000	0.000000
D(15, 6)	66.00000	0.000000
D(15, 7)	82.00000	0.000000
D(15, 8)	56.00000	0.000000
D(15, 9)	7.400000	0.000000
D(15, 10)	1.800000	0.000000
D(15, 11)	3.400000	0.000000
D(15, 12)	10.70000	0.000000
D(15, 13)	3.500000	0.000000
D(15, 14)	6.300000	0.000000
D(15, 15)	0.000000	0.000000
D(15, 16)	97.90000	0.000000
D(16, 1)	435.0000	0.000000
D(16, 2)	428.0000	0.000000
D(16, 3)	459.0000	0.000000
D(16, 4)	456.0000	0.000000
D(16, 5)	312.0000	0.000000
D(16, 6)	166.0000	0.000000
D(16, 7)	182.0000	0.000000
D(16, 8)	156.0000	0.000000
D(16, 9)	98.20000	0.000000
D(16, 10)	97.50000	0.000000
D(16, 11)	100.0000	0.000000
D(16, 12)	105.0000	0.000000
D(16, 13)	93.40000	0.000000
D(16, 14)	101.0000	0.000000
D(16, 15)	97.90000	0.000000
D(16, 16)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	9.960000	0.000000
DURASI(1, 3)	49.32000	0.000000
DURASI(1, 4)	47.52000	0.000000
DURASI(1, 5)	272.4000	0.000000
DURASI(1, 6)	330.0000	0.000000
DURASI(1, 7)	388.8000	0.000000
DURASI(1, 8)	386.4000	0.000000
DURASI(1, 9)	423.6000	0.000000
DURASI(1, 10)	423.6000	0.000000
DURASI(1, 11)	421.2000	0.000000
DURASI(1, 12)	417.6000	0.000000

DURASI(1, 13)	416.4000	0.000000
DURASI(1, 14)	416.4000	0.000000
DURASI(1, 15)	423.6000	0.000000
DURASI(1, 16)	522.0000	0.000000
DURASI(2, 1)	9.960000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	29.28000	0.000000
DURASI(2, 4)	39.60000	0.000000
DURASI(2, 5)	264.0000	0.000000
DURASI(2, 6)	321.6000	0.000000
DURASI(2, 7)	380.4000	0.000000
DURASI(2, 8)	378.0000	0.000000
DURASI(2, 9)	415.2000	0.000000
DURASI(2, 10)	415.2000	0.000000
DURASI(2, 11)	412.8000	0.000000
DURASI(2, 12)	409.2000	0.000000
DURASI(2, 13)	409.2000	0.000000
DURASI(2, 14)	408.0000	0.000000
DURASI(2, 15)	416.4000	0.000000
DURASI(2, 16)	513.6000	0.000000
DURASI(3, 1)	49.32000	0.000000
DURASI(3, 2)	29.28000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	9.000000	0.000000
DURASI(3, 5)	152.4000	0.000000
DURASI(3, 6)	360.0000	0.000000
DURASI(3, 7)	249.6000	0.000000
DURASI(3, 8)	285.6000	0.000000
DURASI(3, 9)	452.4000	0.000000
DURASI(3, 10)	452.4000	0.000000
DURASI(3, 11)	451.2000	0.000000
DURASI(3, 12)	446.4000	0.000000
DURASI(3, 13)	446.4000	0.000000
DURASI(3, 14)	446.4000	0.000000
DURASI(3, 15)	453.6000	0.000000
DURASI(3, 16)	550.8000	0.000000
DURASI(4, 1)	47.52000	0.000000
DURASI(4, 2)	39.60000	0.000000
DURASI(4, 3)	9.000000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	159.6000	0.000000
DURASI(4, 6)	356.4000	0.000000
DURASI(4, 7)	258.0000	0.000000
DURASI(4, 8)	411.6000	0.000000

DURASI(4, 9)	448.8000	0.000000
DURASI(4, 10)	448.8000	0.000000
DURASI(4, 11)	446.4000	0.000000
DURASI(4, 12)	442.8000	0.000000
DURASI(4, 13)	442.8000	0.000000
DURASI(4, 14)	441.6000	0.000000
DURASI(4, 15)	450.0000	0.000000
DURASI(4, 16)	547.2000	0.000000
DURASI(5, 1)	272.4000	0.000000
DURASI(5, 2)	264.0000	0.000000
DURASI(5, 3)	152.4000	0.000000
DURASI(5, 4)	159.6000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	102.0000	0.000000
DURASI(5, 7)	122.4000	0.000000
DURASI(5, 8)	160.8000	0.000000
DURASI(5, 9)	276.0000	0.000000
DURASI(5, 10)	276.0000	0.000000
DURASI(5, 11)	273.6000	0.000000
DURASI(5, 12)	270.0000	0.000000
DURASI(5, 13)	268.8000	0.000000
DURASI(5, 14)	268.8000	0.000000
DURASI(5, 15)	276.0000	0.000000
DURASI(5, 16)	374.4000	0.000000
DURASI(6, 1)	330.0000	0.000000
DURASI(6, 2)	321.6000	0.000000
DURASI(6, 3)	360.0000	0.000000
DURASI(6, 4)	356.4000	0.000000
DURASI(6, 5)	102.0000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	57.60000	0.000000
DURASI(6, 8)	60.00000	0.000000
DURASI(6, 9)	85.20000	0.000000
DURASI(6, 10)	78.00000	0.000000
DURASI(6, 11)	76.80000	0.000000
DURASI(6, 12)	66.00000	0.000000
DURASI(6, 13)	85.20000	0.000000
DURASI(6, 14)	82.80000	0.000000
DURASI(6, 15)	79.20000	0.000000
DURASI(6, 16)	199.2000	0.000000
DURASI(7, 1)	388.8000	0.000000
DURASI(7, 2)	380.4000	0.000000
DURASI(7, 3)	249.6000	0.000000
DURASI(7, 4)	258.0000	0.000000

DURASI(7, 5)	122.4000	0.000000
DURASI(7, 6)	57.60000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	33.60000	0.000000
DURASI(7, 9)	104.4000	0.000000
DURASI(7, 10)	97.20000	0.000000
DURASI(7, 11)	96.00000	0.000000
DURASI(7, 12)	97.20000	0.000000
DURASI(7, 13)	104.4000	0.000000
DURASI(7, 14)	102.0000	0.000000
DURASI(7, 15)	98.40000	0.000000
DURASI(7, 16)	218.4000	0.000000
DURASI(8, 1)	386.4000	0.000000
DURASI(8, 2)	378.0000	0.000000
DURASI(8, 3)	285.6000	0.000000
DURASI(8, 4)	411.6000	0.000000
DURASI(8, 5)	160.8000	0.000000
DURASI(8, 6)	60.00000	0.000000
DURASI(8, 7)	33.60000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	73.20000	0.000000
DURASI(8, 10)	66.00000	0.000000
DURASI(8, 11)	64.80000	0.000000
DURASI(8, 12)	66.00000	0.000000
DURASI(8, 13)	73.20000	0.000000
DURASI(8, 14)	70.80000	0.000000
DURASI(8, 15)	67.20000	0.000000
DURASI(8, 16)	187.2000	0.000000
DURASI(9, 1)	423.6000	0.000000
DURASI(9, 2)	415.2000	0.000000
DURASI(9, 3)	452.4000	0.000000
DURASI(9, 4)	448.8000	0.000000
DURASI(9, 5)	276.0000	0.000000
DURASI(9, 6)	85.20000	0.000000
DURASI(9, 7)	104.4000	0.000000
DURASI(9, 8)	73.20000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	8.040000	0.000000
DURASI(9, 11)	7.080000	0.000000
DURASI(9, 12)	12.00000	0.000000
DURASI(9, 13)	5.760000	0.000000
DURASI(9, 14)	5.160000	0.000000
DURASI(9, 15)	8.880000	0.000000
DURASI(9, 16)	117.8400	0.000000

DURASI(10, 1)	423.6000	0.000000
DURASI(10, 2)	415.2000	0.000000
DURASI(10, 3)	452.4000	0.000000
DURASI(10, 4)	448.8000	0.000000
DURASI(10, 5)	276.0000	0.000000
DURASI(10, 6)	78.00000	0.000000
DURASI(10, 7)	97.20000	0.000000
DURASI(10, 8)	66.00000	0.000000
DURASI(10, 9)	8.040000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	2.280000	0.000000
DURASI(10, 12)	12.36000	0.000000
DURASI(10, 13)	7.080000	0.000000
DURASI(10, 14)	5.760000	0.000000
DURASI(10, 15)	2.160000	0.000000
DURASI(10, 16)	117.0000	0.000000
DURASI(11, 1)	421.2000	0.000000
DURASI(11, 2)	412.8000	0.000000
DURASI(11, 3)	451.2000	0.000000
DURASI(11, 4)	446.4000	0.000000
DURASI(11, 5)	273.6000	0.000000
DURASI(11, 6)	76.80000	0.000000
DURASI(11, 7)	96.00000	0.000000
DURASI(11, 8)	64.80000	0.000000
DURASI(11, 9)	7.080000	0.000000
DURASI(11, 10)	2.280000	0.000000
DURASI(11, 11)	0.000000	0.000000
DURASI(11, 12)	10.56000	0.000000
DURASI(11, 13)	11.76000	0.000000
DURASI(11, 14)	6.360000	0.000000
DURASI(11, 15)	4.080000	0.000000
DURASI(11, 16)	120.0000	0.000000
DURASI(12, 1)	417.6000	0.000000
DURASI(12, 2)	409.2000	0.000000
DURASI(12, 3)	446.4000	0.000000
DURASI(12, 4)	442.8000	0.000000
DURASI(12, 5)	270.0000	0.000000
DURASI(12, 6)	66.00000	0.000000
DURASI(12, 7)	97.20000	0.000000
DURASI(12, 8)	66.00000	0.000000
DURASI(12, 9)	12.00000	0.000000
DURASI(12, 10)	12.36000	0.000000
DURASI(12, 11)	10.56000	0.000000
DURASI(12, 12)	0.000000	0.000000

DURASI(12, 13)	12.72000	0.000000
DURASI(12, 14)	7.440000	0.000000
DURASI(12, 15)	12.84000	0.000000
DURASI(12, 16)	126.0000	0.000000
DURASI(13, 1)	416.4000	0.000000
DURASI(13, 2)	409.2000	0.000000
DURASI(13, 3)	446.4000	0.000000
DURASI(13, 4)	442.8000	0.000000
DURASI(13, 5)	268.8000	0.000000
DURASI(13, 6)	85.20000	0.000000
DURASI(13, 7)	104.4000	0.000000
DURASI(13, 8)	73.20000	0.000000
DURASI(13, 9)	5.760000	0.000000
DURASI(13, 10)	7.080000	0.000000
DURASI(13, 11)	11.76000	0.000000
DURASI(13, 12)	12.72000	0.000000
DURASI(13, 13)	0.000000	0.000000
DURASI(13, 14)	5.160000	0.000000
DURASI(13, 15)	4.200000	0.000000
DURASI(13, 16)	112.0800	0.000000
DURASI(14, 1)	416.4000	0.000000
DURASI(14, 2)	408.0000	0.000000
DURASI(14, 3)	446.4000	0.000000
DURASI(14, 4)	441.6000	0.000000
DURASI(14, 5)	268.8000	0.000000
DURASI(14, 6)	82.80000	0.000000
DURASI(14, 7)	102.0000	0.000000
DURASI(14, 8)	70.80000	0.000000
DURASI(14, 9)	5.160000	0.000000
DURASI(14, 10)	5.760000	0.000000
DURASI(14, 11)	6.360000	0.000000
DURASI(14, 12)	7.440000	0.000000
DURASI(14, 13)	5.160000	0.000000
DURASI(14, 14)	0.000000	0.000000
DURASI(14, 15)	7.560000	0.000000
DURASI(14, 16)	121.2000	0.000000
DURASI(15, 1)	423.6000	0.000000
DURASI(15, 2)	416.4000	0.000000
DURASI(15, 3)	453.6000	0.000000
DURASI(15, 4)	450.0000	0.000000
DURASI(15, 5)	276.0000	0.000000
DURASI(15, 6)	79.20000	0.000000
DURASI(15, 7)	98.40000	0.000000
DURASI(15, 8)	67.20000	0.000000

DURASI(15, 9)	8.880000	0.000000
DURASI(15, 10)	2.160000	0.000000
DURASI(15, 11)	4.080000	0.000000
DURASI(15, 12)	12.84000	0.000000
DURASI(15, 13)	4.200000	0.000000
DURASI(15, 14)	7.560000	0.000000
DURASI(15, 15)	0.000000	0.000000
DURASI(15, 16)	117.4800	0.000000
DURASI(16, 1)	522.0000	0.000000
DURASI(16, 2)	513.6000	0.000000
DURASI(16, 3)	550.8000	0.000000
DURASI(16, 4)	547.2000	0.000000
DURASI(16, 5)	374.4000	0.000000
DURASI(16, 6)	199.2000	0.000000
DURASI(16, 7)	218.4000	0.000000
DURASI(16, 8)	187.2000	0.000000
DURASI(16, 9)	117.8400	0.000000
DURASI(16, 10)	117.0000	0.000000
DURASI(16, 11)	120.0000	0.000000
DURASI(16, 12)	126.0000	0.000000
DURASI(16, 13)	112.0800	0.000000
DURASI(16, 14)	121.2000	0.000000
DURASI(16, 15)	117.4800	0.000000
DURASI(16, 16)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster* 3 analisis sensitivitas skenario 2

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i,j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..11/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 540 540 540 660 540 540;
tutup = 1020 1260 1260 660 1260 1260 1260 1260 780 1260 1260;
```

D =

```
!ritel
!0    56    58    59    61    62    63    64    65    66
      67;
0     345   343   433   464   510   508   472   507   503
      495   !0;
345   0     20.2  102   133   179   176   142   176   172
      164   !56;
343   20.2  0     114   145   191   188   153   188   184
      175   !58;
433   102   114   0     48.4  94.1  91.2  56.6  91.3  87.3
      78.7  !59;
464   133   145   48.4  0     31.5  33.1  27.2  61.9  57.9
      49.3  !61;
510   179   191   94.1  31.5  0     3.4   58.4  21.5  12.1
      16.2  !62;
508   176   188   91.2  33.1  3.4   0     78.6  18.1  8.8
      14.5  !63;
```

```

472  142  153  56.6  27.2  58.4  78.6  0    34.7  30.7
      22.1  !64;
507  176  188  91.3  61.9  21.5  18.1  34.7  0    10.9
      35.6  !65;
503  172  184  87.3  57.9  12.1  8.8   30.7  10.9  0
      23.8  !66;
495  164  175  78.7  49.3  16.2  14.5  22.1  35.6  23.8  0;
      !67;

```

```

durasi =
0      414  411.6  519.6  556.8  612   609.6  566.4  608.4  603.6
      594
414    0    24.24  122.4  159.6  214.8  211.2  170.4  211.2  206.4
      196.8
411.6  24.24  0    136.8  174   229.2  225.6  183.6  225.6  220.8
      210
519.6  122.4  136.8  0    58.08  112.92  109.44  67.92
      109.56  104.76  94.44
556.8  159.6  174   58.08  0    37.8  39.72  32.64  74.28  69.48
      59.16
612    214.8  229.2  112.92  37.8  0    4.08  70.08  25.8
      14.52  19.44
609.6  211.2  225.6  109.44  39.72  4.08  0    94.32  21.72
      10.56  17.4
566.4  170.4  183.6  67.92  32.64  70.08  94.32  0    41.64  36.84
      26.52
608.4  211.2  225.6  109.56  74.28  25.8  21.72  41.64  0
      13.08  42.72
603.6  206.4  220.8  104.76  69.48  14.52  10.56  36.84  13.08  0
      28.56
594    196.8  210   94.44  59.16  19.44  17.4  26.52  42.72  28.56  0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
            @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
    );

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 3* analisis sensitivitas skenario 2

Global optimal solution found.

Objective value:	1099.100
Objective bound:	1099.100
Infeasibilities:	0.000000
Extended solver steps:	1833
Total solver iterations:	29901
Elapsed runtime seconds:	2.94

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 4 sebesar 433 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 20.2 km
 rute pengiriman dari ritel 3 ke ritel 1 sebesar 343 km
 rute pengiriman dari ritel 4 ke ritel 5 sebesar 48.4 km
 rute pengiriman dari ritel 5 ke ritel 7 sebesar 33.1 km
 rute pengiriman dari ritel 6 ke ritel 11 sebesar 16.2 km
 rute pengiriman dari ritel 7 ke ritel 9 sebesar 18.1 km
 rute pengiriman dari ritel 8 ke ritel 2 sebesar 142 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 10.9 km
 rute pengiriman dari ritel 10 ke ritel 6 sebesar 12.1 km
 rute pengiriman dari ritel 11 ke ritel 8 sebesar 22.1 km

Model Class: MILP

Total variables:	132
Nonlinear variables:	0
Integer variables:	121
Total constraints:	154
Nonlinear constraints:	0
Total nonzeros:	780
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000

BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	660.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	660.0000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	780.0000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
T(1)	1872.000	0.000000
T(2)	1175.760	0.000000
T(3)	1230.000	0.000000
T(4)	540.0000	0.000000
T(5)	628.0800	0.000000
T(6)	869.4000	0.000000
T(7)	698.2800	0.000000
T(8)	975.3600	0.000000
T(9)	750.0000	0.000000
T(10)	793.0800	0.000000
T(11)	918.8400	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	0.000000	345.0000
X(1, 3)	0.000000	343.0000
X(1, 4)	1.000000	433.0000
X(1, 5)	0.000000	464.0000

X(1, 6)	0.000000	510.0000
X(1, 7)	0.000000	508.0000
X(1, 8)	0.000000	472.0000
X(1, 9)	0.000000	507.0000
X(1, 10)	0.000000	503.0000
X(1, 11)	0.000000	495.0000
X(2, 1)	0.000000	345.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	20.20000
X(2, 4)	0.000000	102.0000
X(2, 5)	0.000000	133.0000
X(2, 6)	0.000000	179.0000
X(2, 7)	0.000000	176.0000
X(2, 8)	0.000000	142.0000
X(2, 9)	0.000000	176.0000
X(2, 10)	0.000000	172.0000
X(2, 11)	0.000000	164.0000
X(3, 1)	1.000000	343.0000
X(3, 2)	0.000000	20.20000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	114.0000
X(3, 5)	0.000000	145.0000
X(3, 6)	0.000000	191.0000
X(3, 7)	0.000000	188.0000
X(3, 8)	0.000000	153.0000
X(3, 9)	0.000000	188.0000
X(3, 10)	0.000000	184.0000
X(3, 11)	0.000000	175.0000
X(4, 1)	0.000000	433.0000
X(4, 2)	0.000000	102.0000
X(4, 3)	0.000000	114.0000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	48.40000
X(4, 6)	0.000000	94.10000
X(4, 7)	0.000000	91.20000
X(4, 8)	0.000000	56.60000
X(4, 9)	0.000000	91.30000
X(4, 10)	0.000000	87.30000
X(4, 11)	0.000000	78.70000
X(5, 1)	0.000000	464.0000
X(5, 2)	0.000000	133.0000
X(5, 3)	0.000000	145.0000
X(5, 4)	0.000000	48.40000
X(5, 5)	0.000000	0.000000

X(5, 6)	0.000000	31.50000
X(5, 7)	1.000000	33.10000
X(5, 8)	0.000000	27.20000
X(5, 9)	0.000000	61.90000
X(5, 10)	0.000000	57.90000
X(5, 11)	0.000000	49.30000
X(6, 1)	0.000000	510.0000
X(6, 2)	0.000000	179.0000
X(6, 3)	0.000000	191.0000
X(6, 4)	0.000000	94.10000
X(6, 5)	0.000000	31.50000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.400000
X(6, 8)	0.000000	58.40000
X(6, 9)	0.000000	21.50000
X(6, 10)	0.000000	12.10000
X(6, 11)	1.000000	16.20000
X(7, 1)	0.000000	508.0000
X(7, 2)	0.000000	176.0000
X(7, 3)	0.000000	188.0000
X(7, 4)	0.000000	91.20000
X(7, 5)	0.000000	33.10000
X(7, 6)	0.000000	3.400000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	78.60000
X(7, 9)	1.000000	18.10000
X(7, 10)	0.000000	8.800000
X(7, 11)	0.000000	14.50000
X(8, 1)	0.000000	472.0000
X(8, 2)	1.000000	142.0000
X(8, 3)	0.000000	153.0000
X(8, 4)	0.000000	56.60000
X(8, 5)	0.000000	27.20000
X(8, 6)	0.000000	58.40000
X(8, 7)	0.000000	78.60000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	34.70000
X(8, 10)	0.000000	30.70000
X(8, 11)	0.000000	22.10000
X(9, 1)	0.000000	507.0000
X(9, 2)	0.000000	176.0000
X(9, 3)	0.000000	188.0000
X(9, 4)	0.000000	91.30000
X(9, 5)	0.000000	61.90000

X(9, 6)	0.000000	21.50000
X(9, 7)	0.000000	18.10000
X(9, 8)	0.000000	34.70000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	10.90000
X(9, 11)	0.000000	35.60000
X(10, 1)	0.000000	503.0000
X(10, 2)	0.000000	172.0000
X(10, 3)	0.000000	184.0000
X(10, 4)	0.000000	87.30000
X(10, 5)	0.000000	57.90000
X(10, 6)	1.000000	12.10000
X(10, 7)	0.000000	8.800000
X(10, 8)	0.000000	30.70000
X(10, 9)	0.000000	10.90000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	23.80000
X(11, 1)	0.000000	495.0000
X(11, 2)	0.000000	164.0000
X(11, 3)	0.000000	175.0000
X(11, 4)	0.000000	78.70000
X(11, 5)	0.000000	49.30000
X(11, 6)	0.000000	16.20000
X(11, 7)	0.000000	14.50000
X(11, 8)	1.000000	22.10000
X(11, 9)	0.000000	35.60000
X(11, 10)	0.000000	23.80000
X(11, 11)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	345.0000	0.000000
D(1, 3)	343.0000	0.000000
D(1, 4)	433.0000	0.000000
D(1, 5)	464.0000	0.000000
D(1, 6)	510.0000	0.000000
D(1, 7)	508.0000	0.000000
D(1, 8)	472.0000	0.000000
D(1, 9)	507.0000	0.000000
D(1, 10)	503.0000	0.000000
D(1, 11)	495.0000	0.000000
D(2, 1)	345.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	20.20000	0.000000
D(2, 4)	102.0000	0.000000
D(2, 5)	133.0000	0.000000

D(2, 6)	179.0000	0.000000
D(2, 7)	176.0000	0.000000
D(2, 8)	142.0000	0.000000
D(2, 9)	176.0000	0.000000
D(2, 10)	172.0000	0.000000
D(2, 11)	164.0000	0.000000
D(3, 1)	343.0000	0.000000
D(3, 2)	20.20000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	114.0000	0.000000
D(3, 5)	145.0000	0.000000
D(3, 6)	191.0000	0.000000
D(3, 7)	188.0000	0.000000
D(3, 8)	153.0000	0.000000
D(3, 9)	188.0000	0.000000
D(3, 10)	184.0000	0.000000
D(3, 11)	175.0000	0.000000
D(4, 1)	433.0000	0.000000
D(4, 2)	102.0000	0.000000
D(4, 3)	114.0000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	48.40000	0.000000
D(4, 6)	94.10000	0.000000
D(4, 7)	91.20000	0.000000
D(4, 8)	56.60000	0.000000
D(4, 9)	91.30000	0.000000
D(4, 10)	87.30000	0.000000
D(4, 11)	78.70000	0.000000
D(5, 1)	464.0000	0.000000
D(5, 2)	133.0000	0.000000
D(5, 3)	145.0000	0.000000
D(5, 4)	48.40000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	31.50000	0.000000
D(5, 7)	33.10000	0.000000
D(5, 8)	27.20000	0.000000
D(5, 9)	61.90000	0.000000
D(5, 10)	57.90000	0.000000
D(5, 11)	49.30000	0.000000
D(6, 1)	510.0000	0.000000
D(6, 2)	179.0000	0.000000
D(6, 3)	191.0000	0.000000
D(6, 4)	94.10000	0.000000
D(6, 5)	31.50000	0.000000

D(6, 6)	0.000000	0.000000
D(6, 7)	3.400000	0.000000
D(6, 8)	58.40000	0.000000
D(6, 9)	21.50000	0.000000
D(6, 10)	12.10000	0.000000
D(6, 11)	16.20000	0.000000
D(7, 1)	508.0000	0.000000
D(7, 2)	176.0000	0.000000
D(7, 3)	188.0000	0.000000
D(7, 4)	91.20000	0.000000
D(7, 5)	33.10000	0.000000
D(7, 6)	3.400000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	78.60000	0.000000
D(7, 9)	18.10000	0.000000
D(7, 10)	8.800000	0.000000
D(7, 11)	14.50000	0.000000
D(8, 1)	472.0000	0.000000
D(8, 2)	142.0000	0.000000
D(8, 3)	153.0000	0.000000
D(8, 4)	56.60000	0.000000
D(8, 5)	27.20000	0.000000
D(8, 6)	58.40000	0.000000
D(8, 7)	78.60000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	34.70000	0.000000
D(8, 10)	30.70000	0.000000
D(8, 11)	22.10000	0.000000
D(9, 1)	507.0000	0.000000
D(9, 2)	176.0000	0.000000
D(9, 3)	188.0000	0.000000
D(9, 4)	91.30000	0.000000
D(9, 5)	61.90000	0.000000
D(9, 6)	21.50000	0.000000
D(9, 7)	18.10000	0.000000
D(9, 8)	34.70000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	10.90000	0.000000
D(9, 11)	35.60000	0.000000
D(10, 1)	503.0000	0.000000
D(10, 2)	172.0000	0.000000
D(10, 3)	184.0000	0.000000
D(10, 4)	87.30000	0.000000
D(10, 5)	57.90000	0.000000

D(10, 6)	12.10000	0.000000
D(10, 7)	8.800000	0.000000
D(10, 8)	30.70000	0.000000
D(10, 9)	10.90000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	23.80000	0.000000
D(11, 1)	495.0000	0.000000
D(11, 2)	164.0000	0.000000
D(11, 3)	175.0000	0.000000
D(11, 4)	78.70000	0.000000
D(11, 5)	49.30000	0.000000
D(11, 6)	16.20000	0.000000
D(11, 7)	14.50000	0.000000
D(11, 8)	22.10000	0.000000
D(11, 9)	35.60000	0.000000
D(11, 10)	23.80000	0.000000
D(11, 11)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	414.0000	0.000000
DURASI(1, 3)	411.6000	0.000000
DURASI(1, 4)	519.6000	0.000000
DURASI(1, 5)	556.8000	0.000000
DURASI(1, 6)	612.0000	0.000000
DURASI(1, 7)	609.6000	0.000000
DURASI(1, 8)	566.4000	0.000000
DURASI(1, 9)	608.4000	0.000000
DURASI(1, 10)	603.6000	0.000000
DURASI(1, 11)	594.0000	0.000000
DURASI(2, 1)	414.0000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	24.24000	0.000000
DURASI(2, 4)	122.4000	0.000000
DURASI(2, 5)	159.6000	0.000000
DURASI(2, 6)	214.8000	0.000000
DURASI(2, 7)	211.2000	0.000000
DURASI(2, 8)	170.4000	0.000000
DURASI(2, 9)	211.2000	0.000000
DURASI(2, 10)	206.4000	0.000000
DURASI(2, 11)	196.8000	0.000000
DURASI(3, 1)	411.6000	0.000000
DURASI(3, 2)	24.24000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	136.8000	0.000000
DURASI(3, 5)	174.0000	0.000000

DURASI(3, 6)	229.2000	0.000000
DURASI(3, 7)	225.6000	0.000000
DURASI(3, 8)	183.6000	0.000000
DURASI(3, 9)	225.6000	0.000000
DURASI(3, 10)	220.8000	0.000000
DURASI(3, 11)	210.0000	0.000000
DURASI(4, 1)	519.6000	0.000000
DURASI(4, 2)	122.4000	0.000000
DURASI(4, 3)	136.8000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	58.08000	0.000000
DURASI(4, 6)	112.9200	0.000000
DURASI(4, 7)	109.4400	0.000000
DURASI(4, 8)	67.92000	0.000000
DURASI(4, 9)	109.5600	0.000000
DURASI(4, 10)	104.7600	0.000000
DURASI(4, 11)	94.44000	0.000000
DURASI(5, 1)	556.8000	0.000000
DURASI(5, 2)	159.6000	0.000000
DURASI(5, 3)	174.0000	0.000000
DURASI(5, 4)	58.08000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	37.80000	0.000000
DURASI(5, 7)	39.72000	0.000000
DURASI(5, 8)	32.64000	0.000000
DURASI(5, 9)	74.28000	0.000000
DURASI(5, 10)	69.48000	0.000000
DURASI(5, 11)	59.16000	0.000000
DURASI(6, 1)	612.0000	0.000000
DURASI(6, 2)	214.8000	0.000000
DURASI(6, 3)	229.2000	0.000000
DURASI(6, 4)	112.9200	0.000000
DURASI(6, 5)	37.80000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.080000	0.000000
DURASI(6, 8)	70.08000	0.000000
DURASI(6, 9)	25.80000	0.000000
DURASI(6, 10)	14.52000	0.000000
DURASI(6, 11)	19.44000	0.000000
DURASI(7, 1)	609.6000	0.000000
DURASI(7, 2)	211.2000	0.000000
DURASI(7, 3)	225.6000	0.000000
DURASI(7, 4)	109.4400	0.000000
DURASI(7, 5)	39.72000	0.000000

DURASI(7, 6)	4.080000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	94.32000	0.000000
DURASI(7, 9)	21.72000	0.000000
DURASI(7, 10)	10.56000	0.000000
DURASI(7, 11)	17.40000	0.000000
DURASI(8, 1)	566.4000	0.000000
DURASI(8, 2)	170.4000	0.000000
DURASI(8, 3)	183.6000	0.000000
DURASI(8, 4)	67.92000	0.000000
DURASI(8, 5)	32.64000	0.000000
DURASI(8, 6)	70.08000	0.000000
DURASI(8, 7)	94.32000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	41.64000	0.000000
DURASI(8, 10)	36.84000	0.000000
DURASI(8, 11)	26.52000	0.000000
DURASI(9, 1)	608.4000	0.000000
DURASI(9, 2)	211.2000	0.000000
DURASI(9, 3)	225.6000	0.000000
DURASI(9, 4)	109.5600	0.000000
DURASI(9, 5)	74.28000	0.000000
DURASI(9, 6)	25.80000	0.000000
DURASI(9, 7)	21.72000	0.000000
DURASI(9, 8)	41.64000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	13.08000	0.000000
DURASI(9, 11)	42.72000	0.000000
DURASI(10, 1)	603.6000	0.000000
DURASI(10, 2)	206.4000	0.000000
DURASI(10, 3)	220.8000	0.000000
DURASI(10, 4)	104.7600	0.000000
DURASI(10, 5)	69.48000	0.000000
DURASI(10, 6)	14.52000	0.000000
DURASI(10, 7)	10.56000	0.000000
DURASI(10, 8)	36.84000	0.000000
DURASI(10, 9)	13.08000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	28.56000	0.000000
DURASI(11, 1)	594.0000	0.000000
DURASI(11, 2)	196.8000	0.000000
DURASI(11, 3)	210.0000	0.000000
DURASI(11, 4)	94.44000	0.000000
DURASI(11, 5)	59.16000	0.000000

DURASI(11, 6)	19.44000	0.000000
DURASI(11, 7)	17.40000	0.000000
DURASI(11, 8)	26.52000	0.000000
DURASI(11, 9)	42.72000	0.000000
DURASI(11, 10)	28.56000	0.000000
DURASI(11, 11)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster* 4 analisis sensitivitas skenario 2

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i,j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..12/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 660 540 540 540 540 540 540;
tutup = 1020 1260 660 1260 1260 780 1260 1260 1260 1260 1260 1260;
1260;
```

D =

```
!ritel
!0      33      34      35      36      37      38      44      45      46      47
      48;
0      252     234     258     254     256     259     398     422     548
      548     341     !0;
252    0       20      44      39      42      46      184     208     334
      334     127     !33;
234    20      0       24      20      23      25      164     188     314
      314     107     !34;
258    44      24      0       7       6       9       138     158     295
      295     88      !35;
254    39      20      7       0       3       6       156     166     306
      306     99      !36;
256    42      23      6       3       0       7       156     164     305
      305     98      !37;
```

259	46	25	9	6	7	0	141	161	306	
	306	99	!38;							
398	184	164	138	156	156	141	0	24.4	102	
	102	57.5	!44;							
422	208	188	158	166	164	161	24.4	0	77.2	78
	80.9	!45;								
548	334	314	295	306	305	306	102	77.2	0	1.7
	145	!46;								
548	334	314	295	306	305	306	102	78	1.7	0
	144	!47;								
341	127	107	88	99	98	99	57.5	80.9	145	
	144	0;	!48;							

```

durasi =
0      302.4 280.8 309.6 304.8 307.2 310.8 477.6 506.4 657.6
      657.6 409.2
302.4 0      24    52.8 46.8 50.4 55.2 220.8 249.6 400.8
      400.8 152.4
280.8 24    0      28.8 24   27.6 30   196.8 225.6 376.8
      376.8 128.4
309.6 52.8 28.8 0      8.4 7.2 10.8 165.6 189.6 354
      354 105.6
304.8 46.8 24    8.4 0    3.6 7.2 187.2 199.2 367.2
      367.2 118.8
307.2 50.4 27.6 7.2 3.6 0    8.4 187.2 196.8 366
      366 117.6
310.8 55.2 30    10.8 7.2 8.4 0    169.2 193.2 367.2
      367.2 118.8
477.6 220.8 196.8 165.6 187.2 187.2 169.2 0    29.28 122.4
      122.4 69
506.4 249.6 225.6 189.6 199.2 196.8 193.2 29.28 0    92.64
      93.6 97.08
657.6 400.8 376.8 354 367.2 366 367.2 122.4 92.64 0
      2.04 174
657.6 400.8 376.8 354 367.2 366 367.2 122.4 93.6 2.04 0
      172.8
409.2 152.4 128.4 105.6 118.8 117.6 118.8 69 97.08 174
      172.8 0;

```

```

Bongkar = 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

```

```

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

- Hasil dari *solution report* pada *cluster 4* analisis sensitivitas skenario 2

Global optimal solution found.

Objective value:	1036.300
Objective bound:	1036.300
Infeasibilities:	0.000000
Extended solver steps:	2461
Total solver iterations:	24912
Elapsed runtime seconds:	2.21

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 252 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 20 km
 rute pengiriman dari ritel 3 ke ritel 5 sebesar 20 km
 rute pengiriman dari ritel 4 ke ritel 1 sebesar 258 km
 rute pengiriman dari ritel 5 ke ritel 6 sebesar 3 km
 rute pengiriman dari ritel 6 ke ritel 7 sebesar 7 km
 rute pengiriman dari ritel 7 ke ritel 8 sebesar 141 km
 rute pengiriman dari ritel 8 ke ritel 9 sebesar 24.4 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 77.2 km
 rute pengiriman dari ritel 10 ke ritel 11 sebesar 1.7 km
 rute pengiriman dari ritel 11 ke ritel 12 sebesar 144 km
 rute pengiriman dari ritel 12 ke ritel 4 sebesar 88 km

Model Class: MILP

Total variables:	156
Nonlinear variables:	0
Integer variables:	144
Total constraints:	180
Nonlinear constraints:	0
Total nonzeros:	935

Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	0.3000000	0.000000
BONGKAR(2)	0.3000000	0.000000
BONGKAR(3)	0.3000000	0.000000
BONGKAR(4)	0.3000000	0.000000
BONGKAR(5)	0.3000000	0.000000
BONGKAR(6)	0.3000000	0.000000
BONGKAR(7)	0.3000000	0.000000
BONGKAR(8)	0.3000000	0.000000
BONGKAR(9)	0.3000000	0.000000
BONGKAR(10)	0.3000000	0.000000
BONGKAR(11)	0.3000000	0.000000
BONGKAR(12)	0.3000000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	660.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
BUKA(12)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	660.0000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	780.0000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
TUTUP(12)	1260.000	0.000000
T(1)	1917.600	0.000000
T(2)	540.0000	0.000000

T(3)	564.3000	0.000000
T(4)	1259.700	0.000000
T(5)	656.1000	0.000000
T(6)	660.0000	0.000000
T(7)	668.7000	0.000000
T(8)	855.8400	0.000000
T(9)	885.4200	0.000000
T(10)	978.3600	0.000000
T(11)	980.7000	0.000000
T(12)	1153.800	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	252.0000
X(1, 3)	0.000000	234.0000
X(1, 4)	0.000000	258.0000
X(1, 5)	0.000000	254.0000
X(1, 6)	0.000000	256.0000
X(1, 7)	0.000000	259.0000
X(1, 8)	0.000000	398.0000
X(1, 9)	0.000000	422.0000
X(1, 10)	0.000000	548.0000
X(1, 11)	0.000000	548.0000
X(1, 12)	0.000000	341.0000
X(2, 1)	0.000000	252.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	20.00000
X(2, 4)	0.000000	44.00000
X(2, 5)	0.000000	39.00000
X(2, 6)	0.000000	42.00000
X(2, 7)	0.000000	46.00000
X(2, 8)	0.000000	184.0000
X(2, 9)	0.000000	208.0000
X(2, 10)	0.000000	334.0000
X(2, 11)	0.000000	334.0000
X(2, 12)	0.000000	127.0000
X(3, 1)	0.000000	234.0000
X(3, 2)	0.000000	20.00000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	24.00000
X(3, 5)	1.000000	20.00000
X(3, 6)	0.000000	23.00000
X(3, 7)	0.000000	25.00000
X(3, 8)	0.000000	164.0000
X(3, 9)	0.000000	188.0000
X(3, 10)	0.000000	314.0000

X(3, 11)	0.000000	314.0000
X(3, 12)	0.000000	107.0000
X(4, 1)	1.000000	258.0000
X(4, 2)	0.000000	44.00000
X(4, 3)	0.000000	24.00000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	7.000000
X(4, 6)	0.000000	6.000000
X(4, 7)	0.000000	9.000000
X(4, 8)	0.000000	138.0000
X(4, 9)	0.000000	158.0000
X(4, 10)	0.000000	295.0000
X(4, 11)	0.000000	295.0000
X(4, 12)	0.000000	88.00000
X(5, 1)	0.000000	254.0000
X(5, 2)	0.000000	39.00000
X(5, 3)	0.000000	20.00000
X(5, 4)	0.000000	7.000000
X(5, 5)	0.000000	0.000000
X(5, 6)	1.000000	3.000000
X(5, 7)	0.000000	6.000000
X(5, 8)	0.000000	156.0000
X(5, 9)	0.000000	166.0000
X(5, 10)	0.000000	306.0000
X(5, 11)	0.000000	306.0000
X(5, 12)	0.000000	99.00000
X(6, 1)	0.000000	256.0000
X(6, 2)	0.000000	42.00000
X(6, 3)	0.000000	23.00000
X(6, 4)	0.000000	6.000000
X(6, 5)	0.000000	3.000000
X(6, 6)	0.000000	0.000000
X(6, 7)	1.000000	7.000000
X(6, 8)	0.000000	156.0000
X(6, 9)	0.000000	164.0000
X(6, 10)	0.000000	305.0000
X(6, 11)	0.000000	305.0000
X(6, 12)	0.000000	98.00000
X(7, 1)	0.000000	259.0000
X(7, 2)	0.000000	46.00000
X(7, 3)	0.000000	25.00000
X(7, 4)	0.000000	9.000000
X(7, 5)	0.000000	6.000000
X(7, 6)	0.000000	7.000000

X(7, 7)	0.000000	0.000000
X(7, 8)	1.000000	141.0000
X(7, 9)	0.000000	161.0000
X(7, 10)	0.000000	306.0000
X(7, 11)	0.000000	306.0000
X(7, 12)	0.000000	99.00000
X(8, 1)	0.000000	398.0000
X(8, 2)	0.000000	184.0000
X(8, 3)	0.000000	164.0000
X(8, 4)	0.000000	138.0000
X(8, 5)	0.000000	156.0000
X(8, 6)	0.000000	156.0000
X(8, 7)	0.000000	141.0000
X(8, 8)	0.000000	0.000000
X(8, 9)	1.000000	24.40000
X(8, 10)	0.000000	102.0000
X(8, 11)	0.000000	102.0000
X(8, 12)	0.000000	57.50000
X(9, 1)	0.000000	422.0000
X(9, 2)	0.000000	208.0000
X(9, 3)	0.000000	188.0000
X(9, 4)	0.000000	158.0000
X(9, 5)	0.000000	166.0000
X(9, 6)	0.000000	164.0000
X(9, 7)	0.000000	161.0000
X(9, 8)	0.000000	24.40000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	77.20000
X(9, 11)	0.000000	78.00000
X(9, 12)	0.000000	80.90000
X(10, 1)	0.000000	548.0000
X(10, 2)	0.000000	334.0000
X(10, 3)	0.000000	314.0000
X(10, 4)	0.000000	295.0000
X(10, 5)	0.000000	306.0000
X(10, 6)	0.000000	305.0000
X(10, 7)	0.000000	306.0000
X(10, 8)	0.000000	102.0000
X(10, 9)	0.000000	77.20000
X(10, 10)	0.000000	0.000000
X(10, 11)	1.000000	1.700000
X(10, 12)	0.000000	145.0000
X(11, 1)	0.000000	548.0000
X(11, 2)	0.000000	334.0000

X(11, 3)	0.000000	314.0000
X(11, 4)	0.000000	295.0000
X(11, 5)	0.000000	306.0000
X(11, 6)	0.000000	305.0000
X(11, 7)	0.000000	306.0000
X(11, 8)	0.000000	102.0000
X(11, 9)	0.000000	78.00000
X(11, 10)	0.000000	1.700000
X(11, 11)	0.000000	0.000000
X(11, 12)	1.000000	144.0000
X(12, 1)	0.000000	341.0000
X(12, 2)	0.000000	127.0000
X(12, 3)	0.000000	107.0000
X(12, 4)	1.000000	88.00000
X(12, 5)	0.000000	99.00000
X(12, 6)	0.000000	98.00000
X(12, 7)	0.000000	99.00000
X(12, 8)	0.000000	57.50000
X(12, 9)	0.000000	80.90000
X(12, 10)	0.000000	145.0000
X(12, 11)	0.000000	144.0000
X(12, 12)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	252.0000	0.000000
D(1, 3)	234.0000	0.000000
D(1, 4)	258.0000	0.000000
D(1, 5)	254.0000	0.000000
D(1, 6)	256.0000	0.000000
D(1, 7)	259.0000	0.000000
D(1, 8)	398.0000	0.000000
D(1, 9)	422.0000	0.000000
D(1, 10)	548.0000	0.000000
D(1, 11)	548.0000	0.000000
D(1, 12)	341.0000	0.000000
D(2, 1)	252.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	20.00000	0.000000
D(2, 4)	44.00000	0.000000
D(2, 5)	39.00000	0.000000
D(2, 6)	42.00000	0.000000
D(2, 7)	46.00000	0.000000
D(2, 8)	184.0000	0.000000
D(2, 9)	208.0000	0.000000
D(2, 10)	334.0000	0.000000

D(2, 11)	334.0000	0.000000
D(2, 12)	127.0000	0.000000
D(3, 1)	234.0000	0.000000
D(3, 2)	20.00000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	24.00000	0.000000
D(3, 5)	20.00000	0.000000
D(3, 6)	23.00000	0.000000
D(3, 7)	25.00000	0.000000
D(3, 8)	164.0000	0.000000
D(3, 9)	188.0000	0.000000
D(3, 10)	314.0000	0.000000
D(3, 11)	314.0000	0.000000
D(3, 12)	107.0000	0.000000
D(4, 1)	258.0000	0.000000
D(4, 2)	44.00000	0.000000
D(4, 3)	24.00000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	7.000000	0.000000
D(4, 6)	6.000000	0.000000
D(4, 7)	9.000000	0.000000
D(4, 8)	138.0000	0.000000
D(4, 9)	158.0000	0.000000
D(4, 10)	295.0000	0.000000
D(4, 11)	295.0000	0.000000
D(4, 12)	88.00000	0.000000
D(5, 1)	254.0000	0.000000
D(5, 2)	39.00000	0.000000
D(5, 3)	20.00000	0.000000
D(5, 4)	7.000000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	3.000000	0.000000
D(5, 7)	6.000000	0.000000
D(5, 8)	156.0000	0.000000
D(5, 9)	166.0000	0.000000
D(5, 10)	306.0000	0.000000
D(5, 11)	306.0000	0.000000
D(5, 12)	99.00000	0.000000
D(6, 1)	256.0000	0.000000
D(6, 2)	42.00000	0.000000
D(6, 3)	23.00000	0.000000
D(6, 4)	6.000000	0.000000
D(6, 5)	3.000000	0.000000
D(6, 6)	0.000000	0.000000

D(6, 7)	7.000000	0.000000
D(6, 8)	156.0000	0.000000
D(6, 9)	164.0000	0.000000
D(6, 10)	305.0000	0.000000
D(6, 11)	305.0000	0.000000
D(6, 12)	98.00000	0.000000
D(7, 1)	259.0000	0.000000
D(7, 2)	46.00000	0.000000
D(7, 3)	25.00000	0.000000
D(7, 4)	9.000000	0.000000
D(7, 5)	6.000000	0.000000
D(7, 6)	7.000000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	141.0000	0.000000
D(7, 9)	161.0000	0.000000
D(7, 10)	306.0000	0.000000
D(7, 11)	306.0000	0.000000
D(7, 12)	99.00000	0.000000
D(8, 1)	398.0000	0.000000
D(8, 2)	184.0000	0.000000
D(8, 3)	164.0000	0.000000
D(8, 4)	138.0000	0.000000
D(8, 5)	156.0000	0.000000
D(8, 6)	156.0000	0.000000
D(8, 7)	141.0000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	24.40000	0.000000
D(8, 10)	102.0000	0.000000
D(8, 11)	102.0000	0.000000
D(8, 12)	57.50000	0.000000
D(9, 1)	422.0000	0.000000
D(9, 2)	208.0000	0.000000
D(9, 3)	188.0000	0.000000
D(9, 4)	158.0000	0.000000
D(9, 5)	166.0000	0.000000
D(9, 6)	164.0000	0.000000
D(9, 7)	161.0000	0.000000
D(9, 8)	24.40000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	77.20000	0.000000
D(9, 11)	78.00000	0.000000
D(9, 12)	80.90000	0.000000
D(10, 1)	548.0000	0.000000
D(10, 2)	334.0000	0.000000

D(10, 3)	314.0000	0.000000
D(10, 4)	295.0000	0.000000
D(10, 5)	306.0000	0.000000
D(10, 6)	305.0000	0.000000
D(10, 7)	306.0000	0.000000
D(10, 8)	102.0000	0.000000
D(10, 9)	77.20000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	1.700000	0.000000
D(10, 12)	145.0000	0.000000
D(11, 1)	548.0000	0.000000
D(11, 2)	334.0000	0.000000
D(11, 3)	314.0000	0.000000
D(11, 4)	295.0000	0.000000
D(11, 5)	306.0000	0.000000
D(11, 6)	305.0000	0.000000
D(11, 7)	306.0000	0.000000
D(11, 8)	102.0000	0.000000
D(11, 9)	78.00000	0.000000
D(11, 10)	1.700000	0.000000
D(11, 11)	0.000000	0.000000
D(11, 12)	144.0000	0.000000
D(12, 1)	341.0000	0.000000
D(12, 2)	127.0000	0.000000
D(12, 3)	107.0000	0.000000
D(12, 4)	88.00000	0.000000
D(12, 5)	99.00000	0.000000
D(12, 6)	98.00000	0.000000
D(12, 7)	99.00000	0.000000
D(12, 8)	57.50000	0.000000
D(12, 9)	80.90000	0.000000
D(12, 10)	145.0000	0.000000
D(12, 11)	144.0000	0.000000
D(12, 12)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	302.4000	0.000000
DURASI(1, 3)	280.8000	0.000000
DURASI(1, 4)	309.6000	0.000000
DURASI(1, 5)	304.8000	0.000000
DURASI(1, 6)	307.2000	0.000000
DURASI(1, 7)	310.8000	0.000000
DURASI(1, 8)	477.6000	0.000000
DURASI(1, 9)	506.4000	0.000000
DURASI(1, 10)	657.6000	0.000000

DURASI(1, 11)	657.6000	0.000000
DURASI(1, 12)	409.2000	0.000000
DURASI(2, 1)	302.4000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	24.00000	0.000000
DURASI(2, 4)	52.80000	0.000000
DURASI(2, 5)	46.80000	0.000000
DURASI(2, 6)	50.40000	0.000000
DURASI(2, 7)	55.20000	0.000000
DURASI(2, 8)	220.8000	0.000000
DURASI(2, 9)	249.6000	0.000000
DURASI(2, 10)	400.8000	0.000000
DURASI(2, 11)	400.8000	0.000000
DURASI(2, 12)	152.4000	0.000000
DURASI(3, 1)	280.8000	0.000000
DURASI(3, 2)	24.00000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	28.80000	0.000000
DURASI(3, 5)	24.00000	0.000000
DURASI(3, 6)	27.60000	0.000000
DURASI(3, 7)	30.00000	0.000000
DURASI(3, 8)	196.8000	0.000000
DURASI(3, 9)	225.6000	0.000000
DURASI(3, 10)	376.8000	0.000000
DURASI(3, 11)	376.8000	0.000000
DURASI(3, 12)	128.4000	0.000000
DURASI(4, 1)	309.6000	0.000000
DURASI(4, 2)	52.80000	0.000000
DURASI(4, 3)	28.80000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	8.400000	0.000000
DURASI(4, 6)	7.200000	0.000000
DURASI(4, 7)	10.80000	0.000000
DURASI(4, 8)	165.6000	0.000000
DURASI(4, 9)	189.6000	0.000000
DURASI(4, 10)	354.0000	0.000000
DURASI(4, 11)	354.0000	0.000000
DURASI(4, 12)	105.6000	0.000000
DURASI(5, 1)	304.8000	0.000000
DURASI(5, 2)	46.80000	0.000000
DURASI(5, 3)	24.00000	0.000000
DURASI(5, 4)	8.400000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	3.600000	0.000000

DURASI(5, 7)	7.200000	0.000000
DURASI(5, 8)	187.2000	0.000000
DURASI(5, 9)	199.2000	0.000000
DURASI(5, 10)	367.2000	0.000000
DURASI(5, 11)	367.2000	0.000000
DURASI(5, 12)	118.8000	0.000000
DURASI(6, 1)	307.2000	0.000000
DURASI(6, 2)	50.40000	0.000000
DURASI(6, 3)	27.60000	0.000000
DURASI(6, 4)	7.200000	0.000000
DURASI(6, 5)	3.600000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	8.400000	0.000000
DURASI(6, 8)	187.2000	0.000000
DURASI(6, 9)	196.8000	0.000000
DURASI(6, 10)	366.0000	0.000000
DURASI(6, 11)	366.0000	0.000000
DURASI(6, 12)	117.6000	0.000000
DURASI(7, 1)	310.8000	0.000000
DURASI(7, 2)	55.20000	0.000000
DURASI(7, 3)	30.00000	0.000000
DURASI(7, 4)	10.80000	0.000000
DURASI(7, 5)	7.200000	0.000000
DURASI(7, 6)	8.400000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	169.2000	0.000000
DURASI(7, 9)	193.2000	0.000000
DURASI(7, 10)	367.2000	0.000000
DURASI(7, 11)	367.2000	0.000000
DURASI(7, 12)	118.8000	0.000000
DURASI(8, 1)	477.6000	0.000000
DURASI(8, 2)	220.8000	0.000000
DURASI(8, 3)	196.8000	0.000000
DURASI(8, 4)	165.6000	0.000000
DURASI(8, 5)	187.2000	0.000000
DURASI(8, 6)	187.2000	0.000000
DURASI(8, 7)	169.2000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	29.28000	0.000000
DURASI(8, 10)	122.4000	0.000000
DURASI(8, 11)	122.4000	0.000000
DURASI(8, 12)	69.00000	0.000000
DURASI(9, 1)	506.4000	0.000000
DURASI(9, 2)	249.6000	0.000000

DURASI(9, 3)	225.6000	0.000000
DURASI(9, 4)	189.6000	0.000000
DURASI(9, 5)	199.2000	0.000000
DURASI(9, 6)	196.8000	0.000000
DURASI(9, 7)	193.2000	0.000000
DURASI(9, 8)	29.28000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	92.64000	0.000000
DURASI(9, 11)	93.60000	0.000000
DURASI(9, 12)	97.08000	0.000000
DURASI(10, 1)	657.6000	0.000000
DURASI(10, 2)	400.8000	0.000000
DURASI(10, 3)	376.8000	0.000000
DURASI(10, 4)	354.0000	0.000000
DURASI(10, 5)	367.2000	0.000000
DURASI(10, 6)	366.0000	0.000000
DURASI(10, 7)	367.2000	0.000000
DURASI(10, 8)	122.4000	0.000000
DURASI(10, 9)	92.64000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	2.040000	0.000000
DURASI(10, 12)	174.0000	0.000000
DURASI(11, 1)	657.6000	0.000000
DURASI(11, 2)	400.8000	0.000000
DURASI(11, 3)	376.8000	0.000000
DURASI(11, 4)	354.0000	0.000000
DURASI(11, 5)	367.2000	0.000000
DURASI(11, 6)	366.0000	0.000000
DURASI(11, 7)	367.2000	0.000000
DURASI(11, 8)	122.4000	0.000000
DURASI(11, 9)	93.60000	0.000000
DURASI(11, 10)	2.040000	0.000000
DURASI(11, 11)	0.000000	0.000000
DURASI(11, 12)	172.8000	0.000000
DURASI(12, 1)	409.2000	0.000000
DURASI(12, 2)	152.4000	0.000000
DURASI(12, 3)	128.4000	0.000000
DURASI(12, 4)	105.6000	0.000000
DURASI(12, 5)	118.8000	0.000000
DURASI(12, 6)	117.6000	0.000000
DURASI(12, 7)	118.8000	0.000000
DURASI(12, 8)	69.00000	0.000000
DURASI(12, 9)	97.08000	0.000000
DURASI(12, 10)	174.0000	0.000000

DURASI(12, 11)	172.8000	0.000000
DURASI(12, 12)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 5* analisis sensitivitas skenario 2

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..11/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 660 540 540 540 540 540 540 540;
tutup = 1020 660 1260 780 1260 1260 1260 1260 1260 1260 1260;
```

```
D =
!ritel
!0      16      19      20      21      39      40      41      42      43
      49;
0      49.3    161     160     160     312     316     321     321     320
      323     !0;
49.3   0       126     125     125     277     281     287     287     285
      289     !16;
161    126     0       5.4     1.7     171     175     180     181     179
      182     !19;
160    125     5.4     0       3.1     169     173     179     179     177
      180     !20;
160    125     1.7     3.1     0       169     173     179     179     177
      180     !21;
312    277     171     169     169     0       4       10     10     9     14
      !39;
316    281     175     173     173     4       0       9.5    9.8    8.1
      13.2    !40;
```

```

321  287  180  179  179  10  9.5  0  0.9  1.9  9.5
      !41;
321  287  181  179  179  10  9.8  0.9  0  1.7
      10.3  !42;
320  285  179  177  177  9  8.1  1.9  1.7  0
      11.1  !43;
323  289  182  180  180  14  13.2  9.5  10.3  11.1  0;
      !49;

```

```

durasi =
0      59.16 193.2 192  192  374.4 379.2 385.2 385.2 384
      387.6
59.16 0      151.2 150  150  332.4 337.2 344.4 344.4 342
      346.8
193.2 151.2 0      6.48 2.04 205.2 210  216  217.2 214.8
      218.4
192  150  6.48 0      3.72 202.8 207.6 214.8 214.8 212.4
      216
192  150  2.04 3.72 0      202.8 207.6 214.8 214.8 212.4
      216
374.4 332.4 205.2 202.8 202.8 0  4.8  12  12  10.8
      16.8
379.2 337.2 210  207.6 207.6 4.8  0  11.4 11.76 9.72
      15.84
385.2 344.4 216  214.8 214.8 12  11.4 0  1.08 2.28
      11.4
385.2 344.4 217.2 214.8 214.8 12  11.76 1.08 0  2.04
      12.36
384  342  214.8 212.4 212.4 10.8 9.72 2.28 2.04 0
      13.32
387.6 346.8 218.4 216  216  16.8 15.84 11.4 12.36 13.32 0;

```

```

Bongkar= 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;
MIN =

```

```

        @SUM (ritel(i) :
                @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
        @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
        @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
        @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
        @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
        @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
        @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 5* analisis sensitivitas skenario 2

Global optimal solution found.

Objective value: 697.3000
 Objective bound: 697.3000
 Infeasibilities: 0.000000
 Extended solver steps: 497
 Total solver iterations: 5586
 Elapsed runtime seconds: 1.05

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 49.3 km
 rute pengiriman dari ritel 2 ke ritel 4 sebesar 125 km
 rute pengiriman dari ritel 3 ke ritel 6 sebesar 171 km
 rute pengiriman dari ritel 4 ke ritel 5 sebesar 3.1 km
 rute pengiriman dari ritel 5 ke ritel 3 sebesar 1.7 km
 rute pengiriman dari ritel 6 ke ritel 7 sebesar 4 km
 rute pengiriman dari ritel 7 ke ritel 10 sebesar 8.1 km
 rute pengiriman dari ritel 8 ke ritel 11 sebesar 9.5 km
 rute pengiriman dari ritel 9 ke ritel 8 sebesar 0.9 km
 rute pengiriman dari ritel 10 ke ritel 9 sebesar 1.7 km
 rute pengiriman dari ritel 11 ke ritel 1 sebesar 323 km

Model Class: MILP

Total variables: 132
 Nonlinear variables: 0
 Integer variables: 121
 Total constraints: 154
 Nonlinear constraints: 0
 Total nonzeros: 780
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000

BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	660.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	780.0000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
T(1)	1647.600	0.000000
T(2)	540.0000	0.000000
T(3)	785.7600	0.000000
T(4)	720.0000	0.000000
T(5)	753.7200	0.000000
T(6)	1020.960	0.000000
T(7)	1055.760	0.000000
T(8)	1158.600	0.000000
T(9)	1127.520	0.000000
T(10)	1095.480	0.000000
T(11)	1230.000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	49.30000
X(1, 3)	0.000000	161.0000
X(1, 4)	0.000000	160.0000
X(1, 5)	0.000000	160.0000
X(1, 6)	0.000000	312.0000
X(1, 7)	0.000000	316.0000

X(1, 8)	0.000000	321.0000
X(1, 9)	0.000000	321.0000
X(1, 10)	0.000000	320.0000
X(1, 11)	0.000000	323.0000
X(2, 1)	0.000000	49.30000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	126.0000
X(2, 4)	1.000000	125.0000
X(2, 5)	0.000000	125.0000
X(2, 6)	0.000000	277.0000
X(2, 7)	0.000000	281.0000
X(2, 8)	0.000000	287.0000
X(2, 9)	0.000000	287.0000
X(2, 10)	0.000000	285.0000
X(2, 11)	0.000000	289.0000
X(3, 1)	0.000000	161.0000
X(3, 2)	0.000000	126.0000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	5.400000
X(3, 5)	0.000000	1.700000
X(3, 6)	1.000000	171.0000
X(3, 7)	0.000000	175.0000
X(3, 8)	0.000000	180.0000
X(3, 9)	0.000000	181.0000
X(3, 10)	0.000000	179.0000
X(3, 11)	0.000000	182.0000
X(4, 1)	0.000000	160.0000
X(4, 2)	0.000000	125.0000
X(4, 3)	0.000000	5.400000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	3.100000
X(4, 6)	0.000000	169.0000
X(4, 7)	0.000000	173.0000
X(4, 8)	0.000000	179.0000
X(4, 9)	0.000000	179.0000
X(4, 10)	0.000000	177.0000
X(4, 11)	0.000000	180.0000
X(5, 1)	0.000000	160.0000
X(5, 2)	0.000000	125.0000
X(5, 3)	1.000000	1.700000
X(5, 4)	0.000000	3.100000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	169.0000
X(5, 7)	0.000000	173.0000

X(5, 8)	0.000000	179.0000
X(5, 9)	0.000000	179.0000
X(5, 10)	0.000000	177.0000
X(5, 11)	0.000000	180.0000
X(6, 1)	0.000000	312.0000
X(6, 2)	0.000000	277.0000
X(6, 3)	0.000000	171.0000
X(6, 4)	0.000000	169.0000
X(6, 5)	0.000000	169.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	1.000000	4.000000
X(6, 8)	0.000000	10.00000
X(6, 9)	0.000000	10.00000
X(6, 10)	0.000000	9.000000
X(6, 11)	0.000000	14.00000
X(7, 1)	0.000000	316.0000
X(7, 2)	0.000000	281.0000
X(7, 3)	0.000000	175.0000
X(7, 4)	0.000000	173.0000
X(7, 5)	0.000000	173.0000
X(7, 6)	0.000000	4.000000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	9.500000
X(7, 9)	0.000000	9.800000
X(7, 10)	1.000000	8.100000
X(7, 11)	0.000000	13.20000
X(8, 1)	0.000000	321.0000
X(8, 2)	0.000000	287.0000
X(8, 3)	0.000000	180.0000
X(8, 4)	0.000000	179.0000
X(8, 5)	0.000000	179.0000
X(8, 6)	0.000000	10.00000
X(8, 7)	0.000000	9.500000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	0.9000000
X(8, 10)	0.000000	1.900000
X(8, 11)	1.000000	9.500000
X(9, 1)	0.000000	321.0000
X(9, 2)	0.000000	287.0000
X(9, 3)	0.000000	181.0000
X(9, 4)	0.000000	179.0000
X(9, 5)	0.000000	179.0000
X(9, 6)	0.000000	10.00000
X(9, 7)	0.000000	9.800000

X(9, 8)	1.000000	0.9000000
X(9, 9)	0.000000	0.000000
X(9, 10)	0.000000	1.700000
X(9, 11)	0.000000	10.30000
X(10, 1)	0.000000	320.0000
X(10, 2)	0.000000	285.0000
X(10, 3)	0.000000	179.0000
X(10, 4)	0.000000	177.0000
X(10, 5)	0.000000	177.0000
X(10, 6)	0.000000	9.000000
X(10, 7)	0.000000	8.100000
X(10, 8)	0.000000	1.900000
X(10, 9)	1.000000	1.700000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	11.10000
X(11, 1)	1.000000	323.0000
X(11, 2)	0.000000	289.0000
X(11, 3)	0.000000	182.0000
X(11, 4)	0.000000	180.0000
X(11, 5)	0.000000	180.0000
X(11, 6)	0.000000	14.00000
X(11, 7)	0.000000	13.20000
X(11, 8)	0.000000	9.500000
X(11, 9)	0.000000	10.30000
X(11, 10)	0.000000	11.10000
X(11, 11)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	49.30000	0.000000
D(1, 3)	161.0000	0.000000
D(1, 4)	160.0000	0.000000
D(1, 5)	160.0000	0.000000
D(1, 6)	312.0000	0.000000
D(1, 7)	316.0000	0.000000
D(1, 8)	321.0000	0.000000
D(1, 9)	321.0000	0.000000
D(1, 10)	320.0000	0.000000
D(1, 11)	323.0000	0.000000
D(2, 1)	49.30000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	126.0000	0.000000
D(2, 4)	125.0000	0.000000
D(2, 5)	125.0000	0.000000
D(2, 6)	277.0000	0.000000
D(2, 7)	281.0000	0.000000

D(2, 8)	287.0000	0.000000
D(2, 9)	287.0000	0.000000
D(2, 10)	285.0000	0.000000
D(2, 11)	289.0000	0.000000
D(3, 1)	161.0000	0.000000
D(3, 2)	126.0000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	5.400000	0.000000
D(3, 5)	1.700000	0.000000
D(3, 6)	171.0000	0.000000
D(3, 7)	175.0000	0.000000
D(3, 8)	180.0000	0.000000
D(3, 9)	181.0000	0.000000
D(3, 10)	179.0000	0.000000
D(3, 11)	182.0000	0.000000
D(4, 1)	160.0000	0.000000
D(4, 2)	125.0000	0.000000
D(4, 3)	5.400000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	3.100000	0.000000
D(4, 6)	169.0000	0.000000
D(4, 7)	173.0000	0.000000
D(4, 8)	179.0000	0.000000
D(4, 9)	179.0000	0.000000
D(4, 10)	177.0000	0.000000
D(4, 11)	180.0000	0.000000
D(5, 1)	160.0000	0.000000
D(5, 2)	125.0000	0.000000
D(5, 3)	1.700000	0.000000
D(5, 4)	3.100000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	169.0000	0.000000
D(5, 7)	173.0000	0.000000
D(5, 8)	179.0000	0.000000
D(5, 9)	179.0000	0.000000
D(5, 10)	177.0000	0.000000
D(5, 11)	180.0000	0.000000
D(6, 1)	312.0000	0.000000
D(6, 2)	277.0000	0.000000
D(6, 3)	171.0000	0.000000
D(6, 4)	169.0000	0.000000
D(6, 5)	169.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	4.000000	0.000000

D(6, 8)	10.00000	0.000000
D(6, 9)	10.00000	0.000000
D(6, 10)	9.000000	0.000000
D(6, 11)	14.00000	0.000000
D(7, 1)	316.0000	0.000000
D(7, 2)	281.0000	0.000000
D(7, 3)	175.0000	0.000000
D(7, 4)	173.0000	0.000000
D(7, 5)	173.0000	0.000000
D(7, 6)	4.000000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	9.500000	0.000000
D(7, 9)	9.800000	0.000000
D(7, 10)	8.100000	0.000000
D(7, 11)	13.20000	0.000000
D(8, 1)	321.0000	0.000000
D(8, 2)	287.0000	0.000000
D(8, 3)	180.0000	0.000000
D(8, 4)	179.0000	0.000000
D(8, 5)	179.0000	0.000000
D(8, 6)	10.00000	0.000000
D(8, 7)	9.500000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	0.9000000	0.000000
D(8, 10)	1.900000	0.000000
D(8, 11)	9.500000	0.000000
D(9, 1)	321.0000	0.000000
D(9, 2)	287.0000	0.000000
D(9, 3)	181.0000	0.000000
D(9, 4)	179.0000	0.000000
D(9, 5)	179.0000	0.000000
D(9, 6)	10.00000	0.000000
D(9, 7)	9.800000	0.000000
D(9, 8)	0.9000000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	1.700000	0.000000
D(9, 11)	10.30000	0.000000
D(10, 1)	320.0000	0.000000
D(10, 2)	285.0000	0.000000
D(10, 3)	179.0000	0.000000
D(10, 4)	177.0000	0.000000
D(10, 5)	177.0000	0.000000
D(10, 6)	9.000000	0.000000
D(10, 7)	8.100000	0.000000

D(10, 8)	1.900000	0.000000
D(10, 9)	1.700000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	11.10000	0.000000
D(11, 1)	323.0000	0.000000
D(11, 2)	289.0000	0.000000
D(11, 3)	182.0000	0.000000
D(11, 4)	180.0000	0.000000
D(11, 5)	180.0000	0.000000
D(11, 6)	14.00000	0.000000
D(11, 7)	13.20000	0.000000
D(11, 8)	9.500000	0.000000
D(11, 9)	10.30000	0.000000
D(11, 10)	11.10000	0.000000
D(11, 11)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	59.16000	0.000000
DURASI(1, 3)	193.2000	0.000000
DURASI(1, 4)	192.0000	0.000000
DURASI(1, 5)	192.0000	0.000000
DURASI(1, 6)	374.4000	0.000000
DURASI(1, 7)	379.2000	0.000000
DURASI(1, 8)	385.2000	0.000000
DURASI(1, 9)	385.2000	0.000000
DURASI(1, 10)	384.0000	0.000000
DURASI(1, 11)	387.6000	0.000000
DURASI(2, 1)	59.16000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	151.2000	0.000000
DURASI(2, 4)	150.0000	0.000000
DURASI(2, 5)	150.0000	0.000000
DURASI(2, 6)	332.4000	0.000000
DURASI(2, 7)	337.2000	0.000000
DURASI(2, 8)	344.4000	0.000000
DURASI(2, 9)	344.4000	0.000000
DURASI(2, 10)	342.0000	0.000000
DURASI(2, 11)	346.8000	0.000000
DURASI(3, 1)	193.2000	0.000000
DURASI(3, 2)	151.2000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	6.480000	0.000000
DURASI(3, 5)	2.040000	0.000000
DURASI(3, 6)	205.2000	0.000000
DURASI(3, 7)	210.0000	0.000000

DURASI(3, 8)	216.0000	0.000000
DURASI(3, 9)	217.2000	0.000000
DURASI(3, 10)	214.8000	0.000000
DURASI(3, 11)	218.4000	0.000000
DURASI(4, 1)	192.0000	0.000000
DURASI(4, 2)	150.0000	0.000000
DURASI(4, 3)	6.480000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	3.720000	0.000000
DURASI(4, 6)	202.8000	0.000000
DURASI(4, 7)	207.6000	0.000000
DURASI(4, 8)	214.8000	0.000000
DURASI(4, 9)	214.8000	0.000000
DURASI(4, 10)	212.4000	0.000000
DURASI(4, 11)	216.0000	0.000000
DURASI(5, 1)	192.0000	0.000000
DURASI(5, 2)	150.0000	0.000000
DURASI(5, 3)	2.040000	0.000000
DURASI(5, 4)	3.720000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	202.8000	0.000000
DURASI(5, 7)	207.6000	0.000000
DURASI(5, 8)	214.8000	0.000000
DURASI(5, 9)	214.8000	0.000000
DURASI(5, 10)	212.4000	0.000000
DURASI(5, 11)	216.0000	0.000000
DURASI(6, 1)	374.4000	0.000000
DURASI(6, 2)	332.4000	0.000000
DURASI(6, 3)	205.2000	0.000000
DURASI(6, 4)	202.8000	0.000000
DURASI(6, 5)	202.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.800000	0.000000
DURASI(6, 8)	12.00000	0.000000
DURASI(6, 9)	12.00000	0.000000
DURASI(6, 10)	10.80000	0.000000
DURASI(6, 11)	16.80000	0.000000
DURASI(7, 1)	379.2000	0.000000
DURASI(7, 2)	337.2000	0.000000
DURASI(7, 3)	210.0000	0.000000
DURASI(7, 4)	207.6000	0.000000
DURASI(7, 5)	207.6000	0.000000
DURASI(7, 6)	4.800000	0.000000
DURASI(7, 7)	0.000000	0.000000

DURASI(7, 8)	11.40000	0.000000
DURASI(7, 9)	11.76000	0.000000
DURASI(7, 10)	9.720000	0.000000
DURASI(7, 11)	15.84000	0.000000
DURASI(8, 1)	385.2000	0.000000
DURASI(8, 2)	344.4000	0.000000
DURASI(8, 3)	216.0000	0.000000
DURASI(8, 4)	214.8000	0.000000
DURASI(8, 5)	214.8000	0.000000
DURASI(8, 6)	12.00000	0.000000
DURASI(8, 7)	11.40000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	1.080000	0.000000
DURASI(8, 10)	2.280000	0.000000
DURASI(8, 11)	11.40000	0.000000
DURASI(9, 1)	385.2000	0.000000
DURASI(9, 2)	344.4000	0.000000
DURASI(9, 3)	217.2000	0.000000
DURASI(9, 4)	214.8000	0.000000
DURASI(9, 5)	214.8000	0.000000
DURASI(9, 6)	12.00000	0.000000
DURASI(9, 7)	11.76000	0.000000
DURASI(9, 8)	1.080000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	2.040000	0.000000
DURASI(9, 11)	12.36000	0.000000
DURASI(10, 1)	384.0000	0.000000
DURASI(10, 2)	342.0000	0.000000
DURASI(10, 3)	214.8000	0.000000
DURASI(10, 4)	212.4000	0.000000
DURASI(10, 5)	212.4000	0.000000
DURASI(10, 6)	10.80000	0.000000
DURASI(10, 7)	9.720000	0.000000
DURASI(10, 8)	2.280000	0.000000
DURASI(10, 9)	2.040000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	13.32000	0.000000
DURASI(11, 1)	387.6000	0.000000
DURASI(11, 2)	346.8000	0.000000
DURASI(11, 3)	218.4000	0.000000
DURASI(11, 4)	216.0000	0.000000
DURASI(11, 5)	216.0000	0.000000
DURASI(11, 6)	16.80000	0.000000
DURASI(11, 7)	15.84000	0.000000

DURASI(11, 8)	11.40000	0.000000
DURASI(11, 9)	12.36000	0.000000
DURASI(11, 10)	13.32000	0.000000
DURASI(11, 11)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster* 6 analisis sensitivitas skenario 2

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..8/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 540 540 660;
tutup = 1020 660 1260 1260 1260 1260 1260 780;
```

D =

```
!ritel
!0    4    17    18    22    23    24    28;
0    12.3  115  115  193  102  93   157  !0;
12.3  0    120  121  198  83.1  75.1  148  !4;
115  120  0    1.1  96.1  83   96.4  45.8  !17;
115  121  1.1  0    95   84.5  97.8  46   !18;
193  198  96.1  95   0    194  266  103  !22;
102  83.1  83   84.5  194  0    14.9  75.3  !23;
93   75.1  96.4  97.8  266  14.9  0    76.6  !24;
157  148  45.8  46   103  75.3  76.6  0;   !28;
```

durasi =

```
0    14.76  138   138   231.6  122.4  111.6  188.4
14.76  0    144   145.2  237.6  99.72  90.12  177.6
138   144   0    1.32  115.32  99.6   115.68  54.96
138   145.2  1.32  0    114   101.4  117.36  55.2
```



```

231.6 237.6 115.32      114    0      232.8 319.2 123.6
122.4 99.72 99.6   101.4 232.8 0      17.88 90.36
111.6 90.12 115.68      117.36      319.2 17.88 0      91.92
188.4 177.6 54.96 55.2  123.6 90.36 91.92 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

```

```

!Fungsi batasan;

```

```

!setiap ritel dikunjungi satu kali;

```

```

@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

```

```

!perjalanan diawali dari depot;

```

```

@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

```

```

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

```

```

!pelaksanaan;

```

```

@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

```

```

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 6* analisis sensitivitas skenario 2

Global optimal solution found.

Objective value:	623.9000
Objective bound:	623.9000
Infeasibilities:	0.000000
Extended solver steps:	24
Total solver iterations:	8274
Elapsed runtime seconds:	0.48

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 12.3 km
rute pengiriman dari ritel 2 ke ritel 8 sebesar 148 km
rute pengiriman dari ritel 3 ke ritel 4 sebesar 1.1 km
rute pengiriman dari ritel 4 ke ritel 5 sebesar 95 km
rute pengiriman dari ritel 5 ke ritel 1 sebesar 193 km
rute pengiriman dari ritel 6 ke ritel 3 sebesar 83 km
rute pengiriman dari ritel 7 ke ritel 6 sebesar 14.9 km
rute pengiriman dari ritel 8 ke ritel 7 sebesar 76.59999999999999 km

Model Class: MILP

Total variables:	72
Nonlinear variables:	0

Integer variables: 64
 Total constraints: 88
 Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	660.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	780.0000	0.000000
T(1)	1491.600	0.000000
T(2)	540.0000	0.000000
T(3)	1054.680	0.000000
T(4)	1086.000	0.000000
T(5)	1230.000	0.000000
T(6)	925.0800	0.000000
T(7)	869.5200	0.000000
T(8)	747.6000	0.000000

X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	12.30000
X(1, 3)	0.000000	115.0000
X(1, 4)	0.000000	115.0000
X(1, 5)	0.000000	193.0000
X(1, 6)	0.000000	102.0000
X(1, 7)	0.000000	93.00000
X(1, 8)	0.000000	157.0000
X(2, 1)	0.000000	12.30000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	120.0000
X(2, 4)	0.000000	121.0000
X(2, 5)	0.000000	198.0000
X(2, 6)	0.000000	83.10000
X(2, 7)	0.000000	75.10000
X(2, 8)	1.000000	148.0000
X(3, 1)	0.000000	115.0000
X(3, 2)	0.000000	120.0000
X(3, 3)	0.000000	0.000000
X(3, 4)	1.000000	1.100000
X(3, 5)	0.000000	96.10000
X(3, 6)	0.000000	83.00000
X(3, 7)	0.000000	96.40000
X(3, 8)	0.000000	45.80000
X(4, 1)	0.000000	115.0000
X(4, 2)	0.000000	121.0000
X(4, 3)	0.000000	1.100000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	95.00000
X(4, 6)	0.000000	84.50000
X(4, 7)	0.000000	97.80000
X(4, 8)	0.000000	46.00000
X(5, 1)	1.000000	193.0000
X(5, 2)	0.000000	198.0000
X(5, 3)	0.000000	96.10000
X(5, 4)	0.000000	95.00000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	194.0000
X(5, 7)	0.000000	266.0000
X(5, 8)	0.000000	103.0000
X(6, 1)	0.000000	102.0000
X(6, 2)	0.000000	83.10000
X(6, 3)	1.000000	83.00000
X(6, 4)	0.000000	84.50000

X(6, 5)	0.000000	194.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	14.90000
X(6, 8)	0.000000	75.30000
X(7, 1)	0.000000	93.00000
X(7, 2)	0.000000	75.10000
X(7, 3)	0.000000	96.40000
X(7, 4)	0.000000	97.80000
X(7, 5)	0.000000	266.0000
X(7, 6)	1.000000	14.90000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	76.60000
X(8, 1)	0.000000	157.0000
X(8, 2)	0.000000	148.0000
X(8, 3)	0.000000	45.80000
X(8, 4)	0.000000	46.00000
X(8, 5)	0.000000	103.0000
X(8, 6)	0.000000	75.30000
X(8, 7)	1.000000	76.60000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	12.30000	0.000000
D(1, 3)	115.0000	0.000000
D(1, 4)	115.0000	0.000000
D(1, 5)	193.0000	0.000000
D(1, 6)	102.0000	0.000000
D(1, 7)	93.00000	0.000000
D(1, 8)	157.0000	0.000000
D(2, 1)	12.30000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	120.0000	0.000000
D(2, 4)	121.0000	0.000000
D(2, 5)	198.0000	0.000000
D(2, 6)	83.10000	0.000000
D(2, 7)	75.10000	0.000000
D(2, 8)	148.0000	0.000000
D(3, 1)	115.0000	0.000000
D(3, 2)	120.0000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	1.100000	0.000000
D(3, 5)	96.10000	0.000000
D(3, 6)	83.00000	0.000000
D(3, 7)	96.40000	0.000000
D(3, 8)	45.80000	0.000000

D(4, 1)	115.0000	0.000000
D(4, 2)	121.0000	0.000000
D(4, 3)	1.100000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	95.00000	0.000000
D(4, 6)	84.50000	0.000000
D(4, 7)	97.80000	0.000000
D(4, 8)	46.00000	0.000000
D(5, 1)	193.0000	0.000000
D(5, 2)	198.0000	0.000000
D(5, 3)	96.10000	0.000000
D(5, 4)	95.00000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	194.0000	0.000000
D(5, 7)	266.0000	0.000000
D(5, 8)	103.0000	0.000000
D(6, 1)	102.0000	0.000000
D(6, 2)	83.10000	0.000000
D(6, 3)	83.00000	0.000000
D(6, 4)	84.50000	0.000000
D(6, 5)	194.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	14.90000	0.000000
D(6, 8)	75.30000	0.000000
D(7, 1)	93.00000	0.000000
D(7, 2)	75.10000	0.000000
D(7, 3)	96.40000	0.000000
D(7, 4)	97.80000	0.000000
D(7, 5)	266.0000	0.000000
D(7, 6)	14.90000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	76.60000	0.000000
D(8, 1)	157.0000	0.000000
D(8, 2)	148.0000	0.000000
D(8, 3)	45.80000	0.000000
D(8, 4)	46.00000	0.000000
D(8, 5)	103.0000	0.000000
D(8, 6)	75.30000	0.000000
D(8, 7)	76.60000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	14.76000	0.000000
DURASI(1, 3)	138.0000	0.000000
DURASI(1, 4)	138.0000	0.000000

DURASI(1, 5)	231.6000	0.000000
DURASI(1, 6)	122.4000	0.000000
DURASI(1, 7)	111.6000	0.000000
DURASI(1, 8)	188.4000	0.000000
DURASI(2, 1)	14.76000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	144.0000	0.000000
DURASI(2, 4)	145.2000	0.000000
DURASI(2, 5)	237.6000	0.000000
DURASI(2, 6)	99.72000	0.000000
DURASI(2, 7)	90.12000	0.000000
DURASI(2, 8)	177.6000	0.000000
DURASI(3, 1)	138.0000	0.000000
DURASI(3, 2)	144.0000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	1.320000	0.000000
DURASI(3, 5)	115.3200	0.000000
DURASI(3, 6)	99.60000	0.000000
DURASI(3, 7)	115.6800	0.000000
DURASI(3, 8)	54.96000	0.000000
DURASI(4, 1)	138.0000	0.000000
DURASI(4, 2)	145.2000	0.000000
DURASI(4, 3)	1.320000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	114.0000	0.000000
DURASI(4, 6)	101.4000	0.000000
DURASI(4, 7)	117.3600	0.000000
DURASI(4, 8)	55.20000	0.000000
DURASI(5, 1)	231.6000	0.000000
DURASI(5, 2)	237.6000	0.000000
DURASI(5, 3)	115.3200	0.000000
DURASI(5, 4)	114.0000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	232.8000	0.000000
DURASI(5, 7)	319.2000	0.000000
DURASI(5, 8)	123.6000	0.000000
DURASI(6, 1)	122.4000	0.000000
DURASI(6, 2)	99.72000	0.000000
DURASI(6, 3)	99.60000	0.000000
DURASI(6, 4)	101.4000	0.000000
DURASI(6, 5)	232.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	17.88000	0.000000
DURASI(6, 8)	90.36000	0.000000

DURASI(7, 1)	111.6000	0.000000
DURASI(7, 2)	90.12000	0.000000
DURASI(7, 3)	115.6800	0.000000
DURASI(7, 4)	117.3600	0.000000
DURASI(7, 5)	319.2000	0.000000
DURASI(7, 6)	17.88000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	91.92000	0.000000
DURASI(8, 1)	188.4000	0.000000
DURASI(8, 2)	177.6000	0.000000
DURASI(8, 3)	54.96000	0.000000
DURASI(8, 4)	55.20000	0.000000
DURASI(8, 5)	123.6000	0.000000
DURASI(8, 6)	90.36000	0.000000
DURASI(8, 7)	91.92000	0.000000
DURASI(8, 8)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 7* analisis sensitivitas skenario 2

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..8/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 660 540 540 540 540;
tutup = 1020 660 1260 780 1260 1260 1260 1260;
```

D =

```
!ritel
!0   12   13   14   15   25   26   27;
0    146  190  192  194  92.2  93.8  93   !0;
146  0    63.4  64.1  66.9  157   159   158  !12;
190  63.4  0    3.2   5.9   200   201   201  !13;
192  64.1  3.2  0    2.9   203   205   204  !14;
194  66.9  5.9  2.9  0    204   206   205  !15;
92.2 157   200  203  204  0    3.1   1.4  !25;
93.8 159   201  205  206  3.1  0    4    !26;
93   158   201  204  205  1.4  4    0;   !27;
```

durasi =

```
0    175.2  228   230.4  232.8  110.64   112.56   111.6
175.2 0    76.08  76.92  80.28  188.4   190.8   189.6
228  76.08 0    3.84   7.08   240    241.2   241.2
230.4 76.92 3.84 0    3.48   243.6  246    244.8
232.8 80.28 7.08 3.48 0    244.8  247.2  246
```

```

110.64      188.4 240    243.6 244.8 0      3.72  1.68
112.56      190.8 241.2 246    247.2 3.72  0      4.8
111.6 189.6 241.2 244.8 246    1.68  4.8   0;

```

```

Bongkar = 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

```

```

!Fungsi batasan;

```

```

!setiap ritel dikunjungi satu kali;

```

```

@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

```

```

!perjalanan diawali dari depot;

```

```

@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

```

```

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

```

```

!pelaksanaan;

```

```

@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

```

```

!rute;

```

```

@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 7* analisis sensitivitas skenario 2

Global optimal solution found.

Objective value:	517.4000
Objective bound:	517.4000
Infeasibilities:	0.000000
Extended solver steps:	5
Total solver iterations:	1219
Elapsed runtime seconds:	0.36

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 146 km
rute pengiriman dari ritel 2 ke ritel 4 sebesar 64.09999999999999 km
rute pengiriman dari ritel 3 ke ritel 7 sebesar 201 km
rute pengiriman dari ritel 4 ke ritel 5 sebesar 2.9 km
rute pengiriman dari ritel 5 ke ritel 3 sebesar 5.9 km
rute pengiriman dari ritel 6 ke ritel 8 sebesar 1.4 km
rute pengiriman dari ritel 7 ke ritel 6 sebesar 3.1 km
rute pengiriman dari ritel 8 ke ritel 1 sebesar 93 km

Model Class: MILP

Total variables:	72
Nonlinear variables:	0
Integer variables:	64

Total constraints: 88
 Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	660.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	780.0000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
T(1)	1492.800	0.000000
T(2)	540.0000	0.000000
T(3)	730.5600	0.000000
T(4)	660.0000	0.000000
T(5)	693.4800	0.000000
T(6)	1198.320	0.000000
T(7)	1001.760	0.000000
T(8)	1230.000	0.000000
X(1, 1)	0.000000	0.000000

X(1, 2)	1.000000	146.0000
X(1, 3)	0.000000	190.0000
X(1, 4)	0.000000	192.0000
X(1, 5)	0.000000	194.0000
X(1, 6)	0.000000	92.20000
X(1, 7)	0.000000	93.80000
X(1, 8)	0.000000	93.00000
X(2, 1)	0.000000	146.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	63.40000
X(2, 4)	1.000000	64.10000
X(2, 5)	0.000000	66.90000
X(2, 6)	0.000000	157.0000
X(2, 7)	0.000000	159.0000
X(2, 8)	0.000000	158.0000
X(3, 1)	0.000000	190.0000
X(3, 2)	0.000000	63.40000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	3.200000
X(3, 5)	0.000000	5.900000
X(3, 6)	0.000000	200.0000
X(3, 7)	1.000000	201.0000
X(3, 8)	0.000000	201.0000
X(4, 1)	0.000000	192.0000
X(4, 2)	0.000000	64.10000
X(4, 3)	0.000000	3.200000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	2.900000
X(4, 6)	0.000000	203.0000
X(4, 7)	0.000000	205.0000
X(4, 8)	0.000000	204.0000
X(5, 1)	0.000000	194.0000
X(5, 2)	0.000000	66.90000
X(5, 3)	1.000000	5.900000
X(5, 4)	0.000000	2.900000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	204.0000
X(5, 7)	0.000000	206.0000
X(5, 8)	0.000000	205.0000
X(6, 1)	0.000000	92.20000
X(6, 2)	0.000000	157.0000
X(6, 3)	0.000000	200.0000
X(6, 4)	0.000000	203.0000
X(6, 5)	0.000000	204.0000

X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.100000
X(6, 8)	1.000000	1.400000
X(7, 1)	0.000000	93.80000
X(7, 2)	0.000000	159.0000
X(7, 3)	0.000000	201.0000
X(7, 4)	0.000000	205.0000
X(7, 5)	0.000000	206.0000
X(7, 6)	1.000000	3.100000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	4.000000
X(8, 1)	1.000000	93.00000
X(8, 2)	0.000000	158.0000
X(8, 3)	0.000000	201.0000
X(8, 4)	0.000000	204.0000
X(8, 5)	0.000000	205.0000
X(8, 6)	0.000000	1.400000
X(8, 7)	0.000000	4.000000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	146.0000	0.000000
D(1, 3)	190.0000	0.000000
D(1, 4)	192.0000	0.000000
D(1, 5)	194.0000	0.000000
D(1, 6)	92.20000	0.000000
D(1, 7)	93.80000	0.000000
D(1, 8)	93.00000	0.000000
D(2, 1)	146.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	63.40000	0.000000
D(2, 4)	64.10000	0.000000
D(2, 5)	66.90000	0.000000
D(2, 6)	157.0000	0.000000
D(2, 7)	159.0000	0.000000
D(2, 8)	158.0000	0.000000
D(3, 1)	190.0000	0.000000
D(3, 2)	63.40000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	3.200000	0.000000
D(3, 5)	5.900000	0.000000
D(3, 6)	200.0000	0.000000
D(3, 7)	201.0000	0.000000
D(3, 8)	201.0000	0.000000
D(4, 1)	192.0000	0.000000

D(4, 2)	64.10000	0.000000
D(4, 3)	3.200000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	2.900000	0.000000
D(4, 6)	203.0000	0.000000
D(4, 7)	205.0000	0.000000
D(4, 8)	204.0000	0.000000
D(5, 1)	194.0000	0.000000
D(5, 2)	66.90000	0.000000
D(5, 3)	5.900000	0.000000
D(5, 4)	2.900000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	204.0000	0.000000
D(5, 7)	206.0000	0.000000
D(5, 8)	205.0000	0.000000
D(6, 1)	92.20000	0.000000
D(6, 2)	157.0000	0.000000
D(6, 3)	200.0000	0.000000
D(6, 4)	203.0000	0.000000
D(6, 5)	204.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.100000	0.000000
D(6, 8)	1.400000	0.000000
D(7, 1)	93.80000	0.000000
D(7, 2)	159.0000	0.000000
D(7, 3)	201.0000	0.000000
D(7, 4)	205.0000	0.000000
D(7, 5)	206.0000	0.000000
D(7, 6)	3.100000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	4.000000	0.000000
D(8, 1)	93.00000	0.000000
D(8, 2)	158.0000	0.000000
D(8, 3)	201.0000	0.000000
D(8, 4)	204.0000	0.000000
D(8, 5)	205.0000	0.000000
D(8, 6)	1.400000	0.000000
D(8, 7)	4.000000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	175.2000	0.000000
DURASI(1, 3)	228.0000	0.000000
DURASI(1, 4)	230.4000	0.000000
DURASI(1, 5)	232.8000	0.000000

DURASI(1, 6)	110.6400	0.000000
DURASI(1, 7)	112.5600	0.000000
DURASI(1, 8)	111.6000	0.000000
DURASI(2, 1)	175.2000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	76.08000	0.000000
DURASI(2, 4)	76.92000	0.000000
DURASI(2, 5)	80.28000	0.000000
DURASI(2, 6)	188.4000	0.000000
DURASI(2, 7)	190.8000	0.000000
DURASI(2, 8)	189.6000	0.000000
DURASI(3, 1)	228.0000	0.000000
DURASI(3, 2)	76.08000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	3.840000	0.000000
DURASI(3, 5)	7.080000	0.000000
DURASI(3, 6)	240.0000	0.000000
DURASI(3, 7)	241.2000	0.000000
DURASI(3, 8)	241.2000	0.000000
DURASI(4, 1)	230.4000	0.000000
DURASI(4, 2)	76.92000	0.000000
DURASI(4, 3)	3.840000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	3.480000	0.000000
DURASI(4, 6)	243.6000	0.000000
DURASI(4, 7)	246.0000	0.000000
DURASI(4, 8)	244.8000	0.000000
DURASI(5, 1)	232.8000	0.000000
DURASI(5, 2)	80.28000	0.000000
DURASI(5, 3)	7.080000	0.000000
DURASI(5, 4)	3.480000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	244.8000	0.000000
DURASI(5, 7)	247.2000	0.000000
DURASI(5, 8)	246.0000	0.000000
DURASI(6, 1)	110.6400	0.000000
DURASI(6, 2)	188.4000	0.000000
DURASI(6, 3)	240.0000	0.000000
DURASI(6, 4)	243.6000	0.000000
DURASI(6, 5)	244.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	3.720000	0.000000
DURASI(6, 8)	1.680000	0.000000
DURASI(7, 1)	112.5600	0.000000

DURASI(7, 2)	190.8000	0.000000
DURASI(7, 3)	241.2000	0.000000
DURASI(7, 4)	246.0000	0.000000
DURASI(7, 5)	247.2000	0.000000
DURASI(7, 6)	3.720000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	4.800000	0.000000
DURASI(8, 1)	111.6000	0.000000
DURASI(8, 2)	189.6000	0.000000
DURASI(8, 3)	241.2000	0.000000
DURASI(8, 4)	244.8000	0.000000
DURASI(8, 5)	246.0000	0.000000
DURASI(8, 6)	1.680000	0.000000
DURASI(8, 7)	4.800000	0.000000
DURASI(8, 8)	0.000000	0.000000

Lampiran 13 (Pemrograman Lingo Untuk Analisis Sensitivitas Skenario 3)

- Hasil dari *solution report* pada *cluster 1* analisis sensitivitas skenario 3

Global optimal solution found.

Objective value: 54.60000
 Objective bound: 54.60000
 Infeasibilities: 0.000000
 Extended solver steps: 277
 Total solver iterations: 2159
 Elapsed runtime seconds: 0.31

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 8.9 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 6.8 km
 rute pengiriman dari ritel 3 ke ritel 4 sebesar 7.9 km
 rute pengiriman dari ritel 4 ke ritel 5 sebesar 3.9 km
 rute pengiriman dari ritel 5 ke ritel 6 sebesar 2.6 km
 rute pengiriman dari ritel 6 ke ritel 8 sebesar 2.5 km
 rute pengiriman dari ritel 7 ke ritel 1 sebesar 19.2 km
 rute pengiriman dari ritel 8 ke ritel 7 sebesar 2.8 km

Model Class: MILP

Total variables: 72
 Nonlinear variables: 0
 Integer variables: 64

 Total constraints: 88
 Nonlinear constraints: 0

 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	660.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	780.0000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
T(1)	1285.800	0.000000
T(2)	540.0000	0.000000
T(3)	705.8400	0.000000
T(4)	745.3200	0.000000
T(5)	780.0000	0.000000

T(6)	813.1200	0.000000
T(7)	879.4800	0.000000
T(8)	846.1200	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	8.900000
X(1, 3)	0.000000	13.60000
X(1, 4)	0.000000	19.70000
X(1, 5)	0.000000	20.70000
X(1, 6)	0.000000	21.50000
X(1, 7)	0.000000	19.20000
X(1, 8)	0.000000	18.10000
X(2, 1)	0.000000	8.900000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	6.800000
X(2, 4)	0.000000	13.30000
X(2, 5)	0.000000	14.60000
X(2, 6)	0.000000	13.10000
X(2, 7)	0.000000	10.90000
X(2, 8)	0.000000	8.700000
X(3, 1)	0.000000	13.60000
X(3, 2)	0.000000	6.800000
X(3, 3)	0.000000	0.000000
X(3, 4)	1.000000	7.900000
X(3, 5)	0.000000	10.30000
X(3, 6)	0.000000	10.50000
X(3, 7)	0.000000	8.100000
X(3, 8)	0.000000	9.400000
X(4, 1)	0.000000	19.70000
X(4, 2)	0.000000	13.30000
X(4, 3)	0.000000	7.900000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	3.900000
X(4, 6)	0.000000	4.600000
X(4, 7)	0.000000	4.600000
X(4, 8)	0.000000	5.600000
X(5, 1)	0.000000	20.70000
X(5, 2)	0.000000	14.60000
X(5, 3)	0.000000	10.30000
X(5, 4)	0.000000	3.900000
X(5, 5)	0.000000	0.000000
X(5, 6)	1.000000	2.600000
X(5, 7)	0.000000	5.400000
X(5, 8)	0.000000	3.400000
X(6, 1)	0.000000	21.50000

X(6, 2)	0.000000	13.10000
X(6, 3)	0.000000	10.50000
X(6, 4)	0.000000	4.600000
X(6, 5)	0.000000	2.600000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.600000
X(6, 8)	1.000000	2.500000
X(7, 1)	1.000000	19.20000
X(7, 2)	0.000000	10.90000
X(7, 3)	0.000000	8.100000
X(7, 4)	0.000000	4.600000
X(7, 5)	0.000000	5.400000
X(7, 6)	0.000000	3.600000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	2.800000
X(8, 1)	0.000000	18.10000
X(8, 2)	0.000000	8.700000
X(8, 3)	0.000000	9.400000
X(8, 4)	0.000000	5.600000
X(8, 5)	0.000000	3.400000
X(8, 6)	0.000000	2.500000
X(8, 7)	1.000000	2.800000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	8.900000	0.000000
D(1, 3)	13.60000	0.000000
D(1, 4)	19.70000	0.000000
D(1, 5)	20.70000	0.000000
D(1, 6)	21.50000	0.000000
D(1, 7)	19.20000	0.000000
D(1, 8)	18.10000	0.000000
D(2, 1)	8.900000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	6.800000	0.000000
D(2, 4)	13.30000	0.000000
D(2, 5)	14.60000	0.000000
D(2, 6)	13.10000	0.000000
D(2, 7)	10.90000	0.000000
D(2, 8)	8.700000	0.000000
D(3, 1)	13.60000	0.000000
D(3, 2)	6.800000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	7.900000	0.000000
D(3, 5)	10.30000	0.000000

D(3, 6)	10.50000	0.000000
D(3, 7)	8.100000	0.000000
D(3, 8)	9.400000	0.000000
D(4, 1)	19.70000	0.000000
D(4, 2)	13.30000	0.000000
D(4, 3)	7.900000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	3.900000	0.000000
D(4, 6)	4.600000	0.000000
D(4, 7)	4.600000	0.000000
D(4, 8)	5.600000	0.000000
D(5, 1)	20.70000	0.000000
D(5, 2)	14.60000	0.000000
D(5, 3)	10.30000	0.000000
D(5, 4)	3.900000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	2.600000	0.000000
D(5, 7)	5.400000	0.000000
D(5, 8)	3.400000	0.000000
D(6, 1)	21.50000	0.000000
D(6, 2)	13.10000	0.000000
D(6, 3)	10.50000	0.000000
D(6, 4)	4.600000	0.000000
D(6, 5)	2.600000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.600000	0.000000
D(6, 8)	2.500000	0.000000
D(7, 1)	19.20000	0.000000
D(7, 2)	10.90000	0.000000
D(7, 3)	8.100000	0.000000
D(7, 4)	4.600000	0.000000
D(7, 5)	5.400000	0.000000
D(7, 6)	3.600000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	2.800000	0.000000
D(8, 1)	18.10000	0.000000
D(8, 2)	8.700000	0.000000
D(8, 3)	9.400000	0.000000
D(8, 4)	5.600000	0.000000
D(8, 5)	3.400000	0.000000
D(8, 6)	2.500000	0.000000
D(8, 7)	2.800000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000

DURASI(1, 2)	10.68000	0.000000
DURASI(1, 3)	16.32000	0.000000
DURASI(1, 4)	23.64000	0.000000
DURASI(1, 5)	24.84000	0.000000
DURASI(1, 6)	25.80000	0.000000
DURASI(1, 7)	23.04000	0.000000
DURASI(1, 8)	21.72000	0.000000
DURASI(2, 1)	10.68000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	8.160000	0.000000
DURASI(2, 4)	15.96000	0.000000
DURASI(2, 5)	17.52000	0.000000
DURASI(2, 6)	15.72000	0.000000
DURASI(2, 7)	13.08000	0.000000
DURASI(2, 8)	10.44000	0.000000
DURASI(3, 1)	16.32000	0.000000
DURASI(3, 2)	8.160000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	9.480000	0.000000
DURASI(3, 5)	12.36000	0.000000
DURASI(3, 6)	12.60000	0.000000
DURASI(3, 7)	9.720000	0.000000
DURASI(3, 8)	11.28000	0.000000
DURASI(4, 1)	23.64000	0.000000
DURASI(4, 2)	15.96000	0.000000
DURASI(4, 3)	9.480000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	4.680000	0.000000
DURASI(4, 6)	5.520000	0.000000
DURASI(4, 7)	5.520000	0.000000
DURASI(4, 8)	6.720000	0.000000
DURASI(5, 1)	24.84000	0.000000
DURASI(5, 2)	17.52000	0.000000
DURASI(5, 3)	12.36000	0.000000
DURASI(5, 4)	4.680000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	3.120000	0.000000
DURASI(5, 7)	6.480000	0.000000
DURASI(5, 8)	4.080000	0.000000
DURASI(6, 1)	25.80000	0.000000
DURASI(6, 2)	15.72000	0.000000
DURASI(6, 3)	12.60000	0.000000
DURASI(6, 4)	5.520000	0.000000
DURASI(6, 5)	3.120000	0.000000

DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.320000	0.000000
DURASI(6, 8)	3.000000	0.000000
DURASI(7, 1)	23.04000	0.000000
DURASI(7, 2)	13.08000	0.000000
DURASI(7, 3)	9.720000	0.000000
DURASI(7, 4)	5.520000	0.000000
DURASI(7, 5)	6.480000	0.000000
DURASI(7, 6)	4.320000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	3.360000	0.000000
DURASI(8, 1)	21.72000	0.000000
DURASI(8, 2)	10.44000	0.000000
DURASI(8, 3)	11.28000	0.000000
DURASI(8, 4)	6.720000	0.000000
DURASI(8, 5)	4.080000	0.000000
DURASI(8, 6)	3.000000	0.000000
DURASI(8, 7)	3.360000	0.000000
DURASI(8, 8)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 2* analisis sensitivitas skenario 3

model:

```
!parameter model:
    Buka           = waktu buka ritel
    Tutup          = waktu tutup ritel
    Bongkar        = waktu loading/unloading di ritel
    D              = jarak antar ritel
    T              = waktu memulai pelayanan pada ritel
    Durasi         = Durasi pengiriman
    R              = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..16/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 660 540 540 780 540 540 540 540 540 540
540 540;
```

```
tutup = 1020 660 1260 1260 780 1260 1260 900 1260 1260 1260
1260 1260 1260 1260 1260;
```

D =

```
!ritel
1    2    3    4    5    6    7    8    9    10   11
    12   13   14   15   16
!0   3    6    7    29   30   31   32   50   51   52
    53   54   55   57   60;
0    8.3  41.1  39.6  227  275  324  322  353  353
    351  348  347  347  353  435  !0;
8.3  0    24.4  33   220  268  317  315  346  346
    344  341  341  340  347  428  !3;
41.1 24.4  0    7.5  127  300  208  238  377  377
    376  372  372  372  378  459  !6;
39.6 33   7.5  0    133  297  215  343  374  374
    372  369  369  368  375  456  !7;
```


227	220	127	133	0	85	102	134	230	230	
	228	225	224	224	230	312	!29;			
275	268	300	297	85	0	48	50	71	65	64
	55	71	69	66	166	!30;				
324	317	208	215	102	48	0	28	87	81	80
	81	87	85	82	182	!31;				
322	315	238	343	134	50	28	0	61	55	54
	55	61	59	56	156	!32;				
353	346	377	374	230	71	87	61	0	6.7	5.9
	10	4.8	4.3	7.4	98.2	!50;				
353	346	377	374	230	65	81	55	6.7	0	1.9
	10.3	5.9	4.8	1.8	97.5	!51;				
351	344	376	372	228	64	80	54	5.9	1.9	0
	8.8	9.8	5.3	3.4	100	!52;				
348	341	372	369	225	55	81	55	10	10.3	8.8
	0	10.6	6.2	10.7	105	!53;				
347	341	372	369	224	71	87	61	4.8	5.9	9.8
	10.6	0	4.3	3.5	93.4	!54;				
347	340	372	368	224	69	85	59	4.3	4.8	5.3
	6.2	4.3	0	6.3	101	!55;				
353	347	378	375	230	66	82	56	7.4	1.8	3.4
	10.7	3.5	6.3	0	97.9	!57;				
435	428	459	456	312	166	182	156	98.2	97.5	
	100	105	93.4	101	97.9	0;	!60;			

durasi =

0	9.96	49.32	47.52	272.4	330	388.8	386.4	423.6	423.6	
	421.2	417.6	416.4	416.4	423.6	522				
9.96	0	29.28	39.6	264	321.6	380.4	378	415.2	415.2	
	412.8	409.2	409.2	408	416.4	513.6				
49.32	29.28	0	9	152.4	360	249.6	285.6	452.4	452.4	
	451.2	446.4	446.4	446.4	453.6	550.8				
47.52	39.6	9	0	159.6	356.4	258	411.6	448.8	448.8	
	446.4	442.8	442.8	441.6	450	547.2				
272.4	264	152.4	159.6	0	102	122.4	160.8	276	276	
	273.6	270	268.8	268.8	276	374.4				
330	321.6	360	356.4	102	0	57.6	60	85.2	78	
	76.8	66	85.2	82.8	79.2	199.2				
388.8	380.4	249.6	258	122.4	57.6	0	33.6	104.4	97.2	96
	97.2	104.4	102	98.4	218.4					
386.4	378	285.6	411.6	160.8	60	33.6	0	73.2	66	
	64.8	66	73.2	70.8	67.2	187.2				
423.6	415.2	452.4	448.8	276	85.2	104.4	73.2	0	8.04	
	7.08	12	5.76	5.16	8.88	117.84				

```

423.6 415.2 452.4 448.8 276 78 97.2 66 8.04 0
      2.28 12.36 7.08 5.76 2.16 117
421.2 412.8 451.2 446.4 273.6 76.8 96 64.8 7.08 2.28 0
      10.56 11.76 6.36 4.08 120
417.6 409.2 446.4 442.8 270 66 97.2 66 12 12.36
      10.56 0 12.72 7.44 12.84 126
416.4 409.2 446.4 442.8 268.8 85.2 104.4 73.2 5.76 7.08
      11.76 12.72 0 5.16 4.2 112.08
416.4 408 446.4 441.6 268.8 82.8 102 70.8 5.16 5.76
      6.36 7.44 5.16 0 7.56 121.2
423.6 416.4 453.6 450 276 79.2 98.4 67.2 8.88 2.16
      4.08 12.84 4.2 7.56 0 117.48
522 513.6 550.8 547.2 374.4 199.2 218.4 187.2 117.84
      117 120 126 112.08 121.2 117.48 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) - R * (1 -
x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 2* analisis sensitivitas skenario 3

Feasible solution found.	
Objective value:	905.0000
Objective bound:	619.8000
Infeasibilities:	0.000000
Extended solver steps:	4006
Total solver iterations:	77246
Elapsed runtime seconds:	11.04

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 8.3000000000000001 km

rute pengiriman dari ritel 2 ke ritel 4 sebesar 33 km

rute pengiriman dari ritel 3 ke ritel 5 sebesar 127 km

rute pengiriman dari ritel 4 ke ritel 3 sebesar 7.5 km
 rute pengiriman dari ritel 5 ke ritel 7 sebesar 102 km
 rute pengiriman dari ritel 6 ke ritel 1 sebesar 275 km
 rute pengiriman dari ritel 7 ke ritel 8 sebesar 28 km
 rute pengiriman dari ritel 8 ke ritel 10 sebesar 55 km
 rute pengiriman dari ritel 9 ke ritel 14 sebesar 4.3 km
 rute pengiriman dari ritel 10 ke ritel 16 sebesar 97.5 km
 rute pengiriman dari ritel 11 ke ritel 9 sebesar 5.9 km
 rute pengiriman dari ritel 12 ke ritel 6 sebesar 55 km
 rute pengiriman dari ritel 13 ke ritel 15 sebesar 3.5 km
 rute pengiriman dari ritel 14 ke ritel 12 sebesar 6.2 km
 rute pengiriman dari ritel 15 ke ritel 11 sebesar 3.4 km
 rute pengiriman dari ritel 16 ke ritel 13 sebesar 93.40000000000001 km

Model Class: MILP

Total variables:	272
Nonlinear variables:	0
Integer variables:	256
Total constraints:	304
Nonlinear constraints:	0
Total nonzeros:	1695
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BONGKAR(12)	30.00000	0.000000
BONGKAR(13)	30.00000	0.000000
BONGKAR(14)	30.00000	0.000000
BONGKAR(15)	30.00000	0.000000

BONGKAR(16)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	660.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	780.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
BUKA(12)	540.0000	0.000000
BUKA(13)	540.0000	0.000000
BUKA(14)	540.0000	0.000000
BUKA(15)	540.0000	0.000000
BUKA(16)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	780.0000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	900.0000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
TUTUP(12)	1260.000	0.000000
TUTUP(13)	1260.000	0.000000
TUTUP(14)	1260.000	0.000000
TUTUP(15)	1260.000	0.000000
TUTUP(16)	1260.000	0.000000
T(1)	1260.000	0.000000
T(2)	540.0000	0.000000
T(3)	690.0000	0.000000
T(4)	660.0000	0.000000
T(5)	720.0000	0.000000
T(6)	1050.000	0.000000
T(7)	750.0000	0.000000
T(8)	780.0000	0.000000
T(9)	960.0000	0.000000
T(10)	810.0000	0.000000
T(11)	930.0000	0.000000

T(12)	1020.0000	0.000000
T(13)	870.0000	0.000000
T(14)	990.0000	0.000000
T(15)	900.0000	0.000000
T(16)	840.0000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	8.300000
X(1, 3)	0.000000	41.100000
X(1, 4)	0.000000	39.600000
X(1, 5)	0.000000	227.0000
X(1, 6)	0.000000	275.0000
X(1, 7)	0.000000	324.0000
X(1, 8)	0.000000	322.0000
X(1, 9)	0.000000	353.0000
X(1, 10)	0.000000	353.0000
X(1, 11)	0.000000	351.0000
X(1, 12)	0.000000	348.0000
X(1, 13)	0.000000	347.0000
X(1, 14)	0.000000	347.0000
X(1, 15)	0.000000	353.0000
X(1, 16)	0.000000	435.0000
X(2, 1)	0.000000	8.300000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	24.400000
X(2, 4)	1.000000	33.000000
X(2, 5)	0.000000	220.0000
X(2, 6)	0.000000	268.0000
X(2, 7)	0.000000	317.0000
X(2, 8)	0.000000	315.0000
X(2, 9)	0.000000	346.0000
X(2, 10)	0.000000	346.0000
X(2, 11)	0.000000	344.0000
X(2, 12)	0.000000	341.0000
X(2, 13)	0.000000	341.0000
X(2, 14)	0.000000	340.0000
X(2, 15)	0.000000	347.0000
X(2, 16)	0.000000	428.0000
X(3, 1)	0.000000	41.100000
X(3, 2)	0.000000	24.400000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	7.500000
X(3, 5)	1.000000	127.0000
X(3, 6)	0.000000	300.0000
X(3, 7)	0.000000	208.0000

X(3, 8)	0.000000	238.0000
X(3, 9)	0.000000	377.0000
X(3, 10)	0.000000	377.0000
X(3, 11)	0.000000	376.0000
X(3, 12)	0.000000	372.0000
X(3, 13)	0.000000	372.0000
X(3, 14)	0.000000	372.0000
X(3, 15)	0.000000	378.0000
X(3, 16)	0.000000	459.0000
X(4, 1)	0.000000	39.60000
X(4, 2)	0.000000	33.00000
X(4, 3)	1.000000	7.500000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	133.0000
X(4, 6)	0.000000	297.0000
X(4, 7)	0.000000	215.0000
X(4, 8)	0.000000	343.0000
X(4, 9)	0.000000	374.0000
X(4, 10)	0.000000	374.0000
X(4, 11)	0.000000	372.0000
X(4, 12)	0.000000	369.0000
X(4, 13)	0.000000	369.0000
X(4, 14)	0.000000	368.0000
X(4, 15)	0.000000	375.0000
X(4, 16)	0.000000	456.0000
X(5, 1)	0.000000	227.0000
X(5, 2)	0.000000	220.0000
X(5, 3)	0.000000	127.0000
X(5, 4)	0.000000	133.0000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	85.00000
X(5, 7)	1.000000	102.0000
X(5, 8)	0.000000	134.0000
X(5, 9)	0.000000	230.0000
X(5, 10)	0.000000	230.0000
X(5, 11)	0.000000	228.0000
X(5, 12)	0.000000	225.0000
X(5, 13)	0.000000	224.0000
X(5, 14)	0.000000	224.0000
X(5, 15)	0.000000	230.0000
X(5, 16)	0.000000	312.0000
X(6, 1)	1.000000	275.0000
X(6, 2)	0.000000	268.0000
X(6, 3)	0.000000	300.0000

X(6, 4)	0.000000	297.0000
X(6, 5)	0.000000	85.00000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	48.00000
X(6, 8)	0.000000	50.00000
X(6, 9)	0.000000	71.00000
X(6, 10)	0.000000	65.00000
X(6, 11)	0.000000	64.00000
X(6, 12)	0.000000	55.00000
X(6, 13)	0.000000	71.00000
X(6, 14)	0.000000	69.00000
X(6, 15)	0.000000	66.00000
X(6, 16)	0.000000	166.0000
X(7, 1)	0.000000	324.0000
X(7, 2)	0.000000	317.0000
X(7, 3)	0.000000	208.0000
X(7, 4)	0.000000	215.0000
X(7, 5)	0.000000	102.0000
X(7, 6)	0.000000	48.00000
X(7, 7)	0.000000	0.000000
X(7, 8)	1.000000	28.00000
X(7, 9)	0.000000	87.00000
X(7, 10)	0.000000	81.00000
X(7, 11)	0.000000	80.00000
X(7, 12)	0.000000	81.00000
X(7, 13)	0.000000	87.00000
X(7, 14)	0.000000	85.00000
X(7, 15)	0.000000	82.00000
X(7, 16)	0.000000	182.0000
X(8, 1)	0.000000	322.0000
X(8, 2)	0.000000	315.0000
X(8, 3)	0.000000	238.0000
X(8, 4)	0.000000	343.0000
X(8, 5)	0.000000	134.0000
X(8, 6)	0.000000	50.00000
X(8, 7)	0.000000	28.00000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	61.00000
X(8, 10)	1.000000	55.00000
X(8, 11)	0.000000	54.00000
X(8, 12)	0.000000	55.00000
X(8, 13)	0.000000	61.00000
X(8, 14)	0.000000	59.00000
X(8, 15)	0.000000	56.00000

X(8, 16)	0.000000	156.0000
X(9, 1)	0.000000	353.0000
X(9, 2)	0.000000	346.0000
X(9, 3)	0.000000	377.0000
X(9, 4)	0.000000	374.0000
X(9, 5)	0.000000	230.0000
X(9, 6)	0.000000	71.00000
X(9, 7)	0.000000	87.00000
X(9, 8)	0.000000	61.00000
X(9, 9)	0.000000	0.000000
X(9, 10)	0.000000	6.700000
X(9, 11)	0.000000	5.900000
X(9, 12)	0.000000	10.00000
X(9, 13)	0.000000	4.800000
X(9, 14)	1.000000	4.300000
X(9, 15)	0.000000	7.400000
X(9, 16)	0.000000	98.20000
X(10, 1)	0.000000	353.0000
X(10, 2)	0.000000	346.0000
X(10, 3)	0.000000	377.0000
X(10, 4)	0.000000	374.0000
X(10, 5)	0.000000	230.0000
X(10, 6)	0.000000	65.00000
X(10, 7)	0.000000	81.00000
X(10, 8)	0.000000	55.00000
X(10, 9)	0.000000	6.700000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	1.900000
X(10, 12)	0.000000	10.30000
X(10, 13)	0.000000	5.900000
X(10, 14)	0.000000	4.800000
X(10, 15)	0.000000	1.800000
X(10, 16)	1.000000	97.50000
X(11, 1)	0.000000	351.0000
X(11, 2)	0.000000	344.0000
X(11, 3)	0.000000	376.0000
X(11, 4)	0.000000	372.0000
X(11, 5)	0.000000	228.0000
X(11, 6)	0.000000	64.00000
X(11, 7)	0.000000	80.00000
X(11, 8)	0.000000	54.00000
X(11, 9)	1.000000	5.900000
X(11, 10)	0.000000	1.900000
X(11, 11)	0.000000	0.000000

X(11, 12)	0.000000	8.800000
X(11, 13)	0.000000	9.800000
X(11, 14)	0.000000	5.300000
X(11, 15)	0.000000	3.400000
X(11, 16)	0.000000	100.0000
X(12, 1)	0.000000	348.0000
X(12, 2)	0.000000	341.0000
X(12, 3)	0.000000	372.0000
X(12, 4)	0.000000	369.0000
X(12, 5)	0.000000	225.0000
X(12, 6)	1.000000	55.00000
X(12, 7)	0.000000	81.00000
X(12, 8)	0.000000	55.00000
X(12, 9)	0.000000	10.00000
X(12, 10)	0.000000	10.30000
X(12, 11)	0.000000	8.800000
X(12, 12)	0.000000	0.000000
X(12, 13)	0.000000	10.60000
X(12, 14)	0.000000	6.200000
X(12, 15)	0.000000	10.70000
X(12, 16)	0.000000	105.0000
X(13, 1)	0.000000	347.0000
X(13, 2)	0.000000	341.0000
X(13, 3)	0.000000	372.0000
X(13, 4)	0.000000	369.0000
X(13, 5)	0.000000	224.0000
X(13, 6)	0.000000	71.00000
X(13, 7)	0.000000	87.00000
X(13, 8)	0.000000	61.00000
X(13, 9)	0.000000	4.800000
X(13, 10)	0.000000	5.900000
X(13, 11)	0.000000	9.800000
X(13, 12)	0.000000	10.60000
X(13, 13)	0.000000	0.000000
X(13, 14)	0.000000	4.300000
X(13, 15)	1.000000	3.500000
X(13, 16)	0.000000	93.40000
X(14, 1)	0.000000	347.0000
X(14, 2)	0.000000	340.0000
X(14, 3)	0.000000	372.0000
X(14, 4)	0.000000	368.0000
X(14, 5)	0.000000	224.0000
X(14, 6)	0.000000	69.00000
X(14, 7)	0.000000	85.00000

X(14, 8)	0.000000	59.00000
X(14, 9)	0.000000	4.300000
X(14, 10)	0.000000	4.800000
X(14, 11)	0.000000	5.300000
X(14, 12)	1.000000	6.200000
X(14, 13)	0.000000	4.300000
X(14, 14)	0.000000	0.000000
X(14, 15)	0.000000	6.300000
X(14, 16)	0.000000	101.0000
X(15, 1)	0.000000	353.0000
X(15, 2)	0.000000	347.0000
X(15, 3)	0.000000	378.0000
X(15, 4)	0.000000	375.0000
X(15, 5)	0.000000	230.0000
X(15, 6)	0.000000	66.00000
X(15, 7)	0.000000	82.00000
X(15, 8)	0.000000	56.00000
X(15, 9)	0.000000	7.400000
X(15, 10)	0.000000	1.800000
X(15, 11)	1.000000	3.400000
X(15, 12)	0.000000	10.70000
X(15, 13)	0.000000	3.500000
X(15, 14)	0.000000	6.300000
X(15, 15)	0.000000	0.000000
X(15, 16)	0.000000	97.90000
X(16, 1)	0.000000	435.0000
X(16, 2)	0.000000	428.0000
X(16, 3)	0.000000	459.0000
X(16, 4)	0.000000	456.0000
X(16, 5)	0.000000	312.0000
X(16, 6)	0.000000	166.0000
X(16, 7)	0.000000	182.0000
X(16, 8)	0.000000	156.0000
X(16, 9)	0.000000	98.20000
X(16, 10)	0.000000	97.50000
X(16, 11)	0.000000	100.0000
X(16, 12)	0.000000	105.0000
X(16, 13)	1.000000	93.40000
X(16, 14)	0.000000	101.0000
X(16, 15)	0.000000	97.90000
X(16, 16)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	8.300000	0.000000
D(1, 3)	41.10000	0.000000

D(1, 4)	39.60000	0.000000
D(1, 5)	227.0000	0.000000
D(1, 6)	275.0000	0.000000
D(1, 7)	324.0000	0.000000
D(1, 8)	322.0000	0.000000
D(1, 9)	353.0000	0.000000
D(1, 10)	353.0000	0.000000
D(1, 11)	351.0000	0.000000
D(1, 12)	348.0000	0.000000
D(1, 13)	347.0000	0.000000
D(1, 14)	347.0000	0.000000
D(1, 15)	353.0000	0.000000
D(1, 16)	435.0000	0.000000
D(2, 1)	8.300000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	24.40000	0.000000
D(2, 4)	33.00000	0.000000
D(2, 5)	220.0000	0.000000
D(2, 6)	268.0000	0.000000
D(2, 7)	317.0000	0.000000
D(2, 8)	315.0000	0.000000
D(2, 9)	346.0000	0.000000
D(2, 10)	346.0000	0.000000
D(2, 11)	344.0000	0.000000
D(2, 12)	341.0000	0.000000
D(2, 13)	341.0000	0.000000
D(2, 14)	340.0000	0.000000
D(2, 15)	347.0000	0.000000
D(2, 16)	428.0000	0.000000
D(3, 1)	41.10000	0.000000
D(3, 2)	24.40000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	7.500000	0.000000
D(3, 5)	127.0000	0.000000
D(3, 6)	300.0000	0.000000
D(3, 7)	208.0000	0.000000
D(3, 8)	238.0000	0.000000
D(3, 9)	377.0000	0.000000
D(3, 10)	377.0000	0.000000
D(3, 11)	376.0000	0.000000
D(3, 12)	372.0000	0.000000
D(3, 13)	372.0000	0.000000
D(3, 14)	372.0000	0.000000
D(3, 15)	378.0000	0.000000

D(3, 16)	459.0000	0.000000
D(4, 1)	39.60000	0.000000
D(4, 2)	33.00000	0.000000
D(4, 3)	7.500000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	133.0000	0.000000
D(4, 6)	297.0000	0.000000
D(4, 7)	215.0000	0.000000
D(4, 8)	343.0000	0.000000
D(4, 9)	374.0000	0.000000
D(4, 10)	374.0000	0.000000
D(4, 11)	372.0000	0.000000
D(4, 12)	369.0000	0.000000
D(4, 13)	369.0000	0.000000
D(4, 14)	368.0000	0.000000
D(4, 15)	375.0000	0.000000
D(4, 16)	456.0000	0.000000
D(5, 1)	227.0000	0.000000
D(5, 2)	220.0000	0.000000
D(5, 3)	127.0000	0.000000
D(5, 4)	133.0000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	85.00000	0.000000
D(5, 7)	102.0000	0.000000
D(5, 8)	134.0000	0.000000
D(5, 9)	230.0000	0.000000
D(5, 10)	230.0000	0.000000
D(5, 11)	228.0000	0.000000
D(5, 12)	225.0000	0.000000
D(5, 13)	224.0000	0.000000
D(5, 14)	224.0000	0.000000
D(5, 15)	230.0000	0.000000
D(5, 16)	312.0000	0.000000
D(6, 1)	275.0000	0.000000
D(6, 2)	268.0000	0.000000
D(6, 3)	300.0000	0.000000
D(6, 4)	297.0000	0.000000
D(6, 5)	85.00000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	48.00000	0.000000
D(6, 8)	50.00000	0.000000
D(6, 9)	71.00000	0.000000
D(6, 10)	65.00000	0.000000
D(6, 11)	64.00000	0.000000

D(6, 12)	55.00000	0.000000
D(6, 13)	71.00000	0.000000
D(6, 14)	69.00000	0.000000
D(6, 15)	66.00000	0.000000
D(6, 16)	166.0000	0.000000
D(7, 1)	324.0000	0.000000
D(7, 2)	317.0000	0.000000
D(7, 3)	208.0000	0.000000
D(7, 4)	215.0000	0.000000
D(7, 5)	102.0000	0.000000
D(7, 6)	48.00000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	28.00000	0.000000
D(7, 9)	87.00000	0.000000
D(7, 10)	81.00000	0.000000
D(7, 11)	80.00000	0.000000
D(7, 12)	81.00000	0.000000
D(7, 13)	87.00000	0.000000
D(7, 14)	85.00000	0.000000
D(7, 15)	82.00000	0.000000
D(7, 16)	182.0000	0.000000
D(8, 1)	322.0000	0.000000
D(8, 2)	315.0000	0.000000
D(8, 3)	238.0000	0.000000
D(8, 4)	343.0000	0.000000
D(8, 5)	134.0000	0.000000
D(8, 6)	50.00000	0.000000
D(8, 7)	28.00000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	61.00000	0.000000
D(8, 10)	55.00000	0.000000
D(8, 11)	54.00000	0.000000
D(8, 12)	55.00000	0.000000
D(8, 13)	61.00000	0.000000
D(8, 14)	59.00000	0.000000
D(8, 15)	56.00000	0.000000
D(8, 16)	156.0000	0.000000
D(9, 1)	353.0000	0.000000
D(9, 2)	346.0000	0.000000
D(9, 3)	377.0000	0.000000
D(9, 4)	374.0000	0.000000
D(9, 5)	230.0000	0.000000
D(9, 6)	71.00000	0.000000
D(9, 7)	87.00000	0.000000

D(9, 8)	61.00000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	6.700000	0.000000
D(9, 11)	5.900000	0.000000
D(9, 12)	10.00000	0.000000
D(9, 13)	4.800000	0.000000
D(9, 14)	4.300000	0.000000
D(9, 15)	7.400000	0.000000
D(9, 16)	98.20000	0.000000
D(10, 1)	353.0000	0.000000
D(10, 2)	346.0000	0.000000
D(10, 3)	377.0000	0.000000
D(10, 4)	374.0000	0.000000
D(10, 5)	230.0000	0.000000
D(10, 6)	65.00000	0.000000
D(10, 7)	81.00000	0.000000
D(10, 8)	55.00000	0.000000
D(10, 9)	6.700000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	1.900000	0.000000
D(10, 12)	10.30000	0.000000
D(10, 13)	5.900000	0.000000
D(10, 14)	4.800000	0.000000
D(10, 15)	1.800000	0.000000
D(10, 16)	97.50000	0.000000
D(11, 1)	351.0000	0.000000
D(11, 2)	344.0000	0.000000
D(11, 3)	376.0000	0.000000
D(11, 4)	372.0000	0.000000
D(11, 5)	228.0000	0.000000
D(11, 6)	64.00000	0.000000
D(11, 7)	80.00000	0.000000
D(11, 8)	54.00000	0.000000
D(11, 9)	5.900000	0.000000
D(11, 10)	1.900000	0.000000
D(11, 11)	0.000000	0.000000
D(11, 12)	8.800000	0.000000
D(11, 13)	9.800000	0.000000
D(11, 14)	5.300000	0.000000
D(11, 15)	3.400000	0.000000
D(11, 16)	100.0000	0.000000
D(12, 1)	348.0000	0.000000
D(12, 2)	341.0000	0.000000
D(12, 3)	372.0000	0.000000

D(12, 4)	369.0000	0.000000
D(12, 5)	225.0000	0.000000
D(12, 6)	55.00000	0.000000
D(12, 7)	81.00000	0.000000
D(12, 8)	55.00000	0.000000
D(12, 9)	10.00000	0.000000
D(12, 10)	10.30000	0.000000
D(12, 11)	8.800000	0.000000
D(12, 12)	0.000000	0.000000
D(12, 13)	10.60000	0.000000
D(12, 14)	6.200000	0.000000
D(12, 15)	10.70000	0.000000
D(12, 16)	105.0000	0.000000
D(13, 1)	347.0000	0.000000
D(13, 2)	341.0000	0.000000
D(13, 3)	372.0000	0.000000
D(13, 4)	369.0000	0.000000
D(13, 5)	224.0000	0.000000
D(13, 6)	71.00000	0.000000
D(13, 7)	87.00000	0.000000
D(13, 8)	61.00000	0.000000
D(13, 9)	4.800000	0.000000
D(13, 10)	5.900000	0.000000
D(13, 11)	9.800000	0.000000
D(13, 12)	10.60000	0.000000
D(13, 13)	0.000000	0.000000
D(13, 14)	4.300000	0.000000
D(13, 15)	3.500000	0.000000
D(13, 16)	93.40000	0.000000
D(14, 1)	347.0000	0.000000
D(14, 2)	340.0000	0.000000
D(14, 3)	372.0000	0.000000
D(14, 4)	368.0000	0.000000
D(14, 5)	224.0000	0.000000
D(14, 6)	69.00000	0.000000
D(14, 7)	85.00000	0.000000
D(14, 8)	59.00000	0.000000
D(14, 9)	4.300000	0.000000
D(14, 10)	4.800000	0.000000
D(14, 11)	5.300000	0.000000
D(14, 12)	6.200000	0.000000
D(14, 13)	4.300000	0.000000
D(14, 14)	0.000000	0.000000
D(14, 15)	6.300000	0.000000

D(14, 16)	101.0000	0.000000
D(15, 1)	353.0000	0.000000
D(15, 2)	347.0000	0.000000
D(15, 3)	378.0000	0.000000
D(15, 4)	375.0000	0.000000
D(15, 5)	230.0000	0.000000
D(15, 6)	66.00000	0.000000
D(15, 7)	82.00000	0.000000
D(15, 8)	56.00000	0.000000
D(15, 9)	7.400000	0.000000
D(15, 10)	1.800000	0.000000
D(15, 11)	3.400000	0.000000
D(15, 12)	10.70000	0.000000
D(15, 13)	3.500000	0.000000
D(15, 14)	6.300000	0.000000
D(15, 15)	0.000000	0.000000
D(15, 16)	97.90000	0.000000
D(16, 1)	435.0000	0.000000
D(16, 2)	428.0000	0.000000
D(16, 3)	459.0000	0.000000
D(16, 4)	456.0000	0.000000
D(16, 5)	312.0000	0.000000
D(16, 6)	166.0000	0.000000
D(16, 7)	182.0000	0.000000
D(16, 8)	156.0000	0.000000
D(16, 9)	98.20000	0.000000
D(16, 10)	97.50000	0.000000
D(16, 11)	100.0000	0.000000
D(16, 12)	105.0000	0.000000
D(16, 13)	93.40000	0.000000
D(16, 14)	101.0000	0.000000
D(16, 15)	97.90000	0.000000
D(16, 16)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	9.960000	0.000000
DURASI(1, 3)	49.32000	0.000000
DURASI(1, 4)	47.52000	0.000000
DURASI(1, 5)	272.4000	0.000000
DURASI(1, 6)	330.0000	0.000000
DURASI(1, 7)	388.8000	0.000000
DURASI(1, 8)	386.4000	0.000000
DURASI(1, 9)	423.6000	0.000000
DURASI(1, 10)	423.6000	0.000000
DURASI(1, 11)	421.2000	0.000000

DURASI(1, 12)	417.6000	0.000000
DURASI(1, 13)	416.4000	0.000000
DURASI(1, 14)	416.4000	0.000000
DURASI(1, 15)	423.6000	0.000000
DURASI(1, 16)	522.0000	0.000000
DURASI(2, 1)	9.960000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	29.28000	0.000000
DURASI(2, 4)	39.60000	0.000000
DURASI(2, 5)	264.0000	0.000000
DURASI(2, 6)	321.6000	0.000000
DURASI(2, 7)	380.4000	0.000000
DURASI(2, 8)	378.0000	0.000000
DURASI(2, 9)	415.2000	0.000000
DURASI(2, 10)	415.2000	0.000000
DURASI(2, 11)	412.8000	0.000000
DURASI(2, 12)	409.2000	0.000000
DURASI(2, 13)	409.2000	0.000000
DURASI(2, 14)	408.0000	0.000000
DURASI(2, 15)	416.4000	0.000000
DURASI(2, 16)	513.6000	0.000000
DURASI(3, 1)	49.32000	0.000000
DURASI(3, 2)	29.28000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	9.000000	0.000000
DURASI(3, 5)	152.4000	0.000000
DURASI(3, 6)	360.0000	0.000000
DURASI(3, 7)	249.6000	0.000000
DURASI(3, 8)	285.6000	0.000000
DURASI(3, 9)	452.4000	0.000000
DURASI(3, 10)	452.4000	0.000000
DURASI(3, 11)	451.2000	0.000000
DURASI(3, 12)	446.4000	0.000000
DURASI(3, 13)	446.4000	0.000000
DURASI(3, 14)	446.4000	0.000000
DURASI(3, 15)	453.6000	0.000000
DURASI(3, 16)	550.8000	0.000000
DURASI(4, 1)	47.52000	0.000000
DURASI(4, 2)	39.60000	0.000000
DURASI(4, 3)	9.000000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	159.6000	0.000000
DURASI(4, 6)	356.4000	0.000000
DURASI(4, 7)	258.0000	0.000000

DURASI(4, 8)	411.6000	0.000000
DURASI(4, 9)	448.8000	0.000000
DURASI(4, 10)	448.8000	0.000000
DURASI(4, 11)	446.4000	0.000000
DURASI(4, 12)	442.8000	0.000000
DURASI(4, 13)	442.8000	0.000000
DURASI(4, 14)	441.6000	0.000000
DURASI(4, 15)	450.0000	0.000000
DURASI(4, 16)	547.2000	0.000000
DURASI(5, 1)	272.4000	0.000000
DURASI(5, 2)	264.0000	0.000000
DURASI(5, 3)	152.4000	0.000000
DURASI(5, 4)	159.6000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	102.0000	0.000000
DURASI(5, 7)	122.4000	0.000000
DURASI(5, 8)	160.8000	0.000000
DURASI(5, 9)	276.0000	0.000000
DURASI(5, 10)	276.0000	0.000000
DURASI(5, 11)	273.6000	0.000000
DURASI(5, 12)	270.0000	0.000000
DURASI(5, 13)	268.8000	0.000000
DURASI(5, 14)	268.8000	0.000000
DURASI(5, 15)	276.0000	0.000000
DURASI(5, 16)	374.4000	0.000000
DURASI(6, 1)	330.0000	0.000000
DURASI(6, 2)	321.6000	0.000000
DURASI(6, 3)	360.0000	0.000000
DURASI(6, 4)	356.4000	0.000000
DURASI(6, 5)	102.0000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	57.60000	0.000000
DURASI(6, 8)	60.00000	0.000000
DURASI(6, 9)	85.20000	0.000000
DURASI(6, 10)	78.00000	0.000000
DURASI(6, 11)	76.80000	0.000000
DURASI(6, 12)	66.00000	0.000000
DURASI(6, 13)	85.20000	0.000000
DURASI(6, 14)	82.80000	0.000000
DURASI(6, 15)	79.20000	0.000000
DURASI(6, 16)	199.2000	0.000000
DURASI(7, 1)	388.8000	0.000000
DURASI(7, 2)	380.4000	0.000000
DURASI(7, 3)	249.6000	0.000000

DURASI(7, 4)	258.0000	0.000000
DURASI(7, 5)	122.4000	0.000000
DURASI(7, 6)	57.60000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	33.60000	0.000000
DURASI(7, 9)	104.4000	0.000000
DURASI(7, 10)	97.20000	0.000000
DURASI(7, 11)	96.00000	0.000000
DURASI(7, 12)	97.20000	0.000000
DURASI(7, 13)	104.4000	0.000000
DURASI(7, 14)	102.0000	0.000000
DURASI(7, 15)	98.40000	0.000000
DURASI(7, 16)	218.4000	0.000000
DURASI(8, 1)	386.4000	0.000000
DURASI(8, 2)	378.0000	0.000000
DURASI(8, 3)	285.6000	0.000000
DURASI(8, 4)	411.6000	0.000000
DURASI(8, 5)	160.8000	0.000000
DURASI(8, 6)	60.00000	0.000000
DURASI(8, 7)	33.60000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	73.20000	0.000000
DURASI(8, 10)	66.00000	0.000000
DURASI(8, 11)	64.80000	0.000000
DURASI(8, 12)	66.00000	0.000000
DURASI(8, 13)	73.20000	0.000000
DURASI(8, 14)	70.80000	0.000000
DURASI(8, 15)	67.20000	0.000000
DURASI(8, 16)	187.2000	0.000000
DURASI(9, 1)	423.6000	0.000000
DURASI(9, 2)	415.2000	0.000000
DURASI(9, 3)	452.4000	0.000000
DURASI(9, 4)	448.8000	0.000000
DURASI(9, 5)	276.0000	0.000000
DURASI(9, 6)	85.20000	0.000000
DURASI(9, 7)	104.4000	0.000000
DURASI(9, 8)	73.20000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	8.040000	0.000000
DURASI(9, 11)	7.080000	0.000000
DURASI(9, 12)	12.00000	0.000000
DURASI(9, 13)	5.760000	0.000000
DURASI(9, 14)	5.160000	0.000000
DURASI(9, 15)	8.880000	0.000000

DURASI(9, 16)	117.8400	0.000000
DURASI(10, 1)	423.6000	0.000000
DURASI(10, 2)	415.2000	0.000000
DURASI(10, 3)	452.4000	0.000000
DURASI(10, 4)	448.8000	0.000000
DURASI(10, 5)	276.0000	0.000000
DURASI(10, 6)	78.00000	0.000000
DURASI(10, 7)	97.20000	0.000000
DURASI(10, 8)	66.00000	0.000000
DURASI(10, 9)	8.040000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	2.280000	0.000000
DURASI(10, 12)	12.36000	0.000000
DURASI(10, 13)	7.080000	0.000000
DURASI(10, 14)	5.760000	0.000000
DURASI(10, 15)	2.160000	0.000000
DURASI(10, 16)	117.0000	0.000000
DURASI(11, 1)	421.2000	0.000000
DURASI(11, 2)	412.8000	0.000000
DURASI(11, 3)	451.2000	0.000000
DURASI(11, 4)	446.4000	0.000000
DURASI(11, 5)	273.6000	0.000000
DURASI(11, 6)	76.80000	0.000000
DURASI(11, 7)	96.00000	0.000000
DURASI(11, 8)	64.80000	0.000000
DURASI(11, 9)	7.080000	0.000000
DURASI(11, 10)	2.280000	0.000000
DURASI(11, 11)	0.000000	0.000000
DURASI(11, 12)	10.56000	0.000000
DURASI(11, 13)	11.76000	0.000000
DURASI(11, 14)	6.360000	0.000000
DURASI(11, 15)	4.080000	0.000000
DURASI(11, 16)	120.0000	0.000000
DURASI(12, 1)	417.6000	0.000000
DURASI(12, 2)	409.2000	0.000000
DURASI(12, 3)	446.4000	0.000000
DURASI(12, 4)	442.8000	0.000000
DURASI(12, 5)	270.0000	0.000000
DURASI(12, 6)	66.00000	0.000000
DURASI(12, 7)	97.20000	0.000000
DURASI(12, 8)	66.00000	0.000000
DURASI(12, 9)	12.00000	0.000000
DURASI(12, 10)	12.36000	0.000000
DURASI(12, 11)	10.56000	0.000000

DURASI(12, 12)	0.000000	0.000000
DURASI(12, 13)	12.72000	0.000000
DURASI(12, 14)	7.440000	0.000000
DURASI(12, 15)	12.84000	0.000000
DURASI(12, 16)	126.0000	0.000000
DURASI(13, 1)	416.4000	0.000000
DURASI(13, 2)	409.2000	0.000000
DURASI(13, 3)	446.4000	0.000000
DURASI(13, 4)	442.8000	0.000000
DURASI(13, 5)	268.8000	0.000000
DURASI(13, 6)	85.20000	0.000000
DURASI(13, 7)	104.4000	0.000000
DURASI(13, 8)	73.20000	0.000000
DURASI(13, 9)	5.760000	0.000000
DURASI(13, 10)	7.080000	0.000000
DURASI(13, 11)	11.76000	0.000000
DURASI(13, 12)	12.72000	0.000000
DURASI(13, 13)	0.000000	0.000000
DURASI(13, 14)	5.160000	0.000000
DURASI(13, 15)	4.200000	0.000000
DURASI(13, 16)	112.0800	0.000000
DURASI(14, 1)	416.4000	0.000000
DURASI(14, 2)	408.0000	0.000000
DURASI(14, 3)	446.4000	0.000000
DURASI(14, 4)	441.6000	0.000000
DURASI(14, 5)	268.8000	0.000000
DURASI(14, 6)	82.80000	0.000000
DURASI(14, 7)	102.0000	0.000000
DURASI(14, 8)	70.80000	0.000000
DURASI(14, 9)	5.160000	0.000000
DURASI(14, 10)	5.760000	0.000000
DURASI(14, 11)	6.360000	0.000000
DURASI(14, 12)	7.440000	0.000000
DURASI(14, 13)	5.160000	0.000000
DURASI(14, 14)	0.000000	0.000000
DURASI(14, 15)	7.560000	0.000000
DURASI(14, 16)	121.2000	0.000000
DURASI(15, 1)	423.6000	0.000000
DURASI(15, 2)	416.4000	0.000000
DURASI(15, 3)	453.6000	0.000000
DURASI(15, 4)	450.0000	0.000000
DURASI(15, 5)	276.0000	0.000000
DURASI(15, 6)	79.20000	0.000000
DURASI(15, 7)	98.40000	0.000000

DURASI(15, 8)	67.20000	0.000000
DURASI(15, 9)	8.880000	0.000000
DURASI(15, 10)	2.160000	0.000000
DURASI(15, 11)	4.080000	0.000000
DURASI(15, 12)	12.84000	0.000000
DURASI(15, 13)	4.200000	0.000000
DURASI(15, 14)	7.560000	0.000000
DURASI(15, 15)	0.000000	0.000000
DURASI(15, 16)	117.4800	0.000000
DURASI(16, 1)	522.0000	0.000000
DURASI(16, 2)	513.6000	0.000000
DURASI(16, 3)	550.8000	0.000000
DURASI(16, 4)	547.2000	0.000000
DURASI(16, 5)	374.4000	0.000000
DURASI(16, 6)	199.2000	0.000000
DURASI(16, 7)	218.4000	0.000000
DURASI(16, 8)	187.2000	0.000000
DURASI(16, 9)	117.8400	0.000000
DURASI(16, 10)	117.0000	0.000000
DURASI(16, 11)	120.0000	0.000000
DURASI(16, 12)	126.0000	0.000000
DURASI(16, 13)	112.0800	0.000000
DURASI(16, 14)	121.2000	0.000000
DURASI(16, 15)	117.4800	0.000000
DURASI(16, 16)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 3* analisis sensitivitas skenario 3

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i,j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..11/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 780 540 540 660 540 540;
tutup = 1020 1260 1260 660 1260 900 1260 1260 780 1260 1260;
```

D =

```
!ritel
!0      56      58      59      61      62      63      64      65      66
      67;
0      345     343     433     464     510     508     472     507     503
      495     !0;
345    0      20.2    102     133     179     176     142     176     172
      164     !56;
343    20.2    0      114     145     191     188     153     188     184
      175     !58;
433    102     114     0      48.4    94.1    91.2    56.6    91.3    87.3
      78.7    !59;
464    133     145     48.4    0      31.5    33.1    27.2    61.9    57.9
      49.3    !61;
510    179     191     94.1    31.5    0      3.4     58.4    21.5    12.1
      16.2    !62;
508    176     188     91.2    33.1    3.4     0      78.6    18.1    8.8
      14.5    !63;
```



```

472  142  153  56.6  27.2  58.4  78.6  0  34.7  30.7
      22.1  !64;
507  176  188  91.3  61.9  21.5  18.1  34.7  0  10.9
      35.6  !65;
503  172  184  87.3  57.9  12.1  8.8  30.7  10.9  0
      23.8  !66;
495  164  175  78.7  49.3  16.2  14.5  22.1  35.6  23.8  0;
      !67;

```

```

durasi =
0      414  411.6  519.6  556.8  612  609.6  566.4  608.4  603.6
      594
414    0    24.24  122.4  159.6  214.8  211.2  170.4  211.2  206.4
      196.8
411.6  24.24  0    136.8  174  229.2  225.6  183.6  225.6  220.8
      210
519.6  122.4  136.8  0    58.08  112.92  109.44  67.92
      109.56  104.76  94.44
556.8  159.6  174  58.08  0    37.8  39.72  32.64  74.28  69.48
      59.16
612    214.8  229.2  112.92  37.8  0    4.08  70.08  25.8
      14.52  19.44
609.6  211.2  225.6  109.44  39.72  4.08  0    94.32  21.72
      10.56  17.4
566.4  170.4  183.6  67.92  32.64  70.08  94.32  0    41.64  36.84
      26.52
608.4  211.2  225.6  109.56  74.28  25.8  21.72  41.64  0
      13.08  42.72
603.6  206.4  220.8  104.76  69.48  14.52  10.56  36.84  13.08  0
      28.56
594    196.8  210  94.44  59.16  19.44  17.4  26.52  42.72  28.56  0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
            @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
    );

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 3* analisis sensitivitas skenario 3

Global optimal solution found.

Objective value:	1099.100
Objective bound:	1099.100
Infeasibilities:	0.000000
Extended solver steps:	1176
Total solver iterations:	14198
Elapsed runtime seconds:	1.83

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 4 sebesar 433 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 20.2 km
 rute pengiriman dari ritel 3 ke ritel 1 sebesar 343 km
 rute pengiriman dari ritel 4 ke ritel 5 sebesar 48.4 km
 rute pengiriman dari ritel 5 ke ritel 7 sebesar 33.1 km
 rute pengiriman dari ritel 6 ke ritel 11 sebesar 16.2 km
 rute pengiriman dari ritel 7 ke ritel 9 sebesar 18.1 km
 rute pengiriman dari ritel 8 ke ritel 2 sebesar 142 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 10.9 km
 rute pengiriman dari ritel 10 ke ritel 6 sebesar 12.1 km
 rute pengiriman dari ritel 11 ke ritel 8 sebesar 22.1 km

Model Class: MILP

Total variables:	132
Nonlinear variables:	0
Integer variables:	121
Total constraints:	154
Nonlinear constraints:	0
Total nonzeros:	780
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000

BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	780.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	660.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	660.0000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	900.0000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	780.0000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
T(1)	1869.600	0.000000
T(2)	1175.760	0.000000
T(3)	1230.000	0.000000
T(4)	540.0000	0.000000
T(5)	628.0800	0.000000
T(6)	837.1200	0.000000
T(7)	697.8000	0.000000
T(8)	943.0800	0.000000
T(9)	749.5200	0.000000
T(10)	792.6000	0.000000
T(11)	886.5600	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	0.000000	345.0000
X(1, 3)	0.000000	343.0000

X(1, 4)	1.000000	433.0000
X(1, 5)	0.000000	464.0000
X(1, 6)	0.000000	510.0000
X(1, 7)	0.000000	508.0000
X(1, 8)	0.000000	472.0000
X(1, 9)	0.000000	507.0000
X(1, 10)	0.000000	503.0000
X(1, 11)	0.000000	495.0000
X(2, 1)	0.000000	345.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	20.20000
X(2, 4)	0.000000	102.0000
X(2, 5)	0.000000	133.0000
X(2, 6)	0.000000	179.0000
X(2, 7)	0.000000	176.0000
X(2, 8)	0.000000	142.0000
X(2, 9)	0.000000	176.0000
X(2, 10)	0.000000	172.0000
X(2, 11)	0.000000	164.0000
X(3, 1)	1.000000	343.0000
X(3, 2)	0.000000	20.20000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	114.0000
X(3, 5)	0.000000	145.0000
X(3, 6)	0.000000	191.0000
X(3, 7)	0.000000	188.0000
X(3, 8)	0.000000	153.0000
X(3, 9)	0.000000	188.0000
X(3, 10)	0.000000	184.0000
X(3, 11)	0.000000	175.0000
X(4, 1)	0.000000	433.0000
X(4, 2)	0.000000	102.0000
X(4, 3)	0.000000	114.0000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	48.40000
X(4, 6)	0.000000	94.10000
X(4, 7)	0.000000	91.20000
X(4, 8)	0.000000	56.60000
X(4, 9)	0.000000	91.30000
X(4, 10)	0.000000	87.30000
X(4, 11)	0.000000	78.70000
X(5, 1)	0.000000	464.0000
X(5, 2)	0.000000	133.0000
X(5, 3)	0.000000	145.0000

X(5, 4)	0.000000	48.40000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	31.50000
X(5, 7)	1.000000	33.10000
X(5, 8)	0.000000	27.20000
X(5, 9)	0.000000	61.90000
X(5, 10)	0.000000	57.90000
X(5, 11)	0.000000	49.30000
X(6, 1)	0.000000	510.0000
X(6, 2)	0.000000	179.0000
X(6, 3)	0.000000	191.0000
X(6, 4)	0.000000	94.10000
X(6, 5)	0.000000	31.50000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.400000
X(6, 8)	0.000000	58.40000
X(6, 9)	0.000000	21.50000
X(6, 10)	0.000000	12.10000
X(6, 11)	1.000000	16.20000
X(7, 1)	0.000000	508.0000
X(7, 2)	0.000000	176.0000
X(7, 3)	0.000000	188.0000
X(7, 4)	0.000000	91.20000
X(7, 5)	0.000000	33.10000
X(7, 6)	0.000000	3.400000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	78.60000
X(7, 9)	1.000000	18.10000
X(7, 10)	0.000000	8.800000
X(7, 11)	0.000000	14.50000
X(8, 1)	0.000000	472.0000
X(8, 2)	1.000000	142.0000
X(8, 3)	0.000000	153.0000
X(8, 4)	0.000000	56.60000
X(8, 5)	0.000000	27.20000
X(8, 6)	0.000000	58.40000
X(8, 7)	0.000000	78.60000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	34.70000
X(8, 10)	0.000000	30.70000
X(8, 11)	0.000000	22.10000
X(9, 1)	0.000000	507.0000
X(9, 2)	0.000000	176.0000
X(9, 3)	0.000000	188.0000

X(9, 4)	0.000000	91.30000
X(9, 5)	0.000000	61.90000
X(9, 6)	0.000000	21.50000
X(9, 7)	0.000000	18.10000
X(9, 8)	0.000000	34.70000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	10.90000
X(9, 11)	0.000000	35.60000
X(10, 1)	0.000000	503.0000
X(10, 2)	0.000000	172.0000
X(10, 3)	0.000000	184.0000
X(10, 4)	0.000000	87.30000
X(10, 5)	0.000000	57.90000
X(10, 6)	1.000000	12.10000
X(10, 7)	0.000000	8.800000
X(10, 8)	0.000000	30.70000
X(10, 9)	0.000000	10.90000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	23.80000
X(11, 1)	0.000000	495.0000
X(11, 2)	0.000000	164.0000
X(11, 3)	0.000000	175.0000
X(11, 4)	0.000000	78.70000
X(11, 5)	0.000000	49.30000
X(11, 6)	0.000000	16.20000
X(11, 7)	0.000000	14.50000
X(11, 8)	1.000000	22.10000
X(11, 9)	0.000000	35.60000
X(11, 10)	0.000000	23.80000
X(11, 11)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	345.0000	0.000000
D(1, 3)	343.0000	0.000000
D(1, 4)	433.0000	0.000000
D(1, 5)	464.0000	0.000000
D(1, 6)	510.0000	0.000000
D(1, 7)	508.0000	0.000000
D(1, 8)	472.0000	0.000000
D(1, 9)	507.0000	0.000000
D(1, 10)	503.0000	0.000000
D(1, 11)	495.0000	0.000000
D(2, 1)	345.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	20.20000	0.000000

D(2, 4)	102.0000	0.000000
D(2, 5)	133.0000	0.000000
D(2, 6)	179.0000	0.000000
D(2, 7)	176.0000	0.000000
D(2, 8)	142.0000	0.000000
D(2, 9)	176.0000	0.000000
D(2, 10)	172.0000	0.000000
D(2, 11)	164.0000	0.000000
D(3, 1)	343.0000	0.000000
D(3, 2)	20.20000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	114.0000	0.000000
D(3, 5)	145.0000	0.000000
D(3, 6)	191.0000	0.000000
D(3, 7)	188.0000	0.000000
D(3, 8)	153.0000	0.000000
D(3, 9)	188.0000	0.000000
D(3, 10)	184.0000	0.000000
D(3, 11)	175.0000	0.000000
D(4, 1)	433.0000	0.000000
D(4, 2)	102.0000	0.000000
D(4, 3)	114.0000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	48.40000	0.000000
D(4, 6)	94.10000	0.000000
D(4, 7)	91.20000	0.000000
D(4, 8)	56.60000	0.000000
D(4, 9)	91.30000	0.000000
D(4, 10)	87.30000	0.000000
D(4, 11)	78.70000	0.000000
D(5, 1)	464.0000	0.000000
D(5, 2)	133.0000	0.000000
D(5, 3)	145.0000	0.000000
D(5, 4)	48.40000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	31.50000	0.000000
D(5, 7)	33.10000	0.000000
D(5, 8)	27.20000	0.000000
D(5, 9)	61.90000	0.000000
D(5, 10)	57.90000	0.000000
D(5, 11)	49.30000	0.000000
D(6, 1)	510.0000	0.000000
D(6, 2)	179.0000	0.000000
D(6, 3)	191.0000	0.000000

D(6, 4)	94.10000	0.000000
D(6, 5)	31.50000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.400000	0.000000
D(6, 8)	58.40000	0.000000
D(6, 9)	21.50000	0.000000
D(6, 10)	12.10000	0.000000
D(6, 11)	16.20000	0.000000
D(7, 1)	508.0000	0.000000
D(7, 2)	176.0000	0.000000
D(7, 3)	188.0000	0.000000
D(7, 4)	91.20000	0.000000
D(7, 5)	33.10000	0.000000
D(7, 6)	3.400000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	78.60000	0.000000
D(7, 9)	18.10000	0.000000
D(7, 10)	8.800000	0.000000
D(7, 11)	14.50000	0.000000
D(8, 1)	472.0000	0.000000
D(8, 2)	142.0000	0.000000
D(8, 3)	153.0000	0.000000
D(8, 4)	56.60000	0.000000
D(8, 5)	27.20000	0.000000
D(8, 6)	58.40000	0.000000
D(8, 7)	78.60000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	34.70000	0.000000
D(8, 10)	30.70000	0.000000
D(8, 11)	22.10000	0.000000
D(9, 1)	507.0000	0.000000
D(9, 2)	176.0000	0.000000
D(9, 3)	188.0000	0.000000
D(9, 4)	91.30000	0.000000
D(9, 5)	61.90000	0.000000
D(9, 6)	21.50000	0.000000
D(9, 7)	18.10000	0.000000
D(9, 8)	34.70000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	10.90000	0.000000
D(9, 11)	35.60000	0.000000
D(10, 1)	503.0000	0.000000
D(10, 2)	172.0000	0.000000
D(10, 3)	184.0000	0.000000

D(10, 4)	87.30000	0.000000
D(10, 5)	57.90000	0.000000
D(10, 6)	12.10000	0.000000
D(10, 7)	8.800000	0.000000
D(10, 8)	30.70000	0.000000
D(10, 9)	10.90000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	23.80000	0.000000
D(11, 1)	495.0000	0.000000
D(11, 2)	164.0000	0.000000
D(11, 3)	175.0000	0.000000
D(11, 4)	78.70000	0.000000
D(11, 5)	49.30000	0.000000
D(11, 6)	16.20000	0.000000
D(11, 7)	14.50000	0.000000
D(11, 8)	22.10000	0.000000
D(11, 9)	35.60000	0.000000
D(11, 10)	23.80000	0.000000
D(11, 11)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	414.0000	0.000000
DURASI(1, 3)	411.6000	0.000000
DURASI(1, 4)	519.6000	0.000000
DURASI(1, 5)	556.8000	0.000000
DURASI(1, 6)	612.0000	0.000000
DURASI(1, 7)	609.6000	0.000000
DURASI(1, 8)	566.4000	0.000000
DURASI(1, 9)	608.4000	0.000000
DURASI(1, 10)	603.6000	0.000000
DURASI(1, 11)	594.0000	0.000000
DURASI(2, 1)	414.0000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	24.24000	0.000000
DURASI(2, 4)	122.4000	0.000000
DURASI(2, 5)	159.6000	0.000000
DURASI(2, 6)	214.8000	0.000000
DURASI(2, 7)	211.2000	0.000000
DURASI(2, 8)	170.4000	0.000000
DURASI(2, 9)	211.2000	0.000000
DURASI(2, 10)	206.4000	0.000000
DURASI(2, 11)	196.8000	0.000000
DURASI(3, 1)	411.6000	0.000000
DURASI(3, 2)	24.24000	0.000000
DURASI(3, 3)	0.000000	0.000000

DURASI(3, 4)	136.8000	0.000000
DURASI(3, 5)	174.0000	0.000000
DURASI(3, 6)	229.2000	0.000000
DURASI(3, 7)	225.6000	0.000000
DURASI(3, 8)	183.6000	0.000000
DURASI(3, 9)	225.6000	0.000000
DURASI(3, 10)	220.8000	0.000000
DURASI(3, 11)	210.0000	0.000000
DURASI(4, 1)	519.6000	0.000000
DURASI(4, 2)	122.4000	0.000000
DURASI(4, 3)	136.8000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	58.08000	0.000000
DURASI(4, 6)	112.9200	0.000000
DURASI(4, 7)	109.4400	0.000000
DURASI(4, 8)	67.92000	0.000000
DURASI(4, 9)	109.5600	0.000000
DURASI(4, 10)	104.7600	0.000000
DURASI(4, 11)	94.44000	0.000000
DURASI(5, 1)	556.8000	0.000000
DURASI(5, 2)	159.6000	0.000000
DURASI(5, 3)	174.0000	0.000000
DURASI(5, 4)	58.08000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	37.80000	0.000000
DURASI(5, 7)	39.72000	0.000000
DURASI(5, 8)	32.64000	0.000000
DURASI(5, 9)	74.28000	0.000000
DURASI(5, 10)	69.48000	0.000000
DURASI(5, 11)	59.16000	0.000000
DURASI(6, 1)	612.0000	0.000000
DURASI(6, 2)	214.8000	0.000000
DURASI(6, 3)	229.2000	0.000000
DURASI(6, 4)	112.9200	0.000000
DURASI(6, 5)	37.80000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.080000	0.000000
DURASI(6, 8)	70.08000	0.000000
DURASI(6, 9)	25.80000	0.000000
DURASI(6, 10)	14.52000	0.000000
DURASI(6, 11)	19.44000	0.000000
DURASI(7, 1)	609.6000	0.000000
DURASI(7, 2)	211.2000	0.000000
DURASI(7, 3)	225.6000	0.000000

DURASI(7, 4)	109.4400	0.000000
DURASI(7, 5)	39.72000	0.000000
DURASI(7, 6)	4.080000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	94.32000	0.000000
DURASI(7, 9)	21.72000	0.000000
DURASI(7, 10)	10.56000	0.000000
DURASI(7, 11)	17.40000	0.000000
DURASI(8, 1)	566.4000	0.000000
DURASI(8, 2)	170.4000	0.000000
DURASI(8, 3)	183.6000	0.000000
DURASI(8, 4)	67.92000	0.000000
DURASI(8, 5)	32.64000	0.000000
DURASI(8, 6)	70.08000	0.000000
DURASI(8, 7)	94.32000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	41.64000	0.000000
DURASI(8, 10)	36.84000	0.000000
DURASI(8, 11)	26.52000	0.000000
DURASI(9, 1)	608.4000	0.000000
DURASI(9, 2)	211.2000	0.000000
DURASI(9, 3)	225.6000	0.000000
DURASI(9, 4)	109.5600	0.000000
DURASI(9, 5)	74.28000	0.000000
DURASI(9, 6)	25.80000	0.000000
DURASI(9, 7)	21.72000	0.000000
DURASI(9, 8)	41.64000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	13.08000	0.000000
DURASI(9, 11)	42.72000	0.000000
DURASI(10, 1)	603.6000	0.000000
DURASI(10, 2)	206.4000	0.000000
DURASI(10, 3)	220.8000	0.000000
DURASI(10, 4)	104.7600	0.000000
DURASI(10, 5)	69.48000	0.000000
DURASI(10, 6)	14.52000	0.000000
DURASI(10, 7)	10.56000	0.000000
DURASI(10, 8)	36.84000	0.000000
DURASI(10, 9)	13.08000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	28.56000	0.000000
DURASI(11, 1)	594.0000	0.000000
DURASI(11, 2)	196.8000	0.000000
DURASI(11, 3)	210.0000	0.000000

DURASI(11, 4)	94.44000	0.000000
DURASI(11, 5)	59.16000	0.000000
DURASI(11, 6)	19.44000	0.000000
DURASI(11, 7)	17.40000	0.000000
DURASI(11, 8)	26.52000	0.000000
DURASI(11, 9)	42.72000	0.000000
DURASI(11, 10)	28.56000	0.000000
DURASI(11, 11)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster* 4 analisis sensitivitas skenario 3

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i,j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..12/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 780 660 540 540 540 540 540 540;
tutup = 1020 1260 660 1260 900 780 1260 1260 1260 1260 1260 1260;
1260;
```

D =

```
!ritel
!0   33   34   35   36   37   38   44   45   46   47
    48;
0    252  234  258  254  256  259  398  422  548
    548  341  !0;
252  0    20   44   39   42   46   184  208  334
    334  127  !33;
234  20   0    24   20   23   25   164  188  314
    314  107  !34;
258  44   24   0    7    6    9    138  158  295
    295  88   !35;
254  39   20   7    0    3    6    156  166  306
    306  99   !36;
256  42   23   6    3    0    7    156  164  305
    305  98   !37;
```

259	46	25	9	6	7	0	141	161	306	
	306	99	!38;							
398	184	164	138	156	156	141	0	24.4	102	
	102	57.5	!44;							
422	208	188	158	166	164	161	24.4	0	77.2	78
	80.9	!45;								
548	334	314	295	306	305	306	102	77.2	0	1.7
	145	!46;								
548	334	314	295	306	305	306	102	78	1.7	0
	144	!47;								
341	127	107	88	99	98	99	57.5	80.9	145	
	144	0;	!48;							

```

durasi =
0      302.4 280.8 309.6 304.8 307.2 310.8 477.6 506.4 657.6
      657.6 409.2
302.4 0      24    52.8 46.8 50.4 55.2 220.8 249.6 400.8
      400.8 152.4
280.8 24    0      28.8 24   27.6 30   196.8 225.6 376.8
      376.8 128.4
309.6 52.8 28.8 0      8.4 7.2 10.8 165.6 189.6 354
      354 105.6
304.8 46.8 24    8.4 0    3.6 7.2 187.2 199.2 367.2
      367.2 118.8
307.2 50.4 27.6 7.2 3.6 0    8.4 187.2 196.8 366
      366 117.6
310.8 55.2 30    10.8 7.2 8.4 0    169.2 193.2 367.2
      367.2 118.8
477.6 220.8 196.8 165.6 187.2 187.2 169.2 0    29.28 122.4
      122.4 69
506.4 249.6 225.6 189.6 199.2 196.8 193.2 29.28 0    92.64
      93.6 97.08
657.6 400.8 376.8 354 367.2 366 367.2 122.4 92.64 0
      2.04 174
657.6 400.8 376.8 354 367.2 366 367.2 122.4 93.6 2.04 0
      172.8
409.2 152.4 128.4 105.6 118.8 117.6 118.8 69 97.08 174
      172.8 0;

```

```

Bongkar = 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

```



```

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

- Hasil dari *solution report* pada *cluster 4* analisis sensitivitas skenario 3

Global optimal solution found.

Objective value:	1040.300
Objective bound:	1040.300
Infeasibilities:	0.000000
Extended solver steps:	2626
Total solver iterations:	51589
Elapsed runtime seconds:	5.10

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 252 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 20 km
 rute pengiriman dari ritel 3 ke ritel 4 sebesar 24 km
 rute pengiriman dari ritel 4 ke ritel 6 sebesar 6 km
 rute pengiriman dari ritel 5 ke ritel 7 sebesar 6 km
 rute pengiriman dari ritel 6 ke ritel 5 sebesar 3 km
 rute pengiriman dari ritel 7 ke ritel 8 sebesar 141 km
 rute pengiriman dari ritel 8 ke ritel 9 sebesar 24.4 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 77.2 km
 rute pengiriman dari ritel 10 ke ritel 11 sebesar 1.7 km
 rute pengiriman dari ritel 11 ke ritel 12 sebesar 144 km
 rute pengiriman dari ritel 12 ke ritel 1 sebesar 341 km

Model Class: MILP

Total variables:	156
Nonlinear variables:	0
Integer variables:	144
Total constraints:	180
Nonlinear constraints:	0
Total nonzeros:	935

Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	0.3000000	0.000000
BONGKAR(2)	0.3000000	0.000000
BONGKAR(3)	0.3000000	0.000000
BONGKAR(4)	0.3000000	0.000000
BONGKAR(5)	0.3000000	0.000000
BONGKAR(6)	0.3000000	0.000000
BONGKAR(7)	0.3000000	0.000000
BONGKAR(8)	0.3000000	0.000000
BONGKAR(9)	0.3000000	0.000000
BONGKAR(10)	0.3000000	0.000000
BONGKAR(11)	0.3000000	0.000000
BONGKAR(12)	0.3000000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	660.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
BUKA(12)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	660.0000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	780.0000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
TUTUP(12)	1260.000	0.000000
T(1)	1917.600	0.000000
T(2)	540.0000	0.000000

T(3)	564.3000	0.000000
T(4)	593.4000	0.000000
T(5)	780.0000	0.000000
T(6)	776.1000	0.000000
T(7)	787.5000	0.000000
T(8)	961.7400	0.000000
T(9)	991.3200	0.000000
T(10)	1084.260	0.000000
T(11)	1086.600	0.000000
T(12)	1259.700	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	252.0000
X(1, 3)	0.000000	234.0000
X(1, 4)	0.000000	258.0000
X(1, 5)	0.000000	254.0000
X(1, 6)	0.000000	256.0000
X(1, 7)	0.000000	259.0000
X(1, 8)	0.000000	398.0000
X(1, 9)	0.000000	422.0000
X(1, 10)	0.000000	548.0000
X(1, 11)	0.000000	548.0000
X(1, 12)	0.000000	341.0000
X(2, 1)	0.000000	252.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	20.00000
X(2, 4)	0.000000	44.00000
X(2, 5)	0.000000	39.00000
X(2, 6)	0.000000	42.00000
X(2, 7)	0.000000	46.00000
X(2, 8)	0.000000	184.0000
X(2, 9)	0.000000	208.0000
X(2, 10)	0.000000	334.0000
X(2, 11)	0.000000	334.0000
X(2, 12)	0.000000	127.0000
X(3, 1)	0.000000	234.0000
X(3, 2)	0.000000	20.00000
X(3, 3)	0.000000	0.000000
X(3, 4)	1.000000	24.00000
X(3, 5)	0.000000	20.00000
X(3, 6)	0.000000	23.00000
X(3, 7)	0.000000	25.00000
X(3, 8)	0.000000	164.0000
X(3, 9)	0.000000	188.0000
X(3, 10)	0.000000	314.0000

X(3, 11)	0.000000	314.0000
X(3, 12)	0.000000	107.0000
X(4, 1)	0.000000	258.0000
X(4, 2)	0.000000	44.00000
X(4, 3)	0.000000	24.00000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	7.000000
X(4, 6)	1.000000	6.000000
X(4, 7)	0.000000	9.000000
X(4, 8)	0.000000	138.0000
X(4, 9)	0.000000	158.0000
X(4, 10)	0.000000	295.0000
X(4, 11)	0.000000	295.0000
X(4, 12)	0.000000	88.00000
X(5, 1)	0.000000	254.0000
X(5, 2)	0.000000	39.00000
X(5, 3)	0.000000	20.00000
X(5, 4)	0.000000	7.000000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	3.000000
X(5, 7)	1.000000	6.000000
X(5, 8)	0.000000	156.0000
X(5, 9)	0.000000	166.0000
X(5, 10)	0.000000	306.0000
X(5, 11)	0.000000	306.0000
X(5, 12)	0.000000	99.00000
X(6, 1)	0.000000	256.0000
X(6, 2)	0.000000	42.00000
X(6, 3)	0.000000	23.00000
X(6, 4)	0.000000	6.000000
X(6, 5)	1.000000	3.000000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	7.000000
X(6, 8)	0.000000	156.0000
X(6, 9)	0.000000	164.0000
X(6, 10)	0.000000	305.0000
X(6, 11)	0.000000	305.0000
X(6, 12)	0.000000	98.00000
X(7, 1)	0.000000	259.0000
X(7, 2)	0.000000	46.00000
X(7, 3)	0.000000	25.00000
X(7, 4)	0.000000	9.000000
X(7, 5)	0.000000	6.000000
X(7, 6)	0.000000	7.000000

X(7, 7)	0.000000	0.000000
X(7, 8)	1.000000	141.0000
X(7, 9)	0.000000	161.0000
X(7, 10)	0.000000	306.0000
X(7, 11)	0.000000	306.0000
X(7, 12)	0.000000	99.00000
X(8, 1)	0.000000	398.0000
X(8, 2)	0.000000	184.0000
X(8, 3)	0.000000	164.0000
X(8, 4)	0.000000	138.0000
X(8, 5)	0.000000	156.0000
X(8, 6)	0.000000	156.0000
X(8, 7)	0.000000	141.0000
X(8, 8)	0.000000	0.000000
X(8, 9)	1.000000	24.40000
X(8, 10)	0.000000	102.0000
X(8, 11)	0.000000	102.0000
X(8, 12)	0.000000	57.50000
X(9, 1)	0.000000	422.0000
X(9, 2)	0.000000	208.0000
X(9, 3)	0.000000	188.0000
X(9, 4)	0.000000	158.0000
X(9, 5)	0.000000	166.0000
X(9, 6)	0.000000	164.0000
X(9, 7)	0.000000	161.0000
X(9, 8)	0.000000	24.40000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	77.20000
X(9, 11)	0.000000	78.00000
X(9, 12)	0.000000	80.90000
X(10, 1)	0.000000	548.0000
X(10, 2)	0.000000	334.0000
X(10, 3)	0.000000	314.0000
X(10, 4)	0.000000	295.0000
X(10, 5)	0.000000	306.0000
X(10, 6)	0.000000	305.0000
X(10, 7)	0.000000	306.0000
X(10, 8)	0.000000	102.0000
X(10, 9)	0.000000	77.20000
X(10, 10)	0.000000	0.000000
X(10, 11)	1.000000	1.700000
X(10, 12)	0.000000	145.0000
X(11, 1)	0.000000	548.0000
X(11, 2)	0.000000	334.0000

X(11, 3)	0.000000	314.0000
X(11, 4)	0.000000	295.0000
X(11, 5)	0.000000	306.0000
X(11, 6)	0.000000	305.0000
X(11, 7)	0.000000	306.0000
X(11, 8)	0.000000	102.0000
X(11, 9)	0.000000	78.00000
X(11, 10)	0.000000	1.700000
X(11, 11)	0.000000	0.000000
X(11, 12)	1.000000	144.0000
X(12, 1)	1.000000	341.0000
X(12, 2)	0.000000	127.0000
X(12, 3)	0.000000	107.0000
X(12, 4)	0.000000	88.00000
X(12, 5)	0.000000	99.00000
X(12, 6)	0.000000	98.00000
X(12, 7)	0.000000	99.00000
X(12, 8)	0.000000	57.50000
X(12, 9)	0.000000	80.90000
X(12, 10)	0.000000	145.0000
X(12, 11)	0.000000	144.0000
X(12, 12)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	252.0000	0.000000
D(1, 3)	234.0000	0.000000
D(1, 4)	258.0000	0.000000
D(1, 5)	254.0000	0.000000
D(1, 6)	256.0000	0.000000
D(1, 7)	259.0000	0.000000
D(1, 8)	398.0000	0.000000
D(1, 9)	422.0000	0.000000
D(1, 10)	548.0000	0.000000
D(1, 11)	548.0000	0.000000
D(1, 12)	341.0000	0.000000
D(2, 1)	252.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	20.00000	0.000000
D(2, 4)	44.00000	0.000000
D(2, 5)	39.00000	0.000000
D(2, 6)	42.00000	0.000000
D(2, 7)	46.00000	0.000000
D(2, 8)	184.0000	0.000000
D(2, 9)	208.0000	0.000000
D(2, 10)	334.0000	0.000000

D(2, 11)	334.0000	0.000000
D(2, 12)	127.0000	0.000000
D(3, 1)	234.0000	0.000000
D(3, 2)	20.00000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	24.00000	0.000000
D(3, 5)	20.00000	0.000000
D(3, 6)	23.00000	0.000000
D(3, 7)	25.00000	0.000000
D(3, 8)	164.0000	0.000000
D(3, 9)	188.0000	0.000000
D(3, 10)	314.0000	0.000000
D(3, 11)	314.0000	0.000000
D(3, 12)	107.0000	0.000000
D(4, 1)	258.0000	0.000000
D(4, 2)	44.00000	0.000000
D(4, 3)	24.00000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	7.000000	0.000000
D(4, 6)	6.000000	0.000000
D(4, 7)	9.000000	0.000000
D(4, 8)	138.0000	0.000000
D(4, 9)	158.0000	0.000000
D(4, 10)	295.0000	0.000000
D(4, 11)	295.0000	0.000000
D(4, 12)	88.00000	0.000000
D(5, 1)	254.0000	0.000000
D(5, 2)	39.00000	0.000000
D(5, 3)	20.00000	0.000000
D(5, 4)	7.000000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	3.000000	0.000000
D(5, 7)	6.000000	0.000000
D(5, 8)	156.0000	0.000000
D(5, 9)	166.0000	0.000000
D(5, 10)	306.0000	0.000000
D(5, 11)	306.0000	0.000000
D(5, 12)	99.00000	0.000000
D(6, 1)	256.0000	0.000000
D(6, 2)	42.00000	0.000000
D(6, 3)	23.00000	0.000000
D(6, 4)	6.000000	0.000000
D(6, 5)	3.000000	0.000000
D(6, 6)	0.000000	0.000000

D(6, 7)	7.000000	0.000000
D(6, 8)	156.0000	0.000000
D(6, 9)	164.0000	0.000000
D(6, 10)	305.0000	0.000000
D(6, 11)	305.0000	0.000000
D(6, 12)	98.00000	0.000000
D(7, 1)	259.0000	0.000000
D(7, 2)	46.00000	0.000000
D(7, 3)	25.00000	0.000000
D(7, 4)	9.000000	0.000000
D(7, 5)	6.000000	0.000000
D(7, 6)	7.000000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	141.0000	0.000000
D(7, 9)	161.0000	0.000000
D(7, 10)	306.0000	0.000000
D(7, 11)	306.0000	0.000000
D(7, 12)	99.00000	0.000000
D(8, 1)	398.0000	0.000000
D(8, 2)	184.0000	0.000000
D(8, 3)	164.0000	0.000000
D(8, 4)	138.0000	0.000000
D(8, 5)	156.0000	0.000000
D(8, 6)	156.0000	0.000000
D(8, 7)	141.0000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	24.40000	0.000000
D(8, 10)	102.0000	0.000000
D(8, 11)	102.0000	0.000000
D(8, 12)	57.50000	0.000000
D(9, 1)	422.0000	0.000000
D(9, 2)	208.0000	0.000000
D(9, 3)	188.0000	0.000000
D(9, 4)	158.0000	0.000000
D(9, 5)	166.0000	0.000000
D(9, 6)	164.0000	0.000000
D(9, 7)	161.0000	0.000000
D(9, 8)	24.40000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	77.20000	0.000000
D(9, 11)	78.00000	0.000000
D(9, 12)	80.90000	0.000000
D(10, 1)	548.0000	0.000000
D(10, 2)	334.0000	0.000000

D(10, 3)	314.0000	0.000000
D(10, 4)	295.0000	0.000000
D(10, 5)	306.0000	0.000000
D(10, 6)	305.0000	0.000000
D(10, 7)	306.0000	0.000000
D(10, 8)	102.0000	0.000000
D(10, 9)	77.20000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	1.700000	0.000000
D(10, 12)	145.0000	0.000000
D(11, 1)	548.0000	0.000000
D(11, 2)	334.0000	0.000000
D(11, 3)	314.0000	0.000000
D(11, 4)	295.0000	0.000000
D(11, 5)	306.0000	0.000000
D(11, 6)	305.0000	0.000000
D(11, 7)	306.0000	0.000000
D(11, 8)	102.0000	0.000000
D(11, 9)	78.00000	0.000000
D(11, 10)	1.700000	0.000000
D(11, 11)	0.000000	0.000000
D(11, 12)	144.0000	0.000000
D(12, 1)	341.0000	0.000000
D(12, 2)	127.0000	0.000000
D(12, 3)	107.0000	0.000000
D(12, 4)	88.00000	0.000000
D(12, 5)	99.00000	0.000000
D(12, 6)	98.00000	0.000000
D(12, 7)	99.00000	0.000000
D(12, 8)	57.50000	0.000000
D(12, 9)	80.90000	0.000000
D(12, 10)	145.0000	0.000000
D(12, 11)	144.0000	0.000000
D(12, 12)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	302.4000	0.000000
DURASI(1, 3)	280.8000	0.000000
DURASI(1, 4)	309.6000	0.000000
DURASI(1, 5)	304.8000	0.000000
DURASI(1, 6)	307.2000	0.000000
DURASI(1, 7)	310.8000	0.000000
DURASI(1, 8)	477.6000	0.000000
DURASI(1, 9)	506.4000	0.000000
DURASI(1, 10)	657.6000	0.000000

DURASI(1, 11)	657.6000	0.000000
DURASI(1, 12)	409.2000	0.000000
DURASI(2, 1)	302.4000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	24.00000	0.000000
DURASI(2, 4)	52.80000	0.000000
DURASI(2, 5)	46.80000	0.000000
DURASI(2, 6)	50.40000	0.000000
DURASI(2, 7)	55.20000	0.000000
DURASI(2, 8)	220.8000	0.000000
DURASI(2, 9)	249.6000	0.000000
DURASI(2, 10)	400.8000	0.000000
DURASI(2, 11)	400.8000	0.000000
DURASI(2, 12)	152.4000	0.000000
DURASI(3, 1)	280.8000	0.000000
DURASI(3, 2)	24.00000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	28.80000	0.000000
DURASI(3, 5)	24.00000	0.000000
DURASI(3, 6)	27.60000	0.000000
DURASI(3, 7)	30.00000	0.000000
DURASI(3, 8)	196.8000	0.000000
DURASI(3, 9)	225.6000	0.000000
DURASI(3, 10)	376.8000	0.000000
DURASI(3, 11)	376.8000	0.000000
DURASI(3, 12)	128.4000	0.000000
DURASI(4, 1)	309.6000	0.000000
DURASI(4, 2)	52.80000	0.000000
DURASI(4, 3)	28.80000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	8.400000	0.000000
DURASI(4, 6)	7.200000	0.000000
DURASI(4, 7)	10.80000	0.000000
DURASI(4, 8)	165.6000	0.000000
DURASI(4, 9)	189.6000	0.000000
DURASI(4, 10)	354.0000	0.000000
DURASI(4, 11)	354.0000	0.000000
DURASI(4, 12)	105.6000	0.000000
DURASI(5, 1)	304.8000	0.000000
DURASI(5, 2)	46.80000	0.000000
DURASI(5, 3)	24.00000	0.000000
DURASI(5, 4)	8.400000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	3.600000	0.000000

DURASI(5, 7)	7.200000	0.000000
DURASI(5, 8)	187.2000	0.000000
DURASI(5, 9)	199.2000	0.000000
DURASI(5, 10)	367.2000	0.000000
DURASI(5, 11)	367.2000	0.000000
DURASI(5, 12)	118.8000	0.000000
DURASI(6, 1)	307.2000	0.000000
DURASI(6, 2)	50.40000	0.000000
DURASI(6, 3)	27.60000	0.000000
DURASI(6, 4)	7.200000	0.000000
DURASI(6, 5)	3.600000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	8.400000	0.000000
DURASI(6, 8)	187.2000	0.000000
DURASI(6, 9)	196.8000	0.000000
DURASI(6, 10)	366.0000	0.000000
DURASI(6, 11)	366.0000	0.000000
DURASI(6, 12)	117.6000	0.000000
DURASI(7, 1)	310.8000	0.000000
DURASI(7, 2)	55.20000	0.000000
DURASI(7, 3)	30.00000	0.000000
DURASI(7, 4)	10.80000	0.000000
DURASI(7, 5)	7.200000	0.000000
DURASI(7, 6)	8.400000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	169.2000	0.000000
DURASI(7, 9)	193.2000	0.000000
DURASI(7, 10)	367.2000	0.000000
DURASI(7, 11)	367.2000	0.000000
DURASI(7, 12)	118.8000	0.000000
DURASI(8, 1)	477.6000	0.000000
DURASI(8, 2)	220.8000	0.000000
DURASI(8, 3)	196.8000	0.000000
DURASI(8, 4)	165.6000	0.000000
DURASI(8, 5)	187.2000	0.000000
DURASI(8, 6)	187.2000	0.000000
DURASI(8, 7)	169.2000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	29.28000	0.000000
DURASI(8, 10)	122.4000	0.000000
DURASI(8, 11)	122.4000	0.000000
DURASI(8, 12)	69.00000	0.000000
DURASI(9, 1)	506.4000	0.000000
DURASI(9, 2)	249.6000	0.000000

DURASI(9, 3)	225.6000	0.000000
DURASI(9, 4)	189.6000	0.000000
DURASI(9, 5)	199.2000	0.000000
DURASI(9, 6)	196.8000	0.000000
DURASI(9, 7)	193.2000	0.000000
DURASI(9, 8)	29.28000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	92.64000	0.000000
DURASI(9, 11)	93.60000	0.000000
DURASI(9, 12)	97.08000	0.000000
DURASI(10, 1)	657.6000	0.000000
DURASI(10, 2)	400.8000	0.000000
DURASI(10, 3)	376.8000	0.000000
DURASI(10, 4)	354.0000	0.000000
DURASI(10, 5)	367.2000	0.000000
DURASI(10, 6)	366.0000	0.000000
DURASI(10, 7)	367.2000	0.000000
DURASI(10, 8)	122.4000	0.000000
DURASI(10, 9)	92.64000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	2.040000	0.000000
DURASI(10, 12)	174.0000	0.000000
DURASI(11, 1)	657.6000	0.000000
DURASI(11, 2)	400.8000	0.000000
DURASI(11, 3)	376.8000	0.000000
DURASI(11, 4)	354.0000	0.000000
DURASI(11, 5)	367.2000	0.000000
DURASI(11, 6)	366.0000	0.000000
DURASI(11, 7)	367.2000	0.000000
DURASI(11, 8)	122.4000	0.000000
DURASI(11, 9)	93.60000	0.000000
DURASI(11, 10)	2.040000	0.000000
DURASI(11, 11)	0.000000	0.000000
DURASI(11, 12)	172.8000	0.000000
DURASI(12, 1)	409.2000	0.000000
DURASI(12, 2)	152.4000	0.000000
DURASI(12, 3)	128.4000	0.000000
DURASI(12, 4)	105.6000	0.000000
DURASI(12, 5)	118.8000	0.000000
DURASI(12, 6)	117.6000	0.000000
DURASI(12, 7)	118.8000	0.000000
DURASI(12, 8)	69.00000	0.000000
DURASI(12, 9)	97.08000	0.000000
DURASI(12, 10)	174.0000	0.000000

DURASI(12, 11)	172.8000	0.000000
DURASI(12, 12)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 5* analisis sensitivitas skenario 3

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..11/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 660 780 540 540 540 540 540 540;
tutup = 1020 660 1260 780 900 1260 1260 1260 1260 1260 1260;
```

D =

```
!ritel
!0      16      19      20      21      39      40      41      42      43
      49;
0      49.3    161     160     160     312     316     321     321     320
      323     !0;
49.3   0       126     125     125     277     281     287     287     285
      289     !16;
161    126     0       5.4     1.7     171     175     180     181     179
      182     !19;
160    125     5.4     0       3.1     169     173     179     179     177
      180     !20;
160    125     1.7     3.1     0       169     173     179     179     177
      180     !21;
312    277     171     169     169     0       4       10     10     9     14
      !39;
316    281     175     173     173     4       0       9.5    9.8    8.1
      13.2    !40;
```

```

321  287  180  179  179  10  9.5  0  0.9  1.9  9.5
      !41;
321  287  181  179  179  10  9.8  0.9  0  1.7
      10.3  !42;
320  285  179  177  177  9  8.1  1.9  1.7  0
      11.1  !43;
323  289  182  180  180  14  13.2  9.5  10.3  11.1  0;
      !49;

```

```

durasi =
0      59.16 193.2 192  192  374.4 379.2 385.2 385.2 384
      387.6
59.16 0      151.2 150  150  332.4 337.2 344.4 344.4 342
      346.8
193.2 151.2 0      6.48 2.04 205.2 210  216  217.2 214.8
      218.4
192  150  6.48 0      3.72 202.8 207.6 214.8 214.8 212.4
      216
192  150  2.04 3.72 0      202.8 207.6 214.8 214.8 212.4
      216
374.4 332.4 205.2 202.8 202.8 0  4.8  12  12  10.8
      16.8
379.2 337.2 210  207.6 207.6 4.8  0  11.4  11.76 9.72
      15.84
385.2 344.4 216  214.8 214.8 12  11.4  0  1.08 2.28
      11.4
385.2 344.4 217.2 214.8 214.8 12  11.76 1.08 0  2.04
      12.36
384  342  214.8 212.4 212.4 10.8  9.72 2.28 2.04 0
      13.32
387.6 346.8 218.4 216  216  16.8  15.84 11.4  12.36 13.32 0;

```

```

Bongkar= 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;
MIN =

```

```

        @SUM (ritel(i) :
            @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 5* analisis sensitivitas skenario 3

Global optimal solution found.

Objective value: 697.3000
 Objective bound: 697.3000
 Infeasibilities: 0.000000
 Extended solver steps: 679
 Total solver iterations: 5932
 Elapsed runtime seconds: 0.99

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 49.3 km
 rute pengiriman dari ritel 2 ke ritel 4 sebesar 125 km
 rute pengiriman dari ritel 3 ke ritel 6 sebesar 171 km
 rute pengiriman dari ritel 4 ke ritel 5 sebesar 3.1 km
 rute pengiriman dari ritel 5 ke ritel 3 sebesar 1.7 km
 rute pengiriman dari ritel 6 ke ritel 7 sebesar 4 km
 rute pengiriman dari ritel 7 ke ritel 10 sebesar 8.1 km
 rute pengiriman dari ritel 8 ke ritel 11 sebesar 9.5 km
 rute pengiriman dari ritel 9 ke ritel 8 sebesar 0.9 km
 rute pengiriman dari ritel 10 ke ritel 9 sebesar 1.7 km
 rute pengiriman dari ritel 11 ke ritel 1 sebesar 323 km

Model Class: MILP

Total variables: 132
 Nonlinear variables: 0
 Integer variables: 121
 Total constraints: 154
 Nonlinear constraints: 0
 Total nonzeros: 780
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000

BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	660.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	780.0000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
T(1)	1647.600	0.000000
T(2)	540.0000	0.000000
T(3)	812.0400	0.000000
T(4)	720.0000	0.000000
T(5)	780.0000	0.000000
T(6)	1047.240	0.000000
T(7)	1082.040	0.000000
T(8)	1184.880	0.000000
T(9)	1153.800	0.000000
T(10)	1121.760	0.000000
T(11)	1226.280	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	49.30000
X(1, 3)	0.000000	161.0000
X(1, 4)	0.000000	160.0000
X(1, 5)	0.000000	160.0000

X(1, 6)	0.000000	312.0000
X(1, 7)	0.000000	316.0000
X(1, 8)	0.000000	321.0000
X(1, 9)	0.000000	321.0000
X(1, 10)	0.000000	320.0000
X(1, 11)	0.000000	323.0000
X(2, 1)	0.000000	49.30000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	126.0000
X(2, 4)	1.000000	125.0000
X(2, 5)	0.000000	125.0000
X(2, 6)	0.000000	277.0000
X(2, 7)	0.000000	281.0000
X(2, 8)	0.000000	287.0000
X(2, 9)	0.000000	287.0000
X(2, 10)	0.000000	285.0000
X(2, 11)	0.000000	289.0000
X(3, 1)	0.000000	161.0000
X(3, 2)	0.000000	126.0000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	5.400000
X(3, 5)	0.000000	1.700000
X(3, 6)	1.000000	171.0000
X(3, 7)	0.000000	175.0000
X(3, 8)	0.000000	180.0000
X(3, 9)	0.000000	181.0000
X(3, 10)	0.000000	179.0000
X(3, 11)	0.000000	182.0000
X(4, 1)	0.000000	160.0000
X(4, 2)	0.000000	125.0000
X(4, 3)	0.000000	5.400000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	3.100000
X(4, 6)	0.000000	169.0000
X(4, 7)	0.000000	173.0000
X(4, 8)	0.000000	179.0000
X(4, 9)	0.000000	179.0000
X(4, 10)	0.000000	177.0000
X(4, 11)	0.000000	180.0000
X(5, 1)	0.000000	160.0000
X(5, 2)	0.000000	125.0000
X(5, 3)	1.000000	1.700000
X(5, 4)	0.000000	3.100000
X(5, 5)	0.000000	0.000000

X(5, 6)	0.000000	169.0000
X(5, 7)	0.000000	173.0000
X(5, 8)	0.000000	179.0000
X(5, 9)	0.000000	179.0000
X(5, 10)	0.000000	177.0000
X(5, 11)	0.000000	180.0000
X(6, 1)	0.000000	312.0000
X(6, 2)	0.000000	277.0000
X(6, 3)	0.000000	171.0000
X(6, 4)	0.000000	169.0000
X(6, 5)	0.000000	169.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	1.000000	4.000000
X(6, 8)	0.000000	10.00000
X(6, 9)	0.000000	10.00000
X(6, 10)	0.000000	9.000000
X(6, 11)	0.000000	14.00000
X(7, 1)	0.000000	316.0000
X(7, 2)	0.000000	281.0000
X(7, 3)	0.000000	175.0000
X(7, 4)	0.000000	173.0000
X(7, 5)	0.000000	173.0000
X(7, 6)	0.000000	4.000000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	9.500000
X(7, 9)	0.000000	9.800000
X(7, 10)	1.000000	8.100000
X(7, 11)	0.000000	13.20000
X(8, 1)	0.000000	321.0000
X(8, 2)	0.000000	287.0000
X(8, 3)	0.000000	180.0000
X(8, 4)	0.000000	179.0000
X(8, 5)	0.000000	179.0000
X(8, 6)	0.000000	10.00000
X(8, 7)	0.000000	9.500000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	0.9000000
X(8, 10)	0.000000	1.900000
X(8, 11)	1.000000	9.500000
X(9, 1)	0.000000	321.0000
X(9, 2)	0.000000	287.0000
X(9, 3)	0.000000	181.0000
X(9, 4)	0.000000	179.0000
X(9, 5)	0.000000	179.0000

X(9, 6)	0.000000	10.00000
X(9, 7)	0.000000	9.800000
X(9, 8)	1.000000	0.9000000
X(9, 9)	0.000000	0.000000
X(9, 10)	0.000000	1.700000
X(9, 11)	0.000000	10.30000
X(10, 1)	0.000000	320.0000
X(10, 2)	0.000000	285.0000
X(10, 3)	0.000000	179.0000
X(10, 4)	0.000000	177.0000
X(10, 5)	0.000000	177.0000
X(10, 6)	0.000000	9.000000
X(10, 7)	0.000000	8.100000
X(10, 8)	0.000000	1.900000
X(10, 9)	1.000000	1.700000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	11.10000
X(11, 1)	1.000000	323.0000
X(11, 2)	0.000000	289.0000
X(11, 3)	0.000000	182.0000
X(11, 4)	0.000000	180.0000
X(11, 5)	0.000000	180.0000
X(11, 6)	0.000000	14.00000
X(11, 7)	0.000000	13.20000
X(11, 8)	0.000000	9.500000
X(11, 9)	0.000000	10.30000
X(11, 10)	0.000000	11.10000
X(11, 11)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	49.30000	0.000000
D(1, 3)	161.0000	0.000000
D(1, 4)	160.0000	0.000000
D(1, 5)	160.0000	0.000000
D(1, 6)	312.0000	0.000000
D(1, 7)	316.0000	0.000000
D(1, 8)	321.0000	0.000000
D(1, 9)	321.0000	0.000000
D(1, 10)	320.0000	0.000000
D(1, 11)	323.0000	0.000000
D(2, 1)	49.30000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	126.0000	0.000000
D(2, 4)	125.0000	0.000000
D(2, 5)	125.0000	0.000000

D(2, 6)	277.0000	0.000000
D(2, 7)	281.0000	0.000000
D(2, 8)	287.0000	0.000000
D(2, 9)	287.0000	0.000000
D(2, 10)	285.0000	0.000000
D(2, 11)	289.0000	0.000000
D(3, 1)	161.0000	0.000000
D(3, 2)	126.0000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	5.400000	0.000000
D(3, 5)	1.700000	0.000000
D(3, 6)	171.0000	0.000000
D(3, 7)	175.0000	0.000000
D(3, 8)	180.0000	0.000000
D(3, 9)	181.0000	0.000000
D(3, 10)	179.0000	0.000000
D(3, 11)	182.0000	0.000000
D(4, 1)	160.0000	0.000000
D(4, 2)	125.0000	0.000000
D(4, 3)	5.400000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	3.100000	0.000000
D(4, 6)	169.0000	0.000000
D(4, 7)	173.0000	0.000000
D(4, 8)	179.0000	0.000000
D(4, 9)	179.0000	0.000000
D(4, 10)	177.0000	0.000000
D(4, 11)	180.0000	0.000000
D(5, 1)	160.0000	0.000000
D(5, 2)	125.0000	0.000000
D(5, 3)	1.700000	0.000000
D(5, 4)	3.100000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	169.0000	0.000000
D(5, 7)	173.0000	0.000000
D(5, 8)	179.0000	0.000000
D(5, 9)	179.0000	0.000000
D(5, 10)	177.0000	0.000000
D(5, 11)	180.0000	0.000000
D(6, 1)	312.0000	0.000000
D(6, 2)	277.0000	0.000000
D(6, 3)	171.0000	0.000000
D(6, 4)	169.0000	0.000000
D(6, 5)	169.0000	0.000000

D(6, 6)	0.000000	0.000000
D(6, 7)	4.000000	0.000000
D(6, 8)	10.00000	0.000000
D(6, 9)	10.00000	0.000000
D(6, 10)	9.000000	0.000000
D(6, 11)	14.00000	0.000000
D(7, 1)	316.0000	0.000000
D(7, 2)	281.0000	0.000000
D(7, 3)	175.0000	0.000000
D(7, 4)	173.0000	0.000000
D(7, 5)	173.0000	0.000000
D(7, 6)	4.000000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	9.500000	0.000000
D(7, 9)	9.800000	0.000000
D(7, 10)	8.100000	0.000000
D(7, 11)	13.20000	0.000000
D(8, 1)	321.0000	0.000000
D(8, 2)	287.0000	0.000000
D(8, 3)	180.0000	0.000000
D(8, 4)	179.0000	0.000000
D(8, 5)	179.0000	0.000000
D(8, 6)	10.00000	0.000000
D(8, 7)	9.500000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	0.9000000	0.000000
D(8, 10)	1.900000	0.000000
D(8, 11)	9.500000	0.000000
D(9, 1)	321.0000	0.000000
D(9, 2)	287.0000	0.000000
D(9, 3)	181.0000	0.000000
D(9, 4)	179.0000	0.000000
D(9, 5)	179.0000	0.000000
D(9, 6)	10.00000	0.000000
D(9, 7)	9.800000	0.000000
D(9, 8)	0.9000000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	1.700000	0.000000
D(9, 11)	10.30000	0.000000
D(10, 1)	320.0000	0.000000
D(10, 2)	285.0000	0.000000
D(10, 3)	179.0000	0.000000
D(10, 4)	177.0000	0.000000
D(10, 5)	177.0000	0.000000

D(10, 6)	9.000000	0.000000
D(10, 7)	8.100000	0.000000
D(10, 8)	1.900000	0.000000
D(10, 9)	1.700000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	11.10000	0.000000
D(11, 1)	323.0000	0.000000
D(11, 2)	289.0000	0.000000
D(11, 3)	182.0000	0.000000
D(11, 4)	180.0000	0.000000
D(11, 5)	180.0000	0.000000
D(11, 6)	14.00000	0.000000
D(11, 7)	13.20000	0.000000
D(11, 8)	9.500000	0.000000
D(11, 9)	10.30000	0.000000
D(11, 10)	11.10000	0.000000
D(11, 11)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	59.16000	0.000000
DURASI(1, 3)	193.2000	0.000000
DURASI(1, 4)	192.0000	0.000000
DURASI(1, 5)	192.0000	0.000000
DURASI(1, 6)	374.4000	0.000000
DURASI(1, 7)	379.2000	0.000000
DURASI(1, 8)	385.2000	0.000000
DURASI(1, 9)	385.2000	0.000000
DURASI(1, 10)	384.0000	0.000000
DURASI(1, 11)	387.6000	0.000000
DURASI(2, 1)	59.16000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	151.2000	0.000000
DURASI(2, 4)	150.0000	0.000000
DURASI(2, 5)	150.0000	0.000000
DURASI(2, 6)	332.4000	0.000000
DURASI(2, 7)	337.2000	0.000000
DURASI(2, 8)	344.4000	0.000000
DURASI(2, 9)	344.4000	0.000000
DURASI(2, 10)	342.0000	0.000000
DURASI(2, 11)	346.8000	0.000000
DURASI(3, 1)	193.2000	0.000000
DURASI(3, 2)	151.2000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	6.480000	0.000000
DURASI(3, 5)	2.040000	0.000000

DURASI(3, 6)	205.2000	0.000000
DURASI(3, 7)	210.0000	0.000000
DURASI(3, 8)	216.0000	0.000000
DURASI(3, 9)	217.2000	0.000000
DURASI(3, 10)	214.8000	0.000000
DURASI(3, 11)	218.4000	0.000000
DURASI(4, 1)	192.0000	0.000000
DURASI(4, 2)	150.0000	0.000000
DURASI(4, 3)	6.480000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	3.720000	0.000000
DURASI(4, 6)	202.8000	0.000000
DURASI(4, 7)	207.6000	0.000000
DURASI(4, 8)	214.8000	0.000000
DURASI(4, 9)	214.8000	0.000000
DURASI(4, 10)	212.4000	0.000000
DURASI(4, 11)	216.0000	0.000000
DURASI(5, 1)	192.0000	0.000000
DURASI(5, 2)	150.0000	0.000000
DURASI(5, 3)	2.040000	0.000000
DURASI(5, 4)	3.720000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	202.8000	0.000000
DURASI(5, 7)	207.6000	0.000000
DURASI(5, 8)	214.8000	0.000000
DURASI(5, 9)	214.8000	0.000000
DURASI(5, 10)	212.4000	0.000000
DURASI(5, 11)	216.0000	0.000000
DURASI(6, 1)	374.4000	0.000000
DURASI(6, 2)	332.4000	0.000000
DURASI(6, 3)	205.2000	0.000000
DURASI(6, 4)	202.8000	0.000000
DURASI(6, 5)	202.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.800000	0.000000
DURASI(6, 8)	12.00000	0.000000
DURASI(6, 9)	12.00000	0.000000
DURASI(6, 10)	10.80000	0.000000
DURASI(6, 11)	16.80000	0.000000
DURASI(7, 1)	379.2000	0.000000
DURASI(7, 2)	337.2000	0.000000
DURASI(7, 3)	210.0000	0.000000
DURASI(7, 4)	207.6000	0.000000
DURASI(7, 5)	207.6000	0.000000

DURASI(7, 6)	4.800000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	11.40000	0.000000
DURASI(7, 9)	11.76000	0.000000
DURASI(7, 10)	9.720000	0.000000
DURASI(7, 11)	15.84000	0.000000
DURASI(8, 1)	385.2000	0.000000
DURASI(8, 2)	344.4000	0.000000
DURASI(8, 3)	216.0000	0.000000
DURASI(8, 4)	214.8000	0.000000
DURASI(8, 5)	214.8000	0.000000
DURASI(8, 6)	12.00000	0.000000
DURASI(8, 7)	11.40000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	1.080000	0.000000
DURASI(8, 10)	2.280000	0.000000
DURASI(8, 11)	11.40000	0.000000
DURASI(9, 1)	385.2000	0.000000
DURASI(9, 2)	344.4000	0.000000
DURASI(9, 3)	217.2000	0.000000
DURASI(9, 4)	214.8000	0.000000
DURASI(9, 5)	214.8000	0.000000
DURASI(9, 6)	12.00000	0.000000
DURASI(9, 7)	11.76000	0.000000
DURASI(9, 8)	1.080000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	2.040000	0.000000
DURASI(9, 11)	12.36000	0.000000
DURASI(10, 1)	384.0000	0.000000
DURASI(10, 2)	342.0000	0.000000
DURASI(10, 3)	214.8000	0.000000
DURASI(10, 4)	212.4000	0.000000
DURASI(10, 5)	212.4000	0.000000
DURASI(10, 6)	10.80000	0.000000
DURASI(10, 7)	9.720000	0.000000
DURASI(10, 8)	2.280000	0.000000
DURASI(10, 9)	2.040000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	13.32000	0.000000
DURASI(11, 1)	387.6000	0.000000
DURASI(11, 2)	346.8000	0.000000
DURASI(11, 3)	218.4000	0.000000
DURASI(11, 4)	216.0000	0.000000
DURASI(11, 5)	216.0000	0.000000

DURASI(11, 6)	16.80000	0.000000
DURASI(11, 7)	15.84000	0.000000
DURASI(11, 8)	11.40000	0.000000
DURASI(11, 9)	12.36000	0.000000
DURASI(11, 10)	13.32000	0.000000
DURASI(11, 11)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 6* analisis sensitivitas skenario 3

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..8/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 540 780 660;
tutup = 1020 660 1260 1260 1260 1260 900 780;
```

D =

```
!ritel
!0    4    17    18    22    23    24    28;
0     12.3  115   115   193   102   93    157   !0;
12.3  0     120   121   198   83.1  75.1  148   !4;
115   120   0     1.1   96.1  83    96.4  45.8  !17;
115   121   1.1   0     95    84.5  97.8  46    !18;
193   198   96.1  95    0     194   266   103   !22;
102   83.1  83    84.5  194   0     14.9  75.3  !23;
93    75.1  96.4  97.8  266   14.9  0     76.6  !24;
157   148   45.8  46    103   75.3  76.6  0;    !28;
```

durasi =

```
0     14.76  138   138   231.6  122.4  111.6  188.4
14.76 0     144   145.2  237.6  99.72  90.12  177.6
138   144   0     1.32  115.32      99.6  115.68      54.96
138   145.2  1.32  0     114    101.4  117.36      55.2
```

```

231.6 237.6 115.32      114    0      232.8 319.2 123.6
122.4 99.72 99.6   101.4 232.8 0      17.88 90.36
111.6 90.12 115.68      117.36      319.2 17.88 0      91.92
188.4 177.6 54.96 55.2  123.6 90.36 91.92 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

```

```

!Fungsi batasan;

```

```

!setiap ritel dikunjungi satu kali;

```

```

@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

```

```

!perjalanan diawali dari depot;

```

```

@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

```

```

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

```

```

!pelaksanaan;

```

```

@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

```

```

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 6* analisis sensitivitas skenario 3

Global optimal solution found.

Objective value:	623.9000
Objective bound:	623.9000
Infeasibilities:	0.000000
Extended solver steps:	0
Total solver iterations:	551
Elapsed runtime seconds:	0.18

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 12.3 km
rute pengiriman dari ritel 2 ke ritel 8 sebesar 148 km
rute pengiriman dari ritel 3 ke ritel 4 sebesar 1.1 km
rute pengiriman dari ritel 4 ke ritel 5 sebesar 95 km
rute pengiriman dari ritel 5 ke ritel 1 sebesar 193 km
rute pengiriman dari ritel 6 ke ritel 3 sebesar 83 km
rute pengiriman dari ritel 7 ke ritel 6 sebesar 14.9 km
rute pengiriman dari ritel 8 ke ritel 7 sebesar 76.59999999999999 km

Model Class: MILP

Total variables:	72
Nonlinear variables:	0

Integer variables: 64
 Total constraints: 88
 Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	780.0000	0.000000
BUKA(8)	660.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	900.0000	0.000000
TUTUP(8)	780.0000	0.000000
T(1)	1491.600	0.000000
T(2)	540.0000	0.000000
T(3)	1047.000	0.000000
T(4)	1078.320	0.000000
T(5)	1222.320	0.000000
T(6)	917.4000	0.000000
T(7)	869.5200	0.000000
T(8)	747.6000	0.000000

X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	12.30000
X(1, 3)	0.000000	115.0000
X(1, 4)	0.000000	115.0000
X(1, 5)	0.000000	193.0000
X(1, 6)	0.000000	102.0000
X(1, 7)	0.000000	93.00000
X(1, 8)	0.000000	157.0000
X(2, 1)	0.000000	12.30000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	120.0000
X(2, 4)	0.000000	121.0000
X(2, 5)	0.000000	198.0000
X(2, 6)	0.000000	83.10000
X(2, 7)	0.000000	75.10000
X(2, 8)	1.000000	148.0000
X(3, 1)	0.000000	115.0000
X(3, 2)	0.000000	120.0000
X(3, 3)	0.000000	0.000000
X(3, 4)	1.000000	1.100000
X(3, 5)	0.000000	96.10000
X(3, 6)	0.000000	83.00000
X(3, 7)	0.000000	96.40000
X(3, 8)	0.000000	45.80000
X(4, 1)	0.000000	115.0000
X(4, 2)	0.000000	121.0000
X(4, 3)	0.000000	1.100000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	95.00000
X(4, 6)	0.000000	84.50000
X(4, 7)	0.000000	97.80000
X(4, 8)	0.000000	46.00000
X(5, 1)	1.000000	193.0000
X(5, 2)	0.000000	198.0000
X(5, 3)	0.000000	96.10000
X(5, 4)	0.000000	95.00000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	194.0000
X(5, 7)	0.000000	266.0000
X(5, 8)	0.000000	103.0000
X(6, 1)	0.000000	102.0000
X(6, 2)	0.000000	83.10000
X(6, 3)	1.000000	83.00000
X(6, 4)	0.000000	84.50000

X(6, 5)	0.000000	194.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	14.90000
X(6, 8)	0.000000	75.30000
X(7, 1)	0.000000	93.00000
X(7, 2)	0.000000	75.10000
X(7, 3)	0.000000	96.40000
X(7, 4)	0.000000	97.80000
X(7, 5)	0.000000	266.0000
X(7, 6)	1.000000	14.90000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	76.60000
X(8, 1)	0.000000	157.0000
X(8, 2)	0.000000	148.0000
X(8, 3)	0.000000	45.80000
X(8, 4)	0.000000	46.00000
X(8, 5)	0.000000	103.0000
X(8, 6)	0.000000	75.30000
X(8, 7)	1.000000	76.60000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	12.30000	0.000000
D(1, 3)	115.0000	0.000000
D(1, 4)	115.0000	0.000000
D(1, 5)	193.0000	0.000000
D(1, 6)	102.0000	0.000000
D(1, 7)	93.00000	0.000000
D(1, 8)	157.0000	0.000000
D(2, 1)	12.30000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	120.0000	0.000000
D(2, 4)	121.0000	0.000000
D(2, 5)	198.0000	0.000000
D(2, 6)	83.10000	0.000000
D(2, 7)	75.10000	0.000000
D(2, 8)	148.0000	0.000000
D(3, 1)	115.0000	0.000000
D(3, 2)	120.0000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	1.100000	0.000000
D(3, 5)	96.10000	0.000000
D(3, 6)	83.00000	0.000000
D(3, 7)	96.40000	0.000000
D(3, 8)	45.80000	0.000000

D(4, 1)	115.0000	0.000000
D(4, 2)	121.0000	0.000000
D(4, 3)	1.100000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	95.00000	0.000000
D(4, 6)	84.50000	0.000000
D(4, 7)	97.80000	0.000000
D(4, 8)	46.00000	0.000000
D(5, 1)	193.0000	0.000000
D(5, 2)	198.0000	0.000000
D(5, 3)	96.10000	0.000000
D(5, 4)	95.00000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	194.0000	0.000000
D(5, 7)	266.0000	0.000000
D(5, 8)	103.0000	0.000000
D(6, 1)	102.0000	0.000000
D(6, 2)	83.10000	0.000000
D(6, 3)	83.00000	0.000000
D(6, 4)	84.50000	0.000000
D(6, 5)	194.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	14.90000	0.000000
D(6, 8)	75.30000	0.000000
D(7, 1)	93.00000	0.000000
D(7, 2)	75.10000	0.000000
D(7, 3)	96.40000	0.000000
D(7, 4)	97.80000	0.000000
D(7, 5)	266.0000	0.000000
D(7, 6)	14.90000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	76.60000	0.000000
D(8, 1)	157.0000	0.000000
D(8, 2)	148.0000	0.000000
D(8, 3)	45.80000	0.000000
D(8, 4)	46.00000	0.000000
D(8, 5)	103.0000	0.000000
D(8, 6)	75.30000	0.000000
D(8, 7)	76.60000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	14.76000	0.000000
DURASI(1, 3)	138.0000	0.000000
DURASI(1, 4)	138.0000	0.000000

DURASI(1, 5)	231.6000	0.000000
DURASI(1, 6)	122.4000	0.000000
DURASI(1, 7)	111.6000	0.000000
DURASI(1, 8)	188.4000	0.000000
DURASI(2, 1)	14.76000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	144.0000	0.000000
DURASI(2, 4)	145.2000	0.000000
DURASI(2, 5)	237.6000	0.000000
DURASI(2, 6)	99.72000	0.000000
DURASI(2, 7)	90.12000	0.000000
DURASI(2, 8)	177.6000	0.000000
DURASI(3, 1)	138.0000	0.000000
DURASI(3, 2)	144.0000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	1.320000	0.000000
DURASI(3, 5)	115.3200	0.000000
DURASI(3, 6)	99.60000	0.000000
DURASI(3, 7)	115.6800	0.000000
DURASI(3, 8)	54.96000	0.000000
DURASI(4, 1)	138.0000	0.000000
DURASI(4, 2)	145.2000	0.000000
DURASI(4, 3)	1.320000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	114.0000	0.000000
DURASI(4, 6)	101.4000	0.000000
DURASI(4, 7)	117.3600	0.000000
DURASI(4, 8)	55.20000	0.000000
DURASI(5, 1)	231.6000	0.000000
DURASI(5, 2)	237.6000	0.000000
DURASI(5, 3)	115.3200	0.000000
DURASI(5, 4)	114.0000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	232.8000	0.000000
DURASI(5, 7)	319.2000	0.000000
DURASI(5, 8)	123.6000	0.000000
DURASI(6, 1)	122.4000	0.000000
DURASI(6, 2)	99.72000	0.000000
DURASI(6, 3)	99.60000	0.000000
DURASI(6, 4)	101.4000	0.000000
DURASI(6, 5)	232.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	17.88000	0.000000
DURASI(6, 8)	90.36000	0.000000

DURASI(7, 1)	111.6000	0.000000
DURASI(7, 2)	90.12000	0.000000
DURASI(7, 3)	115.6800	0.000000
DURASI(7, 4)	117.3600	0.000000
DURASI(7, 5)	319.2000	0.000000
DURASI(7, 6)	17.88000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	91.92000	0.000000
DURASI(8, 1)	188.4000	0.000000
DURASI(8, 2)	177.6000	0.000000
DURASI(8, 3)	54.96000	0.000000
DURASI(8, 4)	55.20000	0.000000
DURASI(8, 5)	123.6000	0.000000
DURASI(8, 6)	90.36000	0.000000
DURASI(8, 7)	91.92000	0.000000
DURASI(8, 8)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 7* analisis sensitivitas skenario 3

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..8/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 660 780 540 540 540;
tutup = 1020 660 1260 780 900 1260 1260 1260;
```

D =

```
!ritel
!0   12   13   14   15   25   26   27;
0    146  190  192  194  92.2  93.8  93   !0;
146  0    63.4  64.1  66.9  157   159   158  !12;
190  63.4  0    3.2   5.9   200   201   201  !13;
192  64.1  3.2   0    2.9   203   205   204  !14;
194  66.9  5.9   2.9   0    204   206   205  !15;
92.2 157   200   203   204   0    3.1   1.4  !25;
93.8 159   201   205   206   3.1   0    4    !26;
93   158   201   204   205   1.4   4    0;   !27;
```

durasi =

```
0    175.2  228   230.4  232.8  110.64   112.56   111.6
175.2 0    76.08  76.92  80.28  188.4   190.8   189.6
228  76.08 0    3.84   7.08   240    241.2   241.2
230.4 76.92 3.84 0    3.48   243.6  246    244.8
232.8 80.28 7.08 3.48 0    244.8  247.2  246
```

```

110.64      188.4 240    243.6 244.8 0      3.72  1.68
112.56      190.8 241.2 246    247.2 3.72  0      4.8
111.6 189.6 241.2 244.8 246    1.68  4.8   0;

```

```

Bongkar = 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

```

```

!Fungsi batasan;

```

```

!setiap ritel dikunjungi satu kali;

```

```

@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

```

```

!perjalanan diawali dari depot;

```

```

@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

```

```

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

```

```

!pelaksanaan;

```

```

@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

```

```

!rute;

```

```

@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

- Hasil dari *solution report* pada *cluster 7* analisis sensitivitas skenario 3

```

Global optimal solution found.
Objective value:           517.4000
Objective bound:          517.4000
Infeasibilities:          0.000000
Extended solver steps:    0
Total solver iterations:  532
Elapsed runtime seconds:  0.19

```

Rute yang paling optimal adalah:

```

rute pengiriman dari ritel 1 ke ritel 2 sebesar 146 km
rute pengiriman dari ritel 2 ke ritel 4 sebesar 64.099999999999999 km
rute pengiriman dari ritel 3 ke ritel 7 sebesar 201 km
rute pengiriman dari ritel 4 ke ritel 5 sebesar 2.9 km
rute pengiriman dari ritel 5 ke ritel 3 sebesar 5.9 km
rute pengiriman dari ritel 6 ke ritel 8 sebesar 1.4 km
rute pengiriman dari ritel 7 ke ritel 6 sebesar 3.1 km
rute pengiriman dari ritel 8 ke ritel 1 sebesar 93 km
Model Class:              MILP

```

```

Total variables:          72
Nonlinear variables:      0
Integer variables:        64

```

Total constraints: 88
 Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	660.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	780.0000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
T(1)	1488.000	0.000000
T(2)	540.0000	0.000000
T(3)	817.0800	0.000000
T(4)	746.5200	0.000000
T(5)	780.0000	0.000000
T(6)	1198.320	0.000000
T(7)	1164.600	0.000000
T(8)	1230.000	0.000000
X(1, 1)	0.000000	0.000000

X(1, 2)	1.000000	146.0000
X(1, 3)	0.000000	190.0000
X(1, 4)	0.000000	192.0000
X(1, 5)	0.000000	194.0000
X(1, 6)	0.000000	92.20000
X(1, 7)	0.000000	93.80000
X(1, 8)	0.000000	93.00000
X(2, 1)	0.000000	146.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	63.40000
X(2, 4)	1.000000	64.10000
X(2, 5)	0.000000	66.90000
X(2, 6)	0.000000	157.0000
X(2, 7)	0.000000	159.0000
X(2, 8)	0.000000	158.0000
X(3, 1)	0.000000	190.0000
X(3, 2)	0.000000	63.40000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	3.200000
X(3, 5)	0.000000	5.900000
X(3, 6)	0.000000	200.0000
X(3, 7)	1.000000	201.0000
X(3, 8)	0.000000	201.0000
X(4, 1)	0.000000	192.0000
X(4, 2)	0.000000	64.10000
X(4, 3)	0.000000	3.200000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	2.900000
X(4, 6)	0.000000	203.0000
X(4, 7)	0.000000	205.0000
X(4, 8)	0.000000	204.0000
X(5, 1)	0.000000	194.0000
X(5, 2)	0.000000	66.90000
X(5, 3)	1.000000	5.900000
X(5, 4)	0.000000	2.900000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	204.0000
X(5, 7)	0.000000	206.0000
X(5, 8)	0.000000	205.0000
X(6, 1)	0.000000	92.20000
X(6, 2)	0.000000	157.0000
X(6, 3)	0.000000	200.0000
X(6, 4)	0.000000	203.0000
X(6, 5)	0.000000	204.0000

X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.100000
X(6, 8)	1.000000	1.400000
X(7, 1)	0.000000	93.80000
X(7, 2)	0.000000	159.0000
X(7, 3)	0.000000	201.0000
X(7, 4)	0.000000	205.0000
X(7, 5)	0.000000	206.0000
X(7, 6)	1.000000	3.100000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	4.000000
X(8, 1)	1.000000	93.00000
X(8, 2)	0.000000	158.0000
X(8, 3)	0.000000	201.0000
X(8, 4)	0.000000	204.0000
X(8, 5)	0.000000	205.0000
X(8, 6)	0.000000	1.400000
X(8, 7)	0.000000	4.000000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	146.0000	0.000000
D(1, 3)	190.0000	0.000000
D(1, 4)	192.0000	0.000000
D(1, 5)	194.0000	0.000000
D(1, 6)	92.20000	0.000000
D(1, 7)	93.80000	0.000000
D(1, 8)	93.00000	0.000000
D(2, 1)	146.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	63.40000	0.000000
D(2, 4)	64.10000	0.000000
D(2, 5)	66.90000	0.000000
D(2, 6)	157.0000	0.000000
D(2, 7)	159.0000	0.000000
D(2, 8)	158.0000	0.000000
D(3, 1)	190.0000	0.000000
D(3, 2)	63.40000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	3.200000	0.000000
D(3, 5)	5.900000	0.000000
D(3, 6)	200.0000	0.000000
D(3, 7)	201.0000	0.000000
D(3, 8)	201.0000	0.000000
D(4, 1)	192.0000	0.000000

D(4, 2)	64.10000	0.000000
D(4, 3)	3.200000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	2.900000	0.000000
D(4, 6)	203.0000	0.000000
D(4, 7)	205.0000	0.000000
D(4, 8)	204.0000	0.000000
D(5, 1)	194.0000	0.000000
D(5, 2)	66.90000	0.000000
D(5, 3)	5.900000	0.000000
D(5, 4)	2.900000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	204.0000	0.000000
D(5, 7)	206.0000	0.000000
D(5, 8)	205.0000	0.000000
D(6, 1)	92.20000	0.000000
D(6, 2)	157.0000	0.000000
D(6, 3)	200.0000	0.000000
D(6, 4)	203.0000	0.000000
D(6, 5)	204.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.100000	0.000000
D(6, 8)	1.400000	0.000000
D(7, 1)	93.80000	0.000000
D(7, 2)	159.0000	0.000000
D(7, 3)	201.0000	0.000000
D(7, 4)	205.0000	0.000000
D(7, 5)	206.0000	0.000000
D(7, 6)	3.100000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	4.000000	0.000000
D(8, 1)	93.00000	0.000000
D(8, 2)	158.0000	0.000000
D(8, 3)	201.0000	0.000000
D(8, 4)	204.0000	0.000000
D(8, 5)	205.0000	0.000000
D(8, 6)	1.400000	0.000000
D(8, 7)	4.000000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	175.2000	0.000000
DURASI(1, 3)	228.0000	0.000000
DURASI(1, 4)	230.4000	0.000000
DURASI(1, 5)	232.8000	0.000000

DURASI(1, 6)	110.6400	0.000000
DURASI(1, 7)	112.5600	0.000000
DURASI(1, 8)	111.6000	0.000000
DURASI(2, 1)	175.2000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	76.08000	0.000000
DURASI(2, 4)	76.92000	0.000000
DURASI(2, 5)	80.28000	0.000000
DURASI(2, 6)	188.4000	0.000000
DURASI(2, 7)	190.8000	0.000000
DURASI(2, 8)	189.6000	0.000000
DURASI(3, 1)	228.0000	0.000000
DURASI(3, 2)	76.08000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	3.840000	0.000000
DURASI(3, 5)	7.080000	0.000000
DURASI(3, 6)	240.0000	0.000000
DURASI(3, 7)	241.2000	0.000000
DURASI(3, 8)	241.2000	0.000000
DURASI(4, 1)	230.4000	0.000000
DURASI(4, 2)	76.92000	0.000000
DURASI(4, 3)	3.840000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	3.480000	0.000000
DURASI(4, 6)	243.6000	0.000000
DURASI(4, 7)	246.0000	0.000000
DURASI(4, 8)	244.8000	0.000000
DURASI(5, 1)	232.8000	0.000000
DURASI(5, 2)	80.28000	0.000000
DURASI(5, 3)	7.080000	0.000000
DURASI(5, 4)	3.480000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	244.8000	0.000000
DURASI(5, 7)	247.2000	0.000000
DURASI(5, 8)	246.0000	0.000000
DURASI(6, 1)	110.6400	0.000000
DURASI(6, 2)	188.4000	0.000000
DURASI(6, 3)	240.0000	0.000000
DURASI(6, 4)	243.6000	0.000000
DURASI(6, 5)	244.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	3.720000	0.000000
DURASI(6, 8)	1.680000	0.000000
DURASI(7, 1)	112.5600	0.000000

DURASI(7, 2)	190.8000	0.000000
DURASI(7, 3)	241.2000	0.000000
DURASI(7, 4)	246.0000	0.000000
DURASI(7, 5)	247.2000	0.000000
DURASI(7, 6)	3.720000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	4.800000	0.000000
DURASI(8, 1)	111.6000	0.000000
DURASI(8, 2)	189.6000	0.000000
DURASI(8, 3)	241.2000	0.000000
DURASI(8, 4)	244.8000	0.000000
DURASI(8, 5)	246.0000	0.000000
DURASI(8, 6)	1.680000	0.000000
DURASI(8, 7)	4.800000	0.000000
DURASI(8, 8)	0.000000	0.000000

Lampiran 14 (Pemrograman Lingo Untuk Analisis Sensitivitas Skenario 4)

- Hasil dari *solution report* pada *cluster 1* analisis sensitivitas skenario 4

Global optimal solution found.

Objective value: 54.60000
 Objective bound: 54.60000
 Infeasibilities: 0.000000
 Extended solver steps: 174
 Total solver iterations: 2733
 Elapsed runtime seconds: 0.34

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 8.9 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 6.8 km
 rute pengiriman dari ritel 3 ke ritel 4 sebesar 7.9 km
 rute pengiriman dari ritel 4 ke ritel 5 sebesar 3.9 km
 rute pengiriman dari ritel 5 ke ritel 6 sebesar 2.6 km
 rute pengiriman dari ritel 6 ke ritel 7 sebesar 3.6 km
 rute pengiriman dari ritel 7 ke ritel 8 sebesar 2.8 km
 rute pengiriman dari ritel 8 ke ritel 1 sebesar 18.1 km

Model Class: MILP

Total variables: 72
 Nonlinear variables: 0
 Integer variables: 64

Total constraints: 88
 Nonlinear constraints: 0

Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000

BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	660.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	900.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	780.0000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1020.000	0.000000
T(1)	1285.800	0.000000
T(2)	540.0000	0.000000
T(3)	660.0000	0.000000
T(4)	699.4800	0.000000
T(5)	780.0000	0.000000
T(6)	813.1200	0.000000
T(7)	956.6400	0.000000
T(8)	990.0000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	8.900000
X(1, 3)	0.000000	13.60000
X(1, 4)	0.000000	19.70000
X(1, 5)	0.000000	20.70000
X(1, 6)	0.000000	21.50000
X(1, 7)	0.000000	19.20000
X(1, 8)	0.000000	18.10000
X(2, 1)	0.000000	8.900000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	6.800000
X(2, 4)	0.000000	13.30000
X(2, 5)	0.000000	14.60000
X(2, 6)	0.000000	13.10000
X(2, 7)	0.000000	10.90000
X(2, 8)	0.000000	8.700000

X(3, 1)	0.000000	13.60000
X(3, 2)	0.000000	6.800000
X(3, 3)	0.000000	0.000000
X(3, 4)	1.000000	7.900000
X(3, 5)	0.000000	10.30000
X(3, 6)	0.000000	10.50000
X(3, 7)	0.000000	8.100000
X(3, 8)	0.000000	9.400000
X(4, 1)	0.000000	19.70000
X(4, 2)	0.000000	13.30000
X(4, 3)	0.000000	7.900000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	3.900000
X(4, 6)	0.000000	4.600000
X(4, 7)	0.000000	4.600000
X(4, 8)	0.000000	5.600000
X(5, 1)	0.000000	20.70000
X(5, 2)	0.000000	14.60000
X(5, 3)	0.000000	10.30000
X(5, 4)	0.000000	3.900000
X(5, 5)	0.000000	0.000000
X(5, 6)	1.000000	2.600000
X(5, 7)	0.000000	5.400000
X(5, 8)	0.000000	3.400000
X(6, 1)	0.000000	21.50000
X(6, 2)	0.000000	13.10000
X(6, 3)	0.000000	10.50000
X(6, 4)	0.000000	4.600000
X(6, 5)	0.000000	2.600000
X(6, 6)	0.000000	0.000000
X(6, 7)	1.000000	3.600000
X(6, 8)	0.000000	2.500000
X(7, 1)	0.000000	19.20000
X(7, 2)	0.000000	10.90000
X(7, 3)	0.000000	8.100000
X(7, 4)	0.000000	4.600000
X(7, 5)	0.000000	5.400000
X(7, 6)	0.000000	3.600000
X(7, 7)	0.000000	0.000000
X(7, 8)	1.000000	2.800000
X(8, 1)	1.000000	18.10000
X(8, 2)	0.000000	8.700000
X(8, 3)	0.000000	9.400000
X(8, 4)	0.000000	5.600000

X(8, 5)	0.000000	3.400000
X(8, 6)	0.000000	2.500000
X(8, 7)	0.000000	2.800000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	8.900000	0.000000
D(1, 3)	13.60000	0.000000
D(1, 4)	19.70000	0.000000
D(1, 5)	20.70000	0.000000
D(1, 6)	21.50000	0.000000
D(1, 7)	19.20000	0.000000
D(1, 8)	18.10000	0.000000
D(2, 1)	8.900000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	6.800000	0.000000
D(2, 4)	13.30000	0.000000
D(2, 5)	14.60000	0.000000
D(2, 6)	13.10000	0.000000
D(2, 7)	10.90000	0.000000
D(2, 8)	8.700000	0.000000
D(3, 1)	13.60000	0.000000
D(3, 2)	6.800000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	7.900000	0.000000
D(3, 5)	10.30000	0.000000
D(3, 6)	10.50000	0.000000
D(3, 7)	8.100000	0.000000
D(3, 8)	9.400000	0.000000
D(4, 1)	19.70000	0.000000
D(4, 2)	13.30000	0.000000
D(4, 3)	7.900000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	3.900000	0.000000
D(4, 6)	4.600000	0.000000
D(4, 7)	4.600000	0.000000
D(4, 8)	5.600000	0.000000
D(5, 1)	20.70000	0.000000
D(5, 2)	14.60000	0.000000
D(5, 3)	10.30000	0.000000
D(5, 4)	3.900000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	2.600000	0.000000
D(5, 7)	5.400000	0.000000
D(5, 8)	3.400000	0.000000

D(6, 1)	21.50000	0.000000
D(6, 2)	13.10000	0.000000
D(6, 3)	10.50000	0.000000
D(6, 4)	4.600000	0.000000
D(6, 5)	2.600000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.600000	0.000000
D(6, 8)	2.500000	0.000000
D(7, 1)	19.20000	0.000000
D(7, 2)	10.90000	0.000000
D(7, 3)	8.100000	0.000000
D(7, 4)	4.600000	0.000000
D(7, 5)	5.400000	0.000000
D(7, 6)	3.600000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	2.800000	0.000000
D(8, 1)	18.10000	0.000000
D(8, 2)	8.700000	0.000000
D(8, 3)	9.400000	0.000000
D(8, 4)	5.600000	0.000000
D(8, 5)	3.400000	0.000000
D(8, 6)	2.500000	0.000000
D(8, 7)	2.800000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	10.68000	0.000000
DURASI(1, 3)	16.32000	0.000000
DURASI(1, 4)	23.64000	0.000000
DURASI(1, 5)	24.84000	0.000000
DURASI(1, 6)	25.80000	0.000000
DURASI(1, 7)	23.04000	0.000000
DURASI(1, 8)	21.72000	0.000000
DURASI(2, 1)	10.68000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	8.160000	0.000000
DURASI(2, 4)	15.96000	0.000000
DURASI(2, 5)	17.52000	0.000000
DURASI(2, 6)	15.72000	0.000000
DURASI(2, 7)	13.08000	0.000000
DURASI(2, 8)	10.44000	0.000000
DURASI(3, 1)	16.32000	0.000000
DURASI(3, 2)	8.160000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	9.480000	0.000000

DURASI(3, 5)	12.36000	0.000000
DURASI(3, 6)	12.60000	0.000000
DURASI(3, 7)	9.720000	0.000000
DURASI(3, 8)	11.28000	0.000000
DURASI(4, 1)	23.64000	0.000000
DURASI(4, 2)	15.96000	0.000000
DURASI(4, 3)	9.480000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	4.680000	0.000000
DURASI(4, 6)	5.520000	0.000000
DURASI(4, 7)	5.520000	0.000000
DURASI(4, 8)	6.720000	0.000000
DURASI(5, 1)	24.84000	0.000000
DURASI(5, 2)	17.52000	0.000000
DURASI(5, 3)	12.36000	0.000000
DURASI(5, 4)	4.680000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	3.120000	0.000000
DURASI(5, 7)	6.480000	0.000000
DURASI(5, 8)	4.080000	0.000000
DURASI(6, 1)	25.80000	0.000000
DURASI(6, 2)	15.72000	0.000000
DURASI(6, 3)	12.60000	0.000000
DURASI(6, 4)	5.520000	0.000000
DURASI(6, 5)	3.120000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.320000	0.000000
DURASI(6, 8)	3.000000	0.000000
DURASI(7, 1)	23.04000	0.000000
DURASI(7, 2)	13.08000	0.000000
DURASI(7, 3)	9.720000	0.000000
DURASI(7, 4)	5.520000	0.000000
DURASI(7, 5)	6.480000	0.000000
DURASI(7, 6)	4.320000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	3.360000	0.000000
DURASI(8, 1)	21.72000	0.000000
DURASI(8, 2)	10.44000	0.000000
DURASI(8, 3)	11.28000	0.000000
DURASI(8, 4)	6.720000	0.000000
DURASI(8, 5)	4.080000	0.000000
DURASI(8, 6)	3.000000	0.000000
DURASI(8, 7)	3.360000	0.000000
DURASI(8, 8)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 2* analisis sensitivitas skenario 4

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..16/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 660 540 900 780 540 540 540 540 540 540
540 540;
tutup = 1020 660 1260 1260 780 1260 1020 900 1260 1260 1260
1260 1260 1260 1260 1260;
```

D =

```
!ritel
1      2      3      4      5      6      7      8      9      10     11
      12     13     14     15     16
!0     3      6      7      29     30     31     32     50     51     52
      53     54     55     57     60;
0      8.3   41.1  39.6  227   275   324   322   353   353
      351   348   347   347   353   435   !0;
8.3    0     24.4  33    220   268   317   315   346   346
      344   341   341   340   347   428   !3;
41.1   24.4  0     7.5   127   300   208   238   377   377
      376   372   372   372   378   459   !6;
39.6   33    7.5   0     133   297   215   343   374   374
      372   369   369   368   375   456   !7;
```

227	220	127	133	0	85	102	134	230	230	
	228	225	224	224	230	312	!29;			
275	268	300	297	85	0	48	50	71	65	64
	55	71	69	66	166	!30;				
324	317	208	215	102	48	0	28	87	81	80
	81	87	85	82	182	!31;				
322	315	238	343	134	50	28	0	61	55	54
	55	61	59	56	156	!32;				
353	346	377	374	230	71	87	61	0	6.7	5.9
	10	4.8	4.3	7.4	98.2	!50;				
353	346	377	374	230	65	81	55	6.7	0	1.9
	10.3	5.9	4.8	1.8	97.5	!51;				
351	344	376	372	228	64	80	54	5.9	1.9	0
	8.8	9.8	5.3	3.4	100	!52;				
348	341	372	369	225	55	81	55	10	10.3	8.8
	0	10.6	6.2	10.7	105	!53;				
347	341	372	369	224	71	87	61	4.8	5.9	9.8
	10.6	0	4.3	3.5	93.4	!54;				
347	340	372	368	224	69	85	59	4.3	4.8	5.3
	6.2	4.3	0	6.3	101	!55;				
353	347	378	375	230	66	82	56	7.4	1.8	3.4
	10.7	3.5	6.3	0	97.9	!57;				
435	428	459	456	312	166	182	156	98.2	97.5	
	100	105	93.4	101	97.9	0;	!60;			

durasi =

0	9.96	49.32	47.52	272.4	330	388.8	386.4	423.6	423.6	
	421.2	417.6	416.4	416.4	423.6	522				
9.96	0	29.28	39.6	264	321.6	380.4	378	415.2	415.2	
	412.8	409.2	409.2	408	416.4	513.6				
49.32	29.28	0	9	152.4	360	249.6	285.6	452.4	452.4	
	451.2	446.4	446.4	446.4	453.6	550.8				
47.52	39.6	9	0	159.6	356.4	258	411.6	448.8	448.8	
	446.4	442.8	442.8	441.6	450	547.2				
272.4	264	152.4	159.6	0	102	122.4	160.8	276	276	
	273.6	270	268.8	268.8	276	374.4				
330	321.6	360	356.4	102	0	57.6	60	85.2	78	
	76.8	66	85.2	82.8	79.2	199.2				
388.8	380.4	249.6	258	122.4	57.6	0	33.6	104.4	97.2	96
	97.2	104.4	102	98.4	218.4					
386.4	378	285.6	411.6	160.8	60	33.6	0	73.2	66	
	64.8	66	73.2	70.8	67.2	187.2				
423.6	415.2	452.4	448.8	276	85.2	104.4	73.2	0	8.04	
	7.08	12	5.76	5.16	8.88	117.84				

```

423.6 415.2 452.4 448.8 276 78 97.2 66 8.04 0
      2.28 12.36 7.08 5.76 2.16 117
421.2 412.8 451.2 446.4 273.6 76.8 96 64.8 7.08 2.28 0
      10.56 11.76 6.36 4.08 120
417.6 409.2 446.4 442.8 270 66 97.2 66 12 12.36
      10.56 0 12.72 7.44 12.84 126
416.4 409.2 446.4 442.8 268.8 85.2 104.4 73.2 5.76 7.08
      11.76 12.72 0 5.16 4.2 112.08
416.4 408 446.4 441.6 268.8 82.8 102 70.8 5.16 5.76
      6.36 7.44 5.16 0 7.56 121.2
423.6 416.4 453.6 450 276 79.2 98.4 67.2 8.88 2.16
      4.08 12.84 4.2 7.56 0 117.48
522 513.6 550.8 547.2 374.4 199.2 218.4 187.2 117.84
      117 120 126 112.08 121.2 117.48 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) - R * (1 -
x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 2* analisis sensitivitas skenario 4

Feasible solution found.	
Objective value:	996.9000
Objective bound:	671.2349
Infeasibilities:	0.000000
Extended solver steps:	9593
Total solver iterations:	78235
Elapsed runtime seconds:	10.59

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 8.300000000000001 km

rute pengiriman dari ritel 2 ke ritel 4 sebesar 33 km

rute pengiriman dari ritel 3 ke ritel 1 sebesar 41.1 km
 rute pengiriman dari ritel 4 ke ritel 5 sebesar 133 km
 rute pengiriman dari ritel 5 ke ritel 6 sebesar 85 km
 rute pengiriman dari ritel 6 ke ritel 16 sebesar 166 km
 rute pengiriman dari ritel 7 ke ritel 3 sebesar 208 km
 rute pengiriman dari ritel 8 ke ritel 9 sebesar 61 km
 rute pengiriman dari ritel 9 ke ritel 15 sebesar 7.4 km
 rute pengiriman dari ritel 10 ke ritel 14 sebesar 4.8 km
 rute pengiriman dari ritel 11 ke ritel 10 sebesar 1.9 km
 rute pengiriman dari ritel 12 ke ritel 8 sebesar 55 km
 rute pengiriman dari ritel 13 ke ritel 12 sebesar 10.6 km
 rute pengiriman dari ritel 14 ke ritel 7 sebesar 85 km
 rute pengiriman dari ritel 15 ke ritel 11 sebesar 3.4 km
 rute pengiriman dari ritel 16 ke ritel 13 sebesar 93.40000000000001 km
 Model Class: MILP

Total variables:	272
Nonlinear variables:	0
Integer variables:	256
Total constraints:	304
Nonlinear constraints:	0
Total nonzeros:	1695
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BONGKAR(12)	30.00000	0.000000
BONGKAR(13)	30.00000	0.000000
BONGKAR(14)	30.00000	0.000000

BONGKAR(15)	30.00000	0.000000
BONGKAR(16)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	660.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	900.0000	0.000000
BUKA(8)	780.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
BUKA(12)	540.0000	0.000000
BUKA(13)	540.0000	0.000000
BUKA(14)	540.0000	0.000000
BUKA(15)	540.0000	0.000000
BUKA(16)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	780.0000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1020.000	0.000000
TUTUP(8)	900.0000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
TUTUP(12)	1260.000	0.000000
TUTUP(13)	1260.000	0.000000
TUTUP(14)	1260.000	0.000000
TUTUP(15)	1260.000	0.000000
TUTUP(16)	1260.000	0.000000
T(1)	1260.000	0.000000
T(2)	600.0000	0.000000
T(3)	1020.000	0.000000
T(4)	630.0000	0.000000
T(5)	660.0000	0.000000
T(6)	690.0000	0.000000
T(7)	990.0000	0.000000
T(8)	810.0000	0.000000
T(9)	840.0000	0.000000
T(10)	930.0000	0.000000

T(11)	900.0000	0.000000
T(12)	780.0000	0.000000
T(13)	750.0000	0.000000
T(14)	960.0000	0.000000
T(15)	870.0000	0.000000
T(16)	720.0000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	8.300000
X(1, 3)	0.000000	41.10000
X(1, 4)	0.000000	39.60000
X(1, 5)	0.000000	227.0000
X(1, 6)	0.000000	275.0000
X(1, 7)	0.000000	324.0000
X(1, 8)	0.000000	322.0000
X(1, 9)	0.000000	353.0000
X(1, 10)	0.000000	353.0000
X(1, 11)	0.000000	351.0000
X(1, 12)	0.000000	348.0000
X(1, 13)	0.000000	347.0000
X(1, 14)	0.000000	347.0000
X(1, 15)	0.000000	353.0000
X(1, 16)	0.000000	435.0000
X(2, 1)	0.000000	8.300000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	24.40000
X(2, 4)	1.000000	33.00000
X(2, 5)	0.000000	220.0000
X(2, 6)	0.000000	268.0000
X(2, 7)	0.000000	317.0000
X(2, 8)	0.000000	315.0000
X(2, 9)	0.000000	346.0000
X(2, 10)	0.000000	346.0000
X(2, 11)	0.000000	344.0000
X(2, 12)	0.000000	341.0000
X(2, 13)	0.000000	341.0000
X(2, 14)	0.000000	340.0000
X(2, 15)	0.000000	347.0000
X(2, 16)	0.000000	428.0000
X(3, 1)	1.000000	41.10000
X(3, 2)	0.000000	24.40000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	7.500000
X(3, 5)	0.000000	127.0000
X(3, 6)	0.000000	300.0000

X(3, 7)	0.000000	208.0000
X(3, 8)	0.000000	238.0000
X(3, 9)	0.000000	377.0000
X(3, 10)	0.000000	377.0000
X(3, 11)	0.000000	376.0000
X(3, 12)	0.000000	372.0000
X(3, 13)	0.000000	372.0000
X(3, 14)	0.000000	372.0000
X(3, 15)	0.000000	378.0000
X(3, 16)	0.000000	459.0000
X(4, 1)	0.000000	39.60000
X(4, 2)	0.000000	33.00000
X(4, 3)	0.000000	7.500000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	133.0000
X(4, 6)	0.000000	297.0000
X(4, 7)	0.000000	215.0000
X(4, 8)	0.000000	343.0000
X(4, 9)	0.000000	374.0000
X(4, 10)	0.000000	374.0000
X(4, 11)	0.000000	372.0000
X(4, 12)	0.000000	369.0000
X(4, 13)	0.000000	369.0000
X(4, 14)	0.000000	368.0000
X(4, 15)	0.000000	375.0000
X(4, 16)	0.000000	456.0000
X(5, 1)	0.000000	227.0000
X(5, 2)	0.000000	220.0000
X(5, 3)	0.000000	127.0000
X(5, 4)	0.000000	133.0000
X(5, 5)	0.000000	0.000000
X(5, 6)	1.000000	85.00000
X(5, 7)	0.000000	102.0000
X(5, 8)	0.000000	134.0000
X(5, 9)	0.000000	230.0000
X(5, 10)	0.000000	230.0000
X(5, 11)	0.000000	228.0000
X(5, 12)	0.000000	225.0000
X(5, 13)	0.000000	224.0000
X(5, 14)	0.000000	224.0000
X(5, 15)	0.000000	230.0000
X(5, 16)	0.000000	312.0000
X(6, 1)	0.000000	275.0000
X(6, 2)	0.000000	268.0000

X(6, 3)	0.000000	300.0000
X(6, 4)	0.000000	297.0000
X(6, 5)	0.000000	85.00000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	48.00000
X(6, 8)	0.000000	50.00000
X(6, 9)	0.000000	71.00000
X(6, 10)	0.000000	65.00000
X(6, 11)	0.000000	64.00000
X(6, 12)	0.000000	55.00000
X(6, 13)	0.000000	71.00000
X(6, 14)	0.000000	69.00000
X(6, 15)	0.000000	66.00000
X(6, 16)	1.000000	166.0000
X(7, 1)	0.000000	324.0000
X(7, 2)	0.000000	317.0000
X(7, 3)	1.000000	208.0000
X(7, 4)	0.000000	215.0000
X(7, 5)	0.000000	102.0000
X(7, 6)	0.000000	48.00000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	28.00000
X(7, 9)	0.000000	87.00000
X(7, 10)	0.000000	81.00000
X(7, 11)	0.000000	80.00000
X(7, 12)	0.000000	81.00000
X(7, 13)	0.000000	87.00000
X(7, 14)	0.000000	85.00000
X(7, 15)	0.000000	82.00000
X(7, 16)	0.000000	182.0000
X(8, 1)	0.000000	322.0000
X(8, 2)	0.000000	315.0000
X(8, 3)	0.000000	238.0000
X(8, 4)	0.000000	343.0000
X(8, 5)	0.000000	134.0000
X(8, 6)	0.000000	50.00000
X(8, 7)	0.000000	28.00000
X(8, 8)	0.000000	0.000000
X(8, 9)	1.000000	61.00000
X(8, 10)	0.000000	55.00000
X(8, 11)	0.000000	54.00000
X(8, 12)	0.000000	55.00000
X(8, 13)	0.000000	61.00000
X(8, 14)	0.000000	59.00000

X(8, 15)	0.000000	56.00000
X(8, 16)	0.000000	156.0000
X(9, 1)	0.000000	353.0000
X(9, 2)	0.000000	346.0000
X(9, 3)	0.000000	377.0000
X(9, 4)	0.000000	374.0000
X(9, 5)	0.000000	230.0000
X(9, 6)	0.000000	71.00000
X(9, 7)	0.000000	87.00000
X(9, 8)	0.000000	61.00000
X(9, 9)	0.000000	0.000000
X(9, 10)	0.000000	6.700000
X(9, 11)	0.000000	5.900000
X(9, 12)	0.000000	10.00000
X(9, 13)	0.000000	4.800000
X(9, 14)	0.000000	4.300000
X(9, 15)	1.000000	7.400000
X(9, 16)	0.000000	98.20000
X(10, 1)	0.000000	353.0000
X(10, 2)	0.000000	346.0000
X(10, 3)	0.000000	377.0000
X(10, 4)	0.000000	374.0000
X(10, 5)	0.000000	230.0000
X(10, 6)	0.000000	65.00000
X(10, 7)	0.000000	81.00000
X(10, 8)	0.000000	55.00000
X(10, 9)	0.000000	6.700000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	1.900000
X(10, 12)	0.000000	10.30000
X(10, 13)	0.000000	5.900000
X(10, 14)	1.000000	4.800000
X(10, 15)	0.000000	1.800000
X(10, 16)	0.000000	97.50000
X(11, 1)	0.000000	351.0000
X(11, 2)	0.000000	344.0000
X(11, 3)	0.000000	376.0000
X(11, 4)	0.000000	372.0000
X(11, 5)	0.000000	228.0000
X(11, 6)	0.000000	64.00000
X(11, 7)	0.000000	80.00000
X(11, 8)	0.000000	54.00000
X(11, 9)	0.000000	5.900000
X(11, 10)	1.000000	1.900000

X(11, 11)	0.000000	0.000000
X(11, 12)	0.000000	8.800000
X(11, 13)	0.000000	9.800000
X(11, 14)	0.000000	5.300000
X(11, 15)	0.000000	3.400000
X(11, 16)	0.000000	100.0000
X(12, 1)	0.000000	348.0000
X(12, 2)	0.000000	341.0000
X(12, 3)	0.000000	372.0000
X(12, 4)	0.000000	369.0000
X(12, 5)	0.000000	225.0000
X(12, 6)	0.000000	55.00000
X(12, 7)	0.000000	81.00000
X(12, 8)	1.000000	55.00000
X(12, 9)	0.000000	10.00000
X(12, 10)	0.000000	10.30000
X(12, 11)	0.000000	8.800000
X(12, 12)	0.000000	0.000000
X(12, 13)	0.000000	10.60000
X(12, 14)	0.000000	6.200000
X(12, 15)	0.000000	10.70000
X(12, 16)	0.000000	105.0000
X(13, 1)	0.000000	347.0000
X(13, 2)	0.000000	341.0000
X(13, 3)	0.000000	372.0000
X(13, 4)	0.000000	369.0000
X(13, 5)	0.000000	224.0000
X(13, 6)	0.000000	71.00000
X(13, 7)	0.000000	87.00000
X(13, 8)	0.000000	61.00000
X(13, 9)	0.000000	4.800000
X(13, 10)	0.000000	5.900000
X(13, 11)	0.000000	9.800000
X(13, 12)	1.000000	10.60000
X(13, 13)	0.000000	0.000000
X(13, 14)	0.000000	4.300000
X(13, 15)	0.000000	3.500000
X(13, 16)	0.000000	93.40000
X(14, 1)	0.000000	347.0000
X(14, 2)	0.000000	340.0000
X(14, 3)	0.000000	372.0000
X(14, 4)	0.000000	368.0000
X(14, 5)	0.000000	224.0000
X(14, 6)	0.000000	69.00000

X(14, 7)	1.000000	85.00000
X(14, 8)	0.000000	59.00000
X(14, 9)	0.000000	4.300000
X(14, 10)	0.000000	4.800000
X(14, 11)	0.000000	5.300000
X(14, 12)	0.000000	6.200000
X(14, 13)	0.000000	4.300000
X(14, 14)	0.000000	0.000000
X(14, 15)	0.000000	6.300000
X(14, 16)	0.000000	101.0000
X(15, 1)	0.000000	353.0000
X(15, 2)	0.000000	347.0000
X(15, 3)	0.000000	378.0000
X(15, 4)	0.000000	375.0000
X(15, 5)	0.000000	230.0000
X(15, 6)	0.000000	66.00000
X(15, 7)	0.000000	82.00000
X(15, 8)	0.000000	56.00000
X(15, 9)	0.000000	7.400000
X(15, 10)	0.000000	1.800000
X(15, 11)	1.000000	3.400000
X(15, 12)	0.000000	10.70000
X(15, 13)	0.000000	3.500000
X(15, 14)	0.000000	6.300000
X(15, 15)	0.000000	0.000000
X(15, 16)	0.000000	97.90000
X(16, 1)	0.000000	435.0000
X(16, 2)	0.000000	428.0000
X(16, 3)	0.000000	459.0000
X(16, 4)	0.000000	456.0000
X(16, 5)	0.000000	312.0000
X(16, 6)	0.000000	166.0000
X(16, 7)	0.000000	182.0000
X(16, 8)	0.000000	156.0000
X(16, 9)	0.000000	98.20000
X(16, 10)	0.000000	97.50000
X(16, 11)	0.000000	100.0000
X(16, 12)	0.000000	105.0000
X(16, 13)	1.000000	93.40000
X(16, 14)	0.000000	101.0000
X(16, 15)	0.000000	97.90000
X(16, 16)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	8.300000	0.000000

D(1, 3)	41.10000	0.000000
D(1, 4)	39.60000	0.000000
D(1, 5)	227.0000	0.000000
D(1, 6)	275.0000	0.000000
D(1, 7)	324.0000	0.000000
D(1, 8)	322.0000	0.000000
D(1, 9)	353.0000	0.000000
D(1, 10)	353.0000	0.000000
D(1, 11)	351.0000	0.000000
D(1, 12)	348.0000	0.000000
D(1, 13)	347.0000	0.000000
D(1, 14)	347.0000	0.000000
D(1, 15)	353.0000	0.000000
D(1, 16)	435.0000	0.000000
D(2, 1)	8.300000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	24.40000	0.000000
D(2, 4)	33.00000	0.000000
D(2, 5)	220.0000	0.000000
D(2, 6)	268.0000	0.000000
D(2, 7)	317.0000	0.000000
D(2, 8)	315.0000	0.000000
D(2, 9)	346.0000	0.000000
D(2, 10)	346.0000	0.000000
D(2, 11)	344.0000	0.000000
D(2, 12)	341.0000	0.000000
D(2, 13)	341.0000	0.000000
D(2, 14)	340.0000	0.000000
D(2, 15)	347.0000	0.000000
D(2, 16)	428.0000	0.000000
D(3, 1)	41.10000	0.000000
D(3, 2)	24.40000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	7.500000	0.000000
D(3, 5)	127.0000	0.000000
D(3, 6)	300.0000	0.000000
D(3, 7)	208.0000	0.000000
D(3, 8)	238.0000	0.000000
D(3, 9)	377.0000	0.000000
D(3, 10)	377.0000	0.000000
D(3, 11)	376.0000	0.000000
D(3, 12)	372.0000	0.000000
D(3, 13)	372.0000	0.000000
D(3, 14)	372.0000	0.000000

D(3, 15)	378.0000	0.000000
D(3, 16)	459.0000	0.000000
D(4, 1)	39.60000	0.000000
D(4, 2)	33.00000	0.000000
D(4, 3)	7.500000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	133.0000	0.000000
D(4, 6)	297.0000	0.000000
D(4, 7)	215.0000	0.000000
D(4, 8)	343.0000	0.000000
D(4, 9)	374.0000	0.000000
D(4, 10)	374.0000	0.000000
D(4, 11)	372.0000	0.000000
D(4, 12)	369.0000	0.000000
D(4, 13)	369.0000	0.000000
D(4, 14)	368.0000	0.000000
D(4, 15)	375.0000	0.000000
D(4, 16)	456.0000	0.000000
D(5, 1)	227.0000	0.000000
D(5, 2)	220.0000	0.000000
D(5, 3)	127.0000	0.000000
D(5, 4)	133.0000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	85.00000	0.000000
D(5, 7)	102.0000	0.000000
D(5, 8)	134.0000	0.000000
D(5, 9)	230.0000	0.000000
D(5, 10)	230.0000	0.000000
D(5, 11)	228.0000	0.000000
D(5, 12)	225.0000	0.000000
D(5, 13)	224.0000	0.000000
D(5, 14)	224.0000	0.000000
D(5, 15)	230.0000	0.000000
D(5, 16)	312.0000	0.000000
D(6, 1)	275.0000	0.000000
D(6, 2)	268.0000	0.000000
D(6, 3)	300.0000	0.000000
D(6, 4)	297.0000	0.000000
D(6, 5)	85.00000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	48.00000	0.000000
D(6, 8)	50.00000	0.000000
D(6, 9)	71.00000	0.000000
D(6, 10)	65.00000	0.000000

D(6, 11)	64.00000	0.000000
D(6, 12)	55.00000	0.000000
D(6, 13)	71.00000	0.000000
D(6, 14)	69.00000	0.000000
D(6, 15)	66.00000	0.000000
D(6, 16)	166.0000	0.000000
D(7, 1)	324.0000	0.000000
D(7, 2)	317.0000	0.000000
D(7, 3)	208.0000	0.000000
D(7, 4)	215.0000	0.000000
D(7, 5)	102.0000	0.000000
D(7, 6)	48.00000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	28.00000	0.000000
D(7, 9)	87.00000	0.000000
D(7, 10)	81.00000	0.000000
D(7, 11)	80.00000	0.000000
D(7, 12)	81.00000	0.000000
D(7, 13)	87.00000	0.000000
D(7, 14)	85.00000	0.000000
D(7, 15)	82.00000	0.000000
D(7, 16)	182.0000	0.000000
D(8, 1)	322.0000	0.000000
D(8, 2)	315.0000	0.000000
D(8, 3)	238.0000	0.000000
D(8, 4)	343.0000	0.000000
D(8, 5)	134.0000	0.000000
D(8, 6)	50.00000	0.000000
D(8, 7)	28.00000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	61.00000	0.000000
D(8, 10)	55.00000	0.000000
D(8, 11)	54.00000	0.000000
D(8, 12)	55.00000	0.000000
D(8, 13)	61.00000	0.000000
D(8, 14)	59.00000	0.000000
D(8, 15)	56.00000	0.000000
D(8, 16)	156.0000	0.000000
D(9, 1)	353.0000	0.000000
D(9, 2)	346.0000	0.000000
D(9, 3)	377.0000	0.000000
D(9, 4)	374.0000	0.000000
D(9, 5)	230.0000	0.000000
D(9, 6)	71.00000	0.000000

D(9, 7)	87.00000	0.000000
D(9, 8)	61.00000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	6.700000	0.000000
D(9, 11)	5.900000	0.000000
D(9, 12)	10.00000	0.000000
D(9, 13)	4.800000	0.000000
D(9, 14)	4.300000	0.000000
D(9, 15)	7.400000	0.000000
D(9, 16)	98.20000	0.000000
D(10, 1)	353.0000	0.000000
D(10, 2)	346.0000	0.000000
D(10, 3)	377.0000	0.000000
D(10, 4)	374.0000	0.000000
D(10, 5)	230.0000	0.000000
D(10, 6)	65.00000	0.000000
D(10, 7)	81.00000	0.000000
D(10, 8)	55.00000	0.000000
D(10, 9)	6.700000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	1.900000	0.000000
D(10, 12)	10.30000	0.000000
D(10, 13)	5.900000	0.000000
D(10, 14)	4.800000	0.000000
D(10, 15)	1.800000	0.000000
D(10, 16)	97.50000	0.000000
D(11, 1)	351.0000	0.000000
D(11, 2)	344.0000	0.000000
D(11, 3)	376.0000	0.000000
D(11, 4)	372.0000	0.000000
D(11, 5)	228.0000	0.000000
D(11, 6)	64.00000	0.000000
D(11, 7)	80.00000	0.000000
D(11, 8)	54.00000	0.000000
D(11, 9)	5.900000	0.000000
D(11, 10)	1.900000	0.000000
D(11, 11)	0.000000	0.000000
D(11, 12)	8.800000	0.000000
D(11, 13)	9.800000	0.000000
D(11, 14)	5.300000	0.000000
D(11, 15)	3.400000	0.000000
D(11, 16)	100.0000	0.000000
D(12, 1)	348.0000	0.000000
D(12, 2)	341.0000	0.000000

D(12, 3)	372.0000	0.000000
D(12, 4)	369.0000	0.000000
D(12, 5)	225.0000	0.000000
D(12, 6)	55.00000	0.000000
D(12, 7)	81.00000	0.000000
D(12, 8)	55.00000	0.000000
D(12, 9)	10.00000	0.000000
D(12, 10)	10.30000	0.000000
D(12, 11)	8.800000	0.000000
D(12, 12)	0.000000	0.000000
D(12, 13)	10.60000	0.000000
D(12, 14)	6.200000	0.000000
D(12, 15)	10.70000	0.000000
D(12, 16)	105.0000	0.000000
D(13, 1)	347.0000	0.000000
D(13, 2)	341.0000	0.000000
D(13, 3)	372.0000	0.000000
D(13, 4)	369.0000	0.000000
D(13, 5)	224.0000	0.000000
D(13, 6)	71.00000	0.000000
D(13, 7)	87.00000	0.000000
D(13, 8)	61.00000	0.000000
D(13, 9)	4.800000	0.000000
D(13, 10)	5.900000	0.000000
D(13, 11)	9.800000	0.000000
D(13, 12)	10.60000	0.000000
D(13, 13)	0.000000	0.000000
D(13, 14)	4.300000	0.000000
D(13, 15)	3.500000	0.000000
D(13, 16)	93.40000	0.000000
D(14, 1)	347.0000	0.000000
D(14, 2)	340.0000	0.000000
D(14, 3)	372.0000	0.000000
D(14, 4)	368.0000	0.000000
D(14, 5)	224.0000	0.000000
D(14, 6)	69.00000	0.000000
D(14, 7)	85.00000	0.000000
D(14, 8)	59.00000	0.000000
D(14, 9)	4.300000	0.000000
D(14, 10)	4.800000	0.000000
D(14, 11)	5.300000	0.000000
D(14, 12)	6.200000	0.000000
D(14, 13)	4.300000	0.000000
D(14, 14)	0.000000	0.000000

D(14, 15)	6.300000	0.000000
D(14, 16)	101.0000	0.000000
D(15, 1)	353.0000	0.000000
D(15, 2)	347.0000	0.000000
D(15, 3)	378.0000	0.000000
D(15, 4)	375.0000	0.000000
D(15, 5)	230.0000	0.000000
D(15, 6)	66.00000	0.000000
D(15, 7)	82.00000	0.000000
D(15, 8)	56.00000	0.000000
D(15, 9)	7.400000	0.000000
D(15, 10)	1.800000	0.000000
D(15, 11)	3.400000	0.000000
D(15, 12)	10.70000	0.000000
D(15, 13)	3.500000	0.000000
D(15, 14)	6.300000	0.000000
D(15, 15)	0.000000	0.000000
D(15, 16)	97.90000	0.000000
D(16, 1)	435.0000	0.000000
D(16, 2)	428.0000	0.000000
D(16, 3)	459.0000	0.000000
D(16, 4)	456.0000	0.000000
D(16, 5)	312.0000	0.000000
D(16, 6)	166.0000	0.000000
D(16, 7)	182.0000	0.000000
D(16, 8)	156.0000	0.000000
D(16, 9)	98.20000	0.000000
D(16, 10)	97.50000	0.000000
D(16, 11)	100.0000	0.000000
D(16, 12)	105.0000	0.000000
D(16, 13)	93.40000	0.000000
D(16, 14)	101.0000	0.000000
D(16, 15)	97.90000	0.000000
D(16, 16)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	9.960000	0.000000
DURASI(1, 3)	49.32000	0.000000
DURASI(1, 4)	47.52000	0.000000
DURASI(1, 5)	272.4000	0.000000
DURASI(1, 6)	330.0000	0.000000
DURASI(1, 7)	388.8000	0.000000
DURASI(1, 8)	386.4000	0.000000
DURASI(1, 9)	423.6000	0.000000
DURASI(1, 10)	423.6000	0.000000

DURASI(1, 11)	421.2000	0.000000
DURASI(1, 12)	417.6000	0.000000
DURASI(1, 13)	416.4000	0.000000
DURASI(1, 14)	416.4000	0.000000
DURASI(1, 15)	423.6000	0.000000
DURASI(1, 16)	522.0000	0.000000
DURASI(2, 1)	9.960000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	29.28000	0.000000
DURASI(2, 4)	39.60000	0.000000
DURASI(2, 5)	264.0000	0.000000
DURASI(2, 6)	321.6000	0.000000
DURASI(2, 7)	380.4000	0.000000
DURASI(2, 8)	378.0000	0.000000
DURASI(2, 9)	415.2000	0.000000
DURASI(2, 10)	415.2000	0.000000
DURASI(2, 11)	412.8000	0.000000
DURASI(2, 12)	409.2000	0.000000
DURASI(2, 13)	409.2000	0.000000
DURASI(2, 14)	408.0000	0.000000
DURASI(2, 15)	416.4000	0.000000
DURASI(2, 16)	513.6000	0.000000
DURASI(3, 1)	49.32000	0.000000
DURASI(3, 2)	29.28000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	9.000000	0.000000
DURASI(3, 5)	152.4000	0.000000
DURASI(3, 6)	360.0000	0.000000
DURASI(3, 7)	249.6000	0.000000
DURASI(3, 8)	285.6000	0.000000
DURASI(3, 9)	452.4000	0.000000
DURASI(3, 10)	452.4000	0.000000
DURASI(3, 11)	451.2000	0.000000
DURASI(3, 12)	446.4000	0.000000
DURASI(3, 13)	446.4000	0.000000
DURASI(3, 14)	446.4000	0.000000
DURASI(3, 15)	453.6000	0.000000
DURASI(3, 16)	550.8000	0.000000
DURASI(4, 1)	47.52000	0.000000
DURASI(4, 2)	39.60000	0.000000
DURASI(4, 3)	9.000000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	159.6000	0.000000
DURASI(4, 6)	356.4000	0.000000

DURASI(4, 7)	258.0000	0.000000
DURASI(4, 8)	411.6000	0.000000
DURASI(4, 9)	448.8000	0.000000
DURASI(4, 10)	448.8000	0.000000
DURASI(4, 11)	446.4000	0.000000
DURASI(4, 12)	442.8000	0.000000
DURASI(4, 13)	442.8000	0.000000
DURASI(4, 14)	441.6000	0.000000
DURASI(4, 15)	450.0000	0.000000
DURASI(4, 16)	547.2000	0.000000
DURASI(5, 1)	272.4000	0.000000
DURASI(5, 2)	264.0000	0.000000
DURASI(5, 3)	152.4000	0.000000
DURASI(5, 4)	159.6000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	102.0000	0.000000
DURASI(5, 7)	122.4000	0.000000
DURASI(5, 8)	160.8000	0.000000
DURASI(5, 9)	276.0000	0.000000
DURASI(5, 10)	276.0000	0.000000
DURASI(5, 11)	273.6000	0.000000
DURASI(5, 12)	270.0000	0.000000
DURASI(5, 13)	268.8000	0.000000
DURASI(5, 14)	268.8000	0.000000
DURASI(5, 15)	276.0000	0.000000
DURASI(5, 16)	374.4000	0.000000
DURASI(6, 1)	330.0000	0.000000
DURASI(6, 2)	321.6000	0.000000
DURASI(6, 3)	360.0000	0.000000
DURASI(6, 4)	356.4000	0.000000
DURASI(6, 5)	102.0000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	57.60000	0.000000
DURASI(6, 8)	60.00000	0.000000
DURASI(6, 9)	85.20000	0.000000
DURASI(6, 10)	78.00000	0.000000
DURASI(6, 11)	76.80000	0.000000
DURASI(6, 12)	66.00000	0.000000
DURASI(6, 13)	85.20000	0.000000
DURASI(6, 14)	82.80000	0.000000
DURASI(6, 15)	79.20000	0.000000
DURASI(6, 16)	199.2000	0.000000
DURASI(7, 1)	388.8000	0.000000
DURASI(7, 2)	380.4000	0.000000

DURASI(7, 3)	249.6000	0.000000
DURASI(7, 4)	258.0000	0.000000
DURASI(7, 5)	122.4000	0.000000
DURASI(7, 6)	57.60000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	33.60000	0.000000
DURASI(7, 9)	104.4000	0.000000
DURASI(7, 10)	97.20000	0.000000
DURASI(7, 11)	96.00000	0.000000
DURASI(7, 12)	97.20000	0.000000
DURASI(7, 13)	104.4000	0.000000
DURASI(7, 14)	102.0000	0.000000
DURASI(7, 15)	98.40000	0.000000
DURASI(7, 16)	218.4000	0.000000
DURASI(8, 1)	386.4000	0.000000
DURASI(8, 2)	378.0000	0.000000
DURASI(8, 3)	285.6000	0.000000
DURASI(8, 4)	411.6000	0.000000
DURASI(8, 5)	160.8000	0.000000
DURASI(8, 6)	60.00000	0.000000
DURASI(8, 7)	33.60000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	73.20000	0.000000
DURASI(8, 10)	66.00000	0.000000
DURASI(8, 11)	64.80000	0.000000
DURASI(8, 12)	66.00000	0.000000
DURASI(8, 13)	73.20000	0.000000
DURASI(8, 14)	70.80000	0.000000
DURASI(8, 15)	67.20000	0.000000
DURASI(8, 16)	187.2000	0.000000
DURASI(9, 1)	423.6000	0.000000
DURASI(9, 2)	415.2000	0.000000
DURASI(9, 3)	452.4000	0.000000
DURASI(9, 4)	448.8000	0.000000
DURASI(9, 5)	276.0000	0.000000
DURASI(9, 6)	85.20000	0.000000
DURASI(9, 7)	104.4000	0.000000
DURASI(9, 8)	73.20000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	8.040000	0.000000
DURASI(9, 11)	7.080000	0.000000
DURASI(9, 12)	12.00000	0.000000
DURASI(9, 13)	5.760000	0.000000
DURASI(9, 14)	5.160000	0.000000

DURASI(9, 15)	8.880000	0.000000
DURASI(9, 16)	117.8400	0.000000
DURASI(10, 1)	423.6000	0.000000
DURASI(10, 2)	415.2000	0.000000
DURASI(10, 3)	452.4000	0.000000
DURASI(10, 4)	448.8000	0.000000
DURASI(10, 5)	276.0000	0.000000
DURASI(10, 6)	78.00000	0.000000
DURASI(10, 7)	97.20000	0.000000
DURASI(10, 8)	66.00000	0.000000
DURASI(10, 9)	8.040000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	2.280000	0.000000
DURASI(10, 12)	12.36000	0.000000
DURASI(10, 13)	7.080000	0.000000
DURASI(10, 14)	5.760000	0.000000
DURASI(10, 15)	2.160000	0.000000
DURASI(10, 16)	117.0000	0.000000
DURASI(11, 1)	421.2000	0.000000
DURASI(11, 2)	412.8000	0.000000
DURASI(11, 3)	451.2000	0.000000
DURASI(11, 4)	446.4000	0.000000
DURASI(11, 5)	273.6000	0.000000
DURASI(11, 6)	76.80000	0.000000
DURASI(11, 7)	96.00000	0.000000
DURASI(11, 8)	64.80000	0.000000
DURASI(11, 9)	7.080000	0.000000
DURASI(11, 10)	2.280000	0.000000
DURASI(11, 11)	0.000000	0.000000
DURASI(11, 12)	10.56000	0.000000
DURASI(11, 13)	11.76000	0.000000
DURASI(11, 14)	6.360000	0.000000
DURASI(11, 15)	4.080000	0.000000
DURASI(11, 16)	120.0000	0.000000
DURASI(12, 1)	417.6000	0.000000
DURASI(12, 2)	409.2000	0.000000
DURASI(12, 3)	446.4000	0.000000
DURASI(12, 4)	442.8000	0.000000
DURASI(12, 5)	270.0000	0.000000
DURASI(12, 6)	66.00000	0.000000
DURASI(12, 7)	97.20000	0.000000
DURASI(12, 8)	66.00000	0.000000
DURASI(12, 9)	12.00000	0.000000
DURASI(12, 10)	12.36000	0.000000

DURASI(12, 11)	10.56000	0.000000
DURASI(12, 12)	0.000000	0.000000
DURASI(12, 13)	12.72000	0.000000
DURASI(12, 14)	7.440000	0.000000
DURASI(12, 15)	12.84000	0.000000
DURASI(12, 16)	126.0000	0.000000
DURASI(13, 1)	416.4000	0.000000
DURASI(13, 2)	409.2000	0.000000
DURASI(13, 3)	446.4000	0.000000
DURASI(13, 4)	442.8000	0.000000
DURASI(13, 5)	268.8000	0.000000
DURASI(13, 6)	85.20000	0.000000
DURASI(13, 7)	104.4000	0.000000
DURASI(13, 8)	73.20000	0.000000
DURASI(13, 9)	5.760000	0.000000
DURASI(13, 10)	7.080000	0.000000
DURASI(13, 11)	11.76000	0.000000
DURASI(13, 12)	12.72000	0.000000
DURASI(13, 13)	0.000000	0.000000
DURASI(13, 14)	5.160000	0.000000
DURASI(13, 15)	4.200000	0.000000
DURASI(13, 16)	112.0800	0.000000
DURASI(14, 1)	416.4000	0.000000
DURASI(14, 2)	408.0000	0.000000
DURASI(14, 3)	446.4000	0.000000
DURASI(14, 4)	441.6000	0.000000
DURASI(14, 5)	268.8000	0.000000
DURASI(14, 6)	82.80000	0.000000
DURASI(14, 7)	102.0000	0.000000
DURASI(14, 8)	70.80000	0.000000
DURASI(14, 9)	5.160000	0.000000
DURASI(14, 10)	5.760000	0.000000
DURASI(14, 11)	6.360000	0.000000
DURASI(14, 12)	7.440000	0.000000
DURASI(14, 13)	5.160000	0.000000
DURASI(14, 14)	0.000000	0.000000
DURASI(14, 15)	7.560000	0.000000
DURASI(14, 16)	121.2000	0.000000
DURASI(15, 1)	423.6000	0.000000
DURASI(15, 2)	416.4000	0.000000
DURASI(15, 3)	453.6000	0.000000
DURASI(15, 4)	450.0000	0.000000
DURASI(15, 5)	276.0000	0.000000
DURASI(15, 6)	79.20000	0.000000

DURASI(15, 7)	98.40000	0.000000
DURASI(15, 8)	67.20000	0.000000
DURASI(15, 9)	8.880000	0.000000
DURASI(15, 10)	2.160000	0.000000
DURASI(15, 11)	4.080000	0.000000
DURASI(15, 12)	12.84000	0.000000
DURASI(15, 13)	4.200000	0.000000
DURASI(15, 14)	7.560000	0.000000
DURASI(15, 15)	0.000000	0.000000
DURASI(15, 16)	117.4800	0.000000
DURASI(16, 1)	522.0000	0.000000
DURASI(16, 2)	513.6000	0.000000
DURASI(16, 3)	550.8000	0.000000
DURASI(16, 4)	547.2000	0.000000
DURASI(16, 5)	374.4000	0.000000
DURASI(16, 6)	199.2000	0.000000
DURASI(16, 7)	218.4000	0.000000
DURASI(16, 8)	187.2000	0.000000
DURASI(16, 9)	117.8400	0.000000
DURASI(16, 10)	117.0000	0.000000
DURASI(16, 11)	120.0000	0.000000
DURASI(16, 12)	126.0000	0.000000
DURASI(16, 13)	112.0800	0.000000
DURASI(16, 14)	121.2000	0.000000
DURASI(16, 15)	117.4800	0.000000
DURASI(16, 16)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster* 3 analisis sensitivitas skenario 4

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i,j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..11/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 780 900 540 660 540 540;
tutup = 1020 1260 1260 660 1260 900 1020 1260 780 1260 1260;
```

D =

```
!ritel
!0    56    58    59    61    62    63    64    65    66
      67;
0     345   343   433   464   510   508   472   507   503
      495   !0;
345   0     20.2  102   133   179   176   142   176   172
      164   !56;
343   20.2  0     114   145   191   188   153   188   184
      175   !58;
433   102   114   0     48.4  94.1  91.2  56.6  91.3  87.3
      78.7  !59;
464   133   145   48.4  0     31.5  33.1  27.2  61.9  57.9
      49.3  !61;
510   179   191   94.1  31.5  0     3.4   58.4  21.5  12.1
      16.2  !62;
508   176   188   91.2  33.1  3.4   0     78.6  18.1  8.8
      14.5  !63;
```

```

472  142  153  56.6  27.2  58.4  78.6  0  34.7  30.7
      22.1  !64;
507  176  188  91.3  61.9  21.5  18.1  34.7  0  10.9
      35.6  !65;
503  172  184  87.3  57.9  12.1  8.8  30.7  10.9  0
      23.8  !66;
495  164  175  78.7  49.3  16.2  14.5  22.1  35.6  23.8  0;
      !67;

```

```

durasi =
0      414  411.6  519.6  556.8  612  609.6  566.4  608.4  603.6
      594
414    0      24.24  122.4  159.6  214.8  211.2  170.4  211.2  206.4
      196.8
411.6  24.24  0      136.8  174  229.2  225.6  183.6  225.6  220.8
      210
519.6  122.4  136.8  0      58.08  112.92  109.44  67.92
      109.56  104.76  94.44
556.8  159.6  174  58.08  0      37.8  39.72  32.64  74.28  69.48
      59.16
612    214.8  229.2  112.92  37.8  0      4.08  70.08  25.8
      14.52  19.44
609.6  211.2  225.6  109.44  39.72  4.08  0      94.32  21.72
      10.56  17.4
566.4  170.4  183.6  67.92  32.64  70.08  94.32  0      41.64  36.84
      26.52
608.4  211.2  225.6  109.56  74.28  25.8  21.72  41.64  0
      13.08  42.72
603.6  206.4  220.8  104.76  69.48  14.52  10.56  36.84  13.08  0
      28.56
594    196.8  210  94.44  59.16  19.44  17.4  26.52  42.72  28.56  0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
            @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
    );

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 3* analisis sensitivitas skenario 4

Global optimal solution found.

Objective value:	1107.300
Objective bound:	1107.300
Infeasibilities:	0.000000
Extended solver steps:	91
Total solver iterations:	14826
Elapsed runtime seconds:	1.23

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 4 sebesar 433 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 20.2 km
 rute pengiriman dari ritel 3 ke ritel 1 sebesar 343 km
 rute pengiriman dari ritel 4 ke ritel 8 sebesar 56.6 km
 rute pengiriman dari ritel 5 ke ritel 2 sebesar 133 km
 rute pengiriman dari ritel 6 ke ritel 11 sebesar 16.2 km
 rute pengiriman dari ritel 7 ke ritel 5 sebesar 33.1 km
 rute pengiriman dari ritel 8 ke ritel 9 sebesar 34.7 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 10.9 km
 rute pengiriman dari ritel 10 ke ritel 6 sebesar 12.1 km
 rute pengiriman dari ritel 11 ke ritel 7 sebesar 14.5 km

Model Class: MILP

Total variables:	132
Nonlinear variables:	0
Integer variables:	121
Total constraints:	154
Nonlinear constraints:	0
Total nonzeros:	780
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000

BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	780.0000	0.000000
BUKA(7)	900.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	660.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	660.0000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	900.0000	0.000000
TUTUP(7)	1020.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	780.0000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
T(1)	1863.600	0.000000
T(2)	1159.320	0.000000
T(3)	1213.560	0.000000
T(4)	546.0000	0.000000
T(5)	969.7200	0.000000
T(6)	803.1600	0.000000
T(7)	900.0000	0.000000
T(8)	643.9200	0.000000
T(9)	715.5600	0.000000
T(10)	758.6400	0.000000
T(11)	852.6000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	0.000000	345.0000
X(1, 3)	0.000000	343.0000

X(1, 4)	1.000000	433.0000
X(1, 5)	0.000000	464.0000
X(1, 6)	0.000000	510.0000
X(1, 7)	0.000000	508.0000
X(1, 8)	0.000000	472.0000
X(1, 9)	0.000000	507.0000
X(1, 10)	0.000000	503.0000
X(1, 11)	0.000000	495.0000
X(2, 1)	0.000000	345.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	20.20000
X(2, 4)	0.000000	102.0000
X(2, 5)	0.000000	133.0000
X(2, 6)	0.000000	179.0000
X(2, 7)	0.000000	176.0000
X(2, 8)	0.000000	142.0000
X(2, 9)	0.000000	176.0000
X(2, 10)	0.000000	172.0000
X(2, 11)	0.000000	164.0000
X(3, 1)	1.000000	343.0000
X(3, 2)	0.000000	20.20000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	114.0000
X(3, 5)	0.000000	145.0000
X(3, 6)	0.000000	191.0000
X(3, 7)	0.000000	188.0000
X(3, 8)	0.000000	153.0000
X(3, 9)	0.000000	188.0000
X(3, 10)	0.000000	184.0000
X(3, 11)	0.000000	175.0000
X(4, 1)	0.000000	433.0000
X(4, 2)	0.000000	102.0000
X(4, 3)	0.000000	114.0000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	48.40000
X(4, 6)	0.000000	94.10000
X(4, 7)	0.000000	91.20000
X(4, 8)	1.000000	56.60000
X(4, 9)	0.000000	91.30000
X(4, 10)	0.000000	87.30000
X(4, 11)	0.000000	78.70000
X(5, 1)	0.000000	464.0000
X(5, 2)	1.000000	133.0000
X(5, 3)	0.000000	145.0000

X(5, 4)	0.000000	48.40000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	31.50000
X(5, 7)	0.000000	33.10000
X(5, 8)	0.000000	27.20000
X(5, 9)	0.000000	61.90000
X(5, 10)	0.000000	57.90000
X(5, 11)	0.000000	49.30000
X(6, 1)	0.000000	510.0000
X(6, 2)	0.000000	179.0000
X(6, 3)	0.000000	191.0000
X(6, 4)	0.000000	94.10000
X(6, 5)	0.000000	31.50000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.400000
X(6, 8)	0.000000	58.40000
X(6, 9)	0.000000	21.50000
X(6, 10)	0.000000	12.10000
X(6, 11)	1.000000	16.20000
X(7, 1)	0.000000	508.0000
X(7, 2)	0.000000	176.0000
X(7, 3)	0.000000	188.0000
X(7, 4)	0.000000	91.20000
X(7, 5)	1.000000	33.10000
X(7, 6)	0.000000	3.400000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	78.60000
X(7, 9)	0.000000	18.10000
X(7, 10)	0.000000	8.800000
X(7, 11)	0.000000	14.50000
X(8, 1)	0.000000	472.0000
X(8, 2)	0.000000	142.0000
X(8, 3)	0.000000	153.0000
X(8, 4)	0.000000	56.60000
X(8, 5)	0.000000	27.20000
X(8, 6)	0.000000	58.40000
X(8, 7)	0.000000	78.60000
X(8, 8)	0.000000	0.000000
X(8, 9)	1.000000	34.70000
X(8, 10)	0.000000	30.70000
X(8, 11)	0.000000	22.10000
X(9, 1)	0.000000	507.0000
X(9, 2)	0.000000	176.0000
X(9, 3)	0.000000	188.0000

X(9, 4)	0.000000	91.30000
X(9, 5)	0.000000	61.90000
X(9, 6)	0.000000	21.50000
X(9, 7)	0.000000	18.10000
X(9, 8)	0.000000	34.70000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	10.90000
X(9, 11)	0.000000	35.60000
X(10, 1)	0.000000	503.0000
X(10, 2)	0.000000	172.0000
X(10, 3)	0.000000	184.0000
X(10, 4)	0.000000	87.30000
X(10, 5)	0.000000	57.90000
X(10, 6)	1.000000	12.10000
X(10, 7)	0.000000	8.800000
X(10, 8)	0.000000	30.70000
X(10, 9)	0.000000	10.90000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	23.80000
X(11, 1)	0.000000	495.0000
X(11, 2)	0.000000	164.0000
X(11, 3)	0.000000	175.0000
X(11, 4)	0.000000	78.70000
X(11, 5)	0.000000	49.30000
X(11, 6)	0.000000	16.20000
X(11, 7)	1.000000	14.50000
X(11, 8)	0.000000	22.10000
X(11, 9)	0.000000	35.60000
X(11, 10)	0.000000	23.80000
X(11, 11)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	345.0000	0.000000
D(1, 3)	343.0000	0.000000
D(1, 4)	433.0000	0.000000
D(1, 5)	464.0000	0.000000
D(1, 6)	510.0000	0.000000
D(1, 7)	508.0000	0.000000
D(1, 8)	472.0000	0.000000
D(1, 9)	507.0000	0.000000
D(1, 10)	503.0000	0.000000
D(1, 11)	495.0000	0.000000
D(2, 1)	345.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	20.20000	0.000000

D(2, 4)	102.0000	0.000000
D(2, 5)	133.0000	0.000000
D(2, 6)	179.0000	0.000000
D(2, 7)	176.0000	0.000000
D(2, 8)	142.0000	0.000000
D(2, 9)	176.0000	0.000000
D(2, 10)	172.0000	0.000000
D(2, 11)	164.0000	0.000000
D(3, 1)	343.0000	0.000000
D(3, 2)	20.20000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	114.0000	0.000000
D(3, 5)	145.0000	0.000000
D(3, 6)	191.0000	0.000000
D(3, 7)	188.0000	0.000000
D(3, 8)	153.0000	0.000000
D(3, 9)	188.0000	0.000000
D(3, 10)	184.0000	0.000000
D(3, 11)	175.0000	0.000000
D(4, 1)	433.0000	0.000000
D(4, 2)	102.0000	0.000000
D(4, 3)	114.0000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	48.40000	0.000000
D(4, 6)	94.10000	0.000000
D(4, 7)	91.20000	0.000000
D(4, 8)	56.60000	0.000000
D(4, 9)	91.30000	0.000000
D(4, 10)	87.30000	0.000000
D(4, 11)	78.70000	0.000000
D(5, 1)	464.0000	0.000000
D(5, 2)	133.0000	0.000000
D(5, 3)	145.0000	0.000000
D(5, 4)	48.40000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	31.50000	0.000000
D(5, 7)	33.10000	0.000000
D(5, 8)	27.20000	0.000000
D(5, 9)	61.90000	0.000000
D(5, 10)	57.90000	0.000000
D(5, 11)	49.30000	0.000000
D(6, 1)	510.0000	0.000000
D(6, 2)	179.0000	0.000000
D(6, 3)	191.0000	0.000000

D(6, 4)	94.10000	0.000000
D(6, 5)	31.50000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.400000	0.000000
D(6, 8)	58.40000	0.000000
D(6, 9)	21.50000	0.000000
D(6, 10)	12.10000	0.000000
D(6, 11)	16.20000	0.000000
D(7, 1)	508.0000	0.000000
D(7, 2)	176.0000	0.000000
D(7, 3)	188.0000	0.000000
D(7, 4)	91.20000	0.000000
D(7, 5)	33.10000	0.000000
D(7, 6)	3.400000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	78.60000	0.000000
D(7, 9)	18.10000	0.000000
D(7, 10)	8.800000	0.000000
D(7, 11)	14.50000	0.000000
D(8, 1)	472.0000	0.000000
D(8, 2)	142.0000	0.000000
D(8, 3)	153.0000	0.000000
D(8, 4)	56.60000	0.000000
D(8, 5)	27.20000	0.000000
D(8, 6)	58.40000	0.000000
D(8, 7)	78.60000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	34.70000	0.000000
D(8, 10)	30.70000	0.000000
D(8, 11)	22.10000	0.000000
D(9, 1)	507.0000	0.000000
D(9, 2)	176.0000	0.000000
D(9, 3)	188.0000	0.000000
D(9, 4)	91.30000	0.000000
D(9, 5)	61.90000	0.000000
D(9, 6)	21.50000	0.000000
D(9, 7)	18.10000	0.000000
D(9, 8)	34.70000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	10.90000	0.000000
D(9, 11)	35.60000	0.000000
D(10, 1)	503.0000	0.000000
D(10, 2)	172.0000	0.000000
D(10, 3)	184.0000	0.000000

D(10, 4)	87.30000	0.000000
D(10, 5)	57.90000	0.000000
D(10, 6)	12.10000	0.000000
D(10, 7)	8.800000	0.000000
D(10, 8)	30.70000	0.000000
D(10, 9)	10.90000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	23.80000	0.000000
D(11, 1)	495.0000	0.000000
D(11, 2)	164.0000	0.000000
D(11, 3)	175.0000	0.000000
D(11, 4)	78.70000	0.000000
D(11, 5)	49.30000	0.000000
D(11, 6)	16.20000	0.000000
D(11, 7)	14.50000	0.000000
D(11, 8)	22.10000	0.000000
D(11, 9)	35.60000	0.000000
D(11, 10)	23.80000	0.000000
D(11, 11)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	414.0000	0.000000
DURASI(1, 3)	411.6000	0.000000
DURASI(1, 4)	519.6000	0.000000
DURASI(1, 5)	556.8000	0.000000
DURASI(1, 6)	612.0000	0.000000
DURASI(1, 7)	609.6000	0.000000
DURASI(1, 8)	566.4000	0.000000
DURASI(1, 9)	608.4000	0.000000
DURASI(1, 10)	603.6000	0.000000
DURASI(1, 11)	594.0000	0.000000
DURASI(2, 1)	414.0000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	24.24000	0.000000
DURASI(2, 4)	122.4000	0.000000
DURASI(2, 5)	159.6000	0.000000
DURASI(2, 6)	214.8000	0.000000
DURASI(2, 7)	211.2000	0.000000
DURASI(2, 8)	170.4000	0.000000
DURASI(2, 9)	211.2000	0.000000
DURASI(2, 10)	206.4000	0.000000
DURASI(2, 11)	196.8000	0.000000
DURASI(3, 1)	411.6000	0.000000
DURASI(3, 2)	24.24000	0.000000
DURASI(3, 3)	0.000000	0.000000

DURASI(3, 4)	136.8000	0.000000
DURASI(3, 5)	174.0000	0.000000
DURASI(3, 6)	229.2000	0.000000
DURASI(3, 7)	225.6000	0.000000
DURASI(3, 8)	183.6000	0.000000
DURASI(3, 9)	225.6000	0.000000
DURASI(3, 10)	220.8000	0.000000
DURASI(3, 11)	210.0000	0.000000
DURASI(4, 1)	519.6000	0.000000
DURASI(4, 2)	122.4000	0.000000
DURASI(4, 3)	136.8000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	58.08000	0.000000
DURASI(4, 6)	112.9200	0.000000
DURASI(4, 7)	109.4400	0.000000
DURASI(4, 8)	67.92000	0.000000
DURASI(4, 9)	109.5600	0.000000
DURASI(4, 10)	104.7600	0.000000
DURASI(4, 11)	94.44000	0.000000
DURASI(5, 1)	556.8000	0.000000
DURASI(5, 2)	159.6000	0.000000
DURASI(5, 3)	174.0000	0.000000
DURASI(5, 4)	58.08000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	37.80000	0.000000
DURASI(5, 7)	39.72000	0.000000
DURASI(5, 8)	32.64000	0.000000
DURASI(5, 9)	74.28000	0.000000
DURASI(5, 10)	69.48000	0.000000
DURASI(5, 11)	59.16000	0.000000
DURASI(6, 1)	612.0000	0.000000
DURASI(6, 2)	214.8000	0.000000
DURASI(6, 3)	229.2000	0.000000
DURASI(6, 4)	112.9200	0.000000
DURASI(6, 5)	37.80000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.080000	0.000000
DURASI(6, 8)	70.08000	0.000000
DURASI(6, 9)	25.80000	0.000000
DURASI(6, 10)	14.52000	0.000000
DURASI(6, 11)	19.44000	0.000000
DURASI(7, 1)	609.6000	0.000000
DURASI(7, 2)	211.2000	0.000000
DURASI(7, 3)	225.6000	0.000000

DURASI(7, 4)	109.4400	0.000000
DURASI(7, 5)	39.72000	0.000000
DURASI(7, 6)	4.080000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	94.32000	0.000000
DURASI(7, 9)	21.72000	0.000000
DURASI(7, 10)	10.56000	0.000000
DURASI(7, 11)	17.40000	0.000000
DURASI(8, 1)	566.4000	0.000000
DURASI(8, 2)	170.4000	0.000000
DURASI(8, 3)	183.6000	0.000000
DURASI(8, 4)	67.92000	0.000000
DURASI(8, 5)	32.64000	0.000000
DURASI(8, 6)	70.08000	0.000000
DURASI(8, 7)	94.32000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	41.64000	0.000000
DURASI(8, 10)	36.84000	0.000000
DURASI(8, 11)	26.52000	0.000000
DURASI(9, 1)	608.4000	0.000000
DURASI(9, 2)	211.2000	0.000000
DURASI(9, 3)	225.6000	0.000000
DURASI(9, 4)	109.5600	0.000000
DURASI(9, 5)	74.28000	0.000000
DURASI(9, 6)	25.80000	0.000000
DURASI(9, 7)	21.72000	0.000000
DURASI(9, 8)	41.64000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	13.08000	0.000000
DURASI(9, 11)	42.72000	0.000000
DURASI(10, 1)	603.6000	0.000000
DURASI(10, 2)	206.4000	0.000000
DURASI(10, 3)	220.8000	0.000000
DURASI(10, 4)	104.7600	0.000000
DURASI(10, 5)	69.48000	0.000000
DURASI(10, 6)	14.52000	0.000000
DURASI(10, 7)	10.56000	0.000000
DURASI(10, 8)	36.84000	0.000000
DURASI(10, 9)	13.08000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	28.56000	0.000000
DURASI(11, 1)	594.0000	0.000000
DURASI(11, 2)	196.8000	0.000000
DURASI(11, 3)	210.0000	0.000000

DURASI(11, 4)	94.44000	0.000000
DURASI(11, 5)	59.16000	0.000000
DURASI(11, 6)	19.44000	0.000000
DURASI(11, 7)	17.40000	0.000000
DURASI(11, 8)	26.52000	0.000000
DURASI(11, 9)	42.72000	0.000000
DURASI(11, 10)	28.56000	0.000000
DURASI(11, 11)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster* 4 analisis sensitivitas skenario 4

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i,j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..12/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 780 660 900 540 540 540 540 540;
tutup = 1020 1260 660 1260 900 780 1020 1260 1260 1260 1260
1260;
```

D =

```
!ritel
!0   33   34   35   36   37   38   44   45   46   47
    48;
0    252  234  258  254  256  259  398  422  548
    548  341  !0;
252  0    20   44   39   42   46   184  208  334
    334  127  !33;
234  20   0    24   20   23   25   164  188  314
    314  107  !34;
258  44   24   0    7    6    9    138  158  295
    295  88   !35;
254  39   20   7    0    3    6    156  166  306
    306  99   !36;
256  42   23   6    3    0    7    156  164  305
    305  98   !37;
```

259	46	25	9	6	7	0	141	161	306	
	306	99	!38;							
398	184	164	138	156	156	141	0	24.4	102	
	102	57.5	!44;							
422	208	188	158	166	164	161	24.4	0	77.2	78
	80.9	!45;								
548	334	314	295	306	305	306	102	77.2	0	1.7
	145	!46;								
548	334	314	295	306	305	306	102	78	1.7	0
	144	!47;								
341	127	107	88	99	98	99	57.5	80.9	145	
	144	0;	!48;							

```

durasi =
0      302.4 280.8 309.6 304.8 307.2 310.8 477.6 506.4 657.6
      657.6 409.2
302.4 0      24    52.8 46.8 50.4 55.2 220.8 249.6 400.8
      400.8 152.4
280.8 24    0      28.8 24   27.6 30   196.8 225.6 376.8
      376.8 128.4
309.6 52.8 28.8 0      8.4 7.2 10.8 165.6 189.6 354
      354 105.6
304.8 46.8 24    8.4 0    3.6 7.2 187.2 199.2 367.2
      367.2 118.8
307.2 50.4 27.6 7.2 3.6 0    8.4 187.2 196.8 366
      366 117.6
310.8 55.2 30    10.8 7.2 8.4 0    169.2 193.2 367.2
      367.2 118.8
477.6 220.8 196.8 165.6 187.2 187.2 169.2 0    29.28 122.4
      122.4 69
506.4 249.6 225.6 189.6 199.2 196.8 193.2 29.28 0    92.64
      93.6 97.08
657.6 400.8 376.8 354 367.2 366 367.2 122.4 92.64 0
      2.04 174
657.6 400.8 376.8 354 367.2 366 367.2 122.4 93.6 2.04 0
      172.8
409.2 152.4 128.4 105.6 118.8 117.6 118.8 69 97.08 174
      172.8 0;

```

```

Bongkar = 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

```

```

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

- Hasil dari *solution report* pada *cluster 4* analisis sensitivitas skenario 4

Global optimal solution found.

Objective value:	1109.800
Objective bound:	1109.800
Infeasibilities:	0.000000
Extended solver steps:	1131
Total solver iterations:	39059
Elapsed runtime seconds:	2.56

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 252 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 20 km
 rute pengiriman dari ritel 3 ke ritel 6 sebesar 23 km
 rute pengiriman dari ritel 4 ke ritel 12 sebesar 88 km
 rute pengiriman dari ritel 5 ke ritel 7 sebesar 6 km
 rute pengiriman dari ritel 6 ke ritel 5 sebesar 3 km
 rute pengiriman dari ritel 7 ke ritel 4 sebesar 9 km
 rute pengiriman dari ritel 8 ke ritel 9 sebesar 24.4 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 77.2 km
 rute pengiriman dari ritel 10 ke ritel 11 sebesar 1.7 km
 rute pengiriman dari ritel 11 ke ritel 1 sebesar 548 km
 rute pengiriman dari ritel 12 ke ritel 8 sebesar 57.5 km

Model Class: MILP

Total variables:	156
Nonlinear variables:	0
Integer variables:	144
Total constraints:	180
Nonlinear constraints:	0
Total nonzeros:	935

Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	0.3000000	0.000000
BONGKAR(2)	0.3000000	0.000000
BONGKAR(3)	0.3000000	0.000000
BONGKAR(4)	0.3000000	0.000000
BONGKAR(5)	0.3000000	0.000000
BONGKAR(6)	0.3000000	0.000000
BONGKAR(7)	0.3000000	0.000000
BONGKAR(8)	0.3000000	0.000000
BONGKAR(9)	0.3000000	0.000000
BONGKAR(10)	0.3000000	0.000000
BONGKAR(11)	0.3000000	0.000000
BONGKAR(12)	0.3000000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	660.0000	0.000000
BUKA(7)	900.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
BUKA(12)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	660.0000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	780.0000	0.000000
TUTUP(7)	1020.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
TUTUP(12)	1260.000	0.000000
T(1)	1917.600	0.000000
T(2)	540.0000	0.000000

T(3)	659.7000	0.000000
T(4)	911.1000	0.000000
T(5)	783.6000	0.000000
T(6)	779.7000	0.000000
T(7)	900.0000	0.000000
T(8)	1086.300	0.000000
T(9)	1115.880	0.000000
T(10)	1257.360	0.000000
T(11)	1259.700	0.000000
T(12)	1017.000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	252.0000
X(1, 3)	0.000000	234.0000
X(1, 4)	0.000000	258.0000
X(1, 5)	0.000000	254.0000
X(1, 6)	0.000000	256.0000
X(1, 7)	0.000000	259.0000
X(1, 8)	0.000000	398.0000
X(1, 9)	0.000000	422.0000
X(1, 10)	0.000000	548.0000
X(1, 11)	0.000000	548.0000
X(1, 12)	0.000000	341.0000
X(2, 1)	0.000000	252.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	20.00000
X(2, 4)	0.000000	44.00000
X(2, 5)	0.000000	39.00000
X(2, 6)	0.000000	42.00000
X(2, 7)	0.000000	46.00000
X(2, 8)	0.000000	184.0000
X(2, 9)	0.000000	208.0000
X(2, 10)	0.000000	334.0000
X(2, 11)	0.000000	334.0000
X(2, 12)	0.000000	127.0000
X(3, 1)	0.000000	234.0000
X(3, 2)	0.000000	20.00000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	24.00000
X(3, 5)	0.000000	20.00000
X(3, 6)	1.000000	23.00000
X(3, 7)	0.000000	25.00000
X(3, 8)	0.000000	164.0000
X(3, 9)	0.000000	188.0000
X(3, 10)	0.000000	314.0000

X(3, 11)	0.000000	314.0000
X(3, 12)	0.000000	107.0000
X(4, 1)	0.000000	258.0000
X(4, 2)	0.000000	44.00000
X(4, 3)	0.000000	24.00000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	7.000000
X(4, 6)	0.000000	6.000000
X(4, 7)	0.000000	9.000000
X(4, 8)	0.000000	138.0000
X(4, 9)	0.000000	158.0000
X(4, 10)	0.000000	295.0000
X(4, 11)	0.000000	295.0000
X(4, 12)	1.000000	88.00000
X(5, 1)	0.000000	254.0000
X(5, 2)	0.000000	39.00000
X(5, 3)	0.000000	20.00000
X(5, 4)	0.000000	7.000000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	3.000000
X(5, 7)	1.000000	6.000000
X(5, 8)	0.000000	156.0000
X(5, 9)	0.000000	166.0000
X(5, 10)	0.000000	306.0000
X(5, 11)	0.000000	306.0000
X(5, 12)	0.000000	99.00000
X(6, 1)	0.000000	256.0000
X(6, 2)	0.000000	42.00000
X(6, 3)	0.000000	23.00000
X(6, 4)	0.000000	6.000000
X(6, 5)	1.000000	3.000000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	7.000000
X(6, 8)	0.000000	156.0000
X(6, 9)	0.000000	164.0000
X(6, 10)	0.000000	305.0000
X(6, 11)	0.000000	305.0000
X(6, 12)	0.000000	98.00000
X(7, 1)	0.000000	259.0000
X(7, 2)	0.000000	46.00000
X(7, 3)	0.000000	25.00000
X(7, 4)	1.000000	9.000000
X(7, 5)	0.000000	6.000000
X(7, 6)	0.000000	7.000000

X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	141.0000
X(7, 9)	0.000000	161.0000
X(7, 10)	0.000000	306.0000
X(7, 11)	0.000000	306.0000
X(7, 12)	0.000000	99.00000
X(8, 1)	0.000000	398.0000
X(8, 2)	0.000000	184.0000
X(8, 3)	0.000000	164.0000
X(8, 4)	0.000000	138.0000
X(8, 5)	0.000000	156.0000
X(8, 6)	0.000000	156.0000
X(8, 7)	0.000000	141.0000
X(8, 8)	0.000000	0.000000
X(8, 9)	1.000000	24.40000
X(8, 10)	0.000000	102.0000
X(8, 11)	0.000000	102.0000
X(8, 12)	0.000000	57.50000
X(9, 1)	0.000000	422.0000
X(9, 2)	0.000000	208.0000
X(9, 3)	0.000000	188.0000
X(9, 4)	0.000000	158.0000
X(9, 5)	0.000000	166.0000
X(9, 6)	0.000000	164.0000
X(9, 7)	0.000000	161.0000
X(9, 8)	0.000000	24.40000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	77.20000
X(9, 11)	0.000000	78.00000
X(9, 12)	0.000000	80.90000
X(10, 1)	0.000000	548.0000
X(10, 2)	0.000000	334.0000
X(10, 3)	0.000000	314.0000
X(10, 4)	0.000000	295.0000
X(10, 5)	0.000000	306.0000
X(10, 6)	0.000000	305.0000
X(10, 7)	0.000000	306.0000
X(10, 8)	0.000000	102.0000
X(10, 9)	0.000000	77.20000
X(10, 10)	0.000000	0.000000
X(10, 11)	1.000000	1.700000
X(10, 12)	0.000000	145.0000
X(11, 1)	1.000000	548.0000
X(11, 2)	0.000000	334.0000

X(11, 3)	0.000000	314.0000
X(11, 4)	0.000000	295.0000
X(11, 5)	0.000000	306.0000
X(11, 6)	0.000000	305.0000
X(11, 7)	0.000000	306.0000
X(11, 8)	0.000000	102.0000
X(11, 9)	0.000000	78.00000
X(11, 10)	0.000000	1.700000
X(11, 11)	0.000000	0.000000
X(11, 12)	0.000000	144.0000
X(12, 1)	0.000000	341.0000
X(12, 2)	0.000000	127.0000
X(12, 3)	0.000000	107.0000
X(12, 4)	0.000000	88.00000
X(12, 5)	0.000000	99.00000
X(12, 6)	0.000000	98.00000
X(12, 7)	0.000000	99.00000
X(12, 8)	1.000000	57.50000
X(12, 9)	0.000000	80.90000
X(12, 10)	0.000000	145.0000
X(12, 11)	0.000000	144.0000
X(12, 12)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	252.0000	0.000000
D(1, 3)	234.0000	0.000000
D(1, 4)	258.0000	0.000000
D(1, 5)	254.0000	0.000000
D(1, 6)	256.0000	0.000000
D(1, 7)	259.0000	0.000000
D(1, 8)	398.0000	0.000000
D(1, 9)	422.0000	0.000000
D(1, 10)	548.0000	0.000000
D(1, 11)	548.0000	0.000000
D(1, 12)	341.0000	0.000000
D(2, 1)	252.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	20.00000	0.000000
D(2, 4)	44.00000	0.000000
D(2, 5)	39.00000	0.000000
D(2, 6)	42.00000	0.000000
D(2, 7)	46.00000	0.000000
D(2, 8)	184.0000	0.000000
D(2, 9)	208.0000	0.000000
D(2, 10)	334.0000	0.000000

D(2, 11)	334.0000	0.000000
D(2, 12)	127.0000	0.000000
D(3, 1)	234.0000	0.000000
D(3, 2)	20.00000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	24.00000	0.000000
D(3, 5)	20.00000	0.000000
D(3, 6)	23.00000	0.000000
D(3, 7)	25.00000	0.000000
D(3, 8)	164.0000	0.000000
D(3, 9)	188.0000	0.000000
D(3, 10)	314.0000	0.000000
D(3, 11)	314.0000	0.000000
D(3, 12)	107.0000	0.000000
D(4, 1)	258.0000	0.000000
D(4, 2)	44.00000	0.000000
D(4, 3)	24.00000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	7.000000	0.000000
D(4, 6)	6.000000	0.000000
D(4, 7)	9.000000	0.000000
D(4, 8)	138.0000	0.000000
D(4, 9)	158.0000	0.000000
D(4, 10)	295.0000	0.000000
D(4, 11)	295.0000	0.000000
D(4, 12)	88.00000	0.000000
D(5, 1)	254.0000	0.000000
D(5, 2)	39.00000	0.000000
D(5, 3)	20.00000	0.000000
D(5, 4)	7.000000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	3.000000	0.000000
D(5, 7)	6.000000	0.000000
D(5, 8)	156.0000	0.000000
D(5, 9)	166.0000	0.000000
D(5, 10)	306.0000	0.000000
D(5, 11)	306.0000	0.000000
D(5, 12)	99.00000	0.000000
D(6, 1)	256.0000	0.000000
D(6, 2)	42.00000	0.000000
D(6, 3)	23.00000	0.000000
D(6, 4)	6.000000	0.000000
D(6, 5)	3.000000	0.000000
D(6, 6)	0.000000	0.000000

D(6, 7)	7.000000	0.000000
D(6, 8)	156.0000	0.000000
D(6, 9)	164.0000	0.000000
D(6, 10)	305.0000	0.000000
D(6, 11)	305.0000	0.000000
D(6, 12)	98.00000	0.000000
D(7, 1)	259.0000	0.000000
D(7, 2)	46.00000	0.000000
D(7, 3)	25.00000	0.000000
D(7, 4)	9.000000	0.000000
D(7, 5)	6.000000	0.000000
D(7, 6)	7.000000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	141.0000	0.000000
D(7, 9)	161.0000	0.000000
D(7, 10)	306.0000	0.000000
D(7, 11)	306.0000	0.000000
D(7, 12)	99.00000	0.000000
D(8, 1)	398.0000	0.000000
D(8, 2)	184.0000	0.000000
D(8, 3)	164.0000	0.000000
D(8, 4)	138.0000	0.000000
D(8, 5)	156.0000	0.000000
D(8, 6)	156.0000	0.000000
D(8, 7)	141.0000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	24.40000	0.000000
D(8, 10)	102.0000	0.000000
D(8, 11)	102.0000	0.000000
D(8, 12)	57.50000	0.000000
D(9, 1)	422.0000	0.000000
D(9, 2)	208.0000	0.000000
D(9, 3)	188.0000	0.000000
D(9, 4)	158.0000	0.000000
D(9, 5)	166.0000	0.000000
D(9, 6)	164.0000	0.000000
D(9, 7)	161.0000	0.000000
D(9, 8)	24.40000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	77.20000	0.000000
D(9, 11)	78.00000	0.000000
D(9, 12)	80.90000	0.000000
D(10, 1)	548.0000	0.000000
D(10, 2)	334.0000	0.000000

D(10, 3)	314.0000	0.000000
D(10, 4)	295.0000	0.000000
D(10, 5)	306.0000	0.000000
D(10, 6)	305.0000	0.000000
D(10, 7)	306.0000	0.000000
D(10, 8)	102.0000	0.000000
D(10, 9)	77.20000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	1.700000	0.000000
D(10, 12)	145.0000	0.000000
D(11, 1)	548.0000	0.000000
D(11, 2)	334.0000	0.000000
D(11, 3)	314.0000	0.000000
D(11, 4)	295.0000	0.000000
D(11, 5)	306.0000	0.000000
D(11, 6)	305.0000	0.000000
D(11, 7)	306.0000	0.000000
D(11, 8)	102.0000	0.000000
D(11, 9)	78.00000	0.000000
D(11, 10)	1.700000	0.000000
D(11, 11)	0.000000	0.000000
D(11, 12)	144.0000	0.000000
D(12, 1)	341.0000	0.000000
D(12, 2)	127.0000	0.000000
D(12, 3)	107.0000	0.000000
D(12, 4)	88.00000	0.000000
D(12, 5)	99.00000	0.000000
D(12, 6)	98.00000	0.000000
D(12, 7)	99.00000	0.000000
D(12, 8)	57.50000	0.000000
D(12, 9)	80.90000	0.000000
D(12, 10)	145.0000	0.000000
D(12, 11)	144.0000	0.000000
D(12, 12)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	302.4000	0.000000
DURASI(1, 3)	280.8000	0.000000
DURASI(1, 4)	309.6000	0.000000
DURASI(1, 5)	304.8000	0.000000
DURASI(1, 6)	307.2000	0.000000
DURASI(1, 7)	310.8000	0.000000
DURASI(1, 8)	477.6000	0.000000
DURASI(1, 9)	506.4000	0.000000
DURASI(1, 10)	657.6000	0.000000

DURASI(1, 11)	657.6000	0.000000
DURASI(1, 12)	409.2000	0.000000
DURASI(2, 1)	302.4000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	24.00000	0.000000
DURASI(2, 4)	52.80000	0.000000
DURASI(2, 5)	46.80000	0.000000
DURASI(2, 6)	50.40000	0.000000
DURASI(2, 7)	55.20000	0.000000
DURASI(2, 8)	220.8000	0.000000
DURASI(2, 9)	249.6000	0.000000
DURASI(2, 10)	400.8000	0.000000
DURASI(2, 11)	400.8000	0.000000
DURASI(2, 12)	152.4000	0.000000
DURASI(3, 1)	280.8000	0.000000
DURASI(3, 2)	24.00000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	28.80000	0.000000
DURASI(3, 5)	24.00000	0.000000
DURASI(3, 6)	27.60000	0.000000
DURASI(3, 7)	30.00000	0.000000
DURASI(3, 8)	196.8000	0.000000
DURASI(3, 9)	225.6000	0.000000
DURASI(3, 10)	376.8000	0.000000
DURASI(3, 11)	376.8000	0.000000
DURASI(3, 12)	128.4000	0.000000
DURASI(4, 1)	309.6000	0.000000
DURASI(4, 2)	52.80000	0.000000
DURASI(4, 3)	28.80000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	8.400000	0.000000
DURASI(4, 6)	7.200000	0.000000
DURASI(4, 7)	10.80000	0.000000
DURASI(4, 8)	165.6000	0.000000
DURASI(4, 9)	189.6000	0.000000
DURASI(4, 10)	354.0000	0.000000
DURASI(4, 11)	354.0000	0.000000
DURASI(4, 12)	105.6000	0.000000
DURASI(5, 1)	304.8000	0.000000
DURASI(5, 2)	46.80000	0.000000
DURASI(5, 3)	24.00000	0.000000
DURASI(5, 4)	8.400000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	3.600000	0.000000

DURASI(5, 7)	7.200000	0.000000
DURASI(5, 8)	187.2000	0.000000
DURASI(5, 9)	199.2000	0.000000
DURASI(5, 10)	367.2000	0.000000
DURASI(5, 11)	367.2000	0.000000
DURASI(5, 12)	118.8000	0.000000
DURASI(6, 1)	307.2000	0.000000
DURASI(6, 2)	50.40000	0.000000
DURASI(6, 3)	27.60000	0.000000
DURASI(6, 4)	7.200000	0.000000
DURASI(6, 5)	3.600000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	8.400000	0.000000
DURASI(6, 8)	187.2000	0.000000
DURASI(6, 9)	196.8000	0.000000
DURASI(6, 10)	366.0000	0.000000
DURASI(6, 11)	366.0000	0.000000
DURASI(6, 12)	117.6000	0.000000
DURASI(7, 1)	310.8000	0.000000
DURASI(7, 2)	55.20000	0.000000
DURASI(7, 3)	30.00000	0.000000
DURASI(7, 4)	10.80000	0.000000
DURASI(7, 5)	7.200000	0.000000
DURASI(7, 6)	8.400000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	169.2000	0.000000
DURASI(7, 9)	193.2000	0.000000
DURASI(7, 10)	367.2000	0.000000
DURASI(7, 11)	367.2000	0.000000
DURASI(7, 12)	118.8000	0.000000
DURASI(8, 1)	477.6000	0.000000
DURASI(8, 2)	220.8000	0.000000
DURASI(8, 3)	196.8000	0.000000
DURASI(8, 4)	165.6000	0.000000
DURASI(8, 5)	187.2000	0.000000
DURASI(8, 6)	187.2000	0.000000
DURASI(8, 7)	169.2000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	29.28000	0.000000
DURASI(8, 10)	122.4000	0.000000
DURASI(8, 11)	122.4000	0.000000
DURASI(8, 12)	69.00000	0.000000
DURASI(9, 1)	506.4000	0.000000
DURASI(9, 2)	249.6000	0.000000

DURASI(9, 3)	225.6000	0.000000
DURASI(9, 4)	189.6000	0.000000
DURASI(9, 5)	199.2000	0.000000
DURASI(9, 6)	196.8000	0.000000
DURASI(9, 7)	193.2000	0.000000
DURASI(9, 8)	29.28000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	92.64000	0.000000
DURASI(9, 11)	93.60000	0.000000
DURASI(9, 12)	97.08000	0.000000
DURASI(10, 1)	657.6000	0.000000
DURASI(10, 2)	400.8000	0.000000
DURASI(10, 3)	376.8000	0.000000
DURASI(10, 4)	354.0000	0.000000
DURASI(10, 5)	367.2000	0.000000
DURASI(10, 6)	366.0000	0.000000
DURASI(10, 7)	367.2000	0.000000
DURASI(10, 8)	122.4000	0.000000
DURASI(10, 9)	92.64000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	2.040000	0.000000
DURASI(10, 12)	174.0000	0.000000
DURASI(11, 1)	657.6000	0.000000
DURASI(11, 2)	400.8000	0.000000
DURASI(11, 3)	376.8000	0.000000
DURASI(11, 4)	354.0000	0.000000
DURASI(11, 5)	367.2000	0.000000
DURASI(11, 6)	366.0000	0.000000
DURASI(11, 7)	367.2000	0.000000
DURASI(11, 8)	122.4000	0.000000
DURASI(11, 9)	93.60000	0.000000
DURASI(11, 10)	2.040000	0.000000
DURASI(11, 11)	0.000000	0.000000
DURASI(11, 12)	172.8000	0.000000
DURASI(12, 1)	409.2000	0.000000
DURASI(12, 2)	152.4000	0.000000
DURASI(12, 3)	128.4000	0.000000
DURASI(12, 4)	105.6000	0.000000
DURASI(12, 5)	118.8000	0.000000
DURASI(12, 6)	117.6000	0.000000
DURASI(12, 7)	118.8000	0.000000
DURASI(12, 8)	69.00000	0.000000
DURASI(12, 9)	97.08000	0.000000
DURASI(12, 10)	174.0000	0.000000

DURASI(12, 11)	172.8000	0.000000
DURASI(12, 12)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 5* analisis sensitivitas skenario 4

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..11/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 660 780 540 540 540 540 540 540;
tutup = 1020 660 1260 780 900 1260 1260 1260 1260 1260 1260;
```

D =

```
!ritel
!0      16      19      20      21      39      40      41      42      43
      49;
0      49.3    161     160     160     312     316     321     321     320
      323     !0;
49.3   0       126     125     125     277     281     287     287     285
      289     !16;
161    126     0       5.4     1.7     171     175     180     181     179
      182     !19;
160    125     5.4     0       3.1     169     173     179     179     177
      180     !20;
160    125     1.7     3.1     0       169     173     179     179     177
      180     !21;
312    277     171     169     169     0       4       10      10      9      14
      !39;
316    281     175     173     173     4       0       9.5     9.8     8.1
      13.2    !40;
```

```

321  287  180  179  179  10  9.5  0  0.9  1.9  9.5
      !41;
321  287  181  179  179  10  9.8  0.9  0  1.7
      10.3  !42;
320  285  179  177  177  9  8.1  1.9  1.7  0
      11.1  !43;
323  289  182  180  180  14  13.2  9.5  10.3  11.1  0;
      !49;

```

```

durasi =
0      59.16 193.2 192  192  374.4 379.2 385.2 385.2 384
      387.6
59.16 0      151.2 150  150  332.4 337.2 344.4 344.4 342
      346.8
193.2 151.2 0      6.48 2.04 205.2 210  216  217.2 214.8
      218.4
192  150  6.48 0      3.72 202.8 207.6 214.8 214.8 212.4
      216
192  150  2.04 3.72 0      202.8 207.6 214.8 214.8 212.4
      216
374.4 332.4 205.2 202.8 202.8 0      4.8  12  12  10.8
      16.8
379.2 337.2 210  207.6 207.6 4.8  0      11.4  11.76 9.72
      15.84
385.2 344.4 216  214.8 214.8 12  11.4  0  1.08 2.28
      11.4
385.2 344.4 217.2 214.8 214.8 12  11.76 1.08 0  2.04
      12.36
384  342  214.8 212.4 212.4 10.8  9.72 2.28 2.04 0
      13.32
387.6 346.8 218.4 216  216  16.8  15.84 11.4 12.36 13.32 0;

```

```

Bongkar= 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;
MIN =

```

```

        @SUM (ritel(i) :
                @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
        @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
        @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
        @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
        @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
        @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
        @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 5* analisis sensitivitas skenario 4

Global optimal solution found.

Objective value:	697.3000
Objective bound:	697.3000
Infeasibilities:	0.000000
Extended solver steps:	679
Total solver iterations:	5932
Elapsed runtime seconds:	0.76

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 49.3 km
 rute pengiriman dari ritel 2 ke ritel 4 sebesar 125 km
 rute pengiriman dari ritel 3 ke ritel 6 sebesar 171 km
 rute pengiriman dari ritel 4 ke ritel 5 sebesar 3.1 km
 rute pengiriman dari ritel 5 ke ritel 3 sebesar 1.7 km
 rute pengiriman dari ritel 6 ke ritel 7 sebesar 4 km
 rute pengiriman dari ritel 7 ke ritel 10 sebesar 8.1 km
 rute pengiriman dari ritel 8 ke ritel 11 sebesar 9.5 km
 rute pengiriman dari ritel 9 ke ritel 8 sebesar 0.9 km
 rute pengiriman dari ritel 10 ke ritel 9 sebesar 1.7 km
 rute pengiriman dari ritel 11 ke ritel 1 sebesar 323 km

Model Class: MILP

Total variables:	132
Nonlinear variables:	0
Integer variables:	121
Total constraints:	154
Nonlinear constraints:	0
Total nonzeros:	780
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000

BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	660.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	780.0000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
T(1)	1647.600	0.000000
T(2)	540.0000	0.000000
T(3)	812.0400	0.000000
T(4)	720.0000	0.000000
T(5)	780.0000	0.000000
T(6)	1047.240	0.000000
T(7)	1082.040	0.000000
T(8)	1184.880	0.000000
T(9)	1153.800	0.000000
T(10)	1121.760	0.000000
T(11)	1226.280	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	49.30000
X(1, 3)	0.000000	161.0000

X(1, 4)	0.000000	160.0000
X(1, 5)	0.000000	160.0000
X(1, 6)	0.000000	312.0000
X(1, 7)	0.000000	316.0000
X(1, 8)	0.000000	321.0000
X(1, 9)	0.000000	321.0000
X(1, 10)	0.000000	320.0000
X(1, 11)	0.000000	323.0000
X(2, 1)	0.000000	49.30000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	126.0000
X(2, 4)	1.000000	125.0000
X(2, 5)	0.000000	125.0000
X(2, 6)	0.000000	277.0000
X(2, 7)	0.000000	281.0000
X(2, 8)	0.000000	287.0000
X(2, 9)	0.000000	287.0000
X(2, 10)	0.000000	285.0000
X(2, 11)	0.000000	289.0000
X(3, 1)	0.000000	161.0000
X(3, 2)	0.000000	126.0000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	5.400000
X(3, 5)	0.000000	1.700000
X(3, 6)	1.000000	171.0000
X(3, 7)	0.000000	175.0000
X(3, 8)	0.000000	180.0000
X(3, 9)	0.000000	181.0000
X(3, 10)	0.000000	179.0000
X(3, 11)	0.000000	182.0000
X(4, 1)	0.000000	160.0000
X(4, 2)	0.000000	125.0000
X(4, 3)	0.000000	5.400000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	3.100000
X(4, 6)	0.000000	169.0000
X(4, 7)	0.000000	173.0000
X(4, 8)	0.000000	179.0000
X(4, 9)	0.000000	179.0000
X(4, 10)	0.000000	177.0000
X(4, 11)	0.000000	180.0000
X(5, 1)	0.000000	160.0000
X(5, 2)	0.000000	125.0000
X(5, 3)	1.000000	1.700000

X(5, 4)	0.000000	3.100000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	169.0000
X(5, 7)	0.000000	173.0000
X(5, 8)	0.000000	179.0000
X(5, 9)	0.000000	179.0000
X(5, 10)	0.000000	177.0000
X(5, 11)	0.000000	180.0000
X(6, 1)	0.000000	312.0000
X(6, 2)	0.000000	277.0000
X(6, 3)	0.000000	171.0000
X(6, 4)	0.000000	169.0000
X(6, 5)	0.000000	169.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	1.000000	4.000000
X(6, 8)	0.000000	10.00000
X(6, 9)	0.000000	10.00000
X(6, 10)	0.000000	9.000000
X(6, 11)	0.000000	14.00000
X(7, 1)	0.000000	316.0000
X(7, 2)	0.000000	281.0000
X(7, 3)	0.000000	175.0000
X(7, 4)	0.000000	173.0000
X(7, 5)	0.000000	173.0000
X(7, 6)	0.000000	4.000000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	9.500000
X(7, 9)	0.000000	9.800000
X(7, 10)	1.000000	8.100000
X(7, 11)	0.000000	13.20000
X(8, 1)	0.000000	321.0000
X(8, 2)	0.000000	287.0000
X(8, 3)	0.000000	180.0000
X(8, 4)	0.000000	179.0000
X(8, 5)	0.000000	179.0000
X(8, 6)	0.000000	10.00000
X(8, 7)	0.000000	9.500000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	0.9000000
X(8, 10)	0.000000	1.900000
X(8, 11)	1.000000	9.500000
X(9, 1)	0.000000	321.0000
X(9, 2)	0.000000	287.0000
X(9, 3)	0.000000	181.0000

X(9, 4)	0.000000	179.0000
X(9, 5)	0.000000	179.0000
X(9, 6)	0.000000	10.00000
X(9, 7)	0.000000	9.800000
X(9, 8)	1.000000	0.9000000
X(9, 9)	0.000000	0.000000
X(9, 10)	0.000000	1.700000
X(9, 11)	0.000000	10.30000
X(10, 1)	0.000000	320.0000
X(10, 2)	0.000000	285.0000
X(10, 3)	0.000000	179.0000
X(10, 4)	0.000000	177.0000
X(10, 5)	0.000000	177.0000
X(10, 6)	0.000000	9.000000
X(10, 7)	0.000000	8.100000
X(10, 8)	0.000000	1.900000
X(10, 9)	1.000000	1.700000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	11.10000
X(11, 1)	1.000000	323.0000
X(11, 2)	0.000000	289.0000
X(11, 3)	0.000000	182.0000
X(11, 4)	0.000000	180.0000
X(11, 5)	0.000000	180.0000
X(11, 6)	0.000000	14.00000
X(11, 7)	0.000000	13.20000
X(11, 8)	0.000000	9.500000
X(11, 9)	0.000000	10.30000
X(11, 10)	0.000000	11.10000
X(11, 11)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	49.30000	0.000000
D(1, 3)	161.0000	0.000000
D(1, 4)	160.0000	0.000000
D(1, 5)	160.0000	0.000000
D(1, 6)	312.0000	0.000000
D(1, 7)	316.0000	0.000000
D(1, 8)	321.0000	0.000000
D(1, 9)	321.0000	0.000000
D(1, 10)	320.0000	0.000000
D(1, 11)	323.0000	0.000000
D(2, 1)	49.30000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	126.0000	0.000000

D(2, 4)	125.0000	0.000000
D(2, 5)	125.0000	0.000000
D(2, 6)	277.0000	0.000000
D(2, 7)	281.0000	0.000000
D(2, 8)	287.0000	0.000000
D(2, 9)	287.0000	0.000000
D(2, 10)	285.0000	0.000000
D(2, 11)	289.0000	0.000000
D(3, 1)	161.0000	0.000000
D(3, 2)	126.0000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	5.400000	0.000000
D(3, 5)	1.700000	0.000000
D(3, 6)	171.0000	0.000000
D(3, 7)	175.0000	0.000000
D(3, 8)	180.0000	0.000000
D(3, 9)	181.0000	0.000000
D(3, 10)	179.0000	0.000000
D(3, 11)	182.0000	0.000000
D(4, 1)	160.0000	0.000000
D(4, 2)	125.0000	0.000000
D(4, 3)	5.400000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	3.100000	0.000000
D(4, 6)	169.0000	0.000000
D(4, 7)	173.0000	0.000000
D(4, 8)	179.0000	0.000000
D(4, 9)	179.0000	0.000000
D(4, 10)	177.0000	0.000000
D(4, 11)	180.0000	0.000000
D(5, 1)	160.0000	0.000000
D(5, 2)	125.0000	0.000000
D(5, 3)	1.700000	0.000000
D(5, 4)	3.100000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	169.0000	0.000000
D(5, 7)	173.0000	0.000000
D(5, 8)	179.0000	0.000000
D(5, 9)	179.0000	0.000000
D(5, 10)	177.0000	0.000000
D(5, 11)	180.0000	0.000000
D(6, 1)	312.0000	0.000000
D(6, 2)	277.0000	0.000000
D(6, 3)	171.0000	0.000000

D(6, 4)	169.0000	0.000000
D(6, 5)	169.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	4.000000	0.000000
D(6, 8)	10.00000	0.000000
D(6, 9)	10.00000	0.000000
D(6, 10)	9.000000	0.000000
D(6, 11)	14.00000	0.000000
D(7, 1)	316.0000	0.000000
D(7, 2)	281.0000	0.000000
D(7, 3)	175.0000	0.000000
D(7, 4)	173.0000	0.000000
D(7, 5)	173.0000	0.000000
D(7, 6)	4.000000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	9.500000	0.000000
D(7, 9)	9.800000	0.000000
D(7, 10)	8.100000	0.000000
D(7, 11)	13.20000	0.000000
D(8, 1)	321.0000	0.000000
D(8, 2)	287.0000	0.000000
D(8, 3)	180.0000	0.000000
D(8, 4)	179.0000	0.000000
D(8, 5)	179.0000	0.000000
D(8, 6)	10.00000	0.000000
D(8, 7)	9.500000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	0.9000000	0.000000
D(8, 10)	1.900000	0.000000
D(8, 11)	9.500000	0.000000
D(9, 1)	321.0000	0.000000
D(9, 2)	287.0000	0.000000
D(9, 3)	181.0000	0.000000
D(9, 4)	179.0000	0.000000
D(9, 5)	179.0000	0.000000
D(9, 6)	10.00000	0.000000
D(9, 7)	9.800000	0.000000
D(9, 8)	0.9000000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	1.700000	0.000000
D(9, 11)	10.30000	0.000000
D(10, 1)	320.0000	0.000000
D(10, 2)	285.0000	0.000000
D(10, 3)	179.0000	0.000000

D(10, 4)	177.0000	0.000000
D(10, 5)	177.0000	0.000000
D(10, 6)	9.000000	0.000000
D(10, 7)	8.100000	0.000000
D(10, 8)	1.900000	0.000000
D(10, 9)	1.700000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	11.10000	0.000000
D(11, 1)	323.0000	0.000000
D(11, 2)	289.0000	0.000000
D(11, 3)	182.0000	0.000000
D(11, 4)	180.0000	0.000000
D(11, 5)	180.0000	0.000000
D(11, 6)	14.00000	0.000000
D(11, 7)	13.20000	0.000000
D(11, 8)	9.500000	0.000000
D(11, 9)	10.30000	0.000000
D(11, 10)	11.10000	0.000000
D(11, 11)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	59.16000	0.000000
DURASI(1, 3)	193.2000	0.000000
DURASI(1, 4)	192.0000	0.000000
DURASI(1, 5)	192.0000	0.000000
DURASI(1, 6)	374.4000	0.000000
DURASI(1, 7)	379.2000	0.000000
DURASI(1, 8)	385.2000	0.000000
DURASI(1, 9)	385.2000	0.000000
DURASI(1, 10)	384.0000	0.000000
DURASI(1, 11)	387.6000	0.000000
DURASI(2, 1)	59.16000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	151.2000	0.000000
DURASI(2, 4)	150.0000	0.000000
DURASI(2, 5)	150.0000	0.000000
DURASI(2, 6)	332.4000	0.000000
DURASI(2, 7)	337.2000	0.000000
DURASI(2, 8)	344.4000	0.000000
DURASI(2, 9)	344.4000	0.000000
DURASI(2, 10)	342.0000	0.000000
DURASI(2, 11)	346.8000	0.000000
DURASI(3, 1)	193.2000	0.000000
DURASI(3, 2)	151.2000	0.000000
DURASI(3, 3)	0.000000	0.000000

DURASI(3, 4)	6.480000	0.000000
DURASI(3, 5)	2.040000	0.000000
DURASI(3, 6)	205.2000	0.000000
DURASI(3, 7)	210.0000	0.000000
DURASI(3, 8)	216.0000	0.000000
DURASI(3, 9)	217.2000	0.000000
DURASI(3, 10)	214.8000	0.000000
DURASI(3, 11)	218.4000	0.000000
DURASI(4, 1)	192.0000	0.000000
DURASI(4, 2)	150.0000	0.000000
DURASI(4, 3)	6.480000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	3.720000	0.000000
DURASI(4, 6)	202.8000	0.000000
DURASI(4, 7)	207.6000	0.000000
DURASI(4, 8)	214.8000	0.000000
DURASI(4, 9)	214.8000	0.000000
DURASI(4, 10)	212.4000	0.000000
DURASI(4, 11)	216.0000	0.000000
DURASI(5, 1)	192.0000	0.000000
DURASI(5, 2)	150.0000	0.000000
DURASI(5, 3)	2.040000	0.000000
DURASI(5, 4)	3.720000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	202.8000	0.000000
DURASI(5, 7)	207.6000	0.000000
DURASI(5, 8)	214.8000	0.000000
DURASI(5, 9)	214.8000	0.000000
DURASI(5, 10)	212.4000	0.000000
DURASI(5, 11)	216.0000	0.000000
DURASI(6, 1)	374.4000	0.000000
DURASI(6, 2)	332.4000	0.000000
DURASI(6, 3)	205.2000	0.000000
DURASI(6, 4)	202.8000	0.000000
DURASI(6, 5)	202.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.800000	0.000000
DURASI(6, 8)	12.00000	0.000000
DURASI(6, 9)	12.00000	0.000000
DURASI(6, 10)	10.80000	0.000000
DURASI(6, 11)	16.80000	0.000000
DURASI(7, 1)	379.2000	0.000000
DURASI(7, 2)	337.2000	0.000000
DURASI(7, 3)	210.0000	0.000000

DURASI(7, 4)	207.6000	0.000000
DURASI(7, 5)	207.6000	0.000000
DURASI(7, 6)	4.800000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	11.40000	0.000000
DURASI(7, 9)	11.76000	0.000000
DURASI(7, 10)	9.720000	0.000000
DURASI(7, 11)	15.84000	0.000000
DURASI(8, 1)	385.2000	0.000000
DURASI(8, 2)	344.4000	0.000000
DURASI(8, 3)	216.0000	0.000000
DURASI(8, 4)	214.8000	0.000000
DURASI(8, 5)	214.8000	0.000000
DURASI(8, 6)	12.00000	0.000000
DURASI(8, 7)	11.40000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	1.080000	0.000000
DURASI(8, 10)	2.280000	0.000000
DURASI(8, 11)	11.40000	0.000000
DURASI(9, 1)	385.2000	0.000000
DURASI(9, 2)	344.4000	0.000000
DURASI(9, 3)	217.2000	0.000000
DURASI(9, 4)	214.8000	0.000000
DURASI(9, 5)	214.8000	0.000000
DURASI(9, 6)	12.00000	0.000000
DURASI(9, 7)	11.76000	0.000000
DURASI(9, 8)	1.080000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	2.040000	0.000000
DURASI(9, 11)	12.36000	0.000000
DURASI(10, 1)	384.0000	0.000000
DURASI(10, 2)	342.0000	0.000000
DURASI(10, 3)	214.8000	0.000000
DURASI(10, 4)	212.4000	0.000000
DURASI(10, 5)	212.4000	0.000000
DURASI(10, 6)	10.80000	0.000000
DURASI(10, 7)	9.720000	0.000000
DURASI(10, 8)	2.280000	0.000000
DURASI(10, 9)	2.040000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	13.32000	0.000000
DURASI(11, 1)	387.6000	0.000000
DURASI(11, 2)	346.8000	0.000000
DURASI(11, 3)	218.4000	0.000000

DURASI(11, 4)	216.0000	0.000000
DURASI(11, 5)	216.0000	0.000000
DURASI(11, 6)	16.80000	0.000000
DURASI(11, 7)	15.84000	0.000000
DURASI(11, 8)	11.40000	0.000000
DURASI(11, 9)	12.36000	0.000000
DURASI(11, 10)	13.32000	0.000000
DURASI(11, 11)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 6* analisis sensitivitas skenario 4

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..8/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 900 780 660;
tutup = 1020 660 1260 1260 1260 1020 900 780;
```

D =

```
!ritel
!0    4    17    18    22    23    24    28;
0    12.3  115  115  193  102  93  157  !0;
12.3  0    120  121  198  83.1  75.1  148  !4;
115  120  0    1.1  96.1  83  96.4  45.8  !17;
115  121  1.1  0    95  84.5  97.8  46  !18;
193  198  96.1  95  0  194  266  103  !22;
102  83.1  83  84.5  194  0  14.9  75.3  !23;
93  75.1  96.4  97.8  266  14.9  0  76.6  !24;
157  148  45.8  46  103  75.3  76.6  0;  !28;
```

durasi =

```
0    14.76  138  138  231.6  122.4  111.6  188.4
14.76  0    144  145.2  237.6  99.72  90.12  177.6
138  144  0    1.32  115.32  99.6  115.68  54.96
138  145.2  1.32  0    114  101.4  117.36  55.2
```



```

231.6 237.6 115.32      114    0      232.8 319.2 123.6
122.4 99.72 99.6   101.4 232.8 0      17.88 90.36
111.6 90.12 115.68      117.36      319.2 17.88 0      91.92
188.4 177.6 54.96 55.2  123.6 90.36 91.92 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

```

```

!Fungsi batasan;

```

```

!setiap ritel dikunjungi satu kali;

```

```

@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

```

```

!perjalanan diawali dari depot;

```

```

@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

```

```

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

```

```

!pelaksanaan;

```

```

@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

```

```

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

- Hasil dari *solution report* pada *cluster 6* analisis sensitivitas skenario 4

Global optimal solution found.

Objective value:	623.9000
Objective bound:	623.9000
Infeasibilities:	0.000000
Extended solver steps:	0
Total solver iterations:	225
Elapsed runtime seconds:	0.13

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 12.3 km
rute pengiriman dari ritel 2 ke ritel 8 sebesar 148 km
rute pengiriman dari ritel 3 ke ritel 4 sebesar 1.1 km
rute pengiriman dari ritel 4 ke ritel 5 sebesar 95 km
rute pengiriman dari ritel 5 ke ritel 1 sebesar 193 km
rute pengiriman dari ritel 6 ke ritel 3 sebesar 83 km
rute pengiriman dari ritel 7 ke ritel 6 sebesar 14.9 km
rute pengiriman dari ritel 8 ke ritel 7 sebesar 76.59999999999999 km

Model Class: MILP

Total variables:	72
Nonlinear variables:	0

Integer variables: 64
 Total constraints: 88
 Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	900.0000	0.000000
BUKA(7)	780.0000	0.000000
BUKA(8)	660.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1020.000	0.000000
TUTUP(7)	900.0000	0.000000
TUTUP(8)	780.0000	0.000000
T(1)	1491.600	0.000000
T(2)	540.0000	0.000000
T(3)	1047.000	0.000000
T(4)	1078.320	0.000000
T(5)	1230.000	0.000000
T(6)	917.4000	0.000000
T(7)	869.5200	0.000000
T(8)	747.6000	0.000000

X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	12.30000
X(1, 3)	0.000000	115.0000
X(1, 4)	0.000000	115.0000
X(1, 5)	0.000000	193.0000
X(1, 6)	0.000000	102.0000
X(1, 7)	0.000000	93.00000
X(1, 8)	0.000000	157.0000
X(2, 1)	0.000000	12.30000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	120.0000
X(2, 4)	0.000000	121.0000
X(2, 5)	0.000000	198.0000
X(2, 6)	0.000000	83.10000
X(2, 7)	0.000000	75.10000
X(2, 8)	1.000000	148.0000
X(3, 1)	0.000000	115.0000
X(3, 2)	0.000000	120.0000
X(3, 3)	0.000000	0.000000
X(3, 4)	1.000000	1.100000
X(3, 5)	0.000000	96.10000
X(3, 6)	0.000000	83.00000
X(3, 7)	0.000000	96.40000
X(3, 8)	0.000000	45.80000
X(4, 1)	0.000000	115.0000
X(4, 2)	0.000000	121.0000
X(4, 3)	0.000000	1.100000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	95.00000
X(4, 6)	0.000000	84.50000
X(4, 7)	0.000000	97.80000
X(4, 8)	0.000000	46.00000
X(5, 1)	1.000000	193.0000
X(5, 2)	0.000000	198.0000
X(5, 3)	0.000000	96.10000
X(5, 4)	0.000000	95.00000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	194.0000
X(5, 7)	0.000000	266.0000
X(5, 8)	0.000000	103.0000
X(6, 1)	0.000000	102.0000
X(6, 2)	0.000000	83.10000
X(6, 3)	1.000000	83.00000
X(6, 4)	0.000000	84.50000

X(6, 5)	0.000000	194.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	14.90000
X(6, 8)	0.000000	75.30000
X(7, 1)	0.000000	93.00000
X(7, 2)	0.000000	75.10000
X(7, 3)	0.000000	96.40000
X(7, 4)	0.000000	97.80000
X(7, 5)	0.000000	266.0000
X(7, 6)	1.000000	14.90000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	76.60000
X(8, 1)	0.000000	157.0000
X(8, 2)	0.000000	148.0000
X(8, 3)	0.000000	45.80000
X(8, 4)	0.000000	46.00000
X(8, 5)	0.000000	103.0000
X(8, 6)	0.000000	75.30000
X(8, 7)	1.000000	76.60000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	12.30000	0.000000
D(1, 3)	115.0000	0.000000
D(1, 4)	115.0000	0.000000
D(1, 5)	193.0000	0.000000
D(1, 6)	102.0000	0.000000
D(1, 7)	93.00000	0.000000
D(1, 8)	157.0000	0.000000
D(2, 1)	12.30000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	120.0000	0.000000
D(2, 4)	121.0000	0.000000
D(2, 5)	198.0000	0.000000
D(2, 6)	83.10000	0.000000
D(2, 7)	75.10000	0.000000
D(2, 8)	148.0000	0.000000
D(3, 1)	115.0000	0.000000
D(3, 2)	120.0000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	1.100000	0.000000
D(3, 5)	96.10000	0.000000
D(3, 6)	83.00000	0.000000
D(3, 7)	96.40000	0.000000
D(3, 8)	45.80000	0.000000

D(4, 1)	115.0000	0.000000
D(4, 2)	121.0000	0.000000
D(4, 3)	1.100000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	95.00000	0.000000
D(4, 6)	84.50000	0.000000
D(4, 7)	97.80000	0.000000
D(4, 8)	46.00000	0.000000
D(5, 1)	193.0000	0.000000
D(5, 2)	198.0000	0.000000
D(5, 3)	96.10000	0.000000
D(5, 4)	95.00000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	194.0000	0.000000
D(5, 7)	266.0000	0.000000
D(5, 8)	103.0000	0.000000
D(6, 1)	102.0000	0.000000
D(6, 2)	83.10000	0.000000
D(6, 3)	83.00000	0.000000
D(6, 4)	84.50000	0.000000
D(6, 5)	194.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	14.90000	0.000000
D(6, 8)	75.30000	0.000000
D(7, 1)	93.00000	0.000000
D(7, 2)	75.10000	0.000000
D(7, 3)	96.40000	0.000000
D(7, 4)	97.80000	0.000000
D(7, 5)	266.0000	0.000000
D(7, 6)	14.90000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	76.60000	0.000000
D(8, 1)	157.0000	0.000000
D(8, 2)	148.0000	0.000000
D(8, 3)	45.80000	0.000000
D(8, 4)	46.00000	0.000000
D(8, 5)	103.0000	0.000000
D(8, 6)	75.30000	0.000000
D(8, 7)	76.60000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	14.76000	0.000000
DURASI(1, 3)	138.0000	0.000000
DURASI(1, 4)	138.0000	0.000000

DURASI(1, 5)	231.6000	0.000000
DURASI(1, 6)	122.4000	0.000000
DURASI(1, 7)	111.6000	0.000000
DURASI(1, 8)	188.4000	0.000000
DURASI(2, 1)	14.76000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	144.0000	0.000000
DURASI(2, 4)	145.2000	0.000000
DURASI(2, 5)	237.6000	0.000000
DURASI(2, 6)	99.72000	0.000000
DURASI(2, 7)	90.12000	0.000000
DURASI(2, 8)	177.6000	0.000000
DURASI(3, 1)	138.0000	0.000000
DURASI(3, 2)	144.0000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	1.320000	0.000000
DURASI(3, 5)	115.3200	0.000000
DURASI(3, 6)	99.60000	0.000000
DURASI(3, 7)	115.6800	0.000000
DURASI(3, 8)	54.96000	0.000000
DURASI(4, 1)	138.0000	0.000000
DURASI(4, 2)	145.2000	0.000000
DURASI(4, 3)	1.320000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	114.0000	0.000000
DURASI(4, 6)	101.4000	0.000000
DURASI(4, 7)	117.3600	0.000000
DURASI(4, 8)	55.20000	0.000000
DURASI(5, 1)	231.6000	0.000000
DURASI(5, 2)	237.6000	0.000000
DURASI(5, 3)	115.3200	0.000000
DURASI(5, 4)	114.0000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	232.8000	0.000000
DURASI(5, 7)	319.2000	0.000000
DURASI(5, 8)	123.6000	0.000000
DURASI(6, 1)	122.4000	0.000000
DURASI(6, 2)	99.72000	0.000000
DURASI(6, 3)	99.60000	0.000000
DURASI(6, 4)	101.4000	0.000000
DURASI(6, 5)	232.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	17.88000	0.000000
DURASI(6, 8)	90.36000	0.000000

DURASI(7, 1)	111.6000	0.000000
DURASI(7, 2)	90.12000	0.000000
DURASI(7, 3)	115.6800	0.000000
DURASI(7, 4)	117.3600	0.000000
DURASI(7, 5)	319.2000	0.000000
DURASI(7, 6)	17.88000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	91.92000	0.000000
DURASI(8, 1)	188.4000	0.000000
DURASI(8, 2)	177.6000	0.000000
DURASI(8, 3)	54.96000	0.000000
DURASI(8, 4)	55.20000	0.000000
DURASI(8, 5)	123.6000	0.000000
DURASI(8, 6)	90.36000	0.000000
DURASI(8, 7)	91.92000	0.000000
DURASI(8, 8)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 7* analisis sensitivitas skenario 4

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..8/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 660 780 540 540 540;
tutup = 1020 660 1260 780 900 1260 1260 1260;
```

D =

```
!ritel
!0  12  13  14  15  25  26  27;
0   146 190 192 194 92.2 93.8 93  !0;
146 0   63.4 64.1 66.9 157 159 158 !12;
190 63.4 0   3.2 5.9 200 201 201 !13;
192 64.1 3.2 0   2.9 203 205 204 !14;
194 66.9 5.9 2.9 0   204 206 205 !15;
92.2 157 200 203 204 0   3.1 1.4 !25;
93.8 159 201 205 206 3.1 0   4   !26;
93  158 201 204 205 1.4 4   0;   !27;
```

durasi =

```
0   175.2 228 230.4 232.8 110.64 112.56 111.6
175.2 0   76.08 76.92 80.28 188.4 190.8 189.6
228 76.08 0   3.84 7.08 240 241.2 241.2
230.4 76.92 3.84 0   3.48 243.6 246 244.8
```

```

232.8 80.28 7.08 3.48 0 244.8 247.2 246
110.64 188.4 240 243.6 244.8 0 3.72 1.68
112.56 190.8 241.2 246 247.2 3.72 0 4.8
111.6 189.6 241.2 244.8 246 1.68 4.8 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

```

```

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

- Hasil dari *solution report* pada *cluster 7* analisis sensitivitas skenario 4

Global optimal solution found.

Objective value:	517.4000
Objective bound:	517.4000
Infeasibilities:	0.000000
Extended solver steps:	0
Total solver iterations:	532
Elapsed runtime seconds:	0.15

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 146 km
rute pengiriman dari ritel 2 ke ritel 4 sebesar 64.09999999999999 km
rute pengiriman dari ritel 3 ke ritel 7 sebesar 201 km
rute pengiriman dari ritel 4 ke ritel 5 sebesar 2.9 km
rute pengiriman dari ritel 5 ke ritel 3 sebesar 5.9 km
rute pengiriman dari ritel 6 ke ritel 8 sebesar 1.4 km
rute pengiriman dari ritel 7 ke ritel 6 sebesar 3.1 km
rute pengiriman dari ritel 8 ke ritel 1 sebesar 93 km

Model Class: MILP

Total variables:	72
Nonlinear variables:	0

Integer variables: 64
 Total constraints: 88
 Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	660.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	780.0000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
T(1)	1488.000	0.000000
T(2)	540.0000	0.000000
T(3)	817.0800	0.000000
T(4)	746.5200	0.000000
T(5)	780.0000	0.000000
T(6)	1198.320	0.000000
T(7)	1164.600	0.000000
T(8)	1230.000	0.000000

X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	146.0000
X(1, 3)	0.000000	190.0000
X(1, 4)	0.000000	192.0000
X(1, 5)	0.000000	194.0000
X(1, 6)	0.000000	92.20000
X(1, 7)	0.000000	93.80000
X(1, 8)	0.000000	93.00000
X(2, 1)	0.000000	146.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	63.40000
X(2, 4)	1.000000	64.10000
X(2, 5)	0.000000	66.90000
X(2, 6)	0.000000	157.0000
X(2, 7)	0.000000	159.0000
X(2, 8)	0.000000	158.0000
X(3, 1)	0.000000	190.0000
X(3, 2)	0.000000	63.40000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	3.200000
X(3, 5)	0.000000	5.900000
X(3, 6)	0.000000	200.0000
X(3, 7)	1.000000	201.0000
X(3, 8)	0.000000	201.0000
X(4, 1)	0.000000	192.0000
X(4, 2)	0.000000	64.10000
X(4, 3)	0.000000	3.200000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	2.900000
X(4, 6)	0.000000	203.0000
X(4, 7)	0.000000	205.0000
X(4, 8)	0.000000	204.0000
X(5, 1)	0.000000	194.0000
X(5, 2)	0.000000	66.90000
X(5, 3)	1.000000	5.900000
X(5, 4)	0.000000	2.900000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	204.0000
X(5, 7)	0.000000	206.0000
X(5, 8)	0.000000	205.0000
X(6, 1)	0.000000	92.20000
X(6, 2)	0.000000	157.0000
X(6, 3)	0.000000	200.0000
X(6, 4)	0.000000	203.0000

X(6, 5)	0.000000	204.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.100000
X(6, 8)	1.000000	1.400000
X(7, 1)	0.000000	93.80000
X(7, 2)	0.000000	159.0000
X(7, 3)	0.000000	201.0000
X(7, 4)	0.000000	205.0000
X(7, 5)	0.000000	206.0000
X(7, 6)	1.000000	3.100000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	4.000000
X(8, 1)	1.000000	93.00000
X(8, 2)	0.000000	158.0000
X(8, 3)	0.000000	201.0000
X(8, 4)	0.000000	204.0000
X(8, 5)	0.000000	205.0000
X(8, 6)	0.000000	1.400000
X(8, 7)	0.000000	4.000000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	146.0000	0.000000
D(1, 3)	190.0000	0.000000
D(1, 4)	192.0000	0.000000
D(1, 5)	194.0000	0.000000
D(1, 6)	92.20000	0.000000
D(1, 7)	93.80000	0.000000
D(1, 8)	93.00000	0.000000
D(2, 1)	146.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	63.40000	0.000000
D(2, 4)	64.10000	0.000000
D(2, 5)	66.90000	0.000000
D(2, 6)	157.0000	0.000000
D(2, 7)	159.0000	0.000000
D(2, 8)	158.0000	0.000000
D(3, 1)	190.0000	0.000000
D(3, 2)	63.40000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	3.200000	0.000000
D(3, 5)	5.900000	0.000000
D(3, 6)	200.0000	0.000000
D(3, 7)	201.0000	0.000000
D(3, 8)	201.0000	0.000000

D(4, 1)	192.0000	0.000000
D(4, 2)	64.10000	0.000000
D(4, 3)	3.200000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	2.900000	0.000000
D(4, 6)	203.0000	0.000000
D(4, 7)	205.0000	0.000000
D(4, 8)	204.0000	0.000000
D(5, 1)	194.0000	0.000000
D(5, 2)	66.90000	0.000000
D(5, 3)	5.900000	0.000000
D(5, 4)	2.900000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	204.0000	0.000000
D(5, 7)	206.0000	0.000000
D(5, 8)	205.0000	0.000000
D(6, 1)	92.20000	0.000000
D(6, 2)	157.0000	0.000000
D(6, 3)	200.0000	0.000000
D(6, 4)	203.0000	0.000000
D(6, 5)	204.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.100000	0.000000
D(6, 8)	1.400000	0.000000
D(7, 1)	93.80000	0.000000
D(7, 2)	159.0000	0.000000
D(7, 3)	201.0000	0.000000
D(7, 4)	205.0000	0.000000
D(7, 5)	206.0000	0.000000
D(7, 6)	3.100000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	4.000000	0.000000
D(8, 1)	93.00000	0.000000
D(8, 2)	158.0000	0.000000
D(8, 3)	201.0000	0.000000
D(8, 4)	204.0000	0.000000
D(8, 5)	205.0000	0.000000
D(8, 6)	1.400000	0.000000
D(8, 7)	4.000000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	175.2000	0.000000
DURASI(1, 3)	228.0000	0.000000
DURASI(1, 4)	230.4000	0.000000

DURASI(1, 5)	232.8000	0.000000
DURASI(1, 6)	110.6400	0.000000
DURASI(1, 7)	112.5600	0.000000
DURASI(1, 8)	111.6000	0.000000
DURASI(2, 1)	175.2000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	76.08000	0.000000
DURASI(2, 4)	76.92000	0.000000
DURASI(2, 5)	80.28000	0.000000
DURASI(2, 6)	188.4000	0.000000
DURASI(2, 7)	190.8000	0.000000
DURASI(2, 8)	189.6000	0.000000
DURASI(3, 1)	228.0000	0.000000
DURASI(3, 2)	76.08000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	3.840000	0.000000
DURASI(3, 5)	7.080000	0.000000
DURASI(3, 6)	240.0000	0.000000
DURASI(3, 7)	241.2000	0.000000
DURASI(3, 8)	241.2000	0.000000
DURASI(4, 1)	230.4000	0.000000
DURASI(4, 2)	76.92000	0.000000
DURASI(4, 3)	3.840000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	3.480000	0.000000
DURASI(4, 6)	243.6000	0.000000
DURASI(4, 7)	246.0000	0.000000
DURASI(4, 8)	244.8000	0.000000
DURASI(5, 1)	232.8000	0.000000
DURASI(5, 2)	80.28000	0.000000
DURASI(5, 3)	7.080000	0.000000
DURASI(5, 4)	3.480000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	244.8000	0.000000
DURASI(5, 7)	247.2000	0.000000
DURASI(5, 8)	246.0000	0.000000
DURASI(6, 1)	110.6400	0.000000
DURASI(6, 2)	188.4000	0.000000
DURASI(6, 3)	240.0000	0.000000
DURASI(6, 4)	243.6000	0.000000
DURASI(6, 5)	244.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	3.720000	0.000000
DURASI(6, 8)	1.680000	0.000000

DURASI(7, 1)	112.5600	0.000000
DURASI(7, 2)	190.8000	0.000000
DURASI(7, 3)	241.2000	0.000000
DURASI(7, 4)	246.0000	0.000000
DURASI(7, 5)	247.2000	0.000000
DURASI(7, 6)	3.720000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	4.800000	0.000000
DURASI(8, 1)	111.6000	0.000000
DURASI(8, 2)	189.6000	0.000000
DURASI(8, 3)	241.2000	0.000000
DURASI(8, 4)	244.8000	0.000000
DURASI(8, 5)	246.0000	0.000000
DURASI(8, 6)	1.680000	0.000000
DURASI(8, 7)	4.800000	0.000000
DURASI(8, 8)	0.000000	0.000000

Lampiran 15 (Pemrograman Lingo Untuk Analisis Sensitivitas Skenario 5)

- Hasil dari *solution report* pada *cluster 1* analisis sensitivitas skenario 5

Global optimal solution found.

Objective value: 56.20000
 Objective bound: 56.20000
 Infeasibilities: 0.000000
 Extended solver steps: 0
 Total solver iterations: 1324
 Elapsed runtime seconds: 0.17

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 8.9 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 6.8 km
 rute pengiriman dari ritel 3 ke ritel 4 sebesar 7.9 km
 rute pengiriman dari ritel 4 ke ritel 5 sebesar 3.9 km
 rute pengiriman dari ritel 5 ke ritel 8 sebesar 3.4 km
 rute pengiriman dari ritel 6 ke ritel 7 sebesar 3.6 km
 rute pengiriman dari ritel 7 ke ritel 1 sebesar 19.2 km
 rute pengiriman dari ritel 8 ke ritel 6 sebesar 2.5 km

Model Class: MILP

Total variables: 72
 Nonlinear variables: 0
 Integer variables: 64
 Total constraints: 88
 Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000

BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	660.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	1020.000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	900.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	780.0000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	1140.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1020.000	0.000000
T(1)	1283.640	0.000000
T(2)	540.0000	0.000000
T(3)	750.0000	0.000000
T(4)	789.4800	0.000000
T(5)	870.0000	0.000000
T(6)	1020.000	0.000000
T(7)	1230.000	0.000000
T(8)	904.0800	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	8.900000
X(1, 3)	0.000000	13.60000
X(1, 4)	0.000000	19.70000
X(1, 5)	0.000000	20.70000
X(1, 6)	0.000000	21.50000
X(1, 7)	0.000000	19.20000
X(1, 8)	0.000000	18.10000
X(2, 1)	0.000000	8.900000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	6.800000
X(2, 4)	0.000000	13.30000
X(2, 5)	0.000000	14.60000
X(2, 6)	0.000000	13.10000
X(2, 7)	0.000000	10.90000
X(2, 8)	0.000000	8.700000

X(3, 1)	0.000000	13.60000
X(3, 2)	0.000000	6.800000
X(3, 3)	0.000000	0.000000
X(3, 4)	1.000000	7.900000
X(3, 5)	0.000000	10.30000
X(3, 6)	0.000000	10.50000
X(3, 7)	0.000000	8.100000
X(3, 8)	0.000000	9.400000
X(4, 1)	0.000000	19.70000
X(4, 2)	0.000000	13.30000
X(4, 3)	0.000000	7.900000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	3.900000
X(4, 6)	0.000000	4.600000
X(4, 7)	0.000000	4.600000
X(4, 8)	0.000000	5.600000
X(5, 1)	0.000000	20.70000
X(5, 2)	0.000000	14.60000
X(5, 3)	0.000000	10.30000
X(5, 4)	0.000000	3.900000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	2.600000
X(5, 7)	0.000000	5.400000
X(5, 8)	1.000000	3.400000
X(6, 1)	0.000000	21.50000
X(6, 2)	0.000000	13.10000
X(6, 3)	0.000000	10.50000
X(6, 4)	0.000000	4.600000
X(6, 5)	0.000000	2.600000
X(6, 6)	0.000000	0.000000
X(6, 7)	1.000000	3.600000
X(6, 8)	0.000000	2.500000
X(7, 1)	1.000000	19.20000
X(7, 2)	0.000000	10.90000
X(7, 3)	0.000000	8.100000
X(7, 4)	0.000000	4.600000
X(7, 5)	0.000000	5.400000
X(7, 6)	0.000000	3.600000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	2.800000
X(8, 1)	0.000000	18.10000
X(8, 2)	0.000000	8.700000
X(8, 3)	0.000000	9.400000
X(8, 4)	0.000000	5.600000

X(8, 5)	0.000000	3.400000
X(8, 6)	1.000000	2.500000
X(8, 7)	0.000000	2.800000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	8.900000	0.000000
D(1, 3)	13.60000	0.000000
D(1, 4)	19.70000	0.000000
D(1, 5)	20.70000	0.000000
D(1, 6)	21.50000	0.000000
D(1, 7)	19.20000	0.000000
D(1, 8)	18.10000	0.000000
D(2, 1)	8.900000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	6.800000	0.000000
D(2, 4)	13.30000	0.000000
D(2, 5)	14.60000	0.000000
D(2, 6)	13.10000	0.000000
D(2, 7)	10.90000	0.000000
D(2, 8)	8.700000	0.000000
D(3, 1)	13.60000	0.000000
D(3, 2)	6.800000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	7.900000	0.000000
D(3, 5)	10.30000	0.000000
D(3, 6)	10.50000	0.000000
D(3, 7)	8.100000	0.000000
D(3, 8)	9.400000	0.000000
D(4, 1)	19.70000	0.000000
D(4, 2)	13.30000	0.000000
D(4, 3)	7.900000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	3.900000	0.000000
D(4, 6)	4.600000	0.000000
D(4, 7)	4.600000	0.000000
D(4, 8)	5.600000	0.000000
D(5, 1)	20.70000	0.000000
D(5, 2)	14.60000	0.000000
D(5, 3)	10.30000	0.000000
D(5, 4)	3.900000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	2.600000	0.000000
D(5, 7)	5.400000	0.000000
D(5, 8)	3.400000	0.000000

D(6, 1)	21.50000	0.000000
D(6, 2)	13.10000	0.000000
D(6, 3)	10.50000	0.000000
D(6, 4)	4.600000	0.000000
D(6, 5)	2.600000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.600000	0.000000
D(6, 8)	2.500000	0.000000
D(7, 1)	19.20000	0.000000
D(7, 2)	10.90000	0.000000
D(7, 3)	8.100000	0.000000
D(7, 4)	4.600000	0.000000
D(7, 5)	5.400000	0.000000
D(7, 6)	3.600000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	2.800000	0.000000
D(8, 1)	18.10000	0.000000
D(8, 2)	8.700000	0.000000
D(8, 3)	9.400000	0.000000
D(8, 4)	5.600000	0.000000
D(8, 5)	3.400000	0.000000
D(8, 6)	2.500000	0.000000
D(8, 7)	2.800000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	10.68000	0.000000
DURASI(1, 3)	16.32000	0.000000
DURASI(1, 4)	23.64000	0.000000
DURASI(1, 5)	24.84000	0.000000
DURASI(1, 6)	25.80000	0.000000
DURASI(1, 7)	23.04000	0.000000
DURASI(1, 8)	21.72000	0.000000
DURASI(2, 1)	10.68000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	8.160000	0.000000
DURASI(2, 4)	15.96000	0.000000
DURASI(2, 5)	17.52000	0.000000
DURASI(2, 6)	15.72000	0.000000
DURASI(2, 7)	13.08000	0.000000
DURASI(2, 8)	10.44000	0.000000
DURASI(3, 1)	16.32000	0.000000
DURASI(3, 2)	8.160000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	9.480000	0.000000

DURASI(3, 5)	12.36000	0.000000
DURASI(3, 6)	12.60000	0.000000
DURASI(3, 7)	9.720000	0.000000
DURASI(3, 8)	11.28000	0.000000
DURASI(4, 1)	23.64000	0.000000
DURASI(4, 2)	15.96000	0.000000
DURASI(4, 3)	9.480000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	4.680000	0.000000
DURASI(4, 6)	5.520000	0.000000
DURASI(4, 7)	5.520000	0.000000
DURASI(4, 8)	6.720000	0.000000
DURASI(5, 1)	24.84000	0.000000
DURASI(5, 2)	17.52000	0.000000
DURASI(5, 3)	12.36000	0.000000
DURASI(5, 4)	4.680000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	3.120000	0.000000
DURASI(5, 7)	6.480000	0.000000
DURASI(5, 8)	4.080000	0.000000
DURASI(6, 1)	25.80000	0.000000
DURASI(6, 2)	15.72000	0.000000
DURASI(6, 3)	12.60000	0.000000
DURASI(6, 4)	5.520000	0.000000
DURASI(6, 5)	3.120000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.320000	0.000000
DURASI(6, 8)	3.000000	0.000000
DURASI(7, 1)	23.04000	0.000000
DURASI(7, 2)	13.08000	0.000000
DURASI(7, 3)	9.720000	0.000000
DURASI(7, 4)	5.520000	0.000000
DURASI(7, 5)	6.480000	0.000000
DURASI(7, 6)	4.320000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	3.360000	0.000000
DURASI(8, 1)	21.72000	0.000000
DURASI(8, 2)	10.44000	0.000000
DURASI(8, 3)	11.28000	0.000000
DURASI(8, 4)	6.720000	0.000000
DURASI(8, 5)	4.080000	0.000000
DURASI(8, 6)	3.000000	0.000000
DURASI(8, 7)	3.360000	0.000000
DURASI(8, 8)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 2* analisis sensitivitas skenario 5

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..16/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 660 540 900 780 540 1020 540 540 540
540 540 540;
tutup = 1020 660 1260 1260 780 1260 1020 900 1260 1140 1260
1260 1260 1260 1260 1260;
```

D =

```
!ritel
1   2   3   4   5   6   7   8   9   10  11
   12  13  14  15  16
!0  3   6   7   29  30  31  32  50  51  52
   53  54  55  57  60;
0   8.3 41.1 39.6 227 275 324 322 353 353
   351 348 347 347 353 435 !0;
8.3 0   24.4 33  220 268 317 315 346 346
   344 341 341 340 347 428 !3;
41.1 24.4 0   7.5 127 300 208 238 377 377
   376 372 372 372 378 459 !6;
```


39.6	33	7.5	0	133	297	215	343	374	374	
	372	369	369	368	375	456	!7;			
227	220	127	133	0	85	102	134	230	230	
	228	225	224	224	230	312	!29;			
275	268	300	297	85	0	48	50	71	65	64
	55	71	69	66	166	!30;				
324	317	208	215	102	48	0	28	87	81	80
	81	87	85	82	182	!31;				
322	315	238	343	134	50	28	0	61	55	54
	55	61	59	56	156	!32;				
353	346	377	374	230	71	87	61	0	6.7	5.9
	10	4.8	4.3	7.4	98.2	!50;				
353	346	377	374	230	65	81	55	6.7	0	1.9
	10.3	5.9	4.8	1.8	97.5	!51;				
351	344	376	372	228	64	80	54	5.9	1.9	0
	8.8	9.8	5.3	3.4	100	!52;				
348	341	372	369	225	55	81	55	10	10.3	8.8
	0	10.6	6.2	10.7	105	!53;				
347	341	372	369	224	71	87	61	4.8	5.9	9.8
	10.6	0	4.3	3.5	93.4	!54;				
347	340	372	368	224	69	85	59	4.3	4.8	5.3
	6.2	4.3	0	6.3	101	!55;				
353	347	378	375	230	66	82	56	7.4	1.8	3.4
	10.7	3.5	6.3	0	97.9	!57;				
435	428	459	456	312	166	182	156	98.2	97.5	
	100	105	93.4	101	97.9	0;	!60;			

durasi =

0	9.96	49.32	47.52	272.4	330	388.8	386.4	423.6	423.6	
	421.2	417.6	416.4	416.4	423.6	522				
9.96	0	29.28	39.6	264	321.6	380.4	378	415.2	415.2	
	412.8	409.2	409.2	408	416.4	513.6				
49.32	29.28	0	9	152.4	360	249.6	285.6	452.4	452.4	
	451.2	446.4	446.4	446.4	453.6	550.8				
47.52	39.6	9	0	159.6	356.4	258	411.6	448.8	448.8	
	446.4	442.8	442.8	441.6	450	547.2				
272.4	264	152.4	159.6	0	102	122.4	160.8	276	276	
	273.6	270	268.8	268.8	276	374.4				
330	321.6	360	356.4	102	0	57.6	60	85.2	78	
	76.8	66	85.2	82.8	79.2	199.2				
388.8	380.4	249.6	258	122.4	57.6	0	33.6	104.4	97.2	96
	97.2	104.4	102	98.4	218.4					
386.4	378	285.6	411.6	160.8	60	33.6	0	73.2	66	
	64.8	66	73.2	70.8	67.2	187.2				

```

423.6 415.2 452.4 448.8 276 85.2 104.4 73.2 0 8.04
      7.08 12 5.76 5.16 8.88 117.84
423.6 415.2 452.4 448.8 276 78 97.2 66 8.04 0
      2.28 12.36 7.08 5.76 2.16 117
421.2 412.8 451.2 446.4 273.6 76.8 96 64.8 7.08 2.28 0
      10.56 11.76 6.36 4.08 120
417.6 409.2 446.4 442.8 270 66 97.2 66 12 12.36
      10.56 0 12.72 7.44 12.84 126
416.4 409.2 446.4 442.8 268.8 85.2 104.4 73.2 5.76 7.08
      11.76 12.72 0 5.16 4.2 112.08
416.4 408 446.4 441.6 268.8 82.8 102 70.8 5.16 5.76
      6.36 7.44 5.16 0 7.56 121.2
423.6 416.4 453.6 450 276 79.2 98.4 67.2 8.88 2.16
      4.08 12.84 4.2 7.56 0 117.48
522 513.6 550.8 547.2 374.4 199.2 218.4 187.2 117.84
      117 120 126 112.08 121.2 117.48 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text () = @write("Rute yang paling optimal adalah: ",
@newline(1));

@text () = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

```

```

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) - R * (1 -
x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 2* analisis sensitivitas skenario 5

Feasible solution found.	
Objective value:	1344.100
Objective bound:	673.4261
Infeasibilities:	0.000000
Extended solver steps:	7097
Total solver iterations:	45565
Elapsed runtime seconds:	6.47

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 8.300000000000001 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 24.4 km
 rute pengiriman dari ritel 3 ke ritel 4 sebesar 7.5 km
 rute pengiriman dari ritel 4 ke ritel 12 sebesar 369 km
 rute pengiriman dari ritel 5 ke ritel 8 sebesar 134 km
 rute pengiriman dari ritel 6 ke ritel 5 sebesar 85 km
 rute pengiriman dari ritel 7 ke ritel 11 sebesar 80 km
 rute pengiriman dari ritel 8 ke ritel 7 sebesar 28 km
 rute pengiriman dari ritel 9 ke ritel 16 sebesar 98.2 km
 rute pengiriman dari ritel 10 ke ritel 14 sebesar 4.8 km
 rute pengiriman dari ritel 11 ke ritel 15 sebesar 3.4 km
 rute pengiriman dari ritel 12 ke ritel 6 sebesar 55 km
 rute pengiriman dari ritel 13 ke ritel 1 sebesar 347 km
 rute pengiriman dari ritel 14 ke ritel 9 sebesar 4.3 km
 rute pengiriman dari ritel 15 ke ritel 10 sebesar 1.8 km
 rute pengiriman dari ritel 16 ke ritel 13 sebesar 93.40000000000001 km

Model Class: MILP

Total variables: 272
 Nonlinear variables: 0
 Integer variables: 256

 Total constraints: 304
 Nonlinear constraints: 0

 Total nonzeros: 1695
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BONGKAR(12)	30.00000	0.000000

BONGKAR(13)	30.00000	0.000000
BONGKAR(14)	30.00000	0.000000
BONGKAR(15)	30.00000	0.000000
BONGKAR(16)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	660.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	900.0000	0.000000
BUKA(8)	780.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	1020.000	0.000000
BUKA(11)	540.0000	0.000000
BUKA(12)	540.0000	0.000000
BUKA(13)	540.0000	0.000000
BUKA(14)	540.0000	0.000000
BUKA(15)	540.0000	0.000000
BUKA(16)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	780.0000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1020.000	0.000000
TUTUP(8)	900.0000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1140.000	0.000000
TUTUP(11)	1260.000	0.000000
TUTUP(12)	1260.000	0.000000
TUTUP(13)	1260.000	0.000000
TUTUP(14)	1260.000	0.000000
TUTUP(15)	1260.000	0.000000
TUTUP(16)	1260.000	0.000000
T(1)	1260.000	0.000000
T(2)	540.0000	0.000000
T(3)	570.0000	0.000000
T(4)	600.0000	0.000000
T(5)	750.0000	0.000000
T(6)	690.0000	0.000000
T(7)	900.0000	0.000000
T(8)	780.0000	0.000000

T(9)	1080.000	0.000000
T(10)	1020.000	0.000000
T(11)	960.0000	0.000000
T(12)	631.0000	0.000000
T(13)	1230.000	0.000000
T(14)	1050.000	0.000000
T(15)	990.0000	0.000000
T(16)	1200.000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	8.300000
X(1, 3)	0.000000	41.10000
X(1, 4)	0.000000	39.60000
X(1, 5)	0.000000	227.0000
X(1, 6)	0.000000	275.0000
X(1, 7)	0.000000	324.0000
X(1, 8)	0.000000	322.0000
X(1, 9)	0.000000	353.0000
X(1, 10)	0.000000	353.0000
X(1, 11)	0.000000	351.0000
X(1, 12)	0.000000	348.0000
X(1, 13)	0.000000	347.0000
X(1, 14)	0.000000	347.0000
X(1, 15)	0.000000	353.0000
X(1, 16)	0.000000	435.0000
X(2, 1)	0.000000	8.300000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	24.40000
X(2, 4)	0.000000	33.00000
X(2, 5)	0.000000	220.0000
X(2, 6)	0.000000	268.0000
X(2, 7)	0.000000	317.0000
X(2, 8)	0.000000	315.0000
X(2, 9)	0.000000	346.0000
X(2, 10)	0.000000	346.0000
X(2, 11)	0.000000	344.0000
X(2, 12)	0.000000	341.0000
X(2, 13)	0.000000	341.0000
X(2, 14)	0.000000	340.0000
X(2, 15)	0.000000	347.0000
X(2, 16)	0.000000	428.0000
X(3, 1)	0.000000	41.10000
X(3, 2)	0.000000	24.40000
X(3, 3)	0.000000	0.000000
X(3, 4)	1.000000	7.500000

X(3, 5)	0.000000	127.0000
X(3, 6)	0.000000	300.0000
X(3, 7)	0.000000	208.0000
X(3, 8)	0.000000	238.0000
X(3, 9)	0.000000	377.0000
X(3, 10)	0.000000	377.0000
X(3, 11)	0.000000	376.0000
X(3, 12)	0.000000	372.0000
X(3, 13)	0.000000	372.0000
X(3, 14)	0.000000	372.0000
X(3, 15)	0.000000	378.0000
X(3, 16)	0.000000	459.0000
X(4, 1)	0.000000	39.60000
X(4, 2)	0.000000	33.00000
X(4, 3)	0.000000	7.500000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	133.0000
X(4, 6)	0.000000	297.0000
X(4, 7)	0.000000	215.0000
X(4, 8)	0.000000	343.0000
X(4, 9)	0.000000	374.0000
X(4, 10)	0.000000	374.0000
X(4, 11)	0.000000	372.0000
X(4, 12)	1.000000	369.0000
X(4, 13)	0.000000	369.0000
X(4, 14)	0.000000	368.0000
X(4, 15)	0.000000	375.0000
X(4, 16)	0.000000	456.0000
X(5, 1)	0.000000	227.0000
X(5, 2)	0.000000	220.0000
X(5, 3)	0.000000	127.0000
X(5, 4)	0.000000	133.0000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	85.00000
X(5, 7)	0.000000	102.0000
X(5, 8)	1.000000	134.0000
X(5, 9)	0.000000	230.0000
X(5, 10)	0.000000	230.0000
X(5, 11)	0.000000	228.0000
X(5, 12)	0.000000	225.0000
X(5, 13)	0.000000	224.0000
X(5, 14)	0.000000	224.0000
X(5, 15)	0.000000	230.0000
X(5, 16)	0.000000	312.0000

X(6, 1)	0.000000	275.0000
X(6, 2)	0.000000	268.0000
X(6, 3)	0.000000	300.0000
X(6, 4)	0.000000	297.0000
X(6, 5)	1.000000	85.00000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	48.00000
X(6, 8)	0.000000	50.00000
X(6, 9)	0.000000	71.00000
X(6, 10)	0.000000	65.00000
X(6, 11)	0.000000	64.00000
X(6, 12)	0.000000	55.00000
X(6, 13)	0.000000	71.00000
X(6, 14)	0.000000	69.00000
X(6, 15)	0.000000	66.00000
X(6, 16)	0.000000	166.0000
X(7, 1)	0.000000	324.0000
X(7, 2)	0.000000	317.0000
X(7, 3)	0.000000	208.0000
X(7, 4)	0.000000	215.0000
X(7, 5)	0.000000	102.0000
X(7, 6)	0.000000	48.00000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	28.00000
X(7, 9)	0.000000	87.00000
X(7, 10)	0.000000	81.00000
X(7, 11)	1.000000	80.00000
X(7, 12)	0.000000	81.00000
X(7, 13)	0.000000	87.00000
X(7, 14)	0.000000	85.00000
X(7, 15)	0.000000	82.00000
X(7, 16)	0.000000	182.0000
X(8, 1)	0.000000	322.0000
X(8, 2)	0.000000	315.0000
X(8, 3)	0.000000	238.0000
X(8, 4)	0.000000	343.0000
X(8, 5)	0.000000	134.0000
X(8, 6)	0.000000	50.00000
X(8, 7)	1.000000	28.00000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	61.00000
X(8, 10)	0.000000	55.00000
X(8, 11)	0.000000	54.00000
X(8, 12)	0.000000	55.00000

X(8, 13)	0.000000	61.00000
X(8, 14)	0.000000	59.00000
X(8, 15)	0.000000	56.00000
X(8, 16)	0.000000	156.0000
X(9, 1)	0.000000	353.0000
X(9, 2)	0.000000	346.0000
X(9, 3)	0.000000	377.0000
X(9, 4)	0.000000	374.0000
X(9, 5)	0.000000	230.0000
X(9, 6)	0.000000	71.00000
X(9, 7)	0.000000	87.00000
X(9, 8)	0.000000	61.00000
X(9, 9)	0.000000	0.000000
X(9, 10)	0.000000	6.700000
X(9, 11)	0.000000	5.900000
X(9, 12)	0.000000	10.00000
X(9, 13)	0.000000	4.800000
X(9, 14)	0.000000	4.300000
X(9, 15)	0.000000	7.400000
X(9, 16)	1.000000	98.20000
X(10, 1)	0.000000	353.0000
X(10, 2)	0.000000	346.0000
X(10, 3)	0.000000	377.0000
X(10, 4)	0.000000	374.0000
X(10, 5)	0.000000	230.0000
X(10, 6)	0.000000	65.00000
X(10, 7)	0.000000	81.00000
X(10, 8)	0.000000	55.00000
X(10, 9)	0.000000	6.700000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	1.900000
X(10, 12)	0.000000	10.30000
X(10, 13)	0.000000	5.900000
X(10, 14)	1.000000	4.800000
X(10, 15)	0.000000	1.800000
X(10, 16)	0.000000	97.50000
X(11, 1)	0.000000	351.0000
X(11, 2)	0.000000	344.0000
X(11, 3)	0.000000	376.0000
X(11, 4)	0.000000	372.0000
X(11, 5)	0.000000	228.0000
X(11, 6)	0.000000	64.00000
X(11, 7)	0.000000	80.00000
X(11, 8)	0.000000	54.00000

X(11, 9)	0.000000	5.900000
X(11, 10)	0.000000	1.900000
X(11, 11)	0.000000	0.000000
X(11, 12)	0.000000	8.800000
X(11, 13)	0.000000	9.800000
X(11, 14)	0.000000	5.300000
X(11, 15)	1.000000	3.400000
X(11, 16)	0.000000	100.0000
X(12, 1)	0.000000	348.0000
X(12, 2)	0.000000	341.0000
X(12, 3)	0.000000	372.0000
X(12, 4)	0.000000	369.0000
X(12, 5)	0.000000	225.0000
X(12, 6)	1.000000	55.00000
X(12, 7)	0.000000	81.00000
X(12, 8)	0.000000	55.00000
X(12, 9)	0.000000	10.00000
X(12, 10)	0.000000	10.30000
X(12, 11)	0.000000	8.800000
X(12, 12)	0.000000	0.000000
X(12, 13)	0.000000	10.60000
X(12, 14)	0.000000	6.200000
X(12, 15)	0.000000	10.70000
X(12, 16)	0.000000	105.0000
X(13, 1)	1.000000	347.0000
X(13, 2)	0.000000	341.0000
X(13, 3)	0.000000	372.0000
X(13, 4)	0.000000	369.0000
X(13, 5)	0.000000	224.0000
X(13, 6)	0.000000	71.00000
X(13, 7)	0.000000	87.00000
X(13, 8)	0.000000	61.00000
X(13, 9)	0.000000	4.800000
X(13, 10)	0.000000	5.900000
X(13, 11)	0.000000	9.800000
X(13, 12)	0.000000	10.60000
X(13, 13)	0.000000	0.000000
X(13, 14)	0.000000	4.300000
X(13, 15)	0.000000	3.500000
X(13, 16)	0.000000	93.40000
X(14, 1)	0.000000	347.0000
X(14, 2)	0.000000	340.0000
X(14, 3)	0.000000	372.0000
X(14, 4)	0.000000	368.0000

X(14, 5)	0.000000	224.0000
X(14, 6)	0.000000	69.00000
X(14, 7)	0.000000	85.00000
X(14, 8)	0.000000	59.00000
X(14, 9)	1.000000	4.300000
X(14, 10)	0.000000	4.800000
X(14, 11)	0.000000	5.300000
X(14, 12)	0.000000	6.200000
X(14, 13)	0.000000	4.300000
X(14, 14)	0.000000	0.000000
X(14, 15)	0.000000	6.300000
X(14, 16)	0.000000	101.0000
X(15, 1)	0.000000	353.0000
X(15, 2)	0.000000	347.0000
X(15, 3)	0.000000	378.0000
X(15, 4)	0.000000	375.0000
X(15, 5)	0.000000	230.0000
X(15, 6)	0.000000	66.00000
X(15, 7)	0.000000	82.00000
X(15, 8)	0.000000	56.00000
X(15, 9)	0.000000	7.400000
X(15, 10)	1.000000	1.800000
X(15, 11)	0.000000	3.400000
X(15, 12)	0.000000	10.70000
X(15, 13)	0.000000	3.500000
X(15, 14)	0.000000	6.300000
X(15, 15)	0.000000	0.000000
X(15, 16)	0.000000	97.90000
X(16, 1)	0.000000	435.0000
X(16, 2)	0.000000	428.0000
X(16, 3)	0.000000	459.0000
X(16, 4)	0.000000	456.0000
X(16, 5)	0.000000	312.0000
X(16, 6)	0.000000	166.0000
X(16, 7)	0.000000	182.0000
X(16, 8)	0.000000	156.0000
X(16, 9)	0.000000	98.20000
X(16, 10)	0.000000	97.50000
X(16, 11)	0.000000	100.0000
X(16, 12)	0.000000	105.0000
X(16, 13)	1.000000	93.40000
X(16, 14)	0.000000	101.0000
X(16, 15)	0.000000	97.90000
X(16, 16)	0.000000	0.000000

D(1, 1)	0.000000	0.000000
D(1, 2)	8.300000	0.000000
D(1, 3)	41.10000	0.000000
D(1, 4)	39.60000	0.000000
D(1, 5)	227.0000	0.000000
D(1, 6)	275.0000	0.000000
D(1, 7)	324.0000	0.000000
D(1, 8)	322.0000	0.000000
D(1, 9)	353.0000	0.000000
D(1, 10)	353.0000	0.000000
D(1, 11)	351.0000	0.000000
D(1, 12)	348.0000	0.000000
D(1, 13)	347.0000	0.000000
D(1, 14)	347.0000	0.000000
D(1, 15)	353.0000	0.000000
D(1, 16)	435.0000	0.000000
D(2, 1)	8.300000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	24.40000	0.000000
D(2, 4)	33.00000	0.000000
D(2, 5)	220.0000	0.000000
D(2, 6)	268.0000	0.000000
D(2, 7)	317.0000	0.000000
D(2, 8)	315.0000	0.000000
D(2, 9)	346.0000	0.000000
D(2, 10)	346.0000	0.000000
D(2, 11)	344.0000	0.000000
D(2, 12)	341.0000	0.000000
D(2, 13)	341.0000	0.000000
D(2, 14)	340.0000	0.000000
D(2, 15)	347.0000	0.000000
D(2, 16)	428.0000	0.000000
D(3, 1)	41.10000	0.000000
D(3, 2)	24.40000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	7.500000	0.000000
D(3, 5)	127.0000	0.000000
D(3, 6)	300.0000	0.000000
D(3, 7)	208.0000	0.000000
D(3, 8)	238.0000	0.000000
D(3, 9)	377.0000	0.000000
D(3, 10)	377.0000	0.000000
D(3, 11)	376.0000	0.000000
D(3, 12)	372.0000	0.000000

D(3, 13)	372.0000	0.000000
D(3, 14)	372.0000	0.000000
D(3, 15)	378.0000	0.000000
D(3, 16)	459.0000	0.000000
D(4, 1)	39.60000	0.000000
D(4, 2)	33.00000	0.000000
D(4, 3)	7.500000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	133.0000	0.000000
D(4, 6)	297.0000	0.000000
D(4, 7)	215.0000	0.000000
D(4, 8)	343.0000	0.000000
D(4, 9)	374.0000	0.000000
D(4, 10)	374.0000	0.000000
D(4, 11)	372.0000	0.000000
D(4, 12)	369.0000	0.000000
D(4, 13)	369.0000	0.000000
D(4, 14)	368.0000	0.000000
D(4, 15)	375.0000	0.000000
D(4, 16)	456.0000	0.000000
D(5, 1)	227.0000	0.000000
D(5, 2)	220.0000	0.000000
D(5, 3)	127.0000	0.000000
D(5, 4)	133.0000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	85.00000	0.000000
D(5, 7)	102.0000	0.000000
D(5, 8)	134.0000	0.000000
D(5, 9)	230.0000	0.000000
D(5, 10)	230.0000	0.000000
D(5, 11)	228.0000	0.000000
D(5, 12)	225.0000	0.000000
D(5, 13)	224.0000	0.000000
D(5, 14)	224.0000	0.000000
D(5, 15)	230.0000	0.000000
D(5, 16)	312.0000	0.000000
D(6, 1)	275.0000	0.000000
D(6, 2)	268.0000	0.000000
D(6, 3)	300.0000	0.000000
D(6, 4)	297.0000	0.000000
D(6, 5)	85.00000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	48.00000	0.000000
D(6, 8)	50.00000	0.000000

D(6, 9)	71.00000	0.000000
D(6, 10)	65.00000	0.000000
D(6, 11)	64.00000	0.000000
D(6, 12)	55.00000	0.000000
D(6, 13)	71.00000	0.000000
D(6, 14)	69.00000	0.000000
D(6, 15)	66.00000	0.000000
D(6, 16)	166.0000	0.000000
D(7, 1)	324.0000	0.000000
D(7, 2)	317.0000	0.000000
D(7, 3)	208.0000	0.000000
D(7, 4)	215.0000	0.000000
D(7, 5)	102.0000	0.000000
D(7, 6)	48.00000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	28.00000	0.000000
D(7, 9)	87.00000	0.000000
D(7, 10)	81.00000	0.000000
D(7, 11)	80.00000	0.000000
D(7, 12)	81.00000	0.000000
D(7, 13)	87.00000	0.000000
D(7, 14)	85.00000	0.000000
D(7, 15)	82.00000	0.000000
D(7, 16)	182.0000	0.000000
D(8, 1)	322.0000	0.000000
D(8, 2)	315.0000	0.000000
D(8, 3)	238.0000	0.000000
D(8, 4)	343.0000	0.000000
D(8, 5)	134.0000	0.000000
D(8, 6)	50.00000	0.000000
D(8, 7)	28.00000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	61.00000	0.000000
D(8, 10)	55.00000	0.000000
D(8, 11)	54.00000	0.000000
D(8, 12)	55.00000	0.000000
D(8, 13)	61.00000	0.000000
D(8, 14)	59.00000	0.000000
D(8, 15)	56.00000	0.000000
D(8, 16)	156.0000	0.000000
D(9, 1)	353.0000	0.000000
D(9, 2)	346.0000	0.000000
D(9, 3)	377.0000	0.000000
D(9, 4)	374.0000	0.000000

D(9, 5)	230.0000	0.000000
D(9, 6)	71.00000	0.000000
D(9, 7)	87.00000	0.000000
D(9, 8)	61.00000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	6.700000	0.000000
D(9, 11)	5.900000	0.000000
D(9, 12)	10.00000	0.000000
D(9, 13)	4.800000	0.000000
D(9, 14)	4.300000	0.000000
D(9, 15)	7.400000	0.000000
D(9, 16)	98.20000	0.000000
D(10, 1)	353.0000	0.000000
D(10, 2)	346.0000	0.000000
D(10, 3)	377.0000	0.000000
D(10, 4)	374.0000	0.000000
D(10, 5)	230.0000	0.000000
D(10, 6)	65.00000	0.000000
D(10, 7)	81.00000	0.000000
D(10, 8)	55.00000	0.000000
D(10, 9)	6.700000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	1.900000	0.000000
D(10, 12)	10.30000	0.000000
D(10, 13)	5.900000	0.000000
D(10, 14)	4.800000	0.000000
D(10, 15)	1.800000	0.000000
D(10, 16)	97.50000	0.000000
D(11, 1)	351.0000	0.000000
D(11, 2)	344.0000	0.000000
D(11, 3)	376.0000	0.000000
D(11, 4)	372.0000	0.000000
D(11, 5)	228.0000	0.000000
D(11, 6)	64.00000	0.000000
D(11, 7)	80.00000	0.000000
D(11, 8)	54.00000	0.000000
D(11, 9)	5.900000	0.000000
D(11, 10)	1.900000	0.000000
D(11, 11)	0.000000	0.000000
D(11, 12)	8.800000	0.000000
D(11, 13)	9.800000	0.000000
D(11, 14)	5.300000	0.000000
D(11, 15)	3.400000	0.000000
D(11, 16)	100.0000	0.000000

D(12, 1)	348.0000	0.000000
D(12, 2)	341.0000	0.000000
D(12, 3)	372.0000	0.000000
D(12, 4)	369.0000	0.000000
D(12, 5)	225.0000	0.000000
D(12, 6)	55.00000	0.000000
D(12, 7)	81.00000	0.000000
D(12, 8)	55.00000	0.000000
D(12, 9)	10.00000	0.000000
D(12, 10)	10.30000	0.000000
D(12, 11)	8.800000	0.000000
D(12, 12)	0.000000	0.000000
D(12, 13)	10.60000	0.000000
D(12, 14)	6.200000	0.000000
D(12, 15)	10.70000	0.000000
D(12, 16)	105.0000	0.000000
D(13, 1)	347.0000	0.000000
D(13, 2)	341.0000	0.000000
D(13, 3)	372.0000	0.000000
D(13, 4)	369.0000	0.000000
D(13, 5)	224.0000	0.000000
D(13, 6)	71.00000	0.000000
D(13, 7)	87.00000	0.000000
D(13, 8)	61.00000	0.000000
D(13, 9)	4.800000	0.000000
D(13, 10)	5.900000	0.000000
D(13, 11)	9.800000	0.000000
D(13, 12)	10.60000	0.000000
D(13, 13)	0.000000	0.000000
D(13, 14)	4.300000	0.000000
D(13, 15)	3.500000	0.000000
D(13, 16)	93.40000	0.000000
D(14, 1)	347.0000	0.000000
D(14, 2)	340.0000	0.000000
D(14, 3)	372.0000	0.000000
D(14, 4)	368.0000	0.000000
D(14, 5)	224.0000	0.000000
D(14, 6)	69.00000	0.000000
D(14, 7)	85.00000	0.000000
D(14, 8)	59.00000	0.000000
D(14, 9)	4.300000	0.000000
D(14, 10)	4.800000	0.000000
D(14, 11)	5.300000	0.000000
D(14, 12)	6.200000	0.000000

D(14, 13)	4.300000	0.000000
D(14, 14)	0.000000	0.000000
D(14, 15)	6.300000	0.000000
D(14, 16)	101.0000	0.000000
D(15, 1)	353.0000	0.000000
D(15, 2)	347.0000	0.000000
D(15, 3)	378.0000	0.000000
D(15, 4)	375.0000	0.000000
D(15, 5)	230.0000	0.000000
D(15, 6)	66.00000	0.000000
D(15, 7)	82.00000	0.000000
D(15, 8)	56.00000	0.000000
D(15, 9)	7.400000	0.000000
D(15, 10)	1.800000	0.000000
D(15, 11)	3.400000	0.000000
D(15, 12)	10.70000	0.000000
D(15, 13)	3.500000	0.000000
D(15, 14)	6.300000	0.000000
D(15, 15)	0.000000	0.000000
D(15, 16)	97.90000	0.000000
D(16, 1)	435.0000	0.000000
D(16, 2)	428.0000	0.000000
D(16, 3)	459.0000	0.000000
D(16, 4)	456.0000	0.000000
D(16, 5)	312.0000	0.000000
D(16, 6)	166.0000	0.000000
D(16, 7)	182.0000	0.000000
D(16, 8)	156.0000	0.000000
D(16, 9)	98.20000	0.000000
D(16, 10)	97.50000	0.000000
D(16, 11)	100.0000	0.000000
D(16, 12)	105.0000	0.000000
D(16, 13)	93.40000	0.000000
D(16, 14)	101.0000	0.000000
D(16, 15)	97.90000	0.000000
D(16, 16)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	9.960000	0.000000
DURASI(1, 3)	49.32000	0.000000
DURASI(1, 4)	47.52000	0.000000
DURASI(1, 5)	272.4000	0.000000
DURASI(1, 6)	330.0000	0.000000
DURASI(1, 7)	388.8000	0.000000
DURASI(1, 8)	386.4000	0.000000

DURASI(1, 9)	423.6000	0.000000
DURASI(1, 10)	423.6000	0.000000
DURASI(1, 11)	421.2000	0.000000
DURASI(1, 12)	417.6000	0.000000
DURASI(1, 13)	416.4000	0.000000
DURASI(1, 14)	416.4000	0.000000
DURASI(1, 15)	423.6000	0.000000
DURASI(1, 16)	522.0000	0.000000
DURASI(2, 1)	9.960000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	29.28000	0.000000
DURASI(2, 4)	39.60000	0.000000
DURASI(2, 5)	264.0000	0.000000
DURASI(2, 6)	321.6000	0.000000
DURASI(2, 7)	380.4000	0.000000
DURASI(2, 8)	378.0000	0.000000
DURASI(2, 9)	415.2000	0.000000
DURASI(2, 10)	415.2000	0.000000
DURASI(2, 11)	412.8000	0.000000
DURASI(2, 12)	409.2000	0.000000
DURASI(2, 13)	409.2000	0.000000
DURASI(2, 14)	408.0000	0.000000
DURASI(2, 15)	416.4000	0.000000
DURASI(2, 16)	513.6000	0.000000
DURASI(3, 1)	49.32000	0.000000
DURASI(3, 2)	29.28000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	9.000000	0.000000
DURASI(3, 5)	152.4000	0.000000
DURASI(3, 6)	360.0000	0.000000
DURASI(3, 7)	249.6000	0.000000
DURASI(3, 8)	285.6000	0.000000
DURASI(3, 9)	452.4000	0.000000
DURASI(3, 10)	452.4000	0.000000
DURASI(3, 11)	451.2000	0.000000
DURASI(3, 12)	446.4000	0.000000
DURASI(3, 13)	446.4000	0.000000
DURASI(3, 14)	446.4000	0.000000
DURASI(3, 15)	453.6000	0.000000
DURASI(3, 16)	550.8000	0.000000
DURASI(4, 1)	47.52000	0.000000
DURASI(4, 2)	39.60000	0.000000
DURASI(4, 3)	9.000000	0.000000
DURASI(4, 4)	0.000000	0.000000

DURASI(4, 5)	159.6000	0.000000
DURASI(4, 6)	356.4000	0.000000
DURASI(4, 7)	258.0000	0.000000
DURASI(4, 8)	411.6000	0.000000
DURASI(4, 9)	448.8000	0.000000
DURASI(4, 10)	448.8000	0.000000
DURASI(4, 11)	446.4000	0.000000
DURASI(4, 12)	442.8000	0.000000
DURASI(4, 13)	442.8000	0.000000
DURASI(4, 14)	441.6000	0.000000
DURASI(4, 15)	450.0000	0.000000
DURASI(4, 16)	547.2000	0.000000
DURASI(5, 1)	272.4000	0.000000
DURASI(5, 2)	264.0000	0.000000
DURASI(5, 3)	152.4000	0.000000
DURASI(5, 4)	159.6000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	102.0000	0.000000
DURASI(5, 7)	122.4000	0.000000
DURASI(5, 8)	160.8000	0.000000
DURASI(5, 9)	276.0000	0.000000
DURASI(5, 10)	276.0000	0.000000
DURASI(5, 11)	273.6000	0.000000
DURASI(5, 12)	270.0000	0.000000
DURASI(5, 13)	268.8000	0.000000
DURASI(5, 14)	268.8000	0.000000
DURASI(5, 15)	276.0000	0.000000
DURASI(5, 16)	374.4000	0.000000
DURASI(6, 1)	330.0000	0.000000
DURASI(6, 2)	321.6000	0.000000
DURASI(6, 3)	360.0000	0.000000
DURASI(6, 4)	356.4000	0.000000
DURASI(6, 5)	102.0000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	57.60000	0.000000
DURASI(6, 8)	60.00000	0.000000
DURASI(6, 9)	85.20000	0.000000
DURASI(6, 10)	78.00000	0.000000
DURASI(6, 11)	76.80000	0.000000
DURASI(6, 12)	66.00000	0.000000
DURASI(6, 13)	85.20000	0.000000
DURASI(6, 14)	82.80000	0.000000
DURASI(6, 15)	79.20000	0.000000
DURASI(6, 16)	199.2000	0.000000

DURASI(7, 1)	388.8000	0.000000
DURASI(7, 2)	380.4000	0.000000
DURASI(7, 3)	249.6000	0.000000
DURASI(7, 4)	258.0000	0.000000
DURASI(7, 5)	122.4000	0.000000
DURASI(7, 6)	57.60000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	33.60000	0.000000
DURASI(7, 9)	104.4000	0.000000
DURASI(7, 10)	97.20000	0.000000
DURASI(7, 11)	96.00000	0.000000
DURASI(7, 12)	97.20000	0.000000
DURASI(7, 13)	104.4000	0.000000
DURASI(7, 14)	102.0000	0.000000
DURASI(7, 15)	98.40000	0.000000
DURASI(7, 16)	218.4000	0.000000
DURASI(8, 1)	386.4000	0.000000
DURASI(8, 2)	378.0000	0.000000
DURASI(8, 3)	285.6000	0.000000
DURASI(8, 4)	411.6000	0.000000
DURASI(8, 5)	160.8000	0.000000
DURASI(8, 6)	60.00000	0.000000
DURASI(8, 7)	33.60000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	73.20000	0.000000
DURASI(8, 10)	66.00000	0.000000
DURASI(8, 11)	64.80000	0.000000
DURASI(8, 12)	66.00000	0.000000
DURASI(8, 13)	73.20000	0.000000
DURASI(8, 14)	70.80000	0.000000
DURASI(8, 15)	67.20000	0.000000
DURASI(8, 16)	187.2000	0.000000
DURASI(9, 1)	423.6000	0.000000
DURASI(9, 2)	415.2000	0.000000
DURASI(9, 3)	452.4000	0.000000
DURASI(9, 4)	448.8000	0.000000
DURASI(9, 5)	276.0000	0.000000
DURASI(9, 6)	85.20000	0.000000
DURASI(9, 7)	104.4000	0.000000
DURASI(9, 8)	73.20000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	8.040000	0.000000
DURASI(9, 11)	7.080000	0.000000
DURASI(9, 12)	12.00000	0.000000

DURASI(9, 13)	5.760000	0.000000
DURASI(9, 14)	5.160000	0.000000
DURASI(9, 15)	8.880000	0.000000
DURASI(9, 16)	117.8400	0.000000
DURASI(10, 1)	423.6000	0.000000
DURASI(10, 2)	415.2000	0.000000
DURASI(10, 3)	452.4000	0.000000
DURASI(10, 4)	448.8000	0.000000
DURASI(10, 5)	276.0000	0.000000
DURASI(10, 6)	78.00000	0.000000
DURASI(10, 7)	97.20000	0.000000
DURASI(10, 8)	66.00000	0.000000
DURASI(10, 9)	8.040000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	2.280000	0.000000
DURASI(10, 12)	12.36000	0.000000
DURASI(10, 13)	7.080000	0.000000
DURASI(10, 14)	5.760000	0.000000
DURASI(10, 15)	2.160000	0.000000
DURASI(10, 16)	117.0000	0.000000
DURASI(11, 1)	421.2000	0.000000
DURASI(11, 2)	412.8000	0.000000
DURASI(11, 3)	451.2000	0.000000
DURASI(11, 4)	446.4000	0.000000
DURASI(11, 5)	273.6000	0.000000
DURASI(11, 6)	76.80000	0.000000
DURASI(11, 7)	96.00000	0.000000
DURASI(11, 8)	64.80000	0.000000
DURASI(11, 9)	7.080000	0.000000
DURASI(11, 10)	2.280000	0.000000
DURASI(11, 11)	0.000000	0.000000
DURASI(11, 12)	10.56000	0.000000
DURASI(11, 13)	11.76000	0.000000
DURASI(11, 14)	6.360000	0.000000
DURASI(11, 15)	4.080000	0.000000
DURASI(11, 16)	120.0000	0.000000
DURASI(12, 1)	417.6000	0.000000
DURASI(12, 2)	409.2000	0.000000
DURASI(12, 3)	446.4000	0.000000
DURASI(12, 4)	442.8000	0.000000
DURASI(12, 5)	270.0000	0.000000
DURASI(12, 6)	66.00000	0.000000
DURASI(12, 7)	97.20000	0.000000
DURASI(12, 8)	66.00000	0.000000

DURASI(12, 9)	12.00000	0.000000
DURASI(12, 10)	12.36000	0.000000
DURASI(12, 11)	10.56000	0.000000
DURASI(12, 12)	0.000000	0.000000
DURASI(12, 13)	12.72000	0.000000
DURASI(12, 14)	7.440000	0.000000
DURASI(12, 15)	12.84000	0.000000
DURASI(12, 16)	126.0000	0.000000
DURASI(13, 1)	416.4000	0.000000
DURASI(13, 2)	409.2000	0.000000
DURASI(13, 3)	446.4000	0.000000
DURASI(13, 4)	442.8000	0.000000
DURASI(13, 5)	268.8000	0.000000
DURASI(13, 6)	85.20000	0.000000
DURASI(13, 7)	104.4000	0.000000
DURASI(13, 8)	73.20000	0.000000
DURASI(13, 9)	5.760000	0.000000
DURASI(13, 10)	7.080000	0.000000
DURASI(13, 11)	11.76000	0.000000
DURASI(13, 12)	12.72000	0.000000
DURASI(13, 13)	0.000000	0.000000
DURASI(13, 14)	5.160000	0.000000
DURASI(13, 15)	4.200000	0.000000
DURASI(13, 16)	112.0800	0.000000
DURASI(14, 1)	416.4000	0.000000
DURASI(14, 2)	408.0000	0.000000
DURASI(14, 3)	446.4000	0.000000
DURASI(14, 4)	441.6000	0.000000
DURASI(14, 5)	268.8000	0.000000
DURASI(14, 6)	82.80000	0.000000
DURASI(14, 7)	102.0000	0.000000
DURASI(14, 8)	70.80000	0.000000
DURASI(14, 9)	5.160000	0.000000
DURASI(14, 10)	5.760000	0.000000
DURASI(14, 11)	6.360000	0.000000
DURASI(14, 12)	7.440000	0.000000
DURASI(14, 13)	5.160000	0.000000
DURASI(14, 14)	0.000000	0.000000
DURASI(14, 15)	7.560000	0.000000
DURASI(14, 16)	121.2000	0.000000
DURASI(15, 1)	423.6000	0.000000
DURASI(15, 2)	416.4000	0.000000
DURASI(15, 3)	453.6000	0.000000
DURASI(15, 4)	450.0000	0.000000

DURASI(15, 5)	276.0000	0.000000
DURASI(15, 6)	79.20000	0.000000
DURASI(15, 7)	98.40000	0.000000
DURASI(15, 8)	67.20000	0.000000
DURASI(15, 9)	8.880000	0.000000
DURASI(15, 10)	2.160000	0.000000
DURASI(15, 11)	4.080000	0.000000
DURASI(15, 12)	12.84000	0.000000
DURASI(15, 13)	4.200000	0.000000
DURASI(15, 14)	7.560000	0.000000
DURASI(15, 15)	0.000000	0.000000
DURASI(15, 16)	117.4800	0.000000
DURASI(16, 1)	522.0000	0.000000
DURASI(16, 2)	513.6000	0.000000
DURASI(16, 3)	550.8000	0.000000
DURASI(16, 4)	547.2000	0.000000
DURASI(16, 5)	374.4000	0.000000
DURASI(16, 6)	199.2000	0.000000
DURASI(16, 7)	218.4000	0.000000
DURASI(16, 8)	187.2000	0.000000
DURASI(16, 9)	117.8400	0.000000
DURASI(16, 10)	117.0000	0.000000
DURASI(16, 11)	120.0000	0.000000
DURASI(16, 12)	126.0000	0.000000
DURASI(16, 13)	112.0800	0.000000
DURASI(16, 14)	121.2000	0.000000
DURASI(16, 15)	117.4800	0.000000
DURASI(16, 16)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 3* analisis sensitivitas skenario 5

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i,j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..11/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 540 780 900 540 660 540 540;
tutup = 1020 1260 1260 660 1260 900 1020 1260 780 1260 1260;
```

D =

```
!ritel
!0      56      58      59      61      62      63      64      65      66
        67;
0       345     343     433     464     510     508     472     507     503
        495     !0;
345    0       20.2    102     133     179     176     142     176     172
        164     !56;
343    20.2    0       114     145     191     188     153     188     184
        175     !58;
433    102     114     0       48.4    94.1    91.2    56.6    91.3    87.3
        78.7    !59;
464    133     145     48.4    0       31.5    33.1    27.2    61.9    57.9
        49.3    !61;
510    179     191     94.1    31.5    0       3.4     58.4    21.5    12.1
        16.2    !62;
508    176     188     91.2    33.1    3.4     0       78.6    18.1    8.8
        14.5    !63;
```



```

472  142  153  56.6  27.2  58.4  78.6  0    34.7  30.7
      22.1  !64;
507  176  188  91.3  61.9  21.5  18.1  34.7  0    10.9
      35.6  !65;
503  172  184  87.3  57.9  12.1  8.8   30.7  10.9  0
      23.8  !66;
495  164  175  78.7  49.3  16.2  14.5  22.1  35.6  23.8  0;
      !67;

```

```

durasi =
0      414  411.6  519.6  556.8  612   609.6  566.4  608.4  603.6
      594
414    0    24.24  122.4  159.6  214.8  211.2  170.4  211.2  206.4
      196.8
411.6  24.24  0    136.8  174   229.2  225.6  183.6  225.6  220.8
      210
519.6  122.4  136.8  0    58.08  112.92  109.44  67.92
      109.56  104.76  94.44
556.8  159.6  174   58.08  0    37.8  39.72  32.64  74.28  69.48
      59.16
612    214.8  229.2  112.92  37.8  0    4.08  70.08  25.8
      14.52  19.44
609.6  211.2  225.6  109.44  39.72  4.08  0    94.32  21.72
      10.56  17.4
566.4  170.4  183.6  67.92  32.64  70.08  94.32  0    41.64  36.84
      26.52
608.4  211.2  225.6  109.56  74.28  25.8  21.72  41.64  0
      13.08  42.72
603.6  206.4  220.8  104.76  69.48  14.52  10.56  36.84  13.08  0
      28.56
594    196.8  210   94.44  59.16  19.44  17.4  26.52  42.72  28.56  0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
            @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
    );

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 3* analisis sensitivitas skenario 5

Global optimal solution found.

Objective value:	1107.300
Objective bound:	1107.300
Infeasibilities:	0.000000
Extended solver steps:	91
Total solver iterations:	14826
Elapsed runtime seconds:	1.23

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 4 sebesar 433 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 20.2 km
 rute pengiriman dari ritel 3 ke ritel 1 sebesar 343 km
 rute pengiriman dari ritel 4 ke ritel 8 sebesar 56.6 km
 rute pengiriman dari ritel 5 ke ritel 2 sebesar 133 km
 rute pengiriman dari ritel 6 ke ritel 11 sebesar 16.2 km
 rute pengiriman dari ritel 7 ke ritel 5 sebesar 33.1 km
 rute pengiriman dari ritel 8 ke ritel 9 sebesar 34.7 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 10.9 km
 rute pengiriman dari ritel 10 ke ritel 6 sebesar 12.1 km
 rute pengiriman dari ritel 11 ke ritel 7 sebesar 14.5 km

Model Class: MILP

Total variables:	132
Nonlinear variables:	0
Integer variables:	121
Total constraints:	154
Nonlinear constraints:	0
Total nonzeros:	780
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000

BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	780.0000	0.000000
BUKA(7)	900.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	660.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	660.0000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	900.0000	0.000000
TUTUP(7)	1020.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	780.0000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
T(1)	1863.600	0.000000
T(2)	1159.320	0.000000
T(3)	1213.560	0.000000
T(4)	546.0000	0.000000
T(5)	969.7200	0.000000
T(6)	803.1600	0.000000
T(7)	900.0000	0.000000
T(8)	643.9200	0.000000
T(9)	715.5600	0.000000
T(10)	758.6400	0.000000
T(11)	852.6000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	0.000000	345.0000
X(1, 3)	0.000000	343.0000

X(1, 4)	1.000000	433.0000
X(1, 5)	0.000000	464.0000
X(1, 6)	0.000000	510.0000
X(1, 7)	0.000000	508.0000
X(1, 8)	0.000000	472.0000
X(1, 9)	0.000000	507.0000
X(1, 10)	0.000000	503.0000
X(1, 11)	0.000000	495.0000
X(2, 1)	0.000000	345.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	20.20000
X(2, 4)	0.000000	102.0000
X(2, 5)	0.000000	133.0000
X(2, 6)	0.000000	179.0000
X(2, 7)	0.000000	176.0000
X(2, 8)	0.000000	142.0000
X(2, 9)	0.000000	176.0000
X(2, 10)	0.000000	172.0000
X(2, 11)	0.000000	164.0000
X(3, 1)	1.000000	343.0000
X(3, 2)	0.000000	20.20000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	114.0000
X(3, 5)	0.000000	145.0000
X(3, 6)	0.000000	191.0000
X(3, 7)	0.000000	188.0000
X(3, 8)	0.000000	153.0000
X(3, 9)	0.000000	188.0000
X(3, 10)	0.000000	184.0000
X(3, 11)	0.000000	175.0000
X(4, 1)	0.000000	433.0000
X(4, 2)	0.000000	102.0000
X(4, 3)	0.000000	114.0000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	48.40000
X(4, 6)	0.000000	94.10000
X(4, 7)	0.000000	91.20000
X(4, 8)	1.000000	56.60000
X(4, 9)	0.000000	91.30000
X(4, 10)	0.000000	87.30000
X(4, 11)	0.000000	78.70000
X(5, 1)	0.000000	464.0000
X(5, 2)	1.000000	133.0000
X(5, 3)	0.000000	145.0000

X(5, 4)	0.000000	48.40000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	31.50000
X(5, 7)	0.000000	33.10000
X(5, 8)	0.000000	27.20000
X(5, 9)	0.000000	61.90000
X(5, 10)	0.000000	57.90000
X(5, 11)	0.000000	49.30000
X(6, 1)	0.000000	510.0000
X(6, 2)	0.000000	179.0000
X(6, 3)	0.000000	191.0000
X(6, 4)	0.000000	94.10000
X(6, 5)	0.000000	31.50000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.400000
X(6, 8)	0.000000	58.40000
X(6, 9)	0.000000	21.50000
X(6, 10)	0.000000	12.10000
X(6, 11)	1.000000	16.20000
X(7, 1)	0.000000	508.0000
X(7, 2)	0.000000	176.0000
X(7, 3)	0.000000	188.0000
X(7, 4)	0.000000	91.20000
X(7, 5)	1.000000	33.10000
X(7, 6)	0.000000	3.400000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	78.60000
X(7, 9)	0.000000	18.10000
X(7, 10)	0.000000	8.800000
X(7, 11)	0.000000	14.50000
X(8, 1)	0.000000	472.0000
X(8, 2)	0.000000	142.0000
X(8, 3)	0.000000	153.0000
X(8, 4)	0.000000	56.60000
X(8, 5)	0.000000	27.20000
X(8, 6)	0.000000	58.40000
X(8, 7)	0.000000	78.60000
X(8, 8)	0.000000	0.000000
X(8, 9)	1.000000	34.70000
X(8, 10)	0.000000	30.70000
X(8, 11)	0.000000	22.10000
X(9, 1)	0.000000	507.0000
X(9, 2)	0.000000	176.0000
X(9, 3)	0.000000	188.0000

X(9, 4)	0.000000	91.30000
X(9, 5)	0.000000	61.90000
X(9, 6)	0.000000	21.50000
X(9, 7)	0.000000	18.10000
X(9, 8)	0.000000	34.70000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	10.90000
X(9, 11)	0.000000	35.60000
X(10, 1)	0.000000	503.0000
X(10, 2)	0.000000	172.0000
X(10, 3)	0.000000	184.0000
X(10, 4)	0.000000	87.30000
X(10, 5)	0.000000	57.90000
X(10, 6)	1.000000	12.10000
X(10, 7)	0.000000	8.800000
X(10, 8)	0.000000	30.70000
X(10, 9)	0.000000	10.90000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	23.80000
X(11, 1)	0.000000	495.0000
X(11, 2)	0.000000	164.0000
X(11, 3)	0.000000	175.0000
X(11, 4)	0.000000	78.70000
X(11, 5)	0.000000	49.30000
X(11, 6)	0.000000	16.20000
X(11, 7)	1.000000	14.50000
X(11, 8)	0.000000	22.10000
X(11, 9)	0.000000	35.60000
X(11, 10)	0.000000	23.80000
X(11, 11)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	345.0000	0.000000
D(1, 3)	343.0000	0.000000
D(1, 4)	433.0000	0.000000
D(1, 5)	464.0000	0.000000
D(1, 6)	510.0000	0.000000
D(1, 7)	508.0000	0.000000
D(1, 8)	472.0000	0.000000
D(1, 9)	507.0000	0.000000
D(1, 10)	503.0000	0.000000
D(1, 11)	495.0000	0.000000
D(2, 1)	345.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	20.20000	0.000000

D(2, 4)	102.0000	0.000000
D(2, 5)	133.0000	0.000000
D(2, 6)	179.0000	0.000000
D(2, 7)	176.0000	0.000000
D(2, 8)	142.0000	0.000000
D(2, 9)	176.0000	0.000000
D(2, 10)	172.0000	0.000000
D(2, 11)	164.0000	0.000000
D(3, 1)	343.0000	0.000000
D(3, 2)	20.20000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	114.0000	0.000000
D(3, 5)	145.0000	0.000000
D(3, 6)	191.0000	0.000000
D(3, 7)	188.0000	0.000000
D(3, 8)	153.0000	0.000000
D(3, 9)	188.0000	0.000000
D(3, 10)	184.0000	0.000000
D(3, 11)	175.0000	0.000000
D(4, 1)	433.0000	0.000000
D(4, 2)	102.0000	0.000000
D(4, 3)	114.0000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	48.40000	0.000000
D(4, 6)	94.10000	0.000000
D(4, 7)	91.20000	0.000000
D(4, 8)	56.60000	0.000000
D(4, 9)	91.30000	0.000000
D(4, 10)	87.30000	0.000000
D(4, 11)	78.70000	0.000000
D(5, 1)	464.0000	0.000000
D(5, 2)	133.0000	0.000000
D(5, 3)	145.0000	0.000000
D(5, 4)	48.40000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	31.50000	0.000000
D(5, 7)	33.10000	0.000000
D(5, 8)	27.20000	0.000000
D(5, 9)	61.90000	0.000000
D(5, 10)	57.90000	0.000000
D(5, 11)	49.30000	0.000000
D(6, 1)	510.0000	0.000000
D(6, 2)	179.0000	0.000000
D(6, 3)	191.0000	0.000000

D(6, 4)	94.10000	0.000000
D(6, 5)	31.50000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.400000	0.000000
D(6, 8)	58.40000	0.000000
D(6, 9)	21.50000	0.000000
D(6, 10)	12.10000	0.000000
D(6, 11)	16.20000	0.000000
D(7, 1)	508.0000	0.000000
D(7, 2)	176.0000	0.000000
D(7, 3)	188.0000	0.000000
D(7, 4)	91.20000	0.000000
D(7, 5)	33.10000	0.000000
D(7, 6)	3.400000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	78.60000	0.000000
D(7, 9)	18.10000	0.000000
D(7, 10)	8.800000	0.000000
D(7, 11)	14.50000	0.000000
D(8, 1)	472.0000	0.000000
D(8, 2)	142.0000	0.000000
D(8, 3)	153.0000	0.000000
D(8, 4)	56.60000	0.000000
D(8, 5)	27.20000	0.000000
D(8, 6)	58.40000	0.000000
D(8, 7)	78.60000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	34.70000	0.000000
D(8, 10)	30.70000	0.000000
D(8, 11)	22.10000	0.000000
D(9, 1)	507.0000	0.000000
D(9, 2)	176.0000	0.000000
D(9, 3)	188.0000	0.000000
D(9, 4)	91.30000	0.000000
D(9, 5)	61.90000	0.000000
D(9, 6)	21.50000	0.000000
D(9, 7)	18.10000	0.000000
D(9, 8)	34.70000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	10.90000	0.000000
D(9, 11)	35.60000	0.000000
D(10, 1)	503.0000	0.000000
D(10, 2)	172.0000	0.000000
D(10, 3)	184.0000	0.000000

D(10, 4)	87.30000	0.000000
D(10, 5)	57.90000	0.000000
D(10, 6)	12.10000	0.000000
D(10, 7)	8.800000	0.000000
D(10, 8)	30.70000	0.000000
D(10, 9)	10.90000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	23.80000	0.000000
D(11, 1)	495.0000	0.000000
D(11, 2)	164.0000	0.000000
D(11, 3)	175.0000	0.000000
D(11, 4)	78.70000	0.000000
D(11, 5)	49.30000	0.000000
D(11, 6)	16.20000	0.000000
D(11, 7)	14.50000	0.000000
D(11, 8)	22.10000	0.000000
D(11, 9)	35.60000	0.000000
D(11, 10)	23.80000	0.000000
D(11, 11)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	414.0000	0.000000
DURASI(1, 3)	411.6000	0.000000
DURASI(1, 4)	519.6000	0.000000
DURASI(1, 5)	556.8000	0.000000
DURASI(1, 6)	612.0000	0.000000
DURASI(1, 7)	609.6000	0.000000
DURASI(1, 8)	566.4000	0.000000
DURASI(1, 9)	608.4000	0.000000
DURASI(1, 10)	603.6000	0.000000
DURASI(1, 11)	594.0000	0.000000
DURASI(2, 1)	414.0000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	24.24000	0.000000
DURASI(2, 4)	122.4000	0.000000
DURASI(2, 5)	159.6000	0.000000
DURASI(2, 6)	214.8000	0.000000
DURASI(2, 7)	211.2000	0.000000
DURASI(2, 8)	170.4000	0.000000
DURASI(2, 9)	211.2000	0.000000
DURASI(2, 10)	206.4000	0.000000
DURASI(2, 11)	196.8000	0.000000
DURASI(3, 1)	411.6000	0.000000
DURASI(3, 2)	24.24000	0.000000
DURASI(3, 3)	0.000000	0.000000

DURASI(3, 4)	136.8000	0.000000
DURASI(3, 5)	174.0000	0.000000
DURASI(3, 6)	229.2000	0.000000
DURASI(3, 7)	225.6000	0.000000
DURASI(3, 8)	183.6000	0.000000
DURASI(3, 9)	225.6000	0.000000
DURASI(3, 10)	220.8000	0.000000
DURASI(3, 11)	210.0000	0.000000
DURASI(4, 1)	519.6000	0.000000
DURASI(4, 2)	122.4000	0.000000
DURASI(4, 3)	136.8000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	58.08000	0.000000
DURASI(4, 6)	112.9200	0.000000
DURASI(4, 7)	109.4400	0.000000
DURASI(4, 8)	67.92000	0.000000
DURASI(4, 9)	109.5600	0.000000
DURASI(4, 10)	104.7600	0.000000
DURASI(4, 11)	94.44000	0.000000
DURASI(5, 1)	556.8000	0.000000
DURASI(5, 2)	159.6000	0.000000
DURASI(5, 3)	174.0000	0.000000
DURASI(5, 4)	58.08000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	37.80000	0.000000
DURASI(5, 7)	39.72000	0.000000
DURASI(5, 8)	32.64000	0.000000
DURASI(5, 9)	74.28000	0.000000
DURASI(5, 10)	69.48000	0.000000
DURASI(5, 11)	59.16000	0.000000
DURASI(6, 1)	612.0000	0.000000
DURASI(6, 2)	214.8000	0.000000
DURASI(6, 3)	229.2000	0.000000
DURASI(6, 4)	112.9200	0.000000
DURASI(6, 5)	37.80000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.080000	0.000000
DURASI(6, 8)	70.08000	0.000000
DURASI(6, 9)	25.80000	0.000000
DURASI(6, 10)	14.52000	0.000000
DURASI(6, 11)	19.44000	0.000000
DURASI(7, 1)	609.6000	0.000000
DURASI(7, 2)	211.2000	0.000000
DURASI(7, 3)	225.6000	0.000000

DURASI(7, 4)	109.4400	0.000000
DURASI(7, 5)	39.72000	0.000000
DURASI(7, 6)	4.080000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	94.32000	0.000000
DURASI(7, 9)	21.72000	0.000000
DURASI(7, 10)	10.56000	0.000000
DURASI(7, 11)	17.40000	0.000000
DURASI(8, 1)	566.4000	0.000000
DURASI(8, 2)	170.4000	0.000000
DURASI(8, 3)	183.6000	0.000000
DURASI(8, 4)	67.92000	0.000000
DURASI(8, 5)	32.64000	0.000000
DURASI(8, 6)	70.08000	0.000000
DURASI(8, 7)	94.32000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	41.64000	0.000000
DURASI(8, 10)	36.84000	0.000000
DURASI(8, 11)	26.52000	0.000000
DURASI(9, 1)	608.4000	0.000000
DURASI(9, 2)	211.2000	0.000000
DURASI(9, 3)	225.6000	0.000000
DURASI(9, 4)	109.5600	0.000000
DURASI(9, 5)	74.28000	0.000000
DURASI(9, 6)	25.80000	0.000000
DURASI(9, 7)	21.72000	0.000000
DURASI(9, 8)	41.64000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	13.08000	0.000000
DURASI(9, 11)	42.72000	0.000000
DURASI(10, 1)	603.6000	0.000000
DURASI(10, 2)	206.4000	0.000000
DURASI(10, 3)	220.8000	0.000000
DURASI(10, 4)	104.7600	0.000000
DURASI(10, 5)	69.48000	0.000000
DURASI(10, 6)	14.52000	0.000000
DURASI(10, 7)	10.56000	0.000000
DURASI(10, 8)	36.84000	0.000000
DURASI(10, 9)	13.08000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	28.56000	0.000000
DURASI(11, 1)	594.0000	0.000000
DURASI(11, 2)	196.8000	0.000000
DURASI(11, 3)	210.0000	0.000000

DURASI(11, 4)	94.44000	0.000000
DURASI(11, 5)	59.16000	0.000000
DURASI(11, 6)	19.44000	0.000000
DURASI(11, 7)	17.40000	0.000000
DURASI(11, 8)	26.52000	0.000000
DURASI(11, 9)	42.72000	0.000000
DURASI(11, 10)	28.56000	0.000000
DURASI(11, 11)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster* 4 analisis sensitivitas skenario 5

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i,j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..12/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 780 660 900 1020 540 540 540 540;
tutup = 1020 1260 660 1260 900 780 1020 1140 1260 1260 1260
1260;
```

D =

```
!ritel
!0      33      34      35      36      37      38      44      45      46      47
      48;
0      252     234     258     254     256     259     398     422     548
      548     341     !0;
252    0       20      44      39      42      46      184     208     334
      334     127     !33;
234    20      0       24      20      23      25      164     188     314
      314     107     !34;
258    44      24      0       7       6       9       138     158     295
      295     88      !35;
254    39      20      7       0       3       6       156     166     306
      306     99      !36;
256    42      23      6       3       0       7       156     164     305
      305     98      !37;
```

259	46	25	9	6	7	0	141	161	306	
	306	99	!38;							
398	184	164	138	156	156	141	0	24.4	102	
	102	57.5	!44;							
422	208	188	158	166	164	161	24.4	0	77.2	78
	80.9	!45;								
548	334	314	295	306	305	306	102	77.2	0	1.7
	145	!46;								
548	334	314	295	306	305	306	102	78	1.7	0
	144	!47;								
341	127	107	88	99	98	99	57.5	80.9	145	
	144	0;	!48;							

```

durasi =
0      302.4 280.8 309.6 304.8 307.2 310.8 477.6 506.4 657.6
      657.6 409.2
302.4 0      24    52.8 46.8  50.4  55.2  220.8 249.6 400.8
      400.8 152.4
280.8 24    0      28.8 24    27.6  30    196.8 225.6 376.8
      376.8 128.4
309.6 52.8 28.8  0      8.4  7.2   10.8  165.6 189.6 354
      354   105.6
304.8 46.8 24    8.4  0      3.6   7.2   187.2 199.2 367.2
      367.2 118.8
307.2 50.4 27.6  7.2  3.6  0      8.4   187.2 196.8 366
      366   117.6
310.8 55.2 30    10.8 7.2   8.4   0     169.2 193.2 367.2
      367.2 118.8
477.6 220.8 196.8 165.6 187.2 187.2 169.2 0     29.28 122.4
      122.4 69
506.4 249.6 225.6 189.6 199.2 196.8 193.2 29.28 0     92.64
      93.6  97.08
657.6 400.8 376.8 354   367.2 366   367.2 122.4 92.64 0
      2.04  174
657.6 400.8 376.8 354   367.2 366   367.2 122.4 93.6  2.04  0
      172.8
409.2 152.4 128.4 105.6 118.8 117.6 118.8 69    97.08 174
      172.8 0;

```

```

Bongkar = 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text () = @writefor (rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

```



```

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

- Hasil dari *solution report* pada *cluster 4* analisis sensitivitas skenario 5

Global optimal solution found.

Objective value:	1109.800
Objective bound:	1109.800
Infeasibilities:	0.000000
Extended solver steps:	1053
Total solver iterations:	20957
Elapsed runtime seconds:	1.84

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 252 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 20 km
 rute pengiriman dari ritel 3 ke ritel 6 sebesar 23 km
 rute pengiriman dari ritel 4 ke ritel 12 sebesar 88 km
 rute pengiriman dari ritel 5 ke ritel 7 sebesar 6 km
 rute pengiriman dari ritel 6 ke ritel 5 sebesar 3 km
 rute pengiriman dari ritel 7 ke ritel 4 sebesar 9 km
 rute pengiriman dari ritel 8 ke ritel 9 sebesar 24.4 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 77.2 km
 rute pengiriman dari ritel 10 ke ritel 11 sebesar 1.7 km
 rute pengiriman dari ritel 11 ke ritel 1 sebesar 548 km
 rute pengiriman dari ritel 12 ke ritel 8 sebesar 57.5 km

Model Class: MILP

Total variables:	156
Nonlinear variables:	0
Integer variables:	144
Total constraints:	180
Nonlinear constraints:	0
Total nonzeros:	935

Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	0.3000000	0.000000
BONGKAR(2)	0.3000000	0.000000
BONGKAR(3)	0.3000000	0.000000
BONGKAR(4)	0.3000000	0.000000
BONGKAR(5)	0.3000000	0.000000
BONGKAR(6)	0.3000000	0.000000
BONGKAR(7)	0.3000000	0.000000
BONGKAR(8)	0.3000000	0.000000
BONGKAR(9)	0.3000000	0.000000
BONGKAR(10)	0.3000000	0.000000
BONGKAR(11)	0.3000000	0.000000
BONGKAR(12)	0.3000000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	660.0000	0.000000
BUKA(7)	900.0000	0.000000
BUKA(8)	1020.000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
BUKA(12)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	660.0000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	780.0000	0.000000
TUTUP(7)	1020.000	0.000000
TUTUP(8)	1140.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
TUTUP(12)	1260.000	0.000000
T(1)	1917.600	0.000000
T(2)	540.0000	0.000000

T(3)	632.1000	0.000000
T(4)	911.1000	0.000000
T(5)	892.5000	0.000000
T(6)	660.0000	0.000000
T(7)	900.0000	0.000000
T(8)	1086.300	0.000000
T(9)	1164.420	0.000000
T(10)	1257.360	0.000000
T(11)	1259.700	0.000000
T(12)	1017.000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	252.0000
X(1, 3)	0.000000	234.0000
X(1, 4)	0.000000	258.0000
X(1, 5)	0.000000	254.0000
X(1, 6)	0.000000	256.0000
X(1, 7)	0.000000	259.0000
X(1, 8)	0.000000	398.0000
X(1, 9)	0.000000	422.0000
X(1, 10)	0.000000	548.0000
X(1, 11)	0.000000	548.0000
X(1, 12)	0.000000	341.0000
X(2, 1)	0.000000	252.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	20.00000
X(2, 4)	0.000000	44.00000
X(2, 5)	0.000000	39.00000
X(2, 6)	0.000000	42.00000
X(2, 7)	0.000000	46.00000
X(2, 8)	0.000000	184.0000
X(2, 9)	0.000000	208.0000
X(2, 10)	0.000000	334.0000
X(2, 11)	0.000000	334.0000
X(2, 12)	0.000000	127.0000
X(3, 1)	0.000000	234.0000
X(3, 2)	0.000000	20.00000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	24.00000
X(3, 5)	0.000000	20.00000
X(3, 6)	1.000000	23.00000
X(3, 7)	0.000000	25.00000
X(3, 8)	0.000000	164.0000
X(3, 9)	0.000000	188.0000
X(3, 10)	0.000000	314.0000

X(3, 11)	0.000000	314.0000
X(3, 12)	0.000000	107.0000
X(4, 1)	0.000000	258.0000
X(4, 2)	0.000000	44.00000
X(4, 3)	0.000000	24.00000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	7.000000
X(4, 6)	0.000000	6.000000
X(4, 7)	0.000000	9.000000
X(4, 8)	0.000000	138.0000
X(4, 9)	0.000000	158.0000
X(4, 10)	0.000000	295.0000
X(4, 11)	0.000000	295.0000
X(4, 12)	1.000000	88.00000
X(5, 1)	0.000000	254.0000
X(5, 2)	0.000000	39.00000
X(5, 3)	0.000000	20.00000
X(5, 4)	0.000000	7.000000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	3.000000
X(5, 7)	1.000000	6.000000
X(5, 8)	0.000000	156.0000
X(5, 9)	0.000000	166.0000
X(5, 10)	0.000000	306.0000
X(5, 11)	0.000000	306.0000
X(5, 12)	0.000000	99.00000
X(6, 1)	0.000000	256.0000
X(6, 2)	0.000000	42.00000
X(6, 3)	0.000000	23.00000
X(6, 4)	0.000000	6.000000
X(6, 5)	1.000000	3.000000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	7.000000
X(6, 8)	0.000000	156.0000
X(6, 9)	0.000000	164.0000
X(6, 10)	0.000000	305.0000
X(6, 11)	0.000000	305.0000
X(6, 12)	0.000000	98.00000
X(7, 1)	0.000000	259.0000
X(7, 2)	0.000000	46.00000
X(7, 3)	0.000000	25.00000
X(7, 4)	1.000000	9.000000
X(7, 5)	0.000000	6.000000
X(7, 6)	0.000000	7.000000

X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	141.0000
X(7, 9)	0.000000	161.0000
X(7, 10)	0.000000	306.0000
X(7, 11)	0.000000	306.0000
X(7, 12)	0.000000	99.00000
X(8, 1)	0.000000	398.0000
X(8, 2)	0.000000	184.0000
X(8, 3)	0.000000	164.0000
X(8, 4)	0.000000	138.0000
X(8, 5)	0.000000	156.0000
X(8, 6)	0.000000	156.0000
X(8, 7)	0.000000	141.0000
X(8, 8)	0.000000	0.000000
X(8, 9)	1.000000	24.40000
X(8, 10)	0.000000	102.0000
X(8, 11)	0.000000	102.0000
X(8, 12)	0.000000	57.50000
X(9, 1)	0.000000	422.0000
X(9, 2)	0.000000	208.0000
X(9, 3)	0.000000	188.0000
X(9, 4)	0.000000	158.0000
X(9, 5)	0.000000	166.0000
X(9, 6)	0.000000	164.0000
X(9, 7)	0.000000	161.0000
X(9, 8)	0.000000	24.40000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	77.20000
X(9, 11)	0.000000	78.00000
X(9, 12)	0.000000	80.90000
X(10, 1)	0.000000	548.0000
X(10, 2)	0.000000	334.0000
X(10, 3)	0.000000	314.0000
X(10, 4)	0.000000	295.0000
X(10, 5)	0.000000	306.0000
X(10, 6)	0.000000	305.0000
X(10, 7)	0.000000	306.0000
X(10, 8)	0.000000	102.0000
X(10, 9)	0.000000	77.20000
X(10, 10)	0.000000	0.000000
X(10, 11)	1.000000	1.700000
X(10, 12)	0.000000	145.0000
X(11, 1)	1.000000	548.0000
X(11, 2)	0.000000	334.0000

X(11, 3)	0.000000	314.0000
X(11, 4)	0.000000	295.0000
X(11, 5)	0.000000	306.0000
X(11, 6)	0.000000	305.0000
X(11, 7)	0.000000	306.0000
X(11, 8)	0.000000	102.0000
X(11, 9)	0.000000	78.00000
X(11, 10)	0.000000	1.700000
X(11, 11)	0.000000	0.000000
X(11, 12)	0.000000	144.0000
X(12, 1)	0.000000	341.0000
X(12, 2)	0.000000	127.0000
X(12, 3)	0.000000	107.0000
X(12, 4)	0.000000	88.00000
X(12, 5)	0.000000	99.00000
X(12, 6)	0.000000	98.00000
X(12, 7)	0.000000	99.00000
X(12, 8)	1.000000	57.50000
X(12, 9)	0.000000	80.90000
X(12, 10)	0.000000	145.0000
X(12, 11)	0.000000	144.0000
X(12, 12)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	252.0000	0.000000
D(1, 3)	234.0000	0.000000
D(1, 4)	258.0000	0.000000
D(1, 5)	254.0000	0.000000
D(1, 6)	256.0000	0.000000
D(1, 7)	259.0000	0.000000
D(1, 8)	398.0000	0.000000
D(1, 9)	422.0000	0.000000
D(1, 10)	548.0000	0.000000
D(1, 11)	548.0000	0.000000
D(1, 12)	341.0000	0.000000
D(2, 1)	252.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	20.00000	0.000000
D(2, 4)	44.00000	0.000000
D(2, 5)	39.00000	0.000000
D(2, 6)	42.00000	0.000000
D(2, 7)	46.00000	0.000000
D(2, 8)	184.0000	0.000000
D(2, 9)	208.0000	0.000000
D(2, 10)	334.0000	0.000000

D(2, 11)	334.0000	0.000000
D(2, 12)	127.0000	0.000000
D(3, 1)	234.0000	0.000000
D(3, 2)	20.00000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	24.00000	0.000000
D(3, 5)	20.00000	0.000000
D(3, 6)	23.00000	0.000000
D(3, 7)	25.00000	0.000000
D(3, 8)	164.0000	0.000000
D(3, 9)	188.0000	0.000000
D(3, 10)	314.0000	0.000000
D(3, 11)	314.0000	0.000000
D(3, 12)	107.0000	0.000000
D(4, 1)	258.0000	0.000000
D(4, 2)	44.00000	0.000000
D(4, 3)	24.00000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	7.000000	0.000000
D(4, 6)	6.000000	0.000000
D(4, 7)	9.000000	0.000000
D(4, 8)	138.0000	0.000000
D(4, 9)	158.0000	0.000000
D(4, 10)	295.0000	0.000000
D(4, 11)	295.0000	0.000000
D(4, 12)	88.00000	0.000000
D(5, 1)	254.0000	0.000000
D(5, 2)	39.00000	0.000000
D(5, 3)	20.00000	0.000000
D(5, 4)	7.000000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	3.000000	0.000000
D(5, 7)	6.000000	0.000000
D(5, 8)	156.0000	0.000000
D(5, 9)	166.0000	0.000000
D(5, 10)	306.0000	0.000000
D(5, 11)	306.0000	0.000000
D(5, 12)	99.00000	0.000000
D(6, 1)	256.0000	0.000000
D(6, 2)	42.00000	0.000000
D(6, 3)	23.00000	0.000000
D(6, 4)	6.000000	0.000000
D(6, 5)	3.000000	0.000000
D(6, 6)	0.000000	0.000000

D(6, 7)	7.000000	0.000000
D(6, 8)	156.0000	0.000000
D(6, 9)	164.0000	0.000000
D(6, 10)	305.0000	0.000000
D(6, 11)	305.0000	0.000000
D(6, 12)	98.00000	0.000000
D(7, 1)	259.0000	0.000000
D(7, 2)	46.00000	0.000000
D(7, 3)	25.00000	0.000000
D(7, 4)	9.000000	0.000000
D(7, 5)	6.000000	0.000000
D(7, 6)	7.000000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	141.0000	0.000000
D(7, 9)	161.0000	0.000000
D(7, 10)	306.0000	0.000000
D(7, 11)	306.0000	0.000000
D(7, 12)	99.00000	0.000000
D(8, 1)	398.0000	0.000000
D(8, 2)	184.0000	0.000000
D(8, 3)	164.0000	0.000000
D(8, 4)	138.0000	0.000000
D(8, 5)	156.0000	0.000000
D(8, 6)	156.0000	0.000000
D(8, 7)	141.0000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	24.40000	0.000000
D(8, 10)	102.0000	0.000000
D(8, 11)	102.0000	0.000000
D(8, 12)	57.50000	0.000000
D(9, 1)	422.0000	0.000000
D(9, 2)	208.0000	0.000000
D(9, 3)	188.0000	0.000000
D(9, 4)	158.0000	0.000000
D(9, 5)	166.0000	0.000000
D(9, 6)	164.0000	0.000000
D(9, 7)	161.0000	0.000000
D(9, 8)	24.40000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	77.20000	0.000000
D(9, 11)	78.00000	0.000000
D(9, 12)	80.90000	0.000000
D(10, 1)	548.0000	0.000000
D(10, 2)	334.0000	0.000000

D(10, 3)	314.0000	0.000000
D(10, 4)	295.0000	0.000000
D(10, 5)	306.0000	0.000000
D(10, 6)	305.0000	0.000000
D(10, 7)	306.0000	0.000000
D(10, 8)	102.0000	0.000000
D(10, 9)	77.20000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	1.700000	0.000000
D(10, 12)	145.0000	0.000000
D(11, 1)	548.0000	0.000000
D(11, 2)	334.0000	0.000000
D(11, 3)	314.0000	0.000000
D(11, 4)	295.0000	0.000000
D(11, 5)	306.0000	0.000000
D(11, 6)	305.0000	0.000000
D(11, 7)	306.0000	0.000000
D(11, 8)	102.0000	0.000000
D(11, 9)	78.00000	0.000000
D(11, 10)	1.700000	0.000000
D(11, 11)	0.000000	0.000000
D(11, 12)	144.0000	0.000000
D(12, 1)	341.0000	0.000000
D(12, 2)	127.0000	0.000000
D(12, 3)	107.0000	0.000000
D(12, 4)	88.00000	0.000000
D(12, 5)	99.00000	0.000000
D(12, 6)	98.00000	0.000000
D(12, 7)	99.00000	0.000000
D(12, 8)	57.50000	0.000000
D(12, 9)	80.90000	0.000000
D(12, 10)	145.0000	0.000000
D(12, 11)	144.0000	0.000000
D(12, 12)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	302.4000	0.000000
DURASI(1, 3)	280.8000	0.000000
DURASI(1, 4)	309.6000	0.000000
DURASI(1, 5)	304.8000	0.000000
DURASI(1, 6)	307.2000	0.000000
DURASI(1, 7)	310.8000	0.000000
DURASI(1, 8)	477.6000	0.000000
DURASI(1, 9)	506.4000	0.000000
DURASI(1, 10)	657.6000	0.000000

DURASI(1, 11)	657.6000	0.000000
DURASI(1, 12)	409.2000	0.000000
DURASI(2, 1)	302.4000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	24.00000	0.000000
DURASI(2, 4)	52.80000	0.000000
DURASI(2, 5)	46.80000	0.000000
DURASI(2, 6)	50.40000	0.000000
DURASI(2, 7)	55.20000	0.000000
DURASI(2, 8)	220.8000	0.000000
DURASI(2, 9)	249.6000	0.000000
DURASI(2, 10)	400.8000	0.000000
DURASI(2, 11)	400.8000	0.000000
DURASI(2, 12)	152.4000	0.000000
DURASI(3, 1)	280.8000	0.000000
DURASI(3, 2)	24.00000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	28.80000	0.000000
DURASI(3, 5)	24.00000	0.000000
DURASI(3, 6)	27.60000	0.000000
DURASI(3, 7)	30.00000	0.000000
DURASI(3, 8)	196.8000	0.000000
DURASI(3, 9)	225.6000	0.000000
DURASI(3, 10)	376.8000	0.000000
DURASI(3, 11)	376.8000	0.000000
DURASI(3, 12)	128.4000	0.000000
DURASI(4, 1)	309.6000	0.000000
DURASI(4, 2)	52.80000	0.000000
DURASI(4, 3)	28.80000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	8.400000	0.000000
DURASI(4, 6)	7.200000	0.000000
DURASI(4, 7)	10.80000	0.000000
DURASI(4, 8)	165.6000	0.000000
DURASI(4, 9)	189.6000	0.000000
DURASI(4, 10)	354.0000	0.000000
DURASI(4, 11)	354.0000	0.000000
DURASI(4, 12)	105.6000	0.000000
DURASI(5, 1)	304.8000	0.000000
DURASI(5, 2)	46.80000	0.000000
DURASI(5, 3)	24.00000	0.000000
DURASI(5, 4)	8.400000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	3.600000	0.000000

DURASI(5, 7)	7.200000	0.000000
DURASI(5, 8)	187.2000	0.000000
DURASI(5, 9)	199.2000	0.000000
DURASI(5, 10)	367.2000	0.000000
DURASI(5, 11)	367.2000	0.000000
DURASI(5, 12)	118.8000	0.000000
DURASI(6, 1)	307.2000	0.000000
DURASI(6, 2)	50.40000	0.000000
DURASI(6, 3)	27.60000	0.000000
DURASI(6, 4)	7.200000	0.000000
DURASI(6, 5)	3.600000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	8.400000	0.000000
DURASI(6, 8)	187.2000	0.000000
DURASI(6, 9)	196.8000	0.000000
DURASI(6, 10)	366.0000	0.000000
DURASI(6, 11)	366.0000	0.000000
DURASI(6, 12)	117.6000	0.000000
DURASI(7, 1)	310.8000	0.000000
DURASI(7, 2)	55.20000	0.000000
DURASI(7, 3)	30.00000	0.000000
DURASI(7, 4)	10.80000	0.000000
DURASI(7, 5)	7.200000	0.000000
DURASI(7, 6)	8.400000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	169.2000	0.000000
DURASI(7, 9)	193.2000	0.000000
DURASI(7, 10)	367.2000	0.000000
DURASI(7, 11)	367.2000	0.000000
DURASI(7, 12)	118.8000	0.000000
DURASI(8, 1)	477.6000	0.000000
DURASI(8, 2)	220.8000	0.000000
DURASI(8, 3)	196.8000	0.000000
DURASI(8, 4)	165.6000	0.000000
DURASI(8, 5)	187.2000	0.000000
DURASI(8, 6)	187.2000	0.000000
DURASI(8, 7)	169.2000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	29.28000	0.000000
DURASI(8, 10)	122.4000	0.000000
DURASI(8, 11)	122.4000	0.000000
DURASI(8, 12)	69.00000	0.000000
DURASI(9, 1)	506.4000	0.000000
DURASI(9, 2)	249.6000	0.000000

DURASI(9, 3)	225.6000	0.000000
DURASI(9, 4)	189.6000	0.000000
DURASI(9, 5)	199.2000	0.000000
DURASI(9, 6)	196.8000	0.000000
DURASI(9, 7)	193.2000	0.000000
DURASI(9, 8)	29.28000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	92.64000	0.000000
DURASI(9, 11)	93.60000	0.000000
DURASI(9, 12)	97.08000	0.000000
DURASI(10, 1)	657.6000	0.000000
DURASI(10, 2)	400.8000	0.000000
DURASI(10, 3)	376.8000	0.000000
DURASI(10, 4)	354.0000	0.000000
DURASI(10, 5)	367.2000	0.000000
DURASI(10, 6)	366.0000	0.000000
DURASI(10, 7)	367.2000	0.000000
DURASI(10, 8)	122.4000	0.000000
DURASI(10, 9)	92.64000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	2.040000	0.000000
DURASI(10, 12)	174.0000	0.000000
DURASI(11, 1)	657.6000	0.000000
DURASI(11, 2)	400.8000	0.000000
DURASI(11, 3)	376.8000	0.000000
DURASI(11, 4)	354.0000	0.000000
DURASI(11, 5)	367.2000	0.000000
DURASI(11, 6)	366.0000	0.000000
DURASI(11, 7)	367.2000	0.000000
DURASI(11, 8)	122.4000	0.000000
DURASI(11, 9)	93.60000	0.000000
DURASI(11, 10)	2.040000	0.000000
DURASI(11, 11)	0.000000	0.000000
DURASI(11, 12)	172.8000	0.000000
DURASI(12, 1)	409.2000	0.000000
DURASI(12, 2)	152.4000	0.000000
DURASI(12, 3)	128.4000	0.000000
DURASI(12, 4)	105.6000	0.000000
DURASI(12, 5)	118.8000	0.000000
DURASI(12, 6)	117.6000	0.000000
DURASI(12, 7)	118.8000	0.000000
DURASI(12, 8)	69.00000	0.000000
DURASI(12, 9)	97.08000	0.000000
DURASI(12, 10)	174.0000	0.000000

DURASI(12, 11)	172.8000	0.000000
DURASI(12, 12)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 5* analisis sensitivitas skenario 5

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..11/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 660 780 540 540 1020 540 540 540;
tutup = 1020 660 1260 780 900 1260 1260 1140 1260 1260 1260;
```

D =

```
!ritel
!0      16      19      20      21      39      40      41      42      43
      49;
0      49.3    161     160     160     312     316     321     321     320
      323     !0;
49.3   0       126     125     125     277     281     287     287     285
      289     !16;
161    126     0       5.4     1.7     171     175     180     181     179
      182     !19;
160    125     5.4     0       3.1     169     173     179     179     177
      180     !20;
160    125     1.7     3.1     0       169     173     179     179     177
      180     !21;
312    277     171     169     169     0       4       10     10     9     14
      !39;
316    281     175     173     173     4       0       9.5    9.8    8.1
      13.2    !40;
```

```

321  287  180  179  179  10  9.5  0  0.9  1.9  9.5
      !41;
321  287  181  179  179  10  9.8  0.9  0  1.7
      10.3  !42;
320  285  179  177  177  9  8.1  1.9  1.7  0
      11.1  !43;
323  289  182  180  180  14  13.2  9.5  10.3  11.1  0;
      !49;

```

```

durasi =
0      59.16 193.2 192  192  374.4 379.2 385.2 385.2 384
      387.6
59.16 0      151.2 150  150  332.4 337.2 344.4 344.4 342
      346.8
193.2 151.2 0      6.48 2.04 205.2 210  216  217.2 214.8
      218.4
192  150  6.48 0      3.72 202.8 207.6 214.8 214.8 212.4
      216
192  150  2.04 3.72 0      202.8 207.6 214.8 214.8 212.4
      216
374.4 332.4 205.2 202.8 202.8 0  4.8  12  12  10.8
      16.8
379.2 337.2 210  207.6 207.6 4.8  0  11.4 11.76 9.72
      15.84
385.2 344.4 216  214.8 214.8 12  11.4 0  1.08 2.28
      11.4
385.2 344.4 217.2 214.8 214.8 12  11.76 1.08 0  2.04
      12.36
384  342  214.8 212.4 212.4 10.8 9.72 2.28 2.04 0
      13.32
387.6 346.8 218.4 216  216  16.8 15.84 11.4 12.36 13.32 0;

```

```

Bongkar= 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;
MIN =

```

```

        @SUM (ritel(i) :
                @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
        @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
        @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
        @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
        @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
        @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
        @BIN(x(i, j)));

End

```


➤ Hasil dari *solution report* pada *cluster 5* analisis sensitivitas skenario 5

Global optimal solution found.

Objective value:	697.6000
Objective bound:	697.6000
Infeasibilities:	0.000000
Extended solver steps:	530
Total solver iterations:	15179
Elapsed runtime seconds:	1.26

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 49.3 km
 rute pengiriman dari ritel 2 ke ritel 4 sebesar 125 km
 rute pengiriman dari ritel 3 ke ritel 5 sebesar 1.7 km
 rute pengiriman dari ritel 4 ke ritel 3 sebesar 5.4 km
 rute pengiriman dari ritel 5 ke ritel 11 sebesar 180 km
 rute pengiriman dari ritel 6 ke ritel 1 sebesar 312 km
 rute pengiriman dari ritel 7 ke ritel 6 sebesar 4 km
 rute pengiriman dari ritel 8 ke ritel 9 sebesar 0.9 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 1.7 km
 rute pengiriman dari ritel 10 ke ritel 7 sebesar 8.1 km
 rute pengiriman dari ritel 11 ke ritel 8 sebesar 9.5 km

Model Class: MILP

Total variables:	132
Nonlinear variables:	0
Integer variables:	121
Total constraints:	154
Nonlinear constraints:	0
Total nonzeros:	780
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000

BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	660.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	1020.000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	780.0000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1140.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
T(1)	1647.600	0.000000
T(2)	540.0000	0.000000
T(3)	756.4800	0.000000
T(4)	720.0000	0.000000
T(5)	804.9600	0.000000
T(6)	1230.000	0.000000
T(7)	1195.200	0.000000
T(8)	1092.360	0.000000
T(9)	1123.440	0.000000
T(10)	1155.480	0.000000
T(11)	1050.960	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	49.30000
X(1, 3)	0.000000	161.0000

X(1, 4)	0.000000	160.0000
X(1, 5)	0.000000	160.0000
X(1, 6)	0.000000	312.0000
X(1, 7)	0.000000	316.0000
X(1, 8)	0.000000	321.0000
X(1, 9)	0.000000	321.0000
X(1, 10)	0.000000	320.0000
X(1, 11)	0.000000	323.0000
X(2, 1)	0.000000	49.30000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	126.0000
X(2, 4)	1.000000	125.0000
X(2, 5)	0.000000	125.0000
X(2, 6)	0.000000	277.0000
X(2, 7)	0.000000	281.0000
X(2, 8)	0.000000	287.0000
X(2, 9)	0.000000	287.0000
X(2, 10)	0.000000	285.0000
X(2, 11)	0.000000	289.0000
X(3, 1)	0.000000	161.0000
X(3, 2)	0.000000	126.0000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	5.400000
X(3, 5)	1.000000	1.700000
X(3, 6)	0.000000	171.0000
X(3, 7)	0.000000	175.0000
X(3, 8)	0.000000	180.0000
X(3, 9)	0.000000	181.0000
X(3, 10)	0.000000	179.0000
X(3, 11)	0.000000	182.0000
X(4, 1)	0.000000	160.0000
X(4, 2)	0.000000	125.0000
X(4, 3)	1.000000	5.400000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	3.100000
X(4, 6)	0.000000	169.0000
X(4, 7)	0.000000	173.0000
X(4, 8)	0.000000	179.0000
X(4, 9)	0.000000	179.0000
X(4, 10)	0.000000	177.0000
X(4, 11)	0.000000	180.0000
X(5, 1)	0.000000	160.0000
X(5, 2)	0.000000	125.0000
X(5, 3)	0.000000	1.700000

X(5, 4)	0.000000	3.100000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	169.0000
X(5, 7)	0.000000	173.0000
X(5, 8)	0.000000	179.0000
X(5, 9)	0.000000	179.0000
X(5, 10)	0.000000	177.0000
X(5, 11)	1.000000	180.0000
X(6, 1)	1.000000	312.0000
X(6, 2)	0.000000	277.0000
X(6, 3)	0.000000	171.0000
X(6, 4)	0.000000	169.0000
X(6, 5)	0.000000	169.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	4.000000
X(6, 8)	0.000000	10.00000
X(6, 9)	0.000000	10.00000
X(6, 10)	0.000000	9.000000
X(6, 11)	0.000000	14.00000
X(7, 1)	0.000000	316.0000
X(7, 2)	0.000000	281.0000
X(7, 3)	0.000000	175.0000
X(7, 4)	0.000000	173.0000
X(7, 5)	0.000000	173.0000
X(7, 6)	1.000000	4.000000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	9.500000
X(7, 9)	0.000000	9.800000
X(7, 10)	0.000000	8.100000
X(7, 11)	0.000000	13.20000
X(8, 1)	0.000000	321.0000
X(8, 2)	0.000000	287.0000
X(8, 3)	0.000000	180.0000
X(8, 4)	0.000000	179.0000
X(8, 5)	0.000000	179.0000
X(8, 6)	0.000000	10.00000
X(8, 7)	0.000000	9.500000
X(8, 8)	0.000000	0.000000
X(8, 9)	1.000000	0.9000000
X(8, 10)	0.000000	1.900000
X(8, 11)	0.000000	9.500000
X(9, 1)	0.000000	321.0000
X(9, 2)	0.000000	287.0000
X(9, 3)	0.000000	181.0000

X(9, 4)	0.000000	179.0000
X(9, 5)	0.000000	179.0000
X(9, 6)	0.000000	10.00000
X(9, 7)	0.000000	9.800000
X(9, 8)	0.000000	0.9000000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	1.700000
X(9, 11)	0.000000	10.30000
X(10, 1)	0.000000	320.0000
X(10, 2)	0.000000	285.0000
X(10, 3)	0.000000	179.0000
X(10, 4)	0.000000	177.0000
X(10, 5)	0.000000	177.0000
X(10, 6)	0.000000	9.000000
X(10, 7)	1.000000	8.100000
X(10, 8)	0.000000	1.900000
X(10, 9)	0.000000	1.700000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	11.10000
X(11, 1)	0.000000	323.0000
X(11, 2)	0.000000	289.0000
X(11, 3)	0.000000	182.0000
X(11, 4)	0.000000	180.0000
X(11, 5)	0.000000	180.0000
X(11, 6)	0.000000	14.00000
X(11, 7)	0.000000	13.20000
X(11, 8)	1.000000	9.500000
X(11, 9)	0.000000	10.30000
X(11, 10)	0.000000	11.10000
X(11, 11)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	49.30000	0.000000
D(1, 3)	161.0000	0.000000
D(1, 4)	160.0000	0.000000
D(1, 5)	160.0000	0.000000
D(1, 6)	312.0000	0.000000
D(1, 7)	316.0000	0.000000
D(1, 8)	321.0000	0.000000
D(1, 9)	321.0000	0.000000
D(1, 10)	320.0000	0.000000
D(1, 11)	323.0000	0.000000
D(2, 1)	49.30000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	126.0000	0.000000

D(2, 4)	125.0000	0.000000
D(2, 5)	125.0000	0.000000
D(2, 6)	277.0000	0.000000
D(2, 7)	281.0000	0.000000
D(2, 8)	287.0000	0.000000
D(2, 9)	287.0000	0.000000
D(2, 10)	285.0000	0.000000
D(2, 11)	289.0000	0.000000
D(3, 1)	161.0000	0.000000
D(3, 2)	126.0000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	5.400000	0.000000
D(3, 5)	1.700000	0.000000
D(3, 6)	171.0000	0.000000
D(3, 7)	175.0000	0.000000
D(3, 8)	180.0000	0.000000
D(3, 9)	181.0000	0.000000
D(3, 10)	179.0000	0.000000
D(3, 11)	182.0000	0.000000
D(4, 1)	160.0000	0.000000
D(4, 2)	125.0000	0.000000
D(4, 3)	5.400000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	3.100000	0.000000
D(4, 6)	169.0000	0.000000
D(4, 7)	173.0000	0.000000
D(4, 8)	179.0000	0.000000
D(4, 9)	179.0000	0.000000
D(4, 10)	177.0000	0.000000
D(4, 11)	180.0000	0.000000
D(5, 1)	160.0000	0.000000
D(5, 2)	125.0000	0.000000
D(5, 3)	1.700000	0.000000
D(5, 4)	3.100000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	169.0000	0.000000
D(5, 7)	173.0000	0.000000
D(5, 8)	179.0000	0.000000
D(5, 9)	179.0000	0.000000
D(5, 10)	177.0000	0.000000
D(5, 11)	180.0000	0.000000
D(6, 1)	312.0000	0.000000
D(6, 2)	277.0000	0.000000
D(6, 3)	171.0000	0.000000

D(6, 4)	169.0000	0.000000
D(6, 5)	169.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	4.000000	0.000000
D(6, 8)	10.00000	0.000000
D(6, 9)	10.00000	0.000000
D(6, 10)	9.000000	0.000000
D(6, 11)	14.00000	0.000000
D(7, 1)	316.0000	0.000000
D(7, 2)	281.0000	0.000000
D(7, 3)	175.0000	0.000000
D(7, 4)	173.0000	0.000000
D(7, 5)	173.0000	0.000000
D(7, 6)	4.000000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	9.500000	0.000000
D(7, 9)	9.800000	0.000000
D(7, 10)	8.100000	0.000000
D(7, 11)	13.20000	0.000000
D(8, 1)	321.0000	0.000000
D(8, 2)	287.0000	0.000000
D(8, 3)	180.0000	0.000000
D(8, 4)	179.0000	0.000000
D(8, 5)	179.0000	0.000000
D(8, 6)	10.00000	0.000000
D(8, 7)	9.500000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	0.9000000	0.000000
D(8, 10)	1.900000	0.000000
D(8, 11)	9.500000	0.000000
D(9, 1)	321.0000	0.000000
D(9, 2)	287.0000	0.000000
D(9, 3)	181.0000	0.000000
D(9, 4)	179.0000	0.000000
D(9, 5)	179.0000	0.000000
D(9, 6)	10.00000	0.000000
D(9, 7)	9.800000	0.000000
D(9, 8)	0.9000000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	1.700000	0.000000
D(9, 11)	10.30000	0.000000
D(10, 1)	320.0000	0.000000
D(10, 2)	285.0000	0.000000
D(10, 3)	179.0000	0.000000

D(10, 4)	177.0000	0.000000
D(10, 5)	177.0000	0.000000
D(10, 6)	9.000000	0.000000
D(10, 7)	8.100000	0.000000
D(10, 8)	1.900000	0.000000
D(10, 9)	1.700000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	11.10000	0.000000
D(11, 1)	323.0000	0.000000
D(11, 2)	289.0000	0.000000
D(11, 3)	182.0000	0.000000
D(11, 4)	180.0000	0.000000
D(11, 5)	180.0000	0.000000
D(11, 6)	14.00000	0.000000
D(11, 7)	13.20000	0.000000
D(11, 8)	9.500000	0.000000
D(11, 9)	10.30000	0.000000
D(11, 10)	11.10000	0.000000
D(11, 11)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	59.16000	0.000000
DURASI(1, 3)	193.2000	0.000000
DURASI(1, 4)	192.0000	0.000000
DURASI(1, 5)	192.0000	0.000000
DURASI(1, 6)	374.4000	0.000000
DURASI(1, 7)	379.2000	0.000000
DURASI(1, 8)	385.2000	0.000000
DURASI(1, 9)	385.2000	0.000000
DURASI(1, 10)	384.0000	0.000000
DURASI(1, 11)	387.6000	0.000000
DURASI(2, 1)	59.16000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	151.2000	0.000000
DURASI(2, 4)	150.0000	0.000000
DURASI(2, 5)	150.0000	0.000000
DURASI(2, 6)	332.4000	0.000000
DURASI(2, 7)	337.2000	0.000000
DURASI(2, 8)	344.4000	0.000000
DURASI(2, 9)	344.4000	0.000000
DURASI(2, 10)	342.0000	0.000000
DURASI(2, 11)	346.8000	0.000000
DURASI(3, 1)	193.2000	0.000000
DURASI(3, 2)	151.2000	0.000000
DURASI(3, 3)	0.000000	0.000000

DURASI(3, 4)	6.480000	0.000000
DURASI(3, 5)	2.040000	0.000000
DURASI(3, 6)	205.2000	0.000000
DURASI(3, 7)	210.0000	0.000000
DURASI(3, 8)	216.0000	0.000000
DURASI(3, 9)	217.2000	0.000000
DURASI(3, 10)	214.8000	0.000000
DURASI(3, 11)	218.4000	0.000000
DURASI(4, 1)	192.0000	0.000000
DURASI(4, 2)	150.0000	0.000000
DURASI(4, 3)	6.480000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	3.720000	0.000000
DURASI(4, 6)	202.8000	0.000000
DURASI(4, 7)	207.6000	0.000000
DURASI(4, 8)	214.8000	0.000000
DURASI(4, 9)	214.8000	0.000000
DURASI(4, 10)	212.4000	0.000000
DURASI(4, 11)	216.0000	0.000000
DURASI(5, 1)	192.0000	0.000000
DURASI(5, 2)	150.0000	0.000000
DURASI(5, 3)	2.040000	0.000000
DURASI(5, 4)	3.720000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	202.8000	0.000000
DURASI(5, 7)	207.6000	0.000000
DURASI(5, 8)	214.8000	0.000000
DURASI(5, 9)	214.8000	0.000000
DURASI(5, 10)	212.4000	0.000000
DURASI(5, 11)	216.0000	0.000000
DURASI(6, 1)	374.4000	0.000000
DURASI(6, 2)	332.4000	0.000000
DURASI(6, 3)	205.2000	0.000000
DURASI(6, 4)	202.8000	0.000000
DURASI(6, 5)	202.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.800000	0.000000
DURASI(6, 8)	12.00000	0.000000
DURASI(6, 9)	12.00000	0.000000
DURASI(6, 10)	10.80000	0.000000
DURASI(6, 11)	16.80000	0.000000
DURASI(7, 1)	379.2000	0.000000
DURASI(7, 2)	337.2000	0.000000
DURASI(7, 3)	210.0000	0.000000

DURASI(7, 4)	207.6000	0.000000
DURASI(7, 5)	207.6000	0.000000
DURASI(7, 6)	4.800000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	11.40000	0.000000
DURASI(7, 9)	11.76000	0.000000
DURASI(7, 10)	9.720000	0.000000
DURASI(7, 11)	15.84000	0.000000
DURASI(8, 1)	385.2000	0.000000
DURASI(8, 2)	344.4000	0.000000
DURASI(8, 3)	216.0000	0.000000
DURASI(8, 4)	214.8000	0.000000
DURASI(8, 5)	214.8000	0.000000
DURASI(8, 6)	12.00000	0.000000
DURASI(8, 7)	11.40000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	1.080000	0.000000
DURASI(8, 10)	2.280000	0.000000
DURASI(8, 11)	11.40000	0.000000
DURASI(9, 1)	385.2000	0.000000
DURASI(9, 2)	344.4000	0.000000
DURASI(9, 3)	217.2000	0.000000
DURASI(9, 4)	214.8000	0.000000
DURASI(9, 5)	214.8000	0.000000
DURASI(9, 6)	12.00000	0.000000
DURASI(9, 7)	11.76000	0.000000
DURASI(9, 8)	1.080000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	2.040000	0.000000
DURASI(9, 11)	12.36000	0.000000
DURASI(10, 1)	384.0000	0.000000
DURASI(10, 2)	342.0000	0.000000
DURASI(10, 3)	214.8000	0.000000
DURASI(10, 4)	212.4000	0.000000
DURASI(10, 5)	212.4000	0.000000
DURASI(10, 6)	10.80000	0.000000
DURASI(10, 7)	9.720000	0.000000
DURASI(10, 8)	2.280000	0.000000
DURASI(10, 9)	2.040000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	13.32000	0.000000
DURASI(11, 1)	387.6000	0.000000
DURASI(11, 2)	346.8000	0.000000
DURASI(11, 3)	218.4000	0.000000

DURASI(11, 4)	216.0000	0.000000
DURASI(11, 5)	216.0000	0.000000
DURASI(11, 6)	16.80000	0.000000
DURASI(11, 7)	15.84000	0.000000
DURASI(11, 8)	11.40000	0.000000
DURASI(11, 9)	12.36000	0.000000
DURASI(11, 10)	13.32000	0.000000
DURASI(11, 11)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 6* analisis sensitivitas skenario 5

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..8/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 1020 540 900 780 660;
tutup = 1020 660 1260 1140 1260 1020 900 780;
```

D =

```
!ritel
!0    4    17    18    22    23    24    28;
0    12.3  115  115  193  102  93  157  !0;
12.3  0    120  121  198  83.1  75.1  148  !4;
115  120  0    1.1  96.1  83  96.4  45.8  !17;
115  121  1.1  0    95  84.5  97.8  46  !18;
193  198  96.1  95  0    194  266  103  !22;
102  83.1  83  84.5  194  0    14.9  75.3  !23;
93  75.1  96.4  97.8  266  14.9  0    76.6  !24;
157  148  45.8  46  103  75.3  76.6  0;  !28;
```

durasi =

```
0    14.76  138  138  231.6  122.4  111.6  188.4
14.76  0    144  145.2  237.6  99.72  90.12  177.6
138  144  0    1.32  115.32  99.6  115.68  54.96
138  145.2  1.32  0    114  101.4  117.36  55.2
```

```

231.6 237.6 115.32      114    0      232.8 319.2 123.6
122.4 99.72 99.6   101.4 232.8 0      17.88 90.36
111.6 90.12 115.68      117.36      319.2 17.88 0      91.92
188.4 177.6 54.96 55.2  123.6 90.36 91.92 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

```

```

!Fungsi batasan;

```

```

!setiap ritel dikunjungi satu kali;

```

```

@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

```

```

!perjalanan diawali dari depot;

```

```

@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

```

```

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

```

```

!pelaksanaan;

```

```

@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

```

```

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 6* analisis sensitivitas skenario 5

Global optimal solution found.

Objective value:	623.9000
Objective bound:	623.9000
Infeasibilities:	0.000000
Extended solver steps:	0
Total solver iterations:	1
Elapsed runtime seconds:	0.11

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 12.3 km
rute pengiriman dari ritel 2 ke ritel 8 sebesar 148 km
rute pengiriman dari ritel 3 ke ritel 4 sebesar 1.1 km
rute pengiriman dari ritel 4 ke ritel 5 sebesar 95 km
rute pengiriman dari ritel 5 ke ritel 1 sebesar 193 km
rute pengiriman dari ritel 6 ke ritel 3 sebesar 83 km
rute pengiriman dari ritel 7 ke ritel 6 sebesar 14.9 km
rute pengiriman dari ritel 8 ke ritel 7 sebesar 76.59999999999999 km
Model Class: MILP

Total variables:	72
Nonlinear variables:	0

Integer variables: 64
 Total constraints: 88
 Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	1020.000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	900.0000	0.000000
BUKA(7)	780.0000	0.000000
BUKA(8)	660.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1140.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1020.000	0.000000
TUTUP(7)	900.0000	0.000000
TUTUP(8)	780.0000	0.000000
T(1)	1491.600	0.000000
T(2)	540.0000	0.000000
T(3)	1047.000	0.000000
T(4)	1078.320	0.000000
T(5)	1230.000	0.000000
T(6)	917.4000	0.000000
T(7)	869.5200	0.000000
T(8)	747.6000	0.000000

X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	12.30000
X(1, 3)	0.000000	115.0000
X(1, 4)	0.000000	115.0000
X(1, 5)	0.000000	193.0000
X(1, 6)	0.000000	102.0000
X(1, 7)	0.000000	93.00000
X(1, 8)	0.000000	157.0000
X(2, 1)	0.000000	12.30000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	120.0000
X(2, 4)	0.000000	121.0000
X(2, 5)	0.000000	198.0000
X(2, 6)	0.000000	83.10000
X(2, 7)	0.000000	75.10000
X(2, 8)	1.000000	148.0000
X(3, 1)	0.000000	115.0000
X(3, 2)	0.000000	120.0000
X(3, 3)	0.000000	0.000000
X(3, 4)	1.000000	1.100000
X(3, 5)	0.000000	96.10000
X(3, 6)	0.000000	83.00000
X(3, 7)	0.000000	96.40000
X(3, 8)	0.000000	45.80000
X(4, 1)	0.000000	115.0000
X(4, 2)	0.000000	121.0000
X(4, 3)	0.000000	1.100000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	95.00000
X(4, 6)	0.000000	84.50000
X(4, 7)	0.000000	97.80000
X(4, 8)	0.000000	46.00000
X(5, 1)	1.000000	193.0000
X(5, 2)	0.000000	198.0000
X(5, 3)	0.000000	96.10000
X(5, 4)	0.000000	95.00000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	194.0000
X(5, 7)	0.000000	266.0000
X(5, 8)	0.000000	103.0000
X(6, 1)	0.000000	102.0000
X(6, 2)	0.000000	83.10000
X(6, 3)	1.000000	83.00000
X(6, 4)	0.000000	84.50000

X(6, 5)	0.000000	194.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	14.90000
X(6, 8)	0.000000	75.30000
X(7, 1)	0.000000	93.00000
X(7, 2)	0.000000	75.10000
X(7, 3)	0.000000	96.40000
X(7, 4)	0.000000	97.80000
X(7, 5)	0.000000	266.0000
X(7, 6)	1.000000	14.90000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	76.60000
X(8, 1)	0.000000	157.0000
X(8, 2)	0.000000	148.0000
X(8, 3)	0.000000	45.80000
X(8, 4)	0.000000	46.00000
X(8, 5)	0.000000	103.0000
X(8, 6)	0.000000	75.30000
X(8, 7)	1.000000	76.60000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	12.30000	0.000000
D(1, 3)	115.0000	0.000000
D(1, 4)	115.0000	0.000000
D(1, 5)	193.0000	0.000000
D(1, 6)	102.0000	0.000000
D(1, 7)	93.00000	0.000000
D(1, 8)	157.0000	0.000000
D(2, 1)	12.30000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	120.0000	0.000000
D(2, 4)	121.0000	0.000000
D(2, 5)	198.0000	0.000000
D(2, 6)	83.10000	0.000000
D(2, 7)	75.10000	0.000000
D(2, 8)	148.0000	0.000000
D(3, 1)	115.0000	0.000000
D(3, 2)	120.0000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	1.100000	0.000000
D(3, 5)	96.10000	0.000000
D(3, 6)	83.00000	0.000000
D(3, 7)	96.40000	0.000000
D(3, 8)	45.80000	0.000000

D(4, 1)	115.0000	0.000000
D(4, 2)	121.0000	0.000000
D(4, 3)	1.100000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	95.00000	0.000000
D(4, 6)	84.50000	0.000000
D(4, 7)	97.80000	0.000000
D(4, 8)	46.00000	0.000000
D(5, 1)	193.0000	0.000000
D(5, 2)	198.0000	0.000000
D(5, 3)	96.10000	0.000000
D(5, 4)	95.00000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	194.0000	0.000000
D(5, 7)	266.0000	0.000000
D(5, 8)	103.0000	0.000000
D(6, 1)	102.0000	0.000000
D(6, 2)	83.10000	0.000000
D(6, 3)	83.00000	0.000000
D(6, 4)	84.50000	0.000000
D(6, 5)	194.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	14.90000	0.000000
D(6, 8)	75.30000	0.000000
D(7, 1)	93.00000	0.000000
D(7, 2)	75.10000	0.000000
D(7, 3)	96.40000	0.000000
D(7, 4)	97.80000	0.000000
D(7, 5)	266.0000	0.000000
D(7, 6)	14.90000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	76.60000	0.000000
D(8, 1)	157.0000	0.000000
D(8, 2)	148.0000	0.000000
D(8, 3)	45.80000	0.000000
D(8, 4)	46.00000	0.000000
D(8, 5)	103.0000	0.000000
D(8, 6)	75.30000	0.000000
D(8, 7)	76.60000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	14.76000	0.000000
DURASI(1, 3)	138.0000	0.000000
DURASI(1, 4)	138.0000	0.000000

DURASI(1, 5)	231.6000	0.000000
DURASI(1, 6)	122.4000	0.000000
DURASI(1, 7)	111.6000	0.000000
DURASI(1, 8)	188.4000	0.000000
DURASI(2, 1)	14.76000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	144.0000	0.000000
DURASI(2, 4)	145.2000	0.000000
DURASI(2, 5)	237.6000	0.000000
DURASI(2, 6)	99.72000	0.000000
DURASI(2, 7)	90.12000	0.000000
DURASI(2, 8)	177.6000	0.000000
DURASI(3, 1)	138.0000	0.000000
DURASI(3, 2)	144.0000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	1.320000	0.000000
DURASI(3, 5)	115.3200	0.000000
DURASI(3, 6)	99.60000	0.000000
DURASI(3, 7)	115.6800	0.000000
DURASI(3, 8)	54.96000	0.000000
DURASI(4, 1)	138.0000	0.000000
DURASI(4, 2)	145.2000	0.000000
DURASI(4, 3)	1.320000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	114.0000	0.000000
DURASI(4, 6)	101.4000	0.000000
DURASI(4, 7)	117.3600	0.000000
DURASI(4, 8)	55.20000	0.000000
DURASI(5, 1)	231.6000	0.000000
DURASI(5, 2)	237.6000	0.000000
DURASI(5, 3)	115.3200	0.000000
DURASI(5, 4)	114.0000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	232.8000	0.000000
DURASI(5, 7)	319.2000	0.000000
DURASI(5, 8)	123.6000	0.000000
DURASI(6, 1)	122.4000	0.000000
DURASI(6, 2)	99.72000	0.000000
DURASI(6, 3)	99.60000	0.000000
DURASI(6, 4)	101.4000	0.000000
DURASI(6, 5)	232.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	17.88000	0.000000
DURASI(6, 8)	90.36000	0.000000

DURASI(7, 1)	111.6000	0.000000
DURASI(7, 2)	90.12000	0.000000
DURASI(7, 3)	115.6800	0.000000
DURASI(7, 4)	117.3600	0.000000
DURASI(7, 5)	319.2000	0.000000
DURASI(7, 6)	17.88000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	91.92000	0.000000
DURASI(8, 1)	188.4000	0.000000
DURASI(8, 2)	177.6000	0.000000
DURASI(8, 3)	54.96000	0.000000
DURASI(8, 4)	55.20000	0.000000
DURASI(8, 5)	123.6000	0.000000
DURASI(8, 6)	90.36000	0.000000
DURASI(8, 7)	91.92000	0.000000
DURASI(8, 8)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 7* analisis sensitivitas skenario 5

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..8/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 660 780 1020 540 540;
tutup = 1020 660 1260 780 900 1140 1260 1260;
```

D =

```
!ritel
!0   12   13   14   15   25   26   27;
0    146  190  192  194  92.2  93.8  93   !0;
146  0    63.4  64.1  66.9  157   159   158  !12;
190  63.4  0    3.2   5.9   200   201   201  !13;
192  64.1  3.2   0    2.9   203   205   204  !14;
194  66.9  5.9   2.9   0    204   206   205  !15;
92.2 157   200   203   204   0    3.1   1.4  !25;
93.8 159   201   205   206   3.1   0    4    !26;
93   158   201   204   205   1.4   4    0;   !27;
```

durasi =

```
0    175.2  228   230.4  232.8  110.64   112.56   111.6
175.2 0    76.08  76.92  80.28  188.4   190.8   189.6
228  76.08 0    3.84   7.08   240    241.2   241.2
230.4 76.92 3.84 0    3.48   243.6  246    244.8
232.8 80.28 7.08 3.48 0    244.8  247.2  246
```

```

110.64      188.4 240    243.6 244.8 0      3.72  1.68
112.56      190.8 241.2 246    247.2 3.72  0      4.8
111.6 189.6 241.2 244.8 246    1.68  4.8   0;

```

```

Bongkar = 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

```

```

!Fungsi batasan;

```

```

!setiap ritel dikunjungi satu kali;

```

```

@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

```

```

!perjalanan diawali dari depot;

```

```

@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

```

```

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

```

```

!pelaksanaan;

```

```

@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

```

```

!rute;

```

```

@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 7* analisis sensitivitas skenario 5

Global optimal solution found.

Objective value:	518.1000
Objective bound:	518.1000
Infeasibilities:	0.000000
Extended solver steps:	0
Total solver iterations:	431
Elapsed runtime seconds:	0.13

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 146 km
rute pengiriman dari ritel 2 ke ritel 4 sebesar 64.09999999999999 km
rute pengiriman dari ritel 3 ke ritel 6 sebesar 200 km
rute pengiriman dari ritel 4 ke ritel 5 sebesar 2.9 km
rute pengiriman dari ritel 5 ke ritel 3 sebesar 5.9 km
rute pengiriman dari ritel 6 ke ritel 8 sebesar 1.4 km
rute pengiriman dari ritel 7 ke ritel 1 sebesar 93.8 km
rute pengiriman dari ritel 8 ke ritel 7 sebesar 4 km

Model Class: MILP

Total variables:	72
Nonlinear variables:	0
Integer variables:	64

Total constraints: 88
 Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	660.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	1020.000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	780.0000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	1140.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
T(1)	1488.000	0.000000
T(2)	540.0000	0.000000
T(3)	817.0800	0.000000
T(4)	660.0000	0.000000
T(5)	780.0000	0.000000
T(6)	1088.080	0.000000
T(7)	1230.000	0.000000
T(8)	1141.680	0.000000
X(1, 1)	0.000000	0.000000

X(1, 2)	1.000000	146.0000
X(1, 3)	0.000000	190.0000
X(1, 4)	0.000000	192.0000
X(1, 5)	0.000000	194.0000
X(1, 6)	0.000000	92.20000
X(1, 7)	0.000000	93.80000
X(1, 8)	0.000000	93.00000
X(2, 1)	0.000000	146.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	63.40000
X(2, 4)	1.000000	64.10000
X(2, 5)	0.000000	66.90000
X(2, 6)	0.000000	157.0000
X(2, 7)	0.000000	159.0000
X(2, 8)	0.000000	158.0000
X(3, 1)	0.000000	190.0000
X(3, 2)	0.000000	63.40000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	3.200000
X(3, 5)	0.000000	5.900000
X(3, 6)	1.000000	200.0000
X(3, 7)	0.000000	201.0000
X(3, 8)	0.000000	201.0000
X(4, 1)	0.000000	192.0000
X(4, 2)	0.000000	64.10000
X(4, 3)	0.000000	3.200000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	2.900000
X(4, 6)	0.000000	203.0000
X(4, 7)	0.000000	205.0000
X(4, 8)	0.000000	204.0000
X(5, 1)	0.000000	194.0000
X(5, 2)	0.000000	66.90000
X(5, 3)	1.000000	5.900000
X(5, 4)	0.000000	2.900000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	204.0000
X(5, 7)	0.000000	206.0000
X(5, 8)	0.000000	205.0000
X(6, 1)	0.000000	92.20000
X(6, 2)	0.000000	157.0000
X(6, 3)	0.000000	200.0000
X(6, 4)	0.000000	203.0000
X(6, 5)	0.000000	204.0000

X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.100000
X(6, 8)	1.000000	1.400000
X(7, 1)	1.000000	93.80000
X(7, 2)	0.000000	159.0000
X(7, 3)	0.000000	201.0000
X(7, 4)	0.000000	205.0000
X(7, 5)	0.000000	206.0000
X(7, 6)	0.000000	3.100000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	4.000000
X(8, 1)	0.000000	93.00000
X(8, 2)	0.000000	158.0000
X(8, 3)	0.000000	201.0000
X(8, 4)	0.000000	204.0000
X(8, 5)	0.000000	205.0000
X(8, 6)	0.000000	1.400000
X(8, 7)	1.000000	4.000000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	146.0000	0.000000
D(1, 3)	190.0000	0.000000
D(1, 4)	192.0000	0.000000
D(1, 5)	194.0000	0.000000
D(1, 6)	92.20000	0.000000
D(1, 7)	93.80000	0.000000
D(1, 8)	93.00000	0.000000
D(2, 1)	146.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	63.40000	0.000000
D(2, 4)	64.10000	0.000000
D(2, 5)	66.90000	0.000000
D(2, 6)	157.0000	0.000000
D(2, 7)	159.0000	0.000000
D(2, 8)	158.0000	0.000000
D(3, 1)	190.0000	0.000000
D(3, 2)	63.40000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	3.200000	0.000000
D(3, 5)	5.900000	0.000000
D(3, 6)	200.0000	0.000000
D(3, 7)	201.0000	0.000000
D(3, 8)	201.0000	0.000000
D(4, 1)	192.0000	0.000000

D(4, 2)	64.10000	0.000000
D(4, 3)	3.200000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	2.900000	0.000000
D(4, 6)	203.0000	0.000000
D(4, 7)	205.0000	0.000000
D(4, 8)	204.0000	0.000000
D(5, 1)	194.0000	0.000000
D(5, 2)	66.90000	0.000000
D(5, 3)	5.900000	0.000000
D(5, 4)	2.900000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	204.0000	0.000000
D(5, 7)	206.0000	0.000000
D(5, 8)	205.0000	0.000000
D(6, 1)	92.20000	0.000000
D(6, 2)	157.0000	0.000000
D(6, 3)	200.0000	0.000000
D(6, 4)	203.0000	0.000000
D(6, 5)	204.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.100000	0.000000
D(6, 8)	1.400000	0.000000
D(7, 1)	93.80000	0.000000
D(7, 2)	159.0000	0.000000
D(7, 3)	201.0000	0.000000
D(7, 4)	205.0000	0.000000
D(7, 5)	206.0000	0.000000
D(7, 6)	3.100000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	4.000000	0.000000
D(8, 1)	93.00000	0.000000
D(8, 2)	158.0000	0.000000
D(8, 3)	201.0000	0.000000
D(8, 4)	204.0000	0.000000
D(8, 5)	205.0000	0.000000
D(8, 6)	1.400000	0.000000
D(8, 7)	4.000000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	175.2000	0.000000
DURASI(1, 3)	228.0000	0.000000
DURASI(1, 4)	230.4000	0.000000
DURASI(1, 5)	232.8000	0.000000

DURASI(1, 6)	110.6400	0.000000
DURASI(1, 7)	112.5600	0.000000
DURASI(1, 8)	111.6000	0.000000
DURASI(2, 1)	175.2000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	76.08000	0.000000
DURASI(2, 4)	76.92000	0.000000
DURASI(2, 5)	80.28000	0.000000
DURASI(2, 6)	188.4000	0.000000
DURASI(2, 7)	190.8000	0.000000
DURASI(2, 8)	189.6000	0.000000
DURASI(3, 1)	228.0000	0.000000
DURASI(3, 2)	76.08000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	3.840000	0.000000
DURASI(3, 5)	7.080000	0.000000
DURASI(3, 6)	240.0000	0.000000
DURASI(3, 7)	241.2000	0.000000
DURASI(3, 8)	241.2000	0.000000
DURASI(4, 1)	230.4000	0.000000
DURASI(4, 2)	76.92000	0.000000
DURASI(4, 3)	3.840000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	3.480000	0.000000
DURASI(4, 6)	243.6000	0.000000
DURASI(4, 7)	246.0000	0.000000
DURASI(4, 8)	244.8000	0.000000
DURASI(5, 1)	232.8000	0.000000
DURASI(5, 2)	80.28000	0.000000
DURASI(5, 3)	7.080000	0.000000
DURASI(5, 4)	3.480000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	244.8000	0.000000
DURASI(5, 7)	247.2000	0.000000
DURASI(5, 8)	246.0000	0.000000
DURASI(6, 1)	110.6400	0.000000
DURASI(6, 2)	188.4000	0.000000
DURASI(6, 3)	240.0000	0.000000
DURASI(6, 4)	243.6000	0.000000
DURASI(6, 5)	244.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	3.720000	0.000000
DURASI(6, 8)	1.680000	0.000000
DURASI(7, 1)	112.5600	0.000000

DURASI(7, 2)	190.8000	0.000000
DURASI(7, 3)	241.2000	0.000000
DURASI(7, 4)	246.0000	0.000000
DURASI(7, 5)	247.2000	0.000000
DURASI(7, 6)	3.720000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	4.800000	0.000000
DURASI(8, 1)	111.6000	0.000000
DURASI(8, 2)	189.6000	0.000000
DURASI(8, 3)	241.2000	0.000000
DURASI(8, 4)	244.8000	0.000000
DURASI(8, 5)	246.0000	0.000000
DURASI(8, 6)	1.680000	0.000000
DURASI(8, 7)	4.800000	0.000000
DURASI(8, 8)	0.000000	0.000000

Lampiran 16 (Pemrograman Lingo Untuk Analisis Sensitivitas Skenario 6)

- Hasil dari *solution report* pada *cluster 1* analisis sensitivitas skenario 6

Global optimal solution found.

Objective value: 59.40000
 Objective bound: 59.40000
 Infeasibilities: 0.000000
 Extended solver steps: 0
 Total solver iterations: 188
 Elapsed runtime seconds: 0.11

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 8.9 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 6.8 km
 rute pengiriman dari ritel 3 ke ritel 7 sebesar 8.1 km
 rute pengiriman dari ritel 4 ke ritel 1 sebesar 19.7 km
 rute pengiriman dari ritel 5 ke ritel 8 sebesar 3.4 km
 rute pengiriman dari ritel 6 ke ritel 4 sebesar 4.6 km
 rute pengiriman dari ritel 7 ke ritel 5 sebesar 5.4 km
 rute pengiriman dari ritel 8 ke ritel 6 sebesar 2.5 km

Model Class: MILP

Total variables: 72
 Nonlinear variables: 0
 Integer variables: 64
 Total constraints: 88
 Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000

BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	660.0000	0.000000
BUKA(4)	1140.000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	1020.000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	900.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	780.0000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	1140.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1020.000	0.000000
T(1)	1283.640	0.000000
T(2)	540.0000	0.000000
T(3)	660.0000	0.000000
T(4)	1230.000	0.000000
T(5)	870.0000	0.000000
T(6)	1110.000	0.000000
T(7)	699.7200	0.000000
T(8)	990.0000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	8.900000
X(1, 3)	0.000000	13.60000
X(1, 4)	0.000000	19.70000
X(1, 5)	0.000000	20.70000
X(1, 6)	0.000000	21.50000
X(1, 7)	0.000000	19.20000
X(1, 8)	0.000000	18.10000
X(2, 1)	0.000000	8.900000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	6.800000
X(2, 4)	0.000000	13.30000
X(2, 5)	0.000000	14.60000
X(2, 6)	0.000000	13.10000
X(2, 7)	0.000000	10.90000
X(2, 8)	0.000000	8.700000
X(3, 1)	0.000000	13.60000

X(3, 2)	0.000000	6.800000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	7.900000
X(3, 5)	0.000000	10.30000
X(3, 6)	0.000000	10.50000
X(3, 7)	1.000000	8.100000
X(3, 8)	0.000000	9.400000
X(4, 1)	1.000000	19.70000
X(4, 2)	0.000000	13.30000
X(4, 3)	0.000000	7.900000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	3.900000
X(4, 6)	0.000000	4.600000
X(4, 7)	0.000000	4.600000
X(4, 8)	0.000000	5.600000
X(5, 1)	0.000000	20.70000
X(5, 2)	0.000000	14.60000
X(5, 3)	0.000000	10.30000
X(5, 4)	0.000000	3.900000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	2.600000
X(5, 7)	0.000000	5.400000
X(5, 8)	1.000000	3.400000
X(6, 1)	0.000000	21.50000
X(6, 2)	0.000000	13.10000
X(6, 3)	0.000000	10.50000
X(6, 4)	1.000000	4.600000
X(6, 5)	0.000000	2.600000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.600000
X(6, 8)	0.000000	2.500000
X(7, 1)	0.000000	19.20000
X(7, 2)	0.000000	10.90000
X(7, 3)	0.000000	8.100000
X(7, 4)	0.000000	4.600000
X(7, 5)	1.000000	5.400000
X(7, 6)	0.000000	3.600000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	2.800000
X(8, 1)	0.000000	18.10000
X(8, 2)	0.000000	8.700000
X(8, 3)	0.000000	9.400000
X(8, 4)	0.000000	5.600000
X(8, 5)	0.000000	3.400000

X(8, 6)	1.000000	2.500000
X(8, 7)	0.000000	2.800000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	8.900000	0.000000
D(1, 3)	13.60000	0.000000
D(1, 4)	19.70000	0.000000
D(1, 5)	20.70000	0.000000
D(1, 6)	21.50000	0.000000
D(1, 7)	19.20000	0.000000
D(1, 8)	18.10000	0.000000
D(2, 1)	8.900000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	6.800000	0.000000
D(2, 4)	13.30000	0.000000
D(2, 5)	14.60000	0.000000
D(2, 6)	13.10000	0.000000
D(2, 7)	10.90000	0.000000
D(2, 8)	8.700000	0.000000
D(3, 1)	13.60000	0.000000
D(3, 2)	6.800000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	7.900000	0.000000
D(3, 5)	10.30000	0.000000
D(3, 6)	10.50000	0.000000
D(3, 7)	8.100000	0.000000
D(3, 8)	9.400000	0.000000
D(4, 1)	19.70000	0.000000
D(4, 2)	13.30000	0.000000
D(4, 3)	7.900000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	3.900000	0.000000
D(4, 6)	4.600000	0.000000
D(4, 7)	4.600000	0.000000
D(4, 8)	5.600000	0.000000
D(5, 1)	20.70000	0.000000
D(5, 2)	14.60000	0.000000
D(5, 3)	10.30000	0.000000
D(5, 4)	3.900000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	2.600000	0.000000
D(5, 7)	5.400000	0.000000
D(5, 8)	3.400000	0.000000
D(6, 1)	21.50000	0.000000

D(6, 2)	13.10000	0.000000
D(6, 3)	10.50000	0.000000
D(6, 4)	4.600000	0.000000
D(6, 5)	2.600000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.600000	0.000000
D(6, 8)	2.500000	0.000000
D(7, 1)	19.20000	0.000000
D(7, 2)	10.90000	0.000000
D(7, 3)	8.100000	0.000000
D(7, 4)	4.600000	0.000000
D(7, 5)	5.400000	0.000000
D(7, 6)	3.600000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	2.800000	0.000000
D(8, 1)	18.10000	0.000000
D(8, 2)	8.700000	0.000000
D(8, 3)	9.400000	0.000000
D(8, 4)	5.600000	0.000000
D(8, 5)	3.400000	0.000000
D(8, 6)	2.500000	0.000000
D(8, 7)	2.800000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	10.68000	0.000000
DURASI(1, 3)	16.32000	0.000000
DURASI(1, 4)	23.64000	0.000000
DURASI(1, 5)	24.84000	0.000000
DURASI(1, 6)	25.80000	0.000000
DURASI(1, 7)	23.04000	0.000000
DURASI(1, 8)	21.72000	0.000000
DURASI(2, 1)	10.68000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	8.160000	0.000000
DURASI(2, 4)	15.96000	0.000000
DURASI(2, 5)	17.52000	0.000000
DURASI(2, 6)	15.72000	0.000000
DURASI(2, 7)	13.08000	0.000000
DURASI(2, 8)	10.44000	0.000000
DURASI(3, 1)	16.32000	0.000000
DURASI(3, 2)	8.160000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	9.480000	0.000000
DURASI(3, 5)	12.36000	0.000000

DURASI(3, 6)	12.60000	0.000000
DURASI(3, 7)	9.720000	0.000000
DURASI(3, 8)	11.28000	0.000000
DURASI(4, 1)	23.64000	0.000000
DURASI(4, 2)	15.96000	0.000000
DURASI(4, 3)	9.480000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	4.680000	0.000000
DURASI(4, 6)	5.520000	0.000000
DURASI(4, 7)	5.520000	0.000000
DURASI(4, 8)	6.720000	0.000000
DURASI(5, 1)	24.84000	0.000000
DURASI(5, 2)	17.52000	0.000000
DURASI(5, 3)	12.36000	0.000000
DURASI(5, 4)	4.680000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	3.120000	0.000000
DURASI(5, 7)	6.480000	0.000000
DURASI(5, 8)	4.080000	0.000000
DURASI(6, 1)	25.80000	0.000000
DURASI(6, 2)	15.72000	0.000000
DURASI(6, 3)	12.60000	0.000000
DURASI(6, 4)	5.520000	0.000000
DURASI(6, 5)	3.120000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.320000	0.000000
DURASI(6, 8)	3.000000	0.000000
DURASI(7, 1)	23.04000	0.000000
DURASI(7, 2)	13.08000	0.000000
DURASI(7, 3)	9.720000	0.000000
DURASI(7, 4)	5.520000	0.000000
DURASI(7, 5)	6.480000	0.000000
DURASI(7, 6)	4.320000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	3.360000	0.000000
DURASI(8, 1)	21.72000	0.000000
DURASI(8, 2)	10.44000	0.000000
DURASI(8, 3)	11.28000	0.000000
DURASI(8, 4)	6.720000	0.000000
DURASI(8, 5)	4.080000	0.000000
DURASI(8, 6)	3.000000	0.000000
DURASI(8, 7)	3.360000	0.000000
DURASI(8, 8)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 2* analisis sensitivitas skenario 6

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..16/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 1140 540 660 540 900 780 540 1020 540 540 540
540 540 540;
tutup = 1020 660 1260 1260 780 1260 1020 900 1260 1140 1260
1260 1260 1260 1260 1260;
```

D =

```
!ritel
1      2      3      4      5      6      7      8      9      10     11
      12     13     14     15     16
!0     3      6      7      29     30     31     32     50     51     52
      53     54     55     57     60;
0      8.3   41.1  39.6  227   275   324   322   353   353
      351   348   347   347   353   435   !0;
8.3   0      24.4  33    220   268   317   315   346   346
      344   341   341   340   347   428   !3;
41.1  24.4  0      7.5   127   300   208   238   377   377
      376   372   372   372   378   459   !6;
39.6  33     7.5   0      133   297   215   343   374   374
      372   369   369   368   375   456   !7;
```

227	220	127	133	0	85	102	134	230	230	
	228	225	224	224	230	312	!29;			
275	268	300	297	85	0	48	50	71	65	64
	55	71	69	66	166	!30;				
324	317	208	215	102	48	0	28	87	81	80
	81	87	85	82	182	!31;				
322	315	238	343	134	50	28	0	61	55	54
	55	61	59	56	156	!32;				
353	346	377	374	230	71	87	61	0	6.7	5.9
	10	4.8	4.3	7.4	98.2	!50;				
353	346	377	374	230	65	81	55	6.7	0	1.9
	10.3	5.9	4.8	1.8	97.5	!51;				
351	344	376	372	228	64	80	54	5.9	1.9	0
	8.8	9.8	5.3	3.4	100	!52;				
348	341	372	369	225	55	81	55	10	10.3	8.8
	0	10.6	6.2	10.7	105	!53;				
347	341	372	369	224	71	87	61	4.8	5.9	9.8
	10.6	0	4.3	3.5	93.4	!54;				
347	340	372	368	224	69	85	59	4.3	4.8	5.3
	6.2	4.3	0	6.3	101	!55;				
353	347	378	375	230	66	82	56	7.4	1.8	3.4
	10.7	3.5	6.3	0	97.9	!57;				
435	428	459	456	312	166	182	156	98.2	97.5	
	100	105	93.4	101	97.9	0;	!60;			

durasi =

0	9.96	49.32	47.52	272.4	330	388.8	386.4	423.6	423.6	
	421.2	417.6	416.4	416.4	423.6	522				
9.96	0	29.28	39.6	264	321.6	380.4	378	415.2	415.2	
	412.8	409.2	409.2	408	416.4	513.6				
49.32	29.28	0	9	152.4	360	249.6	285.6	452.4	452.4	
	451.2	446.4	446.4	446.4	453.6	550.8				
47.52	39.6	9	0	159.6	356.4	258	411.6	448.8	448.8	
	446.4	442.8	442.8	441.6	450	547.2				
272.4	264	152.4	159.6	0	102	122.4	160.8	276	276	
	273.6	270	268.8	268.8	276	374.4				
330	321.6	360	356.4	102	0	57.6	60	85.2	78	
	76.8	66	85.2	82.8	79.2	199.2				
388.8	380.4	249.6	258	122.4	57.6	0	33.6	104.4	97.2	96
	97.2	104.4	102	98.4	218.4					
386.4	378	285.6	411.6	160.8	60	33.6	0	73.2	66	
	64.8	66	73.2	70.8	67.2	187.2				
423.6	415.2	452.4	448.8	276	85.2	104.4	73.2	0	8.04	
	7.08	12	5.76	5.16	8.88	117.84				

```

423.6 415.2 452.4 448.8 276 78 97.2 66 8.04 0
      2.28 12.36 7.08 5.76 2.16 117
421.2 412.8 451.2 446.4 273.6 76.8 96 64.8 7.08 2.28 0
      10.56 11.76 6.36 4.08 120
417.6 409.2 446.4 442.8 270 66 97.2 66 12 12.36
      10.56 0 12.72 7.44 12.84 126
416.4 409.2 446.4 442.8 268.8 85.2 104.4 73.2 5.76 7.08
      11.76 12.72 0 5.16 4.2 112.08
416.4 408 446.4 441.6 268.8 82.8 102 70.8 5.16 5.76
      6.36 7.44 5.16 0 7.56 121.2
423.6 416.4 453.6 450 276 79.2 98.4 67.2 8.88 2.16
      4.08 12.84 4.2 7.56 0 117.48
522 513.6 550.8 547.2 374.4 199.2 218.4 187.2 117.84
      117 120 126 112.08 121.2 117.48 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) - R * (1 -
x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 2* analisis sensitivitas skenario 6

Feasible solution found.	
Objective value:	1361.900
Objective bound:	673.7000
Infeasibilities:	0.000000
Extended solver steps:	3531
Total solver iterations:	23746
Elapsed runtime seconds:	6.38

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 8.300000000000001 km

rute pengiriman dari ritel 2 ke ritel 12 sebesar 341 km

rute pengiriman dari ritel 3 ke ritel 4 sebesar 7.5 km

rute pengiriman dari ritel 4 ke ritel 1 sebesar 39.6 km
 rute pengiriman dari ritel 5 ke ritel 8 sebesar 134 km
 rute pengiriman dari ritel 6 ke ritel 5 sebesar 85 km
 rute pengiriman dari ritel 7 ke ritel 11 sebesar 80 km
 rute pengiriman dari ritel 8 ke ritel 7 sebesar 28 km
 rute pengiriman dari ritel 9 ke ritel 16 sebesar 98.2 km
 rute pengiriman dari ritel 10 ke ritel 3 sebesar 377 km
 rute pengiriman dari ritel 11 ke ritel 14 sebesar 5.3 km
 rute pengiriman dari ritel 12 ke ritel 6 sebesar 55 km
 rute pengiriman dari ritel 13 ke ritel 15 sebesar 3.5 km
 rute pengiriman dari ritel 14 ke ritel 9 sebesar 4.3 km
 rute pengiriman dari ritel 15 ke ritel 10 sebesar 1.8 km
 rute pengiriman dari ritel 16 ke ritel 13 sebesar 93.40000000000001 km

Model Class: MILP

Total variables:	272
Nonlinear variables:	0
Integer variables:	256
Total constraints:	304
Nonlinear constraints:	0
Total nonzeros:	1695
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BONGKAR(12)	30.00000	0.000000
BONGKAR(13)	30.00000	0.000000
BONGKAR(14)	30.00000	0.000000
BONGKAR(15)	30.00000	0.000000

BONGKAR(16)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	1140.000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	660.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	900.0000	0.000000
BUKA(8)	780.0000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	1020.000	0.000000
BUKA(11)	540.0000	0.000000
BUKA(12)	540.0000	0.000000
BUKA(13)	540.0000	0.000000
BUKA(14)	540.0000	0.000000
BUKA(15)	540.0000	0.000000
BUKA(16)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	780.0000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1020.000	0.000000
TUTUP(8)	900.0000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1140.000	0.000000
TUTUP(11)	1260.000	0.000000
TUTUP(12)	1260.000	0.000000
TUTUP(13)	1260.000	0.000000
TUTUP(14)	1260.000	0.000000
TUTUP(15)	1260.000	0.000000
TUTUP(16)	1260.000	0.000000
T(1)	1260.000	0.000000
T(2)	570.0000	0.000000
T(3)	1140.000	0.000000
T(4)	1170.000	0.000000
T(5)	750.0000	0.000000
T(6)	720.0000	0.000000
T(7)	900.0000	0.000000
T(8)	810.0000	0.000000
T(9)	990.0000	0.000000
T(10)	1110.000	0.000000
T(11)	930.0000	0.000000

T(12)	690.0000	0.000000
T(13)	1050.000	0.000000
T(14)	960.0000	0.000000
T(15)	1080.000	0.000000
T(16)	1020.000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	8.300000
X(1, 3)	0.000000	41.10000
X(1, 4)	0.000000	39.60000
X(1, 5)	0.000000	227.0000
X(1, 6)	0.000000	275.0000
X(1, 7)	0.000000	324.0000
X(1, 8)	0.000000	322.0000
X(1, 9)	0.000000	353.0000
X(1, 10)	0.000000	353.0000
X(1, 11)	0.000000	351.0000
X(1, 12)	0.000000	348.0000
X(1, 13)	0.000000	347.0000
X(1, 14)	0.000000	347.0000
X(1, 15)	0.000000	353.0000
X(1, 16)	0.000000	435.0000
X(2, 1)	0.000000	8.300000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	24.40000
X(2, 4)	0.000000	33.00000
X(2, 5)	0.000000	220.0000
X(2, 6)	0.000000	268.0000
X(2, 7)	0.000000	317.0000
X(2, 8)	0.000000	315.0000
X(2, 9)	0.000000	346.0000
X(2, 10)	0.000000	346.0000
X(2, 11)	0.000000	344.0000
X(2, 12)	1.000000	341.0000
X(2, 13)	0.000000	341.0000
X(2, 14)	0.000000	340.0000
X(2, 15)	0.000000	347.0000
X(2, 16)	0.000000	428.0000
X(3, 1)	0.000000	41.10000
X(3, 2)	0.000000	24.40000
X(3, 3)	0.000000	0.000000
X(3, 4)	1.000000	7.500000
X(3, 5)	0.000000	127.0000
X(3, 6)	0.000000	300.0000
X(3, 7)	0.000000	208.0000

X(3, 8)	0.000000	238.0000
X(3, 9)	0.000000	377.0000
X(3, 10)	0.000000	377.0000
X(3, 11)	0.000000	376.0000
X(3, 12)	0.000000	372.0000
X(3, 13)	0.000000	372.0000
X(3, 14)	0.000000	372.0000
X(3, 15)	0.000000	378.0000
X(3, 16)	0.000000	459.0000
X(4, 1)	1.000000	39.60000
X(4, 2)	0.000000	33.00000
X(4, 3)	0.000000	7.500000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	133.0000
X(4, 6)	0.000000	297.0000
X(4, 7)	0.000000	215.0000
X(4, 8)	0.000000	343.0000
X(4, 9)	0.000000	374.0000
X(4, 10)	0.000000	374.0000
X(4, 11)	0.000000	372.0000
X(4, 12)	0.000000	369.0000
X(4, 13)	0.000000	369.0000
X(4, 14)	0.000000	368.0000
X(4, 15)	0.000000	375.0000
X(4, 16)	0.000000	456.0000
X(5, 1)	0.000000	227.0000
X(5, 2)	0.000000	220.0000
X(5, 3)	0.000000	127.0000
X(5, 4)	0.000000	133.0000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	85.00000
X(5, 7)	0.000000	102.0000
X(5, 8)	1.000000	134.0000
X(5, 9)	0.000000	230.0000
X(5, 10)	0.000000	230.0000
X(5, 11)	0.000000	228.0000
X(5, 12)	0.000000	225.0000
X(5, 13)	0.000000	224.0000
X(5, 14)	0.000000	224.0000
X(5, 15)	0.000000	230.0000
X(5, 16)	0.000000	312.0000
X(6, 1)	0.000000	275.0000
X(6, 2)	0.000000	268.0000
X(6, 3)	0.000000	300.0000

X(6, 4)	0.000000	297.0000
X(6, 5)	1.000000	85.00000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	48.00000
X(6, 8)	0.000000	50.00000
X(6, 9)	0.000000	71.00000
X(6, 10)	0.000000	65.00000
X(6, 11)	0.000000	64.00000
X(6, 12)	0.000000	55.00000
X(6, 13)	0.000000	71.00000
X(6, 14)	0.000000	69.00000
X(6, 15)	0.000000	66.00000
X(6, 16)	0.000000	166.0000
X(7, 1)	0.000000	324.0000
X(7, 2)	0.000000	317.0000
X(7, 3)	0.000000	208.0000
X(7, 4)	0.000000	215.0000
X(7, 5)	0.000000	102.0000
X(7, 6)	0.000000	48.00000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	28.00000
X(7, 9)	0.000000	87.00000
X(7, 10)	0.000000	81.00000
X(7, 11)	1.000000	80.00000
X(7, 12)	0.000000	81.00000
X(7, 13)	0.000000	87.00000
X(7, 14)	0.000000	85.00000
X(7, 15)	0.000000	82.00000
X(7, 16)	0.000000	182.0000
X(8, 1)	0.000000	322.0000
X(8, 2)	0.000000	315.0000
X(8, 3)	0.000000	238.0000
X(8, 4)	0.000000	343.0000
X(8, 5)	0.000000	134.0000
X(8, 6)	0.000000	50.00000
X(8, 7)	1.000000	28.00000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	61.00000
X(8, 10)	0.000000	55.00000
X(8, 11)	0.000000	54.00000
X(8, 12)	0.000000	55.00000
X(8, 13)	0.000000	61.00000
X(8, 14)	0.000000	59.00000
X(8, 15)	0.000000	56.00000

X(8, 16)	0.000000	156.0000
X(9, 1)	0.000000	353.0000
X(9, 2)	0.000000	346.0000
X(9, 3)	0.000000	377.0000
X(9, 4)	0.000000	374.0000
X(9, 5)	0.000000	230.0000
X(9, 6)	0.000000	71.00000
X(9, 7)	0.000000	87.00000
X(9, 8)	0.000000	61.00000
X(9, 9)	0.000000	0.000000
X(9, 10)	0.000000	6.700000
X(9, 11)	0.000000	5.900000
X(9, 12)	0.000000	10.00000
X(9, 13)	0.000000	4.800000
X(9, 14)	0.000000	4.300000
X(9, 15)	0.000000	7.400000
X(9, 16)	1.000000	98.20000
X(10, 1)	0.000000	353.0000
X(10, 2)	0.000000	346.0000
X(10, 3)	1.000000	377.0000
X(10, 4)	0.000000	374.0000
X(10, 5)	0.000000	230.0000
X(10, 6)	0.000000	65.00000
X(10, 7)	0.000000	81.00000
X(10, 8)	0.000000	55.00000
X(10, 9)	0.000000	6.700000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	1.900000
X(10, 12)	0.000000	10.30000
X(10, 13)	0.000000	5.900000
X(10, 14)	0.000000	4.800000
X(10, 15)	0.000000	1.800000
X(10, 16)	0.000000	97.50000
X(11, 1)	0.000000	351.0000
X(11, 2)	0.000000	344.0000
X(11, 3)	0.000000	376.0000
X(11, 4)	0.000000	372.0000
X(11, 5)	0.000000	228.0000
X(11, 6)	0.000000	64.00000
X(11, 7)	0.000000	80.00000
X(11, 8)	0.000000	54.00000
X(11, 9)	0.000000	5.900000
X(11, 10)	0.000000	1.900000
X(11, 11)	0.000000	0.000000

X(11, 12)	0.000000	8.800000
X(11, 13)	0.000000	9.800000
X(11, 14)	1.000000	5.300000
X(11, 15)	0.000000	3.400000
X(11, 16)	0.000000	100.0000
X(12, 1)	0.000000	348.0000
X(12, 2)	0.000000	341.0000
X(12, 3)	0.000000	372.0000
X(12, 4)	0.000000	369.0000
X(12, 5)	0.000000	225.0000
X(12, 6)	1.000000	55.00000
X(12, 7)	0.000000	81.00000
X(12, 8)	0.000000	55.00000
X(12, 9)	0.000000	10.00000
X(12, 10)	0.000000	10.30000
X(12, 11)	0.000000	8.800000
X(12, 12)	0.000000	0.000000
X(12, 13)	0.000000	10.60000
X(12, 14)	0.000000	6.200000
X(12, 15)	0.000000	10.70000
X(12, 16)	0.000000	105.0000
X(13, 1)	0.000000	347.0000
X(13, 2)	0.000000	341.0000
X(13, 3)	0.000000	372.0000
X(13, 4)	0.000000	369.0000
X(13, 5)	0.000000	224.0000
X(13, 6)	0.000000	71.00000
X(13, 7)	0.000000	87.00000
X(13, 8)	0.000000	61.00000
X(13, 9)	0.000000	4.800000
X(13, 10)	0.000000	5.900000
X(13, 11)	0.000000	9.800000
X(13, 12)	0.000000	10.60000
X(13, 13)	0.000000	0.000000
X(13, 14)	0.000000	4.300000
X(13, 15)	1.000000	3.500000
X(13, 16)	0.000000	93.40000
X(14, 1)	0.000000	347.0000
X(14, 2)	0.000000	340.0000
X(14, 3)	0.000000	372.0000
X(14, 4)	0.000000	368.0000
X(14, 5)	0.000000	224.0000
X(14, 6)	0.000000	69.00000
X(14, 7)	0.000000	85.00000

X(14, 8)	0.000000	59.00000
X(14, 9)	1.000000	4.300000
X(14, 10)	0.000000	4.800000
X(14, 11)	0.000000	5.300000
X(14, 12)	0.000000	6.200000
X(14, 13)	0.000000	4.300000
X(14, 14)	0.000000	0.000000
X(14, 15)	0.000000	6.300000
X(14, 16)	0.000000	101.0000
X(15, 1)	0.000000	353.0000
X(15, 2)	0.000000	347.0000
X(15, 3)	0.000000	378.0000
X(15, 4)	0.000000	375.0000
X(15, 5)	0.000000	230.0000
X(15, 6)	0.000000	66.00000
X(15, 7)	0.000000	82.00000
X(15, 8)	0.000000	56.00000
X(15, 9)	0.000000	7.400000
X(15, 10)	1.000000	1.800000
X(15, 11)	0.000000	3.400000
X(15, 12)	0.000000	10.70000
X(15, 13)	0.000000	3.500000
X(15, 14)	0.000000	6.300000
X(15, 15)	0.000000	0.000000
X(15, 16)	0.000000	97.90000
X(16, 1)	0.000000	435.0000
X(16, 2)	0.000000	428.0000
X(16, 3)	0.000000	459.0000
X(16, 4)	0.000000	456.0000
X(16, 5)	0.000000	312.0000
X(16, 6)	0.000000	166.0000
X(16, 7)	0.000000	182.0000
X(16, 8)	0.000000	156.0000
X(16, 9)	0.000000	98.20000
X(16, 10)	0.000000	97.50000
X(16, 11)	0.000000	100.0000
X(16, 12)	0.000000	105.0000
X(16, 13)	1.000000	93.40000
X(16, 14)	0.000000	101.0000
X(16, 15)	0.000000	97.90000
X(16, 16)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	8.300000	0.000000
D(1, 3)	41.10000	0.000000

D(1, 4)	39.60000	0.000000
D(1, 5)	227.0000	0.000000
D(1, 6)	275.0000	0.000000
D(1, 7)	324.0000	0.000000
D(1, 8)	322.0000	0.000000
D(1, 9)	353.0000	0.000000
D(1, 10)	353.0000	0.000000
D(1, 11)	351.0000	0.000000
D(1, 12)	348.0000	0.000000
D(1, 13)	347.0000	0.000000
D(1, 14)	347.0000	0.000000
D(1, 15)	353.0000	0.000000
D(1, 16)	435.0000	0.000000
D(2, 1)	8.300000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	24.40000	0.000000
D(2, 4)	33.00000	0.000000
D(2, 5)	220.0000	0.000000
D(2, 6)	268.0000	0.000000
D(2, 7)	317.0000	0.000000
D(2, 8)	315.0000	0.000000
D(2, 9)	346.0000	0.000000
D(2, 10)	346.0000	0.000000
D(2, 11)	344.0000	0.000000
D(2, 12)	341.0000	0.000000
D(2, 13)	341.0000	0.000000
D(2, 14)	340.0000	0.000000
D(2, 15)	347.0000	0.000000
D(2, 16)	428.0000	0.000000
D(3, 1)	41.10000	0.000000
D(3, 2)	24.40000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	7.500000	0.000000
D(3, 5)	127.0000	0.000000
D(3, 6)	300.0000	0.000000
D(3, 7)	208.0000	0.000000
D(3, 8)	238.0000	0.000000
D(3, 9)	377.0000	0.000000
D(3, 10)	377.0000	0.000000
D(3, 11)	376.0000	0.000000
D(3, 12)	372.0000	0.000000
D(3, 13)	372.0000	0.000000
D(3, 14)	372.0000	0.000000
D(3, 15)	378.0000	0.000000

D(3, 16)	459.0000	0.000000
D(4, 1)	39.60000	0.000000
D(4, 2)	33.00000	0.000000
D(4, 3)	7.500000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	133.0000	0.000000
D(4, 6)	297.0000	0.000000
D(4, 7)	215.0000	0.000000
D(4, 8)	343.0000	0.000000
D(4, 9)	374.0000	0.000000
D(4, 10)	374.0000	0.000000
D(4, 11)	372.0000	0.000000
D(4, 12)	369.0000	0.000000
D(4, 13)	369.0000	0.000000
D(4, 14)	368.0000	0.000000
D(4, 15)	375.0000	0.000000
D(4, 16)	456.0000	0.000000
D(5, 1)	227.0000	0.000000
D(5, 2)	220.0000	0.000000
D(5, 3)	127.0000	0.000000
D(5, 4)	133.0000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	85.00000	0.000000
D(5, 7)	102.0000	0.000000
D(5, 8)	134.0000	0.000000
D(5, 9)	230.0000	0.000000
D(5, 10)	230.0000	0.000000
D(5, 11)	228.0000	0.000000
D(5, 12)	225.0000	0.000000
D(5, 13)	224.0000	0.000000
D(5, 14)	224.0000	0.000000
D(5, 15)	230.0000	0.000000
D(5, 16)	312.0000	0.000000
D(6, 1)	275.0000	0.000000
D(6, 2)	268.0000	0.000000
D(6, 3)	300.0000	0.000000
D(6, 4)	297.0000	0.000000
D(6, 5)	85.00000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	48.00000	0.000000
D(6, 8)	50.00000	0.000000
D(6, 9)	71.00000	0.000000
D(6, 10)	65.00000	0.000000
D(6, 11)	64.00000	0.000000

D(6, 12)	55.00000	0.000000
D(6, 13)	71.00000	0.000000
D(6, 14)	69.00000	0.000000
D(6, 15)	66.00000	0.000000
D(6, 16)	166.0000	0.000000
D(7, 1)	324.0000	0.000000
D(7, 2)	317.0000	0.000000
D(7, 3)	208.0000	0.000000
D(7, 4)	215.0000	0.000000
D(7, 5)	102.0000	0.000000
D(7, 6)	48.00000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	28.00000	0.000000
D(7, 9)	87.00000	0.000000
D(7, 10)	81.00000	0.000000
D(7, 11)	80.00000	0.000000
D(7, 12)	81.00000	0.000000
D(7, 13)	87.00000	0.000000
D(7, 14)	85.00000	0.000000
D(7, 15)	82.00000	0.000000
D(7, 16)	182.0000	0.000000
D(8, 1)	322.0000	0.000000
D(8, 2)	315.0000	0.000000
D(8, 3)	238.0000	0.000000
D(8, 4)	343.0000	0.000000
D(8, 5)	134.0000	0.000000
D(8, 6)	50.00000	0.000000
D(8, 7)	28.00000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	61.00000	0.000000
D(8, 10)	55.00000	0.000000
D(8, 11)	54.00000	0.000000
D(8, 12)	55.00000	0.000000
D(8, 13)	61.00000	0.000000
D(8, 14)	59.00000	0.000000
D(8, 15)	56.00000	0.000000
D(8, 16)	156.0000	0.000000
D(9, 1)	353.0000	0.000000
D(9, 2)	346.0000	0.000000
D(9, 3)	377.0000	0.000000
D(9, 4)	374.0000	0.000000
D(9, 5)	230.0000	0.000000
D(9, 6)	71.00000	0.000000
D(9, 7)	87.00000	0.000000

D(9, 8)	61.00000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	6.700000	0.000000
D(9, 11)	5.900000	0.000000
D(9, 12)	10.00000	0.000000
D(9, 13)	4.800000	0.000000
D(9, 14)	4.300000	0.000000
D(9, 15)	7.400000	0.000000
D(9, 16)	98.20000	0.000000
D(10, 1)	353.0000	0.000000
D(10, 2)	346.0000	0.000000
D(10, 3)	377.0000	0.000000
D(10, 4)	374.0000	0.000000
D(10, 5)	230.0000	0.000000
D(10, 6)	65.00000	0.000000
D(10, 7)	81.00000	0.000000
D(10, 8)	55.00000	0.000000
D(10, 9)	6.700000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	1.900000	0.000000
D(10, 12)	10.30000	0.000000
D(10, 13)	5.900000	0.000000
D(10, 14)	4.800000	0.000000
D(10, 15)	1.800000	0.000000
D(10, 16)	97.50000	0.000000
D(11, 1)	351.0000	0.000000
D(11, 2)	344.0000	0.000000
D(11, 3)	376.0000	0.000000
D(11, 4)	372.0000	0.000000
D(11, 5)	228.0000	0.000000
D(11, 6)	64.00000	0.000000
D(11, 7)	80.00000	0.000000
D(11, 8)	54.00000	0.000000
D(11, 9)	5.900000	0.000000
D(11, 10)	1.900000	0.000000
D(11, 11)	0.000000	0.000000
D(11, 12)	8.800000	0.000000
D(11, 13)	9.800000	0.000000
D(11, 14)	5.300000	0.000000
D(11, 15)	3.400000	0.000000
D(11, 16)	100.0000	0.000000
D(12, 1)	348.0000	0.000000
D(12, 2)	341.0000	0.000000
D(12, 3)	372.0000	0.000000

D(12, 4)	369.0000	0.000000
D(12, 5)	225.0000	0.000000
D(12, 6)	55.00000	0.000000
D(12, 7)	81.00000	0.000000
D(12, 8)	55.00000	0.000000
D(12, 9)	10.00000	0.000000
D(12, 10)	10.30000	0.000000
D(12, 11)	8.800000	0.000000
D(12, 12)	0.000000	0.000000
D(12, 13)	10.60000	0.000000
D(12, 14)	6.200000	0.000000
D(12, 15)	10.70000	0.000000
D(12, 16)	105.0000	0.000000
D(13, 1)	347.0000	0.000000
D(13, 2)	341.0000	0.000000
D(13, 3)	372.0000	0.000000
D(13, 4)	369.0000	0.000000
D(13, 5)	224.0000	0.000000
D(13, 6)	71.00000	0.000000
D(13, 7)	87.00000	0.000000
D(13, 8)	61.00000	0.000000
D(13, 9)	4.800000	0.000000
D(13, 10)	5.900000	0.000000
D(13, 11)	9.800000	0.000000
D(13, 12)	10.60000	0.000000
D(13, 13)	0.000000	0.000000
D(13, 14)	4.300000	0.000000
D(13, 15)	3.500000	0.000000
D(13, 16)	93.40000	0.000000
D(14, 1)	347.0000	0.000000
D(14, 2)	340.0000	0.000000
D(14, 3)	372.0000	0.000000
D(14, 4)	368.0000	0.000000
D(14, 5)	224.0000	0.000000
D(14, 6)	69.00000	0.000000
D(14, 7)	85.00000	0.000000
D(14, 8)	59.00000	0.000000
D(14, 9)	4.300000	0.000000
D(14, 10)	4.800000	0.000000
D(14, 11)	5.300000	0.000000
D(14, 12)	6.200000	0.000000
D(14, 13)	4.300000	0.000000
D(14, 14)	0.000000	0.000000
D(14, 15)	6.300000	0.000000

D(14, 16)	101.0000	0.000000
D(15, 1)	353.0000	0.000000
D(15, 2)	347.0000	0.000000
D(15, 3)	378.0000	0.000000
D(15, 4)	375.0000	0.000000
D(15, 5)	230.0000	0.000000
D(15, 6)	66.00000	0.000000
D(15, 7)	82.00000	0.000000
D(15, 8)	56.00000	0.000000
D(15, 9)	7.400000	0.000000
D(15, 10)	1.800000	0.000000
D(15, 11)	3.400000	0.000000
D(15, 12)	10.70000	0.000000
D(15, 13)	3.500000	0.000000
D(15, 14)	6.300000	0.000000
D(15, 15)	0.000000	0.000000
D(15, 16)	97.90000	0.000000
D(16, 1)	435.0000	0.000000
D(16, 2)	428.0000	0.000000
D(16, 3)	459.0000	0.000000
D(16, 4)	456.0000	0.000000
D(16, 5)	312.0000	0.000000
D(16, 6)	166.0000	0.000000
D(16, 7)	182.0000	0.000000
D(16, 8)	156.0000	0.000000
D(16, 9)	98.20000	0.000000
D(16, 10)	97.50000	0.000000
D(16, 11)	100.0000	0.000000
D(16, 12)	105.0000	0.000000
D(16, 13)	93.40000	0.000000
D(16, 14)	101.0000	0.000000
D(16, 15)	97.90000	0.000000
D(16, 16)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	9.960000	0.000000
DURASI(1, 3)	49.32000	0.000000
DURASI(1, 4)	47.52000	0.000000
DURASI(1, 5)	272.4000	0.000000
DURASI(1, 6)	330.0000	0.000000
DURASI(1, 7)	388.8000	0.000000
DURASI(1, 8)	386.4000	0.000000
DURASI(1, 9)	423.6000	0.000000
DURASI(1, 10)	423.6000	0.000000
DURASI(1, 11)	421.2000	0.000000

DURASI(1, 12)	417.6000	0.000000
DURASI(1, 13)	416.4000	0.000000
DURASI(1, 14)	416.4000	0.000000
DURASI(1, 15)	423.6000	0.000000
DURASI(1, 16)	522.0000	0.000000
DURASI(2, 1)	9.960000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	29.28000	0.000000
DURASI(2, 4)	39.60000	0.000000
DURASI(2, 5)	264.0000	0.000000
DURASI(2, 6)	321.6000	0.000000
DURASI(2, 7)	380.4000	0.000000
DURASI(2, 8)	378.0000	0.000000
DURASI(2, 9)	415.2000	0.000000
DURASI(2, 10)	415.2000	0.000000
DURASI(2, 11)	412.8000	0.000000
DURASI(2, 12)	409.2000	0.000000
DURASI(2, 13)	409.2000	0.000000
DURASI(2, 14)	408.0000	0.000000
DURASI(2, 15)	416.4000	0.000000
DURASI(2, 16)	513.6000	0.000000
DURASI(3, 1)	49.32000	0.000000
DURASI(3, 2)	29.28000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	9.000000	0.000000
DURASI(3, 5)	152.4000	0.000000
DURASI(3, 6)	360.0000	0.000000
DURASI(3, 7)	249.6000	0.000000
DURASI(3, 8)	285.6000	0.000000
DURASI(3, 9)	452.4000	0.000000
DURASI(3, 10)	452.4000	0.000000
DURASI(3, 11)	451.2000	0.000000
DURASI(3, 12)	446.4000	0.000000
DURASI(3, 13)	446.4000	0.000000
DURASI(3, 14)	446.4000	0.000000
DURASI(3, 15)	453.6000	0.000000
DURASI(3, 16)	550.8000	0.000000
DURASI(4, 1)	47.52000	0.000000
DURASI(4, 2)	39.60000	0.000000
DURASI(4, 3)	9.000000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	159.6000	0.000000
DURASI(4, 6)	356.4000	0.000000
DURASI(4, 7)	258.0000	0.000000

DURASI(4, 8)	411.6000	0.000000
DURASI(4, 9)	448.8000	0.000000
DURASI(4, 10)	448.8000	0.000000
DURASI(4, 11)	446.4000	0.000000
DURASI(4, 12)	442.8000	0.000000
DURASI(4, 13)	442.8000	0.000000
DURASI(4, 14)	441.6000	0.000000
DURASI(4, 15)	450.0000	0.000000
DURASI(4, 16)	547.2000	0.000000
DURASI(5, 1)	272.4000	0.000000
DURASI(5, 2)	264.0000	0.000000
DURASI(5, 3)	152.4000	0.000000
DURASI(5, 4)	159.6000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	102.0000	0.000000
DURASI(5, 7)	122.4000	0.000000
DURASI(5, 8)	160.8000	0.000000
DURASI(5, 9)	276.0000	0.000000
DURASI(5, 10)	276.0000	0.000000
DURASI(5, 11)	273.6000	0.000000
DURASI(5, 12)	270.0000	0.000000
DURASI(5, 13)	268.8000	0.000000
DURASI(5, 14)	268.8000	0.000000
DURASI(5, 15)	276.0000	0.000000
DURASI(5, 16)	374.4000	0.000000
DURASI(6, 1)	330.0000	0.000000
DURASI(6, 2)	321.6000	0.000000
DURASI(6, 3)	360.0000	0.000000
DURASI(6, 4)	356.4000	0.000000
DURASI(6, 5)	102.0000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	57.60000	0.000000
DURASI(6, 8)	60.00000	0.000000
DURASI(6, 9)	85.20000	0.000000
DURASI(6, 10)	78.00000	0.000000
DURASI(6, 11)	76.80000	0.000000
DURASI(6, 12)	66.00000	0.000000
DURASI(6, 13)	85.20000	0.000000
DURASI(6, 14)	82.80000	0.000000
DURASI(6, 15)	79.20000	0.000000
DURASI(6, 16)	199.2000	0.000000
DURASI(7, 1)	388.8000	0.000000
DURASI(7, 2)	380.4000	0.000000
DURASI(7, 3)	249.6000	0.000000

DURASI(7, 4)	258.0000	0.000000
DURASI(7, 5)	122.4000	0.000000
DURASI(7, 6)	57.60000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	33.60000	0.000000
DURASI(7, 9)	104.4000	0.000000
DURASI(7, 10)	97.20000	0.000000
DURASI(7, 11)	96.00000	0.000000
DURASI(7, 12)	97.20000	0.000000
DURASI(7, 13)	104.4000	0.000000
DURASI(7, 14)	102.0000	0.000000
DURASI(7, 15)	98.40000	0.000000
DURASI(7, 16)	218.4000	0.000000
DURASI(8, 1)	386.4000	0.000000
DURASI(8, 2)	378.0000	0.000000
DURASI(8, 3)	285.6000	0.000000
DURASI(8, 4)	411.6000	0.000000
DURASI(8, 5)	160.8000	0.000000
DURASI(8, 6)	60.00000	0.000000
DURASI(8, 7)	33.60000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	73.20000	0.000000
DURASI(8, 10)	66.00000	0.000000
DURASI(8, 11)	64.80000	0.000000
DURASI(8, 12)	66.00000	0.000000
DURASI(8, 13)	73.20000	0.000000
DURASI(8, 14)	70.80000	0.000000
DURASI(8, 15)	67.20000	0.000000
DURASI(8, 16)	187.2000	0.000000
DURASI(9, 1)	423.6000	0.000000
DURASI(9, 2)	415.2000	0.000000
DURASI(9, 3)	452.4000	0.000000
DURASI(9, 4)	448.8000	0.000000
DURASI(9, 5)	276.0000	0.000000
DURASI(9, 6)	85.20000	0.000000
DURASI(9, 7)	104.4000	0.000000
DURASI(9, 8)	73.20000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	8.040000	0.000000
DURASI(9, 11)	7.080000	0.000000
DURASI(9, 12)	12.00000	0.000000
DURASI(9, 13)	5.760000	0.000000
DURASI(9, 14)	5.160000	0.000000
DURASI(9, 15)	8.880000	0.000000

DURASI(9, 16)	117.8400	0.000000
DURASI(10, 1)	423.6000	0.000000
DURASI(10, 2)	415.2000	0.000000
DURASI(10, 3)	452.4000	0.000000
DURASI(10, 4)	448.8000	0.000000
DURASI(10, 5)	276.0000	0.000000
DURASI(10, 6)	78.00000	0.000000
DURASI(10, 7)	97.20000	0.000000
DURASI(10, 8)	66.00000	0.000000
DURASI(10, 9)	8.040000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	2.280000	0.000000
DURASI(10, 12)	12.36000	0.000000
DURASI(10, 13)	7.080000	0.000000
DURASI(10, 14)	5.760000	0.000000
DURASI(10, 15)	2.160000	0.000000
DURASI(10, 16)	117.0000	0.000000
DURASI(11, 1)	421.2000	0.000000
DURASI(11, 2)	412.8000	0.000000
DURASI(11, 3)	451.2000	0.000000
DURASI(11, 4)	446.4000	0.000000
DURASI(11, 5)	273.6000	0.000000
DURASI(11, 6)	76.80000	0.000000
DURASI(11, 7)	96.00000	0.000000
DURASI(11, 8)	64.80000	0.000000
DURASI(11, 9)	7.080000	0.000000
DURASI(11, 10)	2.280000	0.000000
DURASI(11, 11)	0.000000	0.000000
DURASI(11, 12)	10.56000	0.000000
DURASI(11, 13)	11.76000	0.000000
DURASI(11, 14)	6.360000	0.000000
DURASI(11, 15)	4.080000	0.000000
DURASI(11, 16)	120.0000	0.000000
DURASI(12, 1)	417.6000	0.000000
DURASI(12, 2)	409.2000	0.000000
DURASI(12, 3)	446.4000	0.000000
DURASI(12, 4)	442.8000	0.000000
DURASI(12, 5)	270.0000	0.000000
DURASI(12, 6)	66.00000	0.000000
DURASI(12, 7)	97.20000	0.000000
DURASI(12, 8)	66.00000	0.000000
DURASI(12, 9)	12.00000	0.000000
DURASI(12, 10)	12.36000	0.000000
DURASI(12, 11)	10.56000	0.000000

DURASI(12, 12)	0.000000	0.000000
DURASI(12, 13)	12.72000	0.000000
DURASI(12, 14)	7.440000	0.000000
DURASI(12, 15)	12.84000	0.000000
DURASI(12, 16)	126.0000	0.000000
DURASI(13, 1)	416.4000	0.000000
DURASI(13, 2)	409.2000	0.000000
DURASI(13, 3)	446.4000	0.000000
DURASI(13, 4)	442.8000	0.000000
DURASI(13, 5)	268.8000	0.000000
DURASI(13, 6)	85.20000	0.000000
DURASI(13, 7)	104.4000	0.000000
DURASI(13, 8)	73.20000	0.000000
DURASI(13, 9)	5.760000	0.000000
DURASI(13, 10)	7.080000	0.000000
DURASI(13, 11)	11.76000	0.000000
DURASI(13, 12)	12.72000	0.000000
DURASI(13, 13)	0.000000	0.000000
DURASI(13, 14)	5.160000	0.000000
DURASI(13, 15)	4.200000	0.000000
DURASI(13, 16)	112.0800	0.000000
DURASI(14, 1)	416.4000	0.000000
DURASI(14, 2)	408.0000	0.000000
DURASI(14, 3)	446.4000	0.000000
DURASI(14, 4)	441.6000	0.000000
DURASI(14, 5)	268.8000	0.000000
DURASI(14, 6)	82.80000	0.000000
DURASI(14, 7)	102.0000	0.000000
DURASI(14, 8)	70.80000	0.000000
DURASI(14, 9)	5.160000	0.000000
DURASI(14, 10)	5.760000	0.000000
DURASI(14, 11)	6.360000	0.000000
DURASI(14, 12)	7.440000	0.000000
DURASI(14, 13)	5.160000	0.000000
DURASI(14, 14)	0.000000	0.000000
DURASI(14, 15)	7.560000	0.000000
DURASI(14, 16)	121.2000	0.000000
DURASI(15, 1)	423.6000	0.000000
DURASI(15, 2)	416.4000	0.000000
DURASI(15, 3)	453.6000	0.000000
DURASI(15, 4)	450.0000	0.000000
DURASI(15, 5)	276.0000	0.000000
DURASI(15, 6)	79.20000	0.000000
DURASI(15, 7)	98.40000	0.000000

DURASI(15, 8)	67.20000	0.000000
DURASI(15, 9)	8.880000	0.000000
DURASI(15, 10)	2.160000	0.000000
DURASI(15, 11)	4.080000	0.000000
DURASI(15, 12)	12.84000	0.000000
DURASI(15, 13)	4.200000	0.000000
DURASI(15, 14)	7.560000	0.000000
DURASI(15, 15)	0.000000	0.000000
DURASI(15, 16)	117.4800	0.000000
DURASI(16, 1)	522.0000	0.000000
DURASI(16, 2)	513.6000	0.000000
DURASI(16, 3)	550.8000	0.000000
DURASI(16, 4)	547.2000	0.000000
DURASI(16, 5)	374.4000	0.000000
DURASI(16, 6)	199.2000	0.000000
DURASI(16, 7)	218.4000	0.000000
DURASI(16, 8)	187.2000	0.000000
DURASI(16, 9)	117.8400	0.000000
DURASI(16, 10)	117.0000	0.000000
DURASI(16, 11)	120.0000	0.000000
DURASI(16, 12)	126.0000	0.000000
DURASI(16, 13)	112.0800	0.000000
DURASI(16, 14)	121.2000	0.000000
DURASI(16, 15)	117.4800	0.000000
DURASI(16, 16)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 3* analisis sensitivitas skenario 6

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i,j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..11/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 1140 540 540 540 780 900 540 660 540 540;
tutup = 1020 1260 1260 660 1260 900 1020 1260 780 1260 1260;
```

D =

```
!ritel
!0      56      58      59      61      62      63      64      65      66
      67;
0      345     343     433     464     510     508     472     507     503
      495     !0;
345    0      20.2    102     133     179     176     142     176     172
      164     !56;
343    20.2    0      114     145     191     188     153     188     184
      175     !58;
433    102     114     0      48.4    94.1    91.2    56.6    91.3    87.3
      78.7    !59;
464    133     145     48.4    0      31.5    33.1    27.2    61.9    57.9
      49.3    !61;
510    179     191     94.1    31.5    0      3.4     58.4    21.5    12.1
      16.2    !62;
508    176     188     91.2    33.1    3.4     0      78.6    18.1    8.8
      14.5    !63;
```

```

472  142  153  56.6  27.2  58.4  78.6  0    34.7  30.7
      22.1  !64;
507  176  188  91.3  61.9  21.5  18.1  34.7  0    10.9
      35.6  !65;
503  172  184  87.3  57.9  12.1  8.8   30.7  10.9  0
      23.8  !66;
495  164  175  78.7  49.3  16.2  14.5  22.1  35.6  23.8  0;
      !67;

```

```

durasi =
0      414  411.6  519.6  556.8  612   609.6  566.4  608.4  603.6
      594
414    0    24.24  122.4  159.6  214.8  211.2  170.4  211.2  206.4
      196.8
411.6  24.24  0    136.8  174   229.2  225.6  183.6  225.6  220.8
      210
519.6  122.4  136.8  0    58.08  112.92  109.44  67.92
      109.56  104.76  94.44
556.8  159.6  174   58.08  0    37.8  39.72  32.64  74.28  69.48
      59.16
612    214.8  229.2  112.92  37.8  0    4.08  70.08  25.8
      14.52  19.44
609.6  211.2  225.6  109.44  39.72  4.08  0    94.32  21.72
      10.56  17.4
566.4  170.4  183.6  67.92  32.64  70.08  94.32  0    41.64  36.84
      26.52
608.4  211.2  225.6  109.56  74.28  25.8  21.72  41.64  0
      13.08  42.72
603.6  206.4  220.8  104.76  69.48  14.52  10.56  36.84  13.08  0
      28.56
594    196.8  210   94.44  59.16  19.44  17.4  26.52  42.72  28.56  0;

```

```

Bongkar = 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
            @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
    );

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 3* analisis sensitivitas skenario 6

Global optimal solution found.

Objective value:	1107.300
Objective bound:	1107.300
Infeasibilities:	0.000000
Extended solver steps:	308
Total solver iterations:	12693
Elapsed runtime seconds:	1.03

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 4 sebesar 433 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 20.2 km
 rute pengiriman dari ritel 3 ke ritel 1 sebesar 343 km
 rute pengiriman dari ritel 4 ke ritel 8 sebesar 56.6 km
 rute pengiriman dari ritel 5 ke ritel 2 sebesar 133 km
 rute pengiriman dari ritel 6 ke ritel 11 sebesar 16.2 km
 rute pengiriman dari ritel 7 ke ritel 5 sebesar 33.1 km
 rute pengiriman dari ritel 8 ke ritel 9 sebesar 34.7 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 10.9 km
 rute pengiriman dari ritel 10 ke ritel 6 sebesar 12.1 km
 rute pengiriman dari ritel 11 ke ritel 7 sebesar 14.5 km

Model Class: MILP

Total variables:	132
Nonlinear variables:	0
Integer variables:	121
Total constraints:	154
Nonlinear constraints:	0
Total nonzeros:	780
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000

BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	1140.000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	540.0000	0.000000
BUKA(6)	780.0000	0.000000
BUKA(7)	900.0000	0.000000
BUKA(8)	540.0000	0.000000
BUKA(9)	660.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	660.0000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	900.0000	0.000000
TUTUP(7)	1020.000	0.000000
TUTUP(8)	1260.000	0.000000
TUTUP(9)	780.0000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
T(1)	1863.600	0.000000
T(2)	1159.320	0.000000
T(3)	1213.560	0.000000
T(4)	540.0000	0.000000
T(5)	969.7200	0.000000
T(6)	803.1600	0.000000
T(7)	900.0000	0.000000
T(8)	637.9200	0.000000
T(9)	715.5600	0.000000
T(10)	758.6400	0.000000
T(11)	852.6000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	0.000000	345.0000
X(1, 3)	0.000000	343.0000

X(1, 4)	1.000000	433.0000
X(1, 5)	0.000000	464.0000
X(1, 6)	0.000000	510.0000
X(1, 7)	0.000000	508.0000
X(1, 8)	0.000000	472.0000
X(1, 9)	0.000000	507.0000
X(1, 10)	0.000000	503.0000
X(1, 11)	0.000000	495.0000
X(2, 1)	0.000000	345.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	20.20000
X(2, 4)	0.000000	102.0000
X(2, 5)	0.000000	133.0000
X(2, 6)	0.000000	179.0000
X(2, 7)	0.000000	176.0000
X(2, 8)	0.000000	142.0000
X(2, 9)	0.000000	176.0000
X(2, 10)	0.000000	172.0000
X(2, 11)	0.000000	164.0000
X(3, 1)	1.000000	343.0000
X(3, 2)	0.000000	20.20000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	114.0000
X(3, 5)	0.000000	145.0000
X(3, 6)	0.000000	191.0000
X(3, 7)	0.000000	188.0000
X(3, 8)	0.000000	153.0000
X(3, 9)	0.000000	188.0000
X(3, 10)	0.000000	184.0000
X(3, 11)	0.000000	175.0000
X(4, 1)	0.000000	433.0000
X(4, 2)	0.000000	102.0000
X(4, 3)	0.000000	114.0000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	48.40000
X(4, 6)	0.000000	94.10000
X(4, 7)	0.000000	91.20000
X(4, 8)	1.000000	56.60000
X(4, 9)	0.000000	91.30000
X(4, 10)	0.000000	87.30000
X(4, 11)	0.000000	78.70000
X(5, 1)	0.000000	464.0000
X(5, 2)	1.000000	133.0000
X(5, 3)	0.000000	145.0000

X(5, 4)	0.000000	48.40000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	31.50000
X(5, 7)	0.000000	33.10000
X(5, 8)	0.000000	27.20000
X(5, 9)	0.000000	61.90000
X(5, 10)	0.000000	57.90000
X(5, 11)	0.000000	49.30000
X(6, 1)	0.000000	510.0000
X(6, 2)	0.000000	179.0000
X(6, 3)	0.000000	191.0000
X(6, 4)	0.000000	94.10000
X(6, 5)	0.000000	31.50000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.400000
X(6, 8)	0.000000	58.40000
X(6, 9)	0.000000	21.50000
X(6, 10)	0.000000	12.10000
X(6, 11)	1.000000	16.20000
X(7, 1)	0.000000	508.0000
X(7, 2)	0.000000	176.0000
X(7, 3)	0.000000	188.0000
X(7, 4)	0.000000	91.20000
X(7, 5)	1.000000	33.10000
X(7, 6)	0.000000	3.400000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	78.60000
X(7, 9)	0.000000	18.10000
X(7, 10)	0.000000	8.800000
X(7, 11)	0.000000	14.50000
X(8, 1)	0.000000	472.0000
X(8, 2)	0.000000	142.0000
X(8, 3)	0.000000	153.0000
X(8, 4)	0.000000	56.60000
X(8, 5)	0.000000	27.20000
X(8, 6)	0.000000	58.40000
X(8, 7)	0.000000	78.60000
X(8, 8)	0.000000	0.000000
X(8, 9)	1.000000	34.70000
X(8, 10)	0.000000	30.70000
X(8, 11)	0.000000	22.10000
X(9, 1)	0.000000	507.0000
X(9, 2)	0.000000	176.0000
X(9, 3)	0.000000	188.0000

X(9, 4)	0.000000	91.30000
X(9, 5)	0.000000	61.90000
X(9, 6)	0.000000	21.50000
X(9, 7)	0.000000	18.10000
X(9, 8)	0.000000	34.70000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	10.90000
X(9, 11)	0.000000	35.60000
X(10, 1)	0.000000	503.0000
X(10, 2)	0.000000	172.0000
X(10, 3)	0.000000	184.0000
X(10, 4)	0.000000	87.30000
X(10, 5)	0.000000	57.90000
X(10, 6)	1.000000	12.10000
X(10, 7)	0.000000	8.800000
X(10, 8)	0.000000	30.70000
X(10, 9)	0.000000	10.90000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	23.80000
X(11, 1)	0.000000	495.0000
X(11, 2)	0.000000	164.0000
X(11, 3)	0.000000	175.0000
X(11, 4)	0.000000	78.70000
X(11, 5)	0.000000	49.30000
X(11, 6)	0.000000	16.20000
X(11, 7)	1.000000	14.50000
X(11, 8)	0.000000	22.10000
X(11, 9)	0.000000	35.60000
X(11, 10)	0.000000	23.80000
X(11, 11)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	345.0000	0.000000
D(1, 3)	343.0000	0.000000
D(1, 4)	433.0000	0.000000
D(1, 5)	464.0000	0.000000
D(1, 6)	510.0000	0.000000
D(1, 7)	508.0000	0.000000
D(1, 8)	472.0000	0.000000
D(1, 9)	507.0000	0.000000
D(1, 10)	503.0000	0.000000
D(1, 11)	495.0000	0.000000
D(2, 1)	345.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	20.20000	0.000000

D(2, 4)	102.0000	0.000000
D(2, 5)	133.0000	0.000000
D(2, 6)	179.0000	0.000000
D(2, 7)	176.0000	0.000000
D(2, 8)	142.0000	0.000000
D(2, 9)	176.0000	0.000000
D(2, 10)	172.0000	0.000000
D(2, 11)	164.0000	0.000000
D(3, 1)	343.0000	0.000000
D(3, 2)	20.20000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	114.0000	0.000000
D(3, 5)	145.0000	0.000000
D(3, 6)	191.0000	0.000000
D(3, 7)	188.0000	0.000000
D(3, 8)	153.0000	0.000000
D(3, 9)	188.0000	0.000000
D(3, 10)	184.0000	0.000000
D(3, 11)	175.0000	0.000000
D(4, 1)	433.0000	0.000000
D(4, 2)	102.0000	0.000000
D(4, 3)	114.0000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	48.40000	0.000000
D(4, 6)	94.10000	0.000000
D(4, 7)	91.20000	0.000000
D(4, 8)	56.60000	0.000000
D(4, 9)	91.30000	0.000000
D(4, 10)	87.30000	0.000000
D(4, 11)	78.70000	0.000000
D(5, 1)	464.0000	0.000000
D(5, 2)	133.0000	0.000000
D(5, 3)	145.0000	0.000000
D(5, 4)	48.40000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	31.50000	0.000000
D(5, 7)	33.10000	0.000000
D(5, 8)	27.20000	0.000000
D(5, 9)	61.90000	0.000000
D(5, 10)	57.90000	0.000000
D(5, 11)	49.30000	0.000000
D(6, 1)	510.0000	0.000000
D(6, 2)	179.0000	0.000000
D(6, 3)	191.0000	0.000000

D(6, 4)	94.10000	0.000000
D(6, 5)	31.50000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.400000	0.000000
D(6, 8)	58.40000	0.000000
D(6, 9)	21.50000	0.000000
D(6, 10)	12.10000	0.000000
D(6, 11)	16.20000	0.000000
D(7, 1)	508.0000	0.000000
D(7, 2)	176.0000	0.000000
D(7, 3)	188.0000	0.000000
D(7, 4)	91.20000	0.000000
D(7, 5)	33.10000	0.000000
D(7, 6)	3.400000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	78.60000	0.000000
D(7, 9)	18.10000	0.000000
D(7, 10)	8.800000	0.000000
D(7, 11)	14.50000	0.000000
D(8, 1)	472.0000	0.000000
D(8, 2)	142.0000	0.000000
D(8, 3)	153.0000	0.000000
D(8, 4)	56.60000	0.000000
D(8, 5)	27.20000	0.000000
D(8, 6)	58.40000	0.000000
D(8, 7)	78.60000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	34.70000	0.000000
D(8, 10)	30.70000	0.000000
D(8, 11)	22.10000	0.000000
D(9, 1)	507.0000	0.000000
D(9, 2)	176.0000	0.000000
D(9, 3)	188.0000	0.000000
D(9, 4)	91.30000	0.000000
D(9, 5)	61.90000	0.000000
D(9, 6)	21.50000	0.000000
D(9, 7)	18.10000	0.000000
D(9, 8)	34.70000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	10.90000	0.000000
D(9, 11)	35.60000	0.000000
D(10, 1)	503.0000	0.000000
D(10, 2)	172.0000	0.000000
D(10, 3)	184.0000	0.000000

D(10, 4)	87.30000	0.000000
D(10, 5)	57.90000	0.000000
D(10, 6)	12.10000	0.000000
D(10, 7)	8.800000	0.000000
D(10, 8)	30.70000	0.000000
D(10, 9)	10.90000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	23.80000	0.000000
D(11, 1)	495.0000	0.000000
D(11, 2)	164.0000	0.000000
D(11, 3)	175.0000	0.000000
D(11, 4)	78.70000	0.000000
D(11, 5)	49.30000	0.000000
D(11, 6)	16.20000	0.000000
D(11, 7)	14.50000	0.000000
D(11, 8)	22.10000	0.000000
D(11, 9)	35.60000	0.000000
D(11, 10)	23.80000	0.000000
D(11, 11)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	414.0000	0.000000
DURASI(1, 3)	411.6000	0.000000
DURASI(1, 4)	519.6000	0.000000
DURASI(1, 5)	556.8000	0.000000
DURASI(1, 6)	612.0000	0.000000
DURASI(1, 7)	609.6000	0.000000
DURASI(1, 8)	566.4000	0.000000
DURASI(1, 9)	608.4000	0.000000
DURASI(1, 10)	603.6000	0.000000
DURASI(1, 11)	594.0000	0.000000
DURASI(2, 1)	414.0000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	24.24000	0.000000
DURASI(2, 4)	122.4000	0.000000
DURASI(2, 5)	159.6000	0.000000
DURASI(2, 6)	214.8000	0.000000
DURASI(2, 7)	211.2000	0.000000
DURASI(2, 8)	170.4000	0.000000
DURASI(2, 9)	211.2000	0.000000
DURASI(2, 10)	206.4000	0.000000
DURASI(2, 11)	196.8000	0.000000
DURASI(3, 1)	411.6000	0.000000
DURASI(3, 2)	24.24000	0.000000
DURASI(3, 3)	0.000000	0.000000

DURASI(3, 4)	136.8000	0.000000
DURASI(3, 5)	174.0000	0.000000
DURASI(3, 6)	229.2000	0.000000
DURASI(3, 7)	225.6000	0.000000
DURASI(3, 8)	183.6000	0.000000
DURASI(3, 9)	225.6000	0.000000
DURASI(3, 10)	220.8000	0.000000
DURASI(3, 11)	210.0000	0.000000
DURASI(4, 1)	519.6000	0.000000
DURASI(4, 2)	122.4000	0.000000
DURASI(4, 3)	136.8000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	58.08000	0.000000
DURASI(4, 6)	112.9200	0.000000
DURASI(4, 7)	109.4400	0.000000
DURASI(4, 8)	67.92000	0.000000
DURASI(4, 9)	109.5600	0.000000
DURASI(4, 10)	104.7600	0.000000
DURASI(4, 11)	94.44000	0.000000
DURASI(5, 1)	556.8000	0.000000
DURASI(5, 2)	159.6000	0.000000
DURASI(5, 3)	174.0000	0.000000
DURASI(5, 4)	58.08000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	37.80000	0.000000
DURASI(5, 7)	39.72000	0.000000
DURASI(5, 8)	32.64000	0.000000
DURASI(5, 9)	74.28000	0.000000
DURASI(5, 10)	69.48000	0.000000
DURASI(5, 11)	59.16000	0.000000
DURASI(6, 1)	612.0000	0.000000
DURASI(6, 2)	214.8000	0.000000
DURASI(6, 3)	229.2000	0.000000
DURASI(6, 4)	112.9200	0.000000
DURASI(6, 5)	37.80000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.080000	0.000000
DURASI(6, 8)	70.08000	0.000000
DURASI(6, 9)	25.80000	0.000000
DURASI(6, 10)	14.52000	0.000000
DURASI(6, 11)	19.44000	0.000000
DURASI(7, 1)	609.6000	0.000000
DURASI(7, 2)	211.2000	0.000000
DURASI(7, 3)	225.6000	0.000000

DURASI(7, 4)	109.4400	0.000000
DURASI(7, 5)	39.72000	0.000000
DURASI(7, 6)	4.080000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	94.32000	0.000000
DURASI(7, 9)	21.72000	0.000000
DURASI(7, 10)	10.56000	0.000000
DURASI(7, 11)	17.40000	0.000000
DURASI(8, 1)	566.4000	0.000000
DURASI(8, 2)	170.4000	0.000000
DURASI(8, 3)	183.6000	0.000000
DURASI(8, 4)	67.92000	0.000000
DURASI(8, 5)	32.64000	0.000000
DURASI(8, 6)	70.08000	0.000000
DURASI(8, 7)	94.32000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	41.64000	0.000000
DURASI(8, 10)	36.84000	0.000000
DURASI(8, 11)	26.52000	0.000000
DURASI(9, 1)	608.4000	0.000000
DURASI(9, 2)	211.2000	0.000000
DURASI(9, 3)	225.6000	0.000000
DURASI(9, 4)	109.5600	0.000000
DURASI(9, 5)	74.28000	0.000000
DURASI(9, 6)	25.80000	0.000000
DURASI(9, 7)	21.72000	0.000000
DURASI(9, 8)	41.64000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	13.08000	0.000000
DURASI(9, 11)	42.72000	0.000000
DURASI(10, 1)	603.6000	0.000000
DURASI(10, 2)	206.4000	0.000000
DURASI(10, 3)	220.8000	0.000000
DURASI(10, 4)	104.7600	0.000000
DURASI(10, 5)	69.48000	0.000000
DURASI(10, 6)	14.52000	0.000000
DURASI(10, 7)	10.56000	0.000000
DURASI(10, 8)	36.84000	0.000000
DURASI(10, 9)	13.08000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	28.56000	0.000000
DURASI(11, 1)	594.0000	0.000000
DURASI(11, 2)	196.8000	0.000000
DURASI(11, 3)	210.0000	0.000000

DURASI(11, 4)	94.44000	0.000000
DURASI(11, 5)	59.16000	0.000000
DURASI(11, 6)	19.44000	0.000000
DURASI(11, 7)	17.40000	0.000000
DURASI(11, 8)	26.52000	0.000000
DURASI(11, 9)	42.72000	0.000000
DURASI(11, 10)	28.56000	0.000000
DURASI(11, 11)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster* 4 analisis sensitivitas skenario 6

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i,j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..12/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 540 780 660 900 1020 540 540 1140 540;
tutup = 1020 1260 660 1260 900 780 1020 1140 1260 1260 1260
1260;
```

D =

```
!ritel
!0   33   34   35   36   37   38   44   45   46   47
    48;
0    252  234  258  254  256  259  398  422  548
    548  341  !0;
252  0    20   44   39   42   46   184  208  334
    334  127  !33;
234  20   0    24   20   23   25   164  188  314
    314  107  !34;
258  44   24   0    7    6    9    138  158  295
    295  88   !35;
254  39   20   7    0    3    6    156  166  306
    306  99   !36;
256  42   23   6    3    0    7    156  164  305
    305  98   !37;
```

259	46	25	9	6	7	0	141	161	306	
	306	99	!38;							
398	184	164	138	156	156	141	0	24.4	102	
	102	57.5	!44;							
422	208	188	158	166	164	161	24.4	0	77.2	78
	80.9	!45;								
548	334	314	295	306	305	306	102	77.2	0	1.7
	145	!46;								
548	334	314	295	306	305	306	102	78	1.7	0
	144	!47;								
341	127	107	88	99	98	99	57.5	80.9	145	
	144	0;	!48;							

durasi =

0	302.4	280.8	309.6	304.8	307.2	310.8	477.6	506.4	657.6	
	657.6	409.2								
302.4	0	24	52.8	46.8	50.4	55.2	220.8	249.6	400.8	
	400.8	152.4								
280.8	24	0	28.8	24	27.6	30	196.8	225.6	376.8	
	376.8	128.4								
309.6	52.8	28.8	0	8.4	7.2	10.8	165.6	189.6	354	
	354	105.6								
304.8	46.8	24	8.4	0	3.6	7.2	187.2	199.2	367.2	
	367.2	118.8								
307.2	50.4	27.6	7.2	3.6	0	8.4	187.2	196.8	366	
	366	117.6								
310.8	55.2	30	10.8	7.2	8.4	0	169.2	193.2	367.2	
	367.2	118.8								
477.6	220.8	196.8	165.6	187.2	187.2	169.2	0	29.28	122.4	
	122.4	69								
506.4	249.6	225.6	189.6	199.2	196.8	193.2	29.28	0	92.64	
	93.6	97.08								
657.6	400.8	376.8	354	367.2	366	367.2	122.4	92.64	0	
	2.04	174								
657.6	400.8	376.8	354	367.2	366	367.2	122.4	93.6	2.04	0
	172.8									
409.2	152.4	128.4	105.6	118.8	117.6	118.8	69	97.08	174	
	172.8	0;								

Bongkar = 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3 0.3;
R = 10000000;

```
@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));
```

```

@text () = @writefor (rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

enddata

!fungsi objektif;
MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

```

```

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

- Hasil dari *solution report* pada *cluster 4* analisis sensitivitas skenario 6

Global optimal solution found.

Objective value:	1109.800
Objective bound:	1109.800
Infeasibilities:	0.000000
Extended solver steps:	196
Total solver iterations:	13959
Elapsed runtime seconds:	1.11

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 252 km
 rute pengiriman dari ritel 2 ke ritel 3 sebesar 20 km
 rute pengiriman dari ritel 3 ke ritel 6 sebesar 23 km
 rute pengiriman dari ritel 4 ke ritel 12 sebesar 88 km
 rute pengiriman dari ritel 5 ke ritel 7 sebesar 6 km
 rute pengiriman dari ritel 6 ke ritel 5 sebesar 3 km
 rute pengiriman dari ritel 7 ke ritel 4 sebesar 9 km
 rute pengiriman dari ritel 8 ke ritel 9 sebesar 24.4 km
 rute pengiriman dari ritel 9 ke ritel 10 sebesar 77.2 km
 rute pengiriman dari ritel 10 ke ritel 11 sebesar 1.7 km
 rute pengiriman dari ritel 11 ke ritel 1 sebesar 548 km
 rute pengiriman dari ritel 12 ke ritel 8 sebesar 57.5 km

Model Class: MILP

Total variables:	156
Nonlinear variables:	0
Integer variables:	144
Total constraints:	180
Nonlinear constraints:	0
Total nonzeros:	935

Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	0.3000000	0.000000
BONGKAR(2)	0.3000000	0.000000
BONGKAR(3)	0.3000000	0.000000
BONGKAR(4)	0.3000000	0.000000
BONGKAR(5)	0.3000000	0.000000
BONGKAR(6)	0.3000000	0.000000
BONGKAR(7)	0.3000000	0.000000
BONGKAR(8)	0.3000000	0.000000
BONGKAR(9)	0.3000000	0.000000
BONGKAR(10)	0.3000000	0.000000
BONGKAR(11)	0.3000000	0.000000
BONGKAR(12)	0.3000000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	540.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	660.0000	0.000000
BUKA(7)	900.0000	0.000000
BUKA(8)	1020.000	0.000000
BUKA(9)	540.0000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	1140.000	0.000000
BUKA(12)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	1260.000	0.000000
TUTUP(3)	660.0000	0.000000
TUTUP(4)	1260.000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	780.0000	0.000000
TUTUP(7)	1020.000	0.000000
TUTUP(8)	1140.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
TUTUP(12)	1260.000	0.000000
T(1)	1917.600	0.000000
T(2)	540.0000	0.000000

T(3)	659.7000	0.000000
T(4)	911.1000	0.000000
T(5)	892.5000	0.000000
T(6)	779.7000	0.000000
T(7)	900.0000	0.000000
T(8)	1086.300	0.000000
T(9)	1115.880	0.000000
T(10)	1208.820	0.000000
T(11)	1211.160	0.000000
T(12)	1017.000	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	252.0000
X(1, 3)	0.000000	234.0000
X(1, 4)	0.000000	258.0000
X(1, 5)	0.000000	254.0000
X(1, 6)	0.000000	256.0000
X(1, 7)	0.000000	259.0000
X(1, 8)	0.000000	398.0000
X(1, 9)	0.000000	422.0000
X(1, 10)	0.000000	548.0000
X(1, 11)	0.000000	548.0000
X(1, 12)	0.000000	341.0000
X(2, 1)	0.000000	252.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	1.000000	20.00000
X(2, 4)	0.000000	44.00000
X(2, 5)	0.000000	39.00000
X(2, 6)	0.000000	42.00000
X(2, 7)	0.000000	46.00000
X(2, 8)	0.000000	184.0000
X(2, 9)	0.000000	208.0000
X(2, 10)	0.000000	334.0000
X(2, 11)	0.000000	334.0000
X(2, 12)	0.000000	127.0000
X(3, 1)	0.000000	234.0000
X(3, 2)	0.000000	20.00000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	24.00000
X(3, 5)	0.000000	20.00000
X(3, 6)	1.000000	23.00000
X(3, 7)	0.000000	25.00000
X(3, 8)	0.000000	164.0000
X(3, 9)	0.000000	188.0000
X(3, 10)	0.000000	314.0000

X(3, 11)	0.000000	314.0000
X(3, 12)	0.000000	107.0000
X(4, 1)	0.000000	258.0000
X(4, 2)	0.000000	44.00000
X(4, 3)	0.000000	24.00000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	7.000000
X(4, 6)	0.000000	6.000000
X(4, 7)	0.000000	9.000000
X(4, 8)	0.000000	138.0000
X(4, 9)	0.000000	158.0000
X(4, 10)	0.000000	295.0000
X(4, 11)	0.000000	295.0000
X(4, 12)	1.000000	88.00000
X(5, 1)	0.000000	254.0000
X(5, 2)	0.000000	39.00000
X(5, 3)	0.000000	20.00000
X(5, 4)	0.000000	7.000000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	3.000000
X(5, 7)	1.000000	6.000000
X(5, 8)	0.000000	156.0000
X(5, 9)	0.000000	166.0000
X(5, 10)	0.000000	306.0000
X(5, 11)	0.000000	306.0000
X(5, 12)	0.000000	99.00000
X(6, 1)	0.000000	256.0000
X(6, 2)	0.000000	42.00000
X(6, 3)	0.000000	23.00000
X(6, 4)	0.000000	6.000000
X(6, 5)	1.000000	3.000000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	7.000000
X(6, 8)	0.000000	156.0000
X(6, 9)	0.000000	164.0000
X(6, 10)	0.000000	305.0000
X(6, 11)	0.000000	305.0000
X(6, 12)	0.000000	98.00000
X(7, 1)	0.000000	259.0000
X(7, 2)	0.000000	46.00000
X(7, 3)	0.000000	25.00000
X(7, 4)	1.000000	9.000000
X(7, 5)	0.000000	6.000000
X(7, 6)	0.000000	7.000000

X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	141.0000
X(7, 9)	0.000000	161.0000
X(7, 10)	0.000000	306.0000
X(7, 11)	0.000000	306.0000
X(7, 12)	0.000000	99.00000
X(8, 1)	0.000000	398.0000
X(8, 2)	0.000000	184.0000
X(8, 3)	0.000000	164.0000
X(8, 4)	0.000000	138.0000
X(8, 5)	0.000000	156.0000
X(8, 6)	0.000000	156.0000
X(8, 7)	0.000000	141.0000
X(8, 8)	0.000000	0.000000
X(8, 9)	1.000000	24.40000
X(8, 10)	0.000000	102.0000
X(8, 11)	0.000000	102.0000
X(8, 12)	0.000000	57.50000
X(9, 1)	0.000000	422.0000
X(9, 2)	0.000000	208.0000
X(9, 3)	0.000000	188.0000
X(9, 4)	0.000000	158.0000
X(9, 5)	0.000000	166.0000
X(9, 6)	0.000000	164.0000
X(9, 7)	0.000000	161.0000
X(9, 8)	0.000000	24.40000
X(9, 9)	0.000000	0.000000
X(9, 10)	1.000000	77.20000
X(9, 11)	0.000000	78.00000
X(9, 12)	0.000000	80.90000
X(10, 1)	0.000000	548.0000
X(10, 2)	0.000000	334.0000
X(10, 3)	0.000000	314.0000
X(10, 4)	0.000000	295.0000
X(10, 5)	0.000000	306.0000
X(10, 6)	0.000000	305.0000
X(10, 7)	0.000000	306.0000
X(10, 8)	0.000000	102.0000
X(10, 9)	0.000000	77.20000
X(10, 10)	0.000000	0.000000
X(10, 11)	1.000000	1.700000
X(10, 12)	0.000000	145.0000
X(11, 1)	1.000000	548.0000
X(11, 2)	0.000000	334.0000

X(11, 3)	0.000000	314.0000
X(11, 4)	0.000000	295.0000
X(11, 5)	0.000000	306.0000
X(11, 6)	0.000000	305.0000
X(11, 7)	0.000000	306.0000
X(11, 8)	0.000000	102.0000
X(11, 9)	0.000000	78.00000
X(11, 10)	0.000000	1.700000
X(11, 11)	0.000000	0.000000
X(11, 12)	0.000000	144.0000
X(12, 1)	0.000000	341.0000
X(12, 2)	0.000000	127.0000
X(12, 3)	0.000000	107.0000
X(12, 4)	0.000000	88.00000
X(12, 5)	0.000000	99.00000
X(12, 6)	0.000000	98.00000
X(12, 7)	0.000000	99.00000
X(12, 8)	1.000000	57.50000
X(12, 9)	0.000000	80.90000
X(12, 10)	0.000000	145.0000
X(12, 11)	0.000000	144.0000
X(12, 12)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	252.0000	0.000000
D(1, 3)	234.0000	0.000000
D(1, 4)	258.0000	0.000000
D(1, 5)	254.0000	0.000000
D(1, 6)	256.0000	0.000000
D(1, 7)	259.0000	0.000000
D(1, 8)	398.0000	0.000000
D(1, 9)	422.0000	0.000000
D(1, 10)	548.0000	0.000000
D(1, 11)	548.0000	0.000000
D(1, 12)	341.0000	0.000000
D(2, 1)	252.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	20.00000	0.000000
D(2, 4)	44.00000	0.000000
D(2, 5)	39.00000	0.000000
D(2, 6)	42.00000	0.000000
D(2, 7)	46.00000	0.000000
D(2, 8)	184.0000	0.000000
D(2, 9)	208.0000	0.000000
D(2, 10)	334.0000	0.000000

D(2, 11)	334.0000	0.000000
D(2, 12)	127.0000	0.000000
D(3, 1)	234.0000	0.000000
D(3, 2)	20.00000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	24.00000	0.000000
D(3, 5)	20.00000	0.000000
D(3, 6)	23.00000	0.000000
D(3, 7)	25.00000	0.000000
D(3, 8)	164.0000	0.000000
D(3, 9)	188.0000	0.000000
D(3, 10)	314.0000	0.000000
D(3, 11)	314.0000	0.000000
D(3, 12)	107.0000	0.000000
D(4, 1)	258.0000	0.000000
D(4, 2)	44.00000	0.000000
D(4, 3)	24.00000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	7.000000	0.000000
D(4, 6)	6.000000	0.000000
D(4, 7)	9.000000	0.000000
D(4, 8)	138.0000	0.000000
D(4, 9)	158.0000	0.000000
D(4, 10)	295.0000	0.000000
D(4, 11)	295.0000	0.000000
D(4, 12)	88.00000	0.000000
D(5, 1)	254.0000	0.000000
D(5, 2)	39.00000	0.000000
D(5, 3)	20.00000	0.000000
D(5, 4)	7.000000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	3.000000	0.000000
D(5, 7)	6.000000	0.000000
D(5, 8)	156.0000	0.000000
D(5, 9)	166.0000	0.000000
D(5, 10)	306.0000	0.000000
D(5, 11)	306.0000	0.000000
D(5, 12)	99.00000	0.000000
D(6, 1)	256.0000	0.000000
D(6, 2)	42.00000	0.000000
D(6, 3)	23.00000	0.000000
D(6, 4)	6.000000	0.000000
D(6, 5)	3.000000	0.000000
D(6, 6)	0.000000	0.000000

D(6, 7)	7.000000	0.000000
D(6, 8)	156.0000	0.000000
D(6, 9)	164.0000	0.000000
D(6, 10)	305.0000	0.000000
D(6, 11)	305.0000	0.000000
D(6, 12)	98.00000	0.000000
D(7, 1)	259.0000	0.000000
D(7, 2)	46.00000	0.000000
D(7, 3)	25.00000	0.000000
D(7, 4)	9.000000	0.000000
D(7, 5)	6.000000	0.000000
D(7, 6)	7.000000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	141.0000	0.000000
D(7, 9)	161.0000	0.000000
D(7, 10)	306.0000	0.000000
D(7, 11)	306.0000	0.000000
D(7, 12)	99.00000	0.000000
D(8, 1)	398.0000	0.000000
D(8, 2)	184.0000	0.000000
D(8, 3)	164.0000	0.000000
D(8, 4)	138.0000	0.000000
D(8, 5)	156.0000	0.000000
D(8, 6)	156.0000	0.000000
D(8, 7)	141.0000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	24.40000	0.000000
D(8, 10)	102.0000	0.000000
D(8, 11)	102.0000	0.000000
D(8, 12)	57.50000	0.000000
D(9, 1)	422.0000	0.000000
D(9, 2)	208.0000	0.000000
D(9, 3)	188.0000	0.000000
D(9, 4)	158.0000	0.000000
D(9, 5)	166.0000	0.000000
D(9, 6)	164.0000	0.000000
D(9, 7)	161.0000	0.000000
D(9, 8)	24.40000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	77.20000	0.000000
D(9, 11)	78.00000	0.000000
D(9, 12)	80.90000	0.000000
D(10, 1)	548.0000	0.000000
D(10, 2)	334.0000	0.000000

D(10, 3)	314.0000	0.000000
D(10, 4)	295.0000	0.000000
D(10, 5)	306.0000	0.000000
D(10, 6)	305.0000	0.000000
D(10, 7)	306.0000	0.000000
D(10, 8)	102.0000	0.000000
D(10, 9)	77.20000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	1.700000	0.000000
D(10, 12)	145.0000	0.000000
D(11, 1)	548.0000	0.000000
D(11, 2)	334.0000	0.000000
D(11, 3)	314.0000	0.000000
D(11, 4)	295.0000	0.000000
D(11, 5)	306.0000	0.000000
D(11, 6)	305.0000	0.000000
D(11, 7)	306.0000	0.000000
D(11, 8)	102.0000	0.000000
D(11, 9)	78.00000	0.000000
D(11, 10)	1.700000	0.000000
D(11, 11)	0.000000	0.000000
D(11, 12)	144.0000	0.000000
D(12, 1)	341.0000	0.000000
D(12, 2)	127.0000	0.000000
D(12, 3)	107.0000	0.000000
D(12, 4)	88.00000	0.000000
D(12, 5)	99.00000	0.000000
D(12, 6)	98.00000	0.000000
D(12, 7)	99.00000	0.000000
D(12, 8)	57.50000	0.000000
D(12, 9)	80.90000	0.000000
D(12, 10)	145.0000	0.000000
D(12, 11)	144.0000	0.000000
D(12, 12)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	302.4000	0.000000
DURASI(1, 3)	280.8000	0.000000
DURASI(1, 4)	309.6000	0.000000
DURASI(1, 5)	304.8000	0.000000
DURASI(1, 6)	307.2000	0.000000
DURASI(1, 7)	310.8000	0.000000
DURASI(1, 8)	477.6000	0.000000
DURASI(1, 9)	506.4000	0.000000
DURASI(1, 10)	657.6000	0.000000

DURASI(1, 11)	657.6000	0.000000
DURASI(1, 12)	409.2000	0.000000
DURASI(2, 1)	302.4000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	24.00000	0.000000
DURASI(2, 4)	52.80000	0.000000
DURASI(2, 5)	46.80000	0.000000
DURASI(2, 6)	50.40000	0.000000
DURASI(2, 7)	55.20000	0.000000
DURASI(2, 8)	220.8000	0.000000
DURASI(2, 9)	249.6000	0.000000
DURASI(2, 10)	400.8000	0.000000
DURASI(2, 11)	400.8000	0.000000
DURASI(2, 12)	152.4000	0.000000
DURASI(3, 1)	280.8000	0.000000
DURASI(3, 2)	24.00000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	28.80000	0.000000
DURASI(3, 5)	24.00000	0.000000
DURASI(3, 6)	27.60000	0.000000
DURASI(3, 7)	30.00000	0.000000
DURASI(3, 8)	196.8000	0.000000
DURASI(3, 9)	225.6000	0.000000
DURASI(3, 10)	376.8000	0.000000
DURASI(3, 11)	376.8000	0.000000
DURASI(3, 12)	128.4000	0.000000
DURASI(4, 1)	309.6000	0.000000
DURASI(4, 2)	52.80000	0.000000
DURASI(4, 3)	28.80000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	8.400000	0.000000
DURASI(4, 6)	7.200000	0.000000
DURASI(4, 7)	10.80000	0.000000
DURASI(4, 8)	165.6000	0.000000
DURASI(4, 9)	189.6000	0.000000
DURASI(4, 10)	354.0000	0.000000
DURASI(4, 11)	354.0000	0.000000
DURASI(4, 12)	105.6000	0.000000
DURASI(5, 1)	304.8000	0.000000
DURASI(5, 2)	46.80000	0.000000
DURASI(5, 3)	24.00000	0.000000
DURASI(5, 4)	8.400000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	3.600000	0.000000

DURASI(5, 7)	7.200000	0.000000
DURASI(5, 8)	187.2000	0.000000
DURASI(5, 9)	199.2000	0.000000
DURASI(5, 10)	367.2000	0.000000
DURASI(5, 11)	367.2000	0.000000
DURASI(5, 12)	118.8000	0.000000
DURASI(6, 1)	307.2000	0.000000
DURASI(6, 2)	50.40000	0.000000
DURASI(6, 3)	27.60000	0.000000
DURASI(6, 4)	7.200000	0.000000
DURASI(6, 5)	3.600000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	8.400000	0.000000
DURASI(6, 8)	187.2000	0.000000
DURASI(6, 9)	196.8000	0.000000
DURASI(6, 10)	366.0000	0.000000
DURASI(6, 11)	366.0000	0.000000
DURASI(6, 12)	117.6000	0.000000
DURASI(7, 1)	310.8000	0.000000
DURASI(7, 2)	55.20000	0.000000
DURASI(7, 3)	30.00000	0.000000
DURASI(7, 4)	10.80000	0.000000
DURASI(7, 5)	7.200000	0.000000
DURASI(7, 6)	8.400000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	169.2000	0.000000
DURASI(7, 9)	193.2000	0.000000
DURASI(7, 10)	367.2000	0.000000
DURASI(7, 11)	367.2000	0.000000
DURASI(7, 12)	118.8000	0.000000
DURASI(8, 1)	477.6000	0.000000
DURASI(8, 2)	220.8000	0.000000
DURASI(8, 3)	196.8000	0.000000
DURASI(8, 4)	165.6000	0.000000
DURASI(8, 5)	187.2000	0.000000
DURASI(8, 6)	187.2000	0.000000
DURASI(8, 7)	169.2000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	29.28000	0.000000
DURASI(8, 10)	122.4000	0.000000
DURASI(8, 11)	122.4000	0.000000
DURASI(8, 12)	69.00000	0.000000
DURASI(9, 1)	506.4000	0.000000
DURASI(9, 2)	249.6000	0.000000

DURASI(9, 3)	225.6000	0.000000
DURASI(9, 4)	189.6000	0.000000
DURASI(9, 5)	199.2000	0.000000
DURASI(9, 6)	196.8000	0.000000
DURASI(9, 7)	193.2000	0.000000
DURASI(9, 8)	29.28000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	92.64000	0.000000
DURASI(9, 11)	93.60000	0.000000
DURASI(9, 12)	97.08000	0.000000
DURASI(10, 1)	657.6000	0.000000
DURASI(10, 2)	400.8000	0.000000
DURASI(10, 3)	376.8000	0.000000
DURASI(10, 4)	354.0000	0.000000
DURASI(10, 5)	367.2000	0.000000
DURASI(10, 6)	366.0000	0.000000
DURASI(10, 7)	367.2000	0.000000
DURASI(10, 8)	122.4000	0.000000
DURASI(10, 9)	92.64000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	2.040000	0.000000
DURASI(10, 12)	174.0000	0.000000
DURASI(11, 1)	657.6000	0.000000
DURASI(11, 2)	400.8000	0.000000
DURASI(11, 3)	376.8000	0.000000
DURASI(11, 4)	354.0000	0.000000
DURASI(11, 5)	367.2000	0.000000
DURASI(11, 6)	366.0000	0.000000
DURASI(11, 7)	367.2000	0.000000
DURASI(11, 8)	122.4000	0.000000
DURASI(11, 9)	93.60000	0.000000
DURASI(11, 10)	2.040000	0.000000
DURASI(11, 11)	0.000000	0.000000
DURASI(11, 12)	172.8000	0.000000
DURASI(12, 1)	409.2000	0.000000
DURASI(12, 2)	152.4000	0.000000
DURASI(12, 3)	128.4000	0.000000
DURASI(12, 4)	105.6000	0.000000
DURASI(12, 5)	118.8000	0.000000
DURASI(12, 6)	117.6000	0.000000
DURASI(12, 7)	118.8000	0.000000
DURASI(12, 8)	69.00000	0.000000
DURASI(12, 9)	97.08000	0.000000
DURASI(12, 10)	174.0000	0.000000

DURASI(12, 11)	172.8000	0.000000
DURASI(12, 12)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 5* analisis sensitivitas skenario 6

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..11/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 660 780 540 540 1020 1140 540 540;
tutup = 1020 660 1260 780 900 1260 1260 1140 1260 1260 1260;
```

D =

```
!ritel
!0      16      19      20      21      39      40      41      42      43
      49;
0      49.3    161     160     160     312     316     321     321     320
      323     !0;
49.3   0       126     125     125     277     281     287     287     285
      289     !16;
161    126     0       5.4     1.7     171     175     180     181     179
      182     !19;
160    125     5.4     0       3.1     169     173     179     179     177
      180     !20;
160    125     1.7     3.1     0       169     173     179     179     177
      180     !21;
312    277     171     169     169     0       4       10     10     9     14
      !39;
316    281     175     173     173     4       0       9.5    9.8    8.1
      13.2    !40;
```

```

321  287  180  179  179  10  9.5  0  0.9  1.9  9.5
      !41;
321  287  181  179  179  10  9.8  0.9  0  1.7
      10.3  !42;
320  285  179  177  177  9  8.1  1.9  1.7  0
      11.1  !43;
323  289  182  180  180  14  13.2  9.5  10.3  11.1  0;
      !49;

```

```

durasi =
0      59.16 193.2 192  192  374.4 379.2 385.2 385.2 384
      387.6
59.16 0      151.2 150  150  332.4 337.2 344.4 344.4 342
      346.8
193.2 151.2 0      6.48 2.04 205.2 210  216  217.2 214.8
      218.4
192  150  6.48 0      3.72 202.8 207.6 214.8 214.8 212.4
      216
192  150  2.04 3.72 0      202.8 207.6 214.8 214.8 212.4
      216
374.4 332.4 205.2 202.8 202.8 0  4.8  12  12  10.8
      16.8
379.2 337.2 210  207.6 207.6 4.8  0  11.4 11.76 9.72
      15.84
385.2 344.4 216  214.8 214.8 12  11.4 0  1.08 2.28
      11.4
385.2 344.4 217.2 214.8 214.8 12  11.76 1.08 0  2.04
      12.36
384  342  214.8 212.4 212.4 10.8 9.72 2.28 2.04 0
      13.32
387.6 346.8 218.4 216  216  16.8 15.84 11.4 12.36 13.32 0;

```

```

Bongkar= 30 30 30 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;
MIN =

```

```

        @SUM (ritel(i) :
                @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

!Fungsi batasan;

!setiap ritel dikunjungi satu kali;
@FOR(ritel (j) | j #GT# 1 :
        @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

!perjalanan diawali dari depot;
@FOR (ritel (i) | i #EQ# 1 :
        @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

!perjalanan akan berakhir di depot;
@FOR (ritel (j) | j #EQ# 1 :
        @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

!pelaksanaan;
@FOR (ritel (i)| i #NE# 1 :
        @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

!rute;
@FOR (ritel (z) :
        @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
        @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 5* analisis sensitivitas skenario 6

Global optimal solution found.

Objective value:	700.3000
Objective bound:	700.3000
Infeasibilities:	0.000000
Extended solver steps:	483
Total solver iterations:	23890
Elapsed runtime seconds:	1.38

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 49.3 km
 rute pengiriman dari ritel 2 ke ritel 4 sebesar 125 km
 rute pengiriman dari ritel 3 ke ritel 5 sebesar 1.7 km
 rute pengiriman dari ritel 4 ke ritel 3 sebesar 5.4 km
 rute pengiriman dari ritel 5 ke ritel 11 sebesar 180 km
 rute pengiriman dari ritel 6 ke ritel 1 sebesar 312 km
 rute pengiriman dari ritel 7 ke ritel 6 sebesar 4 km
 rute pengiriman dari ritel 8 ke ritel 10 sebesar 1.9 km
 rute pengiriman dari ritel 9 ke ritel 7 sebesar 9.8000000000000001 km
 rute pengiriman dari ritel 10 ke ritel 9 sebesar 1.7 km
 rute pengiriman dari ritel 11 ke ritel 8 sebesar 9.5 km

Model Class: MILP

Total variables:	132
Nonlinear variables:	0
Integer variables:	121
Total constraints:	154
Nonlinear constraints:	0
Total nonzeros:	780
Nonlinear nonzeros:	0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000

BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BONGKAR(9)	30.00000	0.000000
BONGKAR(10)	30.00000	0.000000
BONGKAR(11)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	660.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	540.0000	0.000000
BUKA(7)	540.0000	0.000000
BUKA(8)	1020.000	0.000000
BUKA(9)	1140.000	0.000000
BUKA(10)	540.0000	0.000000
BUKA(11)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	780.0000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	1260.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1140.000	0.000000
TUTUP(9)	1260.000	0.000000
TUTUP(10)	1260.000	0.000000
TUTUP(11)	1260.000	0.000000
T(1)	1647.600	0.000000
T(2)	540.0000	0.000000
T(3)	756.4800	0.000000
T(4)	720.0000	0.000000
T(5)	788.5200	0.000000
T(6)	1230.000	0.000000
T(7)	1195.200	0.000000
T(8)	1089.120	0.000000
T(9)	1153.440	0.000000
T(10)	1121.400	0.000000
T(11)	1047.720	0.000000
X(1, 1)	0.000000	0.000000
X(1, 2)	1.000000	49.30000
X(1, 3)	0.000000	161.0000

X(1, 4)	0.000000	160.0000
X(1, 5)	0.000000	160.0000
X(1, 6)	0.000000	312.0000
X(1, 7)	0.000000	316.0000
X(1, 8)	0.000000	321.0000
X(1, 9)	0.000000	321.0000
X(1, 10)	0.000000	320.0000
X(1, 11)	0.000000	323.0000
X(2, 1)	0.000000	49.30000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	126.0000
X(2, 4)	1.000000	125.0000
X(2, 5)	0.000000	125.0000
X(2, 6)	0.000000	277.0000
X(2, 7)	0.000000	281.0000
X(2, 8)	0.000000	287.0000
X(2, 9)	0.000000	287.0000
X(2, 10)	0.000000	285.0000
X(2, 11)	0.000000	289.0000
X(3, 1)	0.000000	161.0000
X(3, 2)	0.000000	126.0000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	5.400000
X(3, 5)	1.000000	1.700000
X(3, 6)	0.000000	171.0000
X(3, 7)	0.000000	175.0000
X(3, 8)	0.000000	180.0000
X(3, 9)	0.000000	181.0000
X(3, 10)	0.000000	179.0000
X(3, 11)	0.000000	182.0000
X(4, 1)	0.000000	160.0000
X(4, 2)	0.000000	125.0000
X(4, 3)	1.000000	5.400000
X(4, 4)	0.000000	0.000000
X(4, 5)	0.000000	3.100000
X(4, 6)	0.000000	169.0000
X(4, 7)	0.000000	173.0000
X(4, 8)	0.000000	179.0000
X(4, 9)	0.000000	179.0000
X(4, 10)	0.000000	177.0000
X(4, 11)	0.000000	180.0000
X(5, 1)	0.000000	160.0000
X(5, 2)	0.000000	125.0000
X(5, 3)	0.000000	1.700000

X(5, 4)	0.000000	3.100000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	169.0000
X(5, 7)	0.000000	173.0000
X(5, 8)	0.000000	179.0000
X(5, 9)	0.000000	179.0000
X(5, 10)	0.000000	177.0000
X(5, 11)	1.000000	180.0000
X(6, 1)	1.000000	312.0000
X(6, 2)	0.000000	277.0000
X(6, 3)	0.000000	171.0000
X(6, 4)	0.000000	169.0000
X(6, 5)	0.000000	169.0000
X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	4.000000
X(6, 8)	0.000000	10.00000
X(6, 9)	0.000000	10.00000
X(6, 10)	0.000000	9.000000
X(6, 11)	0.000000	14.00000
X(7, 1)	0.000000	316.0000
X(7, 2)	0.000000	281.0000
X(7, 3)	0.000000	175.0000
X(7, 4)	0.000000	173.0000
X(7, 5)	0.000000	173.0000
X(7, 6)	1.000000	4.000000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	9.500000
X(7, 9)	0.000000	9.800000
X(7, 10)	0.000000	8.100000
X(7, 11)	0.000000	13.20000
X(8, 1)	0.000000	321.0000
X(8, 2)	0.000000	287.0000
X(8, 3)	0.000000	180.0000
X(8, 4)	0.000000	179.0000
X(8, 5)	0.000000	179.0000
X(8, 6)	0.000000	10.00000
X(8, 7)	0.000000	9.500000
X(8, 8)	0.000000	0.000000
X(8, 9)	0.000000	0.9000000
X(8, 10)	1.000000	1.900000
X(8, 11)	0.000000	9.500000
X(9, 1)	0.000000	321.0000
X(9, 2)	0.000000	287.0000
X(9, 3)	0.000000	181.0000

X(9, 4)	0.000000	179.0000
X(9, 5)	0.000000	179.0000
X(9, 6)	0.000000	10.00000
X(9, 7)	1.000000	9.800000
X(9, 8)	0.000000	0.9000000
X(9, 9)	0.000000	0.000000
X(9, 10)	0.000000	1.700000
X(9, 11)	0.000000	10.30000
X(10, 1)	0.000000	320.0000
X(10, 2)	0.000000	285.0000
X(10, 3)	0.000000	179.0000
X(10, 4)	0.000000	177.0000
X(10, 5)	0.000000	177.0000
X(10, 6)	0.000000	9.000000
X(10, 7)	0.000000	8.100000
X(10, 8)	0.000000	1.900000
X(10, 9)	1.000000	1.700000
X(10, 10)	0.000000	0.000000
X(10, 11)	0.000000	11.10000
X(11, 1)	0.000000	323.0000
X(11, 2)	0.000000	289.0000
X(11, 3)	0.000000	182.0000
X(11, 4)	0.000000	180.0000
X(11, 5)	0.000000	180.0000
X(11, 6)	0.000000	14.00000
X(11, 7)	0.000000	13.20000
X(11, 8)	1.000000	9.500000
X(11, 9)	0.000000	10.30000
X(11, 10)	0.000000	11.10000
X(11, 11)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	49.30000	0.000000
D(1, 3)	161.0000	0.000000
D(1, 4)	160.0000	0.000000
D(1, 5)	160.0000	0.000000
D(1, 6)	312.0000	0.000000
D(1, 7)	316.0000	0.000000
D(1, 8)	321.0000	0.000000
D(1, 9)	321.0000	0.000000
D(1, 10)	320.0000	0.000000
D(1, 11)	323.0000	0.000000
D(2, 1)	49.30000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	126.0000	0.000000

D(2, 4)	125.0000	0.000000
D(2, 5)	125.0000	0.000000
D(2, 6)	277.0000	0.000000
D(2, 7)	281.0000	0.000000
D(2, 8)	287.0000	0.000000
D(2, 9)	287.0000	0.000000
D(2, 10)	285.0000	0.000000
D(2, 11)	289.0000	0.000000
D(3, 1)	161.0000	0.000000
D(3, 2)	126.0000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	5.400000	0.000000
D(3, 5)	1.700000	0.000000
D(3, 6)	171.0000	0.000000
D(3, 7)	175.0000	0.000000
D(3, 8)	180.0000	0.000000
D(3, 9)	181.0000	0.000000
D(3, 10)	179.0000	0.000000
D(3, 11)	182.0000	0.000000
D(4, 1)	160.0000	0.000000
D(4, 2)	125.0000	0.000000
D(4, 3)	5.400000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	3.100000	0.000000
D(4, 6)	169.0000	0.000000
D(4, 7)	173.0000	0.000000
D(4, 8)	179.0000	0.000000
D(4, 9)	179.0000	0.000000
D(4, 10)	177.0000	0.000000
D(4, 11)	180.0000	0.000000
D(5, 1)	160.0000	0.000000
D(5, 2)	125.0000	0.000000
D(5, 3)	1.700000	0.000000
D(5, 4)	3.100000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	169.0000	0.000000
D(5, 7)	173.0000	0.000000
D(5, 8)	179.0000	0.000000
D(5, 9)	179.0000	0.000000
D(5, 10)	177.0000	0.000000
D(5, 11)	180.0000	0.000000
D(6, 1)	312.0000	0.000000
D(6, 2)	277.0000	0.000000
D(6, 3)	171.0000	0.000000

D(6, 4)	169.0000	0.000000
D(6, 5)	169.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	4.000000	0.000000
D(6, 8)	10.00000	0.000000
D(6, 9)	10.00000	0.000000
D(6, 10)	9.000000	0.000000
D(6, 11)	14.00000	0.000000
D(7, 1)	316.0000	0.000000
D(7, 2)	281.0000	0.000000
D(7, 3)	175.0000	0.000000
D(7, 4)	173.0000	0.000000
D(7, 5)	173.0000	0.000000
D(7, 6)	4.000000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	9.500000	0.000000
D(7, 9)	9.800000	0.000000
D(7, 10)	8.100000	0.000000
D(7, 11)	13.20000	0.000000
D(8, 1)	321.0000	0.000000
D(8, 2)	287.0000	0.000000
D(8, 3)	180.0000	0.000000
D(8, 4)	179.0000	0.000000
D(8, 5)	179.0000	0.000000
D(8, 6)	10.00000	0.000000
D(8, 7)	9.500000	0.000000
D(8, 8)	0.000000	0.000000
D(8, 9)	0.9000000	0.000000
D(8, 10)	1.900000	0.000000
D(8, 11)	9.500000	0.000000
D(9, 1)	321.0000	0.000000
D(9, 2)	287.0000	0.000000
D(9, 3)	181.0000	0.000000
D(9, 4)	179.0000	0.000000
D(9, 5)	179.0000	0.000000
D(9, 6)	10.00000	0.000000
D(9, 7)	9.800000	0.000000
D(9, 8)	0.9000000	0.000000
D(9, 9)	0.000000	0.000000
D(9, 10)	1.700000	0.000000
D(9, 11)	10.30000	0.000000
D(10, 1)	320.0000	0.000000
D(10, 2)	285.0000	0.000000
D(10, 3)	179.0000	0.000000

D(10, 4)	177.0000	0.000000
D(10, 5)	177.0000	0.000000
D(10, 6)	9.000000	0.000000
D(10, 7)	8.100000	0.000000
D(10, 8)	1.900000	0.000000
D(10, 9)	1.700000	0.000000
D(10, 10)	0.000000	0.000000
D(10, 11)	11.10000	0.000000
D(11, 1)	323.0000	0.000000
D(11, 2)	289.0000	0.000000
D(11, 3)	182.0000	0.000000
D(11, 4)	180.0000	0.000000
D(11, 5)	180.0000	0.000000
D(11, 6)	14.00000	0.000000
D(11, 7)	13.20000	0.000000
D(11, 8)	9.500000	0.000000
D(11, 9)	10.30000	0.000000
D(11, 10)	11.10000	0.000000
D(11, 11)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	59.16000	0.000000
DURASI(1, 3)	193.2000	0.000000
DURASI(1, 4)	192.0000	0.000000
DURASI(1, 5)	192.0000	0.000000
DURASI(1, 6)	374.4000	0.000000
DURASI(1, 7)	379.2000	0.000000
DURASI(1, 8)	385.2000	0.000000
DURASI(1, 9)	385.2000	0.000000
DURASI(1, 10)	384.0000	0.000000
DURASI(1, 11)	387.6000	0.000000
DURASI(2, 1)	59.16000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	151.2000	0.000000
DURASI(2, 4)	150.0000	0.000000
DURASI(2, 5)	150.0000	0.000000
DURASI(2, 6)	332.4000	0.000000
DURASI(2, 7)	337.2000	0.000000
DURASI(2, 8)	344.4000	0.000000
DURASI(2, 9)	344.4000	0.000000
DURASI(2, 10)	342.0000	0.000000
DURASI(2, 11)	346.8000	0.000000
DURASI(3, 1)	193.2000	0.000000
DURASI(3, 2)	151.2000	0.000000
DURASI(3, 3)	0.000000	0.000000

DURASI(3, 4)	6.480000	0.000000
DURASI(3, 5)	2.040000	0.000000
DURASI(3, 6)	205.2000	0.000000
DURASI(3, 7)	210.0000	0.000000
DURASI(3, 8)	216.0000	0.000000
DURASI(3, 9)	217.2000	0.000000
DURASI(3, 10)	214.8000	0.000000
DURASI(3, 11)	218.4000	0.000000
DURASI(4, 1)	192.0000	0.000000
DURASI(4, 2)	150.0000	0.000000
DURASI(4, 3)	6.480000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	3.720000	0.000000
DURASI(4, 6)	202.8000	0.000000
DURASI(4, 7)	207.6000	0.000000
DURASI(4, 8)	214.8000	0.000000
DURASI(4, 9)	214.8000	0.000000
DURASI(4, 10)	212.4000	0.000000
DURASI(4, 11)	216.0000	0.000000
DURASI(5, 1)	192.0000	0.000000
DURASI(5, 2)	150.0000	0.000000
DURASI(5, 3)	2.040000	0.000000
DURASI(5, 4)	3.720000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	202.8000	0.000000
DURASI(5, 7)	207.6000	0.000000
DURASI(5, 8)	214.8000	0.000000
DURASI(5, 9)	214.8000	0.000000
DURASI(5, 10)	212.4000	0.000000
DURASI(5, 11)	216.0000	0.000000
DURASI(6, 1)	374.4000	0.000000
DURASI(6, 2)	332.4000	0.000000
DURASI(6, 3)	205.2000	0.000000
DURASI(6, 4)	202.8000	0.000000
DURASI(6, 5)	202.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	4.800000	0.000000
DURASI(6, 8)	12.000000	0.000000
DURASI(6, 9)	12.000000	0.000000
DURASI(6, 10)	10.800000	0.000000
DURASI(6, 11)	16.800000	0.000000
DURASI(7, 1)	379.2000	0.000000
DURASI(7, 2)	337.2000	0.000000
DURASI(7, 3)	210.0000	0.000000

DURASI(7, 4)	207.6000	0.000000
DURASI(7, 5)	207.6000	0.000000
DURASI(7, 6)	4.800000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	11.40000	0.000000
DURASI(7, 9)	11.76000	0.000000
DURASI(7, 10)	9.720000	0.000000
DURASI(7, 11)	15.84000	0.000000
DURASI(8, 1)	385.2000	0.000000
DURASI(8, 2)	344.4000	0.000000
DURASI(8, 3)	216.0000	0.000000
DURASI(8, 4)	214.8000	0.000000
DURASI(8, 5)	214.8000	0.000000
DURASI(8, 6)	12.00000	0.000000
DURASI(8, 7)	11.40000	0.000000
DURASI(8, 8)	0.000000	0.000000
DURASI(8, 9)	1.080000	0.000000
DURASI(8, 10)	2.280000	0.000000
DURASI(8, 11)	11.40000	0.000000
DURASI(9, 1)	385.2000	0.000000
DURASI(9, 2)	344.4000	0.000000
DURASI(9, 3)	217.2000	0.000000
DURASI(9, 4)	214.8000	0.000000
DURASI(9, 5)	214.8000	0.000000
DURASI(9, 6)	12.00000	0.000000
DURASI(9, 7)	11.76000	0.000000
DURASI(9, 8)	1.080000	0.000000
DURASI(9, 9)	0.000000	0.000000
DURASI(9, 10)	2.040000	0.000000
DURASI(9, 11)	12.36000	0.000000
DURASI(10, 1)	384.0000	0.000000
DURASI(10, 2)	342.0000	0.000000
DURASI(10, 3)	214.8000	0.000000
DURASI(10, 4)	212.4000	0.000000
DURASI(10, 5)	212.4000	0.000000
DURASI(10, 6)	10.80000	0.000000
DURASI(10, 7)	9.720000	0.000000
DURASI(10, 8)	2.280000	0.000000
DURASI(10, 9)	2.040000	0.000000
DURASI(10, 10)	0.000000	0.000000
DURASI(10, 11)	13.32000	0.000000
DURASI(11, 1)	387.6000	0.000000
DURASI(11, 2)	346.8000	0.000000
DURASI(11, 3)	218.4000	0.000000

DURASI(11, 4)	216.0000	0.000000
DURASI(11, 5)	216.0000	0.000000
DURASI(11, 6)	16.80000	0.000000
DURASI(11, 7)	15.84000	0.000000
DURASI(11, 8)	11.40000	0.000000
DURASI(11, 9)	12.36000	0.000000
DURASI(11, 10)	13.32000	0.000000
DURASI(11, 11)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster* 6 analisis sensitivitas skenario 6

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..8/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 1020 1140 900 780 660;
tutup = 1020 660 1260 1140 1260 1020 900 780;
```

D =

```
!ritel
!0    4    17    18    22    23    24    28;
0     12.3  115   115   193   102   93    157   !0;
12.3  0     120   121   198   83.1  75.1  148   !4;
115   120   0     1.1   96.1  83    96.4  45.8  !17;
115   121   1.1   0     95    84.5  97.8  46    !18;
193   198   96.1  95    0     194   266   103   !22;
102   83.1  83    84.5  194   0     14.9  75.3  !23;
93    75.1  96.4  97.8  266   14.9  0     76.6  !24;
157   148   45.8  46    103   75.3  76.6  0;    !28;
```

durasi =

```
0     14.76  138   138   231.6  122.4  111.6  188.4
14.76 0     144   145.2  237.6  99.72  90.12  177.6
138   144   0     1.32  115.32 99.6   115.68 54.96
138   145.2 1.32  0     114   101.4  117.36 55.2
231.6 237.6 115.32 114   0     232.8  319.2 123.6
```



```

122.4 99.72 99.6 101.4 232.8 0 17.88 90.36
111.6 90.12 115.68 117.36 319.2 17.88 0 91.92
188.4 177.6 54.96 55.2 123.6 90.36 91.92 0;

```

```

Bongkar = 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

```

```

!Fungsi batasan;

```

```

!setiap ritel dikunjungi satu kali;

```

```

@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

```

```

!perjalanan diawali dari depot;

```

```

@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

```

```

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

```

```

!pelaksanaan;

```

```

@FOR (ritel (i)| i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

```

```

!rute;

```

```

@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j) :
    @BIN(x(i, j)));

End

```

- Hasil dari *solution report* pada *cluster 6* analisis sensitivitas skenario 6

Global optimal solution found.

Objective value:	623.9000
Objective bound:	623.9000
Infeasibilities:	0.000000
Extended solver steps:	0
Total solver iterations:	1
Elapsed runtime seconds:	0.11

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 12.3 km
rute pengiriman dari ritel 2 ke ritel 8 sebesar 148 km
rute pengiriman dari ritel 3 ke ritel 4 sebesar 1.1 km
rute pengiriman dari ritel 4 ke ritel 5 sebesar 95 km
rute pengiriman dari ritel 5 ke ritel 1 sebesar 193 km
rute pengiriman dari ritel 6 ke ritel 3 sebesar 83 km
rute pengiriman dari ritel 7 ke ritel 6 sebesar 14.9 km
rute pengiriman dari ritel 8 ke ritel 7 sebesar 76.59999999999999 km

Model Class: MILP

Total variables:	72
Nonlinear variables:	0
Integer variables:	64

Total constraints: 88
 Nonlinear constraints: 0
 Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	1020.000	0.000000
BUKA(5)	1140.000	0.000000
BUKA(6)	900.0000	0.000000
BUKA(7)	780.0000	0.000000
BUKA(8)	660.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	1140.000	0.000000
TUTUP(5)	1260.000	0.000000
TUTUP(6)	1020.000	0.000000
TUTUP(7)	900.0000	0.000000
TUTUP(8)	780.0000	0.000000
T(1)	1491.600	0.000000
T(2)	540.0000	0.000000
T(3)	1047.000	0.000000
T(4)	1078.320	0.000000
T(5)	1230.000	0.000000
T(6)	917.4000	0.000000
T(7)	869.5200	0.000000
T(8)	747.6000	0.000000
X(1, 1)	0.000000	0.000000

X(1, 2)	1.000000	12.30000
X(1, 3)	0.000000	115.0000
X(1, 4)	0.000000	115.0000
X(1, 5)	0.000000	193.0000
X(1, 6)	0.000000	102.0000
X(1, 7)	0.000000	93.00000
X(1, 8)	0.000000	157.0000
X(2, 1)	0.000000	12.30000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	120.0000
X(2, 4)	0.000000	121.0000
X(2, 5)	0.000000	198.0000
X(2, 6)	0.000000	83.10000
X(2, 7)	0.000000	75.10000
X(2, 8)	1.000000	148.0000
X(3, 1)	0.000000	115.0000
X(3, 2)	0.000000	120.0000
X(3, 3)	0.000000	0.000000
X(3, 4)	1.000000	1.100000
X(3, 5)	0.000000	96.10000
X(3, 6)	0.000000	83.00000
X(3, 7)	0.000000	96.40000
X(3, 8)	0.000000	45.80000
X(4, 1)	0.000000	115.0000
X(4, 2)	0.000000	121.0000
X(4, 3)	0.000000	1.100000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	95.00000
X(4, 6)	0.000000	84.50000
X(4, 7)	0.000000	97.80000
X(4, 8)	0.000000	46.00000
X(5, 1)	1.000000	193.0000
X(5, 2)	0.000000	198.0000
X(5, 3)	0.000000	96.10000
X(5, 4)	0.000000	95.00000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	194.0000
X(5, 7)	0.000000	266.0000
X(5, 8)	0.000000	103.0000
X(6, 1)	0.000000	102.0000
X(6, 2)	0.000000	83.10000
X(6, 3)	1.000000	83.00000
X(6, 4)	0.000000	84.50000
X(6, 5)	0.000000	194.0000

X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	14.90000
X(6, 8)	0.000000	75.30000
X(7, 1)	0.000000	93.00000
X(7, 2)	0.000000	75.10000
X(7, 3)	0.000000	96.40000
X(7, 4)	0.000000	97.80000
X(7, 5)	0.000000	266.0000
X(7, 6)	1.000000	14.90000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	76.60000
X(8, 1)	0.000000	157.0000
X(8, 2)	0.000000	148.0000
X(8, 3)	0.000000	45.80000
X(8, 4)	0.000000	46.00000
X(8, 5)	0.000000	103.0000
X(8, 6)	0.000000	75.30000
X(8, 7)	1.000000	76.60000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	12.30000	0.000000
D(1, 3)	115.0000	0.000000
D(1, 4)	115.0000	0.000000
D(1, 5)	193.0000	0.000000
D(1, 6)	102.0000	0.000000
D(1, 7)	93.00000	0.000000
D(1, 8)	157.0000	0.000000
D(2, 1)	12.30000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	120.0000	0.000000
D(2, 4)	121.0000	0.000000
D(2, 5)	198.0000	0.000000
D(2, 6)	83.10000	0.000000
D(2, 7)	75.10000	0.000000
D(2, 8)	148.0000	0.000000
D(3, 1)	115.0000	0.000000
D(3, 2)	120.0000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	1.100000	0.000000
D(3, 5)	96.10000	0.000000
D(3, 6)	83.00000	0.000000
D(3, 7)	96.40000	0.000000
D(3, 8)	45.80000	0.000000
D(4, 1)	115.0000	0.000000

D(4, 2)	121.0000	0.000000
D(4, 3)	1.100000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	95.00000	0.000000
D(4, 6)	84.50000	0.000000
D(4, 7)	97.80000	0.000000
D(4, 8)	46.00000	0.000000
D(5, 1)	193.0000	0.000000
D(5, 2)	198.0000	0.000000
D(5, 3)	96.10000	0.000000
D(5, 4)	95.00000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	194.0000	0.000000
D(5, 7)	266.0000	0.000000
D(5, 8)	103.0000	0.000000
D(6, 1)	102.0000	0.000000
D(6, 2)	83.10000	0.000000
D(6, 3)	83.00000	0.000000
D(6, 4)	84.50000	0.000000
D(6, 5)	194.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	14.90000	0.000000
D(6, 8)	75.30000	0.000000
D(7, 1)	93.00000	0.000000
D(7, 2)	75.10000	0.000000
D(7, 3)	96.40000	0.000000
D(7, 4)	97.80000	0.000000
D(7, 5)	266.0000	0.000000
D(7, 6)	14.90000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	76.60000	0.000000
D(8, 1)	157.0000	0.000000
D(8, 2)	148.0000	0.000000
D(8, 3)	45.80000	0.000000
D(8, 4)	46.00000	0.000000
D(8, 5)	103.0000	0.000000
D(8, 6)	75.30000	0.000000
D(8, 7)	76.60000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	14.76000	0.000000
DURASI(1, 3)	138.0000	0.000000
DURASI(1, 4)	138.0000	0.000000
DURASI(1, 5)	231.6000	0.000000

DURASI(1, 6)	122.4000	0.000000
DURASI(1, 7)	111.6000	0.000000
DURASI(1, 8)	188.4000	0.000000
DURASI(2, 1)	14.76000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	144.0000	0.000000
DURASI(2, 4)	145.2000	0.000000
DURASI(2, 5)	237.6000	0.000000
DURASI(2, 6)	99.72000	0.000000
DURASI(2, 7)	90.12000	0.000000
DURASI(2, 8)	177.6000	0.000000
DURASI(3, 1)	138.0000	0.000000
DURASI(3, 2)	144.0000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	1.320000	0.000000
DURASI(3, 5)	115.3200	0.000000
DURASI(3, 6)	99.60000	0.000000
DURASI(3, 7)	115.6800	0.000000
DURASI(3, 8)	54.96000	0.000000
DURASI(4, 1)	138.0000	0.000000
DURASI(4, 2)	145.2000	0.000000
DURASI(4, 3)	1.320000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	114.0000	0.000000
DURASI(4, 6)	101.4000	0.000000
DURASI(4, 7)	117.3600	0.000000
DURASI(4, 8)	55.20000	0.000000
DURASI(5, 1)	231.6000	0.000000
DURASI(5, 2)	237.6000	0.000000
DURASI(5, 3)	115.3200	0.000000
DURASI(5, 4)	114.0000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	232.8000	0.000000
DURASI(5, 7)	319.2000	0.000000
DURASI(5, 8)	123.6000	0.000000
DURASI(6, 1)	122.4000	0.000000
DURASI(6, 2)	99.72000	0.000000
DURASI(6, 3)	99.60000	0.000000
DURASI(6, 4)	101.4000	0.000000
DURASI(6, 5)	232.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	17.88000	0.000000
DURASI(6, 8)	90.36000	0.000000
DURASI(7, 1)	111.6000	0.000000

DURASI(7, 2)	90.12000	0.000000
DURASI(7, 3)	115.6800	0.000000
DURASI(7, 4)	117.3600	0.000000
DURASI(7, 5)	319.2000	0.000000
DURASI(7, 6)	17.88000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	91.92000	0.000000
DURASI(8, 1)	188.4000	0.000000
DURASI(8, 2)	177.6000	0.000000
DURASI(8, 3)	54.96000	0.000000
DURASI(8, 4)	55.20000	0.000000
DURASI(8, 5)	123.6000	0.000000
DURASI(8, 6)	90.36000	0.000000
DURASI(8, 7)	91.92000	0.000000
DURASI(8, 8)	0.000000	0.000000

➤ Pemrograman Lingo untuk *cluster 7* analisis sensitivitas skenario 6

model:

```
!parameter model:
    Buka      = waktu buka ritel
    Tutup     = waktu tutup ritel
    Bongkar   = waktu loading/unloading di ritel
    D         = jarak antar ritel
    T         = waktu memulai pelayanan pada ritel
    Durasi    = Durasi pengiriman
    R         = bilangan rill yang bernilai besar
;
!variabel keputusan:
    x(i, j) = 1 jika kendaraan k beroperasi dari i ke j
;
```

sets:

```
ritel/1..8/: Bongkar, buka, tutup, T;
rute(ritel, ritel) : x, D, durasi;
endsets
```

data:

```
buka = 480 540 540 660 780 1020 1140 540;
tutup = 1020 660 1260 780 900 1140 1260 1260;
```

D =

```
!ritel
!0   12   13   14   15   25   26   27;
0    146  190  192  194  92.2  93.8  93   !0;
146  0    63.4  64.1  66.9  157   159   158  !12;
190  63.4  0    3.2   5.9   200   201   201  !13;
192  64.1  3.2   0    2.9   203   205   204  !14;
194  66.9  5.9   2.9   0    204   206   205  !15;
92.2 157   200   203   204   0    3.1   1.4  !25;
93.8 159   201   205   206   3.1   0    4    !26;
93   158   201   204   205   1.4   4    0;   !27;
```

durasi =

```
0    175.2  228   230.4  232.8  110.64   112.56   111.6
175.2 0    76.08  76.92  80.28  188.4   190.8   189.6
228   76.08  0    3.84   7.08   240    241.2   241.2
230.4 76.92  3.84  0    3.48   243.6  246    244.8
232.8 80.28  7.08  3.48  0    244.8  247.2  246
```

```

110.64      188.4 240    243.6 244.8 0      3.72  1.68
112.56      190.8 241.2 246    247.2 3.72  0      4.8
111.6 189.6 241.2 244.8 246    1.68  4.8   0;

```

```

Bongkar = 30 30 30 30 30 30 30 30;
R = 10000000;

```

```

@text() = @write("Rute yang paling optimal adalah: ",
@newline(1));

```

```

@text() = @writefor(rute(i, j) | x(i, j) #NE# 0 : "rute
pengiriman dari ritel ", i, " ke ritel ", j, " sebesar ", D(i,
j), " km ",
@newline(1));

```

```

enddata

```

```

!fungsi objektif;

```

```

MIN =
    @SUM (ritel(i) :
        @SUM(ritel (j) | i#NE# j: D (i, j) * x(i, j))
);

```

```

!Fungsi batasan;

```

```

!setiap ritel dikunjungi satu kali;

```

```

@FOR(ritel (j) | j #GT# 1 :
    @SUM(ritel (i) | i #NE# j: x(i, j)) = 1
);

```

```

!perjalanan diawali dari depot;

```

```

@FOR (ritel (i) | i #EQ# 1 :
    @SUM (ritel (J) | j #GT# 1 :x(i, j)) = 1
);

```

```

!perjalanan akan berakhir di depot;

```

```

@FOR (ritel (j) | j #EQ# 1 :
    @SUM (ritel (i) | i #GT# 1 : x(i, j)) = 1
);

```

```

!pelaksanaan;

```

```

@FOR (ritel (i) | i #NE# 1 :
    @FOR (ritel (j) : T(j) >= T(i) + Bongkar(i) + durasi(i,
j) - R * (1 - x(i, j)))
);

```

```

!rute;

```

```

@FOR (ritel (z) :
    @SUM(ritel (i) | i #NE# z : x(i, z)) - @SUM(ritel (j) |
j #NE# z : x(z, j)) = 0
);

!time windows;
@FOR (ritel (i) | i #NE# 1 : buka(i) <= T(i)
);

@FOR (ritel (i) | i #NE# 1 : tutup(i) >= T(i) + Bongkar(i)
);

! Variabel keputusan yang memiliki variabel biner;
@FOR (rute (i, j):
    @BIN(x(i, j)));

End

```

➤ Hasil dari *solution report* pada *cluster 7* analisis sensitivitas skenario 6

Global optimal solution found.
Objective value: 518.1000
Objective bound: 518.1000
Infeasibilities: 0.000000
Extended solver steps: 0
Total solver iterations: 11
Elapsed runtime seconds: 0.10

Rute yang paling optimal adalah:

rute pengiriman dari ritel 1 ke ritel 2 sebesar 146 km
rute pengiriman dari ritel 2 ke ritel 4 sebesar 64.09999999999999 km
rute pengiriman dari ritel 3 ke ritel 6 sebesar 200 km
rute pengiriman dari ritel 4 ke ritel 5 sebesar 2.9 km
rute pengiriman dari ritel 5 ke ritel 3 sebesar 5.9 km
rute pengiriman dari ritel 6 ke ritel 8 sebesar 1.4 km
rute pengiriman dari ritel 7 ke ritel 1 sebesar 93.8 km
rute pengiriman dari ritel 8 ke ritel 7 sebesar 4 km

Model Class: MILP

Total variables: 72
Nonlinear variables: 0
Integer variables: 64

Total constraints: 88
 Nonlinear constraints: 0

Total nonzeros: 399
 Nonlinear nonzeros: 0

Variable	Value	Reduced Cost
R	0.1000000E+08	0.000000
BONGKAR(1)	30.00000	0.000000
BONGKAR(2)	30.00000	0.000000
BONGKAR(3)	30.00000	0.000000
BONGKAR(4)	30.00000	0.000000
BONGKAR(5)	30.00000	0.000000
BONGKAR(6)	30.00000	0.000000
BONGKAR(7)	30.00000	0.000000
BONGKAR(8)	30.00000	0.000000
BUKA(1)	480.0000	0.000000
BUKA(2)	540.0000	0.000000
BUKA(3)	540.0000	0.000000
BUKA(4)	660.0000	0.000000
BUKA(5)	780.0000	0.000000
BUKA(6)	1020.000	0.000000
BUKA(7)	1140.000	0.000000
BUKA(8)	540.0000	0.000000
TUTUP(1)	1020.000	0.000000
TUTUP(2)	660.0000	0.000000
TUTUP(3)	1260.000	0.000000
TUTUP(4)	780.0000	0.000000
TUTUP(5)	900.0000	0.000000
TUTUP(6)	1140.000	0.000000
TUTUP(7)	1260.000	0.000000
TUTUP(8)	1260.000	0.000000
T(1)	1488.000	0.000000
T(2)	540.0000	0.000000
T(3)	817.0800	0.000000
T(4)	660.0000	0.000000
T(5)	780.0000	0.000000
T(6)	1087.080	0.000000
T(7)	1153.560	0.000000
T(8)	1118.760	0.000000
X(1, 1)	0.000000	0.000000

X(1, 2)	1.000000	146.0000
X(1, 3)	0.000000	190.0000
X(1, 4)	0.000000	192.0000
X(1, 5)	0.000000	194.0000
X(1, 6)	0.000000	92.20000
X(1, 7)	0.000000	93.80000
X(1, 8)	0.000000	93.00000
X(2, 1)	0.000000	146.0000
X(2, 2)	0.000000	0.000000
X(2, 3)	0.000000	63.40000
X(2, 4)	1.000000	64.10000
X(2, 5)	0.000000	66.90000
X(2, 6)	0.000000	157.0000
X(2, 7)	0.000000	159.0000
X(2, 8)	0.000000	158.0000
X(3, 1)	0.000000	190.0000
X(3, 2)	0.000000	63.40000
X(3, 3)	0.000000	0.000000
X(3, 4)	0.000000	3.200000
X(3, 5)	0.000000	5.900000
X(3, 6)	1.000000	200.0000
X(3, 7)	0.000000	201.0000
X(3, 8)	0.000000	201.0000
X(4, 1)	0.000000	192.0000
X(4, 2)	0.000000	64.10000
X(4, 3)	0.000000	3.200000
X(4, 4)	0.000000	0.000000
X(4, 5)	1.000000	2.900000
X(4, 6)	0.000000	203.0000
X(4, 7)	0.000000	205.0000
X(4, 8)	0.000000	204.0000
X(5, 1)	0.000000	194.0000
X(5, 2)	0.000000	66.90000
X(5, 3)	1.000000	5.900000
X(5, 4)	0.000000	2.900000
X(5, 5)	0.000000	0.000000
X(5, 6)	0.000000	204.0000
X(5, 7)	0.000000	206.0000
X(5, 8)	0.000000	205.0000
X(6, 1)	0.000000	92.20000
X(6, 2)	0.000000	157.0000
X(6, 3)	0.000000	200.0000
X(6, 4)	0.000000	203.0000
X(6, 5)	0.000000	204.0000

X(6, 6)	0.000000	0.000000
X(6, 7)	0.000000	3.100000
X(6, 8)	1.000000	1.400000
X(7, 1)	1.000000	93.80000
X(7, 2)	0.000000	159.0000
X(7, 3)	0.000000	201.0000
X(7, 4)	0.000000	205.0000
X(7, 5)	0.000000	206.0000
X(7, 6)	0.000000	3.100000
X(7, 7)	0.000000	0.000000
X(7, 8)	0.000000	4.000000
X(8, 1)	0.000000	93.00000
X(8, 2)	0.000000	158.0000
X(8, 3)	0.000000	201.0000
X(8, 4)	0.000000	204.0000
X(8, 5)	0.000000	205.0000
X(8, 6)	0.000000	1.400000
X(8, 7)	1.000000	4.000000
X(8, 8)	0.000000	0.000000
D(1, 1)	0.000000	0.000000
D(1, 2)	146.0000	0.000000
D(1, 3)	190.0000	0.000000
D(1, 4)	192.0000	0.000000
D(1, 5)	194.0000	0.000000
D(1, 6)	92.20000	0.000000
D(1, 7)	93.80000	0.000000
D(1, 8)	93.00000	0.000000
D(2, 1)	146.0000	0.000000
D(2, 2)	0.000000	0.000000
D(2, 3)	63.40000	0.000000
D(2, 4)	64.10000	0.000000
D(2, 5)	66.90000	0.000000
D(2, 6)	157.0000	0.000000
D(2, 7)	159.0000	0.000000
D(2, 8)	158.0000	0.000000
D(3, 1)	190.0000	0.000000
D(3, 2)	63.40000	0.000000
D(3, 3)	0.000000	0.000000
D(3, 4)	3.200000	0.000000
D(3, 5)	5.900000	0.000000
D(3, 6)	200.0000	0.000000
D(3, 7)	201.0000	0.000000
D(3, 8)	201.0000	0.000000
D(4, 1)	192.0000	0.000000

D(4, 2)	64.10000	0.000000
D(4, 3)	3.200000	0.000000
D(4, 4)	0.000000	0.000000
D(4, 5)	2.900000	0.000000
D(4, 6)	203.0000	0.000000
D(4, 7)	205.0000	0.000000
D(4, 8)	204.0000	0.000000
D(5, 1)	194.0000	0.000000
D(5, 2)	66.90000	0.000000
D(5, 3)	5.900000	0.000000
D(5, 4)	2.900000	0.000000
D(5, 5)	0.000000	0.000000
D(5, 6)	204.0000	0.000000
D(5, 7)	206.0000	0.000000
D(5, 8)	205.0000	0.000000
D(6, 1)	92.20000	0.000000
D(6, 2)	157.0000	0.000000
D(6, 3)	200.0000	0.000000
D(6, 4)	203.0000	0.000000
D(6, 5)	204.0000	0.000000
D(6, 6)	0.000000	0.000000
D(6, 7)	3.100000	0.000000
D(6, 8)	1.400000	0.000000
D(7, 1)	93.80000	0.000000
D(7, 2)	159.0000	0.000000
D(7, 3)	201.0000	0.000000
D(7, 4)	205.0000	0.000000
D(7, 5)	206.0000	0.000000
D(7, 6)	3.100000	0.000000
D(7, 7)	0.000000	0.000000
D(7, 8)	4.000000	0.000000
D(8, 1)	93.00000	0.000000
D(8, 2)	158.0000	0.000000
D(8, 3)	201.0000	0.000000
D(8, 4)	204.0000	0.000000
D(8, 5)	205.0000	0.000000
D(8, 6)	1.400000	0.000000
D(8, 7)	4.000000	0.000000
D(8, 8)	0.000000	0.000000
DURASI(1, 1)	0.000000	0.000000
DURASI(1, 2)	175.2000	0.000000
DURASI(1, 3)	228.0000	0.000000
DURASI(1, 4)	230.4000	0.000000
DURASI(1, 5)	232.8000	0.000000

DURASI(1, 6)	110.6400	0.000000
DURASI(1, 7)	112.5600	0.000000
DURASI(1, 8)	111.6000	0.000000
DURASI(2, 1)	175.2000	0.000000
DURASI(2, 2)	0.000000	0.000000
DURASI(2, 3)	76.08000	0.000000
DURASI(2, 4)	76.92000	0.000000
DURASI(2, 5)	80.28000	0.000000
DURASI(2, 6)	188.4000	0.000000
DURASI(2, 7)	190.8000	0.000000
DURASI(2, 8)	189.6000	0.000000
DURASI(3, 1)	228.0000	0.000000
DURASI(3, 2)	76.08000	0.000000
DURASI(3, 3)	0.000000	0.000000
DURASI(3, 4)	3.840000	0.000000
DURASI(3, 5)	7.080000	0.000000
DURASI(3, 6)	240.0000	0.000000
DURASI(3, 7)	241.2000	0.000000
DURASI(3, 8)	241.2000	0.000000
DURASI(4, 1)	230.4000	0.000000
DURASI(4, 2)	76.92000	0.000000
DURASI(4, 3)	3.840000	0.000000
DURASI(4, 4)	0.000000	0.000000
DURASI(4, 5)	3.480000	0.000000
DURASI(4, 6)	243.6000	0.000000
DURASI(4, 7)	246.0000	0.000000
DURASI(4, 8)	244.8000	0.000000
DURASI(5, 1)	232.8000	0.000000
DURASI(5, 2)	80.28000	0.000000
DURASI(5, 3)	7.080000	0.000000
DURASI(5, 4)	3.480000	0.000000
DURASI(5, 5)	0.000000	0.000000
DURASI(5, 6)	244.8000	0.000000
DURASI(5, 7)	247.2000	0.000000
DURASI(5, 8)	246.0000	0.000000
DURASI(6, 1)	110.6400	0.000000
DURASI(6, 2)	188.4000	0.000000
DURASI(6, 3)	240.0000	0.000000
DURASI(6, 4)	243.6000	0.000000
DURASI(6, 5)	244.8000	0.000000
DURASI(6, 6)	0.000000	0.000000
DURASI(6, 7)	3.720000	0.000000
DURASI(6, 8)	1.680000	0.000000
DURASI(7, 1)	112.5600	0.000000

DURASI(7, 2)	190.8000	0.000000
DURASI(7, 3)	241.2000	0.000000
DURASI(7, 4)	246.0000	0.000000
DURASI(7, 5)	247.2000	0.000000
DURASI(7, 6)	3.720000	0.000000
DURASI(7, 7)	0.000000	0.000000
DURASI(7, 8)	4.800000	0.000000
DURASI(8, 1)	111.6000	0.000000
DURASI(8, 2)	189.6000	0.000000
DURASI(8, 3)	241.2000	0.000000
DURASI(8, 4)	244.8000	0.000000
DURASI(8, 5)	246.0000	0.000000
DURASI(8, 6)	1.680000	0.000000
DURASI(8, 7)	4.800000	0.000000
DURASI(8, 8)	0.000000	0.000000

Lampiran 17 (Surat Perijinan Perusahaan)



No : 001/HR-PGI/XI/2019
 Perihal : **Balasan Permohonan Ijin Penelitian**

Kepada Yth :
 Dekan Fakultas Teknik
 Universitas 17 Agustus 1945 (UNTAG)
 Di Tempat

Dengan Hormat,

Yang bertandatangan dibawah ini :

Nama : Ilmamananta Harjana
 Jabatan : SPV HR&GA PT Pioneerindo Gourmet International Tbk
 Branch Office Indonesia Timur

Menerangkan Bahwa,

Nama : Deni Hestyantama
 NIM : 1411600030

Telah kami setuju untuk melaksanakan penelitian pada perusahaan kami sebagai syarat penyusunan laporan Skripsi dengan judul :

“ PENENTUAN RUTE DISTRIBUSI UNTUK MEMINIMALKAN BIAYA TRANSPORT DI
 PT PIONEERINDO GOURMET INTERNATIONAL TBK GUDANG CFC CABANG
 SURABAYA “

Demikian surat ini kami sampaikan, dan atas kerjasamanya kami mengucapkan terima kasih.

Sidoarjo, 04 November 2019

Ilmamananta Harjana
 HR&GA Indonesia Timur

PT. PIONEERINDO GOURMET INTERNATIONAL Tbk.

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BIOGRAFI



DENI HESTYANTAMA, lahir pada tanggal 10 Agustus 1997 di Kota Surabaya, Jawa Timur. Merupakan anak pertama dan sekaligus anak tunggal dari pasangan Hany dan Dewi. Penulis menyelesaikan pendidikan Sekolah Dasar di SDN Sidosermo 1/427 Surabaya yang terletak di Jl. Sidosermo PDK I pada tahun 2010. Penulis melanjutkan pendidikan ke jenjang selanjutnya di SMPN 13 Surabaya yang terletak di Jl. Jemursari II, Surabaya dan lulus pada tahun 2013. Kemudian penulis melanjutkan pendidikan ke jenjang selanjutnya di SMK PGRI 13 Surabaya yang terletak di Jl. Sidosermo PDK IV E/2 Surabaya mengambil jurusan Teknik Komputer & Jaringan (TKJ) dan Lulus pada tahun 2016. Pada tahun 2016 penulis melanjutkan pendidikan ke jenjang yang lebih tinggi di Universitas 17 Agustus 1945 Surabaya dengan mengambil jurusan pada Fakultas Teknik Program Studi Teknik Industri.