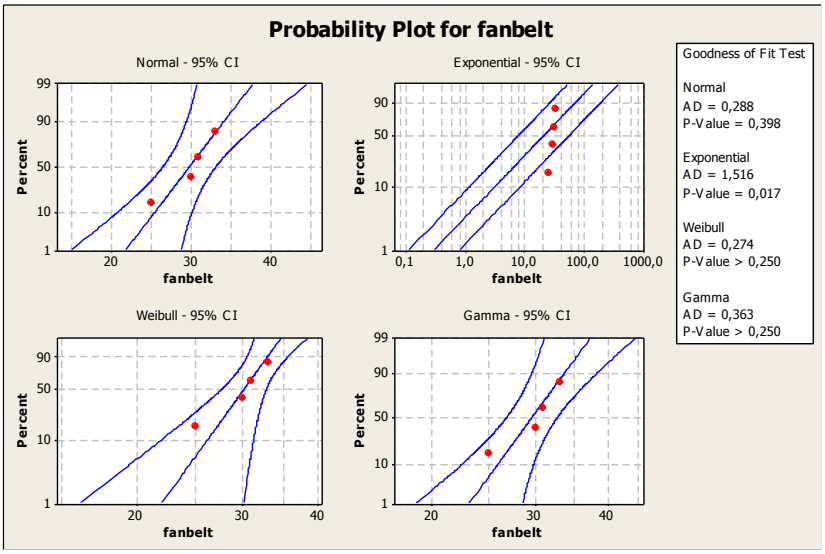
Lampiran

Gambar Mesin produksi CNC Milling

Menentukan distribusi menggunakan aplikasi minitab *time to failure*

1. Komponen fanbelt



Distribution ID Plot for Fanbelt

Descriptive Statistics

N	N*	Mean	StDev	Median	Minimum	Maximum	Skewness	Kurtosis
4	0	29,75	3,40343	30,5	25	33	-1,19854	1,97940

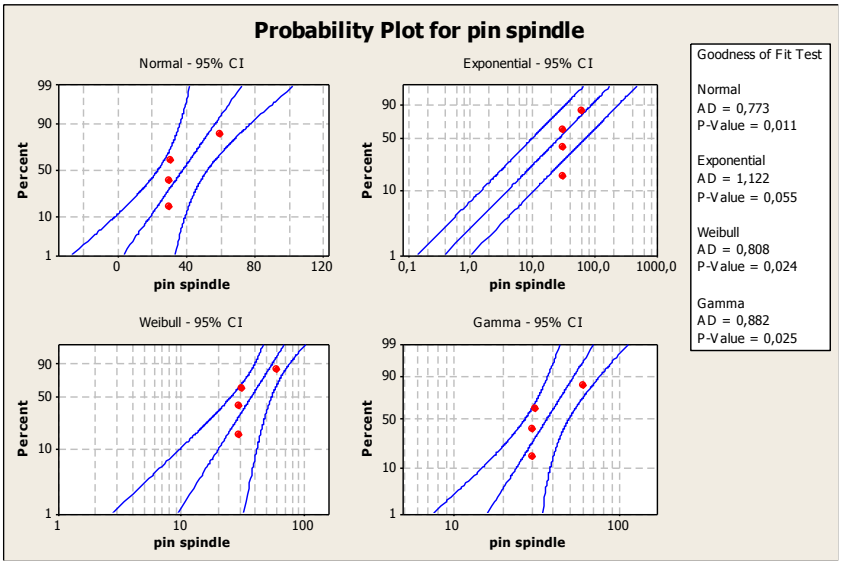
Goodness of Fit Test

Distribution	AD	P
Normal	0,288	0.398
Exponential	1,516	0.017
Weibull	0,274	>0.250
Gamma	0,363	>0.250

ML Estimates of Distribution Parameters

Distribution	Location	Shape	Scale	Threshold
Normal*	29,75000		3,40343	
Exponential			29,75000	
Weibull		13,46790	31,01104	
Gamma		96,55863	0,30810	

2. Komponen pin spindle



Distribution ID Plot for pin spindle

Descriptive Statistics

N	N*	Mean	StDev	Median	Minimum	Maximum	Skewness	Kurtosis
4	0	37,75	14,8408	30,5	30	60	1,99399	3,97939

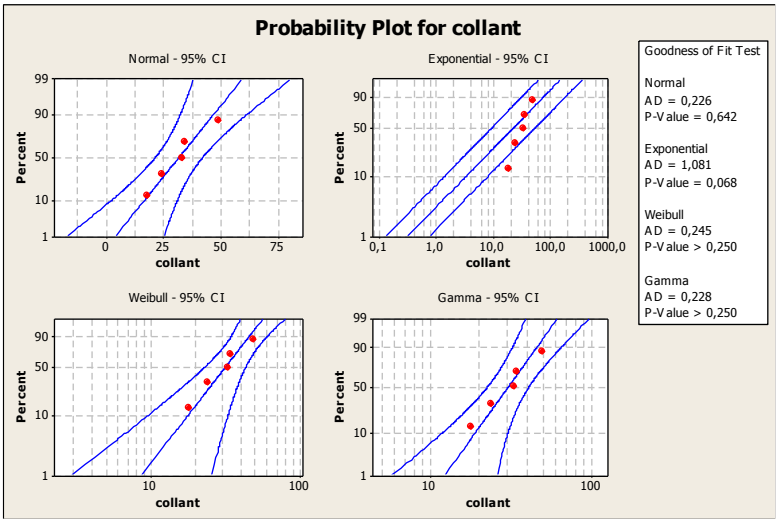
Goodness of Fit Test

Distribution	AD	P
Normal	0,773	0.011
Exponential	1,122	0.055
Weibull	0,808	0.024
Gamma	0,882	0.025

ML Estimates of Distribution Parameters

Distribution	Location	Shape	Scale	Threshold
Normal*	37,75000		14,84082	
Exponential			37,75000	
Weibull		3,06023	42,29910	
Gamma		10,51506	3,59009	

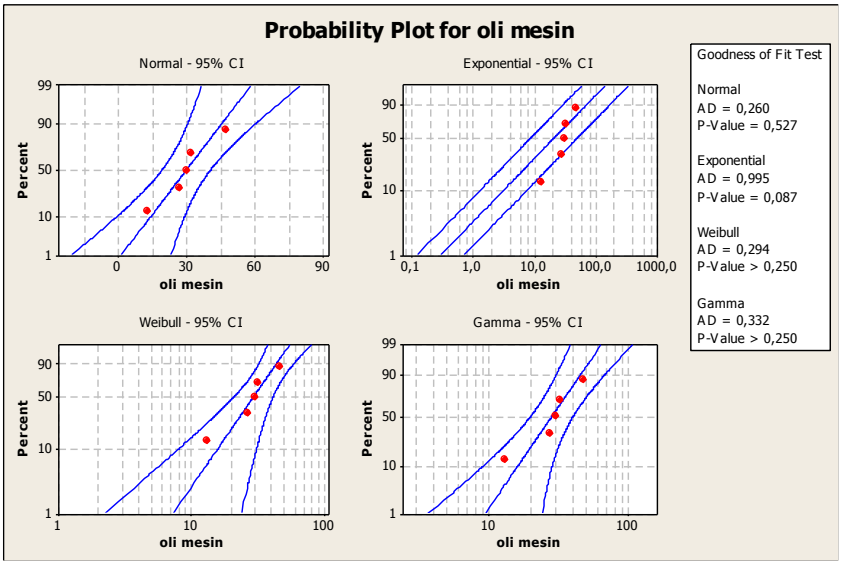
3. Komponen collant



Distribution ID Plot for collant

```
Descriptive Statistics

N   N*   Mean     StDev   Median   Minimum   Maximum   Skewness   Kurtosis
5    0   31,6   11,7601       33        18        49   0,596955   0,446685


Goodness of Fit Test

Distribution      AD       P
Normal         0,226   0.642
Exponential    1,081   0.068
Weibull        0,245  >0.250
Gamma          0,228  >0.250


ML Estimates of Distribution Parameters

Distribution  Location    Shape     Scale  Threshold
Normal*       31,60000           11,76010
Exponential                      31,60000
Weibull                 3,27737  35,31689
Gamma                   9,00763   3,50814
```

4. Komponen Oli mesin



Distribution ID Plot for oli mesin

Descriptive Statistics

N	N*	Mean	StDev	Median	Minimum	Maximum	Skewness	Kurtosis
5	0	29,8	12,1532	30	13	47	0,0778819	1,58420

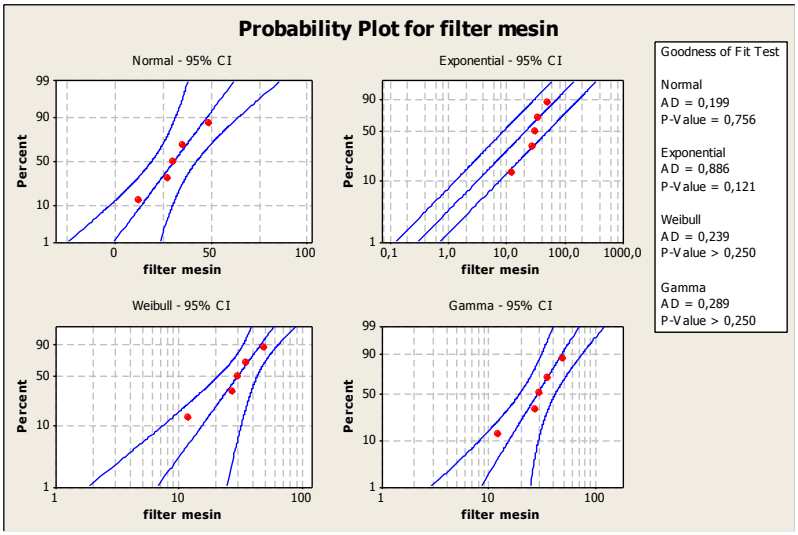
Goodness of Fit Test

Distribution	AD	P
Normal	0,260	0.527
Exponential	0,995	0.087
Weibull	0,294	>0.250
Gamma	0,332	>0.250

ML Estimates of Distribution Parameters

Distribution	Location	Shape	Scale	Threshold
Normal*	29,80000		12,15319	
Exponential			29,80000	
Weibull		3,03491	33,40303	
Gamma		6,49645	4,58712	

5. Komponen Filter mesin



Distribution ID Plot for filter mesin

Descriptive Statistics

N	N*	Mean	StDev	Median	Minimum	Maximum	Skewness	Kurtosis
5	0	30,6	13,3903	30	12	49	-0,0289894	1,13161

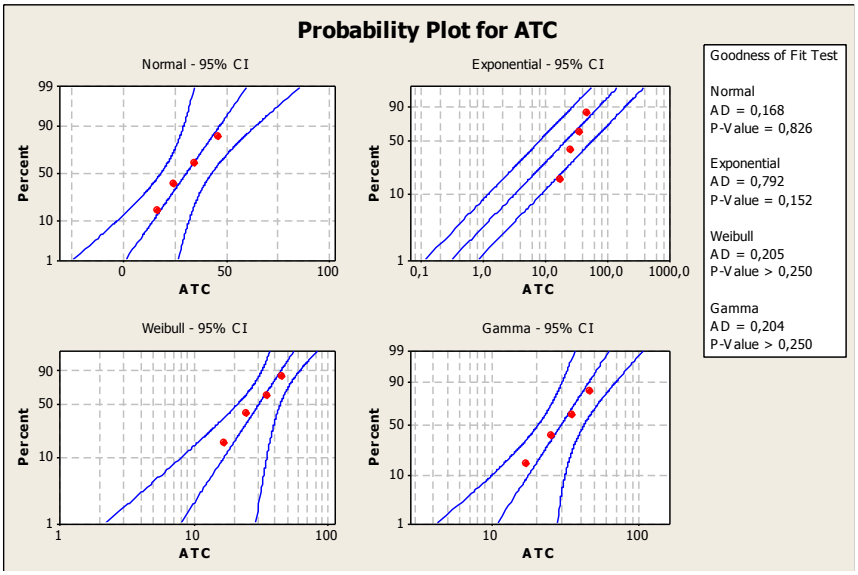
Goodness of Fit Test

Distribution	AD	P
Normal	0,199	0.756
Exponential	0,886	0.121
Weibull	0,239	>0.250
Gamma	0,289	>0.250

ML Estimates of Distribution Parameters

Distribution	Location	Shape	Scale	Threshold
Normal*	30,60000		13,39029	
Exponential			30,60000	
Weibull		2,82363	34,40130	
Gamma		5,41447	5,65152	

6. Komponen ATC



Distribution ID Plot for ATC

Descriptive Statistics

N	N*	Mean	StDev	Median	Minimum	Maximum	Skewness	Kurtosis
4	0	30,75	12,5532	30	17	46	0,280940	-1,25136

Goodness of Fit Test

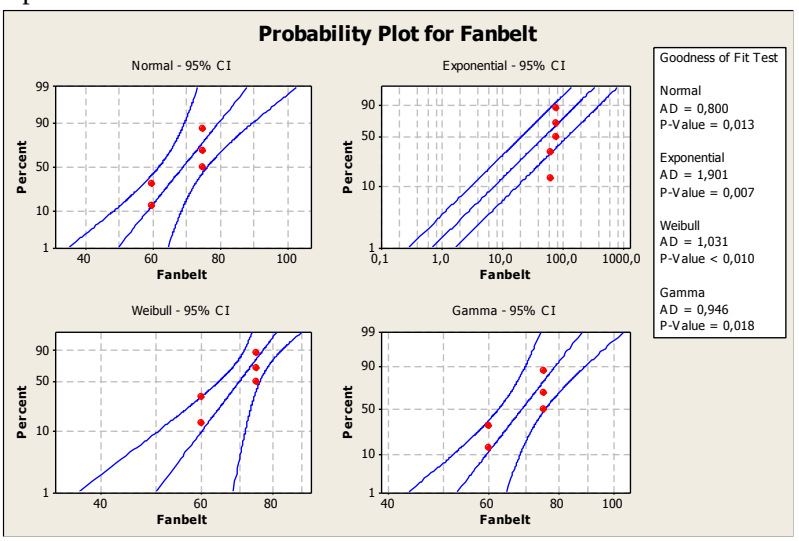
Distribution	AD	P
Normal	0,168	0.826
Exponential	0,792	0.152
Weibull	0,205	>0.250
Gamma	0,204	>0.250

ML Estimates of Distribution Parameters

Distribution	Location	Shape	Scale	Threshold
Normal*	30,75000		12,55322	
Exponential			30,75000	
Weibull		3,16088	34,49248	
Gamma		7,63999	4,02487	

Menentukan distribusi menggunakan aplikasi minitab *time to repair*

1. Komponen Fanbelt



Distribution ID Plot for Fanbelt

Descriptive Statistics

N	N*	Mean	StDev	Median	Minimum	Maximum	Skewness	Kurtosis
5	0	69	8,21584	75	60	75	-0,608581	-3,33333

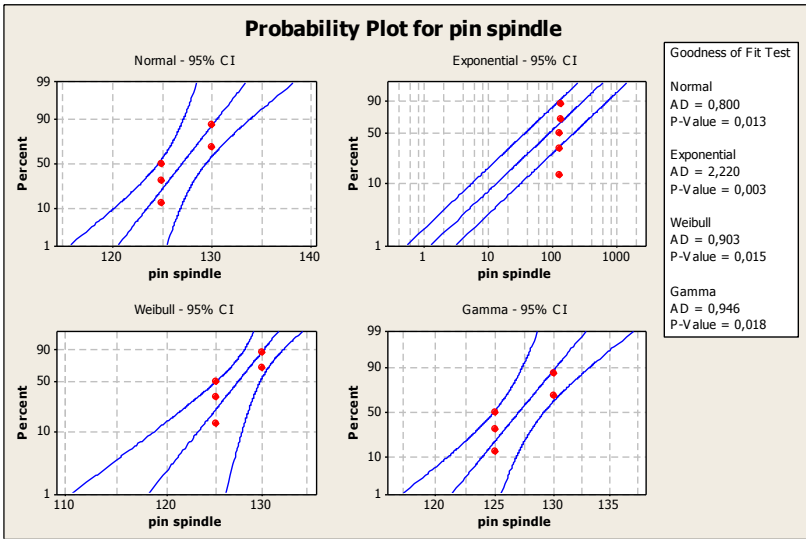
Goodness of Fit Test

Distribution	AD	P
Normal	0,800	0.013
Exponential	1,901	0.007
Weibull	1,031	<0.010
Gamma	0,946	0.018

ML Estimates of Distribution Parameters

Distribution	Location	Shape	Scale	Threshold
Normal*	69,00000		8,21584	
Exponential			69,00000	
Weibull		12,44308	72,21899	
Gamma		85,26097	0,80928	

2. Komponen Pin spindle



Distribution ID Plot for pin spindle

Descriptive Statistics

N	N*	Mean	StDev	Median	Minimum	Maximum	Skewness	Kurtosis
5	0	127	2,73861	125	125	130	0,608581	-3,33333

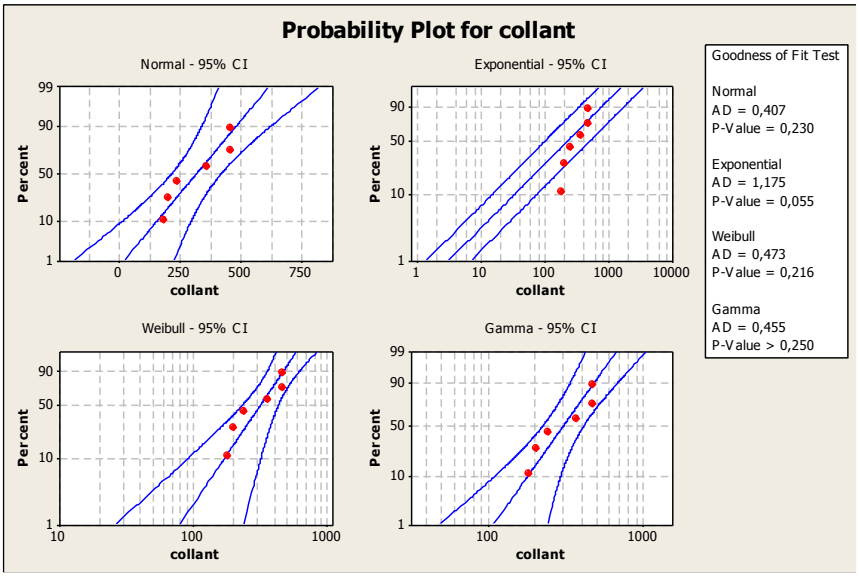
Goodness of Fit Test

Distribution	AD	P
Normal	0,800	0.013
Exponential	2,220	0.003
Weibull	0,903	0.015
Gamma	0,946	0.018

ML Estimates of Distribution Parameters

Distribution	Location	Shape	Scale	Threshold
Normal*	127,00000		2,73861	
Exponential			127,00000	
Weibull		55,86593	128,24056	
Gamma		2701,93623	0,04700	

3. Komponen Collant



Distribution ID Plot for collant

Descriptive Statistics

N	N*	Mean	StDev	Median	Minimum	Maximum	Skewness	Kurtosis
6	0	316,667	127,384	300	180	460	0,200224	-2,48462

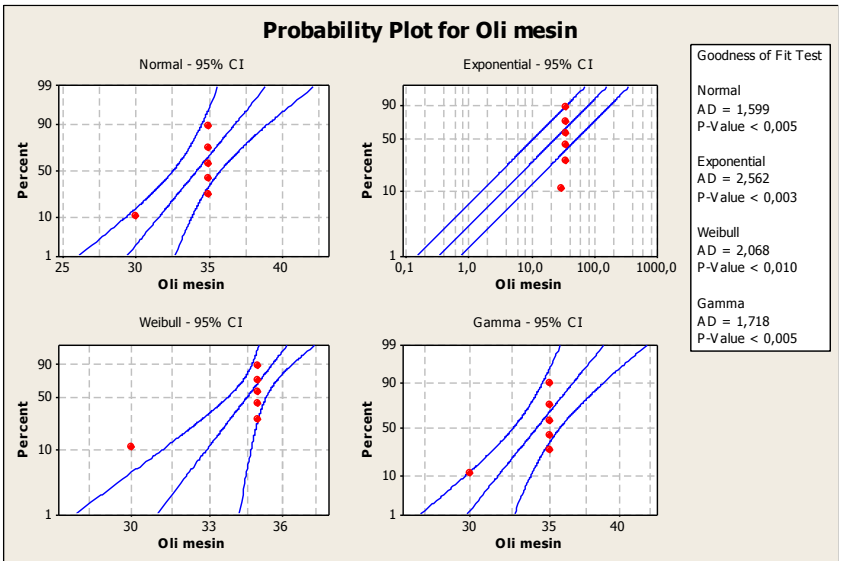
Goodness of Fit Test

Distribution	AD	P
Normal	0,407	0.230
Exponential	1,175	0.055
Weibull	0,473	0.216
Gamma	0,455	>0.250

ML Estimates of Distribution Parameters

Distribution	Location	Shape	Scale	Threshold
Normal*	316,66667		127,38393	
Exponential			316,66667	
Weibull		3,06001	356,21276	
Gamma		7,19448	44,0152	

4. Komponen Oli mesin



Distribution ID Plot for Oli mesin

Descriptive Statistics

N	N*	Mean	StDev	Median	Minimum	Maximum	Skewness	Kurtosis
6	0	34,1667	2,04124	35	30	35	-2,44949	6

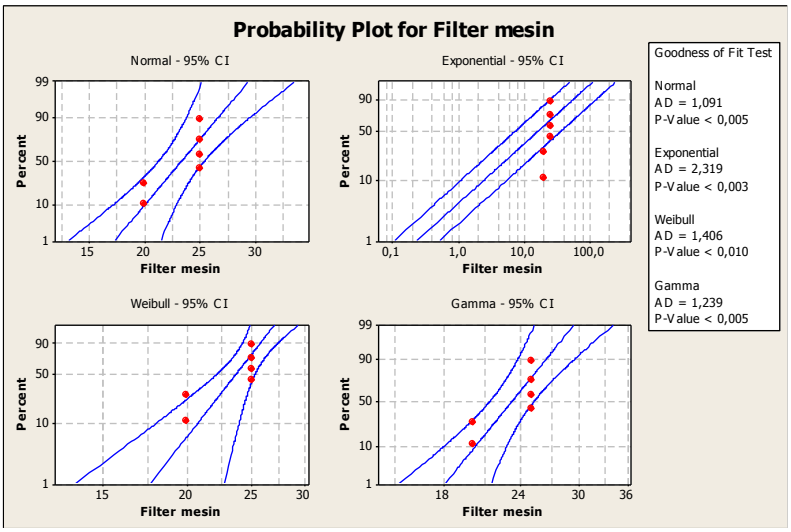
Goodness of Fit Test

Distribution	AD	P
Normal	1,599	<0.005
Exponential	2,562	<0.003
Weibull	2,068	<0.010
Gamma	1,718	<0.005

ML Estimates of Distribution Parameters

Distribution	Location	Shape	Scale	Threshold
Normal*	34,16667		2,04124	
Exponential			34,16667	
Weibull		39,03699	34,83735	
Gamma		313,79793	0,1088	

5. Komponen Filter Mesin



Distribution ID Plot for Filter mesin

Descriptive Statistics

N	N*	Mean	StDev	Median	Minimum	Maximum	Skewness	Kurtosis
6	0	23,3333	2,58199	25	20	25	-0,968246	-1,875

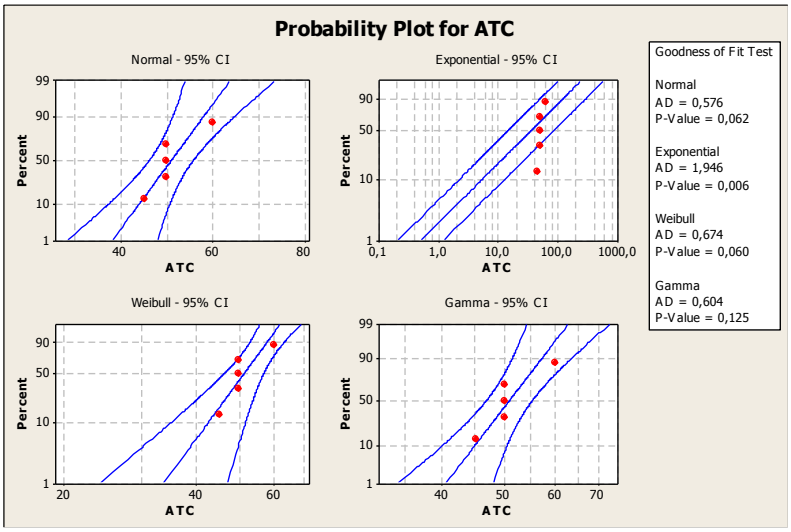
Goodness of Fit Test

Distribution	AD	P
Normal	1,091	<0.005
Exponential	2,319	<0.003
Weibull	1,406	<0.010
Gamma	1,239	<0.005

ML Estimates of Distribution Parameters

Distribution	Location	Shape	Scale	Threshold
Normal*	23,33333		2,58199	
Exponential			23,33333	
Weibull		14,30778	24,33602	
Gamma		92,95980	0,2510	

6. Komponen ATC



Distribution ID Plot for ATC

Descriptive Statistics

N	N*	Mean	StDev	Median	Minimum	Maximum	Skewness	Kurtosis
5	0	51	5,47723	50	45	60	1,29323	2,91667

Goodness of Fit Test

Distribution	AD	P
Normal	0,576	0.062
Exponential	1,946	0.006
Weibull	0,674	0.060
Gamma	0,604	0.125

ML Estimates of Distribution Parameters

Distribution	Location	Shape	Scale	Threshold
Normal*	51,00000		5,47723	
Exponential			51,00000	
Weibull		10,04870	53,35009	
Gamma		113,53433	0,44920	

Data Historis Kerusakan Mesin CNC milling 6 bulan terakhir

Tanggal	*Downtime* (menit)	Nama Komponen	Jenis Kerusakan
22/08/2021	75	Fan Belt	Putus
24/08/2021	125	Pin Spindle	Patah
26/08/2021	460	collant Mampet	Pengurasan
27/08/2021	35	Oli Mesin	Bocor
28/08/2021	25	Filter mesin	pembersihan
29/08/2021	50	ATC	Kesejajaran Toll change
Jumlah	770		

Tanggal	*Downtime* (menit)	Nama Komponen	Jenis Kerusakan
21/09/2021	125	Pin Spindle	Patah
23/09/2021	75	Fan Belt	Putus
23/09/2021	45	ATC	Kesejajaran Toll change
25/09/2021	35	Oli Mesin	Bocor
26/09/2021	25	Filter mesin	pembersihan
27/08/2021	240	collant Mampet	Pengurasan
Jumlah	545		

Tanggal	*Downtime* (menit)	Nama Komponen	Jenis Kerusakan
19/10/2021	125	Pin Spindle	Patah
20/10/2021	460	collant Mampet	Pengurasan
22/10/2021	35	Oli Mesin	Bocor
23/10/2021	25	Filter mesin	pembersihan
27/10/2021	50	ATC	Kesejajaran Toll change
Jumlah	695		

Tanggal	*Downtime* (menit)	Nama Komponen	Jenis Kerusakan
20/11/2021	25	Filter Mesin	Pembersihan Debu
22/11/2021	50	ATC	Kesejajaran Toll change
23/11/2021	360	Collant mampet	Pengurasan Collant
23/11/2021	30	Oli Mesin	Bocor
27/11/2021	25	Filter mesin	pembersihan
28/11/201	75	Fan Belt	Putus
Jumlah	465		
Tanggal	*Downtime* (menit)	Nama Komponen	Jenis Kerusakan
19/11/2021	200	Collant mampet	Pengurasan Collant
20/12/2021	130	Pin Spindle	Patah
20/12/2021	35	Oli Mesin	Bocor
21/12/2021	60	ATC	Kesejajaran Toll change
22/12/2021	60	Fan belt	putus
34/12/2021	20	Filter mesin	pembersihan
Jumlah	505		

Tanggal	*Downtime* (menit)	Nama Komponen	Jenis Kerusakan
18/01/2022	60	Fan belt	putus
19/11/2022	180	Collant mampet	Pengurasan Collant
21/01/2022	130	Pin Spindle	Patah
21/01/2022	35	Oli Mesin	Bocor
22/01/2022	60	Fan belt	putus
24/01/2022	20	Filter mesin	pembersihan
Jumlah	485		

Tabel Komulatif Normal Z

Tabel Sebaran Peluang Kumulatif Normal Z

Z	0,00	0,01	0,02	0,03	0,04	0,05	0,06	0,07	0,08	0,09
-3,8	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001
-3,7	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001
-3,6	0,0002	0,0002	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001	0,0001
-3,5	0,0002	0,0002	0,0002	0,0002	0,0002	0,0002	0,0002	0,0002	0,0002	0,0002
-3,4	0,0003	0,0003	0,0003	0,0003	0,0003	0,0003	0,0003	0,0003	0,0003	0,0002
-3,3	0,0005	0,0005	0,0005	0,0004	0,0004	0,0004	0,0004	0,0004	0,0004	0,0003
-3,2	0,0007	0,0007	0,0006	0,0006	0,0006	0,0006	0,0006	0,0005	0,0005	0,0005
-3,1	0,0010	0,0009	0,0009	0,0009	0,0008	0,0008	0,0008	0,0008	0,0007	0,0007
-3,0	0,0013	0,0013	0,0013	0,0012	0,0012	0,0011	0,0011	0,0011	0,0010	0,0010
-2,9	0,0019	0,0018	0,0018	0,0017	0,0016	0,0016	0,0015	0,0015	0,0014	0,0014
-2,8	0,0026	0,0025	0,0024	0,0023	0,0023	0,0022	0,0021	0,0021	0,0020	0,0019
-2,7	0,0035	0,0034	0,0033	0,0032	0,0031	0,0030	0,0029	0,0028	0,0027	0,0026
-2,6	0,0047	0,0045	0,0044	0,0043	0,0041	0,0040	0,0039	0,0038	0,0037	0,0036
-2,5	0,0062	0,0060	0,0059	0,0057	0,0055	0,0054	0,0052	0,0051	0,0049	0,0048
-2,4	0,0082	0,0080	0,0078	0,0075	0,0073	0,0071	0,0069	0,0068	0,0066	0,0064
-2,3	0,0107	0,0104	0,0102	0,0099	0,0096	0,0094	0,0091	0,0089	0,0087	0,0084
-2,2	0,0139	0,0136	0,0132	0,0129	0,0125	0,0122	0,0119	0,0116	0,0113	0,0110
-2,1	0,0179	0,0174	0,0170	0,0166	0,0162	0,0158	0,0154	0,0150	0,0146	0,0143
-2,0	0,0228	0,0222	0,0217	0,0212	0,0207	0,0202	0,0197	0,0192	0,0188	0,0183
-1,9	0,0287	0,0281	0,0274	0,0268	0,0262	0,0256	0,0250	0,0244	0,0239	0,0233
-1,8	0,0359	0,0351	0,0344	0,0336	0,0329	0,0322	0,0314	0,0307	0,0301	0,0294
-1,7	0,0446	0,0436	0,0427	0,0418	0,0409	0,0401	0,0392	0,0384	0,0375	0,0367
-1,6	0,0548	0,0537	0,0526	0,0516	0,0505	0,0495	0,0485	0,0475	0,0465	0,0455
-1,5	0,0668	0,0655	0,0643	0,0630	0,0618	0,0606	0,0594	0,0582	0,0571	0,0559
-1,4	0,0808	0,0793	0,0778	0,0764	0,0749	0,0735	0,0721	0,0708	0,0694	0,0681
-1,3	0,0968	0,0951	0,0934	0,0918	0,0901	0,0885	0,0869	0,0853	0,0838	0,0823
-1,2	0,1151	0,1131	0,1112	0,1093	0,1075	0,1056	0,1038	0,1020	0,1003	0,0985
-1,1	0,1357	0,1335	0,1314	0,1292	0,1271	0,1251	0,1230	0,1210	0,1190	0,1170
-1,0	0,1587	0,1562	0,1539	0,1515	0,1492	0,1469	0,1446	0,1423	0,1401	0,1379
-0,9	0,1841	0,1814	0,1788	0,1762	0,1736	0,1711	0,1685	0,1660	0,1635	0,1611
-0,8	0,2119	0,2090	0,2061	0,2033	0,2005	0,1977	0,1949	0,1922	0,1894	0,1867
-0,7	0,2420	0,2389	0,2358	0,2327	0,2296	0,2266	0,2236	0,2206	0,2177	0,2148
-0,6	0,2743	0,2709	0,2676	0,2643	0,2611	0,2578	0,2546	0,2514	0,2483	0,2451
-0,5	0,3085	0,3050	0,3015	0,2981	0,2946	0,2912	0,2877	0,2843	0,2810	0,2776
-0,4	0,3446	0,3409	0,3372	0,3336	0,3300	0,3264	0,3228	0,3192	0,3156	0,3121
-0,3	0,3821	0,3783	0,3745	0,3707	0,3669	0,3632	0,3594	0,3557	0,3520	0,3483
-0,2	0,4207	0,4168	0,4129	0,4090	0,4052	0,4013	0,3974	0,3936	0,3897	0,3859
-0,1	0,4602	0,4562	0,4522	0,4483	0,4443	0,4404	0,4364	0,4325	0,4286	0,4247
0,0	0,5000	0,5040	0,5080	0,5120	0,5160	0,5199	0,5239	0,5279	0,5319	0,5359

Tabel Sebaran Peluang Kumulatif Normal Z

Z	0,00	0,01	0,02	0,03	0,04	0,05	0,06	0,07	0,08	0,09
0,0	0,5000	0,5040	0,5080	0,5120	0,5160	0,5199	0,5239	0,5279	0,5319	0,5359
0,1	0,5398	0,5438	0,5478	0,5517	0,5557	0,5596	0,5636	0,5675	0,5714	0,5753
0,2	0,5793	0,5832	0,5871	0,5910	0,5948	0,5987	0,6026	0,6064	0,6103	0,6141
0,3	0,6179	0,6217	0,6255	0,6293	0,6331	0,6368	0,6406	0,6443	0,6480	0,6517
0,4	0,6554	0,6591	0,6628	0,6664	0,6700	0,6736	0,6772	0,6808	0,6844	0,6879
0,5	0,6915	0,6950	0,6985	0,7019	0,7054	0,7088	0,7123	0,7157	0,7190	0,7224
0,6	0,7257	0,7291	0,7324	0,7357	0,7389	0,7422	0,7454	0,7486	0,7517	0,7549
0,7	0,7580	0,7611	0,7642	0,7673	0,7704	0,7734	0,7764	0,7794	0,7823	0,7852
0,8	0,7881	0,7910	0,7939	0,7967	0,7995	0,8023	0,8051	0,8078	0,8106	0,8133
0,9	0,8159	0,8186	0,8212	0,8238	0,8264	0,8289	0,8315	0,8340	0,8365	0,8389
1,0	0,8413	0,8438	0,8461	0,8485	0,8508	0,8531	0,8554	0,8577	0,8599	0,8621
1,1	0,8643	0,8665	0,8686	0,8708	0,8729	0,8749	0,8770	0,8790	0,8810	0,8830
1,2	0,8849	0,8869	0,8888	0,8907	0,8925	0,8944	0,8962	0,8980	0,8997	0,9015
1,3	0,9032	0,9049	0,9066	0,9082	0,9099	0,9115	0,9131	0,9147	0,9162	0,9177
1,4	0,9192	0,9207	0,9222	0,9236	0,9251	0,9265	0,9279	0,9292	0,9306	0,9319
1,5	0,9332	0,9345	0,9357	0,9370	0,9382	0,9394	0,9406	0,9418	0,9429	0,9441
1,6	0,9452	0,9463	0,9474	0,9484	0,9495	0,9505	0,9515	0,9525	0,9535	0,9545
1,7	0,9554	0,9564	0,9573	0,9582	0,9591	0,9599	0,9608	0,9616	0,9625	0,9633
1,8	0,9641	0,9649	0,9656	0,9664	0,9671	0,9678	0,9686	0,9693	0,9699	0,9706
1,9	0,9713	0,9719	0,9726	0,9732	0,9738	0,9744	0,9750	0,9756	0,9761	0,9767
2,0	0,9772	0,9778	0,9783	0,9788	0,9793	0,9798	0,9803	0,9808	0,9812	0,9817
2,1	0,9821	0,9826	0,9830	0,9834	0,9838	0,9842	0,9846	0,9850	0,9854	0,9857
2,2	0,9861	0,9864	0,9868	0,9871	0,9875	0,9878	0,9881	0,9884	0,9887	0,9890
2,3	0,9893	0,9896	0,9898	0,9901	0,9904	0,9906	0,9909	0,9911	0,9913	0,9916
2,4	0,9918	0,9920	0,9922	0,9925	0,9927	0,9929	0,9931	0,9932	0,9934	0,9936
2,5	0,9938	0,9940	0,9941	0,9943	0,9945	0,9946	0,9948	0,9949	0,9951	0,9952
2,6	0,9953	0,9955	0,9956	0,9957	0,9959	0,9960	0,9961	0,9962	0,9963	0,9964
2,7	0,9965	0,9966	0,9967	0,9968	0,9969	0,9970	0,9971	0,9972	0,9973	0,9974
2,8	0,9974	0,9975	0,9976	0,9977	0,9977	0,9978	0,9979	0,9979	0,9980	0,9981
2,9	0,9981	0,9982	0,9982	0,9983	0,9984	0,9984	0,9985	0,9985	0,9986	0,9986
3,0	0,9987	0,9987	0,9987	0,9988	0,9988	0,9989	0,9989	0,9989	0,9990	0,9990
3,1	0,9990	0,9991	0,9991	0,9991	0,9992	0,9992	0,9992	0,9992	0,9993	0,9993
3,2	0,9993	0,9993	0,9994	0,9994	0,9994	0,9994	0,9994	0,9995	0,9995	0,9995
3,3	0,9995	0,9995	0,9995	0,9996	0,9996	0,9996	0,9996	0,9996	0,9996	0,9997
3,4	0,9997	0,9997	0,9997	0,9997	0,9997	0,9997	0,9997	0,9997	0,9997	0,9998
3,5	0,9998	0,9998	0,9998	0,9998	0,9998	0,9998	0,9998	0,9998	0,9998	0,9998
3,6	0,9998	0,9998	0,9999	0,9999	0,9999	0,9999	0,9999	0,9999	0,9999	0,9999
3,8	0,9999	0,9999	0,9999	0,9999	0,9999	0,9999	0,9999	0,9999	0,9999	0,9999

BIOGRAFI

Ghozy Pratama lahir di Surabaya, 05 Oktober 1998. Anak Pertama dari 2 saudara dari pasangan **Lutfiyanto** dan **Rini Rahayu**. Penulis menyelesaikan pendidikan sekolah dasar di SDN 02 Tumpak Rejo, malang lulus di tahun 2010. Kemudian melanjutkan di SMPN 1 Donomulyo, malang lulus di tahun 2013.Lalu melanjutkan Di SMKM 6 Donomulyo, malang lulus di tahun 2016. Setelah itu melanjutkan kuliah di Universitas 17 Agustus 1945 Surabaya dengan mengambil jurusan Teknik Industri pada tahun 2018. Dan Alhamdulillah selesai pada tahun 2022. Berkat petunjuk dan pertolongan Allah SWT, usaha dan disertai doa kedua orang tua dalam menjalani aktivitas akademik di perguruan tinggi Universitas 17 Agustus 1945 Surabaya. Alhamdulillah penulis dapat menyelesaikan tugas akhir dengan skripsi yang berjudul "ANALISIS PERAWATAN MESIN CNC MILLING DENGAN METODE *FAILURE EFFECT ANALYSIS* (FMEA) DI PT. ABC UNTUK MENGHITUNG BIAYA PERAWATAN".