LAMPIRAN

TABLE A.1
Standardized normal probabilities: $\Phi(z) = \int_{-\infty}^{z} (1/\sqrt{2\pi}) e^{-y^2/2}\, dy$

z	$\Phi(z)$	$1 - \Phi(z)$	z	$\Phi(z)$	$1 - \Phi(z)$	z	$\Phi(z)$	$1 - \Phi(z)$
−4.00000	0.00003	0.99997	−3.51000	0.00022	0.99978	−3.02000	0.00126	0.99874
−3.99000	0.00003	0.99997	−3.50000	0.00023	0.99977	−3.01000	0.00131	0.99869
−3.98000	0.00003	0.99997	−3.49000	0.00024	0.99976	−3.00000	0.00135	0.99865
−3.97000	0.00004	0.99996	−3.48000	0.00025	0.99975	−2.99000	0.00139	0.99861
−3.96000	0.00004	0.99996	−3.47000	0.00026	0.99974	−2.98000	0.00144	0.99856
−3.95000	0.00004	0.99996	−3.46000	0.00027	0.99973	−2.97000	0.00149	0.99851
−3.94000	0.00004	0.99996	−3.45000	0.00028	0.99972	−2.96000	0.00154	0.99846
−3.93000	0.00004	0.99996	−3.44000	0.00029	0.99971	−2.95000	0.00159	0.99841
−3.92000	0.00004	0.99996	−3.43000	0.00030	0.99970	−2.94000	0.00164	0.99836
−3.91000	0.00005	0.99995	−3.42000	0.00031	0.99969	−2.93000	0.00169	0.99831
−3.90000	0.00005	0.99995	−3.41000	0.00032	0.99968	−2.92000	0.00175	0.99825
−3.89000	0.00005	0.99995	−3.40000	0.00034	0.99966	−2.91000	0.00181	0.99819
−3.88000	0.00005	0.99995	−3.39000	0.00035	0.99965	−2.90000	0.00187	0.99813
−3.87000	0.00005	0.99995	−3.38000	0.00036	0.99964	−2.89000	0.00193	0.99807
−3.86000	0.00006	0.99994	−3.37000	0.00038	0.99962	−2.88000	0.00199	0.99801
−3.85000	0.00006	0.99994	−3.36000	0.00039	0.99961	−2.87000	0.00205	0.99795
−3.84000	0.00006	0.99994	−3.35000	0.00040	0.99960	−2.86000	0.00212	0.99788
−3.83000	0.00006	0.99994	−3.34000	0.00042	0.99958	−2.85000	0.00219	0.99781
−3.82000	0.00007	0.99993	−3.33000	0.00043	0.99957	−2.84000	0.00226	0.99774
−3.81000	0.00007	0.99993	−3.32000	0.00045	0.99955	−2.83000	0.00233	0.99767
−3.80000	0.00007	0.99993	−3.31000	0.00047	0.99953	−2.82000	0.00240	0.99760
−3.79000	0.00008	0.99992	−3.30000	0.00048	0.99952	−2.81000	0.00248	0.99752
−3.78000	0.00008	0.99992	−3.29000	0.00050	0.99950	−2.80000	0.00255	0.99745
−3.77000	0.00008	0.99992	−3.28000	0.00052	0.99948	−2.79000	0.00264	0.99736
−3.76000	0.00008	0.99992	−3.27000	0.00054	0.99946	−2.78000	0.00272	0.99728
−3.75000	0.00009	0.99991	−3.26000	0.00056	0.99944	−2.77000	0.00280	0.99720
−3.74000	0.00009	0.99991	−3.25000	0.00058	0.99942	−2.76000	0.00289	0.99711
−3.73000	0.00009	0.99991	−3.24000	0.00060	0.99940	−2.75000	0.00298	0.99702
−3.72000	0.00010	0.99990	−3.23000	0.00062	0.99938	−2.74000	0.00307	0.99693
−3.71000	0.00010	0.99990	−3.22000	0.00064	0.99936	−2.73000	0.00317	0.99683
−3.70000	0.00011	0.99989	−3.21000	0.00066	0.99934	−2.72000	0.00326	0.99674
−3.69000	0.00011	0.99989	−3.20000	0.00069	0.99931	−2.71000	0.00336	0.99664
−3.68000	0.00012	0.99988	−3.19000	0.00071	0.99929	−2.70000	0.00347	0.99653
−3.67000	0.00012	0.99988	−3.18000	0.00074	0.99926	−2.69000	0.00357	0.99643
−3.66000	0.00013	0.99987	−3.17000	0.00076	0.99924	−2.68000	0.00368	0.99632
−3.65000	0.00013	0.99987	−3.16000	0.00079	0.99921	−2.67000	0.00379	0.99621
−3.64000	0.00014	0.99986	−3.15000	0.00082	0.99918	−2.66000	0.00391	0.99609
−3.63000	0.00014	0.99986	−3.14000	0.00084	0.99916	−2.65000	0.00402	0.99598
−3.62000	0.00015	0.99985	−3.13000	0.00087	0.99913	−2.64000	0.00415	0.99585
−3.61000	0.00015	0.99985	−3.12000	0.00090	0.99910	−2.63000	0.00427	0.99573
−3.60000	0.00016	0.99984	−3.11000	0.00094	0.99906	−2.62000	0.00440	0.99560
−3.59000	0.00016	0.99984	−3.10000	0.00097	0.99903	−2.61000	0.00453	0.99547
−3.58000	0.00017	0.99983	−3.09000	0.00100	0.99900	−2.60000	0.00466	0.99534
−3.57000	0.00018	0.99982	−3.08000	0.00103	0.99897	−2.59000	0.00480	0.99520
−3.56000	0.00019	0.99981	−3.07000	0.00107	0.99893	−2.58000	0.00494	0.99506
−3.55000	0.00019	0.99981	−3.06000	0.00111	0.99889	−2.57000	0.00508	0.99492
−3.54000	0.00020	0.99980	−3.05000	0.00114	0.99886	−2.56000	0.00523	0.99477
−3.53000	0.00021	0.99979	−3.04000	0.00118	0.99882	−2.55000	0.00539	0.99461
−3.52000	0.00022	0.99978	−3.03000	0.00122	0.99878	−2.54000	0.00554	0.99446

(continued)

TABLE A.1 (CONTINUED)

z	$\Phi(z)$	$1-\Phi(z)$	z	$\Phi(z)$	$1-\Phi(z)$	z	$\Phi(z)$	$1-\Phi(z)$
−2.53000	0.00570	0.99430	−2.03000	0.02118	0.97882	−1.53000	0.06301	0.93699
−2.52000	0.00587	0.99413	−2.02000	0.02169	0.97831	−1.52000	0.06426	0.93574
−2.51000	0.00604	0.99396	−2.01000	0.02222	0.97778	−1.51000	0.06552	0.93448
−2.50000	0.00621	0.99379	−2.00000	0.02275	0.97725	−1.50000	0.06681	0.93319
−2.49000	0.00639	0.99361	−1.99000	0.02330	0.97670	−1.49000	0.06811	0.93189
−2.48000	0.00657	0.99343	−1.98000	0.02385	0.97615	−1.48000	0.06944	0.93056
−2.47000	0.00676	0.99324	−1.97000	0.02442	0.97558	−1.47000	0.07078	0.92922
−2.46000	0.00695	0.99305	−1.96000	0.02500	0.97500	−1.46000	0.07214	0.92786
−2.45000	0.00714	0.99286	−1.95000	0.02559	0.97441	−1.45000	0.07353	0.92647
−2.44000	0.00734	0.99266	−1.94000	0.02619	0.97381	−1.44000	0.07493	0.92507
−2.43000	0.00755	0.99245	−1.93000	0.02680	0.97320	−1.43000	0.07636	0.92364
−2.42000	0.00776	0.99224	−1.92000	0.02743	0.97257	−1.42000	0.07780	0.92220
−2.41000	0.00798	0.99202	−1.91000	0.02807	0.97193	−1.41000	0.07927	0.92073
−2.40000	0.00820	0.99180	−1.90000	0.02872	0.97128	−1.40000	0.08076	0.91924
−2.39000	0.00842	0.99158	−1.89000	0.02938	0.97062	−1.39000	0.08226	0.91774
−2.38000	0.00866	0.99134	−1.88000	0.03005	0.96995	−1.38000	0.08379	0.91621
−2.37000	0.00889	0.99111	−1.87000	0.03074	0.96926	−1.37000	0.08534	0.91466
−2.36000	0.00914	0.99086	−1.86000	0.03144	0.96856	−1.36000	0.08691	0.91309
−2.35000	0.00939	0.99061	−1.85000	0.03216	0.96784	−1.35000	0.08851	0.91149
−2.34000	0.00964	0.99036	−1.84000	0.03288	0.96712	−1.34000	0.09012	0.90988
−2.33000	0.00990	0.99010	−1.83000	0.03362	0.96638	−1.33000	0.09176	0.90824
−2.32000	0.01017	0.98983	−1.82000	0.03438	0.96562	−1.32000	0.09342	0.90658
−2.31000	0.01044	0.98956	−1.81000	0.03515	0.96485	−1.31000	0.09510	0.90490
−2.30000	0.01072	0.98928	−1.80000	0.03593	0.96407	−1.30000	0.09680	0.90320
−2.29000	0.01101	0.98899	−1.79000	0.03673	0.96327	−1.29000	0.09853	0.90147
−2.28000	0.01130	0.98870	−1.78000	0.03754	0.96246	−1.28000	0.10027	0.89973
−2.27000	0.01160	0.98840	−1.77000	0.03836	0.96164	−1.27000	0.10204	0.89796
−2.26000	0.01191	0.98809	−1.76000	0.03920	0.96080	−1.26000	0.10383	0.89617
−2.25000	0.01222	0.98778	−1.75000	0.04006	0.95994	−1.25000	0.10565	0.89435
−2.24000	0.01255	0.98745	−1.74000	0.04093	0.95907	−1.24000	0.10749	0.89251
−2.23000	0.01287	0.98713	−1.73000	0.04182	0.95818	−1.23000	0.10935	0.89065
−2.22000	0.01321	0.98679	−1.72000	0.04272	0.95728	−1.22000	0.11123	0.88877
−2.21000	0.01355	0.98645	−1.71000	0.04363	0.95637	−1.21000	0.11314	0.88686
−2.20000	0.01390	0.98610	−1.70000	0.04457	0.95543	−1.20000	0.11507	0.88493
−2.19000	0.01426	0.98574	−1.69000	0.04551	0.95449	−1.19000	0.11702	0.88298
−2.18000	0.01463	0.98537	−1.68000	0.04648	0.95352	−1.18000	0.11900	0.88100
−2.17000	0.01500	0.98500	−1.67000	0.04746	0.95254	−1.17000	0.12100	0.87900
−2.16000	0.01539	0.98461	−1.66000	0.04846	0.95154	−1.16000	0.12302	0.87698
−2.15000	0.01578	0.98422	−1.65000	0.04947	0.95053	−1.15000	0.12507	0.87493
−2.14000	0.01618	0.98382	−1.64000	0.05050	0.94950	−1.14000	0.12714	0.87286
−2.13000	0.01659	0.98341	−1.63000	0.05155	0.94845	−1.13000	0.12924	0.87076
−2.12000	0.01700	0.98300	−1.62000	0.05262	0.94738	−1.12000	0.13136	0.86864
−2.11000	0.01743	0.98257	−1.61000	0.05370	0.94630	−1.11000	0.13350	0.86650
−2.10000	0.01786	0.98214	−1.60000	0.05480	0.94520	−1.10000	0.13567	0.86433
−2.09000	0.01831	0.98169	−1.59000	0.05592	0.94408	−1.09000	0.13786	0.86214
−2.08000	0.01876	0.98124	−1.58000	0.05705	0.94295	−1.08000	0.14007	0.85993
−2.07000	0.01923	0.98077	−1.57000	0.05821	0.94179	−1.07000	0.14231	0.85769
−2.06000	0.01970	0.98030	−1.56000	0.05938	0.94062	−1.06000	0.14457	0.85543
−2.05000	0.02018	0.97982	−1.55000	0.06057	0.93943	−1.05000	0.14686	0.85314
−2.04000	0.02067	0.97933	−1.54000	0.06178	0.93822	−1.04000	0.14917	0.85083

(continued)

TABLE A.1 (CONTINUED)

z	$\Phi(z)$	$1-\Phi(z)$	z	$\Phi(z)$	$1-\Phi(z)$	z	$\Phi(z)$	$1-\Phi(z)$
−1.03000	0.15150	0.84850	−0.53000	0.29806	0.70194	−0.03000	0.48803	0.51197
−1.02000	0.15386	0.84614	−0.52000	0.30153	0.69847	−0.02000	0.49202	0.50798
−1.01000	0.15625	0.84375	−0.51000	0.30503	0.69497	−0.01000	0.49601	0.50399
−1.00000	0.15866	0.84134	−0.50000	0.30854	0.69146	0.00000	0.50000	0.50000
−0.99000	0.16109	0.83891	−0.49000	0.31207	0.68793	0.01000	0.50399	0.49601
−0.98000	0.16354	0.83646	−0.48000	0.31561	0.68439	0.02000	0.50798	0.49202
−0.97000	0.16602	0.83398	−0.47000	0.31918	0.68082	0.03000	0.51197	0.48803
−0.96000	0.16853	0.83147	−0.46000	0.32276	0.67724	0.04000	0.51595	0.48405
−0.95000	0.17106	0.82894	−0.45000	0.32636	0.67364	0.05000	0.51994	0.48006
−0.94000	0.17361	0.82639	−0.44000	0.32997	0.67003	0.06000	0.52392	0.47608
−0.93000	0.17619	0.82381	−0.43000	0.33360	0.66640	0.07000	0.52790	0.47210
−0.92000	0.17879	0.82121	−0.42000	0.33724	0.66276	0.08000	0.53188	0.46812
−0.91000	0.18141	0.81859	−0.41000	0.34090	0.65910	0.09000	0.53586	0.46414
−0.90000	0.18406	0.81594	−0.40000	0.34458	0.65542	0.10000	0.53983	0.46017
−0.89000	0.18673	0.81327	−0.39000	0.34827	0.65173	0.11000	0.54380	0.45620
−0.88000	0.18943	0.81057	−0.38000	0.35197	0.64803	0.12000	0.54776	0.45224
−0.87000	0.19215	0.80785	−0.37000	0.35569	0.64431	0.13000	0.55172	0.44828
−0.86000	0.19489	0.80511	−0.36000	0.35942	0.64058	0.14000	0.55567	0.44433
−0.85000	0.19766	0.80234	−0.35000	0.36317	0.63683	0.15000	0.55962	0.44038
−0.84000	0.20045	0.79955	−0.34000	0.36693	0.63307	0.16000	0.56356	0.43644
−0.83000	0.20327	0.79673	−0.33000	0.37070	0.62930	0.17000	0.56749	0.43251
−0.82000	0.20611	0.79389	−0.32000	0.37448	0.62552	0.18000	0.57142	0.42858
−0.81000	0.20897	0.79103	−0.31000	0.37828	0.62172	0.19000	0.57535	0.42465
−0.80000	0.21186	0.78814	−0.30000	0.38209	0.61791	0.20000	0.57926	0.42074
−0.79000	0.21476	0.78524	−0.29000	0.38591	0.61409	0.21000	0.58317	0.41683
−0.78000	0.21770	0.78230	−0.28000	0.38974	0.61026	0.22000	0.58706	0.41294
−0.77000	0.22065	0.77935	−0.27000	0.39358	0.60642	0.23000	0.59095	0.40905
−0.76000	0.22363	0.77637	−0.26000	0.39743	0.60257	0.24000	0.59483	0.40517
−0.75000	0.22663	0.77337	−0.25000	0.40129	0.59871	0.25000	0.59871	0.40129
−0.74000	0.22965	0.77035	−0.24000	0.40517	0.59483	0.26000	0.60257	0.39743
−0.73000	0.23269	0.76731	−0.23000	0.40905	0.59095	0.27000	0.60642	0.39358
−0.72000	0.23576	0.76424	−0.22000	0.41294	0.58706	0.28000	0.61026	0.38974
−0.71000	0.23885	0.76115	−0.21000	0.41683	0.58317	0.29000	0.61409	0.38591
−0.70000	0.24196	0.75804	−0.20000	0.42074	0.57926	0.30000	0.61791	0.38209
−0.69000	0.24510	0.75490	−0.19000	0.42465	0.57535	0.31000	0.62172	0.37828
−0.68000	0.24825	0.75175	−0.18000	0.42858	0.57142	0.32000	0.62552	0.37448
−0.67000	0.25143	0.74857	−0.17000	0.43251	0.56750	0.33000	0.62930	0.37070
−0.66000	0.25463	0.74537	−0.16000	0.43644	0.56356	0.34000	0.63307	0.36693
−0.65000	0.25785	0.74215	−0.15000	0.44038	0.55962	0.35000	0.63683	0.36317
−0.64000	0.26109	0.73891	−0.14000	0.44433	0.55567	0.36000	0.64058	0.35942
−0.63000	0.26435	0.73565	−0.13000	0.44828	0.55172	0.37000	0.64431	0.35569
−0.62000	0.26763	0.73237	−0.12000	0.45224	0.54776	0.38000	0.64803	0.35197
−0.61000	0.27093	0.72907	−0.11000	0.45620	0.54380	0.39000	0.65173	0.34827
−0.60000	0.27425	0.72575	−0.10000	0.46017	0.53983	0.40000	0.65542	0.34458
−0.59000	0.27760	0.72240	−0.09000	0.46414	0.53586	0.41000	0.65910	0.34090
−0.58000	0.28096	0.71904	−0.08000	0.46812	0.53188	0.42000	0.66276	0.33724
−0.57000	0.28434	0.71566	−0.07000	0.47210	0.52790	0.43000	0.66640	0.33360
−0.56000	0.28774	0.71226	−0.06000	0.47608	0.52392	0.44000	0.67003	0.32997
−0.55000	0.29116	0.70884	−0.05000	0.48006	0.51994	0.45000	0.67364	0.32636
−0.54000	0.29460	0.70540	−0.04000	0.48405	0.51595	0.46000	0.67724	0.32276

(continued)

TABLE A.1 (CONTINUED)

z	$\Phi(z)$	$1-\Phi(z)$	z	$\Phi(z)$	$1-\Phi(z)$	z	$\Phi(z)$	$1-\Phi(z)$
0.47000	0.68082	0.31918	0.97000	0.83398	0.16602	1.47000	0.92922	0.07078
0.48000	0.68439	0.31561	0.98000	0.83646	0.16354	1.48000	0.93056	0.06944
0.49000	0.68793	0.31207	0.99000	0.83891	0.16109	1.49000	0.93189	0.06811
0.50000	0.69146	0.30854	1.00000	0.84134	0.15866	1.50000	0.93319	0.06681
0.51000	0.69497	0.30503	1.01000	0.84375	0.15625	1.51000	0.93448	0.06552
0.52000	0.69847	0.30153	1.02000	0.84614	0.15386	1.52000	0.93574	0.06426
0.53000	0.70194	0.29806	1.03000	0.84850	0.15150	1.53000	0.93699	0.06301
0.54000	0.70540	0.29460	1.04000	0.85083	0.14917	1.54000	0.93822	0.06178
0.55000	0.70884	0.29116	1.05000	0.85314	0.14686	1.55000	0.93943	0.06057
0.56000	0.71226	0.28774	1.06000	0.85543	0.14457	1.56000	0.94062	0.05938
0.57000	0.71566	0.28434	1.07000	0.85769	0.14231	1.57000	0.94179	0.05821
0.58000	0.71904	0.28096	1.08000	0.85993	0.14007	1.58000	0.94295	0.05705
0.59000	0.72240	0.27760	1.09000	0.86214	0.13786	1.59000	0.94408	0.05592
0.60000	0.72575	0.27425	1.10000	0.86433	0.13567	1.60000	0.94520	0.05480
0.61000	0.72907	0.27093	1.11000	0.86650	0.13350	1.61000	0.94630	0.05370
0.62000	0.73237	0.26763	1.12000	0.86864	0.13136	1.62000	0.94738	0.05262
0.63000	0.73565	0.26435	1.13000	0.87076	0.12924	1.63000	0.94845	0.05155
0.64000	0.73891	0.26109	1.14000	0.87286	0.12714	1.64000	0.94950	0.05050
0.65000	0.74215	0.25785	1.15000	0.87493	0.12507	1.65000	0.95053	0.04947
0.66000	0.74537	0.25463	1.16000	0.87698	0.12302	1.66000	0.95154	0.04846
0.67000	0.74857	0.25143	1.17000	0.87900	0.12100	1.67000	0.95254	0.04746
0.68000	0.75175	0.24825	1.18000	0.88100	0.11900	1.68000	0.95352	0.04648
0.69000	0.75490	0.24510	1.19000	0.88298	0.11702	1.69000	0.95449	0.04551
0.70000	0.75804	0.24196	1.20000	0.88493	0.11507	1.70000	0.95543	0.04457
0.71000	0.76115	0.23885	1.21000	0.88686	0.11314	1.71000	0.95637	0.04363
0.72000	0.76424	0.23576	1.22000	0.88877	0.11123	1.72000	0.95728	0.04272
0.73000	0.76731	0.23270	1.23000	0.89065	0.10935	1.73000	0.95818	0.04182
0.74000	0.77035	0.22965	1.24000	0.89251	0.10749	1.74000	0.95907	0.04093
0.75000	0.77337	0.22663	1.25000	0.89435	0.10565	1.75000	0.95994	0.04006
0.76000	0.77637	0.22363	1.26000	0.89617	0.10383	1.76000	0.96080	0.03920
0.77000	0.77935	0.22065	1.27000	0.89796	0.10204	1.77000	0.96164	0.03836
0.78000	0.78230	0.21770	1.28000	0.89973	0.10027	1.78000	0.96246	0.03754
0.79000	0.78524	0.21476	1.29000	0.90147	0.09853	1.79000	0.96327	0.03673
0.80000	0.78814	0.21186	1.30000	0.90320	0.09680	1.80000	0.96407	0.03593
0.81000	0.79103	0.20897	1.31000	0.90490	0.09510	1.81000	0.96485	0.03515
0.82000	0.79389	0.20611	1.32000	0.90658	0.09342	1.82000	0.96562	0.03438
0.83000	0.79673	0.20327	1.33000	0.90824	0.09176	1.83000	0.96638	0.03362
0.84000	0.79955	0.20045	1.34000	0.90988	0.09012	1.84000	0.96712	0.03288
0.85000	0.80234	0.19766	1.35000	0.91149	0.08851	1.85000	0.96784	0.03216
0.86000	0.80511	0.19489	1.36000	0.91309	0.08691	1.86000	0.96856	0.03144
0.87000	0.80785	0.19215	1.37000	0.91466	0.08534	1.87000	0.96926	0.03074
0.88000	0.81057	0.18943	1.38000	0.91621	0.08379	1.88000	0.96995	0.03005
0.89000	0.81327	0.18673	1.39000	0.91774	0.08226	1.89000	0.97062	0.02938
0.90000	0.81594	0.18406	1.40000	0.91924	0.08076	1.90000	0.97128	0.02872
0.91000	0.81859	0.18141	1.41000	0.92073	0.07927	1.91000	0.97193	0.02807
0.92000	0.82121	0.17879	1.42000	0.92220	0.07780	1.92000	0.97257	0.02743
0.93000	0.82381	0.17619	1.43000	0.92364	0.07636	1.93000	0.97320	0.02680
0.94000	0.82639	0.17361	1.44000	0.92507	0.07493	1.94000	0.97381	0.02619
0.95000	0.82894	0.17106	1.45000	0.92647	0.07353	1.95000	0.97441	0.02559
0.96000	0.83147	0.16853	1.46000	0.92786	0.07214	1.96000	0.97500	0.02500

(continued)

TABLE A.1 (CONTINUED)

z	$\Phi(z)$	$1-\Phi(z)$	z	$\Phi(z)$	$1-\Phi(z)$	z	$\Phi(z)$	$1-\Phi(z)$
1.97000	0.97558	0.02442	2.47000	0.99324	0.00676	2.97000	0.99851	0.00149
1.98000	0.97615	0.02385	2.48000	0.99343	0.00657	2.98000	0.99856	0.00144
1.99000	0.97670	0.02330	2.49000	0.99361	0.00639	2.99000	0.99861	0.00139
2.00000	0.97725	0.02275	2.50000	0.99379	0.00621	3.00000	0.99865	0.00135
2.01000	0.97778	0.02222	2.51000	0.99396	0.00604	3.01000	0.99869	0.00131
2.02000	0.97831	0.02169	2.52000	0.99413	0.00587	3.02000	0.99874	0.00126
2.03000	0.97882	0.02118	2.53000	0.99430	0.00570	3.03000	0.99878	0.00122
2.04000	0.97933	0.02067	2.54000	0.99446	0.00554	3.04000	0.99882	0.00118
2.05000	0.97982	0.02018	2.55000	0.99461	0.00539	3.05000	0.99886	0.00114
2.06000	0.98030	0.01970	2.56000	0.99477	0.00523	3.06000	0.99889	0.00111
2.07000	0.98077	0.01923	2.57000	0.99492	0.00508	3.07000	0.99893	0.00107
2.08000	0.98124	0.01876	2.58000	0.99506	0.00494	3.08000	0.99897	0.00103
2.09000	0.98169	0.01831	2.59000	0.99520	0.00480	3.09000	0.99900	0.00100
2.10000	0.98214	0.01786	2.60000	0.99534	0.00466	3.10000	0.99903	0.00097
2.11000	0.98257	0.01743	2.61000	0.99547	0.00453	3.11000	0.99906	0.00094
2.12000	0.98300	0.01700	2.62000	0.99560	0.00440	3.12000	0.99910	0.00090
2.13000	0.98341	0.01659	2.63000	0.99573	0.00427	3.13000	0.99913	0.00087
2.14000	0.98382	0.01618	2.64000	0.99585	0.00415	3.14000	0.99916	0.00084
2.15000	0.98422	0.01578	2.65000	0.99598	0.00402	3.15000	0.99918	0.00082
2.16000	0.98461	0.01539	2.66000	0.99609	0.00391	3.16000	0.99921	0.00079
2.17000	0.98500	0.01500	2.67000	0.99621	0.00379	3.17000	0.99924	0.00076
2.18000	0.98537	0.01463	2.68000	0.99632	0.00368	3.18000	0.99926	0.00074
2.19000	0.98574	0.01426	2.69000	0.99643	0.00357	3.19000	0.99929	0.00071
2.20000	0.98610	0.01390	2.70000	0.99653	0.00347	3.20000	0.99931	0.00069
2.21000	0.98645	0.01355	2.71000	0.99664	0.00336	3.21000	0.99934	0.00066
2.22000	0.98679	0.01321	2.72000	0.99674	0.00326	3.22000	0.99936	0.00064
2.23000	0.98713	0.01287	2.73000	0.99683	0.00317	3.23000	0.99938	0.00062
2.24000	0.98745	0.01255	2.74000	0.99693	0.00307	3.24000	0.99940	0.00060
2.25000	0.98778	0.01222	2.75000	0.99702	0.00298	3.25000	0.99942	0.00058
2.26000	0.98809	0.01191	2.76000	0.99711	0.00289	3.26000	0.99944	0.00056
2.27000	0.98840	0.01160	2.77000	0.99720	0.00280	3.27000	0.99946	0.00054
2.28000	0.98870	0.01130	2.78000	0.99728	0.00272	3.28000	0.99948	0.00052
2.29000	0.98899	0.01101	2.79000	0.99736	0.00264	3.29000	0.99950	0.00050
2.30000	0.98928	0.01072	2.80000	0.99745	0.00255	3.30000	0.99952	0.00048
2.31000	0.98956	0.01044	2.81000	0.99752	0.00248	3.31000	0.99953	0.00047
2.32000	0.98983	0.01017	2.82000	0.99760	0.00240	3.32000	0.99955	0.00045
2.33000	0.99010	0.00990	2.83000	0.99767	0.00233	3.33000	0.99957	0.00043
2.34000	0.99036	0.00964	2.84000	0.99774	0.00226	3.34000	0.99958	0.00042
2.35000	0.99061	0.00939	2.85000	0.99781	0.00219	3.35000	0.99960	0.00040
2.36000	0.99086	0.00914	2.86000	0.99788	0.00212	3.36000	0.99961	0.00039
2.37000	0.99111	0.00889	2.87000	0.99795	0.00205	3.37000	0.99962	0.00038
2.38000	0.99134	0.00866	2.88000	0.99801	0.00199	3.38000	0.99964	0.00036
2.39000	0.99158	0.00842	2.89000	0.99807	0.00193	3.39000	0.99965	0.00035
2.40000	0.99180	0.00820	2.90000	0.99813	0.00187	3.40000	0.99966	0.00034
2.41000	0.99202	0.00798	2.91000	0.99819	0.00181	3.41000	0.99968	0.00032
2.42000	0.99224	0.00776	2.92000	0.99825	0.00175	3.42000	0.99969	0.00031
2.43000	0.99245	0.00755	2.93000	0.99831	0.00169	3.43000	0.99970	0.00030
2.44000	0.99266	0.00734	2.94000	0.99836	0.00164	3.44000	0.99971	0.00029
2.45000	0.99286	0.00714	2.95000	0.99841	0.00159	3.45000	0.99972	0.00028
2.46000	0.99305	0.00695	2.96000	0.99846	0.00154	3.46000	0.99973	0.00027

(continued)

TABLE A.1 (CONTINUED)

z	$\Phi(z)$	$1-\Phi(z)$	z	$\Phi(z)$	$1-\Phi(z)$	z	$\Phi(z)$	$1-\Phi(z)$
3.47000	0.99974	0.00026	3.65000	0.99987	0.00013	3.83000	0.99994	0.00006
3.48000	0.99975	0.00025	3.66000	0.99987	0.00013	3.84000	0.99994	0.00006
3.49000	0.99976	0.00024	3.67000	0.99988	0.00012	3.85000	0.99994	0.00006
3.50000	0.99977	0.00023	3.68000	0.99988	0.00012	3.86000	0.99994	0.00006
3.51000	0.99978	0.00022	3.69000	0.99989	0.00011	3.87000	0.99995	0.00005
3.52000	0.99978	0.00022	3.70000	0.99989	0.00011	3.88000	0.99995	0.00005
3.53000	0.99979	0.00021	3.71000	0.99990	0.00010	3.89000	0.99995	0.00005
3.54000	0.99980	0.00020	3.72000	0.99990	0.00010	3.90000	0.99995	0.00005
3.55000	0.99981	0.00019	3.73000	0.99990	0.00010	3.91000	0.99995	0.00005
3.56000	0.99981	0.00019	3.74000	0.99991	0.00009	3.92000	0.99995	0.00005
3.57000	0.99982	0.00018	3.75000	0.99991	0.00009	3.93000	0.99996	0.00004
3.58000	0.99983	0.00017	3.76000	0.99992	0.00008	3.94000	0.99996	0.00004
3.59000	0.99983	0.00017	3.77000	0.99992	0.00008	3.95000	0.99996	0.00004
3.60000	0.99984	0.00016	3.78000	0.99992	0.00008	3.96000	0.99996	0.00004
3.61000	0.99985	0.00015	3.79000	0.99993	0.00007	3.97000	0.99996	0.00004
3.62000	0.99985	0.00015	3.80000	0.99993	0.00007	3.98000	0.99996	0.00004
3.63000	0.99986	0.00014	3.81000	0.99993	0.00007	3.99000	0.99997	0.00003
3.64000	0.99986	0.00014	3.82000	0.99993	0.00007	4.00000	0.99997	0.00003

TABLE A.7
Critical values for the Kolmogorov-Smirnov test for normality (Lilliefors test)

Sample size, n	α 0.20	0.15	0.10	0.05	0.01
4	0.300	0.319	0.352	0.381	0.417
5	0.285	0.299	0.315	0.337	0.405
6	0.265	0.277	0.294	0.319	0.364
7	0.247	0.258	0.276	0.300	0.348
8	0.233	0.244	0.261	0.285	0.331
9	0.223	0.233	0.249	0.271	0.311
10	0.215	0.224	0.239	0.258	0.294
11	0.206	0.217	0.230	0.249	0.284
12	0.199	0.212	0.223	0.242	0.275
13	0.190	0.202	0.214	0.234	0.268
14	0.183	0.194	0.207	0.227	0.261
15	0.177	0.187	0.201	0.220	0.257
16	0.173	0.182	0.195	0.213	0.250
17	0.169	0.177	0.189	0.206	0.245
18	0.166	0.173	0.184	0.200	0.239
19	0.163	0.169	0.179	0.195	0.235
20	0.160	0.166	0.174	0.190	0.231
25	0.149	0.153	0.165	0.180	0.203
30	0.131	0.136	0.144	0.161	0.187
$n > 30$	$\frac{0.736}{\sqrt{n}}$	$\frac{0.768}{\sqrt{n}}$	$\frac{0.805}{\sqrt{n}}$	$\frac{0.886}{\sqrt{n}}$	$\frac{1.031}{\sqrt{n}}$

TABLE A.9
Gamma function

x	$\Gamma(x)$	x	$\Gamma(x)$	x	$\Gamma(x)$	x	$\Gamma(x)$
1.01	.99433	1.51	.88659	2.01	1.00427	2.51	1.33875
1.02	.98884	1.52	.88704	2.02	1.00862	2.52	1.34830
1.03	.98355	1.53	.88757	2.03	1.01306	2.53	1.35798
1.04	.97844	1.54	.88818	2.04	1.01758	2.54	1.36779
1.05	.97350	1.55	.88887	2.05	1.02218	2.55	1.37775
1.06	.96874	1.56	.88964	2.06	1.02687	2.56	1.38784
1.07	.96415	1.57	.89049	2.07	1.03164	2.57	1.39807
1.08	.95973	1.58	.89142	2.08	1.03650	2.58	1.40844
1.09	.95546	1.59	.89243	2.09	1.04145	2.59	1.41896
1.10	.95135	1.60	.89352	2.10	1.04649	2.60	1.42962
1.11	.94740	1.61	.89468	2.11	1.05161	2.61	1.44044
1.12	.94359	1.62	.89592	2.12	1.05682	2.62	1.45140
1.13	.93993	1.63	.89724	2.13	1.06212	2.63	1.46251
1.14	.93642	1.64	.89864	2.14	1.06751	2.64	1.47377
1.15	.93304	1.65	.90012	2.15	1.07300	2.65	1.48519
1.16	.92980	1.66	.90167	2.16	1.07857	2.66	1.49677
1.17	.92670	1.67	.90330	2.17	1.08424	2.67	1.50851
1.18	.92373	1.68	.90500	2.18	1.09000	2.68	1.52040
1.19	.92089	1.69	.90678	2.19	1.09585	2.69	1.53246
1.20	.91817	1.70	.90864	2.20	1.10180	2.70	1.54469
1.21	.91558	1.71	.91057	2.21	1.10785	2.71	1.55708
1.22	.91311	1.72	.91258	2.22	1.11399	2.72	1.56964
1.23	.91075	1.73	.91467	2.23	1.12023	2.73	1.58237
1.24	.90852	1.74	.91683	2.24	1.12657	2.74	1.59528
1.25	.90640	1.75	.91906	2.25	1.13300	2.75	1.60836
1.26	.90440	1.76	.92137	2.26	1.13954	2.76	1.62162
1.27	.90250	1.77	.92376	2.27	1.14618	2.77	1.63506
1.28	.90072	1.78	.92623	2.28	1.15292	2.78	1.64868
1.29	.89904	1.79	.92877	2.29	1.15976	2.79	1.66249
1.30	.89747	1.80	.93138	2.30	1.16671	2.80	1.67649
1.31	.89600	1.81	.93408	2.31	1.17377	2.81	1.69068
1.32	.89464	1.82	.93685	2.32	1.18093	2.82	1.70506
1.33	.89338	1.83	.93969	2.33	1.18819	2.83	1.71963
1.34	.89222	1.84	.94261	2.34	1.19557	2.84	1.73441
1.35	.89115	1.85	.94561	2.35	1.20305	2.85	1.74938
1.36	.89018	1.86	.94869	2.36	1.21065	2.86	1.76456
1.37	.88931	1.87	.95184	2.37	1.21836	2.87	1.77994
1.38	.88854	1.88	.95507	2.38	1.22618	2.88	1.79553
1.39	.88785	1.89	.95838	2.39	1.23412	2.89	1.81134
1.40	.88726	1.90	.96177	2.40	1.24217	2.90	1.82736
1.41	.88676	1.91	.96523	2.41	1.25034	2.91	1.84359
1.42	.88636	1.92	.96877	2.42	1.25863	2.92	1.86005
1.43	.88604	1.93	.97240	2.43	1.26703	2.93	1.87673
1.44	.88581	1.94	.97610	2.44	1.27556	2.94	1.89363
1.45	.88566	1.95	.97988	2.45	1.28421	2.95	1.91077
1.46	.88560	1.96	.98374	2.46	1.29298	2.96	1.92814
1.47	.88563	1.97	.98769	2.47	1.30188	2.97	1.94574
1.48	.88575	1.98	.99171	2.48	1.31091	2.98	1.96358
1.49	.88595	1.99	.99581	2.49	1.32006	2.99	1.98167
1.50	.88623	2.00	1	2.50	1.32934	3.00	2

delto med

FR-TK-012-00

LEMBAR PERBAIKAN MESIN / PERALATAN

BAGIAN : Liquid		PELAPOR : Suratmi	
NAMA MESIN / TYPE : Filling botol OBH		DILAPORKAN	TGL/JAM : 24/5/22 14.45
NO. INVENTARIS : A		SELESAI	TGL/JAM : 25/5/22 10.15

MASALAH YANG DILAPORKAN :

1. Motor buka Center produk mati
2.
3.
4.

ANALISA MASALAH :

1. Brosler habis atau aus
2.
3.
4.

RENCANA TINDAKAN :

1. Ganti brostel baru
2.
3.
4.

PENGGANTIAN SPARE PART :

Nama Part	Jumlah
Brostel	2

CATATAN : 1.
2.

DILAKSANAKAN OLEH,	MENYETUJUI,	MENGETAHUI,
Dian & Wiwit	Eko	Suratmi
TEKNISI BENGKEL	OPERATOR MESIN	KABAG / MANDOR MESIN

DIPERIKSA OLEH,
KABAG.

Penentuan Jenis Distribusi *Time to Failure*

Pemilihan jenis distribusi kegagalan ini menggunakan *Least Square Curve Fitting*, yang berdasarkan nilai r paling besar atau nilai *index of fit.* Dibawah ini merupakan penentuan distribusi kegagalan komponen Pisau Belah dan *Seal O-ring*

2. Penentuan Distribusi Kegagalan Pisau Belah

e. Distribusi Normal

- No = 1

  $\backslash Xi = ti$ = 2555

  $Xi^2 = 2555^2 = 6528025$

  $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{38 + 0{,}4} = \frac{0{,}7}{38{,}4} = 0{,}0182$

  $yi = zi = \phi^{-1}[F(ti)]$

  $yi = zi = \phi^{-1}[0.0182] = -2{,}0918$ → dilihat dari tabel *standard normal probabilities*

  $Yi^2 = -2{,}0918^2 = 4{,}3755$

  $Xi.Yi = 2555\ x(-2{,}0918) = -5344{,}4941$

- No = 38

  $Xi = ti$ = 458940

  $Xi^2 = 458940^2 = 210625923600$

  $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{38 - 0{,}3}{38 + 0{,}4} = \frac{37{,}7}{38{,}4} = 0{,}9818$

  $yi = zi = \phi^{-1}[F(ti)]$

  $yi = zi = \phi^{-1}[0.9818] = 2{,}0918$ → dilihat dari tabel *standard normal probabilities*

  $Yi^2 = 2{,}0918^2 = 4{,}3755$

  $Xi.Yi = 458940\ x\ 4{,}3755\ = 960000{,}8308$

- Total

  ΣXi = Σti = 2208850

  ΣXi^2 = 415515736312

  Σ[F(ti)] = 19

  ΣYi = 0

  ΣYi^2 = 34,5718

  ΣXi.Yi = 2405192,5818

$(\Sigma Xi)^2$ = 4879018323604

$(\Sigma Yi)^2$ = 0

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(38 * 2405192{,}5818) - (2208850 * 0)}{\sqrt{((38 * 415515736312) - 4879018323604)((38 * 34{,}5718) - 0}}$$

$$= 0{,}763408$$

f. Distribusi Log Normal

- No = 1

$\backslash Xi = lnti$ = 7,8458

$Xi^2 = 7{,}8458^2 = 61{,}5567$

$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{38 + 0{,}4} = \frac{0{,}7}{38{,}4} = 0{,}0182$

$yi = zi = \phi^{-1}[F(ti)]$

$yi = zi = \phi^{-1}[0.0182] = -2{,}0918$ → dilihat dari tabel *standard normal probabilities*

$Yi^2 = -2{,}0918^2 = 4{,}3755$

$Xi.Yi = 7{,}8458\ x(-2{,}0918) = -16{,}4117$

- No = 38

$Xi = lnti$ = 13,0367

$Xi^2 = 13{,}0367^2 = 169{,}9549$

$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{38 - 0{,}3}{38 + 0{,}4} = \frac{37{,}7}{38{,}4} = 0{,}9818$

$yi = zi = \phi^{-1}[F(ti)]$

$yi = zi = \phi^{-1}[0.9818] = 2{,}0918$ → dilihat dari tabel *standard normal probabilities*

$Yi^2 = 2{,}0918^2 = 4{,}3755$

$Xi.Yi = 13{,}0367\ x\ 4{,}3755\ = 27{,}2698$

- Total

ΣXi = Σlnti = 387,9805

ΣXi^2 = 4021,9493

$\Sigma[F(ti)]$ = 19

ΣYi = 0

ΣYi^2 = 34,5718

$\Sigma Xi.Yi$ = 45,4434

$(\Sigma Xi)^2$ = 150528,8973

$(\Sigma Yi)^2$ = 0

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(38 * 45{,}4434) - (2208850 * 0)}{\sqrt{((38 * 387{,}9805) - 150528{,}8973)((38 * 34{,}5718) - 0}} = 0{,}9923152$$

g. Distribusi Eksponensial

- No = 1

$\backslash Xi = ti$ = 2555

$Xi^2 = 2555^2 = 6528025$

$$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{38 + 0{,}4} = \frac{0{,}7}{38{,}4} = 0{,}0182$$

$$yi = ln\left[\left[\frac{1}{1 - F(ti)}\right]\right] = ln\left[\left[\frac{1}{1 - 0{,}0182}\right]\right] = 0{,}0184$$

$Yi^2 = 0{,}0184^2 = 0{,}0003$

$Xi.Yi = 2555\ x\ 0{,}0184 = 47{,}0053$

- No = 38

$Xi = ti$ = 458940

$Xi^2 = 458940^2 = 210625923600$

$$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{38 - 0{,}3}{38 + 0{,}4} = \frac{37{,}7}{38{,}4} = 0{,}9818$$

$$yi = yi = ln\left[\left[\frac{1}{1 - F(ti)}\right]\right] = ln\left[\left[\frac{1}{1 - 0{,}9818}\right]\right] = 67{,}4775$$

$Yi^2 = 2{,}0918^2 = 4{,}3755$

$Xi.Yi = 458940\ x\ 16{,}0379\ = 1837931{,}8893$

- Total

  ΣXi = Σti = 2208850

  ΣXi^2 = 415515736312

  Σ[F(ti)] = 19

  ΣYi = 37,0129

  ΣYi^2 = 67,4775

  ΣXi.Yi = 4947304,1079

  $(\Sigma Xi)^2$ = 4879018323604

  $(\Sigma Yi)^2$ = 1369,9537

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(38 * 4947304{,}1079) - (2208850 * 37{,}0129)}{\sqrt{((38 * 415515736312) - 4879018323604)((38 * 67{,}4775) - 1369{,}9537}} = 0{,}9307523$$

h. Ditribusi Weibull

- No = 1

  $\backslash Xi = lnti$ = 7,8458

  $Xi^2 = 7{,}8458^2 = 61{,}5567$

  $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{38 + 0{,}4} = \frac{0{,}7}{38{,}4} = 0{,}0182$

  $yi = ln\left[ln\left[\frac{1}{1 - F(ti)}\right]\right] = ln\left[ln\left[\frac{1}{1 - 0{,}0182}\right]\right] = -3{,}9955$

  $Yi^2 = (-3{,}9955)^2 = \ 15{,}9644$

  $Xi.Yi = 7{,}8458\ x(-3{,}9955) = -31{,}3483$

- No = 38

  $Xi = lnti$ = 13,0367

  $Xi^2 = 13{,}0367^2 = 169{,}9549$

  $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{38 - 0{,}3}{38 + 0{,}4} = \frac{37{,}7}{38{,}4} = 0{,}9818$

$$yi = ln\left[ln\left[\frac{1}{1-F(ti)}\right]\right] = ln\left[ln\left[\frac{1}{1-0{,}9818}\right]\right] = 1{,}3875$$

$$Yi^2 = 1{,}3875^2 = 1{,}9251$$

$$Xi.Yi = 13{,}0367\ x\ 1{,}9251\ = 18{,}0881$$

- Total

  ΣXi = Σlnti = 385,8436

  ΣXi^2 = 3974,2029

  Σ[F(ti)] = 19

  ΣYi = -21,1702

  ΣYi^2 = 65,8776

  ΣXi.Yi = -161,5614

  $(\Sigma Xi)^2$ = 148875,3078

  $(\Sigma Yi)^2$ = 448,1773

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(38 * 45{,}4434) - (2208850 * 0)}{\sqrt{((38 * 387{,}9805) - 150528{,}8973)((38 * 34{,}5718) - 0}} = 0{,}9923152$$

Distribusi	**Index Of Fit**
Eksponensial	0,9308
Normal	0,7634
Log Normal	0,9923
Weibull	0,9682

didapatkan nilai r yang paling besar yang akan digunakan yaitu distribusi Log Normal

2. Penentuan Distribusi Kegagalan *Seal O-Ring*

e. Distribusi Normal

- No = 1

  $\backslash Xi = ti$ = 5730

$Xi^2 = 5730^2 = 32832900$

$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{18 + 0{,}4} = \frac{0{,}7}{18{,}4} = 0{,}0380$

$yi = zi = \phi^{-1}[F(ti)]$

$yi = zi = \phi^{-1}[0.0380] = -1{,}7739$ → dilihat dari tabel *standard normal probabilities*

$Yi^2 = -1{,}7739^2 = 3{,}1466$

$Xi.Yi = 2555\ x(-1{,}7739) = -10164{,}1954$

- No = 18

  $Xi = ti$ = 221720

  $Xi^2 = 221720^2 = 49159758400$

  $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{18 - 0{,}3}{18 + 0{,}4} = \frac{17{,}7}{18{,}4} = 0{,}9620$

  $yi = zi = \phi^{-1}[F(ti)]$

  $yi = zi = \phi^{-1}[0.9620] = 1{,}7739$ → dilihat dari tabel *standard normal probabilities*

  $Yi^2 = 1{,}7739^2 = 3{,}1466$

  $Xi.Yi = 221720\ x\ 1{,}7739\ = 393299{,}3735$

- Total

  ΣXi = Σti = 1461900

  ΣXi^2 = 191935137650

  Σ[F(ti)] = 9

  ΣYi = 0

  ΣYi^2 = 15,1143724

  ΣXi.Yi = 1003683,972

  $(\Sigma Xi)^2$ = 2137151610000

  $(\Sigma Yi)^2$ = 0

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(18 * 1003683{,}972) - (1461900 * 0)}{\sqrt{((18 * 191935147650) - 2137151610000)((18 * 15{,}1143724) - 0}}$$

$$= 0{,}954186$$

b. Distribusi Log Normal

- No = 1

  $\backslash Xi = lnti$ = 8,6535

  $Xi^2 = 8{,}6535^2 = 74{,}8826$

  $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{18 + 0{,}4} = \frac{0{,}7}{18{,}4} = 0{,}03880$

  $yi = zi = \phi^{-1}[F(ti)]$

  $yi = zi = \phi^{-1}[0.03880] = -1{,}7739$ → dilihat dari tabel *standard normal probabilities*

  $Yi^2 = -1{,}7739^2 = 3{,}1466$

  $Xi.Yi = 8{,}6535\ x(-1{,}7739) = -15{,}3500$

- No = 18

  $Xi = lnti$ = 12,3092

  $Xi^2 = 13{,}0367^2 = 169{,}9549$

  $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{38 - 0{,}3}{38 + 0{,}4} = \frac{37{,}7}{38{,}4} = 0{,}9818$

  $yi = zi = \phi^{-1}[F(ti)]$

  $yi = zi = \phi^{-1}[0.9818] = 0{,}9620$ → dilihat dari tabel *standard normal probabilities*

  $Yi^2 = 1{,}7739^2 = 3{,}1466$

  $Xi.Yi = 12{,}3092\ x\ 3{,}1466\ = 21{,}8347$

- Total

  ΣXi = Σlnti = 196,327358

  ΣXi^2 = 2159,384147

  Σ[F(ti)] = 9

  ΣYi = 0

  ΣYi^2 = 15,1143724

  ΣXi.Yi = 16,1574155

  $(\Sigma Xi)^2$ = 38544,43

  $(\Sigma Yi)^2$ = 0

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(18 * 16{,}1574155) - (196{,}327358 * 0)}{\sqrt{((18 * 2159{,}384147) - 38544{,}43)((18 * 15{,}1143724) - 0}} = 0{,}978852$$

c. Distribusi Eksponensial

- No = 1

  $\backslash Xi = ti$ = 5370

  $Xi^2 = 5370^2 = 3282900$

  $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{18 + 0{,}4} = \frac{0{,}7}{18{,}4} = 0{,}0380$

  $yi = ln\left[\left[\frac{1}{1 - F(ti)}\right]\right] = ln\left[\left[\frac{1}{1 - 0{,}0380}\right]\right] = 0{,}0388$

  $Yi^2 = 0{,}0380^2 = 0{,}0015$

  $Xi.Yi = 5730\ x\ 0{,}0388 = 222{,}2439$

- No = 18

  $Xi = ti$ = 221720

  $Xi^2 = 221720^2 = 49159758400$

  $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{18 - 0{,}3}{18 + 0{,}4} = \frac{17{,}7}{18{,}4} = 0{,}9620$

  $yi = yi = ln\left[\left[\frac{1}{1 - F(ti)}\right]\right] = ln\left[\left[\frac{1}{1 - 0{,}9620}\right]\right] = 3{,}2690$

  $Yi^2 = 3{,}2690^2 = 10{,}6865$

  $Xi.Yi = 221720\ x\ 3{,}2690\ = 724808{,}3579$

- Total

  ΣXi = Σti = 1461900

  ΣXi^2 = 191935147650

  Σ[F(ti)] = 9

  ΣYi = 17,1606566

  ΣYi^2 = 29,41110567

ΣXi.Yi = 2355575,72

$(\Sigma Xi)^2$ = 2137151610000

$(\Sigma Yi)^2$ = 294,4881363

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(18 * 2355575{,}72) - (1461900 * 17{,}1606566)}{\sqrt{((18 * 191935147650) - 213715610000)((18 * 29{,}41110567) - 294{,}4881363}}$$

$$= 0{,}984056$$

d. Ditribusi Weibull

- No = 1

$\backslash Xi = lnti$ = 8,6535

$Xi^2 = 8{,}6535^2 = 74{,}8826$

$$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{18 + 0{,}4} = \frac{0{,}7}{18{,}4} = 0{,}0380$$

$$yi = ln\left[ln\left[\frac{1}{1 - F(ti)}\right]\right] = ln\left[ln\left[\frac{1}{1 - 0{,}0380}\right]\right] = -3{,}2497$$

$Yi^2 = (-3{,}2497)^2 = 10{,}5605$

$Xi.Yi = 8{,}6535\ x(-3{,}2497) = -28{,}1211$

- No = 18

$Xi = lnti$ = 12,3092

$Xi^2 = 12{,}3092^2 = 151{,}5157$

$$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{18 - 0{,}3}{18 + 0{,}4} = \frac{17{,}7}{18{,}4} = 0{,}9620$$

$$yi = ln\left[ln\left[\frac{1}{1 - F(ti)}\right]\right] = ln\left[ln\left[\frac{1}{1 - 0{,}9620}\right]\right] = 1{,}1845$$

$Yi^2 = 1{,}1845^2 = 1{,}4030$

$Xi.Yi = 12{,}3092\ x\ 1{,}1845\ = 14{,}5801$

- Total

ΣXi = Σlnti = 196,327358

ΣXi^2 = 2159,384147

$\Sigma[F(ti)]$ = 9

ΣYi = -9,7522

ΣYi^2 = 28,3322

$\Sigma Xi.Yi$ = -86,0839

$(\Sigma Xi)^2$ = 38544,432

$(\Sigma Yi)^2$ = 95,106264

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(18 * (-86{,}083958)) - (196{,}327358 * (-9{,}7522441))}{\sqrt{((18 * 2159{,}384147) - 38544{,}432)((18 * 28{,}3322873) - 95{,}1062}} = 0{,}995136$$

Distribusi	**Index Of Fit**
Eksponensial	0,9841
Normal	0,9542
Log Normal	0,9789
Weibull	0,9951

didapatkan nilai r yang paling besar yang akan digunakan yaitu distribusi *weibull*.

Uji kecocokan *Goodness of Fit* Data Kerusakan Komponen

1. Uji Kecocokan *Goodness of Fit* Data Kerusakan Komponen Pisau Belah

Pengujian ini ditujukan untuk menentukan hipotesis terhadap pola distribusi yang telah terpilih. Pada komponen pisau belah distribusi yang terpilih yaitu distribusi Lognormal sehingga menggunakan uji *Kolomogrov-Smirnov*

Hipotesis untuk uji *Kolomogrov-Smirnov* adalah :

H_0 : Data *time to failure* berdistribusi Log Normal

H_1 : Data *time to failure* tidak berdistribusi Log Normal

α = 0,05

Penerimaan apabila $D_n < D_{tabel}$

$D_n = \max(D_1, D_2)$

$D_n max = 0{,}1052$

$$D_1 = max\left\{\phi\left(\frac{ti - \bar{t}}{s}\right) - \left(\frac{t-1}{n}\right)\right\}$$

$$D_1 = \left\{\phi\left(\frac{7{,}8458 - 10{,}2100}{1{,}2635}\right) - \left(\frac{1-1}{38}\right)\right\}$$

$D_1 = \{\underline{\phi(-1{,}87)} - (0)\}$

Dilihat dari tabel *standard normal probabilities*

$D_1 = 0{,}0291$

$$D_2 = \left\{\left(\frac{i}{n}\right) - \phi\left(\frac{ti - \bar{t}}{s}\right)\right\}$$

$$D_2 = \left\{\left(\frac{1}{38}\right) - \phi\left(\frac{7{,}8458 - 10{,}21000}{1{,}2635}\right)\right\}$$

$D_2 = \{(0{,}026) - \underline{\phi(-1{,}87)}\}$

Dilihat dari tabel *standard normal probabilities*

$D_2 = (0{,}026 - 0{,}0291) = -0{,}0028$

$$s = \sqrt{\frac{\sum_{i=1}^{n}(7{,}8458 - 10{,}2100)^2}{38 - 1}}$$

$s = 1{,}2635$

$D_n max = 0{,}1052 < D_{tabel} = 0{,}2190 \rightarrow$ Dilihat dari tabel nilai kritis *Kolmogorov-Smirnov*

$D_n max = 0{,}1052 < D_{tabel} = 0{,}2190 :\ H_0\ diterima$

2. Uji Kecocokan *Goodness of Fit* Data Kerusakan Komponen *Seal O-Ring*

Pengujian ini ditujukan untuk menentukan hipotesis terhadap pola distribusi yang telah terpilih. Pada komponen *seal o-ring* distribusi yang terpilih yaitu distribusi Weibull sehingga menggunakan uji *Mann's Test*

Hipotesis untuk uji *Mann's test*adalah :

H_0 : Data *time to failure* berdistribusi Weibull

H_1 : Data *time to failure* tidak berdistribusi Weibull

α = 0,05

H_0 diterima apabila $M < F_{crit}, k_2, k_1$

Perhitungan

n = 8

$$k_1 = \left[\frac{r}{n}\right] = \left[\frac{18}{2}\right] = 9$$

$$k_2 = \left[\frac{r-1}{2}\right] = \left[\frac{18-1}{2}\right] = 8{,}5$$

$$Z_i = ln\left[-ln\left(1 - \frac{i-0{,}5}{n+0{,}25}\right)\right]$$

$$Z_i = ln\left[-ln\left(1 - \frac{1-0{,}5}{18+0{,}25}\right)\right] = -3{,}5835$$

$$M_i = Z_{i+1} - Z_i$$

$$M_i = -2{,}4561 - (-3{,}5835) = -1{,}1273$$

$$M = \frac{k_1 \sum[(lnt_{i+1} - lnti_1)/M_i]}{k_2 \sum[(lnt_{i+1} - lnti_1)/M_i]}$$

$$M = \frac{9 * 14{,}4142}{8{,}5 * 14{,}4142} = 1{,}0588$$

Jadi, keputusan $M < F_{crit}$ = 1,0588 <3,229583

↳ Dilihat dari tabel F

Maximum Likelihood Estimator

1. LogNormal mempunyai 3 parameter yaitu μ, s, dan t_{med}
   a. $\hat{\mu} = \frac{\sum_{i=1}^{n} ln\ ti}{n}$

      $$\hat{\mu} = \frac{385{,}8436}{38} = 10{,}1538$$

   b. $\hat{s} = \sqrt{\frac{\sum_{i=1}^{n}(lnti - \hat{u})^2}{n}}$

$$\hat{s} = \sqrt{\frac{56{,}4317}{38}} = 1{,}2186$$

c. $t_{med} = e^{\mu}$

$t_{med} = e^{10{,}1538} = 25688{,}0138$

2. Distribusi *Weibull* menggunakan dua parameter yaitu α (*scale parameter*) dan β (*shape parameter*).

a. θ (*scale parameter*)

$$\alpha = \frac{\sum y_i}{n} - \frac{b\sum x_i}{n}$$

$$\alpha = \frac{-9{,}7522}{18} - \frac{1{,}125239426 * 196{,}3274}{18}$$

$$\alpha = -12{,}81486267$$

$$\theta = exp^{-\alpha/\beta}$$

$$\theta = exp^{-(-\frac{12{,}81486267}{1{,}125239426})}$$

$$\theta = 88306{,}17284$$

b. β (*shape parameter*)

$$\beta = \frac{n\sum x_i y_i - (\sum x_i)(\sum y_i)}{n\sum x_i^2 - (\sum x_i)^2}$$

$$\beta = \frac{18 * (-86{,}083958) - (196{,}3274)(-9{,}7522)}{18 * (2159{,}3841) - (38544{,}4316)} = 1{,}125239426$$

Penentuan Nilai Tengah dari Distribusi Data Antar Waktu Antar Kerusakan (*Mean Time to Failure*)

Menghitung nilai MTTF komponen pisau belah dan komponen *seal o-ring* yang sesuai dengan distribusi yang terpilih terhadap data *time to failure* sebagai berikut :

3. Komponen Pisau Belah (Log Normal)

MTTF = $t_{med} \,.\, e^{\frac{s^2}{2}}$

$$= 25688{,}0138 * (\exp\frac{1{,}2635^2}{2})$$

$$= 53976{,}3756$$

4. Komponen *Seal O-Ring* (*Weibull*)

$$\text{MTTF} = \theta\Gamma\left(1 + \frac{1}{\beta}\right)$$

$$= 88306{,}17284 * \Gamma(1 + \frac{1}{1{,}125})$$

$$= 88306{,}17284 * \Gamma(0{,}96) \rightarrow DIlihat\ dari\ tabel\ gamma$$

$$= 88306{,}17284 * 1{,}89$$

$$= 84930{,}2279$$

Penentuan Jenis Distribusi *Time to Repair*

Dibawah ini merupakan penentuan distribusi kegagalan komponen Pisau Belah dan *Seal O-ring*

1. Penentuan Distribusi Kegagalan Pisau Belah
   a. Distribusi Normal
   - No = 1

     $\backslash Xi = ti$ = 15

     $Xi^2 = 15^2 = 225$

     $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{39 + 0{,}4} = \frac{0{,}7}{39{,}4} = 0{,}0178$

     $yi = zi = \phi^{-1}[F(ti)]$

     $yi = zi = \phi^{-1}[0.0178] = -2{,}1022$ → dilihat dari tabel *standard normal probabilities*

     $Yi^2 = -2{,}1022^2 = 4{,}4194$

     $Xi.Yi = 15\ x(-2{,}1022) = -31{,}5335$
   - No = 39

     $Xi = ti$ = 90

     $Xi^2 = 90^2 = 8100$

     $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{39 - 0{,}3}{39 + 0{,}4} = \frac{38{,}7}{39{,}4} = 0{,}9822$

     $yi = zi = \phi^{-1}[F(ti)]$

     $yi = zi = \phi^{-1}[0.9822] = 2{,}1022$ → dilihat dari tabel *standard normal probabilities*

     $Yi^2 = 2{,}1022^2 = 4{,}4194$

     $Xi.Yi = 90\ x\ 4{,}4194\ = 189{,}2008$
   - Total

     ΣXi = Σti = 1775

     ΣXi^2 = 91075

     Σ[F(ti)] = 19,5

     ΣYi = 38,0077

     ΣYi^2 = 69,405989

     ΣXi.Yi = 2271,2318

     $(\Sigma Xi)^2$ = 3150625

$(\Sigma Yi)^2$ = 0

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(39 * 577{,}90083) - (1775 * 0)}{\sqrt{((39 * 91075) - 3150625)((39 * 35{,}552777) - 0}} = 0{,}9554639$$

b. Distribusi Log Normal

- No = 1

$\backslash Xi = lnti$ = 2,7081

$Xi^2 = 2{,}7081^2 = 7{,}3335$

$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{39 + 0{,}4} = \frac{0{,}7}{39{,}4} = 0{,}0178$

$yi = zi = \phi^{-1}[F(ti)]$

$yi = zi = \phi^{-1}[0.0178] = -2{,}1022$ → dilihat dari tabel *standard normal probabilities*

$Yi^2 = -2{,}1022^2 = 4{,}4194$

$Xi.Yi = 2{,}7081\ x(-2{,}1022) = -5{,}6929$

- No = 39

$Xi = lnti$ = 4,4998

$Xi^2 = 4{,}4998^2 = 20{,}2483$

$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{39 - 0{,}3}{39 + 0{,}4} = \frac{38{,}7}{39{,}4} = 0{,}9822$

$yi = zi = \phi^{-1}[F(ti)]$

$yi = zi = \phi^{-1}[0.9822] = 2{,}1022$ → dilihat dari tabel *standard normal probabilities*

$Yi^2 = 2{,}1022^2 = 4{,}4194$

$Xi.Yi = 4{,}4998\ x\ 2{,}1022\ = 9{,}4596$

- Total

$\Sigma Xi = \Sigma lnti$ = 1775

ΣXi^2 = 146,33439

$\Sigma[F(ti)]$ = 19,5

ΣYi = 0

ΣYi^2 = 35,552777

ΣXi.Yi = 13,2910

$(\Sigma Xi)^2$ = 21413,8

$(\Sigma Yi)^2$ = 0

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(39 * 13{,}2910) - (146{,}33439 * 0)}{\sqrt{((39 * 554{,}44288) - 21413{,}8)((39 * 35{,}552777) - 0}} = 0{,}9617003$$

c. Distribusi Eksponensial

- No = 1

$\backslash Xi = ti$ = 15

$Xi^2 = 15^2 = 225$

$$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{39 + 0{,}4} = \frac{0{,}7}{39{,}4} = 0{,}0178$$

$$yi = ln\left[\left[\frac{1}{1 - F(ti)}\right]\right] = ln\left[\left[\frac{1}{1 - 0{,}0178}\right]\right] = 0{,}0179$$

$Yi^2 = 0{,}0179^2 = 0{,}0003$

$Xi.Yi = 15\ x\ 0{,}0178 = 0{,}2689$

- No = 39

$Xi = ti$ = 90

$Xi^2 = 90^2 = 8100$

$$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{39 - 0{,}3}{39 + 0{,}4} = \frac{38{,}7}{39{,}4} = 0{,}9822$$

$$yi = yi = ln\left[\left[\frac{1}{1 - F(ti)}\right]\right] = ln\left[\left[\frac{1}{1 - 0{,}9822}\right]\right] = 4{,}0304$$

$Yi^2 = 4{,}0304^2 = 16{,}2445$

$Xi.Yi = 90\ x\ 4{,}0304\ = 362{,}7397$

- Total

ΣXi = Σti = 1775

ΣXi^2 = 91075

Σ[F(ti)] = 19,5

ΣYi = 38,0077

ΣYi^2 = 69,405989

ΣXi.Yi = 4947304,1079

$(\Sigma Xi)^2$ = 3150625

$(\Sigma Yi)^2$ = 1444,5875

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(39 * 2271{,}2318) - (1775 * 38{,}0077)}{\sqrt{((39 * 91075) - 3150625)((39 * 69{,}405989) - 1444{,}5875}} = 0{,}9381461$$

d. Ditribusi Weibull

- No = 1

$\backslash Xi = lnti$ = 2,7081

$Xi^2 = 2{,}7081^2 = 7{,}3335$

$$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{39 + 0{,}4} = \frac{0{,}7}{39{,}4} = 0{,}0178$$

$$yi = ln\left[ln\left[\frac{1}{1 - F(ti)}\right]\right] = ln\left[ln\left[\frac{1}{1 - 0{,}0178}\right]\right] = -4{,}0215$$

$Yi^2 = (-4{,}0215)^2 = 16{,}1724$

$Xi.Yi = 7{,}3335\ x(-4{,}0215) = -10{,}8904$

- No = 39

$Xi = lnti$ = 4,4998

$Xi^2 = 4{,}4998^2 = 20{,}2483$

$$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{39 - 0{,}3}{39 + 0{,}4} = \frac{38{,}7}{39{,}4} = 0{,}9822$$

$$yi = ln\left[ln\left[\frac{1}{1 - F(ti)}\right]\right] = ln\left[ln\left[\frac{1}{1 - 0{,}9822}\right]\right] = 1{,}3939$$

$Yi^2 = 1{,}3939^2 = 1{,}9429$

$Xi.Yi = 4{,}4998\ x\ 1{,}3939\ = 6{,}2722$

- Total

  ΣXi = Σlnti = 146,33439

  ΣXi^2 = 554,44288

  Σ[F(ti)] = 19,5

  ΣYi = -21,742966

  ΣYi^2 = 67,781413

  ΣXi.Yi = -65,010634

  $(\Sigma Xi)^2$ = 21413,753

  $(\Sigma Yi)^2$ = 472,75657

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(39 * (-65{,}010634)) - (146{,}33439 * (-21{,}742966))}{\sqrt{((39 * 554{,}44288) - 21413{,}753)((39 * 67{,}781413) - 472{,}75657}}$$

$$= 0{,}958385$$

Distribusi	**Index Of Fit**
Eksponensial	0,9381
Normal	0,9555
Log Normal	0,9617
Weibull	0,9584

didapatkan nilai r yang paling besar yang akan digunakan yaitu distribusi Log Normal

2. Penentuan Distribusi Perbaikan *Seal O-Ring*

a. Distribusi Normal

- No = 1

  $\backslash Xi = ti$ = 30

$Xi^2 = 30^2 = 900$

$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{19 + 0{,}4} = \frac{0{,}7}{19{,}4} = 0{,}0361$

$yi = zi = \phi^{-1}[F(ti)]$

$yi = zi = \phi^{-1}[0.0361] = -1{,}7981$ → dilihat dari tabel *standard normal probabilities*

$Yi^2 = -1{,}7981^2 = 3{,}2331$

$Xi.Yi = 30\ x(-1{,}7981) = -53{,}9423$

- No = 19

  $Xi = ti$ = 240

  $Xi^2 = 240^2 = 57600$

  $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{19 - 0{,}3}{19 + 0{,}4} = \frac{18{,}7}{19{,}4} = 0{,}9639$

  $yi = zi = \phi^{-1}[F(ti)]$

  $yi = zi = \phi^{-1}[0.9639] = 1{,}7981$ → dilihat dari tabel *standard normal probabilities*

  $Yi^2 = 1{,}7981^2 = 3{,}2331$

  $Xi.Yi = 240\ x\ 1{,}7981\ = 431{,}5383$

- Total

  ΣXi = Σti = 1370

  ΣXi^2 = 57600

  Σ[F(ti)] = 9,5

  ΣYi = 0

  ΣYi^2 = 16,07547168

  ΣXi.Yi = 653,0522

  $(\Sigma Xi)^2$ = 1876900

  $(\Sigma Yi)^2$ = 0

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(19 * 653{,}052) - (1370 * 0)}{\sqrt{((19 * 138750) - 1876900)((19 * 16{,}0755) - 0}} = 0{,}81475$$

b. Distribusi Log Normal

- No = 1

  $\backslash Xi = lnti$ = 3,4012

  $Xi^2 = 3{,}4012^2 = 11{,}5681$

  $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{19 + 0{,}4} = \frac{0{,}7}{19{,}4} = 0{,}0361$

  $yi = zi = \phi^{-1}[F(ti)]$

  $yi = zi = \phi^{-1}[0.0361] = -1{,}7981$ → dilihat dari tabel *standard normal probabilities*

  $Yi^2 = -1{,}7981^2 = 3{,}2331$

  $Xi.Yi = 3{,}4012\ x(-1{,}7981) = -6{,}1156$

- No = 19

  $Xi = lnti$ = 5,4806

  $Xi^2 = 5{,}4806^2 = 30{,}0374$

  $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{19 - 0{,}3}{19 + 0{,}4} = \frac{18{,}7}{19{,}4} = 0{,}9639$

  $yi = zi = \phi^{-1}[F(ti)]$

  $yi = zi = \phi^{-1}[0.9639] = 1{,}7981$ → dilihat dari tabel *standard normal probabilities*

  $Yi^2 = 1{,}7891^2 = 3{,}2331$

  $Xi.Yi = 5{,}4806\ x\ 1{,}7981\ = 9{,}8546$

- Total

  ΣXi = Σlnti = 78,775085

  ΣXi^2 = 330,90734

  Σ[F(ti)] = 9,5

  ΣYi = 0

  ΣYi^2 = 16,075472

  ΣXi.Yi = 7,9507319

  $(\Sigma Xi)^2$ = 6205,514

  $(\Sigma Yi)^2$ = 0

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(19 * 7{,}95073) - (78{,}7751 * 0)}{\sqrt{((19 * 330{,}907) - 6205{,}514)((19 * 16{,}07547) - 0}} = 0{,}956145$$

c. Distribusi Eksponensial

- No = 1

  $\backslash Xi = ti$ = 30

  $Xi^2 = 30^2 = 900$

  $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{19 + 0{,}4} = \frac{0{,}7}{19{,}4} = 0{,}0361$

  $yi = ln\left[\left[\frac{1}{1 - F(ti)}\right]\right] = ln\left[\left[\frac{1}{1 - 0{,}0361}\right]\right] = 0{,}0367$

  $Yi^2 = 0{,}0367^2 = 0{,}0014$

  $Xi.Yi = 30\ x\ 0{,}0367 = 1{,}1025$

- No = 19

  $Xi = ti$ = 240

  $Xi^2 = 240^2 = 57600$

  $[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{19 - 0{,}3}{19 + 0{,}4} = \frac{18{,}7}{19{,}4} = 0{,}9639$

  $yi = yi = ln\left[\left[\frac{1}{1 - F(ti)}\right]\right] = ln\left[\left[\frac{1}{1 - 0{,}9639}\right]\right] = 3{,}3219$

  $Yi^2 = 3{,}3219^2 = 31{,}279237$

  $Xi.Yi = 240\ x\ 3{,}3219\ = 797{,}2675$

- Total

ΣXi = Σti = 1370

ΣXi^2 = 138750

Σ[F(ti)] = 9,5

ΣYi = 18,150009

ΣYi^2 = 31,279237

ΣXi.Yi = 2004,521

$(\Sigma Xi)^2$ = 1876900

$(\Sigma Yi)^2$ = 329,42284

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(19 * 2004{,}521) - (1370 * 18{,}15001)}{\sqrt{((19 * 138750) - 1876900)((19 * 31{,}17924) - 329{,}42284}}$$

$$= 0{,}932173$$

d. Ditribusi Weibull

- No = 1

$\backslash Xi = lnti$ = 3,4012

$Xi^2 = 3{,}4012^2 = 11{,}5681$

$$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{1 - 0{,}3}{19 + 0{,}4} = \frac{0{,}7}{19{,}4} = 0{,}0361$$

$$yi = ln\left[ln\left[\frac{1}{1 - F(ti)}\right]\right] = ln\left[ln\left[\frac{1}{1 - 0{,}0361}\right]\right] = -3{,}3036$$

$Yi^2 = (-3{,}306)^2 = 10{,}9140$

$Xi.Yi = 3{,}4012\ x(-3{,}3036) = -11{,}2363$

- No = 19

$Xi = lnti$ = 5,4806

$Xi^2 = 5{,}4806^2 = 30{,}0374$

$$[F(ti)] = \frac{i - 0{,}3}{n + 0{,}4} = \frac{19 - 0{,}3}{19 + 0{,}4} = \frac{18{,}7}{19{,}4} = 0{,}9639$$

$$yi = ln\left[ln\left[\frac{1}{1-F(ti)}\right]\right] = ln\left[ln\left[\frac{1}{1-0{,}9639}\right]\right] = 1{,}2006$$

$$Yi^2 = 1{,}2006^2 = 1{,}4413$$

$$Xi.Yi = 5{,}4806\ x\ 1{,}2006\ = 6{,}5798$$

- Total

  ΣXi = Σlnti = 78,775085

  ΣXi^2 = 330,90734

  Σ[F(ti)] = 9,5

  ΣYi = -10,320435

  ΣYi^2 = 30,172377

  ΣXi.Yi = -33,466568

  $(\Sigma Xi)^2$ = 6205,514

  $(\Sigma Yi)^2$ = 106,5114

- Nilai r

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - (\sum_{i=1}^{n} x_i)(\sum_{i=1}^{n} y_i)}{\sqrt{\left[n(\sum_{i=1}^{n} x_i^2) - (\sum_{i=1}^{n} x_i)^2\right]\left[n(\sum_{i=1}^{n} y_i^2) - (\sum_{i=1}^{n} y_i)^2\right]}}$$

$$r = \frac{(19 * (-33{,}4666)) - (78{,}77508 * (-10{,}3204))}{\sqrt{((19 * 330{,}9073) - 6205{,}514)((19 * 30{,}17238) - 106{,}5114}}$$

$$= 0{,}906903$$

Distribusi	Index Of Fit
Eksponensial	0,9322
Normal	0,8147
Log Normal	0,9561
Weibull	0,9069

didapatkan nilai r yang paling besar yang akan digunakan yaitu distribusi Log Normal

Uji kecocokan *Goodness of Fit* Data Perbaikan Komponen

1. Uji Kecocokan *Goodness of Fit* Data Perbaikan Komponen Pisau Belah

Pengujian ini ditujukan untuk menentukan hipotesis terhadap pola distribusi yang telah terpilih. Pada komponen pisau belah distribusi yang terpilih yaitu distribusi Lognormal sehingga menggunakan uji *Kolomogrov-Smirnov*

Hipotesis untuk uji *Kolomogrov-Smirnov* adalah :

H_0 : Data *time to repair* berdistribusi Log Normal

H_1 : Data *time to repair* tidak berdistribusi Log Normal

α = 0,05

Penerimaan apabila $D_n < D_{tabel}$

$$D_n = \max(D_1, D_2)$$

$$D_n max = 0{,}1807$$

$$D_1 = max\left\{\phi\left(\frac{ti - \bar{t}}{s}\right) - \left(\frac{t-1}{n}\right)\right\}$$

$$D_1 = \left\{\phi\left(\frac{2{,}7081 - 3{,}7522}{0{,}371148}\right) - \left(\frac{1-1}{39}\right)\right\}$$

$$D_1 = \{\underline{\phi(-2{,}81)} - (0)\}$$

Dilihat dari tabel *standard normal probabilities*

$$D_1 = 0{,}0025$$

$$D_2 = \left\{\left(\frac{i}{n}\right) - \phi\left(\frac{ti - \bar{t}}{s}\right)\right\}$$

$$D_2 = \left\{\left(\frac{1}{39}\right) - \phi\left(\frac{2{,}7081 - 3{,}7522}{0{,}371148}\right)\right\}$$

$$D_2 = \{(0{,}025) - \underline{\phi(-2{,}81)}\}$$

Dilihat dari tabel *standard normal probabilities*

$$D_2 = (0{,}025 - 0{,}0025) = 0{,}0232$$

$$s = \sqrt{\frac{\sum_{i=1}^{n}(2{,}7081 - 3{,}722)^2}{39 - 1}}$$

$$s = 0{,}371148$$

$D_n max = 0{,}1807 < D_{tabel} = 0{,}2162$→ Dilihat dari tabel nilai kritis *Kolmogorov-Smirnov*

$D_n max = 0{,}1052 < D_{tabel} = 0{,}2190 : \ H_0 \ diterima$

2. Uji Kecocokan *Goodness of Fit* Data Perbaikan Komponen *Seal O-Ring*

Pengujian ini ditujukan untuk menentukan hipotesis terhadap pola distribusi yang telah terpilih. Pada komponen *seal o-ring* distribusi yang terpilih yaitu distribusi Lognormal sehingga menggunakan uji *Kolmogorov Smirnov Test*

Hipotesis untuk uji *Kolomogrov-Smirnov* adalah :

H_0 : Data *time to repair* berdistribusi Log Normal

H_1 : Data *time to repair* tidak berdistribusi Log Normal

α = 0,05

Penerimaan apabila $D_n < D_{tabel}$

$$D_n = \max(D_1, D_2)$$

$$D_n max = 0{,}1521$$

$$D_1 = max\left\{\phi\left(\frac{ti - \bar{t}}{s}\right) - \left(\frac{t-1}{n}\right)\right\}$$

$$D_1 = \left\{\phi\left(\frac{3{,}4012 - 4{,}1461}{0{,}47580}\right) - \left(\frac{1-1}{19}\right)\right\}$$

$$D_1 = \{\underbrace{\phi(-1{,}56)}_{\text{Dilihat dari tabel } \textit{standard normal probabilities}} - (0)\}$$

$$D_1 = 0{,}0587$$

$$D_2 = \left\{\left(\frac{i}{n}\right) - \phi\left(\frac{ti - \bar{t}}{s}\right)\right\}$$

$$D_2 = \left\{\left(\frac{1}{19}\right) - \phi\left(\frac{3{,}4012 - 4{,}1461}{0{,}47580}\right)\right\}$$

$$D_2 = \{(0{,}053) - \underline{\phi(-1{,}56)}\}$$

→ Dilihat dari tabel *standard normal probabilities*

$$D_2 = (0{,}053 - 0{,}0587) = -0{,}0061$$

$$s = \sqrt{\frac{\sum_{i=1}^{n}(3{,}4012 - 4{,}1461)^2}{19 - 1}}$$

$$s = 0{,}47580$$

$D_n max = 0{,}1521 < D_{tabel} = 0{,}301$→ Dilihat dari tabel nilai kritis *Kolmogorov-Smirnov*

$D_n max = 0{,}1521 < D_{tabel} = 0{,}301 :\ H_0\ diterima$

Maximum Likelihood Estimator

1. LogNormal mempunyai 3 parameter yaitu μ, s, dan t_{med}
   a. $\hat{\mu} = \frac{\sum_{i=1}^{n} ln\ ti}{n}$

      $$\hat{\mu} = \frac{146{,}3344}{39} = 3{,}7522$$

   b. $\hat{s} = \sqrt{\frac{\sum_{i=1}^{n}(lnti - \hat{u})^2}{n}}$

      $$\hat{s} = \sqrt{\frac{5{,}3723}{39}} = 0{,}371148$$

   c. $t_{med} = e^{\mu}$

      $$t_{med} = e^{3{,}7522} = 42{,}6132$$

2. LogNormal mempunyai 3 parameter yaitu μ, s, dan t_{med}

a. $\hat{\mu} = \frac{\sum_{i=1}^{n} ln\ ti}{n}$

$$\hat{\mu} = \frac{78{,}7751}{19} = 4{,}1461$$

b. $\hat{s} = \sqrt{\frac{\sum_{i=1}^{n} (lnti - \hat{u})^2}{n}}$

$$\hat{s} = \sqrt{\frac{4{,}3013}{19}} = 0{,}47580$$

c. $t_{med} = e^{\mu}$

$$t_{med} = e^{4{,}1461} = 63{,}1844$$

Penentuan Nilai Tengah dari Distribusi Data Antar Waktu Antar Perbaikan (*Mean Time to Repair*)

Menghitung nilai MTTR komponen pisau belah dan komponen *seal o-ring* yang sesuai dengan distribusi yang terpilih terhadap data *time to repair* sebagai berikut :

1. Komponen Pisau Belah (Log Normal)

MTTF = $t_{med} \,.\, e\frac{s^2}{2}$

$= 42{,}6132 * (\exp\frac{0{,}371148^2}{2})$

= 45,65163

2. Komponen Pisau Belah (Log Normal)

MTTF = $t_{med} \,.\, e\frac{s^2}{2}$

$= 63{,}1844 * (\exp\frac{0{,}47580^2}{2})$

= 70,75691

Model Perawatan Menggunakan Model Age Replacement

3. Perhitungan Model *Age Replacement* Komponen Pisau Belah

Data dari perhitungan yang telah dilakukan didapatkan hasil sebagai berkut :

MTTF = 53976,4

s = 1,21862

tmed = 25688

MTTR = 45,6516 = Tf = Tp

$$R(tp) = 1 - \phi\left(\frac{1}{s} ln \frac{tp}{t_{med}}\right)$$

$$R(53700) = 1 - \phi(\frac{1}{1{,}21862} \ln \frac{53700}{25688})$$

$$R(53700) = 0{,}272556$$

$$F(tp) = \phi\left(\frac{1}{s} ln \frac{tp}{t_{med}}\right)$$

$$F(53700) = \phi\left(\frac{1}{1{,}21862} \ln \frac{53700}{25688}\right) = 0{,}7274$$

$$M(tp) = M(53700) = \frac{MTTF}{F(tp)} = \frac{MTTF}{F(53600)} = \frac{53976{,}4}{0{,}7274} = 74245{,}74299$$

$$D(tp) = \frac{Tp * R(tp) + Tf * F(tp)}{(tp + Tp) * R(tp) + (M(tp) + Tf) * F(tp)}$$

$$D(tp) = \frac{45{,}6516 * 0{,}27556 + 45{,}6516 * 0{,}7274}{(53700 + 45{,}6516) * 0{,}27556 + (74245{,}74299) * 0{,}7274}$$

$$D(tp) = 0{,}00066491044$$

Diketahui :

Tf = waktu rata-rata perbaikan kerusakan komponen

Tp = waktu pergantian preventif

tp = panjang interval waktu antar tindakan preventif (variabel keputusan)

R(tp) = probabilitas terjadinya siklus pencegahan

F(tp) = probabilitas terjadinya siklus kerusakan

D(tp) = Total *Downtime* per unit waktu

4. Perhitungan Model *Age Replacement* Komponen *Seal O-Ring*

Data dari perhitungan yang telah dilakukan didapatkan hasil sebagai berkut :

MTTF = 84930,2
s = 1,12524
tmed = 88306,2
MTTR = 70,7569 = Tf = Tp

$$R(tp) = 1 - \phi\left(\frac{1}{s} ln \frac{tp}{t_{med}}\right)$$

$$R(151300) = 1 - \phi(\frac{1}{1,12524} \ln \frac{151300}{88306,2})$$

$$R(151300) = 0,31614$$

$$F(tp) = \phi\left(\frac{1}{s} ln \frac{tp}{t_{med}}\right)$$

$$F(151300) = \phi\left(\frac{1}{1,12524} \ln \frac{151300}{88306,2}\right) = 0,683862$$

$$M(tp) = M(151300) = \frac{MTTF}{F(tp)} = \frac{MTTF}{F(151300)} = \frac{84930,2}{0,683862} = 124262,8999$$

$$D(tp) = \frac{Tp * R(tp) + Tf * F(tp)}{(tp + Tp) * R(tp) + (M(tp) + Tf) * F(tp)}$$

$$D(tp) = \frac{70,7569 * 0,31614 + 70,7569 * 0,68386}{151370,7569 * 0,31614 + 124262,8999 * 0,68386}$$

$$D(tp) = 0,000532676725$$

. Interval Waktu Pemeriksaan Berdasarkan Downtime

3. Interval Waktu Pemeriksaan Berdasarkan *Downtime* Komponen Pisau Belah Waktu kerja produktif selama periode bulan Januari 2012 – Desember 2105 : 48 bulan. Total jam kerja produktif Januari 2012 – Desember 2015 adalah 2073600 menit.

Rata-rata jam kerja produktif 1 bulan yaitu $= \frac{2073600}{48} = 43200$ menit

Rata-rata jumlah kerusakan (k) tiap bulan :

c. Jumlah kerusakan periode Januari 2012 – Desember 2015 = 39 kerusakan

d. Rata – rata jumlah kerusakan setiap bulan $= \frac{39}{48} = 0,8$

Rasio jam kerja sebulan terhadap rata – rata waktu perbaikan (μ) adalah :

d. MTTR = 45,6516 menit
e. Rata – rata jam kerja per bulan = 43200 menit
f. $\mu = \frac{jam\ kerja\ per\ bulan}{MTTR} = \frac{43200}{45,6516} = 946,3$

Rasio jam kerja sebulan terhadap waktu pemeriksaan (1/i) :

d. Waktu rata – rata untuk melakukan pemeriksaan komponen berdasarkan wawancara = 45 menit
e. Rata – rata waktu pemeriksaan = $\frac{45}{43200} = 0,00104167$
f. $i = \frac{1}{0,00104167} = 960$ menit

Frekuensi pemeriksaan optimal tiap bulan :

$n = \sqrt{\frac{k*i}{\mu}} = \sqrt{\frac{0,8*960}{45,6516}} = 4,1 \approx 4$ kali per bulan

Interval waktu antar pemeriksaan

$= \frac{1}{n} x\ jam\ kerja\ produktif\ perbulan$

$= \frac{1}{4} x 43200 = 10800\ menit = 180\ jam$

4. Interval Waktu Pemeriksaan Berdasarkan *Downtime* Komponen *Seal O-ring*

Waktu kerja produktif selama periode bulan Januari 2012 – Desember 2105 : 48 bulan. Total jam kerja produktif Januari 2012 – Desember 2015 adalah 2073600 menit.

Rata-rata jam kerja produktif 1 bulan yaitu $= \frac{2073600}{48} = 43200$ menit

Rata-rata jumlah kerusakan (k) tiap bulan :

c. Jumlah kerusakan periode Januari 2012 – Desember 2015 = 19 kerusakan
d. Rata – rata jumlah kerusakan setiap bulan $= \frac{19}{48} = 0,4$

Rasio jam kerja sebulan terhadap rata – rata waktu perbaikan (μ) adalah :

d. MTTR = 70,7569 menit
e. Rata – rata jam kerja per bulan = 43200 menit
f. $\mu = \frac{jam\ kerja\ per\ bulan}{MTTR} = \frac{43200}{45,6516} = 946,3$

Rasio jam kerja sebulan terhadap waktu pemeriksaan (1/i) :

d. Waktu rata – rata untuk melakukan pemeriksaan komponen berdasarkan wawancara = 60 menit
e. Rata – rata waktu pemeriksaan = $\frac{60}{43200} = 0,0013889$
f. $i = \frac{1}{0,0013889} = 720$ menit

Frekuensi pemeriksaan optimal tiap bulan :

$n = \sqrt{\frac{k*i}{\mu}} = \sqrt{\frac{0,4*720}{70,7569}} = 2,01749 \approx 2$ kali per bulan

Interval waktu antar pemeriksaan

$= \frac{1}{n} x\ jam\ kerja\ produktif\ perbulan$

$= \frac{1}{2} x 43200 = 21600\ menit = 360\ jam$

Perbandingan *Reliability*

3. Perbandingan *Reliability* Komponen Pisau Belah

   Perbandingan *reliability* komponen pisau belah yaitu saat sebelum dilakukannya penggantian dan sesudah penggantian dilakukan.

   c. *Reliability* sebelum interval penggantian

   $$R(t) = exp\left[-\left(\frac{t}{t_{med}}\right)^{s}\right]$$

   $$R(t) = exp\left[-\left(\frac{53700}{25688{,}2}\right)^{1{,}218624}\right]$$

   $$R(t) = 0{,}0857636$$

   d. *Reliability* sesudah interval penggantian

   $$R(t-nT) = exp\left[-\left(\frac{t-nT}{t_{med}}\right)^{s}\right]$$

   $$R(t-nT) = exp\left[-\left(\frac{53700-1*53700}{25688{,}2}\right)^{1{,}218624}\right]$$

   $$R(t-nT) = 1$$

4. Perbandingan *Reliability* Komponen *Seal O-Ring*

   Perbandingan *reliability* komponen *seal o-ring* yaitu saat sebelum dilakukannya penggantian dan sesudah penggantian dilakukan.

   c. *Reliability* sebelum interval penggantian

   $$R(t) = exp\left[-\left(\frac{t}{t_{med}}\right)^{s}\right]$$

   $$R(t) = exp\left[-\left(\frac{151300}{88306{,}17}\right)^{1{,}125239}\right]$$

   $$R(t) = 0{,}1599517$$

   d. *Reliability* sesudah interval penggantian

   $$R(t-nT) = exp\left[-\left(\frac{t-nT}{t_{med}}\right)^{s}\right]$$

   $$R(t-nT) = exp\left[-\left(\frac{151300-1*151300}{88306{,}17}\right)^{1{,}125239}\right]$$

$$R(t - nT) = 1$$