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ANALYSIS OF INDUSTRIAL ENGINEERING USING WEIBULL DISTRIBUTION

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ABSTRACT

Industrial engineering is a profession that specializes in optimizing complex processes, systems or organizations. Industrial engineers contribute to more efficient production by developing, improving, and implementing integrated systems of people, money, knowledge, information, and equipment. Lot of responsibilities requires lot of efficiency. In this paper we explain how one should examined their system with the help of Weibull Distribution before start. We examined different situation with the help of numerical.

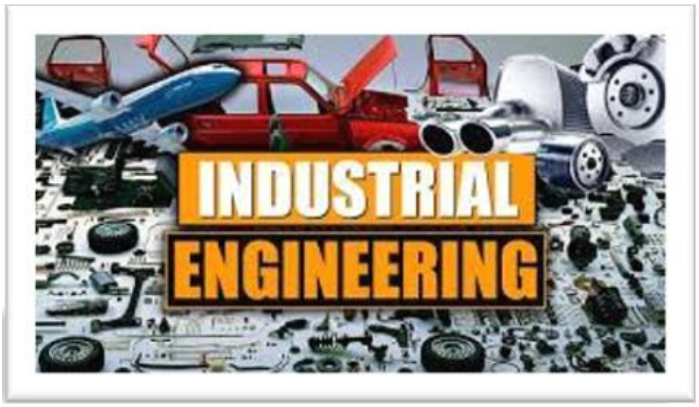
Keywords: Weibull Distribution, Probability Density Function, Reliability Function And Hazard Rate.

INTRODUCTION

A suggested method for modeling the life data for system components with multiple Weibull model failure modes was presented by **E. E. Elmahdy in 2015.** In order to reduce system failure intensity while working with limited financial and time resources, **M. Awad (2016)** suggested a new technique for allocating RGT time for both subsystems and the system level. Using a forward Weibull distribution on an arbitrary index with arbitrary auto-correlation. **R. I. Harris (2017)** expanded the earlier technique for producing correlated synthetic mean wind data with a Rayleigh parent. **F. Ducros & P. Pamphile (2018)** proposed a Bayesian bootstrap method, called Bayesian Restoration Maximization. The key is to provide a sampling from the posterior distribution. The impact of linearity in the Weibull plot on the precision of parameter estimate is covered by **K. Yasuda (2019).** On the basis of sparse data and professional judgment, **M. Compare et al. (2020)** created a Weibull Regression Model within the Bayesian probability framework to account for the influence of these covariates and estimate the model parameters with the associated uncertainty.

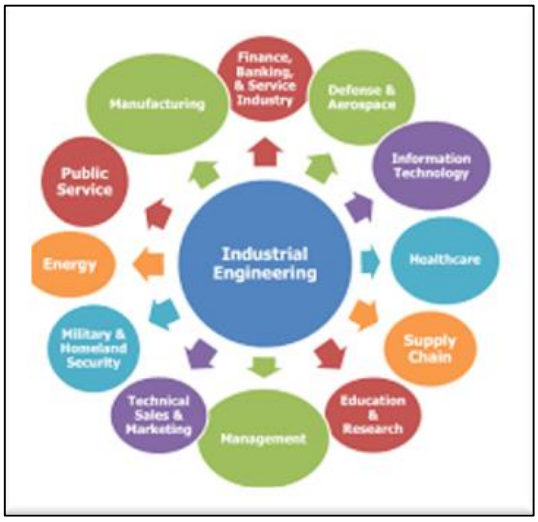
INDUSTRIAL ENGINEERING

Industrial engineering is a branch of engineering management that deals with how to improve or do things in various fields related to the production of industrial or consumer products. This includes increasing efficiency, reducing production costs, improving quality control, ensuring the health and safety of employees, Environmental protection, or compliance with government regulations.



Industrial engineering is used in a wide range of industries to enhance processes and procedures in order to reduce time and costs, as well as to guarantee quality and safety. industrial engineering is a field of study that focuses on a variety of topics, including business management, manufacturing, production, operations, systems and supply chains, ergonomics, logistics, and many more.

A variety of businesses employ industrial engineering to streamline processes and procedures in order to save time and money while maintaining quality and safety. In order to streamline operations and save time and money while preserving quality and safety, industrial engineering is applied. Industrial engineering combines specialized knowledge and abilities to study and assess company management, manufacturing, operations, systems and supply chain, human engineering, and logistics processes and systems.



New technologies like machine learning will play a bigger role in industrial engineering as it develops further. Industrial engineers are therefore highly sought after in a variety of different businesses.

ROLE OF RELIABILITY IN INDUSTRIAL ENGINEERING

A product, system, or service's reliability is a gauge of how likely it is for it to consistently execute the intended function over time. An engineering framework known as reliability engineering allows for the analysis of a product's capacity to carry out its essential activities under predetermined circumstances for a predetermined amount of time.

Companies must put in a lot of work if they want to succeed in today's economy. Reliability and a particularly reliable production process are just two of the numerous variables that influence success. On the other hand, this is influenced by outside forces, including rising consumer demand for dependable, high-quality goods. As a result, businesses are unable to calculate the amount of money they lose each month as a result of unstable production methods. Process dependability is a challenge, although there is room for improvement through significant cost reduction. To maintain stable operation of the production system, the dependability of the

manufacturing process is crucial. It can raise the caliber of the final product and lower manufacturing losses. Because of this, reliability is the article's main focus. A product's ability to be manufactured indicates that it is functional.

WEIBULL DITRIBUTION

The Weibull distribution is one of the most often utilized distributions in reliability engineering. It is a general distribution that may be created by deriving the shape parameter from other distributions.

This continuous probability distribution is used to model failure rates, examine life statistics, and determine product reliability. Large volumes of data from other disciplines, including economics, hydrology, biology, and engineering sciences, can also be used with it. A probability distribution's extreme values, which are frequently used to predict data like dependability, survival, and wind speed.

Distribution is only used because of its flexibility. This is due to the fact that it can replicate many distributions, such as normal and exponential. By using parameters, the Weibull distribution's dependability is evaluated. The Weibull probability density function (pdf) has two different iterations:

1. Two parameter pdf

2. Three parameter pdf

WEIBULL FORMULAS REGARDING DISTRIBUTION

The Weibull distribution can be used to model many different failure distributions. Given a shape parameter (β) and characteristic life (η) the reliability can be determined at a specific point in time (t). The two-parameter Weibull distribution probability density function, reliability functions and hazard rate are given by:

Probability Density Function: $f(t) = \left(\frac{\beta}{\eta}\right)\left(\frac{t}{\eta}\right)^{\beta-1} e^{-\left(\frac{t}{\eta}\right)^{\beta}}$

Reliability Function: $\boldsymbol{R(t)} = e^{-\left(\frac{t}{\eta}\right)^{\beta}}$

Hazard Rate: $\boldsymbol{h(t)} = \left(\frac{\beta}{\eta}\right)\left(\frac{t}{\eta}\right)^{\beta-1}$

The following shape parameter characteristics are noted:

β = 1.0 : Exponential distribution, constant failure rate
β = 3.5 : Normal distribution (approximation)
β < 1.0 : Decreasing failure (hazard) rate
β > 1.0 : Increasing failure (hazard) rate

NUMERICAL ANALYSIS

1. Let t denote the lifetime (in hundreds of hours) of any industrial department. Given

that t ~W(β,η), where β = 2.5, η = 700& time period of interest $t = 700$.

Calculation: Mean life = $\eta \times \Gamma\left(1 + \frac{1}{\beta}\right)$

Mean life = $700 \times \Gamma\left(1 + \frac{1}{700}\right) = 700 \times \Gamma(1.40) =$ **621** hours

Time (Hours)	R(t)	F(t)	f(t)	h(t) (Failures/Hour)
0.000000	1.000000	0.000000	0.000000	0.000000
5.468750	0.999995	0.000005	0.000002	0.000002
10.937500	0.999969	0.000031	0.000007	0.000007
16.406250	0.999916	0.000084	0.000013	0.000013

21.875000	0.999827	0.000173	0.000020	0.000020
27.343750	0.999698	0.000302	0.000028	0.000028
32.812500	0.999524	0.000476	0.000036	0.000036
38.281250	0.999301	0.000699	0.000046	0.000046
43.750000	0.999024	0.000976	0.000056	0.000056
49.218750	0.998690	0.001310	0.000066	0.000067
54.687500	0.998295	0.001705	0.000078	0.000078
60.156250	0.997837	0.002163	0.000090	0.000090
65.625000	0.997313	0.002687	0.000102	0.000103
71.093750	0.996718	0.003282	0.000115	0.000116
76.562500	0.996051	0.003949	0.000129	0.000129
82.031250	0.995310	0.004690	0.000143	0.000143
87.500000	0.994491	0.005509	0.000157	0.000158
92.968750	0.993592	0.006408	0.000172	0.000173
98.437500	0.992612	0.007388	0.000187	0.000188
103.906250	0.991547	0.008453	0.000203	0.000204
109.375000	0.990396	0.009604	0.000218	0.000221
114.843750	0.989157	0.010843	0.000235	0.000237
120.312500	0.987828	0.012172	0.000251	0.000254
125.781250	0.986407	0.013593	0.000268	0.000272
131.250000	0.984892	0.015108	0.000286	0.000290
136.718750	0.983283	0.016717	0.000303	0.000308
142.187500	0.981576	0.018424	0.000321	0.000327
147.656250	0.979772	0.020228	0.000339	0.000346
153.125000	0.977868	0.022132	0.000357	0.000365
158.593750	0.975863	0.024137	0.000376	0.000385
164.062500	0.973757	0.026243	0.000395	0.000405
169.531250	0.971547	0.028453	0.000414	0.000426
175.000000	0.969233	0.030767	0.000433	0.000446
180.468750	0.966814	0.033186	0.000452	0.000468
185.937500	0.964289	0.035711	0.000471	0.000489
191.406250	0.961657	0.038343	0.000491	0.000511
196.875000	0.958918	0.041082	0.000511	0.000533
202.343750	0.956070	0.043930	0.000531	0.000555

207.812500	0.953113	0.046887	0.000551	0.000578
213.281250	0.950048	0.049952	0.000571	0.000601
218.750000	0.946872	0.053128	0.000591	0.000624
224.218750	0.943586	0.056414	0.000611	0.000647
229.687500	0.940190	0.059810	0.000631	0.000671
235.156250	0.936683	0.063317	0.000651	0.000695
240.625000	0.933066	0.066934	0.000672	0.000720
246.093750	0.929337	0.070663	0.000692	0.000744
251.562500	0.925498	0.074502	0.000712	0.000769
257.031250	0.921549	0.078451	0.000732	0.000795
262.500000	0.917489	0.082511	0.000752	0.000820
267.968750	0.913319	0.086681	0.000773	0.000846
273.437500	0.909039	0.090961	0.000793	0.000872
278.906250	0.904650	0.095350	0.000813	0.000898
284.375000	0.900152	0.099848	0.000832	0.000925
289.843750	0.895545	0.104455	0.000852	0.000952
295.312500	0.890831	0.109169	0.000872	0.000979
300.781250	0.886010	0.113990	0.000891	0.001006
306.250000	0.881083	0.118917	0.000911	0.001033
311.718750	0.876051	0.123949	0.000930	0.001061
317.187500	0.870914	0.129086	0.000949	0.001089
322.656250	0.865674	0.134326	0.000968	0.001118
328.125000	0.860332	0.139668	0.000986	0.001146
333.593750	0.854889	0.145111	0.001004	0.001175
339.062500	0.849347	0.150653	0.001023	0.001204
344.531250	0.843705	0.156295	0.001040	0.001233
350.000000	0.837967	0.162033	0.001058	0.001263
355.468750	0.832133	0.167867	0.001075	0.001292
360.937500	0.826205	0.173795	0.001093	0.001322
366.406250	0.820184	0.179816	0.001109	0.001353
371.875000	0.814072	0.185928	0.001126	0.001383
377.343750	0.807871	0.192129	0.001142	0.001414
382.812500	0.801583	0.198417	0.001158	0.001444
388.281250	0.795209	0.204791	0.001173	0.001475

393.750000	0.788751	0.211249	0.001188	0.001507
399.218750	0.782211	0.217789	0.001203	0.001538
404.687500	0.775592	0.224408	0.001218	0.001570
410.156250	0.768894	0.231106	0.001232	0.001602
415.625000	0.762121	0.237879	0.001245	0.001634
421.093750	0.755275	0.244725	0.001259	0.001666
426.562500	0.748357	0.251643	0.001271	0.001699
432.031250	0.741370	0.258630	0.001284	0.001732
437.500000	0.734316	0.265684	0.001296	0.001765
442.968750	0.727197	0.272803	0.001307	0.001798
448.437500	0.720017	0.279983	0.001319	0.001831
453.906250	0.712777	0.287223	0.001329	0.001865
459.375000	0.705479	0.294521	0.001339	0.001899
464.843750	0.698127	0.301873	0.001349	0.001933
470.312500	0.690723	0.309277	0.001359	0.001967
475.781250	0.683269	0.316731	0.001367	0.002001
481.250000	0.675768	0.324232	0.001376	0.002036
486.718750	0.668222	0.331778	0.001384	0.002071
492.187500	0.660635	0.339365	0.001391	0.002106
497.656250	0.653008	0.346992	0.001398	0.002141
503.125000	0.645345	0.354655	0.001404	0.002176
508.593750	0.637648	0.362352	0.001410	0.002212
514.062500	0.629920	0.370080	0.001416	0.002248
519.531250	0.622164	0.377836	0.001421	0.002284
525.000000	0.614381	0.385619	0.001425	0.002320
530.468750	0.606576	0.393424	0.001429	0.002356
535.937500	0.598751	0.401249	0.001433	0.002393
541.406250	0.590909	0.409091	0.001435	0.002429
546.875000	0.583052	0.416948	0.001438	0.002466
552.343750	0.575182	0.424818	0.001440	0.002503
557.812500	0.567304	0.432696	0.001441	0.002541
563.281250	0.559420	0.440580	0.001442	0.002578
568.750000	0.551531	0.448469	0.001443	0.002616
574.218750	0.543642	0.456358	0.001443	0.002653

579.687500	0.535755	0.464245	0.001442	0.002691
585.156250	0.527871	0.472129	0.001441	0.002730
590.625000	0.519996	0.480004	0.001439	0.002768
596.093750	0.512130	0.487870	0.001437	0.002807
601.562500	0.504276	0.495724	0.001435	0.002845
607.031250	0.496438	0.503562	0.001432	0.002884
612.500000	0.488617	0.511383	0.001428	0.002923
617.968750	0.480816	0.519184	0.001424	0.002962
623.437500	0.473039	0.526961	0.001420	0.003002
628.906250	0.465286	0.534714	0.001415	0.003041
634.375000	0.457562	0.542438	0.001410	0.003081
639.843750	0.449867	0.550133	0.001404	0.003121
645.312500	0.442205	0.557795	0.001398	0.003161
650.781250	0.434578	0.565422	0.001391	0.003201
656.250000	0.426989	0.573011	0.001384	0.003242
661.718750	0.419439	0.580561	0.001377	0.003283
667.187500	0.411931	0.588069	0.001369	0.003323
672.656250	0.404467	0.595533	0.001361	0.003364
678.125000	0.397049	0.602951	0.001352	0.003405
683.593750	0.389679	0.610321	0.001343	0.003447
689.062500	0.382359	0.617641	0.001334	0.003488
694.531250	0.375092	0.624908	0.001324	0.003530
700.000000	0.367879	0.632121	0.001314	0.003571
705.468750	0.360723	0.639277	0.001303	0.003613
710.937500	0.353624	0.646376	0.001293	0.003655
716.406250	0.346585	0.653415	0.001282	0.003698
721.875000	0.339607	0.660393	0.001270	0.003740
727.343750	0.332693	0.667307	0.001258	0.003783
732.812500	0.325843	0.674157	0.001247	0.003825
738.281250	0.319060	0.680940	0.001234	0.003868
743.750000	0.312344	0.687656	0.001222	0.003911
749.218750	0.305698	0.694302	0.001209	0.003955
754.687500	0.299122	0.700878	0.001196	0.003998
760.156250	0.292618	0.707382	0.001183	0.004042

765.625000	0.286187	0.713813	0.001169	0.004085
771.093750	0.279831	0.720169	0.001155	0.004129
776.562500	0.273550	0.726450	0.001142	0.004173
782.031250	0.267345	0.732655	0.001127	0.004217
787.500000	0.261219	0.738781	0.001113	0.004262
792.968750	0.255170	0.744830	0.001099	0.004306
798.437500	0.249201	0.750799	0.001084	0.004351
803.906250	0.243312	0.756688	0.001069	0.004395
809.375000	0.237504	0.762496	0.001055	0.004440
814.843750	0.231777	0.768223	0.001040	0.004485
820.312500	0.226133	0.773867	0.001025	0.004531
825.781250	0.220572	0.779428	0.001009	0.004576
831.250000	0.215094	0.784906	0.000994	0.004622
836.718750	0.209699	0.790301	0.000979	0.004667
842.187500	0.204389	0.795611	0.000963	0.004713
847.656250	0.199163	0.800837	0.000948	0.004759
853.125000	0.194022	0.805978	0.000932	0.004805
858.593750	0.188966	0.811034	0.000917	0.004852
864.062500	0.183995	0.816005	0.000901	0.004898
869.531250	0.179109	0.820891	0.000886	0.004945
875.000000	0.174309	0.825691	0.000870	0.004991
880.468750	0.169593	0.830407	0.000854	0.005038
885.937500	0.164963	0.835037	0.000839	0.005085
891.406250	0.160418	0.839582	0.000823	0.005132
896.875000	0.155958	0.844042	0.000808	0.005180
902.343750	0.151583	0.848417	0.000792	0.005227
907.812500	0.147292	0.852708	0.000777	0.005275
913.281250	0.143085	0.856915	0.000762	0.005322
918.750000	0.138963	0.861037	0.000746	0.005370
924.218750	0.134923	0.865077	0.000731	0.005418
929.687500	0.130967	0.869033	0.000716	0.005466
935.156250	0.127093	0.872907	0.000701	0.005515
940.625000	0.123301	0.876699	0.000686	0.005563
946.093750	0.119590	0.880410	0.000671	0.005612

951.562500	0.115960	0.884040	0.000656	0.005660
957.031250	0.112411	0.887589	0.000642	0.005709
962.500000	0.108940	0.891060	0.000627	0.005758
967.968750	0.105549	0.894451	0.000613	0.005807
973.437500	0.102236	0.897764	0.000599	0.005857
978.906250	0.099000	0.901000	0.000585	0.005906
984.375000	0.095840	0.904160	0.000571	0.005956
989.843750	0.092756	0.907244	0.000557	0.006005
995.312500	0.089747	0.910253	0.000543	0.006055
1,000.781250	0.086812	0.913188	0.000530	0.006105
1,006.250000	0.083950	0.916050	0.000517	0.006155
1,011.718750	0.081160	0.918840	0.000504	0.006206
1,017.187500	0.078441	0.921559	0.000491	0.006256
1,022.656250	0.075792	0.924208	0.000478	0.006307
1,028.125000	0.073213	0.926787	0.000465	0.006357
1,033.593750	0.070701	0.929299	0.000453	0.006408
1,039.062500	0.068257	0.931743	0.000441	0.006459
1,044.531250	0.065879	0.934121	0.000429	0.006510
1,050.000000	0.063566	0.936434	0.000417	0.006561
1,055.468750	0.061317	0.938683	0.000405	0.006612
1,060.937500	0.059131	0.940869	0.000394	0.006664
1,066.406250	0.057007	0.942993	0.000383	0.006716
1,071.875000	0.054943	0.945057	0.000372	0.006767
1,077.343750	0.052940	0.947060	0.000361	0.006819
1,082.812500	0.050995	0.949005	0.000350	0.006871
1,088.281250	0.049107	0.950893	0.000340	0.006923
1,093.750000	0.047276	0.952724	0.000330	0.006975
1,099.218750	0.045500	0.954500	0.000320	0.007028
1,104.687500	0.043778	0.956222	0.000310	0.007080
1,110.156250	0.042109	0.957891	0.000300	0.007133
1,115.625000	0.040492	0.959508	0.000291	0.007186
1,121.093750	0.038926	0.961074	0.000282	0.007239
1,126.562500	0.037410	0.962590	0.000273	0.007292
1,132.031250	0.035942	0.964058	0.000264	0.007345

1,137.500000	0.034522	0.965478	0.000255	0.007398
1,142.968750	0.033149	0.966851	0.000247	0.007452
1,148.437500	0.031820	0.968180	0.000239	0.007505
1,153.906250	0.030536	0.969464	0.000231	0.007559
1,159.375000	0.029295	0.970705	0.000223	0.007613
1,164.843750	0.028097	0.971903	0.000215	0.007666
1,170.312500	0.026939	0.973061	0.000208	0.007721
1,175.781250	0.025822	0.974178	0.000201	0.007775
1,181.250000	0.024743	0.975257	0.000194	0.007829
1,186.718750	0.023702	0.976298	0.000187	0.007883
1,192.187500	0.022699	0.977301	0.000180	0.007938
1,197.656250	0.021731	0.978269	0.000174	0.007993
1,203.125000	0.020799	0.979201	0.000167	0.008048
1,208.593750	0.019900	0.980100	0.000161	0.008102
1,214.062500	0.019035	0.980965	0.000155	0.008157
1,219.531250	0.018202	0.981798	0.000149	0.008213
1,225.000000	0.017400	0.982600	0.000144	0.008268
1,230.468750	0.016628	0.983372	0.000138	0.008323
1,235.937500	0.015886	0.984114	0.000133	0.008379
1,241.406250	0.015172	0.984828	0.000128	0.008435
1,246.875000	0.014486	0.985514	0.000123	0.008490
1,252.343750	0.013826	0.986174	0.000118	0.008546
1,257.812500	0.013193	0.986807	0.000113	0.008602
1,263.281250	0.012585	0.987415	0.000109	0.008659
1,268.750000	0.012001	0.987999	0.000105	0.008715
1,274.218750	0.011441	0.988559	0.000100	0.008771
1,279.687500	0.010903	0.989097	0.000096	0.008828
1,285.156250	0.010388	0.989612	0.000092	0.008884
1,290.625000	0.009893	0.990107	0.000088	0.008941
1,296.093750	0.009420	0.990580	0.000085	0.008998
1,301.562500	0.008966	0.991034	0.000081	0.009055
1,307.031250	0.008532	0.991468	0.000078	0.009112
1,312.500000	0.008116	0.991884	0.000074	0.009169
1,317.968750	0.007717	0.992283	0.000071	0.009227

1,323.437500	0.007337	0.992663	0.000068	0.009284
1,328.906250	0.006972	0.993028	0.000065	0.009342
1,334.375000	0.006624	0.993376	0.000062	0.009400
1,339.843750	0.006291	0.993709	0.000059	0.009457
1,345.312500	0.005973	0.994027	0.000057	0.009515
1,350.781250	0.005669	0.994331	0.000054	0.009574
1,356.250000	0.005379	0.994621	0.000052	0.009632
1,361.718750	0.005102	0.994898	0.000049	0.009690
1,367.187500	0.004838	0.995162	0.000047	0.009748
1,372.656250	0.004586	0.995414	0.000045	0.009807
1,378.125000	0.004346	0.995654	0.000043	0.009866
1,383.593750	0.004117	0.995883	0.000041	0.009924
1,389.062500	0.003899	0.996101	0.000039	0.009983
1,394.531250	0.003691	0.996309	0.000037	0.010042

Table 1

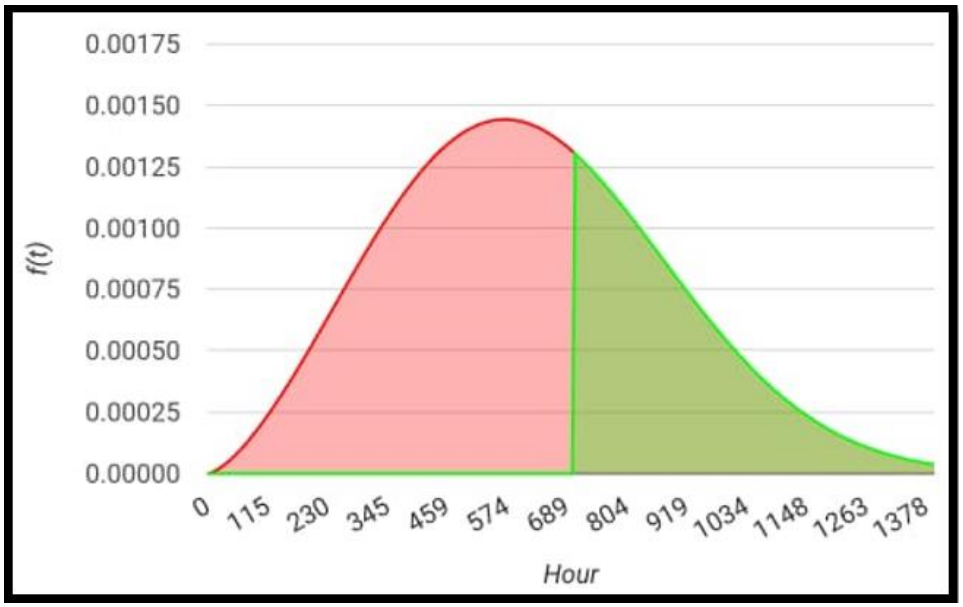


Fig 1: Probability Density Function, $f(t), R(700) = 0.367879$

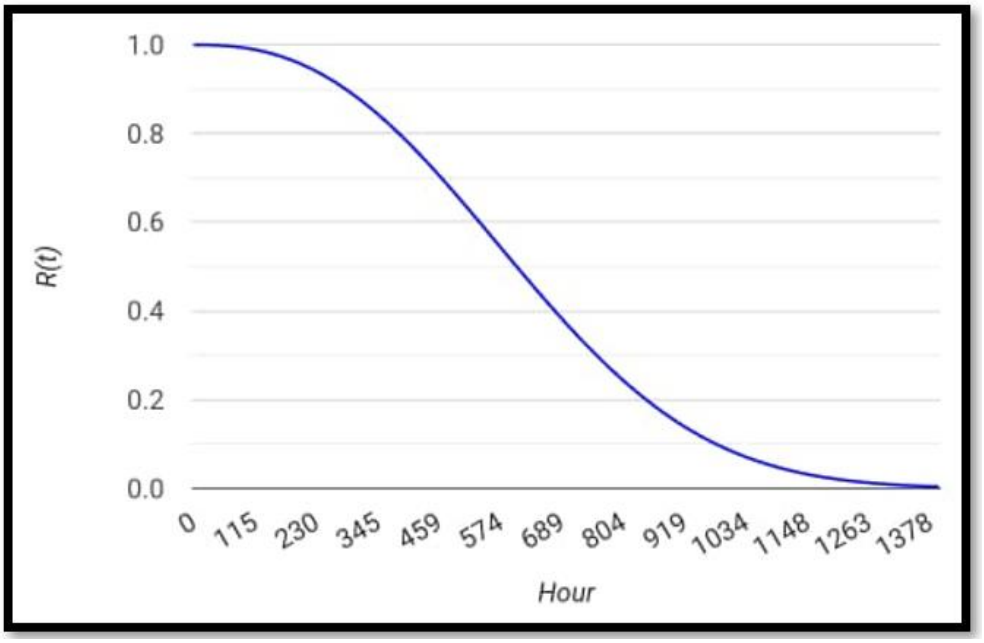


Fig 2: Reliability $R(t)$

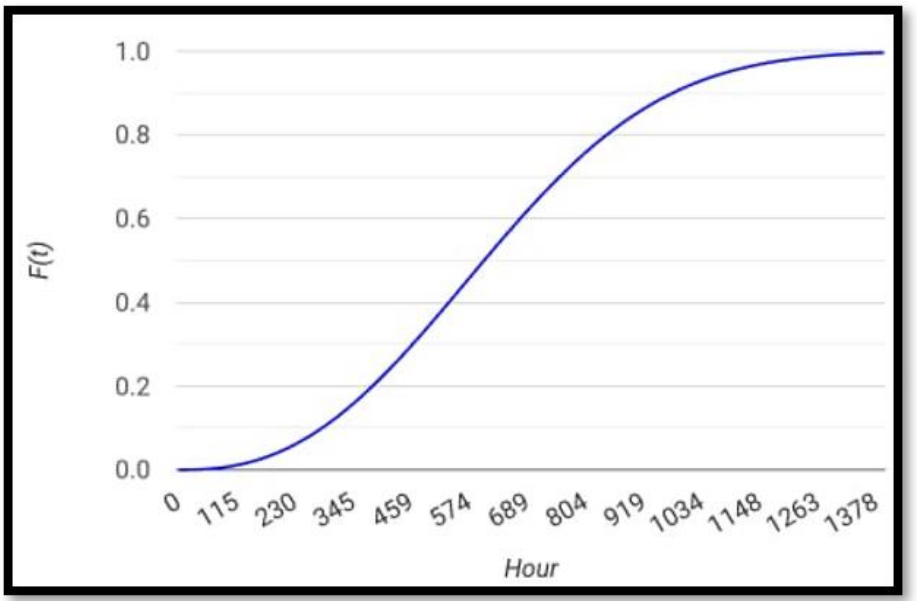


Fig 3: Unreliability $F(t)$

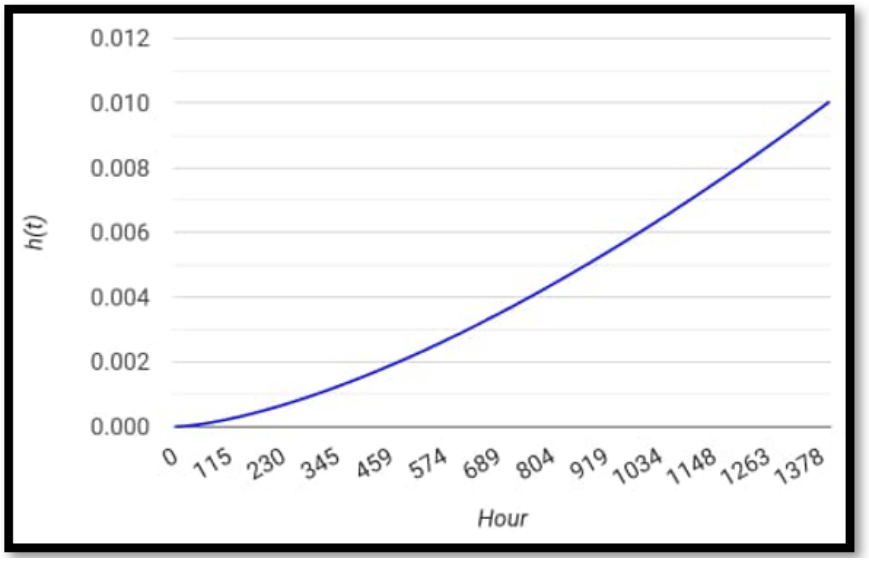


Fig 4: Hazard Rate $h(t) = f(t)/R(t)$

2. Let t denote the lifetime (in hundreds of hours) of any industrial department. Given that t ~ W(β, η), where β = 2.5, η = 700& time period of interest $t = 200$.

Calculation: Mean life = $\eta \times \Gamma\left(1 + \frac{1}{\beta}\right)$

Mean life = $700 \times \Gamma\left(1 + \frac{1}{700}\right) = 700 \times \Gamma(1.40) =$ **621** hours

Time (Hours)	R(t)	F(t)	f(t)	h(t) (Failures/Hour)
0.000000	1.000000	0.000000	0.000000	0.000000
5.468750	0.999995	0.000005	0.000002	0.000002
10.937500	0.999969	0.000031	0.000007	0.000007
16.406250	0.999916	0.000084	0.000013	0.000013
21.875000	0.999827	0.000173	0.000020	0.000020
27.343750	0.999698	0.000302	0.000028	0.000028
32.812500	0.999524	0.000476	0.000036	0.000036
38.281250	0.999301	0.000699	0.000046	0.000046
43.750000	0.999024	0.000976	0.000056	0.000056
49.218750	0.998690	0.001310	0.000066	0.000067
54.687500	0.998295	0.001705	0.000078	0.000078
60.156250	0.997837	0.002163	0.000090	0.000090
65.625000	0.997313	0.002687	0.000102	0.000103
71.093750	0.996718	0.003282	0.000115	0.000116
76.562500	0.996051	0.003949	0.000129	0.000129

82.031250	0.995310	0.004690	0.000143	0.000143
87.500000	0.994491	0.005509	0.000157	0.000158
92.968750	0.993592	0.006408	0.000172	0.000173
98.437500	0.992612	0.007388	0.000187	0.000188
103.906250	0.991547	0.008453	0.000203	0.000204
109.375000	0.990396	0.009604	0.000218	0.000221
114.843750	0.989157	0.010843	0.000235	0.000237
120.312500	0.987828	0.012172	0.000251	0.000254
125.781250	0.986407	0.013593	0.000268	0.000272
131.250000	0.984892	0.015108	0.000286	0.000290
136.718750	0.983283	0.016717	0.000303	0.000308
142.187500	0.981576	0.018424	0.000321	0.000327
147.656250	0.979772	0.020228	0.000339	0.000346
153.125000	0.977868	0.022132	0.000357	0.000365
158.593750	0.975863	0.024137	0.000376	0.000385
164.062500	0.973757	0.026243	0.000395	0.000405
169.531250	0.971547	0.028453	0.000414	0.000426
175.000000	0.969233	0.030767	0.000433	0.000446
180.468750	0.966814	0.033186	0.000452	0.000468
185.937500	0.964289	0.035711	0.000471	0.000489
191.406250	0.961657	0.038343	0.000491	0.000511
196.875000	0.958918	0.041082	0.000511	0.000533
202.343750	0.956070	0.043930	0.000531	0.000555
207.812500	0.953113	0.046887	0.000551	0.000578
213.281250	0.950048	0.049952	0.000571	0.000601
218.750000	0.946872	0.053128	0.000591	0.000624
224.218750	0.943586	0.056414	0.000611	0.000647
229.687500	0.940190	0.059810	0.000631	0.000671
235.156250	0.936683	0.063317	0.000651	0.000695
240.625000	0.933066	0.066934	0.000672	0.000720
246.093750	0.929337	0.070663	0.000692	0.000744
251.562500	0.925498	0.074502	0.000712	0.000769
257.031250	0.921549	0.078451	0.000732	0.000795
262.500000	0.917489	0.082511	0.000752	0.000820

267.968750	0.913319	0.086681	0.000773	0.000846
273.437500	0.909039	0.090961	0.000793	0.000872
278.906250	0.904650	0.095350	0.000813	0.000898
284.375000	0.900152	0.099848	0.000832	0.000925
289.843750	0.895545	0.104455	0.000852	0.000952
295.312500	0.890831	0.109169	0.000872	0.000979
300.781250	0.886010	0.113990	0.000891	0.001006
306.250000	0.881083	0.118917	0.000911	0.001033
311.718750	0.876051	0.123949	0.000930	0.001061
317.187500	0.870914	0.129086	0.000949	0.001089
322.656250	0.865674	0.134326	0.000968	0.001118
328.125000	0.860332	0.139668	0.000986	0.001146
333.593750	0.854889	0.145111	0.001004	0.001175
339.062500	0.849347	0.150653	0.001023	0.001204
344.531250	0.843705	0.156295	0.001040	0.001233
350.000000	0.837967	0.162033	0.001058	0.001263
355.468750	0.832133	0.167867	0.001075	0.001292
360.937500	0.826205	0.173795	0.001093	0.001322
366.406250	0.820184	0.179816	0.001109	0.001353
371.875000	0.814072	0.185928	0.001126	0.001383
377.343750	0.807871	0.192129	0.001142	0.001414
382.812500	0.801583	0.198417	0.001158	0.001444
388.281250	0.795209	0.204791	0.001173	0.001475
393.750000	0.788751	0.211249	0.001188	0.001507
399.218750	0.782211	0.217789	0.001203	0.001538
404.687500	0.775592	0.224408	0.001218	0.001570
410.156250	0.768894	0.231106	0.001232	0.001602
415.625000	0.762121	0.237879	0.001245	0.001634
421.093750	0.755275	0.244725	0.001259	0.001666
426.562500	0.748357	0.251643	0.001271	0.001699
432.031250	0.741370	0.258630	0.001284	0.001732
437.500000	0.734316	0.265684	0.001296	0.001765
442.968750	0.727197	0.272803	0.001307	0.001798
448.437500	0.720017	0.279983	0.001319	0.001831

453.906250	0.712777	0.287223	0.001329	0.001865
459.375000	0.705479	0.294521	0.001339	0.001899
464.843750	0.698127	0.301873	0.001349	0.001933
470.312500	0.690723	0.309277	0.001359	0.001967
475.781250	0.683269	0.316731	0.001367	0.002001
481.250000	0.675768	0.324232	0.001376	0.002036
486.718750	0.668222	0.331778	0.001384	0.002071
492.187500	0.660635	0.339365	0.001391	0.002106
497.656250	0.653008	0.346992	0.001398	0.002141
503.125000	0.645345	0.354655	0.001404	0.002176
508.593750	0.637648	0.362352	0.001410	0.002212
514.062500	0.629920	0.370080	0.001416	0.002248
519.531250	0.622164	0.377836	0.001421	0.002284
525.000000	0.614381	0.385619	0.001425	0.002320
530.468750	0.606576	0.393424	0.001429	0.002356
535.937500	0.598751	0.401249	0.001433	0.002393
541.406250	0.590909	0.409091	0.001435	0.002429
546.875000	0.583052	0.416948	0.001438	0.002466
552.343750	0.575182	0.424818	0.001440	0.002503
557.812500	0.567304	0.432696	0.001441	0.002541
563.281250	0.559420	0.440580	0.001442	0.002578
568.750000	0.551531	0.448469	0.001443	0.002616
574.218750	0.543642	0.456358	0.001443	0.002653
579.687500	0.535755	0.464245	0.001442	0.002691
585.156250	0.527871	0.472129	0.001441	0.002730
590.625000	0.519996	0.480004	0.001439	0.002768
596.093750	0.512130	0.487870	0.001437	0.002807
601.562500	0.504276	0.495724	0.001435	0.002845
607.031250	0.496438	0.503562	0.001432	0.002884
612.500000	0.488617	0.511383	0.001428	0.002923
617.968750	0.480816	0.519184	0.001424	0.002962
623.437500	0.473039	0.526961	0.001420	0.003002
628.906250	0.465286	0.534714	0.001415	0.003041
634.375000	0.457562	0.542438	0.001410	0.003081

639.843750	0.449867	0.550133	0.001404	0.003121
645.312500	0.442205	0.557795	0.001398	0.003161
650.781250	0.434578	0.565422	0.001391	0.003201
656.250000	0.426989	0.573011	0.001384	0.003242
661.718750	0.419439	0.580561	0.001377	0.003283
667.187500	0.411931	0.588069	0.001369	0.003323
672.656250	0.404467	0.595533	0.001361	0.003364
678.125000	0.397049	0.602951	0.001352	0.003405
683.593750	0.389679	0.610321	0.001343	0.003447
689.062500	0.382359	0.617641	0.001334	0.003488
694.531250	0.375092	0.624908	0.001324	0.003530
700.000000	0.367879	0.632121	0.001314	0.003571
705.468750	0.360723	0.639277	0.001303	0.003613
710.937500	0.353624	0.646376	0.001293	0.003655
716.406250	0.346585	0.653415	0.001282	0.003698
721.875000	0.339607	0.660393	0.001270	0.003740
727.343750	0.332693	0.667307	0.001258	0.003783
732.812500	0.325843	0.674157	0.001247	0.003825
738.281250	0.319060	0.680940	0.001234	0.003868
743.750000	0.312344	0.687656	0.001222	0.003911
749.218750	0.305698	0.694302	0.001209	0.003955
754.687500	0.299122	0.700878	0.001196	0.003998
760.156250	0.292618	0.707382	0.001183	0.004042
765.625000	0.286187	0.713813	0.001169	0.004085
771.093750	0.279831	0.720169	0.001155	0.004129
776.562500	0.273550	0.726450	0.001142	0.004173
782.031250	0.267345	0.732655	0.001127	0.004217
787.500000	0.261219	0.738781	0.001113	0.004262
792.968750	0.255170	0.744830	0.001099	0.004306
798.437500	0.249201	0.750799	0.001084	0.004351
803.906250	0.243312	0.756688	0.001069	0.004395
809.375000	0.237504	0.762496	0.001055	0.004440
814.843750	0.231777	0.768223	0.001040	0.004485
820.312500	0.226133	0.773867	0.001025	0.004531

825.781250	0.220572	0.779428	0.001009	0.004576
831.250000	0.215094	0.784906	0.000994	0.004622
836.718750	0.209699	0.790301	0.000979	0.004667
842.187500	0.204389	0.795611	0.000963	0.004713
847.656250	0.199163	0.800837	0.000948	0.004759
853.125000	0.194022	0.805978	0.000932	0.004805
858.593750	0.188966	0.811034	0.000917	0.004852
864.062500	0.183995	0.816005	0.000901	0.004898
869.531250	0.179109	0.820891	0.000886	0.004945
875.000000	0.174309	0.825691	0.000870	0.004991
880.468750	0.169593	0.830407	0.000854	0.005038
885.937500	0.164963	0.835037	0.000839	0.005085
891.406250	0.160418	0.839582	0.000823	0.005132
896.875000	0.155958	0.844042	0.000808	0.005180
902.343750	0.151583	0.848417	0.000792	0.005227
907.812500	0.147292	0.852708	0.000777	0.005275
913.281250	0.143085	0.856915	0.000762	0.005322
918.750000	0.138963	0.861037	0.000746	0.005370
924.218750	0.134923	0.865077	0.000731	0.005418
929.687500	0.130967	0.869033	0.000716	0.005466
935.156250	0.127093	0.872907	0.000701	0.005515
940.625000	0.123301	0.876699	0.000686	0.005563
946.093750	0.119590	0.880410	0.000671	0.005612
951.562500	0.115960	0.884040	0.000656	0.005660
957.031250	0.112411	0.887589	0.000642	0.005709
962.500000	0.108940	0.891060	0.000627	0.005758
967.968750	0.105549	0.894451	0.000613	0.005807
973.437500	0.102236	0.897764	0.000599	0.005857
978.906250	0.099000	0.901000	0.000585	0.005906
984.375000	0.095840	0.904160	0.000571	0.005956
989.843750	0.092756	0.907244	0.000557	0.006005
995.312500	0.089747	0.910253	0.000543	0.006055
1,000.781250	0.086812	0.913188	0.000530	0.006105
1,006.250000	0.083950	0.916050	0.000517	0.006155

1,011.718750	0.081160	0.918840	0.000504	0.006206
1,017.187500	0.078441	0.921559	0.000491	0.006256
1,022.656250	0.075792	0.924208	0.000478	0.006307
1,028.125000	0.073213	0.926787	0.000465	0.006357
1,033.593750	0.070701	0.929299	0.000453	0.006408
1,039.062500	0.068257	0.931743	0.000441	0.006459
1,044.531250	0.065879	0.934121	0.000429	0.006510
1,050.000000	0.063566	0.936434	0.000417	0.006561
1,055.468750	0.061317	0.938683	0.000405	0.006612
1,060.937500	0.059131	0.940869	0.000394	0.006664
1,066.406250	0.057007	0.942993	0.000383	0.006716
1,071.875000	0.054943	0.945057	0.000372	0.006767
1,077.343750	0.052940	0.947060	0.000361	0.006819
1,082.812500	0.050995	0.949005	0.000350	0.006871
1,088.281250	0.049107	0.950893	0.000340	0.006923
1,093.750000	0.047276	0.952724	0.000330	0.006975
1,099.218750	0.045500	0.954500	0.000320	0.007028
1,104.687500	0.043778	0.956222	0.000310	0.007080
1,110.156250	0.042109	0.957891	0.000300	0.007133
1,115.625000	0.040492	0.959508	0.000291	0.007186
1,121.093750	0.038926	0.961074	0.000282	0.007239
1,126.562500	0.037410	0.962590	0.000273	0.007292
1,132.031250	0.035942	0.964058	0.000264	0.007345
1,137.500000	0.034522	0.965478	0.000255	0.007398
1,142.968750	0.033149	0.966851	0.000247	0.007452
1,148.437500	0.031820	0.968180	0.000239	0.007505
1,153.906250	0.030536	0.969464	0.000231	0.007559
1,159.375000	0.029295	0.970705	0.000223	0.007613
1,164.843750	0.028097	0.971903	0.000215	0.007666
1,170.312500	0.026939	0.973061	0.000208	0.007721
1,175.781250	0.025822	0.974178	0.000201	0.007775
1,181.250000	0.024743	0.975257	0.000194	0.007829
1,186.718750	0.023702	0.976298	0.000187	0.007883
1,192.187500	0.022699	0.977301	0.000180	0.007938

1,197.656250	0.021731	0.978269	0.000174	0.007993
1,203.125000	0.020799	0.979201	0.000167	0.008048
1,208.593750	0.019900	0.980100	0.000161	0.008102
1,214.062500	0.019035	0.980965	0.000155	0.008157
1,219.531250	0.018202	0.981798	0.000149	0.008213
1,225.000000	0.017400	0.982600	0.000144	0.008268
1,230.468750	0.016628	0.983372	0.000138	0.008323
1,235.937500	0.015886	0.984114	0.000133	0.008379
1,241.406250	0.015172	0.984828	0.000128	0.008435
1,246.875000	0.014486	0.985514	0.000123	0.008490
1,252.343750	0.013826	0.986174	0.000118	0.008546
1,257.812500	0.013193	0.986807	0.000113	0.008602
1,263.281250	0.012585	0.987415	0.000109	0.008659
1,268.750000	0.012001	0.987999	0.000105	0.008715
1,274.218750	0.011441	0.988559	0.000100	0.008771
1,279.687500	0.010903	0.989097	0.000096	0.008828
1,285.156250	0.010388	0.989612	0.000092	0.008884
1,290.625000	0.009893	0.990107	0.000088	0.008941
1,296.093750	0.009420	0.990580	0.000085	0.008998
1,301.562500	0.008966	0.991034	0.000081	0.009055
1,307.031250	0.008532	0.991468	0.000078	0.009112
1,312.500000	0.008116	0.991884	0.000074	0.009169
1,317.968750	0.007717	0.992283	0.000071	0.009227
1,323.437500	0.007337	0.992663	0.000068	0.009284
1,328.906250	0.006972	0.993028	0.000065	0.009342
1,334.375000	0.006624	0.993376	0.000062	0.009400
1,339.843750	0.006291	0.993709	0.000059	0.009457
1,345.312500	0.005973	0.994027	0.000057	0.009515
1,350.781250	0.005669	0.994331	0.000054	0.009574
1,356.250000	0.005379	0.994621	0.000052	0.009632
1,361.718750	0.005102	0.994898	0.000049	0.009690
1,367.187500	0.004838	0.995162	0.000047	0.009748
1,372.656250	0.004586	0.995414	0.000045	0.009807
1,378.125000	0.004346	0.995654	0.000043	0.009866

1,383.593750	0.004117	0.995883	0.000041	0.009924
1,389.062500	0.003899	0.996101	0.000039	0.009983
1,394.531250	0.003691	0.996309	0.000037	0.010042

Table 2

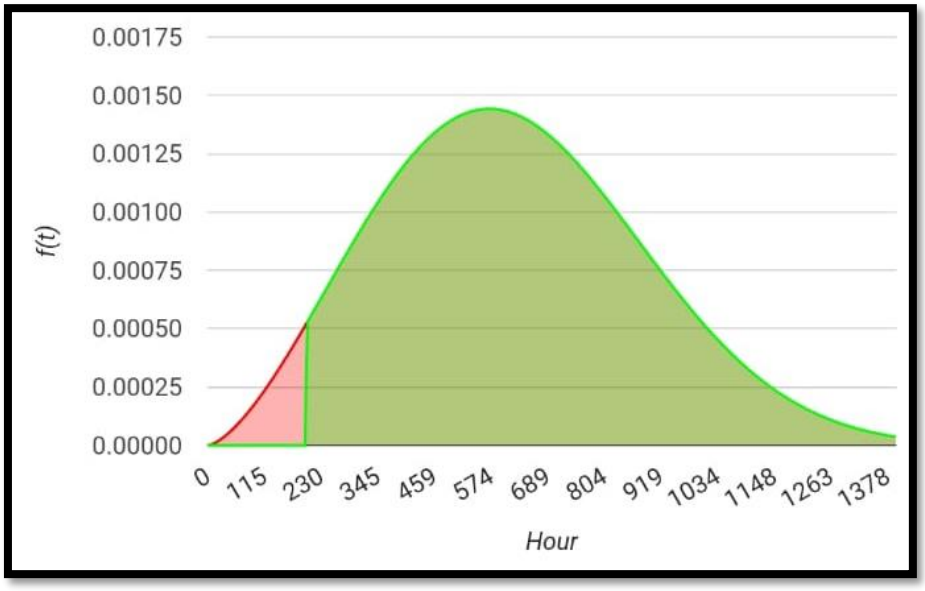


Fig 5: Probability Density Function, $f(t), R(200) = 0.957304$

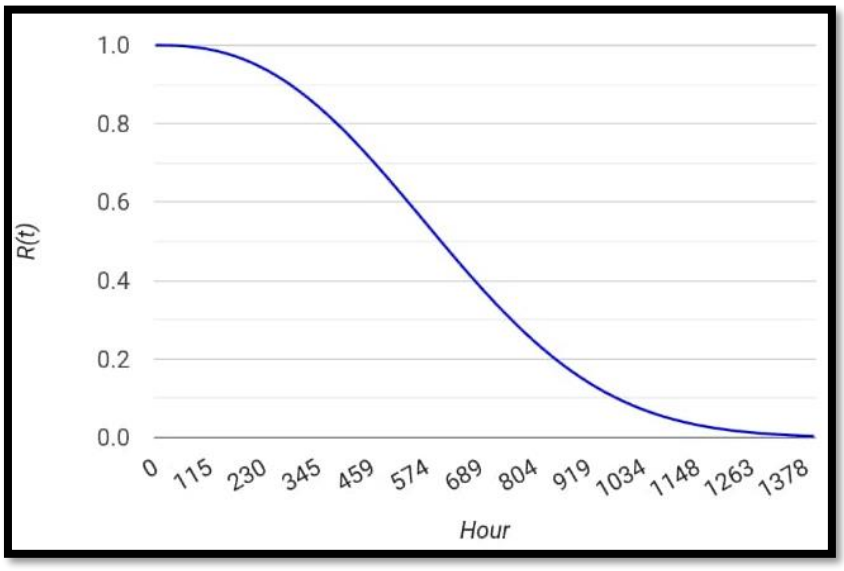


Fig 6: Reliability $R(t)$

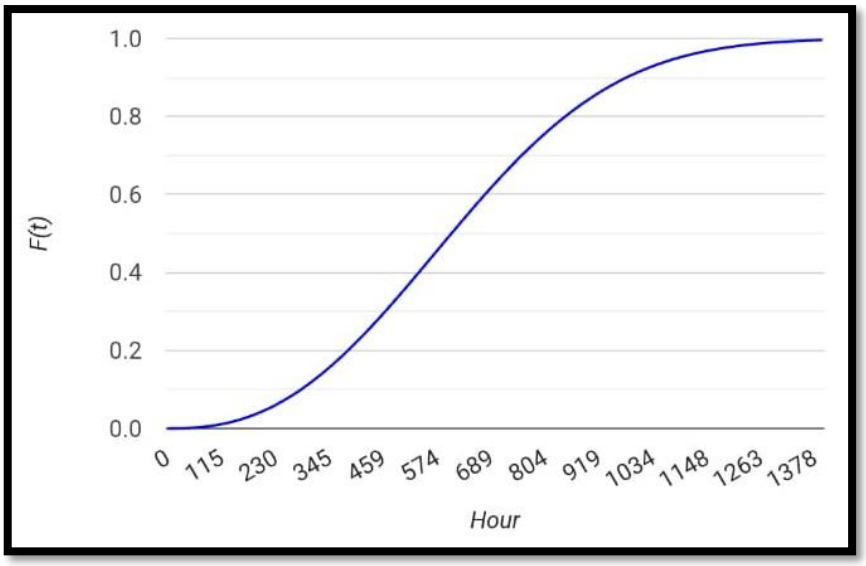


Fig 3: Unreliability $F(t)$

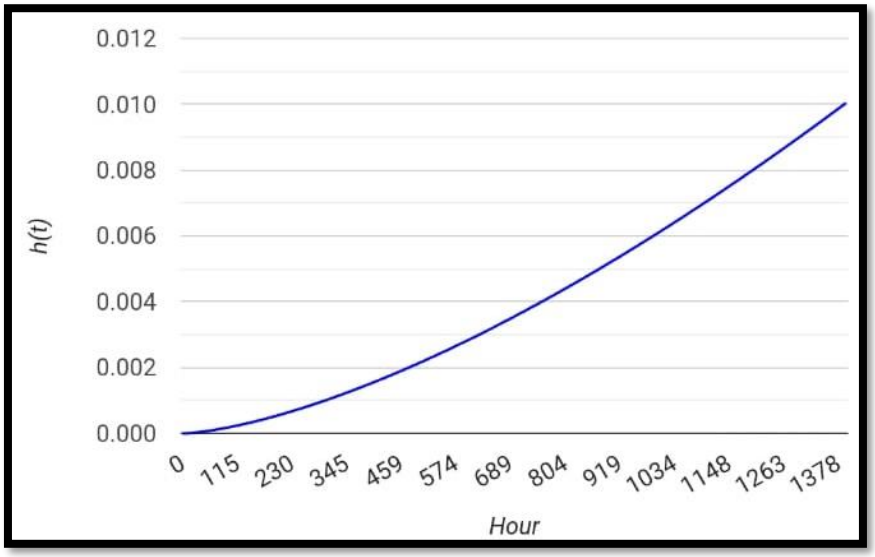


Fig 4: Hazard Rate $h(t) = f(t)/R(t)$

CONCLUSION

In the above two numerical we are trying to check out the reliability of our department which we are going to organize. In both the numerical our motive is to enlighten the ratio of the required data so that our in our industrial department there will be very less chances of the failure. In first numerical we assume shape parameter (β) = 2.5, characteristic life (η) = 700& time period of interest(t) = 700. In this case we see that the reliability at **700** hours is **0.37**, as represented by the green shaded area to the right of the **700** hour point in the probability density function (pdf) plot shown below. The unreliability, or probability of failure, is **0.63**, as represented by the pink shaded area to the left of the **700** hour point in the pdf plot.

While in the numerical we assume shape parameter (β) = 2.5, characteristic life (η) = 700& time period of interest(t) = 200. In this case we see that the reliability at **200** hours is **0.957304**, as represented by the green shaded area to the right of the **200** hour point in the probability density function (pdf) plot shown below. The unreliability, or probability of failure, is **0.042696**, as represented by the pink shaded area to the left of the **200** hour point in the pdf plot.

Both numerical clearly showed that what type of data and in which amount it is required so that the system does not face any failure while running. This paper helps so many industrialists to conduct their organization smoothly.

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