Warranty Analysis of Bulbs

[1]Prof. Prachi D. Mohite, [2]Prof. S. S. Kamble, [3]Prof. Shweta Abhay Khalatkar
[1]Assistant Professor, [2,3] Associate Professor
[1]Electrical Engineering Department,
[1]P.E.S. College of Engineering, Aurangabad, Maharashtra, India

---

***Abstract* - Reliability Life Data Analysis refers to the study and modeling of observed product lives. Life data can be lifetimes of products in the marketplace, such as the time the product operated successfully or the time the product operated before it failed. These lifetimes can be measured in hours, miles, cycles-to-failure, stress cycles or any other metric with which the life or exposure of a product can be measured. So performing warranty analysis we can also predict the returns and failure data.**

***Index terms* - Life, warranty, Weibull,data**

I. Introduction to Reliability Engineering

Since the beginning of history, humanity has attempted to predict the future. Watching the flight of birds, the movement of the leaves on the trees and other methods were some of the practices used. Fortunately, today's engineers do not have to depend on Pythia or a crystal ball in order to predict the future of their products. Through the use of life data analysis, reliability engineers use product life data to determine the probability and capability of parts, components, and systems to perform their required functions for desired periods of time without failure, in specified environments.

Life data can be lifetimes of products in the marketplace, such as the time the product operated successfully or the time the product operated before it failed. These lifetimes can be measured in hours, miles, cycles-to-failure, stress cycles or any other metric with which the life or exposure of a product can be measured. All such data of product lifetimes can be encompassed in the term *life data* or, more specifically, *product life data*. The subsequent analysis and prediction are described as *life data analysis*. For the purpose our examples and discussions to lifetimes of inanimate objects, such as equipment, components and systems as they apply to reliability engineering will be carried out by steps shown in figure 1. Before performing life data analysis, the failure mode and the life units (hours, cycles, miles, etc.) must be specified and clearly defined. Further, it is quite necessary to define exactly what constitutes a failure. In other words, before performing the analysis it must be clear when the product is considered to have actually failed. This may seem rather obvious, but it is not uncommon for problems with failure definitions or time unit discrepancies to completely invalidate the results of expensive and time consuming life testing and analysis.

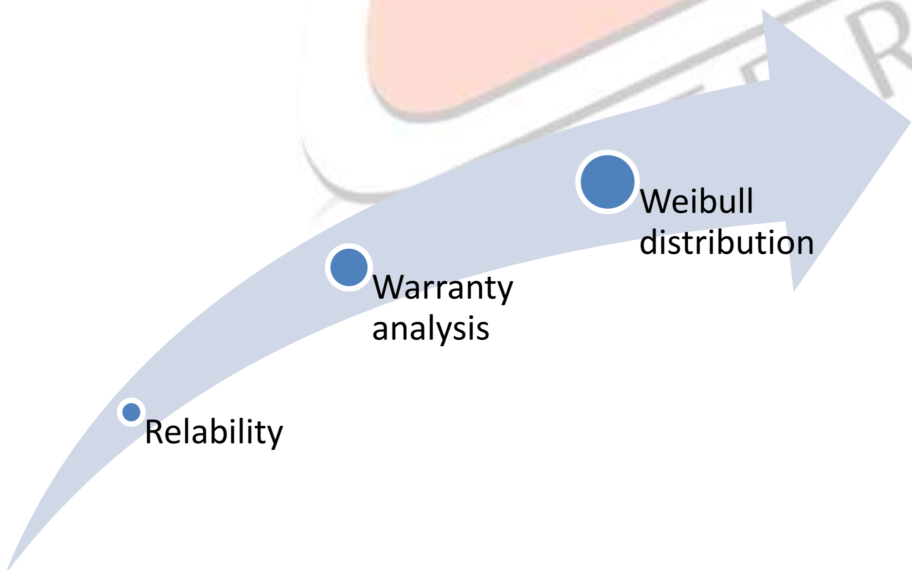


Figure 1 Life data operation.

II. Necessity of warranty analysis

1. We need to make an analysis of the available results before test completion.
2. The failure modes which are occurring are different than those anticipated and such units are withdrawn from the test.
3. We need to analyze a single mode and the actual data set comprises multiple modes.
4. A *warranty analysis* is to be made of all units in the field (non-failed and failed units). The non-failed units are considered to be suspended items (or right censored).

III Warranty Data Analysis

The Weibull++ warranty analysis folio provides different data entry formats for warranty claims data. It allows the user to automatically perform life data analysis, predict future failures (through the use of conditional probability analysis), and provides a method for detecting outliers. One of the data-entry format for storing sales and returns information is the Nevada Chart Format The Nevada format allows the user to convert shipping and warranty return data into the standard reliability data form of failures and suspensions so that it can easily be analyzed with traditional life data analysis methods. For each time period in which a number of products are shipped, there will be a certain number of returns or failures in subsequent time periods, while the rest of the population that was shipped will continue to operate in the following time periods. Example is bulbs sales data is given and warranty returns is calculated.

Nevada Chart Format

6	13	20	32	68	62	82	97	78	112	113	76	0	0	0	0	0	0
	5	9	20	35	52	76	64	76	114	112	89	77	0	0	0	0	0
		4	12	19	31	58	56	77	94	87	114	93	76	0	0	0	0
			5	13	20	31	39	70	69	104	81	104	108	112	0	0	0
				6	10	22	39	48	56	69	89	97	109	92	88	0	0
					4	12	22	36	54	61	52	88	101	97	89	94	0
						4	10	23	35	53	58	65	68	76	107	78	0
							5	10	25	38	33	50	57	79	100	105	0
								6	9	22	20	40	41	75	75	80	0
									6	12	11	17	29	48	67	67	0
										6	4	9	22	40	57	67	0
											0	0	1	2	3	8	0
												0	0	1	2	5	0
													0	0	1	2	0
														0	0	1	0
															0	0	0
																0	0
																	0

Warranty Analysis Results

Weibull++ includes an optional Subset ID column that allows to differentiate between product versions or different designs (lots). Based on the entries, the software will separately analyze (i.e., obtain parameters and failure projections for) each subset of data. Note that it is important to realize that the same limitations with regards to the number of failures that are needed are also applicable here. In other words, distributions can be automatically fitted to lots that have return (failure) data, whereas if no returns have been experienced yet (either because the units are going to be introduced in the future or because no failures happened yet), the user will be asked to specify the parameters, since they can not be computed. Consequently, subsequent estimation/predictions related to these lots would be based on the user specified parameters. The following example illustrates the use of Subset IDs.

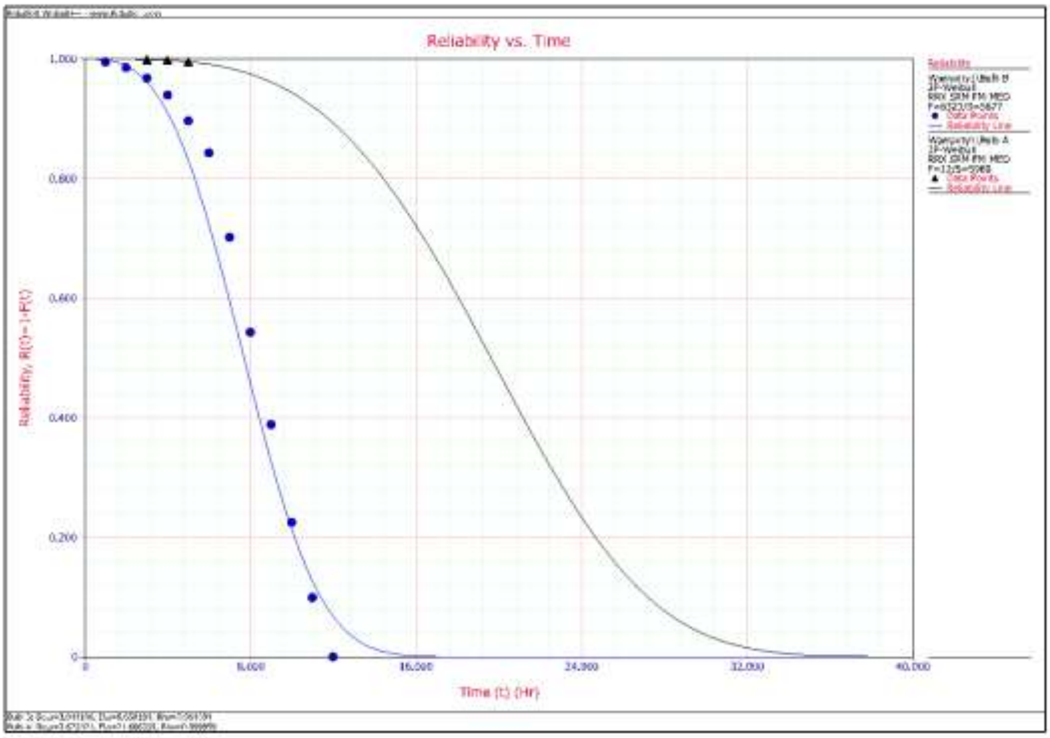
Quick Results Report			
Report Type	Warranty Results		
User Info			
Date:	7/7/2016		
Subset ID: Bulb B			
Distribution:	Weibull-2P		
Analysis:	RRX		
CB Method:	FM		
Ranking:	MED		
Beta	3.044106		
Eta (Hr)	8.650194		
LK Value	-17025.48408		

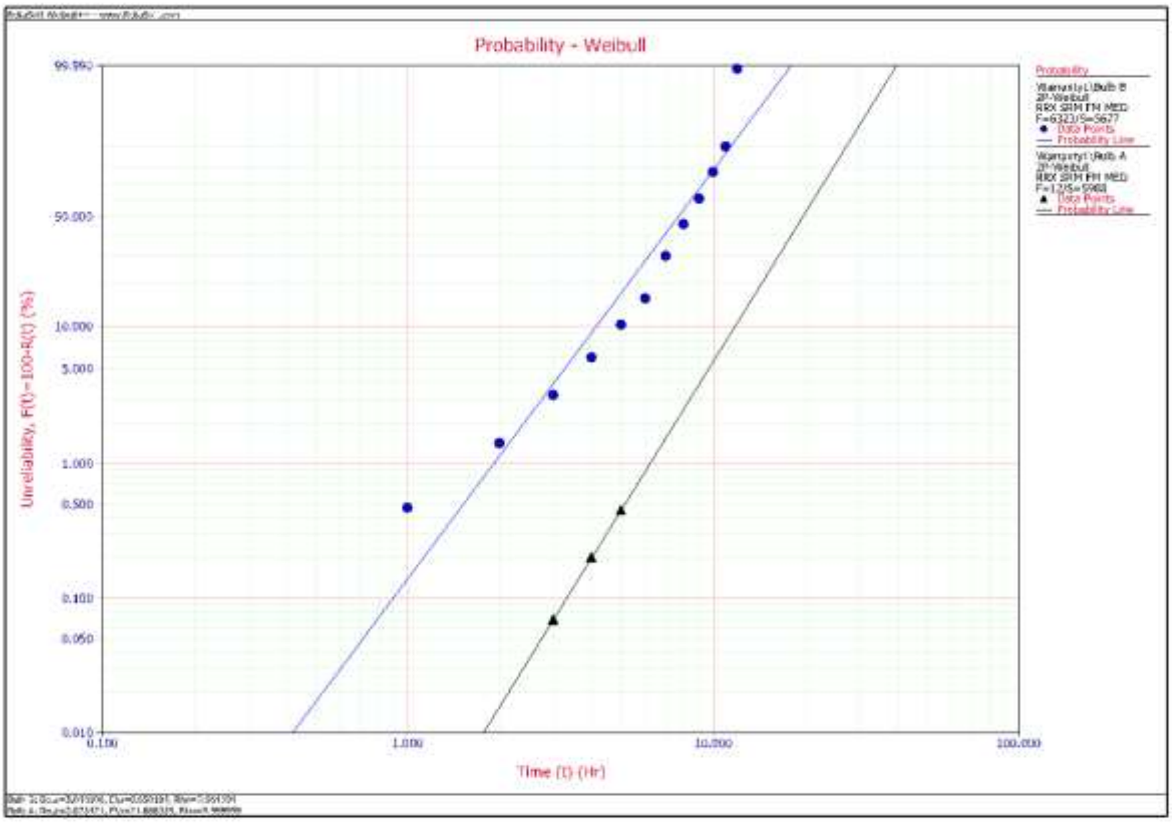
Rho	0.964094		
Fail \ Susp	6323 \ 5677		
LOCAL VAR/COV MATRIX	Var-Beta=0.000800	CV Eta Beta=0.000176	
	CV Eta Beta=0.000176	Var-Eta=0.000939	
Suspend After	6		
Num In State	F/S	End Time	Subset ID
57	F	1	Bulb B
114	F	2	Bulb B
214	F	3	Bulb B
338	F	4	Bulb B
517	F	5	Bulb B
643	F	6	Bulb B
423	S	6	Bulb B
290	S	6	Bulb B
632	S	6	Bulb B
498	S	6	Bulb B
279	S	6	Bulb B
271	S	6	Bulb B
275	S	6	Bulb B
244	S	6	Bulb B
743	S	6	Bulb B
241	S	6	Bulb B
986	S	6	Bulb B
795	S	6	Bulb B
744	F	7	Bulb B
837	F	8	Bulb B
814	F	9	Bulb B
860	F	10	Bulb B
662	F	11	Bulb B
523	F	12	Bulb B
*********			
Subset ID: Bulb A			
Distribution:	Weibull-2P		
Analysis:	RRX		
CB Method:	FM		
Ranking:	MED		
Beta	3.675421		
Eta (Hr)	21.666359		
LK Value	-91.164436		
Rho	0.999959		
Fail \ Susp	12 \ 5988		
LOCAL VAR/COV MATRIX	Var-Beta=0.145420	CV Eta Beta=-1.083682	
	CV Eta Beta=-1.083682	Var-Eta=10.063262	
Suspend After	6		
Num In State	F/S	End Time	Subset ID
1000	S	1	Bulb A
1000	S	2	Bulb A
3	F	3	Bulb A
1000	S	3	Bulb A
4	F	4	Bulb A
999	S	4	Bulb A
5	F	5	Bulb A

997	S	5	Bulb A
992	S	6	Bulb A

Characteristics of the Weibull Distribution

The Weibull distribution is widely used in reliability and life data analysis due to its versatility. Depending on the values of the parameters, the Weibull distribution can be used to model a variety of life behaviors.





IV Conclusion

Once a life data analysis has been performed on warranty data, this information can be used to predict how many warranty returns there will be in subsequent time periods. This methodology uses the concept of conditional reliability (see Basic Statistical Background) to calculate the probability of failure for the remaining units for each shipment time period. This conditional probability of failure is then multiplied by the number of units at risk from that particular period that are still in the field (i.e., the suspensions) in order to predict the number of failures or warranty returns expected for this time period.

V References

[1] http:/ / www. reliasoft. com/ Weibull/ examples/ rc5/ index. htm
[2] http:/ / www. reliasoft. tv/ weibull/ appexamples/ weibull_app_ex_5. html