

Weibull News



Fourth Edition

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What's Happening?!?!... Weibull analysis seems to have caught on fire. I am not sure what is fanning the flames, but this subject is hot! Received a card from Israel: "Dr. Bob, The Weibull seeds you planted have grown into a forest of Weibull trees." Petrochemical and process industries are in the act. Nuclear and electrical power, particularly Florida Power Light, are progressing rapidly. Of course, automotive and aerospace are firmly entrenched Weibull users that continue to find new applications. Some credit must go to Wes Fulton for making WeibullSMITH™ so friendly and expanding its capability so fast. We have three new projects that I want to tell you about and ask for your help: Updating the Weibull Handbook, new software, and the Weibull Rally. And as usual, there is new technology to share: Inspection Data Analysis and Duane-AMSSA growth analysis applied to systems reparability, plus new capabilities in the WeibullSMITH software.

New Software... Wes and I are trying to decide which software to program next. We have made some progress on each of three programs. Please tell us which program should have your 1991 priority. **1. Duane-AMSSA Model** The three applications for this model are (1) tracking a component under development, (2) risk forecasting for old systems where the early data is missing, (3) trend analysis for systems and processes including repairable systems. Advantages: simple, good graphics, data does not have to discriminate between failure modes. Disadvantages: compared to a Monte Carlo model, Duane cannot forecast the effects of corrective action. **2. Risk Analysis** Given the Weibull failure modes, usage rates, current ages of the units in service and productions schedule, how many failures are expected from each mode by month, five or ten years in advance? What effect will inspections and retrofits have? **3. Monte Carlo Simulation** An RMS model based on Weibulls and Log Normals from WeibullSMITH™ that will predict failures by mode by month, with and without renewals and production schedules, with analysis of corrective action such as inspections All RMS parameters like accident rate, spare parts requirements, & availability may be calculated from the output. Please call or write as Wes and I need your input.

The New Weibull Handbook... The original USAF Weibull Handbook is the hallmark document on this subject, but it is eight years old. There is much that should be added. So I have started on The New Weibull Handbook which will have large easy-to-read equations, new chapters, & new methods (learned primarily from my students). WeibullSMITH™ has lots of options and capabilities that will be presented in the New Handbook. I hope it will be a valuable addition to your bookshelf. Chapter Six-"Case Studies" needs examples from different industries, applications and types of "dirty data".

Need your help... You are cordially invited to send an interesting case study, preferable on your letterhead with your byline. This should be excellent public relations for your company and will help young novice students around the world. In return, I will provide you with credits in the **New Handbook** and an original copy of the same, prior to publishing it. Examples might include interesting Weibulls & Log Normals, new applications, new problems with data, two versus three parameter models. Math model examples would be excellent, either Monte Carlo or Duane. 1-3 pages would be ideal. Call me if you would like to discuss this. I would like to use the same examples in our Weibull Rally and our computer tutorial for WeibullSMITH™ unless you object. Do you have any suggestions for topics that should be included?



Reading Equation 3.8

What's a Weibull Rally?... A Weibull Rally is (1) a Postgraduate Weibull Workshop, (2) a forum for Weibull experts, & (3) a WeibullSMITH™ user conference. Florida Power & Light had the first Rally this fall. It was really well received, excellent evaluations! We had a great time! About two dozen FPL Weibull experts gathered for two days of informal rapping, consulting on problems they brought along, & demonstrations of new WeibullSMITH™ capabilities on PC computers. Presentations of good case studies included a cost optimization on when to repair versus replace power poles damaged by woodpeckers? FPL is already planning a 1991 Rally.

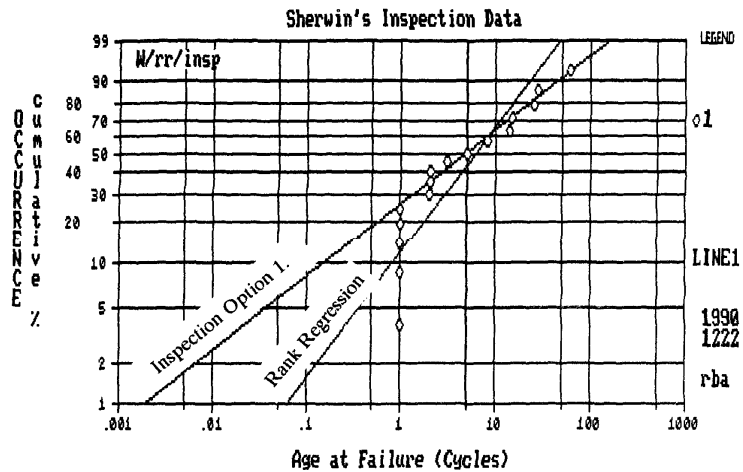
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SAE Rally... SAE is planning a Weibull Rally in the Detroit area in late August. Hope you'll come. Or should we have a Rally on site at your facility?

Inspection Data Analysis... There are several types of inspection data. "Interval" data consists of benign failures discovered at inspection which produces a special form of dirty data. The failures actually occurred earlier in the interval. See Sherwin's data plot. Many author's, including Sherwin, suggest that a more accurate Weibull can be obtained by fitting the top most point in each column.

WeibullSMITH™ now offers this capability as Inspection Option 1. "Probit" data is another type of dirty inspection data, where the probability of finding the crack or defect is less than one or the inspection is destructive. In these two cases the larger uncertainty is in the Y direction. With normal Weibull life data

the larger uncertainty is the time-to-failure, i.e., X and we regress X on Y. With the uncertainty in the Y direction with "Probit" data, we regress the other way, Y on X. This is Inspection Option 2. The data consists of three numbers at each time: inspection time, number inspected, and number of defects found. This data is Binomial so Wes added +/- 2 sigma confidence intervals about each point, two-sided 95%. Wayne Nelson calls this kind of data "Quantal Response" in his two books. Wayne also suggests plotting both kinds of inspection data at the mid point of the interval. This will be your decision and of course, WeibullSMITH™ will do it either way. (Incidentally, I thank Wayne for suggesting that we add inspection data analysis to our workshop material.)



Inspection Option 1 vs Rank Regression

New WeibullSMITH™ Capabilities... ■ Help—the F1 key..from anywhere in the program, you can access the user manual and return to where you were. ■ Data input will "eat" ASCII single column data files without using the "Convert" routine. ■ Labels will allow two titles. You can store labels as a data set. ■ Plots with overlaid dataset plots now include eta, beta, N, and the number of suspensions. ■ One client has always plotted on 1 x 1 Weibull scale and did not want to be confused with variable scales, so Wes has added 1 x 1 as an option. ■ You may omit the view plot sequence as an option. ■ The new View option on the Main Menu let's you make presentations to groups of engineers and managers. You may call up a list of data sets in Weibull or Log Normal format with the return key. ■ Word Perfect 5.0 & 5.1 Grab.Com will bring your WeibullSMITH™ plots into your reports in any size. CGA resolution works best. Another way is to output a Hewlett Package Plotter File (HPGL). Word Perfect eats HPGL files. CGA give better fonts but EGA/VGA has a finer grid. ■ Did you know Log Normal Median Rank Regression is also Maximum Likelihood?...so there is no MLE option in Log NormalSMITH.

Public Weibull-LogNormal Workshops... ■ ASME (212) 705 7123, Los Angeles, February 6-8, 1991, Dallas, December 4-6, 1991. ■ SAE (412) 776 4841, Detroit, February 27-March 1, 1991. ■ UTSI (615) 455 0631, Palm Beach, April 3-5, 1991

On-Site Workshops & Consulting... Dominion Engineering, Wheeltek, Cardiac Pacemakers, Southwire, Warner Robbins Air Force Base, JPL, General Electric Evendale and Lynn, Garrett, SAAB, Volvo Flygmotor, Volvo-GM Trucks, Ford, John Deere, Florida Power & Light, McDonnell-Douglas, Texaco, Duke Power, The Society of Reliability Engineers, Union College, Sunstrand.

Happy New Year!!! Wes Fulton & I send you our best wishes for a wonderful, healthy, happy 1991...I would like to hear from you. Call me at (407) 842 4082 or write:

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For computer questions call Wes Fulton at:
(213) 548 6358 (California time).



**Waiting for
your call....**