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Permission was given on October 1, 2001 via Email to [Dr. Robert B. Abernethy](mailto:Dr.Robert.B.Abernethy) to publish this review on the Internet by Martin Owen ([m.owen@rss.org.uk](mailto:m.owen@rss.org.uk)), Executive Editor of the Royal Statistical Society, 12 Errol Street, London, EC1Y 8LX, UK <http://www.rss.org.uk> and by Malcom A.J. Allison ([Malcolm.Allison@blacksci.co.uk](mailto:Malcolm.Allison@blacksci.co.uk)), Permission Assistant, Blackwell Publishing, Osney Mead, Oxford OX2 0EL, UK <http://www.blacksci.co.uk>. The original copyright was 1997 by the Royal Statistical Society. [Hyperlinks have been added to the review for use as Internet pages at <http://www.barringer1.com> ]

## Book Review

**"1. The New Weibull Handbook**, 2<sup>nd</sup> edn. By [R. B. Abernethy](#). ISBN 0 9653062 0 8. Abernethy, North Palm Beach, 1996. \$88.00. [Please note, [The New Weibull Handbook](#) is now at the 4<sup>th</sup> edition using ISBN 0-9653062-1-6. The price is US\$98 + shipping and handling]

The handbook is used as a manual for training by the author who took early retirement in 1987 to undertake full-time lecturing in Weibull analysis. The print is in a large fount and the equations are in even larger fount so that those of us whose sight is poor will have no excuse for not absorbing the message. There is no doubting the author's enthusiasm for the Weibull distribution and indeed, as I read on, I found myself influenced increasingly by the author's persuasiveness. Some of the claims made for its predictive ability for small samples may seem extravagant but, in this respect, I think that we must bow to the wealth of experience gained by Dr. Abernethy over many years. There is a bewildering variety of software from [Fulton Findings](#) to accompany the handbook, namely [WeibullSMITH](#)<sup>TM</sup>, [VisualSMITH](#)<sup>TM</sup>, [BiWeibullSMITH](#)<sup>TM</sup> and [MonteCarloSMITH](#)<sup>TM</sup>, none of which were presented with the manual for review. True, other life distributions are mentioned such as the log-normal but, in the context of the handbook, they are subservient to the Weibull.

Probability plots are strongly emphasized and sufficient introductory theory is relegated to appendixes. The plotting position recommended, particularly for skew distributions, is the median plotting position. Not having pursued the merits of one plotting position versus another I fail to understand the logic given for this but the author does quote a remark made by Wayne Nelson that such arguments are just as fruitless as arguing religions since they all point to heaven.

Both nonparametric and parametric methods are explained and well illustrated. These include the Kaplan-Meier, maximum likelihood and likelihood ratio approaches. Confidence intervals for parameters and for quantiles such as the B10 life are calculated but the author is not in favour of their use in presentations to management because they are so little understood (in this respect he quotes a 'Forthsooth' from *RSS News* in 1992). I agree with his opinion on this but I take strong exception to his answer to one of the question from readers where he states that 'even most statisticians do not understand the

confidence concept'. However, it may be true that many who profess to be statisticians do not understand the concept.

Particularly in the field of reliability there is much confusion and lack of understanding of classical statistics as enshrined in military standards. Engineers without previous exposure to statistics more readily take to the Bayesian approach. To a certain extent this is catered for by WeiBayes in the handbook, but it is not a full Bayesian approach since a single value is established for the shape parameter on the basis of past experience. There is no natural conjugacy for the Weibull distribution but there is gamma conjugacy for a scale parameter conditional on discrete prior values for the shape parameter (Martz and Waller, 1982). This should not be at all difficult for engineers to assimilate, especially when displays of priors and posteriors are easy to produce.

The difficulties in estimation for the Weibull distribution with a threshold parameter  $t_0$  are not sufficiently emphasized. The technique of subtracting values from failure times and suspension times until the Weibull plot 'straightens' is easier said than done since substantially different values for  $t_0$  can make very little difference to a straightened plot. Another manifestation of this difficulty is that the likelihood function is quite flat over wide ranges of  $t_0$ .

There is a section on reliability growth and the Duane model written by D. P. Weber, a reliability consultant. My only criticism of this section is in his use of the term instantaneous failure rate. There is thus no distinction between its use here and its previous use for non-repairable items. Many researchers now use the rate of occurrence of failures for the repairable case.

I detected few errors in the handbook. On p.2-10 the author states that as time progresses the reliability of components surviving infant mortality increases. To be precise reliability should be replaced by conditional reliability. On p. 2-22 the Weibull closure, or self-locking property, is the reciprocal of the correct answer and in Appendix G-23 the second moment about the origin is incorrect and is also incorrectly signified by  $\mu_2$  rather than by  $\mu'_2$ . There are a few inconsistencies such as the use of both  $s^2$  and  $\sigma^2$  to denote a theoretical variance and the author talks about inverse ranks when he means reverse ranks.

In summary the handbook, together with the previously mentioned software (or other), will be an invaluable aid to reliability engineers. Statisticians would probably prefer a more concise theoretical treatment with more sophisticated applications such as Weibull regression models. As a statistician who is interested in the application of statistical methods in industry I found the many diverse applications and case-studies extremely interesting.

#### *Reference*

Martz, H. J. and Waller, R. A. (1982) *Bayesian Reliability Analysis*. New York: Wiley

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