



# **A Simulation Study of the Error Induced in One-sided Reliability Confidence Bounds for the Weibull Distribution Using a Small Sample Size with Heavily Censored Data**

*Michael A. Hartley*

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Budget limitations have reduced the number of military components available for testing, and time constraints have reduced the amount of time available for actual testing resulting in many items still operating at the end of test cycles. These two factors produce small test populations (small sample size) with “heavily” censored data. The assumption of “normal approximation” for estimates based on these small sample sizes reduces the accuracy of confidence bounds of the probability plots and the associated quantities. This creates a problem in acquisition analysis because the confidence in the probability estimates influences the number of spare parts required to support a mission or deployment or determines the length of warranty ensuring proper operation of systems. This thesis develops a method that simulates small samples with censored data and examines the error of the Fisher-Matrix (FM) and the Likelihood Ratio Bounds (LRB) confidence methods of two test populations (size 10 and 20) with three, five, seven and nine observed failures for the Weibull distribution. This thesis includes a Monte Carlo simulation code written in S-Plus that can be modified by the user to meet their particular needs for any sampling and censoring scheme. To illustrate the approach, the thesis includes a catalog of corrected confidence bounds for the Weibull distribution, which can be used by acquisition analysts to adjust their confidence bounds and obtain a more accurate representation for warranty and reliability work.

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