Step-Stress Accelerated Life Testing Plans against Model Misspecification for the Weibull Distribution

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Abstract

Accelerated life tests are useful for obtaining enough failures for a reasonable analysis of a product's reliability over a relatively shorter period of time. In this paper, we study a special type of accelerated life test, namely, the simple step-stress test and propose step-stress plans that are robust against lifetime distribution misspecification. We assume the Weibull distribution is used for fitting the product's lifetime. However, there exists possibility that the assumed model is not correct. Thus, it is necessary to assess the effect on the reliability estimation due to model misspecification. Under the assumptions of cumulative exposure and Type-I censoring, we derive the expected value and variance for the asymptotic bias of the p-th percentile estimate of the lifetime distribution under normal use conditions. Optimum simple step-stress plans are designed to minimize either the maximum of the asymptotic average bias or the maximum of the mean square error of these estimates when the Weibull distribution might not be correct. Such plans provide protection of the resulting estimates from distribution misspecification.

Keywords
Step-Stress Accelerated Life Test, Cumulative Exposure, Type-I Censoring, Asymptotic Bias, Asymptotic Mean Square Error

Biography

Cheng-Hung Hu is an Assistant Professor in the Department of Industrial Engineering and Management, Yuan Ze University, Chung-Li 32003, Taiwan. He earned B.S. in Applied mathematics from National Tsing Hua University, Masters in the institute of statistics from National Tsing Hua University, Taiwan and PhD in quantitative methods area from Purdue University. His research interests include applied statistics, reliability engineering, and quality engineering. He has published journal and conference papers.