ABSTRACT OF THE DISSERTATION

A General Nonparametric Model For Accelerated Life Testing
With Time-Dependent Covariates

By HUAN-JYH SHYUR

Dissertation Directors:
Professors James T. Luxhøj and E. A. Elsayed

This dissertation introduces a general nonparametric or "distribution-free" model to analyze the lifetime of components under accelerated life testing. Unlike the accelerated failure time (AFT) models, the proposed model shares the advantage of being "distribution-free" with the proportional hazard (PH) model and overcomes the deficiency of the PH model not allowing survival curves corresponding to different values of a covariate to cross.

The extended hazard regression (EHR) model has been successfully used in analyzing the survival time data of non-homogeneous populations in the medical field. It is a general model which encompasses both the PH and the AFT models as special cases. We investigate the EHR model and find it also appears to be flexible and useful in the reliability field.

In this research, we extend and modify the EHR model using the partial likelihood function to analyze failure data with time dependent covariates. The new model can be easily adopted to create an accelerated life testing model with different types of stress loading. For example, stress loading in accelerated life testing can be a step function,

cyclic, or a linear function with time. These types of stress loading reduces the testing time and increases the number of failures of components under test.

The proposed new EHR model with time dependent covariates which incorporates multiple stress loadings requires further verification. Therefore, we conduct an accelerated life test in the laboratory by subjecting components to time dependent stresses and we compare the reliability estimation based on the developed model with that obtained from the experimental results. The combination of the theoretical development of the accelerated life testing model verified by laboratory experiments offers a unique perspective to reliability model building and verification.