Public Abstract

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A NEW MULTIVARIATE WEIBULL REGRESSION FUNCTION

In the manufacturing industry, it may be important to study the relationship between machine component failures under stress. Examples include failures such as integrated circuits and memory chips in electronic merchandise given various levels of electronic shock. Such studies are important for the development of new products and for the improvement of existing products. We assume two component systems for simplicity and we assume the joint probability of failures increases with stress as a cumulative bivariate Weibull function. In the Weibull model, the amount of damage is positive which is natural for experimental factors such as voltage, tension or pressure. First, we describe locally optimal designs under bivariate Weibull assumptions. From among many optimal objective functions, we use the D-optimality criterion which minimizes the inverse of the determinant of information matrix. Since locally optimal designs with non-linear models depend on pre-determined parameter values, misspecified parameter values may lead to designs of the low efficiency. To improve the efficiency of locally optimal designs, we recommend a multi-stage procedure. We show how using a two-stage procedure substantially improves a locally optimal design with misspecified parameters.

In addition to D-optimal designs, we describe c-optimal designs under the trivariate Weibull regression model. We assume that the amount of damage decreases sequentially as the stress progresses through the three components. The target stress can be expressed in terms of a linear predictor function, and we evaluate c-optimal designs for optimizing the prediction of the target stress. To compensate for the loss of efficiency of optimal designs with non-linear models, we show a two-stage procedure, and then compare the efficiency of two-stage adaptive optimal designs with single-stage optimal designs.

Lastly, we suggest an extension under a multivariate Weibull regression function.