

## PREDICTING TYPE II CENSORED DATA FROM $2^k$ FACTORIAL DESIGNS FOR THE WEIBULL DISTRIBUTION

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**ABSTRACT.** Experiments often employ censoring schemes in life tests to shorten the test time or to reduce the test cost. However, censoring restricts the ability to observe failure times exactly. If the lifetime distribution is not normal, incomplete information contained in censored data often causes difficulties with employing the experimental design methods to conduct statistical inferences in engineering applications. The paper develops three new modified maximum likelihood predictors (MMLPs) to predict type II censored data for the Weibull distribution. Once the censored data are predicted, the predicted information can be merged with uncensored data as a pseudo-complete data set. The robust  $2^k$  factorial design method [13] can be employed to identify the significant factors from the experiment for the pseudo-complete data set. A Monte Carlo simulation study is conducted to evaluate the performance of the proposed method, and an example regarding engineering is presented for illustration.

**Keywords:** Type II censored data, Maximum likelihood predictor, Modified maximum likelihood predictor, Robust  $2^k$  factorial design, Weibull distribution

**1. Introduction.** Because engineering technologies have been developed rapidly in recent years, most products have been designed with high reliabilities. It becomes more and more difficult to collect complete information on failure times for life tests. For shortening the test time and reducing the test cost, life tests often are conducted with censoring. Two censored tests, the type I and type II censored tests, are commonly used in industrial engineering applications. The type I censored test is conducted with a time censored scheme, in which the life test is terminated either a predetermined termination time  $t_0$  is reached or all test units fail before the time  $t_0$ . Alternatively, the type II censored test is conducted with a failure censored scheme, in which the life test is terminated if the first  $r$  smallest failure lifetimes are collected, where the number of failure lifetimes is predetermined. Survived units at the termination time of test are considered as censoring. Lawless [6] provides detail discussions for life tests with these two censoring schemes.

Assume that type II censored data on the response variable are collected, in which observations have unequal variances and correlated. Nelson and Hahn [8, 9] employed the simple regression model and proposed techniques for estimating the parameters of the linear regression model. Hahn and Nelson [10] reviewed graphical, estimation method of maximum likelihood and linear estimation methods with censored data in an investigation