Spring 2012

Lifetime prediction and confidence bounds in accelerated degradation testing for lognormal response distributions with an Arrhenius rate relationship

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LIFETIME PREDICTION AND CONFIDENCE BOUNDS IN ACCELERATED DEGRADATION TESTING FOR LOGNORMAL RESPONSE DISTRIBUTIONS WITH AN ARRHENIUS RATE RELATIONSHIP

by

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A DISSERTATION

Presented to the Faculty of the Graduate School of the

MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

In Partial Fulfillment of the Requirements for the Degree

DOCTOR OF PHILOSOPHY

in

APPLIED MATHEMATICS

2012

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ABSTRACT

Determining the lifetime of a product is an important component of quality assurance. Traditional life testing methods are infeasible for products that have been designed to have a very long lifetime because they require a lengthy testing period. An alternative method is accelerated degradation testing, where a response variable determining the usability of the product is measured over time under multiple accelerating stress levels. The resulting data are then used to predict the life distribution of the product under the design stress level. In this dissertation, several methods are proposed and studied for obtaining prediction bounds for the lifetime of a future product and confidence bounds for the mean lifetime of a product using accelerated degradation testing.

The proposed model assumes that products are subjected to a constant accelerating stress. The response variable is measured once for each product, and failure occurs when the response variable crosses a predefined threshold. The model assumes the natural logarithm of the response variable has a normal distribution with a mean that follows an Arrhenius rate relationship and a standard deviation whose natural logarithm follows a quadratic function of the time.

Three methods are presented for obtaining prediction bounds for the lifetime of a future product at the design stress level. These methods use the maximum likelihood, model-based bootstrap, and maximum likelihood predictive density approaches. Two methods are presented for obtaining confidence bounds for the mean lifetime of a product at the design stress level. These techniques represent the delta method and three different variations of the model-based nonparametric bootstrap approach.

The performance of the various methods for obtaining lifetime prediction and confidence bounds are studied using a Monte Carlo simulation study. The results identify several promising approaches.

ACKNOWLEDGEMENTS

I would like to thank my advisor, Dr. V. A. Samaranayake, for all of his advice, support, and patience during this long experience. I would also like to thank my committee members, Dr. Akim Adekpedjou, Dr. Robert Paige, Dr. Xuerong Wen, and Dr. Jeffrey King for their help and support as well as Dr. Leon Hall for his gentle words of encouragement. In addition, I want to acknowledge two former professors, Dr. Gaoxiong Gan and Dr. Gary Gadbury, for making statistics a challenging, yet rewarding, field of study. Finally, I would like to thank all of my friends and family who provided support and encouragement during my long endeavor. This specifically includes my two sons, who have demonstrated the boundless energy and curiosity needed to complete my degree in "letters and numbers."

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1. INTRODUCTION

1.1 PROBLEM STATEMENT

Determining the usable lifetime of a product under design (nominal use) conditions is an important component of quality assurance. Since many products are designed to have a long lifetime under nominal use conditions, the life distribution is often estimated using accelerated life testing. Accelerated life testing examines the time to failure of products subjected to accelerating stresses. Models are used to relate parameters of the life distribution under nominal use conditions to the accelerating stresses. One of the limitations of accelerated life testing is the need to observe failures, which may be infeasible for products that have been designed for a very long lifetime under nominal use conditions because failures may not occur during the test period even under reasonably high levels of the accelerating stresses.

As an alternative, accelerated degradation testing examines the response of products subjected to accelerating stresses as they age. Models are used to relate parameters of the response variable distribution to the accelerating stresses and time. In many cases, the models can be used to define the life distribution of the product under nominal use conditions. One of the primary benefits of accelerated degradation testing is the ability to produce results quickly without waiting for many, if any, failures to occur.

In this dissertation, three methods are presented for obtaining prediction bounds for the lifetime of a future product at the design stress level and two methods are presented for obtaining confidence bounds for the mean lifetime at the design stress level. The first two methods for obtaining prediction bounds extend existing techniques to the case where the standard deviation of the response variable is a function of the accelerating stress and time, while the third method provides a new approach. Both methods for obtaining confidence bounds extend existing techniques.

First, the maximum likelihood approach is presented for obtaining prediction bounds. The maximum likelihood approach is a common technique for analyzing accelerated degradation test data. This technique is presented in detail, for example, in Nelson (1990) and Meeker and Escobar (1998) for the traditional homoscedastic (constant variance) model. The maximum likelihood approach is a naive approach that replaces the unknown parameters in a distribution with their maximum likelihood estimates. In this dissertation, the maximum likelihood approach is reviewed for the traditional constant variance model and then extended for a generalized heteroscedastic (non-constant variance) model. Bjørnstad (1990) refers to the maximum likelihood approach as the estimative approach to prediction.

Second, the model-based bootstrap approach is presented for obtaining prediction bounds. The bootstrap is a common technique for obtaining confidence bounds for the mean lifetime or a lifetime percentile. The model-based nonparametric bootstrap technique generates an empirical distribution for the quantity of interest by repeatedly resampling the standardized residuals from the fitted model with replacement. In this dissertation, the model-based bootstrap approach is extended to obtain prediction bounds. This technique is also presented for the traditional constant variance model and the generalized non-constant variance model. The approach presented for the traditional model uses standard bootstrap analysis techniques, while the approach presented for the generalized model uses an improved bootstrap analysis technique that applies a variance inflation factor to account for the deflation of the variance of the residuals due to the resampling. Very little literature exists for the application of the model-based bootstrap approach for obtaining prediction bounds in accelerated degradation testing.

Third, a new approach is developed for obtaining prediction bounds that is based on the maximum likelihood predictive density technique first proposed by Lejeune and Faulkenberry (1982). The maximum likelihood predictive density technique uses the maximum likelihood approach with the observed responses and a future unobserved response to obtain a predictive density for the response variable. An approximation is made that allows a simplification of the predictive density into a recognizable probability distribution. The approximate predictive density for the response variable is then used to obtain a predictive density for the lifetime of a future product at the design stress level. The percentiles of this predictive density are used as prediction bounds for the lifetime of a future product at the design stress level. Bjørnstad (1990) refers to the maximum likelihood predictive density as a profile predictive likelihood.

Next, the delta method is presented for obtaining confidence bounds. The delta method is a technique for obtaining approximate expected values, variances, and covariances of functions of parameter estimators. The delta method can also be used to obtain approximate asymptotic distributions for functions of maximum likelihood estimators. In this dissertation, the delta method is presented for obtaining an approximate asymptotic distribution for the mean lifetime at the design stress level. This technique is presented for the traditional constant variance model and the generalized non-constant variance model.

Finally, the model-based bootstrap approach is presented for obtaining confidence bounds. As noted before, the bootstrap technique is a common technique for obtaining confidence bounds for the mean lifetime or a lifetime percentile. Meeker and Escobar (1998) and Meeker, Escobar, and Lu (1998) present the bias-corrected percentile method for obtaining confidence bounds using a parametric bootstrap approach for the traditional constant variance model. In this dissertation, the percentile, bias-corrected percentile, and normal theory methods are reviewed for obtaining confidence bounds using a model-based nonparametric bootstrap approach for the traditional constant variance and the generalized non-constant variance models. A simple adjustment is made to the percentile method to adjust for bias.

The objective of this dissertation is to propose and study several methods for obtaining lifetime prediction and confidence bounds for both homoscedastic and heteroscedastic models. The performance of the various methods is compared using a Monte Carlo simulation study.

1.2 OVERVIEW

This dissertation is organized as follows. The remainder of this section provides the generalized non-constant variance model under consideration and demonstrates how to use the model to derive a life distribution. Section 2 describes the applicable literature for accelerated degradation testing, the bootstrap method, and the maximum likelihood predictive density technique. Section 3 presents the three methods for obtaining prediction bounds for the lifetime of a future unit at the design stress level. Section 4 presents the two methods for obtaining confidence bounds for the mean lifetime at the design stress level. Section 5 describes the Monte Carlo simulation study that was performed, and Section 6 discusses the results of the simulation. Section 7 provides the conclusions for this dissertation. Finally, Section 8 provides areas for future research.

1.3 ACCELERATED DEGRADATION MODEL

The accelerated degradation model under consideration assumes that multiple products are subjected to a constant accelerating stress, where the accelerating stress has two or more levels. The response variable for each product is measured only once, and failure is assumed to occur when the response variable crosses a predefined threshold. The model assumes the natural logarithm of the response variable has a normal distribution with a mean that follows an Arrhenius rate relationship and a standard deviation whose natural logarithm follows a quadratic function of the (possibly transformed) time. This model is a generalization of the traditional model that assumes a constant standard deviation for the natural logarithm of the response variable. Under the given model, it can be shown that the life distribution of a product at the design stress also has a normal distribution.

The accelerated degradation model under consideration can be formalized using the following notation. Let $X(t_{ijk})$ denote the natural logarithm of the observed response variable from a product subjected to a constant accelerating stress V_i and measured at time t_{ij}, where $i = 1,\ldots,m$; $j = 1,\ldots,n_i$; and $k = 1,\ldots,\eta_{ij}$. Here $m \geq 2$ denotes the number of accelerating stress levels, n_i denotes the number of measurement times at each accelerating stress level, and η_{ij} denotes the number of replications at each stress level/measurement time combination. Let $Z(t)$ denote the natural logarithm of a future unobserved response variable for a product subjected to the design stress V_0 and measured at time t. Finally, let $\mu(V_i, t_{ij})$ and $\sigma(V_i, t_{ij})$ denote the mean and standard deviation, respectively, of the natural logarithm of the response variable for a product subjected to an accelerating stress V_i and measured at time t_{ij}.

The accelerated degradation model under consideration contains the following assumptions:

1. $X(t_{ijk}) \underset{ind}{\sim} N(\mu(V_i, t_{ij}), \sigma^2(V_i, t_{ij}))$.
2. $Z(t) \sim N(\mu(V_0, t), \sigma^2(V_0, t))$ and Z is independent of the X's.
3. $\mu(V_i, t_{ij}) = \alpha_0 - \alpha_1 t_{ij} e^{\alpha_2 V_i}$ where $\alpha_2 > 0$.
4. $\ln(\sigma(V_i, t_{ij})) = \beta_0 + \beta_1 V_i t_{ij} + \beta_2 V_i t_{ij}^2$.
5. The accelerating stress is transformed such that $0 = V_0 < V_1 < \ldots < V_m$.
6. The measurement times may be transformed so long as $t_{ij} > t_{ik} \Rightarrow \tau(t_{ij}) > \tau(t_{ik})$.
7. μ_0 is a predefined failure threshold.
    a. When $\alpha_1 > 0$, failure occurs when $X(t_{ijk}) \leq \mu_0$.
    b. When $\alpha_1 < 0$, failure occurs when $X(t_{ijk}) \geq \mu_0$.

In this dissertation, the following notation is used: $X_{ijk} = X(t_{ijk})$, $X_i = (X_{i11},\ldots,X_{in_i\eta_{ij}})'$, $X = (X_1,\ldots,X_m)'$, $x_i = (x_{i11},\ldots,x_{in_i\eta_{ij}})'$, and $x = (x_1,\ldots,x_m)'$. Furthermore, it is assumed without loss of generality that $\alpha_1 > 0$. Finally, it is noted that the constant variance model is a special case of the generalized non-constant variance model under consideration where $\beta_1 = \beta_2 = 0$.

1.4 ACCELERATED DEGRADATION MODEL EXAMPLE

Figures 1.1 and 1.2 display an example of the accelerated degradation model described above. The parameters for this example are based, in part, on the Adhesive Bond B example provided by Escobar, Meeker, Kugler, and Kramer (2003). This example is described in more detail in Section 5.2.1.

Figure 1.1 shows the expected value of the natural logarithm of the response variable as a function of time for different levels of the accelerating stress. This figure demonstrates that the expected value is equal for all levels of the accelerating stress at time $t = 0$. This figure also demonstrates that the rate of degradation increases with the accelerating stress level. Failure is assumed to occur when the natural logarithm of the response variable falls below μ_0, which is denoted by the solid line.

Figure 1.2 shows the natural logarithm of the standard deviation of the natural logarithm of the response variable as a function of time for different levels of the accelerating stress. This figure demonstrates that the standard deviation is also equal for all levels of the accelerating stress at time $t = 0$. This figure also demonstrates how an increased exposure to the accelerating stress (either an increase in the exposure time or an increase in the accelerating stress level) affects the standard deviation of the response distribution. The vertical line denotes the maximum measurement time from the example.

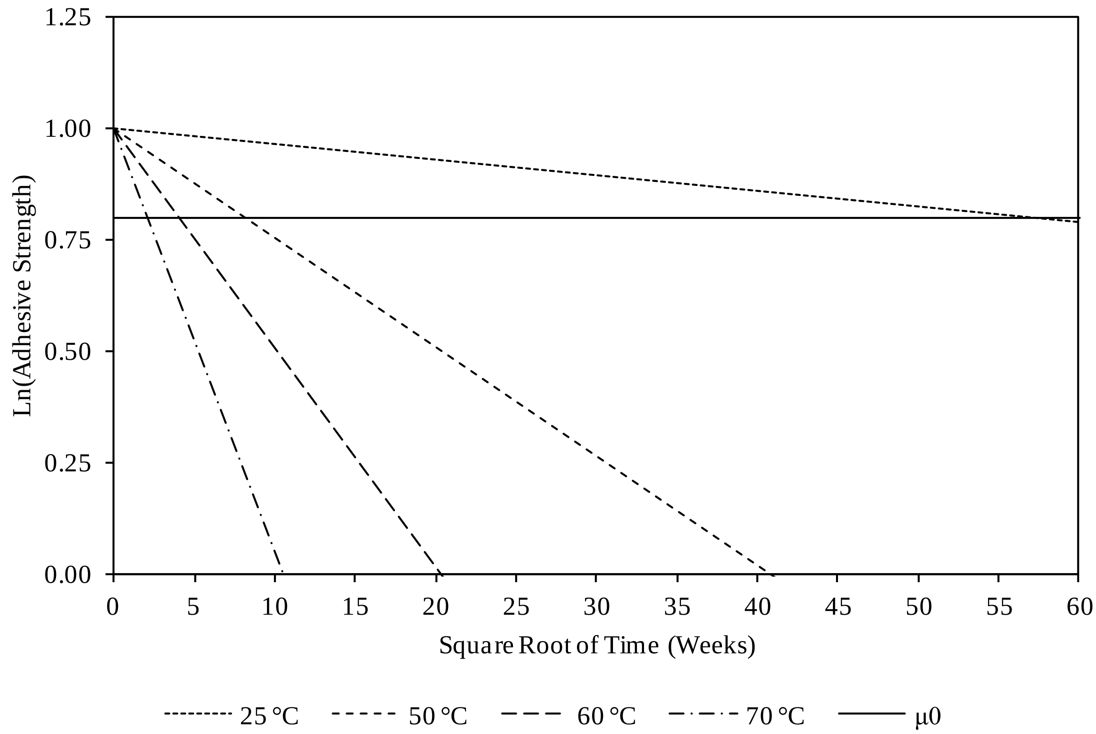

Figure 1.1 Expected Value of the Natural Logarithm of the Response Variable

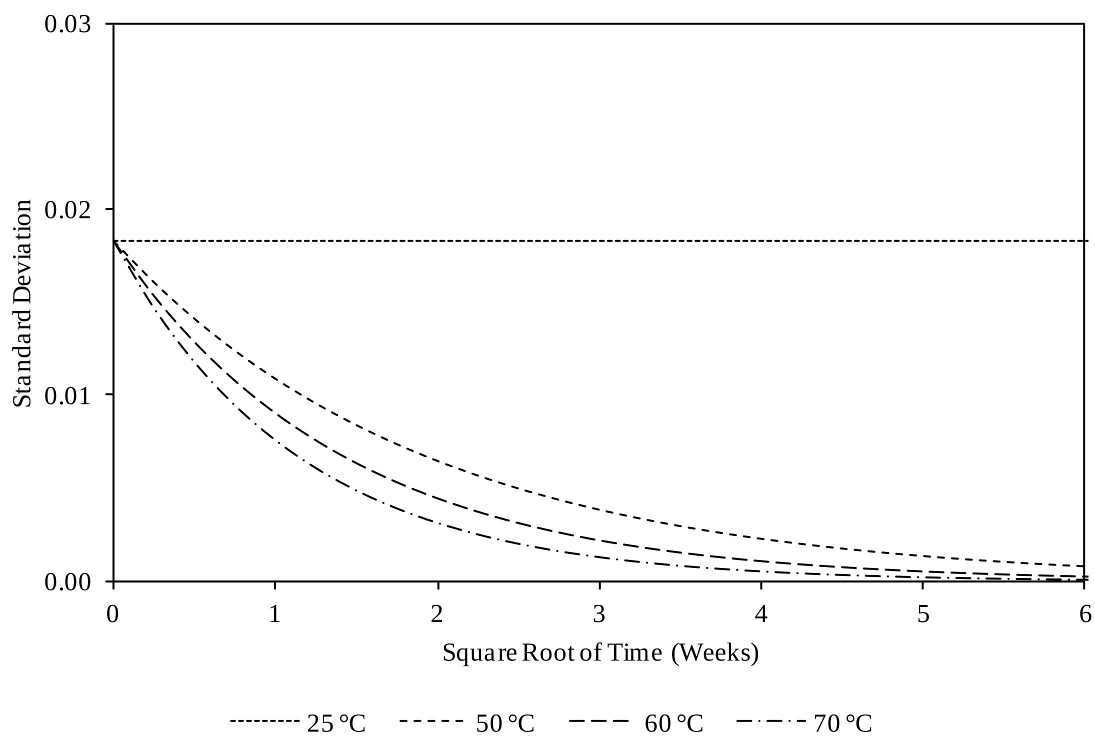

Figure 1.2 Standard Deviation of the Natural Logarithm of the Response Variable

1.5 THE LIFE DISTRIBUTION

Let T denote the lifetime of a product subjected to the design stress level. Let F denote the cumulative distribution function for the random variable T and Φ denote the standard normal cumulative distribution function. Then the probability that a product subjected to the design stress fails by time t is given by

$$F(t) = P(T \leq t) = P(Z(t) \leq \mu_0) = \Phi\left(\frac{\mu_0 - \alpha_0 + \alpha_1 t}{e^{\beta_0}}\right) = \Phi\left(\frac{t - (\alpha_0 - \mu_0) / \alpha_1}{e^{\beta_0} / \alpha_1}\right). \tag{1.1}$$

Then T also has a normal distribution with the following mean and standard deviation:

$$\mu_{life} = \frac{\alpha_0 - \mu_0}{\alpha_1} \text{ and} \tag{1.2}$$

$$\sigma_{life} = \frac{e^{\beta_0}}{\alpha_1}. \tag{1.3}$$

Let z_p denote the $100p^{th}$ percentile of the standard normal distribution and let t_p denote the $100p^{th}$ percentile of F. Then the percentiles of the life distribution at the design stress level are given by

$$t_p = \frac{\alpha_0 - \mu_0}{\alpha_1} + z_p \frac{e^{\beta_0}}{\alpha_1}. \tag{1.4}$$

Let $t_{p,pred}$ denote the $100p^{th}$ prediction bound for the lifetime of a future product subjected to the design stress level and $t_{p,conf}$ denote the $100p^{th}$ confidence bound for the mean lifetime at the design stress level. Then the prediction bounds and confidence bounds are defined by the following equations:

$$P(T \leq t_{p,pred}) = p \text{ and} \tag{1.5}$$

$$P(\mu_{life} \leq t_{p,conf}) = p. \tag{1.6}$$

In practice, the prediction bounds are estimated by the percentiles of the estimated life distribution.

As noted above, several methods are presented for obtaining lifetime prediction and confidence bounds for both the traditional constant variance model and a generalized non-constant variance model. The constant variance model is simply a special case of the generalized model where $\beta_1 = \beta_2 = 0$. It can be shown that the life distribution at the design stress level for this special case is the same as the life distribution for the generalized model. This equivalence is not true, however, for the life distribution at any other stress level.

2. LITERATURE REVIEW

While the literature on traditional accelerated life testing is quite extensive, publications on accelerated degradation testing are relatively sparse in comparison. Nelson (1990); Meeker and Escobar (1998); Meeker, Escobar, and Lu (1998); and Escobar and Meeker (2006) provide an overview of the commonly used accelerated degradation models and analysis techniques. These analysis techniques include the maximum likelihood approach, parametric bootstrap approach, and the delta method.

Nelson (1981, 1990) describes an analysis of the dielectric breakdown strength of insulation specimens. Escobar, Meeker, Kugler, and Kramer (2003) describe an analysis of the strength of an adhesive bond referred to as “Adhesive Bond B.” The Adhesive Bond B example serves as a basis for the accelerated degradation model parameters and test plans used in this dissertation. Shi, Escobar, and Meeker (2009) provide optimal and compromise test plans for the Adhesive Bond B accelerated degradation test.

The previous references describe analyses of accelerated destructive degradation tests where the performance of each specimen was measured only once. Several authors describe analyses for accelerated degradation tests involving repeated measurements. Carey and Koenig (1991) describe an analysis of the propagation delay of an integrated logic family. Lu, Park, and Yang (1997) describe an analysis of the degradation of metal-oxide-semiconductor field-effect transistors (MOSFETs). Meeker and Escobar (1998) and Meeker, Escobar, and Lu (1998) describe an analysis of the power drop for an integrated circuit device referred to as “Device-B” from an accelerated degradation test where the power output was measured multiple times for each device. Shiau and Lin (1999) also provide a nonparametric analysis of the light output from light-emitting diodes.

Efron (1979) originally introduced the bootstrap technique. Efron and Gong (1983) and Efron (1985) describe the bias-corrected percentile method, which is a commonly used bootstrap method for analyzing accelerated degradation test data. In particular, Meeker and Escobar (1998) and Meeker, Escobar, and Lu (1998) describe the use of the bias-corrected percentile method for obtaining confidence bounds from accelerated degradation test data. Efron (1987) describes an improved bootstrap method referred to as the bias-corrected and accelerated, or BC_a, method.

DiCiccio and Efron (1996) survey the various bootstrap methods for producing confidence intervals and discuss the use of bootstrap calibration to improve their coverage probability. Davison and Hinkley (1997) provide an overview of the various bootstrap techniques and note (p. 22) that the variance of the mean under the bootstrap distribution is less than the usual result for the estimated variance of the mean. Efron (1981) also notes that the bootstrap estimate of variance is biased downward for linear statistics. Mukhopadhyay and Samaranayake (2010) extend this concept and demonstrate that the sample variance of bootstrapped residuals is lower than the sample variance of the original residuals.

Lejeune and Faulkenberry (1982) first introduced the maximum likelihood predictive density technique. Jayawardhana and Samaranayake (2002, 2003) use a method based on the maximum likelihood predictive density technique to obtain lower prediction bounds for a Weibull life distribution with an inverse power relationship using accelerated life tests with a single accelerating stress. Jayawardhana and Samaranayake (2003) use a similar method to obtain lower prediction bounds for an exponential life distribution with an inverse power relationship using accelerated life tests with two accelerating stresses. Jayawardhana (2008) extends these results to obtain lower prediction bounds for a Weibull life distribution with an inverse power relationship using accelerated life tests with two accelerating stresses. Alferink and Samaranayake (2011) use similar concepts to obtain prediction bounds in accelerated degradation testing for lognormal response distributions with the Arrhenius rate relationship. The authors assume that the natural logarithm of the standard deviation of the natural logarithm of the response variable follows a linear function of the accelerating stress, but is independent of time.

Bjørnstad (1990) provides an overview of the different types of predictive likelihood techniques. Hall, Peng, and Tajvidi (1999) propose bootstrap calibration to increase the coverage accuracy of most prediction intervals obtained using naïve or predictive likelihood approaches.

3. LIFETIME PREDICTION BOUNDS

In this section, three methods are presented for obtaining prediction bounds for the lifetime of a future product at the design stress level. The first two methods extend existing techniques to the case where the standard deviation of the response variable is a function of the accelerating stress and time, while the third method provides a new approach. As described in Section 1.5, the $100p^{th}$ prediction bound for the lifetime of a future product at the design stress level is defined by

$$P(T \leq t_{p,pred}) = p. \tag{3.1}$$

The first method presented is the maximum likelihood approach. The maximum likelihood approach is a common technique for analyzing accelerated degradation test data. This technique is described in detail by Nelson (1990) and Meeker and Escobar (1998) for the traditional constant variance model. This technique is a naive approach that replaces the unknown parameters in a distribution with their maximum likelihood estimates. In this section, the maximum likelihood approach is reviewed for the traditional constant variance model and then extended for the generalized non-constant variance model. Bjørnstad (1990) refers to the maximum likelihood approach as the estimative approach to prediction.

The second method presented is the model-based bootstrap approach. The bootstrap technique is a common technique for obtaining confidence bounds for the mean lifetime or a lifetime percentile. The model-based nonparametric bootstrap technique generates an empirical distribution for the quantity of interest by repeatedly resampling the standardized residuals from the fitted model with replacement. In this section, the model-based bootstrap approach is extended to obtain prediction bounds. This technique is also presented for the traditional constant variance model and the generalized non-constant variance model. The approach presented for the traditional model uses standard bootstrap analysis techniques, while the approach presented for the generalized model uses an improved bootstrap analysis technique that applies a variance inflation factor to account for the deflation of the variance of the residuals due to the resampling.

The third method presented is a new approach based on the maximum likelihood predictive density technique first proposed by Lejeune and Faulkenberry (1982). The maximum likelihood predictive density technique uses the maximum likelihood estimates based on the observed responses and a future unobserved response to obtain a predictive density for the response variable. An approximation is made that allows a simplification of the predictive density into a recognizable probability distribution. The approximate predictive density for the response variable is then used to obtain a predictive density for the lifetime of a future product at the design stress level. The percentiles of this predictive density are used as prediction bounds for the lifetime of a future product at the design stress level. Bjørnstad (1990) refers to the maximum likelihood predictive density as a profile predictive likelihood.

3.1 THE MAXIMUM LIKELIHOOD APPROACH

The maximum likelihood approach is a common technique for analyzing accelerated degradation test data. This technique is a naive approach that replaces the unknown parameters in a distribution with their maximum likelihood estimates. The percentiles of the estimated life distribution are used as prediction bounds for the lifetime of a future product at the design stress level. In this section, the maximum likelihood approach is first reviewed for the traditional constant variance model and then extended for the generalized non-constant variance model.

3.1.1 Traditional Model. The maximum likelihood approach is often used with the traditional constant variance model. It may be assumed that this constant variance is given by $\ln(\sigma(V_i, t_{ij})) = \beta_0$. Then the joint probability density of X is given by

$$\begin{aligned} f(x) \quad = \quad & \sqrt{2\pi}^{\;-\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}} \exp\left(-\beta_0 \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}\right)\times \\ & \exp\left(-\frac{1}{2}e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} \; x_{ijk} - \alpha_0 + \alpha_1 t_{ij} e^{\alpha_2 V_i} \;\; ^2 \right). \end{aligned} \tag{3.2}$$

The likelihood and log likelihood functions are given by

$$\begin{aligned} L(\alpha_0, \alpha_1, \alpha_2, \beta_0 \mid x) \quad = \quad & \sqrt{2\pi}^{\;-\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}} \exp\left(-\beta_0 \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}\right)\times \\ & \exp\left(-\frac{1}{2}e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} \; x_{ijk} - \alpha_0 + \alpha_1 t_{ij} e^{\alpha_2 V_i} \;\; ^2 \right) \end{aligned} \tag{3.3}$$

and

$$\begin{aligned} \ln(L(\alpha_0, \alpha_1, \alpha_2, \beta_0 \mid x)) \; = \; & -\frac{1}{2}\ln(2\pi)\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij} - \beta_0 \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij} \\ & -\frac{1}{2}e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} \; x_{ijk} - \alpha_0 + \alpha_1 t_{ij} e^{\alpha_2 V_i} \;\; ^2. \end{aligned} \tag{3.4}$$

The maximum likelihood estimates are obtained by setting the partial derivatives of the log likelihood function equal to zero and solving for the parameters. This leads to the following system of maximum likelihood equations:

$$\frac{\partial}{\partial \alpha_0}\ln(L) = 0 = e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} \; x_{ijk} - \alpha_0 + \alpha_1 t_{ij} e^{\alpha_2 V_i} \;\; , \tag{3.5}$$

$$\frac{\partial}{\partial \alpha_1} \ln(L) = 0 = -e^{-2\beta_0} \sum_{i=1}^{m} \sum_{j=1}^{n_i} \sum_{k=1}^{\eta_{ij}} t_{ij} e^{\alpha_2 V_i} \left(x_{ijk} - \left(\alpha_0 + \alpha_1 t_{ij} e^{\alpha_2 V_i} \right) \right), \tag{3.6}$$

$$\frac{\partial}{\partial \alpha_2} \ln(L) = 0 = -e^{-2\beta_0} \sum_{i=1}^{m} \sum_{j=1}^{n_i} \sum_{k=1}^{\eta_{ij}} \alpha_1 V_i t_{ij} e^{\alpha_2 V_i} \left(x_{ijk} - \left(\alpha_0 + \alpha_1 t_{ij} e^{\alpha_2 V_i} \right) \right), \text{ and} \tag{3.7}$$

$$\frac{\partial}{\partial \beta_0} \ln(L) = 0 = -\sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij} + e^{-2\beta_0} \sum_{i=1}^{m} \sum_{j=1}^{n_i} \sum_{k=1}^{\eta_{ij}} \left(x_{ijk} - \left(\alpha_0 + \alpha_1 t_{ij} e^{\alpha_2 V_i} \right) \right)^2. \tag{3.8}$$

It is apparent that this system of maximum likelihood equations is nonlinear and no easy closed-form solution exists for the parameters. Therefore, the maximum likelihood estimates must be obtained using numerical methods. Since many commercially available software packages are designed to minimize functions, it is often more convenient to calculate the maximum likelihood estimates by minimizing the negative log likelihood function in lieu of maximizing the log likelihood function.

The performance of the numerical methods can be improved by specifying initial parameter values that are relatively close to the actual values. The failure to provide adequate initial parameter values can lead to erroneous results or program crashes. The following algorithm is proposed for calculating initial values for the model parameters. This algorithm requires that there exist at least two accelerating stress levels with multiple products subjected to that accelerating stress level.

Let $\tilde{m}$ denote the number of stress levels with multiple products subjected to that accelerating stress level and let $\tilde{n}$ denote the number of pairs of stress levels with multiple products subjected to that accelerating stress level. Then the following algorithm calculates initial values for the model parameters.

1. Fit the natural logarithm of the response values with a separate linear regression model using least squares for each accelerating stress level with multiple products subjected to

that accelerating stress level. Then,

$$X(t_{ijk}) = \gamma_{0\ i} + \gamma_{1\ i} t_{ij} + \varepsilon_{ijk}, \tag{3.9}$$

where $i = 1,\ldots,\tilde{m}$; $j = 1,\ldots,n_i$; $k = 1,\ldots,\eta_{ij}$; and $\varepsilon_{ijk} \sim N(0,\sigma^2)$. Note that

$$\gamma_{0\ i} = \alpha_0 \text{ and} \tag{3.10}$$

$$\gamma_{1\ i} = -\alpha_1 e^{\alpha_2 V_i}. \tag{3.11}$$

2. Calculate an initial value for β_0. Let $\hat{\sigma}_i^2$ denote the mean squared error from each linear regression model. An initial value for β_0 is calculated by taking the average

$$\hat{\beta}_0 = \frac{1}{\tilde{m}} \sum_{i=1}^{\tilde{m}} \ln(\hat{\sigma}_i). \tag{3.12}$$

3. Calculate an initial value for α_2. Using Equation (3.11), an estimate of α_2 is calculated for each pair of accelerating stress levels with multiple products subjected to that accelerating stress level by

$$\hat{\alpha}_{2\ k} = \frac{1}{V_i - V_j} \ln\left(\left|\frac{\hat{\gamma}_{1\ i}}{\hat{\gamma}_{1\ j}}\right|\right), \tag{3.13}$$

where $i = 1,\ldots,\tilde{m}-1$; $j = i+1,\ldots,\tilde{m}$; and $k = 1,\ldots,\tilde{n}$. An initial value for α_2 is then calculated by taking the average

$$\hat{\alpha}_2 = \frac{1}{\tilde{n}} \sum_{k=1}^{\tilde{n}} \left(\hat{\alpha}_2 \right)_k . \tag{3.14}$$

4. Calculate initial values for α_0 and α_1. Using Equations (3.5) and (3.6), the maximum likelihood estimates for α_0 and α_1 satisfy the following pair of equations

$$a_1\hat{\alpha}_0 - b_1\hat{\alpha}_1 = d_1 \text{ and}$$

$$a_2\hat{\alpha}_0 - b_2\hat{\alpha}_1 = d_2,$$

where $a_1 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}$, $a_2 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}t_{ij}e^{\hat{\alpha}_2 V_i}$,

$b_1 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}t_{ij}e^{\hat{\alpha}_2 V_i}$, $b_2 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}t_{ij}^2 e^{2\hat{\alpha}_2 V_i}$,

$d_1 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} x_{ijk}$, and $d_2 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} x_{ijk}t_{ij}e^{\hat{\alpha}_2 V_i}$.

Initial values for α_0 and α_1 are calculated by solving this system of equations using the initial value for α_2. The solution to this system of equations is given by

$$\hat{\alpha}_0 = \left(b_1a_2 - a_1b_2 \right)^{-1} \left(b_1d_2 - b_2d_1 \right) \quad \text{and} \tag{3.15}$$

$$\hat{\alpha}_1 = \left(b_1a_2 - a_1b_2 \right)^{-1} \left(a_1d_2 - a_2d_1 \right) . \tag{3.16}$$

Using these initial values, the maximum likelihood estimates are obtained by numerically maximizing the log likelihood function or minimizing the negative log likelihood function. The maximum likelihood estimates are substituted into the life distribution, producing an estimated life distribution at the design stress level. The percentiles of this estimated life distribution are used as prediction bounds for the lifetime of a future product at the design stress level.

Let $\hat{\alpha}_0, \hat{\alpha}_1$, and $\hat{\beta}_0$ denote the maximum likelihood estimates of α_0, α_1, and β_0. Using Equation (1.4), the lifetime prediction bounds are given by

$$\hat{t}_p = \frac{\hat{\alpha}_0 - \mu_0}{\hat{\alpha}_1} + z_p \frac{e^{\hat{\beta}_0}}{\hat{\alpha}_1}. \tag{3.17}$$

3.1.2 Generalized Model. The maximum likelihood approach can be extended to the generalized non-constant variance model. For this model, the joint probability density of X is given by

$$\begin{aligned} f(x) \quad = \quad & \left(\sqrt{2\pi}\right)^{-\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}} \exp\left(-\beta_0\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij} - \beta_1\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij} - \beta_2\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij}^2\right) \times \\ & \exp\left(-\frac{1}{2}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} e^{-2\beta_0-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2}\left(x_{ijk} - \left(\alpha_0 + \alpha_1 t_{ij}e^{\alpha_2V_i}\right)\right)^2\right). \end{aligned} \tag{3.18}$$

The likelihood and log likelihood functions are given by

$$\begin{aligned} L(\alpha_0,\alpha_1,\alpha_2,\beta_0,\beta_1,\beta_2 \mid x) \; = \quad & \left(\sqrt{2\pi}\right)^{-\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}} \exp\left(-\beta_0\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}\right) \times \\ & \exp\left(-\beta_1\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij} - \beta_2\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij}^2\right) \times \\ & \exp\left(-\frac{1}{2}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} e^{-2\beta_0-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2}\left(x_{ijk} - \left(\alpha_0 + \alpha_1 t_{ij}e^{\alpha_2V_i}\right)\right)^2\right) \end{aligned} \tag{3.19}$$

and

$$\begin{aligned}\ln(L(\alpha_0,\alpha_1,\alpha_2,\beta_0,\beta_1,\beta_2 \mid x)) \;=\;& -\frac{1}{2}\ln(2\pi)\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij} \\ & -\beta_0\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij} - \beta_1\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij} - \beta_2\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij}^2 \\ & -\frac{1}{2}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}e^{-2\beta_0-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2}\left(x_{ijk}-\left(\alpha_0+\alpha_1t_{ij}e^{\alpha_2V_i}\right)\right)^2.\end{aligned} \tag{3.20}$$

The maximum likelihood estimates are obtained by setting the partial derivatives of the log likelihood function equal to zero and solving for the parameters. This leads to the following system of maximum likelihood equations:

$$\frac{\partial}{\partial\alpha_0}\ln(L) = 0 = e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}e^{-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2}\left(x_{ijk}-\left(\alpha_0+\alpha_1t_{ij}e^{\alpha_2V_i}\right)\right), \tag{3.21}$$

$$\frac{\partial}{\partial\alpha_1}\ln(L) = 0 = -e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}e^{-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2}\left(t_{ij}e^{\alpha_2V_i}\right)\left(x_{ijk}-\left(\alpha_0+\alpha_1t_{ij}e^{\alpha_2V_i}\right)\right), \tag{3.22}$$

$$\frac{\partial}{\partial\alpha_2}\ln(L) = 0 = -e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}e^{-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2}\left(\alpha_1V_it_{ij}e^{\alpha_2V_i}\right)\left(x_{ijk}-\left(\alpha_0+\alpha_1t_{ij}e^{\alpha_2V_i}\right)\right), \tag{3.23}$$

$$\frac{\partial}{\partial\beta_0}\ln(L) = 0 = -\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij} + e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}e^{-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2}\left(x_{ijk}-\left(\alpha_0+\alpha_1t_{ij}e^{\alpha_2V_i}\right)\right)^2, \tag{3.24}$$

$$\begin{aligned}\frac{\partial}{\partial\beta_1}\ln(L) = 0 = & -\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij} + \\ & e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}e^{-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2}\left(V_it_{ij}\right)\left(x_{ijk}-\left(\alpha_0+\alpha_1t_{ij}e^{\alpha_2V_i}\right)\right)^2,\end{aligned} \quad \text{and} \tag{3.25}$$

$$\begin{aligned}\frac{\partial}{\partial\beta_2}\ln(L) = 0 = & -\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij}^2 + \\ & e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}e^{-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2}\left(V_it_{ij}^2\right)\left(x_{ijk}-\left(\alpha_0+\alpha_1t_{ij}e^{\alpha_2V_i}\right)\right)^2.\end{aligned} \tag{3.26}$$

It is apparent that this system of maximum likelihood equations is nonlinear and no easy closed-form solution exists for the parameters. Therefore, the maximum likelihood estimates must be obtained using numerical methods. Since many commercially available software packages are designed to minimize functions, it is often more convenient to calculate the maximum likelihood estimates by minimizing the negative log likelihood function in lieu of maximizing the log likelihood function.

The performance of the numerical methods can be improved by specifying initial parameter values that are relatively close to the actual values. The failure to provide adequate initial parameter values can lead to erroneous results or program crashes. This problem is more pronounced for the generalized non-constant variance model.

The following two algorithms are proposed for calculating initial values for the model parameters. These algorithms use the same method to estimate $\alpha_0, \alpha_1,$ and α_2, but they use different methods to estimate $\beta_0, \beta_1,$ and β_2. For both algorithms, let $\hat{\sigma}_{ij}$ denote the estimated standard deviation for all stress/time combination with multiple replications. That is,

$$\hat{\sigma}_{ij} = \sqrt{\frac{1}{\eta_{ij} - 1} \sum_{k=1}^{\eta_{ij}} \left(X_{ijk} - \bar{X}_{ij} \right)^2} \qquad (3.27)$$

for any i, j such that $\eta_{ij} > 1$ where $\bar{X}_{ij} = \frac{1}{\eta_{ij}} \sum_{k=1}^{\eta_{ij}} X_{ijk}$.

The first algorithm requires that there exists at least one accelerating stress level with multiple replications at three or more measurement times. Let $\tilde{m}$ denote the number of stress levels with multiple replications at three or more measurement times. For the first algorithm, fit the natural logarithm of the estimated standard deviations with a separate linear regression model using least squares for each accelerating stress level with multiple replications at three or more measurement times. Then,

$$\ln(\hat{\sigma}_{ij}) = \beta_{0\ i} + \beta_{1\ i} V_i t_{ij} + \beta_{2\ i} V_i t_{ij}^2 + \varepsilon_{ij} \tag{3.28}$$

for $i = 1,\ldots,\tilde{m}$ and any i, j such that $\eta_{ij} > 1$. Note that the distribution of ε_{ij} is unspecified and does not affect this algorithm. Therefore, it can be assumed without loss of generality that $\varepsilon_{ij} \sim N(0,\eta^2)$. Initial values for $\beta_0, \beta_1,$ and β_2 are calculated by taking the averages

$$\hat{\beta}_0 = \frac{1}{\tilde{m}} \sum_{i=1}^{\tilde{m}} \hat{\beta}_{0\ i}, \tag{3.29}$$

$$\hat{\beta}_1 = \frac{1}{\tilde{m}} \sum_{i=1}^{\tilde{m}} \hat{\beta}_{1\ i}, \text{ and} \tag{3.30}$$

$$\hat{\beta}_2 = \frac{1}{\tilde{m}} \sum_{i=1}^{\tilde{m}} \hat{\beta}_{2\ i}. \tag{3.31}$$

The second algorithm only requires that there exist at least three stress/time combinations with multiple replications. These combinations are not restricted to the same accelerating stress level. For the second algorithm, fit the natural logarithm of the estimated standard deviations with one linear regression model using least squares. Then,

$$\ln(\hat{\sigma}_{ij}) = \beta_0 + \beta_1 V_i t_{ij} + \beta_2 V_i t_{ij}^2 + \varepsilon_{ij} \tag{3.32}$$

for any i, j such that $\eta_{ij} > 1$. Note that the distribution of ε_{ij} is unspecified and does not affect this algorithm. Therefore, it can be assumed without loss of generality that $\varepsilon_{ij} \sim N(0,\eta^2)$. Initial values for $\beta_0, \beta_1,$ and β_2 are obtained from the linear regression analysis.

After obtaining initial values for $\beta_0, \beta_1,$ and $\beta_2,$ the two algorithms use an identical method to obtain the remaining initial values for $\alpha_0, \alpha_1,$ and α_2. The remaining steps closely resemble the algorithm used to develop initial parameter values for the constant variance model.

Let $\tilde{m}$ denote the number of stress levels with multiple products subjected to that accelerating stress level and let $\tilde{n}$ denote the number of pairs of stress levels with multiple products subjected to that accelerating stress level. Then the following steps calculate initial values for the remaining parameters.

1. Fit the natural logarithm of the response values with a separate linear regression model using least squares for each accelerating stress level with multiple products subjected to that accelerating stress level. Then,

$$X(t_{ijk}) = \gamma_{0i} + \gamma_{1i} t_{ij} + \varepsilon_{ijk}, \tag{3.33}$$

where $i = 1,\ldots,\tilde{m}$; $j = 1,\ldots,n_i j$; $k = 1,\ldots,\eta_{ij}$; and $\varepsilon_{ijk} \sim N(0,\sigma^2_{ijk})$. Note that

$$\gamma_{0i} = \alpha_0 \text{ and} \tag{3.34}$$

$$\gamma_{1i} = -\alpha_1 e^{\alpha_2 V_i}. \tag{3.35}$$

2. Calculate an initial value for α_2. Using Equation (3.35), an estimate of α_2 is calculated for each pair of accelerating stress levels with multiple products subjected to that accelerating stress level by

$$\hat{\alpha}_{2\ k} = \frac{1}{V_i - V_j} \ln\left(\left| \frac{\hat{\gamma}_{1\ i}}{\hat{\gamma}_{1\ j}} \right| \right), \tag{3.36}$$

where $i = 1, \ldots, \tilde{m} - 1$; $j = i + 1, \ldots, \tilde{m}$; and $k = 1, \ldots, \tilde{n}$. An initial value for α_2 is then calculated by taking the average

$$\hat{\alpha}_2 = \frac{1}{\tilde{n}} \sum_{k=1}^{\tilde{n}} \hat{\alpha}_{2\ k}. \tag{3.37}$$

3. Calculate initial values for α_0 and α_1. Using Equations (3.21) and (3.22), the maximum likelihood estimates for α_0 and α_1 satisfy the following pair of equations

$$a_1\hat{\alpha}_0 - b_1\hat{\alpha}_1 = d_1 \text{ and}$$

$$a_2\hat{\alpha}_0 - b_2\hat{\alpha}_1 = d_2,$$

where $a_1 = \sum_{i=1}^{m}\sum_{j=1}^{n_i} \eta_{ij} e^{-2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2}$, $a_2 = \sum_{i=1}^{m}\sum_{j=1}^{n_i} \eta_{ij} t_{ij} e^{\hat{\alpha}_2 V_i - 2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2}$,

$b_1 = \sum_{i=1}^{m}\sum_{j=1}^{n_i} \eta_{ij} t_{ij} e^{\hat{\alpha}_2 V_i - 2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2}$, $b_2 = \sum_{i=1}^{m}\sum_{j=1}^{n_i} \eta_{ij} t_{ij}^2 e^{2\hat{\alpha}_2 V_i - 2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2}$,

$d_1 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} x_{ijk} e^{-2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2}$, and $d_2 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} x_{ijk} t_{ij} e^{\hat{\alpha}_2 V_i - 2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2}$.

Initial values for α_0 and α_1 are calculated by solving this system of equations using the initial values for $\alpha_2, \beta_1,$ and β_2. The solution to this system of equations is given by

$$\hat{\alpha}_0 = (b_1a_2 - a_1b_2)^{-1}(b_1d_2 - b_2d_1) \quad \text{and} \tag{3.38}$$

$$\hat{\alpha}_1 = (b_1a_2 - a_1b_2)^{-1}(a_1d_2 - a_2d_1) \quad . \tag{3.39}$$

Using these initial values, the maximum likelihood estimates are obtained by numerically maximizing the log likelihood function or minimizing the negative log likelihood function. The maximum likelihood estimates are substituted into the life distribution, producing an estimated life distribution at the design stress level. The percentiles of this estimated life distribution are used as prediction bounds for the lifetime of a future product at the design stress level.

Let $\hat{\alpha}_0, \hat{\alpha}_1,$ and $\hat{\beta}_0$ denote the maximum likelihood estimates of $\alpha_0, \alpha_1,$ and β_0. Using Equation (1.4), the lifetime prediction bounds are given by

$$\hat{t}_p = \frac{\hat{\alpha}_0 - \mu_0}{\hat{\alpha}_1} + z_p \frac{e^{\hat{\beta}_0}}{\hat{\alpha}_1}. \tag{3.40}$$

3.2 THE MODEL-BASED BOOTSTRAP APPROACH

The bootstrap technique is another approach for analyzing accelerated degradation test data. The bootstrap technique is a common technique for obtaining confidence bounds for the mean lifetime or a lifetime percentile. The model-based nonparametric bootstrap technique generates an empirical distribution for the quantity of interest by repeatedly resampling the standardized residuals from the fitted model with replacement. In this section, the model-based bootstrap approach is extended to obtain prediction bounds. This technique is first presented for the traditional constant variance model and then extended for the generalized non-constant variance model. The approach presented for the traditional model uses standard bootstrap analysis techniques, while the approach presented for the generalized model uses an improved bootstrap analysis technique that applies a variance inflation factor to account for the deflation of the variance of the residuals due to the resampling.

3.2.1 Traditional Model. The model-based bootstrap approach is often used with the traditional constant variance model. It may be assumed that this constant variance is given by $\ln(\sigma(V_i, t_{ij})) = \beta_0$. Then the accelerated degradation model can be written as

$$X(t_{ijk}) = \alpha_0 - \alpha_1 t_{ij} e^{\alpha_2 V_i} + \varepsilon_{ijk}, \tag{3.41}$$

where $\varepsilon_{ijk} \underset{iid}{\sim} N(0, e^{2\beta_0})$.

The model-based bootstrap approach uses the maximum likelihood technique to estimate the model parameters. The maximum likelihood approach for the traditional model is discussed in detail in Section 3.1.1. The maximum likelihood estimates are used to calculate the residuals from the fitted model, and the residuals are then standardized by dividing them by their estimated standard deviation.

A set of bootstrap error variables e^*_{ijk} is generated by resampling the standardized residuals with replacement and then multiplying them by their estimated standard deviation. The bootstrap error variables are then used to generate the following bootstrap sample

$$X^*(t_{ijk}) = \hat{\alpha}_0 - \hat{\alpha}_1 t_{ij} e^{\hat{\alpha}_2 V_i} + e^*_{ijk}. \tag{3.42}$$

New maximum likelihood estimates are calculated for each bootstrap sample. A single prediction for the lifetime of a future product at the design stress level is generated using the estimated life distribution obtained from the bootstrap sample maximum likelihood estimates.

Overall model-based bootstrap prediction bounds are then obtained using the percentiles of the empirical distribution of the generated predictions.

3.2.2 Generalized Model. The model-based bootstrap approach can also be extended to the generalized non-constant variance model. Then the accelerated degradation model can be written as

$$X(t_{ijk}) = \alpha_0 - \alpha_1 t_{ij} e^{\alpha_2 V_i} + \varepsilon_{ijk}, \tag{3.43}$$

where $\varepsilon_{ijk} \underset{ind}{\sim} N(0, \mathrm{e}^{2\beta_0 + 2\beta_1 V_i t_{ij} + 2\beta_2 V_i t_{ij}^2})$.

The model-based bootstrap approach uses the maximum likelihood technique to estimate the model parameters. The maximum likelihood approach for the generalized model is discussed in detail in Section 3.1.2. The maximum likelihood estimates are used to calculate the residuals from the fitted model, and the residuals are then standardized by dividing them by their estimated standard deviation.

Mukhopadhyay and Samaranayake (2010) show that the sample variance of bootstrapped residuals is lower than the sample variance of the original residuals. Therefore, the standard bootstrap analysis technique can be improved by applying a variance inflation factor to the residuals to increase the sample variance of the bootstrap sample. The variance inflation factor is a relatively small adjustment for most samples, but it can be significant for small samples. The variance inflation factor is given by

$$k = \left(\frac{\sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij}}{\sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij} - 1} \right)^{1/2}. \tag{3.44}$$

A set of bootstrap error variables e_{ijk}^{*} is generated by resampling the standardized residuals with replacement and then multiplying them by their estimated standard deviation and the variance inflation factor. The bootstrap error variables are then used to generate the following bootstrap sample

$$X^{*}(t_{ijk}) = \hat{\alpha}_0 - \hat{\alpha}_1 t_{ij} e^{\hat{\alpha}_2 V_i} + e_{ijk}^{*}. \tag{3.45}$$

New maximum likelihood estimates are calculated for each bootstrap sample. A single prediction for the lifetime of a future product at the design stress level is generated using the estimated life distribution obtained from the bootstrap sample maximum likelihood estimates. Overall model-based bootstrap prediction bounds are then obtained using the percentiles of the empirical distribution of the generated predictions.

3.3 THE MAXIMUM LIKELIHOOD PREDICTIVE DENSITY APPROACH

A new approach based on the maximum likelihood predictive density technique provides a third technique for analyzing accelerated degradation test data. The maximum likelihood predictive density technique uses the maximum likelihood approach with the observed responses and a future unobserved response to obtain a predictive density for the response variable. An approximation is made that allows a simplification of the predictive density into a recognizable probability distribution. The approximate predictive density for the response variable is then used to obtain a predictive density for the lifetime of a future product at the design stress level. The percentiles of this predictive density are used as prediction bounds for the lifetime of a future product at the design stress level.

3.3.1 Maximum Likelihood Predictive Density. Lejeune and Faulkenberry (1982) were interested in a solution to the prediction problem, which they characterized as the problem of making inferences on a random sample $Y_1,\ldots,Y_m$ given independent observations $X_1,\ldots,X_n$ drawn from the same distribution. The authors referred to $X_1,\ldots,X_n$ as the past outcomes and $Y_1,\ldots,Y_m$ as the future outcomes. The authors were primarily interested in obtaining a predictive density for Z, a statistic based on the future outcomes. The authors proposed

$$\hat{f}(z) = k(x)\sup_{\theta\in\Theta} f(x;\theta)g(z;\theta) \tag{3.46}$$

as a predictive density for Z, where $f(x;\theta)$ is the probability density function of $X_1,\ldots,X_n$, $g(z;\theta)$ is the probability density function of Z, Θ is the parameter space of the unknown parameter θ, and $k(x)$ is a normalizing constant whose existence was assumed. Namely, Lejeune and Faulkenberry proposed a predictive density for Z where the unknown parameter in the joint distribution is replaced with its maximum likelihood estimate determined from the past outcomes and the future outcomes. In this dissertation, the statistic Z is the value of a single future unobserved response.

3.3.2 Maximum Likelihood Predictive Density for the Response Variable. The maximum likelihood predictive density technique uses the maximum likelihood approach with the observed responses and a future unobserved response to obtain a predictive density for the response variable. First, the joint probability density function of X and Z is used to calculate maximum likelihood estimates of the parameters. The joint probability density function of X and Z is given by

$$f(x,z) = \left(\sqrt{2\pi}\right)^{-\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}+1\right)} \exp\left(-\beta_0\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}+1\right)\right)\times$$
$$\exp\left(-\beta_1\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij}-\beta_2\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij}^2\right)\times$$
$$\exp\left(-\frac{1}{2}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}e^{-2\beta_0-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2}\left(x_{ijk}-\alpha_0+\alpha_1t_{ij}e^{\alpha_2V_i}\right)^2\right)\times$$
$$\exp\left(-\frac{1}{2}e^{-2\beta_0}\left(z-\alpha_0+\alpha_1t\right)^2\right). \tag{3.47}$$

The likelihood and log likelihood functions are given by

$$L(\alpha_0,\alpha_1,\alpha_2,\beta_0,\beta_1,\beta_2\mid x,z) = \left(\sqrt{2\pi}\right)^{-\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}+1\right)} \exp\left(-\beta_0\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}+1\right)\right)\times$$
$$\exp\left(-\beta_1\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij}-\beta_2\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij}^2\right)\times$$
$$\exp\left(-\frac{1}{2}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}e^{-2\beta_0-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2}\left(x_{ijk}-\alpha_0+\alpha_1t_{ij}e^{\alpha_2V_i}\right)^2\right)\times$$
$$\exp\left(-\frac{1}{2}e^{-2\beta_0}\left(z-\alpha_0+\alpha_1t\right)^2\right) \tag{3.48}$$

and

$$\ln(L(\alpha_0,\alpha_1,\alpha_2,\beta_0,\beta_1,\beta_2\mid x,z)) = -\frac{1}{2}\ln(2\pi)\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}+1\right)-\beta_0\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}+1\right)-$$
$$\beta_1\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij}-\beta_2\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij}^2-$$
$$\frac{1}{2}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}e^{-2\beta_0-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2}\left(x_{ijk}-\alpha_0+\alpha_1t_{ij}e^{\alpha_2V_i}\right)^2-$$
$$\frac{1}{2}e^{-2\beta_0}\left(z-\alpha_0+\alpha_1t\right)^2 \tag{3.49}$$

The maximum likelihood estimates are obtained by setting the partial derivatives of the log likelihood function equal to zero and solving for the parameters. This leads to the following system of maximum likelihood equations:

$$\frac{\partial}{\partial \alpha_0}\ln(L) = 0 = e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} e^{-2\beta_1 V_i t_{ij} - 2\beta_2 V_i t_{ij}^2}\left(x_{ijk} - \left(\alpha_0 + \alpha_1 t_{ij} e^{\alpha_2 V_i}\right)\right) + e^{-2\beta_0}\left(z - \left(\alpha_0 + \alpha_1 t\right)\right), \tag{3.50}$$

$$\frac{\partial}{\partial \alpha_1}\ln(L) = 0 = -e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} e^{-2\beta_1 V_i t_{ij} - 2\beta_2 V_i t_{ij}^2}\left(t_{ij} e^{\alpha_2 V_i}\right)\left(x_{ijk} - \left(\alpha_0 + \alpha_1 t_{ij} e^{\alpha_2 V_i}\right)\right) - e^{-2\beta_0} t\left(z - \left(\alpha_0 + \alpha_1 t\right)\right), \tag{3.51}$$

$$\frac{\partial}{\partial \alpha_2}\ln(L) = 0 = -e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} e^{-2\beta_1 V_i t_{ij} - 2\beta_2 V_i t_{ij}^2}\left(\alpha_1 V_i t_{ij} e^{\alpha_2 V_i}\right)\left(x_{ijk} - \left(\alpha_0 + \alpha_1 t_{ij} e^{\alpha_2 V_i}\right)\right), \tag{3.52}$$

$$\frac{\partial}{\partial \beta_0}\ln(L) = 0 = -\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij} + 1\right) + e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} e^{-2\beta_1 V_i t_{ij} - 2\beta_2 V_i t_{ij}^2}\left(x_{ijk} - \left(\alpha_0 + \alpha_1 t_{ij} e^{\alpha_2 V_i}\right)\right)^2 + e^{-2\beta_0}\left(z - \left(\alpha_0 + \alpha_1 t\right)\right)^2, \tag{3.53}$$

$$\frac{\partial}{\partial \beta_1}\ln(L) = 0 = -\sum_{i=1}^{m}\sum_{j=1}^{n_i} V_i \eta_{ij} t_{ij} + e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} e^{-2\beta_1 V_i t_{ij} - 2\beta_2 V_i t_{ij}^2}\left(V_i t_{ij}\right)\left(x_{ijk} - \left(\alpha_0 + \alpha_1 t_{ij} e^{\alpha_2 V_i}\right)\right)^2, \text{ and} \tag{3.54}$$

$$\frac{\partial}{\partial \beta_2}\ln(L) = 0 = -\sum_{i=1}^{m}\sum_{j=1}^{n_i} V_i \eta_{ij} t_{ij}^2 + e^{-2\beta_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} e^{-2\beta_1 V_i t_{ij} - 2\beta_2 V_i t_{ij}^2}\left(V_i t_{ij}^2\right)\left(x_{ijk} - \left(\alpha_0 + \alpha_1 t_{ij} e^{\alpha_2 V_i}\right)\right)^2. \tag{3.55}$$

It is apparent that this system of maximum likelihood equations is nonlinear and no easy closed-form solution exists for the full set of parameters. However, it is possible to obtain a closed-form solution for the maximum likelihood estimates of α_0 and α_1 in terms of the other maximum likelihood estimates. Using Equations (3.50) and (3.51), the maximum likelihood estimates of α_0 and α_1 satisfy the following pair of equations

$a_1\hat{\alpha}_0 - b_1\hat{\alpha}_1 = d_1$ and

$$a_2\hat{\alpha}_0 - b_2\hat{\alpha}_1 = d_2,$$

where $a_1 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}e^{-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + 1,\ a_2 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}t_{ij}e^{\hat{\alpha}_2V_i-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + t,$

$$b_1 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}t_{ij}e^{\hat{\alpha}_2V_i-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + t,\ b_2 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}t_{ij}^2e^{2\hat{\alpha}_2V_i-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + t^2,$$

$$d_1 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}x_{ijk}e^{-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + z, \text{ and } d_2 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}x_{ijk}t_{ij}e^{\hat{\alpha}_2V_i-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + zt.$$

The solution to this system of equations is given by

$$\begin{aligned}
\hat{\alpha}_0 &= C^{-1}b_1\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}x_{ijk}t_{ij}e^{\hat{\alpha}_2V_i-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + zt\right) - \\
&\quad C^{-1}b_2\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}x_{ijk}e^{-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + z\right) \\
&= C^{-1}\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}t_{ij}e^{\hat{\alpha}_2V_i-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + t\right)\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}x_{ijk}t_{ij}e^{\hat{\alpha}_2V_i-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + zt\right) - \\
&\quad C^{-1}\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}t_{ij}^2e^{2\hat{\alpha}_2V_i-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + t^2\right)\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}x_{ijk}e^{-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + z\right)
\end{aligned} \tag{3.56}$$

and

$$\begin{aligned}
\hat{\alpha}_1 &= C^{-1}a_1\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}x_{ijk}t_{ij}e^{\hat{\alpha}_2V_i-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + zt\right) - \\
&\quad C^{-1}a_2\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}x_{ijk}e^{-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + z\right) \\
&= C^{-1}\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}e^{-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + 1\right)\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}x_{ijk}t_{ij}e^{\hat{\alpha}_2V_i-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + zt\right) - \\
&\quad C^{-1}\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}t_{ij}e^{\hat{\alpha}_2V_i-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + t\right)\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}x_{ijk}e^{-2\hat{\beta}_1V_it_{ij}-2\hat{\beta}_2V_it_{ij}^2} + z\right),
\end{aligned} \tag{3.57}$$

where

$$C = \left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}t_{ij}e^{\hat{\alpha}_2 V_i - 2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2} + t\right)^2 - \left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}e^{-2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2} + 1\right)\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}t_{ij}^2 e^{2\hat{\alpha}_2 V_i - 2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2} + t^2\right).$$

Using the method proposed by Lejeune and Faulkenberry, the maximum likelihood predictive density for the response variable is obtained by substituting the maximum likelihood estimates into Equation (3.47), yielding

$$\begin{aligned}\hat{f}(z) = \; & k_0(x)\exp\left(-\hat{\beta}_0\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij} + 1\right) - \hat{\beta}_1\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij} - \hat{\beta}_2\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij}^2\right)\times \\ & \exp\left(-\frac{1}{2}e^{-2\hat{\beta}_0}\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}e^{-2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2}\left(x_{ijk} - \hat{\alpha}_0 + \hat{\alpha}_1 t_{ij}e^{\hat{\alpha}_2 V_i}\right)^2\right)\times \\ & \exp\left(-\frac{1}{2}e^{-2\hat{\beta}_0}\left(z - \hat{\alpha}_0 + \hat{\alpha}_1 t\right)^2\right).\end{aligned} \tag{3.58}$$

Here $\hat{\alpha}_2, \hat{\beta}_0, \hat{\beta}_1,$ and $\hat{\beta}_2$ denote the currently unspecified maximum likelihood estimates of $\alpha_2, \beta_0, \beta_1,$ and β_2. Note that $\hat{\alpha}_2, \hat{\beta}_0, \hat{\beta}_1,$ and $\hat{\beta}_2$ are functions of the observed data X and the future observation Z. Using Equation (3.53), the maximum likelihood predictive density function simplifies to

$$\begin{aligned}\hat{f}(z) = \; & \hat{k}(x)\exp\left(-\hat{\beta}_1\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij} - \hat{\beta}_2\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij}^2\right)\times \\ & \left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}}e^{-2\hat{\beta}_1 V_i t - 2\hat{\beta}_2 V_i t_{ij}^2}\xi_{ijk}^{\;2} + \xi_0^{\;2}\right)^{-\frac{1}{2}\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij} + 1\right)},\end{aligned} \tag{3.59}$$

where $\hat{k}(x) = k_0(x)\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij} + 1\right)^{\frac{1}{2}\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij} + 1\right)}\exp\left(-\frac{1}{2}\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij} + 1\right)\right),$

$$\xi_{ijk} = x_{ijk} - \hat{\alpha}_0 + \hat{\alpha}_1 t_{ij} e^{\hat{\alpha}_2 V_i}, \text{ and}$$

$$\xi_0 = z - \hat{\alpha}_0 + \hat{\alpha}_1 t.$$

The maximum likelihood predictive density function for the response variable can be further simplified using

$$\xi_{ijk} = W_{ijk} + k_{ijk} z \text{ and} \tag{3.60}$$

$$\xi_0 = W_0 + k_0 z, \tag{3.61}$$

where $k_{ijk}(t) = C^{-1} \;\; b_2 - b_1 t \;\; - \;\; a_2 - a_1 t \;\; t_{ij} e^{\hat{\alpha}_2 V_i} \;\;,$

$$k_0(t) \;=\; 1 + C^{-1} \;\; b_2 - b_1 t \;\; - \;\; a_2 - a_1 t \;\; t \;\;,$$

$$\begin{aligned} W_{ijk} \;&=\; x_{ijk} + C^{-1} \;\; b_2 - a_2 t_{ij} e^{\hat{\alpha}_2 V_i} \;\; \sum_{i=1}^{m} \sum_{j=1}^{n_i} \sum_{k=1}^{\eta_{ij}} x_{ijk} e^{-2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2} \; - \\ &\quad C^{-1} \;\; b_1 - a_1 t_{ij} e^{\hat{\alpha}_2 V_i} \;\; \sum_{i=1}^{m} \sum_{j=1}^{n_i} \sum_{k=1}^{\eta_{ij}} x_{ijk} t_{ij} e^{\hat{\alpha}_2 V_i - 2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2}, \text{ and} \end{aligned}$$

$$\begin{aligned} W_0 \;&=\; C^{-1} \;\; b_2 - a_2 t \;\; \sum_{i=1}^{m} \sum_{j=1}^{n_i} \sum_{k=1}^{\eta_{ij}} x_{ijk} e^{-2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2} \; - \\ &\quad C^{-1} \;\; b_1 - a_1 t \;\; \sum_{i=1}^{m} \sum_{j=1}^{n_i} \sum_{k=1}^{\eta_{ij}} x_{ijk} t_{ij} e^{\hat{\alpha}_2 V_i - 2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2}. \end{aligned}$$

Using Equations (3.60) and (3.61), the maximum likelihood predictive density function for the response variable can be written as

$$\begin{aligned} \hat{f}(z) \;&=\; \hat{k}(x) \exp\left(-\hat{\beta}_1 \sum_{i=1}^{m} \sum_{j=1}^{n_i} V_i \eta_{ij} t_{ij} - \hat{\beta}_2 \sum_{i=1}^{m} \sum_{j=1}^{n_i} V_i \eta_{ij} t_{ij}^2 \right) \times \\ &\quad \left(\sum_{i=1}^{m} \sum_{j=1}^{n_i} \sum_{k=1}^{\eta_{ij}} e^{-2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2} (W_{ijk} + k_{ijk} z)^2 + (W_0 + k_0 z)^2 \right)^{-\frac{1}{2}\left(\sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij} + 1 \right)}. \end{aligned} \tag{3.62}$$

Let $$A_0 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} e^{-2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2} W_{ijk}^2 + W_0^2, \tag{3.63}$$

$$A_1 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} e^{-2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2} W_{ijk} k_{ijk} + W_0 k_0, \text{ and} \tag{3.64}$$

$$A_2 = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\sum_{k=1}^{\eta_{ij}} e^{-2\hat{\beta}_1 V_i t_{ij} - 2\hat{\beta}_2 V_i t_{ij}^2} k_{ijk}^2 + k_0^2. \tag{3.65}$$

Then the maximum likelihood predictive density for the response variable can be written as

$$\hat{f}(z) = \hat{k}(x)\exp\left(-\hat{\beta}_1 \sum_{i=1}^{m}\sum_{j=1}^{n_i} V_i \eta_{ij} t_{ij} - \hat{\beta}_2 \sum_{i=1}^{m}\sum_{j=1}^{n_i} V_i \eta_{ij} t_{ij}^2\right) \left(A_0 + 2A_1 z + A_2 z^2\right)^{-\frac{1}{2}\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}+1\right)}. \tag{3.66}$$

3.3.3 Approximate Maximum Likelihood Estimates. Equation (3.66) provides the maximum likelihood predictive density for the response variable. As noted above, $\hat{\alpha}_2, \hat{\beta}_0, \hat{\beta}_1,$ and $\hat{\beta}_2$ are functions of the observed data X and the future observation Z. Then $A_0, A_1,$ and A_2 are also functions of the future observation Z. It can easily be seen that $\hat{f}(z)$ is not in the form of any recognizable probability density function and calculation of the density function requires numerical techniques.

An approximation is made that replaces the actual maximum likelihood estimates with approximations that are functions of only the observed data. This approximation allows the maximum likelihood predictive density function for the response variable to be simplified into a recognizable probability density function.

Three different methods are provided for approximating the maximum likelihood estimates. The first two methods begin by estimating the standard deviation of the natural logarithm of the response variable for all stress/time combinations with multiple replications. The different methods are summarized below.

1. The first method is identical to the first algorithm provided in Section 3.1.2. This method fits the natural logarithm of the estimated standard deviations with a separate linear regression model using least squares for each accelerating stress level with multiple replications at three or more measurement times. Approximate maximum likelihood estimates for β_0, β_1, and β_2 are calculated using Equations (3.29), (3.30), and (3.31). This method then fits the natural logarithm of the response values with a separate linear regression model using least squares for each accelerating stress level with multiple products subjected to that accelerating stress level. An approximate maximum likelihood estimate of α_2 is calculated using Equations (3.36) and (3.37). This method requires that there exists at least one accelerating stress level with multiple replications at three or more measurement times.

2. The second method is identical to the second algorithm provided in Section 3.1.2. This method fits natural logarithm of the estimated standard deviations with one linear regression model using least squares. Approximate maximum likelihood estimates for β_0, β_1, and β_2 are obtained directly from the regression analysis. This method then fits the natural logarithm of the response values with a separate linear regression model using least squares for each accelerating stress level with multiple products subjected to that accelerating stress level. An approximate maximum likelihood estimate of α_2 is calculated using Equations (3.36) and (3.37). This method only requires that there exist at least three stress/time combinations with multiple replications.

3. The third method uses the maximum likelihood approach presented in Section 3.1.2. This method uses numerical methods to obtain maximum likelihood estimates of α_2, β_0, β_1, and β_2 that are functions of only the observed data. These estimates are then used as

approximate maximum likelihood estimates for the maximum likelihood predictive density technique.

Each method provides slightly different approximations for the maximum likelihood estimates. The relative performance of these different approximations in obtaining prediction bounds is compared using Monte Carlo simulations.

3.3.4 Approximate Predictive Density for the Response Variable. Let $\tilde{\alpha}_2, \tilde{\beta}_0, \tilde{\beta}_1,$ and $\tilde{\beta}_2$ denote the approximate maximum likelihood estimates obtained using any of the three methods described above. Let $\tilde{A}_0, \tilde{A}_1,$ and $\tilde{A}_2$ denote the values obtained by substituting $\tilde{\alpha}_2, \tilde{\beta}_0,$ $\tilde{\beta}_1,$ and $\tilde{\beta}_2$ into Equations (3.63) through (3.65). An approximate maximum likelihood predictive density for the response variable is obtained by substituting the approximate maximum likelihood estimates into Equation (3.66). This density function can be written as

$$\tilde{f}(z) \quad = \quad \tilde{k}(x) \;\; \tilde{A}_0 + 2\tilde{A}_1 z + \tilde{A}_2 z^2 \;\; ^{-\frac{1}{2}\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}+1\right)}, \tag{3.67}$$

where $\tilde{k}(x) \quad = \quad \hat{k}(x)\exp\left(-\tilde{\beta}_1\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij} - \tilde{\beta}_2\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij}^2\right).$

It can be shown that $\tilde{A}_0\tilde{A}_2 - \tilde{A}_1^2 > 0$. Then the approximate maximum likelihood predictive density function for the response variable can be written as

$$\tilde{f}(z) \quad = \quad \tilde{k}(x) \;\; 1 + \;\; \tilde{A}_0\tilde{A}_2 - \tilde{A}_1^2 \;\; ^{-1} \; \tilde{A}_2^2 \;\; \tilde{A}_1\tilde{A}_2^{-1} + z \;\; ^{2} \;\; ^{-\frac{1}{2}\left(\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}+1\right)}. \tag{3.68}$$

Using the transformation $\tau = \tau(z) = \left(\sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij} \right)^{1/2} \quad \tilde{A}_0 \tilde{A}_2 - \tilde{A}_1^2 \quad ^{-1/2} \tilde{A}_2 \quad \tilde{A}_1 \tilde{A}_2^{-1} + z$, the approximate maximum likelihood predictive density function becomes

$$\tilde{f}(\tau) \quad = \quad k(x) \left(1 + \left(\sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij} \right)^{-1} \tau^2 \right)^{-\frac{1}{2}\left(\sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij} + 1 \right)} . \tag{3.69}$$

This is the probability density function of a Student's t-distribution with $\sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij}$ degrees of freedom. Then it can be shown that $k(x)$ is independent of the observed data and given by

$$k(x) \quad = \quad \left(\pi \sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij} \right)^{-1/2} \Gamma \left(\left(\sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij} + 1 \right) / \ 2 \right) \left(\Gamma \left(\sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij} \ / \ 2 \right) \right)^{-1} . \tag{3.70}$$

3.3.5 Predictive Density for the Lifetime. As specified in the accelerated degradation model, failure is assumed to occur when the response variable crosses a predefined threshold. As before, let T denote the lifetime of a product subjected to the design stress and F denote the cumulative distribution function for the random variable T. Let F_t denote the cumulative distribution function of a Student's t-distribution with $\sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij}$ degrees of freedom. Using the approximate maximum likelihood predictive density for the response variable, the probability that a future product at the design stress fails by time t is given by

$$F(t) = P(T \leq t) = P(Z(t) \leq \mu_0) = P(\tau(Z) \leq \tau(\mu_0)) = F_t(\tau(\mu_0)). \tag{3.71}$$

Note that $\tau(\mu_0)$ is an implicit function of t through the variables $\tilde{A}_0, \tilde{A}_1$, and $\tilde{A}_2$. Thus, the predictive density for T is characterized through a Student's t-distribution with an argument of $\tau(\mu_0)$ and $\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}$ degrees of freedom.

3.3.6 Prediction Bounds. Prediction bounds for the lifetime of a future product at the design stress level are obtained from the percentiles of the predictive density for the lifetime. Let t_p denote the $100p^{th}$ percentile of the predictive density for T and let τ_p denote the $100p^{th}$ percentile of a Student's t-distribution with $\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}$ degrees of freedom. Then t_p is determined by solving

$$\tau(\mu_0) = \tau_p. \tag{3.72}$$

The value of t_p must be solved numerically since no closed-form expression has been found for $\tau(\mu_0)$ as a function of time.

4. CONFIDENCE BOUNDS FOR THE MEAN LIFETIME

In this section, two methods are presented for obtaining confidence bounds for the mean lifetime at the design stress level. Both of these methods extend existing techniques. As described in Section 1.5, the $100p^{th}$ confidence bound for the mean lifetime at the design stress level is defined by

$$P(\mu_{life} \leq t_{p,conf}) = p. \tag{4.1}$$

The first method presented is the delta method. The delta method is a technique for obtaining approximate expected values, variances, and covariances of functions of parameter estimators. The delta method can also be used to obtain approximate asymptotic distributions for functions of maximum likelihood estimators. This technique is presented for obtaining an approximate asymptotic distribution for the mean lifetime at the design stress level. The percentiles of this approximate distribution are used as confidence bounds for the mean lifetime at the design stress level. This technique is first presented for the traditional constant variance model and then the generalized non-constant variance model.

Next, the model-based bootstrap approach is presented again. As noted before, the bootstrap technique is a common technique for obtaining confidence bounds for the mean lifetime or a lifetime percentile. Meeker and Escobar (1998) and Meeker, Escobar, and Lu (1998) present the bias-corrected percentile method for obtaining confidence bounds using a parametric bootstrap approach for the traditional constant variance model. In this section, the percentile, bias-corrected percentile, and normal theory methods are reviewed for obtaining confidence bounds using a model-based nonparametric bootstrap approach for the traditional constant variance and the generalized non-constant variance models. A simple adjustment is made to the percentile method to adjust for bias. The use of the model-based bootstrap approach to generate bootstrap samples for the traditional constant variance and the generalized non-constant variance models is discussed in detail in Sections 3.2.1 and 3.2.2, respectively.

4.1 THE DELTA METHOD

The delta method is a technique for obtaining approximate expected values, variances, and covariances of functions of parameter estimators. The delta method can also be used to obtain approximate asymptotic distributions for functions of maximum likelihood estimators. In this section, the delta method is presented for obtaining an approximate distribution for the mean lifetime at the design stress level. The percentiles of this approximate distribution are then used as confidence bounds for the mean lifetime at the design stress level. This technique is first presented for the traditional constant variance model and then the generalized non-constant variance model.

The asymptotic distribution of the maximum likelihood estimators is employed by the delta method to derive an approximate distribution for the mean lifetime. Let θ denote the vector of model parameters, $\hat{\theta}$ denote the vector of maximum likelihood estimators, and I_θ denote the Fisher Information Matrix. Then the maximum likelihood estimators have an asymptotic normal distribution with a mean vector equal to θ and a covariance matrix equal to I_θ^{-1}.

4.1.1 Traditional Model. The Fisher Information Matrix is obtained by taking the negative of the expected value of the second order partial derivatives of the log likelihood function. For the traditional constant variance model, the individual elements of the Fisher Information Matrix are given by

$$(I_\theta)_{11} = e^{-2\beta_0} \sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij}, \tag{4.2}$$

$$(I_\theta)_{12} = (I_\theta)_{21} = -e^{-2\beta_0} \sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij} t_{ij} e^{\alpha_2 V_i}, \tag{4.3}$$

$$(I_\theta)_{13} = (I_\theta)_{31} = -e^{-2\beta_0} \sum_{i=1}^{m} \sum_{j=1}^{n_i} \alpha_1 V_i \eta_{ij} t_{ij} e^{\alpha_2 V_i}, \tag{4.4}$$

$$(I_\theta)_{14} = (I_\theta)_{41} = 0, \tag{4.5}$$

$$(I_\theta)_{22} = e^{-2\beta_0} \sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij} \left(t_{ij} e^{\alpha_2 V_i} \right)^2, \tag{4.6}$$

$$(I_\theta)_{23} = (I_\theta)_{32} = e^{-2\beta_0} \sum_{i=1}^{m} \sum_{j=1}^{n_i} \alpha_1 V_i \eta_{ij} \left(t_{ij} e^{\alpha_2 V_i} \right)^2, \tag{4.7}$$

$$(I_\theta)_{24} = (I_\theta)_{42} = 0, \tag{4.8}$$

$$(I_\theta)_{33} = e^{-2\beta_0} \sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij} \left(\alpha_1 V_i t_{ij} e^{\alpha_2 V_i} \right)^2, \tag{4.9}$$

$$(I_\theta)_{34} = (I_\theta)_{43} = 0, \text{ and} \tag{4.10}$$

$$(I_\theta)_{44} = 2 \sum_{i=1}^{m} \sum_{j=1}^{n_i} \eta_{ij}. \tag{4.11}$$

Let I_α denote the real symmetric matrix formed from the intersection of the first three rows and columns of the Fisher Information Matrix. Then the Fisher Information Matrix and its inverse can be represented by the real symmetric block diagonal matrices

$$I_\theta = \begin{pmatrix} I_\alpha & 0 \\ 0 & (I_\theta)_{44} \end{pmatrix} \text{ and} \tag{4.12}$$

$$I_\theta^{-1} = \begin{pmatrix} I_\alpha^{-1} & 0 \\ 0 & (I_\theta)_{44}^{-1} \end{pmatrix}. \tag{4.13}$$

Since I_α is a $3\text{x}3$ matrix, its inverse can easily be determined explicitly. As noted above, the mean lifetime at the design stress level is given by

$$\mu_{life} = \frac{\alpha_0 - \mu_0}{\alpha_1}. \tag{4.14}$$

The maximum likelihood estimators have an asymptotic multivariate normal distribution. Therefore, a linear function of the maximum likelihood estimators also has an asymptotic normal distribution. The mean lifetime at the design stress level, however, is not a linear function of the parameters. The delta method derives an approximate distribution for the mean lifetime by first creating a linear approximation of the mean lifetime. To calculate this approximate distribution, the following real-valued function of the parameters is defined:

$$g(\theta) = \frac{\alpha_0 - \mu_0}{\alpha_1}. \tag{4.15}$$

The partial derivatives of g are given by

$$\frac{\partial}{\partial \alpha_0} g(\theta) = \frac{1}{\alpha_1}, \tag{4.16}$$

$$\frac{\partial}{\partial \alpha_1} g(\theta) = -\frac{\alpha_0 - \mu_0}{\alpha_1^2}, \tag{4.17}$$

$$\frac{\partial}{\partial \alpha_2} g(\theta) = 0, \text{ and} \tag{4.18}$$

$$\frac{\partial}{\partial \beta_0} g(\theta) = 0. \tag{4.19}$$

Using the delta method, an approximate distribution for the mean lifetime at the design stress level is a normal distribution with the following mean and variance:

$$\mu_{delta} = \frac{\alpha_0 - \mu_0}{\alpha_1} \text{ and} \tag{4.20}$$

$$\begin{aligned}\sigma^2_{delta} &= (\partial g \,/\, \partial\theta)'(I_\theta^{-1})(\partial g \,/\, \partial\theta) \\ &= \left(\frac{1}{\alpha_1}\right)^2 (I_\theta^{-1})_{11} + \left(\frac{\alpha_0 - \mu_0}{\alpha_1^2}\right)^2 (I_\theta^{-1})_{22} - 2\left(\frac{1}{\alpha_1}\right)\left(\frac{\alpha_0 - \mu_0}{\alpha_1^2}\right)(I_\theta^{-1})_{12}.\end{aligned} \tag{4.21}$$

The percentiles of this approximate distribution are used as confidence bounds for the mean lifetime at the design stress level. Let $\hat{\alpha}_0, \hat{\alpha}_1,$ and $\hat{\beta}_0$ denote the maximum likelihood estimates of $\alpha_0, \alpha_1,$ and β_0. Using Equations (4.20) and (4.21), the confidence bounds are given by

$$\hat{t}_p = \frac{\hat{\alpha}_0 - \mu_0}{\hat{\alpha}_1} + z_p\left(\left(\frac{1}{\hat{\alpha}_1}\right)^2 (\hat{I}_\theta^{-1})_{11} + \left(\frac{\hat{\alpha}_0 - \mu_0}{\hat{\alpha}_1^2}\right)^2 (\hat{I}_\theta^{-1})_{22} - 2\left(\frac{1}{\hat{\alpha}_1}\right)\left(\frac{\hat{\alpha}_0 - \mu_0}{\hat{\alpha}_1^2}\right)(\hat{I}_\theta^{-1})_{12}\right)^{1/2}, \tag{4.22}$$

where $\hat{I}_\theta$ denotes the Fisher Information Matrix calculated with the maximum likelihood estimates.

4.1.2 Generalized Model. The Fisher Information Matrix is obtained by taking the negative of the expected value of the second order partial derivatives of the log likelihood function. For the generalized non-constant variance model, the individual elements of the Fisher Information Matrix are given by

$$(I_\theta)_{11} = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}e^{-2\beta_0-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2}, \tag{4.23}$$

$$(I_\theta)_{12} = (I_\theta)_{21} = -\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}e^{-2\beta_0-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2} \quad t_{ij}e^{\alpha_2V_i} \quad , \tag{4.24}$$

$$(I_\theta)_{13} = (I_\theta)_{31} = -\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}e^{-2\beta_0-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2} \quad \alpha_1V_it_{ij}e^{\alpha_2V_i} \quad , \tag{4.25}$$

$$(I_\theta)_{14} = (I_\theta)_{41} = 0, \tag{4.26}$$

$$(I_\theta)_{15} = (I_\theta)_{51} = 0, \tag{4.27}$$

$$(I_\theta)_{16} = (I_\theta)_{61} = 0, \tag{4.28}$$

$$(I_\theta)_{22} = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}e^{-2\beta_0-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2} \quad t_{ij}e^{\alpha_2V_i} \quad {}^2, \tag{4.29}$$

$$(I_\theta)_{23} = (I_\theta)_{32} = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}e^{-2\beta_0-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2}\alpha_1V_i \quad t_{ij}e^{\alpha_2V_i} \quad {}^2, \tag{4.30}$$

$$(I_\theta)_{24} = (I_\theta)_{42} = 0, \tag{4.31}$$

$$(I_\theta)_{25} = (I_\theta)_{52} = 0, \tag{4.32}$$

$$(I_\theta)_{26} = (I_\theta)_{62} = 0, \tag{4.33}$$

$$(I_\theta)_{33} = \sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}e^{-2\beta_0-2\beta_1V_it_{ij}-2\beta_2V_it_{ij}^2} \quad \alpha_1V_it_{ij}e^{\alpha_2V_i} \quad {}^2, \tag{4.34}$$

$$(I_\theta)_{34} = (I_\theta)_{43} = 0, \tag{4.35}$$

$$(I_\theta)_{35} = (I_\theta)_{53} = 0, \tag{4.36}$$

$$(I_\theta)_{36} = (I_\theta)_{63} = 0, \tag{4.37}$$

$$(I_\theta)_{44} = 2\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}, \tag{4.38}$$

$$(I_\theta)_{45} = (I_\theta)_{54} = 2\sum_{i=1}^{m}\sum_{j=1}^{n_i}V_i\eta_{ij}t_{ij}, \tag{4.39}$$

$$(I_\theta)_{46} = (I_\theta)_{64} = 2\sum_{i=1}^{m}\sum_{j=1}^{n_i} V_i \eta_{ij} t_{ij}^2, \tag{4.40}$$

$$(I_\theta)_{55} = 2\sum_{i=1}^{m}\sum_{j=1}^{n_i} \eta_{ij} \quad V_i t_{ij} \quad ^2, \tag{4.41}$$

$$(I_\theta)_{56} = (I_\theta)_{65} = 2\sum_{i=1}^{m}\sum_{j=1}^{n_i} V_i^2 \eta_{ij} t_{ij}^3, \text{ and} \tag{4.42}$$

$$(I_\theta)_{66} = 2\sum_{i=1}^{m}\sum_{j=1}^{n_i} \eta_{ij} \quad V_i t_{ij}^2 \quad ^2. \tag{4.43}$$

Let I_α denote the real symmetric matrix formed from the intersection of the first three rows and columns of the Fisher Information Matrix and let I_β denote the real symmetric matrix formed from the intersection of the last three rows and columns of the Fisher Information Matrix. Then the Fisher Information Matrix and its inverse can be represented by the real symmetric block diagonal matrices

$$I_\theta = \begin{pmatrix} I_\alpha & 0 \\ 0 & I_\beta \end{pmatrix} \text{ and} \tag{4.44}$$

$$I_\theta^{-1} = \begin{pmatrix} I_\alpha^{-1} & 0 \\ 0 & I_\beta^{-1} \end{pmatrix}. \tag{4.45}$$

Since I_α and I_β are $3\text{x}3$ matrices, their inverses can easily be determined explicitly. As noted above, the mean lifetime at the design stress level is given by

$$\mu_{life} = \frac{\alpha_0 - \mu_0}{\alpha_1}. \tag{4.46}$$

The maximum likelihood estimators have an asymptotic multivariate normal distribution. Therefore, a linear function of the maximum likelihood estimators also has an asymptotic normal distribution. The mean lifetime at the design stress level, however, is not a linear function of the parameters. The delta method derives an approximate distribution for the mean lifetime by first creating a linear approximation of the mean lifetime. To calculate this approximate distribution, the following real-valued function of the parameters is defined:

$$g(\theta) = \frac{\alpha_0 - \mu_0}{\alpha_1}. \tag{4.47}$$

The partial derivatives of g with are given by

$$\frac{\partial}{\partial \alpha_0} g(\theta) = \frac{1}{\alpha_1}, \tag{4.48}$$

$$\frac{\partial}{\partial \alpha_1} g(\theta) = -\frac{\alpha_0 - \mu_0}{\alpha_1^2}, \tag{4.49}$$

$$\frac{\partial}{\partial \alpha_2} g(\theta) = 0, \tag{4.50}$$

$$\frac{\partial}{\partial \beta_0} g(\theta) = 0, \tag{4.51}$$

$$\frac{\partial}{\partial \beta_1} g(\theta) = 0, \text{ and} \tag{4.52}$$

$$\frac{\partial}{\partial \beta_2} g(\theta) = 0. \tag{4.53}$$

Using the delta method, an approximate distribution for the mean lifetime at the design stress level is a normal distribution with the following mean and variance:

$$\mu_{delta} = \frac{\alpha_0 - \mu_0}{\alpha_1} \text{ and} \tag{4.54}$$

$$\sigma^2_{delta} = (\partial g / \partial\theta)'(I_\theta^{-1})(\partial g / \partial\theta)$$

$$= \left(\frac{1}{\alpha_1}\right)^2 (I_\theta^{-1})_{11} + \left(\frac{\alpha_0 - \mu_0}{\alpha_1^2}\right)^2 (I_\theta^{-1})_{22} - 2\left(\frac{1}{\alpha_1}\right)\left(\frac{\alpha_0 - \mu_0}{\alpha_1^2}\right)(I_\theta^{-1})_{12}. \tag{4.55}$$

The percentiles of this approximate distribution are used as confidence bounds for the mean lifetime at the design stress level. Let $\hat{\alpha}_0, \hat{\alpha}_1, \hat{\alpha}_2, \hat{\beta}_0, \hat{\beta}_1,$ and $\hat{\beta}_2$ denote the maximum likelihood estimates of $\alpha_0, \alpha_1, \alpha_2, \beta_0, \beta_1,$ and β_2. Using Equations (4.54) and (4.55), the confidence bounds are given by

$$\hat{t}_p = \frac{\hat{\alpha}_0 - \mu_0}{\hat{\alpha}_1} + z_p \left(\left(\frac{1}{\hat{\alpha}_1}\right)^2 (\hat{I}_\theta^{-1})_{11} + \left(\frac{\hat{\alpha}_0 - \mu_0}{\hat{\alpha}_1^2}\right)^2 (\hat{I}_\theta^{-1})_{22} - 2\left(\frac{1}{\hat{\alpha}_1}\right)\left(\frac{\hat{\alpha}_0 - \mu_0}{\hat{\alpha}_1^2}\right)(\hat{I}_\theta^{-1})_{12} \right)^{1/2}, \tag{4.56}$$

where $\hat{I}_\theta$ denotes the Fisher Information Matrix calculated with the maximum likelihood estimates.

4.2 THE MODEL-BASED BOOTSTRAP APPROACH

As noted before, the bootstrap technique is a common technique for obtaining confidence bounds for the mean lifetime or a lifetime percentile. Meeker and Escobar (1998) and Meeker, Escobar, and Lu (1998) present the bias-corrected percentile method for obtaining confidence bounds using a parametric bootstrap approach for the traditional constant variance model. In this section, the percentile, bias-corrected percentile, and normal theory methods are reviewed for obtaining confidence bounds using a model-based nonparametric bootstrap approach for the traditional constant variance and the generalized non-constant variance models. A simple adjustment is made to the percentile method to adjust for bias. The use of the model-based bootstrap approach to generate bootstrap samples for the traditional constant variance and the generalized non-constant variance models is discussed in detail in Sections 3.2.1 and 3.2.2, respectively.

4.2.1 Percentile Confidence Bounds. The percentile method is one method for obtaining confidence bounds from the bootstrap data. For this method, the confidence bounds are obtained from the empirical distribution of the mean lifetime. A simple adjustment is made to the percentile method to adjust for bias. Let b denote the number of bootstrap samples, $\hat{\mu}_{life}$ denote the maximum likelihood estimate of the mean lifetime from the original sample, $\bar{T}_b$ denote the average of the bootstrap estimates of the mean lifetime, and let $T_{(i)}$ denote the ordered estimates of the mean lifetime for $i = 1,\ldots,b$. Then the percentile confidence bounds for the mean lifetime at the design stress level are given by

$$\hat{t}_p = T_{([(b+1)p])} - (\bar{T}_b - \hat{\mu}_{life}), \qquad (4.57)$$

where the square brackets indicate rounding to the nearest integer.

4.2.2 Bias-Corrected Percentile Confidence Bounds. The bias-corrected percentile method is a more common method for obtaining confidence bounds from the bootstrap data. The bias-corrected percentile method is similar to the percentile method described above, but it uses a more sophisticated correction for bias. Let $\hat{\mu}_{life}$ denote the maximum likelihood estimate of the mean lifetime, T_i denote the bootstrap estimates of the mean lifetime for $i = 1,\ldots,b$, and z_0 denote the bias correction factor. Then,

$$z_0 = \Phi^{-1}\left(\frac{1}{b+1}\sum_{i=1}^{b}\delta_i\right), \tag{4.58}$$

where $\delta_i = 1$ if $T_i < \hat{\mu}_{life}$ and $\delta_i = 0$ if $T_i \geq \hat{\mu}_{life}$. Then the bias-corrected percentile confidence bounds for the mean lifetime at the design stress level are given by

$$\hat{t}_p = T_{([(b+1)\Phi(2z_0 + z_p)])}, \tag{4.59}$$

where the square brackets indicate rounding to the nearest integer. When the bootstrap estimates are symmetric about the maximum likelihood estimate, then $z_0 = 0$ and the bias-corrected percentile confidence bounds are the same as the percentile confidence bounds without the simple bias adjustment.

4.2.3 Normal Theory Confidence Bounds. The normal theory method is another method for obtaining confidence bounds from the bootstrap data. For this method, it is assumed that the bootstrap sample of the mean lifetimes has a normal distribution. The confidence bounds are obtained from the estimated percentiles of this distribution. Specifically, let $\hat{\sigma}_b$ denote the standard deviation of the bootstrap sample of the mean lifetimes. Then the normal theory confidence bounds for the mean lifetime at the design stress level, using a simple adjustment to account for the bias, are given by

$$\hat{t}_p = \hat{\mu}_{life} + z_p\hat{\sigma}_b. \tag{4.60}$$

5. MONTE CARLO SIMULATION

The objective of this dissertation is to propose and study several methods for obtaining lifetime prediction and confidence bounds for both homoscedastic and heteroscedastic models. The performance of the various methods is compared using a Monte Carlo simulation study.

In practice, researchers are primarily interested in the coverage probability of the lifetime prediction and confidence bounds. For prediction bounds, the coverage probability is defined as the probability that a future product subjected to the design stress will fail before the prediction bound. For confidence bounds, the coverage probability is defined as the proportion of time that the confidence bound exceeds the mean lifetime at the design stress level.

5.1 SIMULATION OUTLINE

The Monte Carlo simulation was performed in two parts. The first part of the simulation was based on the Adhesive Bond B example provided by Meeker, Escobar, Kugler, and Kramer (2003). This example represents a situation where the product is expected to have a lifetime at the highest accelerating stress level that is a small fraction of the lifetime at the design stress level. This would occur, for example, when the lifetime at the design stress level is greater than the lifetime at the highest accelerating stress level by an order of magnitude or more. In this situation, a large degree of extrapolation is required to estimate the life distribution at the design stress level. This example is described in Section 5.2.

The second part of the simulation represents a situation where the product is expected to have a lifetime at the highest accelerating stress level that is a significant fraction of the lifetime at the design stress level. This would occur, for example, when the lifetime at the design stress level is within an order of magnitude of the lifetime at the highest accelerating stress level. In this situation, the amount of extrapolation required to estimate the life distribution at the design stress level is reduced, and it is expected that the prediction and confidence bounds will perform better for all of the techniques described above. This example is described below in Section 5.3.

The overall objective of the Monte Carlo simulation study is to compare the performance of the lifetime prediction and confidence bounds obtained from the various techniques described above. The two parts of the simulation were designed to explore different effects on the performance of the lifetime prediction and confidence bounds. The first part of the simulation was designed to explore the effect of changes in the parameter values. In this part, a large number of parameter combinations were selected in combination with a single test plan (sampling scheme). The second part of the simulation was designed to explore the effect of changes in the test plan. In this part, four different test plans were selected in combination with a small number of parameter combinations. The test plans and parameter combinations were deliberately chosen to closely relate to those from the first part of the simulation so that a more meaningful comparison of the results can be made.

5.2 MONTE CARLO SIMULATION (PART 1)

5.2.1 Motivating Example. The first part of the simulation was motivated by the Adhesive Bond B example provided by Meeker, Escobar, Kugler, and Kramer (2003). This example represents a situation where the product is expected to have a lifetime at the highest accelerating stress level that is a small fraction of the lifetime at the design stress level. In this example, multiple samples were subjected to an accelerating stress (temperature), where the temperature had three levels. The design temperature was 25 °C, and the accelerating temperatures were 50 °C, 60 °C, and 70 °C. The temperatures were transformed using

$$V_i = 1000(U_0 - U_i), \tag{5.1}$$

where U_0 denotes the inverse temperature of the design stress level in degrees Kelvin and U_i denotes the inverse temperature of the accelerating stress level i in degrees Kelvin.

The response variable was the strength of the adhesive. The strength was measured once for each sample through a destructive test, and failure was assumed to occur when the strength was less than 40 Newtons. The independent variable was the square root of time, and measurements were made at 0, 2, 4, 6, 12, and 16 weeks.

Figures 1.1 and 1.2 display the accelerated degradation model defined, in part, using this example. Without loss of generality, the parameters were rescaled such that $\alpha_0 = 1$, while the relative rate of degradation, relative standard deviation, and relative failure threshold remained constant. Figure 1.1 shows the expected value of the natural logarithm of the response variable as a function of time for the different levels of the accelerating stress with the failure threshold denoted by the solid line. Figure 1.2 shows the standard deviation of the natural logarithm of the response variable.

5.2.2 Test Plans. The first part of the simulation used a single test plan. The test plan, or sampling scheme, assigns the number of replications to each stress/time combination. This test plan used the same stress levels and measurement times as the test plan provided by Meeker, Escobar, Kugler, and Kramer (2003). This test plan was modified, however, to resemble a more traditional test plan that assigns an equal number of units to each stress/time combination. This modified test plan is nearly identical to the traditional test plan described by Shi, Escobar, and Meeker (2009). The only difference is the addition of three additional replications at time zero.

Table 5.1 Test Plan 1

Temp (°C)	Weeks Aged					
	0	2	4	6	12	16
50	7	7	7	7	7	7
60	0	7	7	7	7	7
70	0	7	7	7	7	7

5.2.3 Parameters. The first part of the simulation began with an initial set of parameters and two special cases. The initial set of parameters was obtained from a graphical analysis of the Adhesive Bond B example. A numerical analysis was not possible since the data were not provided. The two special cases were selected to represent a generalized model with a standard deviation whose natural logarithm follows a linear function of the transformed time and the traditional constant variance model. These three scenarios represent three different situations where the standard deviation increases, decreases, or remains constant with respect to time.

Without loss of generality, the parameters were rescaled such that $\alpha_0 = 1$. The relative rate of degradation, standard deviation, and failure threshold remained constant during this transformation. The initial set of rescaled parameters is listed in the table below along with the mean lifetimes at the design and highest accelerating stress levels. The mean lifetimes are given in numbers of weeks.

Table 5.2 Initial Parameter Values (Part 1)

Scenario	α_1	α_2	β_0	β_1	β_2	Mean Life (Design)	Mean Life (High)
1	0.0035	7.5	-4.0	-2.0	0.6	3265	4
2	0.0035	7.5	-4.0	-2.0	0.0	3265	4
3	0.0035	7.5	-4.0	0.0	0.0	3265	4

The first part of the simulation was then extended using a large number of parameter combinations. Three values were selected for α_1 and α_2, two values were selected for β_0, five values were selected for β_1, and three values were selected for β_2. No other values were chosen for α_0 since this parameter was already rescaled. The parameter values were chosen to examine the effect of a change in the relationship between the response variable and the accelerating stress and age (e.g., an increase or decrease in the degradation rate). The values chosen for each parameter are listed below.

Table 5.3 Extended Parameter Values (Part 1)

α_0	α_1	α_2	β_0	β_1	β_2
1.0	0.003	6.0	-3.0	-2.0	0.00
	0.004	7.0	-4.0	-1.0	0.25
	0.005	8.0		0.0	0.50
				1.0	
				2.0	

Preliminary results from the extended analysis indicated that the simulation program ran successfully if the ratio of the standard deviation to the expected value for the natural logarithm of the response variable was below 0.10 for all stress/time combinations in the test plan. If the ratio exceeded 0.10, the simulation often crashed from a numerical error (e.g., floating overflow). The small ratio of the standard deviation to the expected value is needed due to the large amount of extrapolation required to estimate the life distribution at the design stress level. The large amount of extrapolation arises from the large difference between the mean life at the design and highest accelerating stress levels as well as the short time period in the test plan.

By limiting the ratio of the standard deviation to the expected value, the initial set of 270 parameter combinations was reduced to 102 combinations. The simulation was then performed with this reduced set of parameter combinations. The complete set of parameter combinations, including the three initial combinations described above, is listed in Table A-1 in Appendix A. This table lists the scenario (parameter combination) number, the parameter values, the mean lifetime (in weeks) for the design stress level, and the mean lifetime (in weeks) for the highest accelerating stress level for each parameter combination analyzed. Since α_0 remained constant for each scenario, it is not included in this table.

5.3 MONTE CARLO SIMULATION (PART 2)

5.3.1 Motivating Example. The second part of the simulation was motivated by a class of products where the lifetime at the highest accelerating stress level is a significant fraction of the lifetime at the design stress level. An example of this type of product is medicine, where the shelf-life of a product may be on the order of a few years, but the lifetime under the highest accelerating stress may be only a few months.

This example was created to closely resemble the Adhesive Bond B example so that a meaningful comparison of the results can be made. In this example, it was assumed that multiple samples were subjected to an accelerating stress (temperature), where the temperature had three levels. The design temperature was assumed to be 25 °C, and the accelerating temperatures were assumed to be 50 °C, 60 °C, and 70 °C. The temperatures were transformed using

$$V_i = 1000(U_0 - U_i), \tag{5.2}$$

where U_0 denotes the inverse temperature of the design stress level in degrees Kelvin and U_i denotes the inverse temperature of the accelerating stress level i in degrees Kelvin.

In this example, the response variable could be the concentration of active ingredients or some other measure of potency. The response variable was assumed to be measured once for each sample through a destructive test, and failure was assumed to occur when the natural logarithm of the response variable was less than 80% of the initial natural logarithm of the response variable. The independent variable was the square root of time, and measurements were made at 0, 2, 4, 6, 12, and 16 weeks.

5.3.2 Test Plans. The second part of the simulation used four different test plans. All four test plans used the same accelerating stress levels and measurement times as the traditional test plan in the first part of the simulation, but they assigned a different number of replications to each stress/time combination. The first test plan was identical to the test plan used in the first part of the simulation. The second test plan reduced the number of replications at each stress/time combination, while the third test plan increased the number of replications at each stress/time combination. The final test plan used a large number of replications at each stress/time combination in order to approximate the asymptotic results for large samples. The number of samples assigned to each stress/time combination for the four test plans is contained in the tables below.

Table 5.4 Test Plan 2A

Temp (°C)	Weeks Aged					
	0	2	4	6	12	16
50	7	7	7	7	7	7
60	0	7	7	7	7	7
70	0	7	7	7	7	7

Table 5.5 Test Plan 2B

Temp (°C)	Weeks Aged					
	0	2	4	6	12	16
50	5	5	5	5	5	5
60	0	5	5	5	5	5
70	0	5	5	5	5	5

Table 5.6 Test Plan 2C

Temp (°C)	Weeks Aged					
	0	2	4	6	12	16
50	10	10	10	10	10	10
60	0	10	10	10	10	10
70	0	10	10	10	10	10

Table 5.7 Test Plan 2D

Temp (°C)	Weeks Aged					
	0	2	4	6	12	16
50	20	20	20	20	20	20
60	0	20	20	20	20	20
70	0	20	20	20	20	20

5.3.3 Parameters. Since the goal of the second part of the simulation was to explore the effect of changes in the test plan, each test plan was analyzed using a relatively small number of parameter combinations. The parameter combinations were deliberately chosen to closely relate to those from the first part of the simulation so that a more meaningful comparison of the results can be made.

As before, the parameters were scaled such that $\alpha_0 = 1$. Three values were selected for α_1, three values were selected for α_2, one value was selected for β_0, and three pairs were selected for β_1 and β_2. The values for $\beta_0, \beta_1,$ and β_2 were chosen to match those from the first three scenarios in the first part of the simulation. The resulting 27 parameter combinations are listed in the table below. This table lists the scenario (parameter combination) number, the parameter values, the mean lifetime (in weeks) for the design stress level, and the mean lifetime (in weeks) for the highest accelerating stress level for each parameter combination analyzed.

Table 5.8 Parameter Values (Part 2)

Scenario	α_1	α_2	β_0	β_1	β_2	Mean Life (Design)	Mean Life (High)
1	0.012	1.00	-4.0	-2.0	0.6	278	115
2	0.012	1.00	-4.0	-2.0	0.0	278	115
3	0.012	1.00	-4.0	0.0	0.0	278	115
4	0.012	1.25	-4.0	-2.0	0.6	278	93
5	0.012	1.25	-4.0	-2.0	0.0	278	93
6	0.012	1.25	-4.0	0.0	0.0	278	93
7	0.012	1.50	-4.0	-2.0	0.6	278	74
8	0.012	1.50	-4.0	-2.0	0.0	278	74
9	0.012	1.50	-4.0	0.0	0.0	278	74
10	0.020	1.00	-4.0	-2.0	0.6	100	41
11	0.020	1.00	-4.0	-2.0	0.0	100	41
12	0.020	1.00	-4.0	0.0	0.0	100	41
13	0.020	1.25	-4.0	-2.0	0.6	100	33
14	0.020	1.25	-4.0	-2.0	0.0	100	33
15	0.020	1.25	-4.0	0.0	0.0	100	33
16	0.020	1.50	-4.0	-2.0	0.6	100	27
17	0.020	1.50	-4.0	-2.0	0.0	100	27
18	0.020	1.50	-4.0	0.0	0.0	100	27
19	0.028	1.00	-4.0	-2.0	0.6	51	21
20	0.028	1.00	-4.0	-2.0	0.0	51	21
21	0.028	1.00	-4.0	0.0	0.0	51	21
22	0.028	1.25	-4.0	-2.0	0.6	51	17
23	0.028	1.25	-4.0	-2.0	0.0	51	17
24	0.028	1.25	-4.0	0.0	0.0	51	17
25	0.028	1.50	-4.0	-2.0	0.6	51	14
26	0.028	1.50	-4.0	-2.0	0.0	51	14
27	0.028	1.50	-4.0	0.0	0.0	51	14

5.4 AD-HOC ADJUSTMENTS

Preliminary results indicated that the prediction bound coverage probabilities for the maximum likelihood and maximum likelihood predictive density methods were extremely liberal and would be of no use to researchers. Therefore, the following ad-hoc adjustments were made to both methods.

5.4.1 Maximum Likelihood. The maximum likelihood methods for the traditional constant variance model and the generalized non-constant variance model were modified using a model-based nonparametric bootstrap calibration procedure. Bootstrap calibration is described by DiCiccio and Efron (1996) and Hall, Peng, and Tajvidi (1999). The bootstrap calibration is performed as follows:

1. For each random sample, calculate maximum likelihood estimates for the life distribution parameters μ_{life} and σ_{life} and prediction bounds using the applicable maximum likelihood approach.

2. Generate b bootstrap samples using the model-based nonparametric bootstrap method. For each bootstrap sample, calculate prediction bounds using the applicable maximum likelihood approach. For each prediction bound, calculate the coverage probability under the assumption that the maximum likelihood estimates are the true values. Let C_p denote the coverage probability for the $100p^{th}$ prediction bound. Then,

$$C_p = P_{mle}(T' \le t_{p,pred}) = \Phi\left(\frac{t_{p,pred} - \hat{\mu}_{life}}{\hat{\sigma}_{life}}\right), \tag{5.3}$$

where $\hat{\mu}_{life}$ and $\hat{\sigma}_{life}$ denote the maximum likelihood estimates of the life distribution parameters.

3. Develop a calibration curve by averaging the coverage probabilities for each prediction bound over the number of bootstrap samples. Determine the percentile $\tilde{p}$ whose average coverage probability is the desired coverage probability.

4. Obtain bootstrap calibrated prediction bounds using the applicable maximum likelihood approach with percentiles $\tilde{p}$ instead of p.

5.4.2 Maximum Likelihood Predictive Density. The maximum likelihood predictive density approach results in a life distribution that is characterized through a Student's t-distribution with $\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}$ degrees of freedom. The maximum likelihood predictive density approach was modified to use $\max(\eta_{ij})$ instead of $\sum_{i=1}^{m}\sum_{j=1}^{n_i}\eta_{ij}$ for the degrees of freedom.

5.5 FORTRAN 90 PROGRAM SPECIFICATIONS

The Monte Carlo simulation study was performed using Fortran 90 programs. Subroutines from the International Mathematical and Statistical Libraries (IMSL) Fortran Library, Version 6.01, were used whenever possible. All real-valued variables were defined as double precision variables. Each simulation was started with an initial seed of 123457. The programs generated 5,000 main samples. For each main sample, the programs generated 1,999 bootstrap samples. The Fortran programs are included in the attached CD.

The programs were compiled with the Intel 10.0 developer suite with the openmpi libraries. The programs were run on the Numerical Intensive Computing Cluster. This cluster consists of Dell PowerEdge 2850s, 1850s, 860s, 850s, R710s, and C6100s.

6. RESULTS

In accelerated degradation testing, researchers are primarily interested in the lower percentiles of the life distribution at the design stress level, although the upper percentiles may also be of interest. The following sections compare the performance of the various methods described above for the lower and upper percentiles for a select number of scenarios from each part of the simulation. The coverage probabilities for a select number of lower and upper percentiles are tabulated in Appendix B for all of the test plans and scenarios.

The first section discusses the prediction bound results, and the second section discusses the confidence bound results. The results are grouped by the behavior of the standard deviation. The results are presented separately for situations where the standard deviation of the natural logarithm of the response variable increases, decreases, or remains constant with respect to time.

6.1 PREDICTION BOUND RESULTS

This section displays the lifetime prediction bound results for situations where the standard deviation of the natural logarithm of the response variable increases, decreases, or remains constant with respect to time. For each situation, the performance of the various techniques is plotted for a representative scenario. Representative tables are provided that display statistics from the empirical distribution of the 0.05 and 0.95 prediction bounds for the different methods. This information is used to make a recommendation for the best method. The next six figures display the performance of the recommended method as a function of the mean life at the design stress level (α_1), the ratio of the mean life at the design stress level to the mean life at the highest accelerating stress level (α_2), and the sample size (test plan) for the lower and upper percentiles.

The following nomenclature is used for the prediction bound results:

- NOMINAL denotes the nominal coverage probability.
- MLP1 denotes the results obtained using the maximum likelihood predictive density approach using Method 1 to calculate the approximate maximum likelihood estimates. This method uses the ad-hoc adjustment described in Section 5.4.
- MLP2 denotes the results obtained using the maximum likelihood predictive density approach using Method 2 to calculate the approximate maximum likelihood estimates. This method uses the ad-hoc adjustment described in Section 5.4.
- MLP3 denotes the results obtained using the maximum likelihood predictive density approach using Method 3 to calculate the approximate maximum likelihood estimates. This method uses the ad-hoc adjustment described in Section 5.4.
- MLE0 denotes the results obtained using the uncalibrated maximum likelihood approach with the traditional constant variance model.
- MLE1 denotes the results obtained using the uncalibrated maximum likelihood approach with the generalized non-constant variance model.
- MODL-MLC0 denotes the results obtained using the model-based bootstrap calibrated maximum likelihood approach with the traditional constant variance model.
- MODL-MLC1 denotes the results obtained using the model-based bootstrap calibrated maximum likelihood approach with the generalized non-constant variance model.
- MODL-MLE0 denotes the results obtained using the model-based bootstrap approach with the traditional constant variance model.
- MODL-MLE1 denotes the results obtained using the model-based bootstrap approach with the generalized non-constant variance model.

Since the MLP1 and MLP2 results were generally inferior to the MLP3 results, the MLP1 and MLP2 results are not included in the figures below.

6.1.1 Increasing Standard Deviation. The first set of results is associated with situations where the standard deviation of the natural logarithm of the response variable increases with respect to time. Since product performance is assumed to degrade (as evidenced by a decreasing mean response variable) over time, this situation is not expected to occur in practice. However, the results from this situation do provide an indication of the robustness of the various methods. The results included below are obtained from Scenario 1 (Test Plan 1).

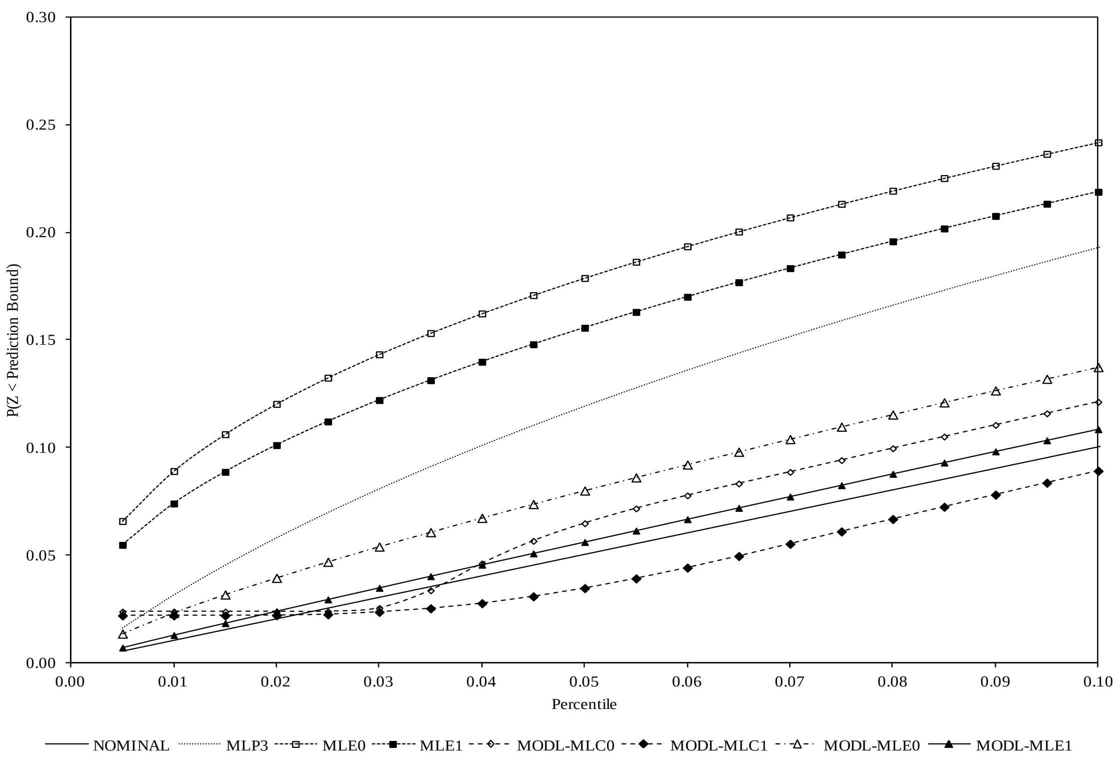

Figure 6.1 Lower Prediction Bound Coverage Probabilities

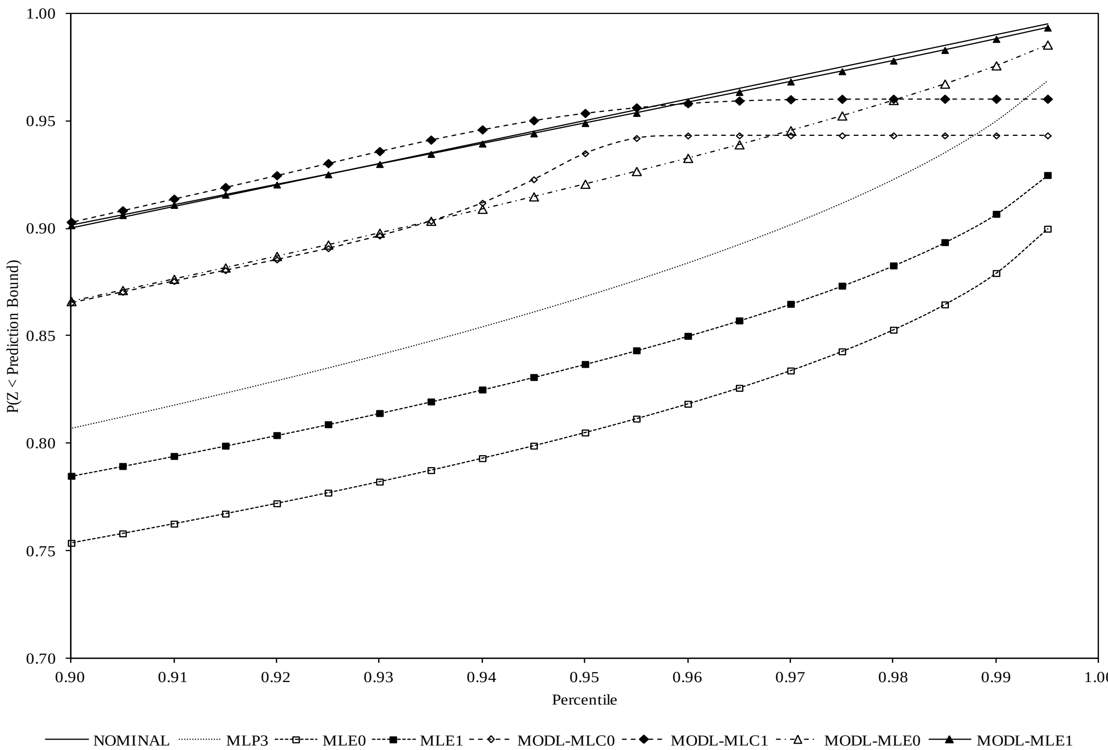

Figure 6.2 Upper Prediction Bound Coverage Probabilities

Table 6.1 Statistics for the 95 Percent Lower Prediction Bounds (Test Plan 1, Scenario 1)

Method	Average	25th Percentile	50th Percentile	75th Percentile	Standard Deviation	Coverage Probability
MLP1	46.69	36.22	44.86	55.44	15.90	0.2311
MLP2	48.97	39.28	46.91	56.47	13.73	0.2519
MLP3	47.85	43.78	47.47	51.43	5.92	0.1193
MLE0	49.16	44.06	48.44	53.47	7.30	0.1788
MLE1	49.19	45.06	48.81	52.91	5.99	0.1557
MODL-MLC0	44.50	40.14	44.00	48.20	6.20	0.0647
MODL-MLC1	43.66	40.21	43.25	46.60	4.93	0.0346
MODL-MLE0	45.29	40.83	44.71	49.13	6.41	0.0800
MODL-MLE1	45.27	41.72	44.94	48.43	5.14	0.0560

Table 6.2 Statistics for the 95 Percent Upper Prediction Bounds (Test Plan 1, Scenario 1)

Method	Average	25th Percentile	50th Percentile	75th Percentile	Standard Deviation	Coverage Probability
MLP1	72.78	56.66	68.89	84.20	22.51	0.7348
MLP2	70.51	55.63	66.86	81.32	20.62	0.7164
MLP3	67.88	62.14	67.15	72.87	8.40	0.8681
MLE0	66.97	59.84	65.98	72.93	10.25	0.8050
MLE1	66.50	60.98	65.77	71.39	8.15	0.8369
MODL-MLC0	75.70	67.40	74.63	82.70	12.05	0.9350
MODL-MLC1	74.24	67.63	73.38	79.98	9.60	0.9538
MODL-MLE0	74.58	65.97	73.23	81.76	12.35	0.9208
MODL-MLE1	73.91	67.31	73.08	79.60	9.69	0.9491

These results indicate that the prediction bounds obtained using the model-based bootstrap method have coverage probabilities that are slightly liberal, but still close to the nominal value, when using the generalized non-constant variance model. None of the other methods produced prediction bounds that would be useful to researchers for all of the lower percentiles. The bootstrap calibrated prediction bounds are conservative, but only for percentiles between 0.05 and 0.95. This is due to the level of extrapolation required for calibrating the prediction bounds less than 0.05 or greater than 0.95. Therefore, the model-based bootstrap method (MODL-MLE1) is the recommended method for obtaining prediction bounds for the lifetime of a future product at the design stress level in situations where the standard deviation of the natural logarithm of the response variable increases with respect to time.

The next six figures display the performance of this method as a function of the mean life at the design stress level (α_1), the ratio of the mean life at the design stress level to the mean life at the highest accelerating stress level (α_2), and the sample sizes (test plan). These figures are obtained using the data from the second part of the simulation. The first two figures were produced using the results from Scenarios 1, 10, and 19 (Test Plan 2a). The next two figures were produced using the results from Scenarios 1, 4, and 7 (Test Plan 2a). The last two figures were produced using the results from Scenario 1 (Test Plans 2a, 2b, 2c, and 2d).

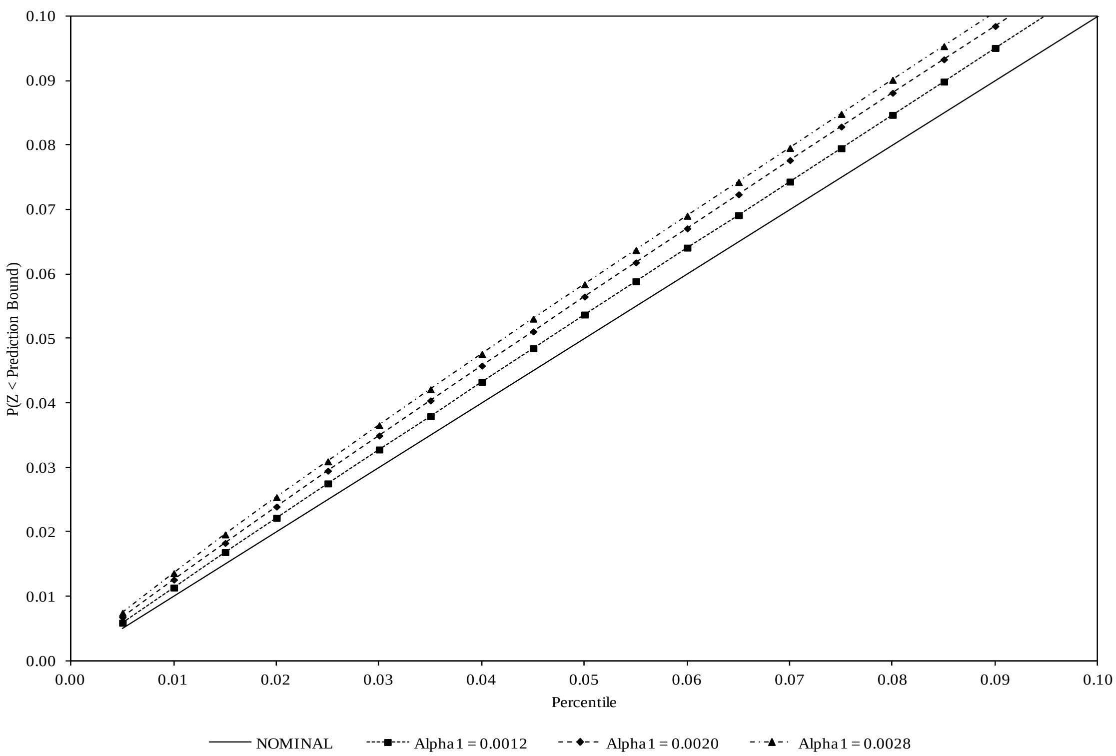

Figure 6.3 Lower Prediction Bound Coverage Probabilities for Different Values of Alpha1

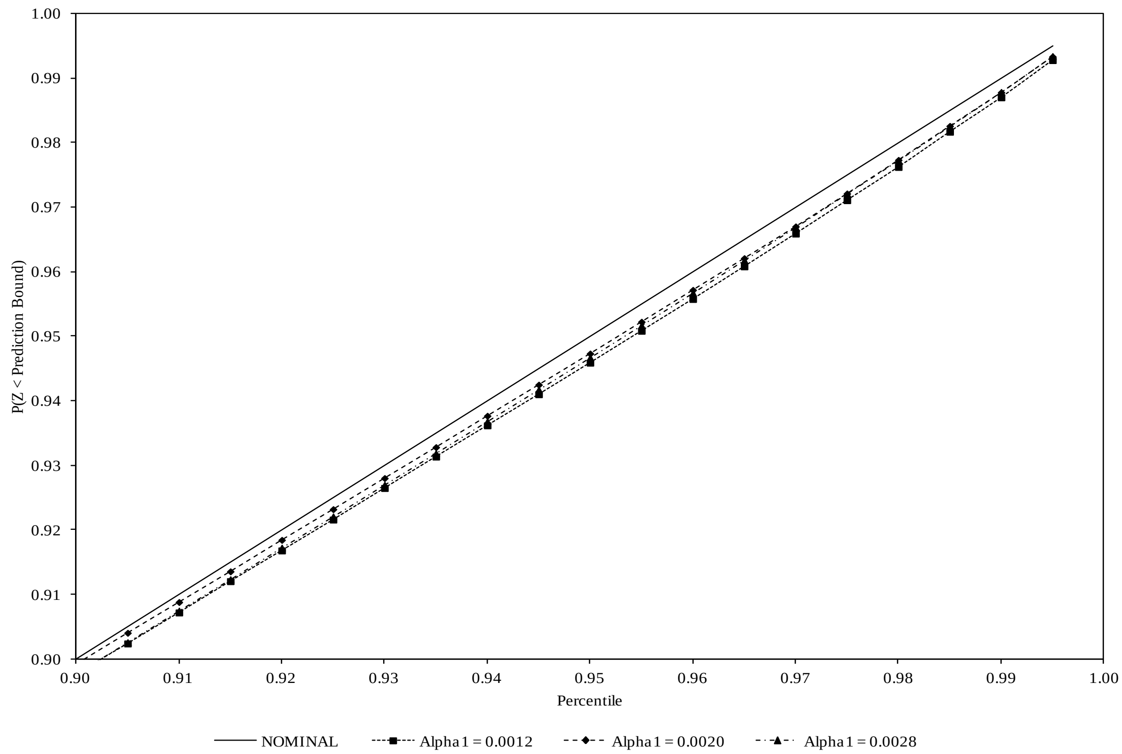

Figure 6.4 Upper Prediction Bound Coverage Probabilities for Different Values of Alpha1

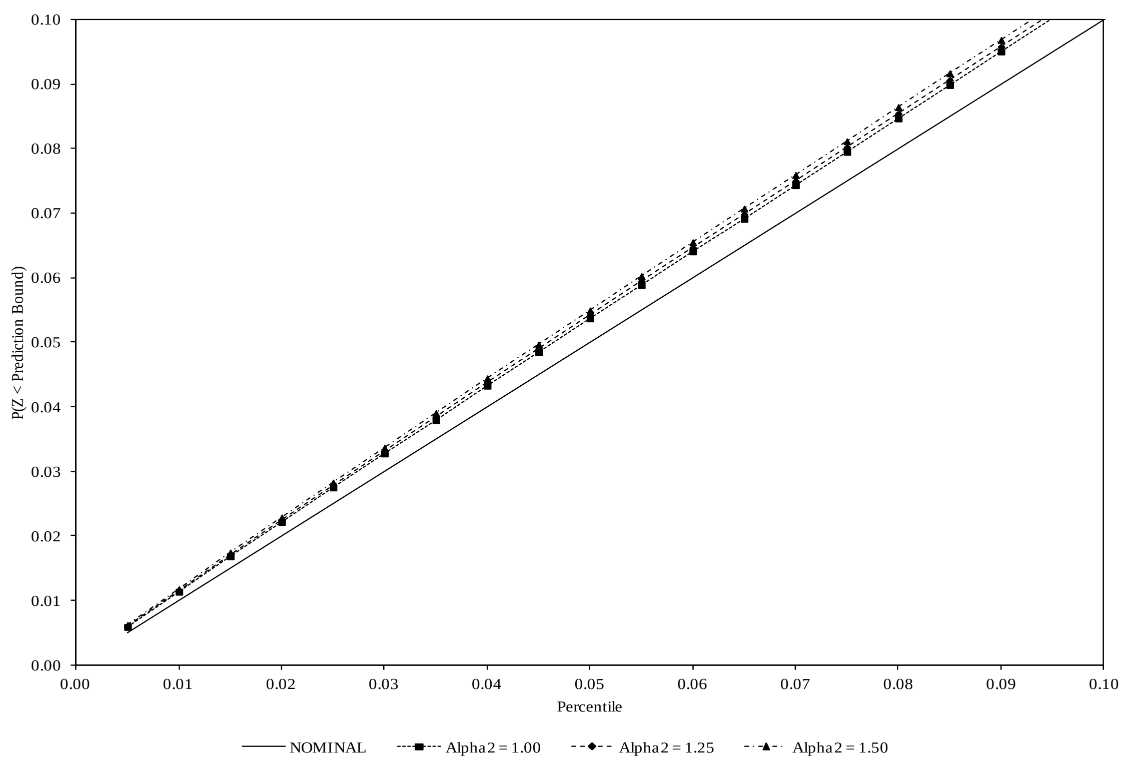

Figure 6.5 Lower Prediction Bound Coverage Probabilities for Different Values of Alpha2

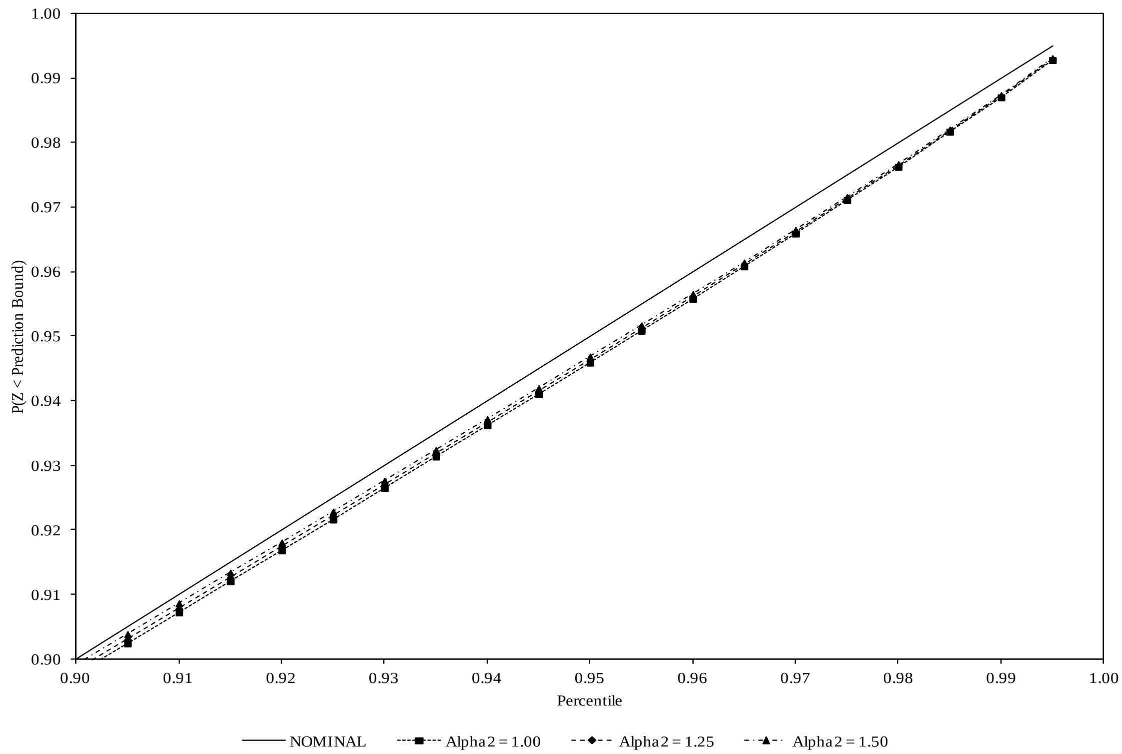

Figure 6.6 Upper Prediction Bound Coverage Probabilities for Different Values of Alpha2

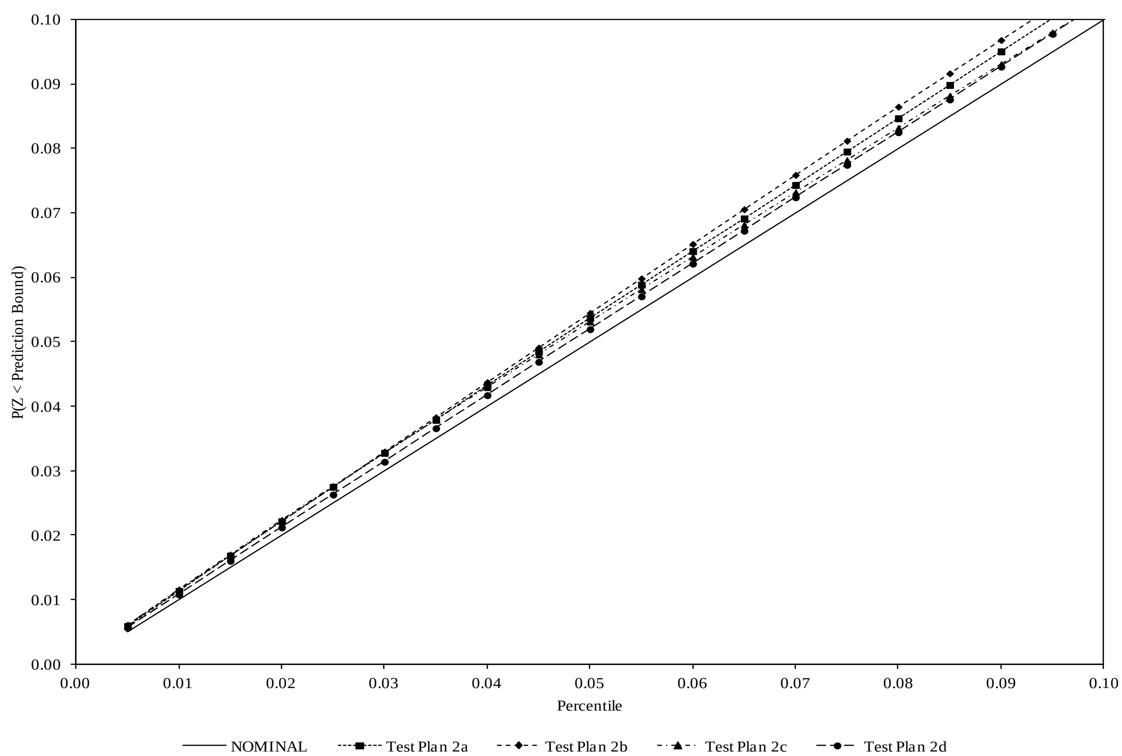

Figure 6.7 Lower Prediction Bound Coverage Probabilities for Different Test Plans

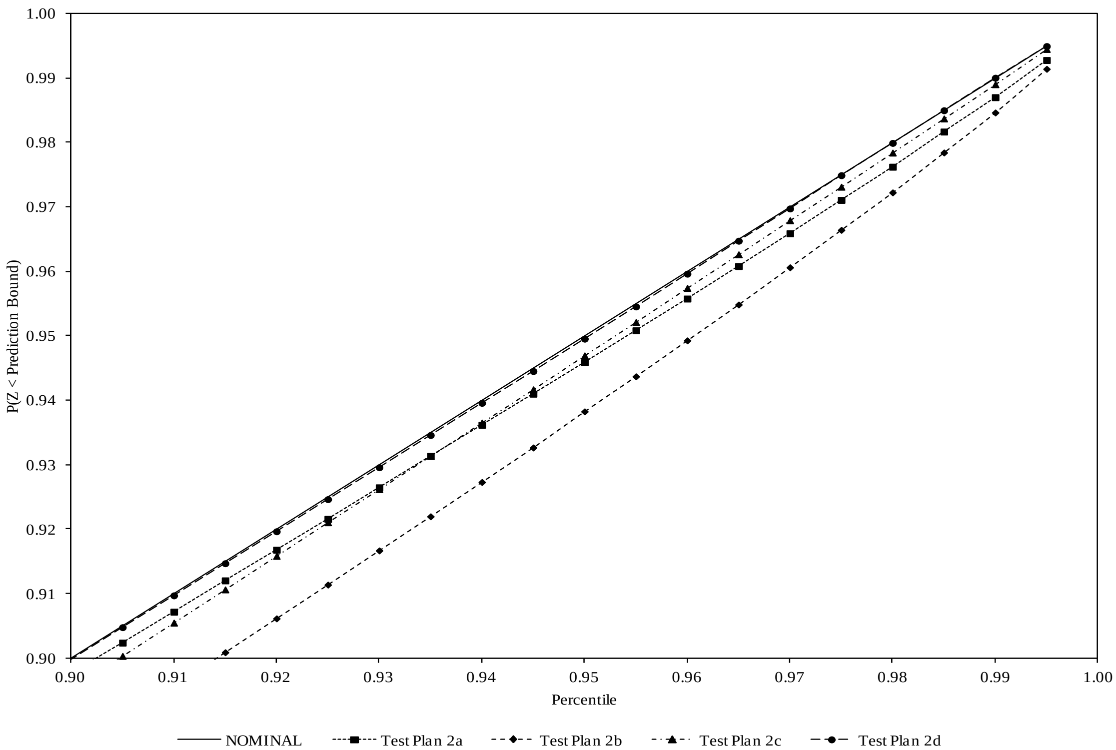

Figure 6.8 Upper Prediction Bound Coverage Probabilities for Different Test Plans

6.1.2 Decreasing Standard Deviation. The second set of results is associated with situations where the standard deviation of the natural logarithm of the response variable decreases with respect to time. The results included below are obtained from Scenario 2 (Test Plan 1).

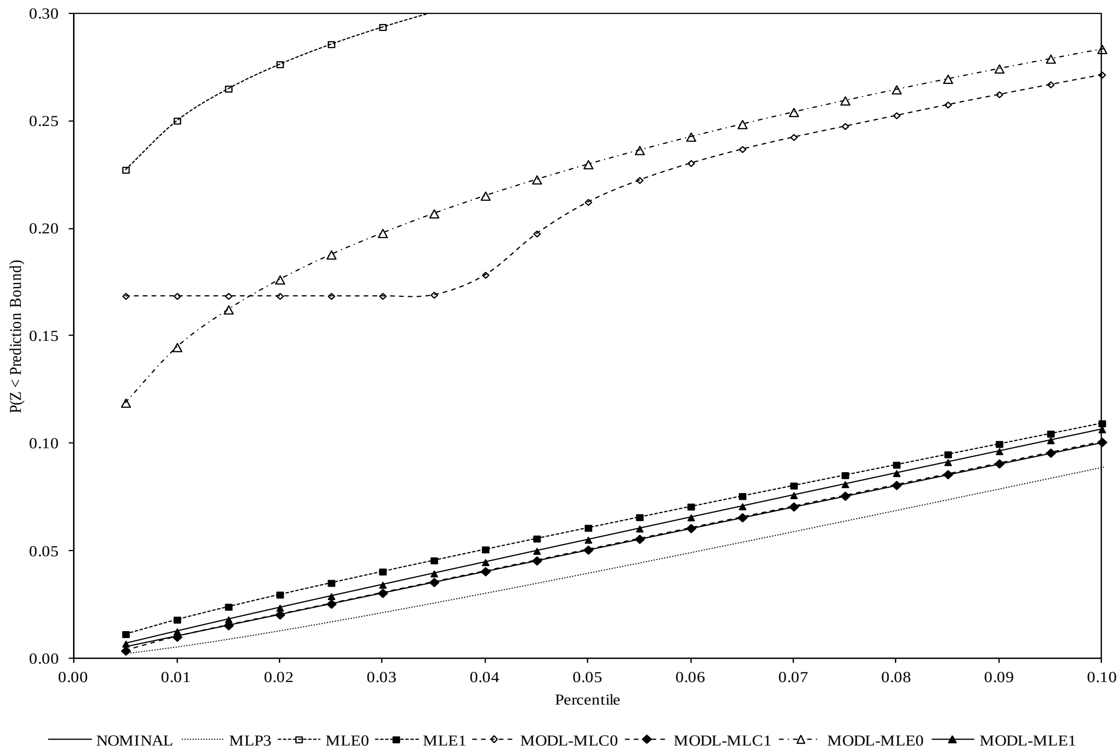

Figure 6.9 Lower Prediction Bound Coverage Probabilities

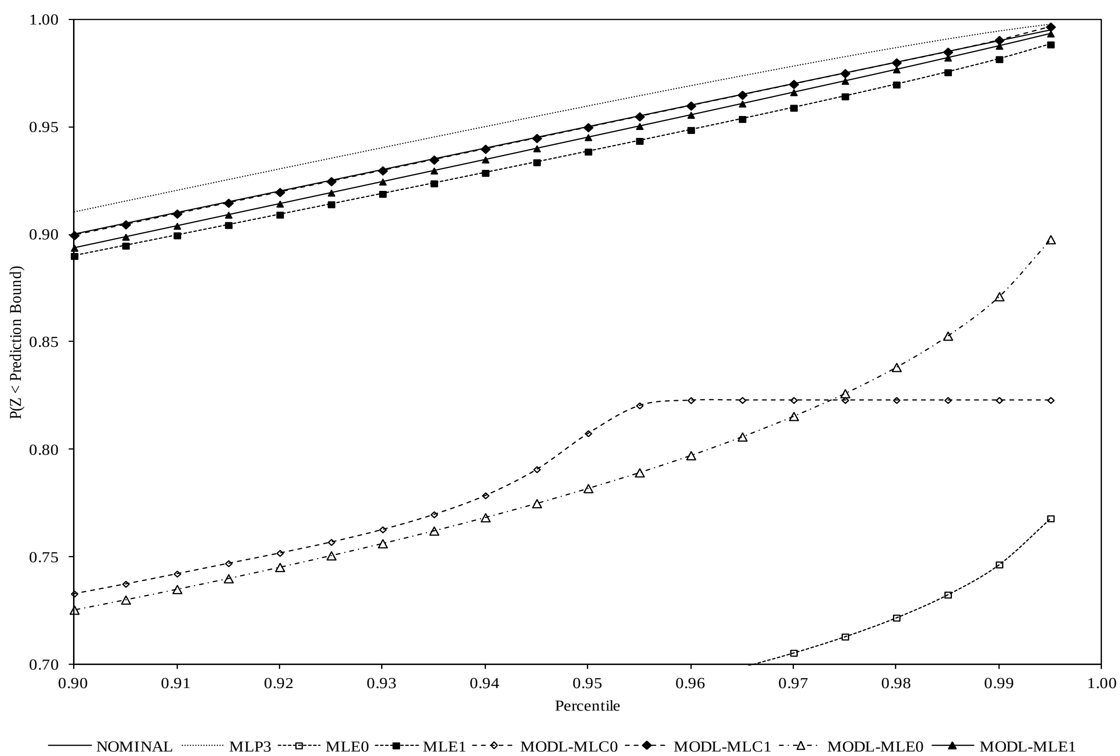

Figure 6.10 Upper Prediction Bound Coverage Probabilities

Table 6.3 Statistics for the 95 Percent Lower Prediction Bounds (Test Plan 1, Scenario 2)

Method	Average	25th Percentile	50th Percentile	75th Percentile	Standard Deviation	Coverage Probability
MLP1	41.86	36.57	44.14	49.93	12.08	0.0864
MLP2	44.55	41.06	45.66	49.13	6.56	0.0518
MLP3	47.19	45.82	47.31	48.69	2.22	0.0393
MLE0	54.36	52.49	54.28	56.21	2.72	0.3182
MLE1	48.50	47.28	48.60	49.83	1.96	0.0606
MODL-MLC0	52.48	50.72	52.44	54.27	2.60	0.2124
MODL-MLC1	47.97	46.72	48.06	49.34	2.02	0.0504
MODL-MLE0	52.82	51.03	52.74	54.61	2.61	0.2299
MODL-MLE1	48.21	46.98	48.29	49.57	2.02	0.0551

Table 6.4 Statistics for the 95 Percent Upper Prediction Bounds (Test Plan 1, Scenario 2)

Method	Average	25th Percentile	50th Percentile	75th Percentile	Standard Deviation	Coverage Probability
MLP1	73.73	62.74	69.31	79.24	17.11	0.8878
MLP2	70.79	62.70	67.24	75.17	12.24	0.9048
MLP3	67.11	65.52	66.94	68.59	2.31	0.9600
MLE0	60.06	57.89	59.89	62.05	3.09	0.6821
MLE1	65.79	64.37	65.66	67.12	2.05	0.9386
MODL-MLC0	62.61	60.13	62.39	64.81	3.49	0.8075
MODL-MLC1	66.39	64.93	66.25	67.73	2.11	0.9500
MODL-MLE0	61.98	59.62	61.75	64.08	3.32	0.7819
MODL-MLE1	66.14	64.68	66.02	67.49	2.11	0.9453

These results indicate that the prediction bounds obtained using the bootstrap calibrated maximum likelihood prediction bounds have coverage probabilities that are nearly identical to the nominal value when using the generalized non-constant variance model. In addition, these results also indicate that the prediction bounds obtained using the model-based bootstrap method have coverage probabilities that are slightly liberal, but still close to the nominal value, when using the generalized non-constant variance model. It can also be seen that the prediction bounds obtained using the maximum likelihood predictive density approach are conservative, but farther away from the nominal value than the model-based bootstrap prediction bounds.

Although the bootstrap calibrated maximum likelihood prediction bounds performed the best in this scenario, the previous results demonstrated that this method is not necessarily robust to changes in the model parameters. For consistency with the other results, the model-based bootstrap method (MODL-MLE1) is the recommended method for obtaining prediction bounds for the lifetime of a future product at the design stress level in situations where the standard deviation of the natural logarithm of the response variable decreases with respect to time.

The next six figures display the performance of this method as a function of the mean life at the design stress level (α_1), the ratio of the mean life at the design stress level to the mean life at the highest accelerating stress level (α_2), and the sample sizes (test plan). These figures are obtained using the data from the second part of the simulation. The first two figures were produced using the results from Scenarios 2, 11, and 20 (Test Plan 2a). The next two figures were produced using the results from Scenarios 2, 5, and 8 (Test Plan 2a). The last two figures were produced using the results from Scenario 2 (Test Plans 2a, 2b, 2c, and 2d).

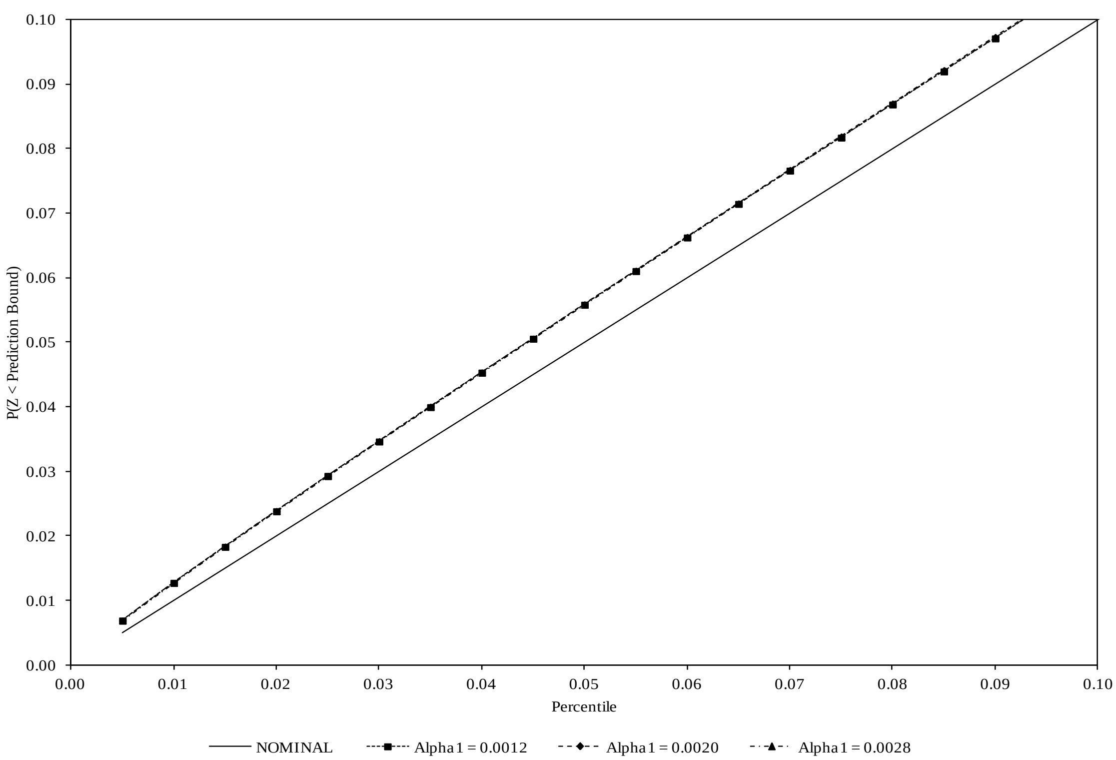

Figure 6.11 Lower Prediction Bound Coverage Probabilities for Different Values of Alpha1

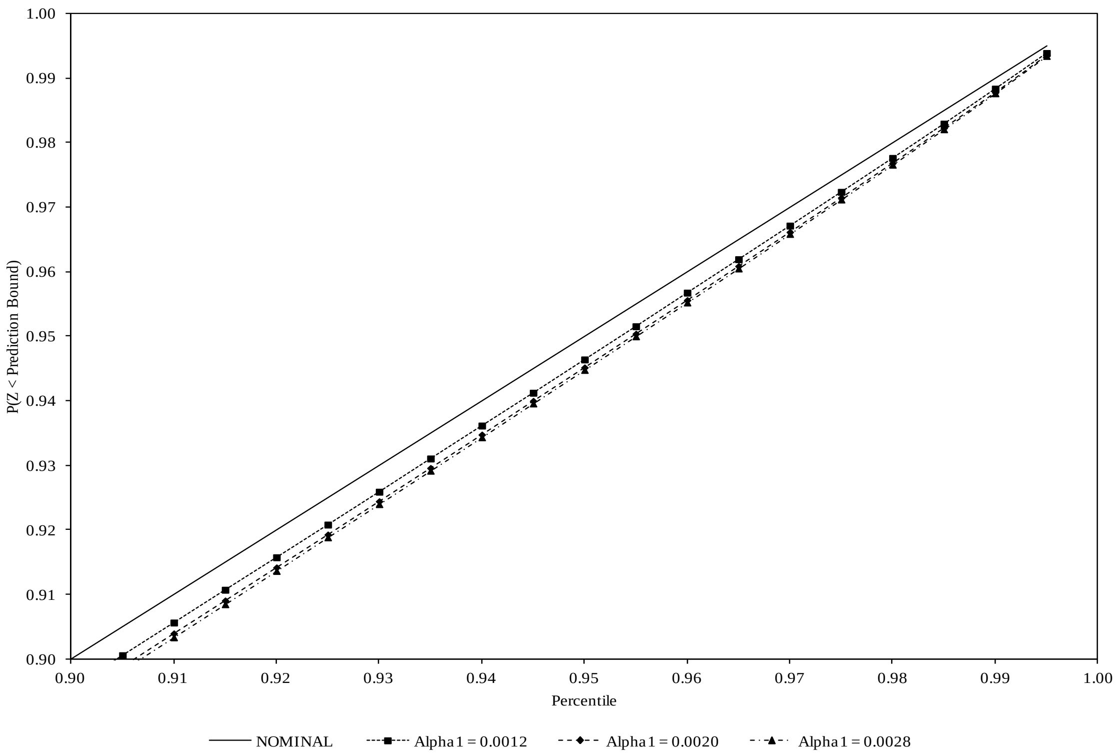

Figure 6.12 Upper Prediction Bound Coverage Probabilities for Different Values of Alpha1

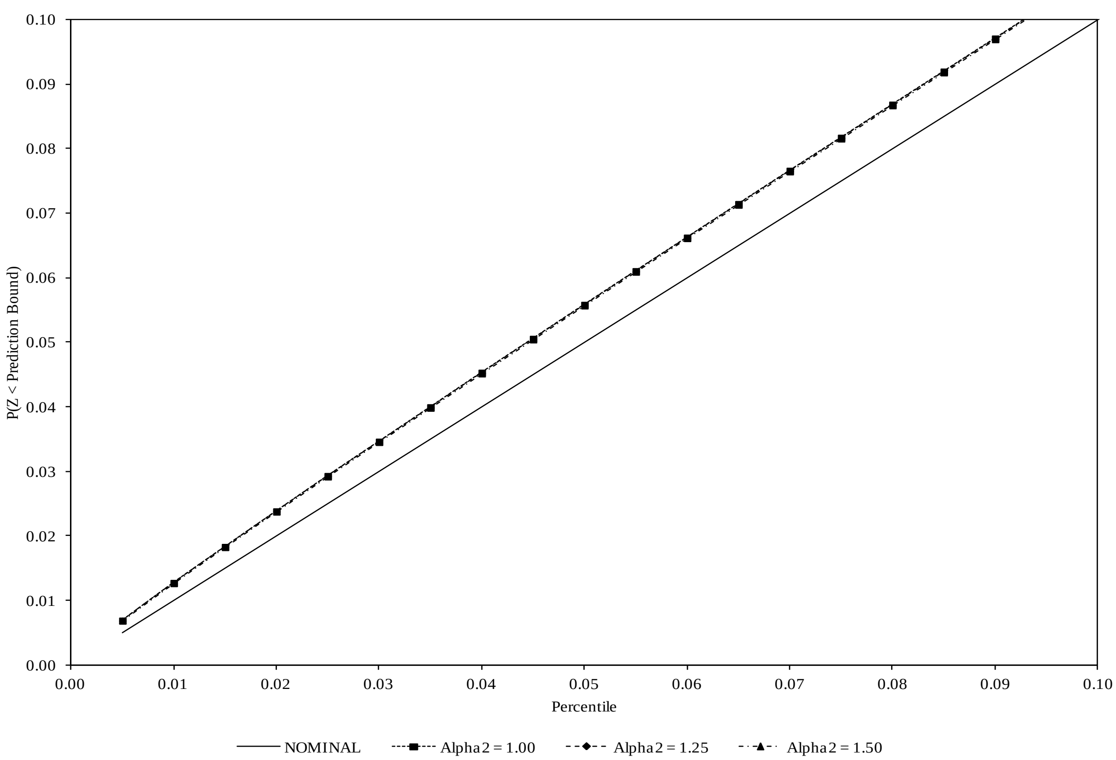

Figure 6.13 Lower Prediction Bound Coverage Probabilities for Different Values of Alpha2

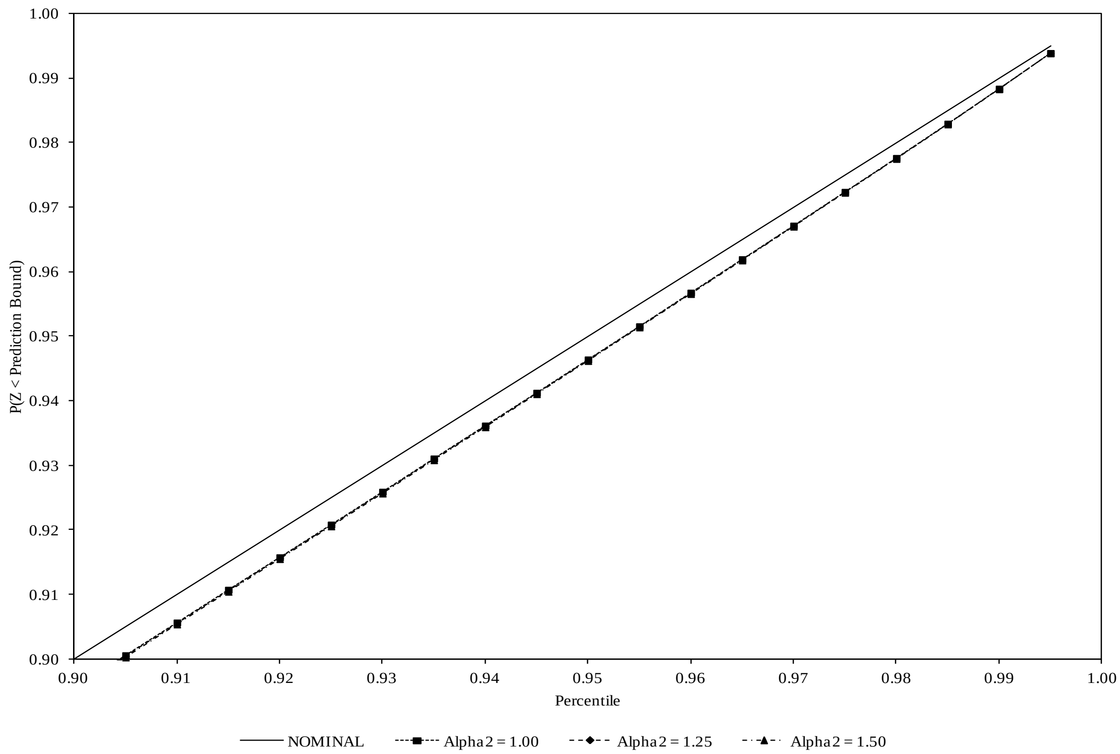

Figure 6.14 Upper Prediction Bound Coverage Probabilities for Different Values of Alpha2

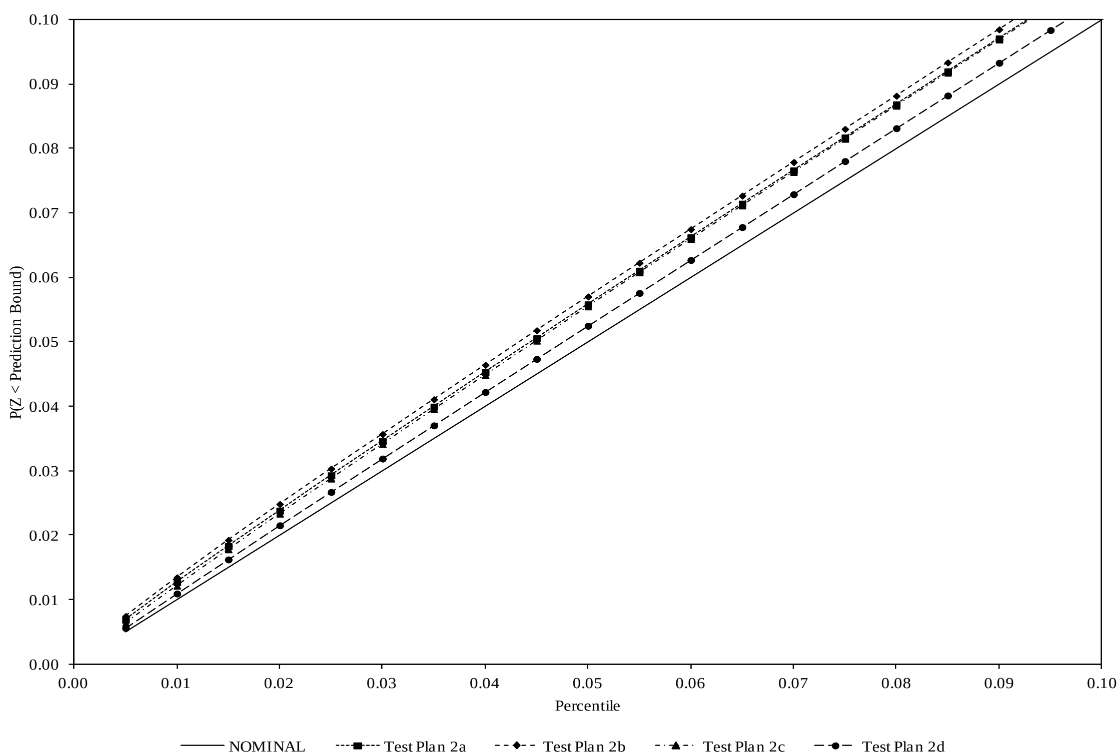

Figure 6.15 Lower Prediction Bound Coverage Probabilities for Different Test Plans

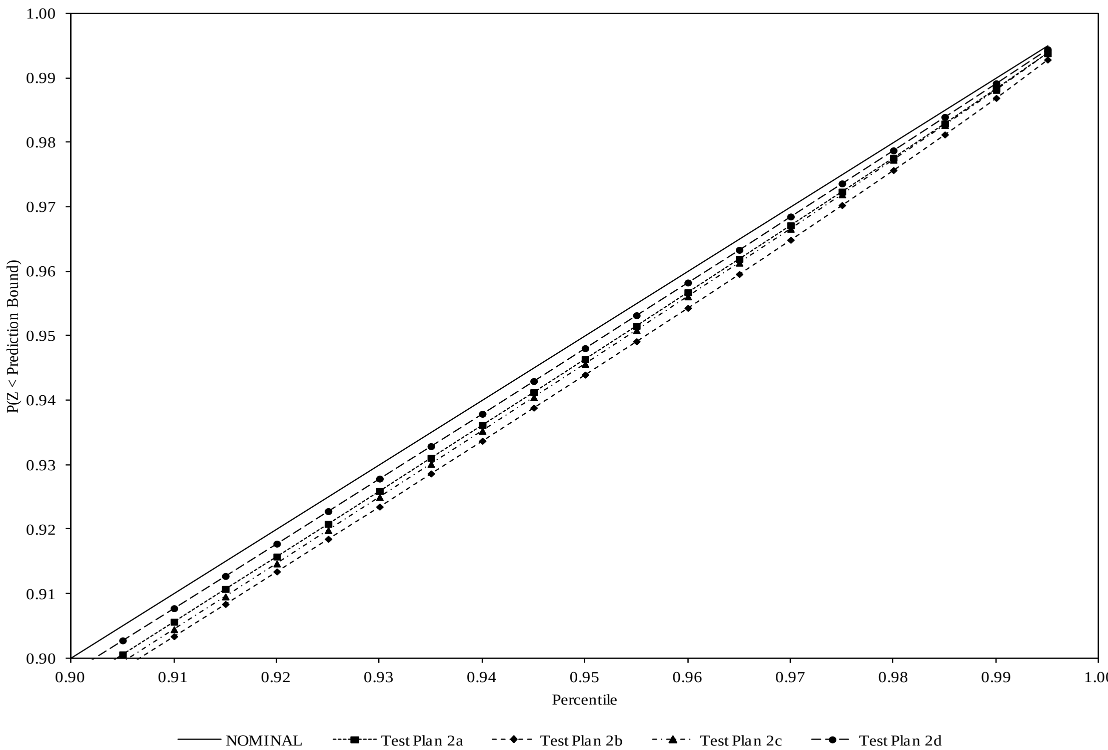

Figure 6.16 Upper Prediction Bound Coverage Probabilities for Different Test Plans

6.1.3 Constant Standard Deviation. The third set of results is associated with situations where the standard deviation of the natural logarithm of the response variable remains constant with respect to time. This is a common assumption in accelerated degradation analysis. The results included below are obtained from Scenario 3 (Test Plan 1).

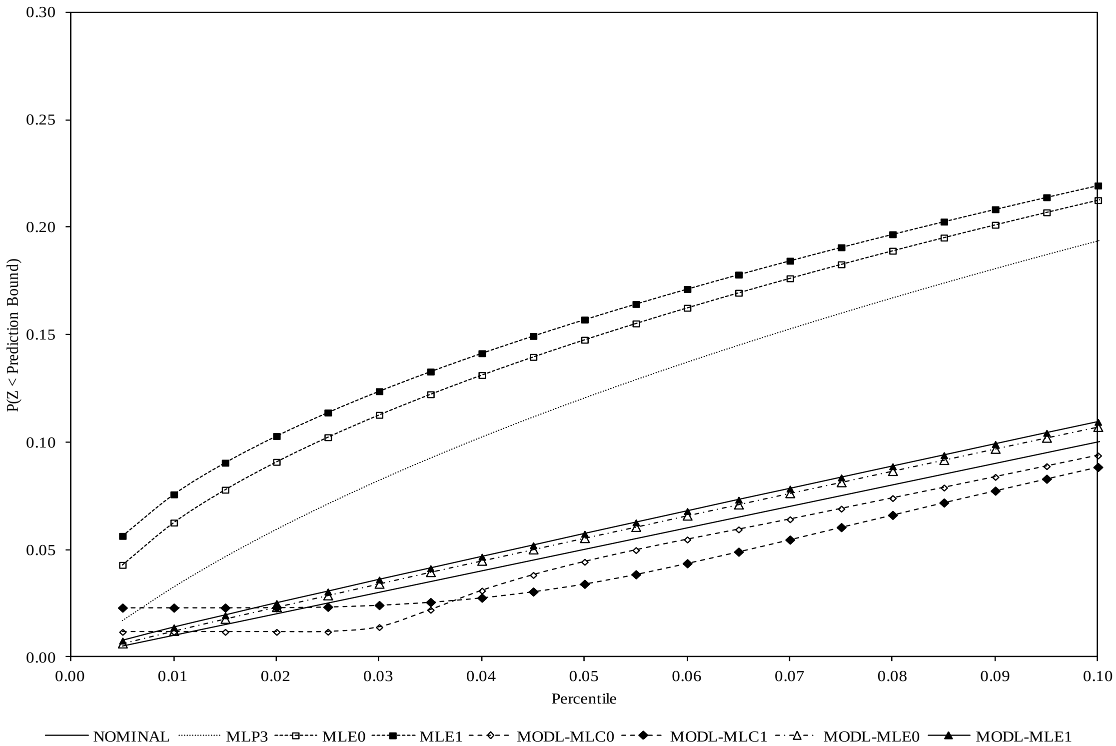

Figure 6.17 Lower Prediction Bound Coverage Probabilities

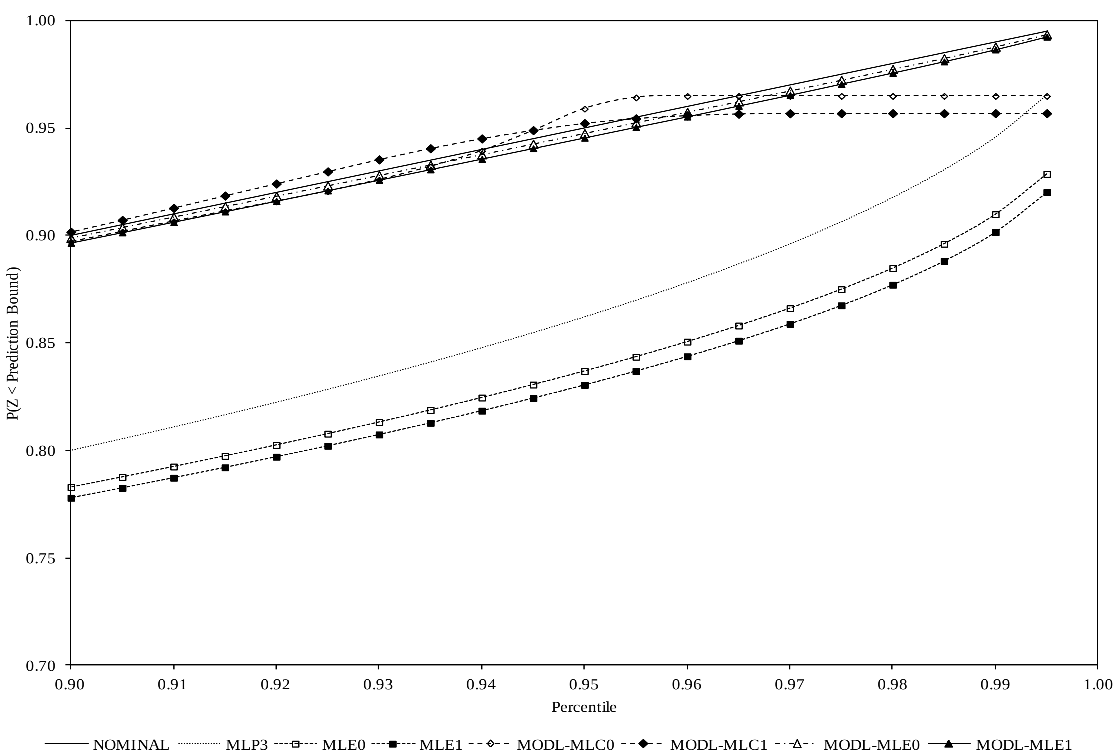

Figure 6.18 Upper Prediction Bound Coverage Probabilities

Table 6.5 Statistics for the 95 Percent Lower Prediction Bounds (Test Plan 1, Scenario 3)

Method	Average	25th Percentile	50th Percentile	75th Percentile	Standard Deviation	Coverage Probability
MLP1	46.01	37.53	45.50	53.58	13.33	0.1957
MLP2	48.26	40.44	46.88	54.36	10.71	0.2089
MLP3	47.82	43.61	47.42	51.55	5.98	0.1205
MLE0	49.15	45.28	48.66	52.68	5.62	0.1476
MLE1	49.17	44.94	48.69	52.92	6.05	0.1570
MODL-MLC0	44.73	41.40	44.36	47.75	4.82	0.0443
MODL-MLC1	43.52	40.02	43.13	46.57	4.97	0.0341
MODL-MLE0	45.40	41.99	45.03	48.50	4.95	0.0554
MODL-MLE1	45.24	41.57	44.82	48.42	5.23	0.0574

Table 6.6 Statistics for the 95 Percent Upper Prediction Bounds (Test Plan 1, Scenario 3)

Method	Average	25th Percentile	50th Percentile	75th Percentile	Standard Deviation	Coverage Probability
MLP1	71.51	58.46	68.37	80.76	18.31	0.7726
MLP2	69.23	57.74	66.93	77.54	15.99	0.7566
MLP3	67.71	61.81	66.99	72.86	8.44	0.8624
MLE0	66.29	60.87	65.60	71.08	7.87	0.8370
MLE1	66.32	60.59	65.62	71.32	8.20	0.8305
MODL-MLC0	74.72	68.44	74.06	80.35	9.25	0.9590
MODL-MLC1	74.29	67.47	73.42	80.25	9.72	0.9523
MODL-MLE0	73.49	66.98	72.56	79.17	9.39	0.9476
MODL-MLE1	73.72	66.92	72.81	79.59	9.74	0.9455

These results indicate that the prediction bounds obtained using the model-based bootstrap method have coverage probabilities that are slightly liberal, but still close to the nominal value, when using the traditional constant variance and the generalized non-constant variance models. Although the model-based bootstrap method with the constant variance model performed the best in this scenario, the previous results demonstrated that this method is not necessarily robust to changes in the model parameters. In particular, it can be seen that the model-based bootstrap method with the constant variance model does not work well in situations where the standard deviation of the natural logarithm of the response variable is not constant. For consistency with the other results, the model-based bootstrap method (MODL-MLE1) is the recommended method for obtaining prediction bounds for the lifetime of a future product at the design stress level in situations where the standard deviation of the natural logarithm of the response variable remains constant with respect to time.

The next six figures display the performance of this method as a function of the mean life at the design stress level (α_1), the ratio of the mean life at the design stress level to the mean life at the highest accelerating stress level (α_2), and the sample sizes (test plan). These figures are obtained using the data from the second part of the simulation. The first two figures were produced using the results from Scenarios 3, 12, and 21 (Test Plan 2a). The next two figures were produced using the results from Scenarios 3, 6, and 9 (Test Plan 2a). The last two figures were produced using the results from Scenario 3 (Test Plans 2a, 2b, 2c, and 2d).

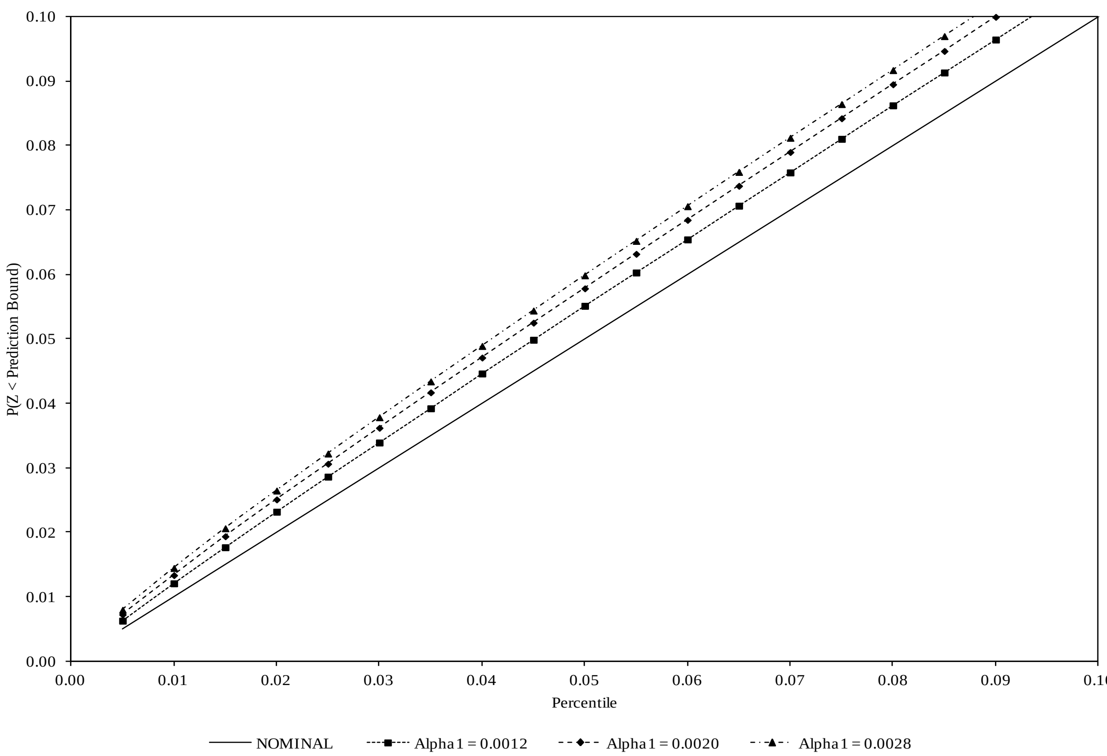

Figure 6.19 Lower Prediction Bound Coverage Probabilities for Different Values of Alpha1

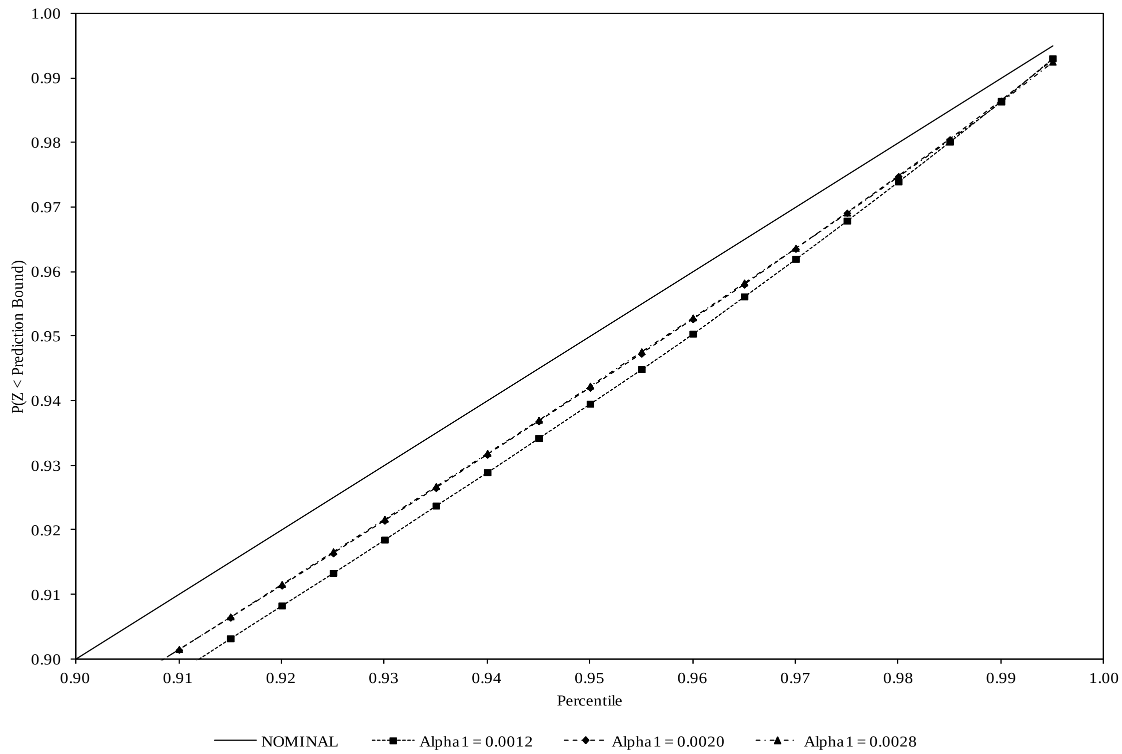

Figure 6.20 Upper Prediction Bound Coverage Probabilities for Different Values of Alpha1

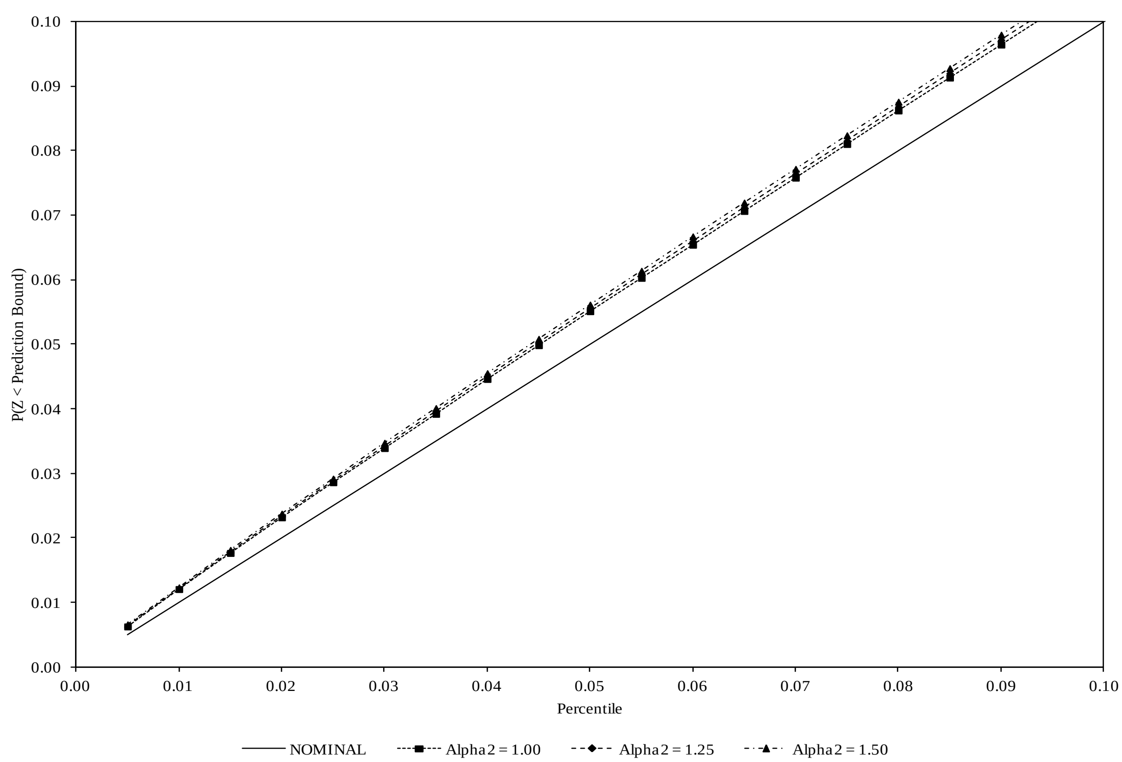

Figure 6.21 Lower Prediction Bound Coverage Probabilities for Different Values of Alpha2

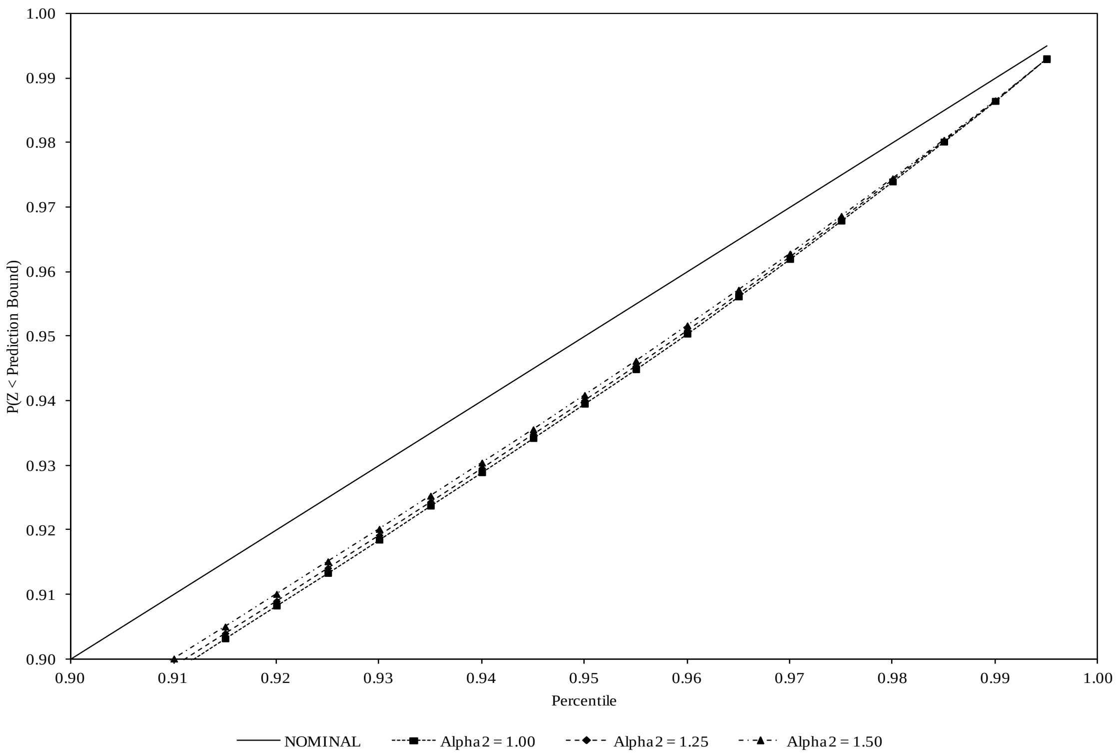

Figure 6.22 Upper Prediction Bound Coverage Probabilities for Different Values of Alpha2

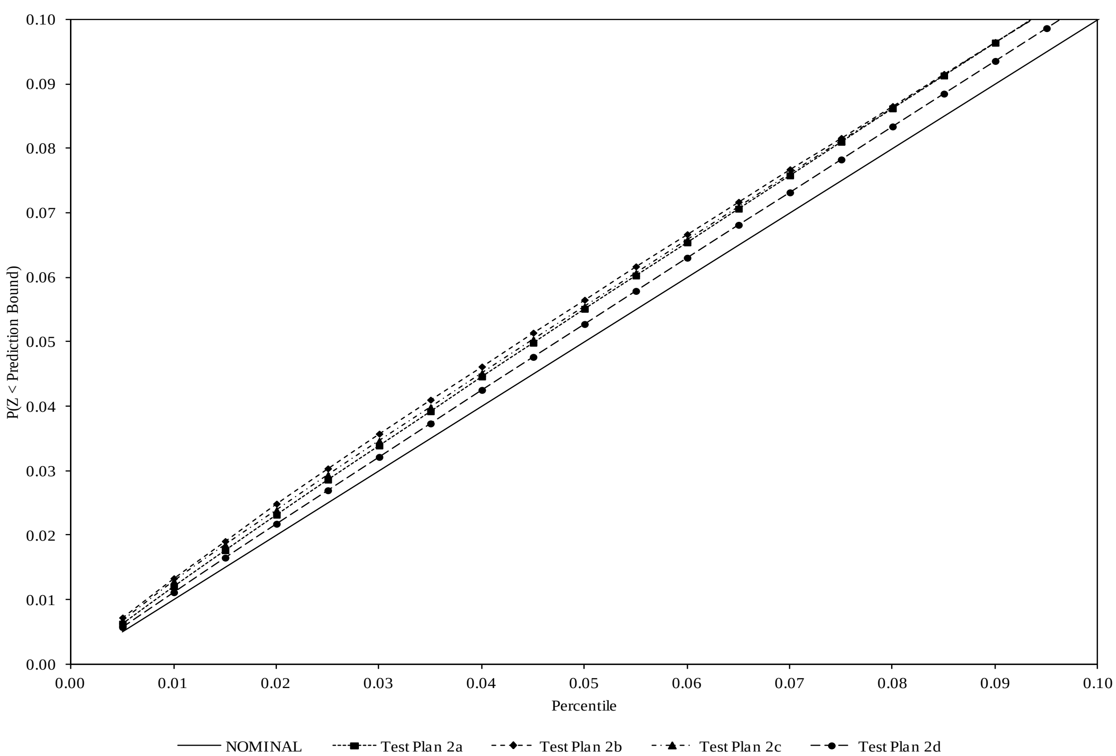

Figure 6.23 Lower Prediction Bound Coverage Probabilities for Different Test Plans

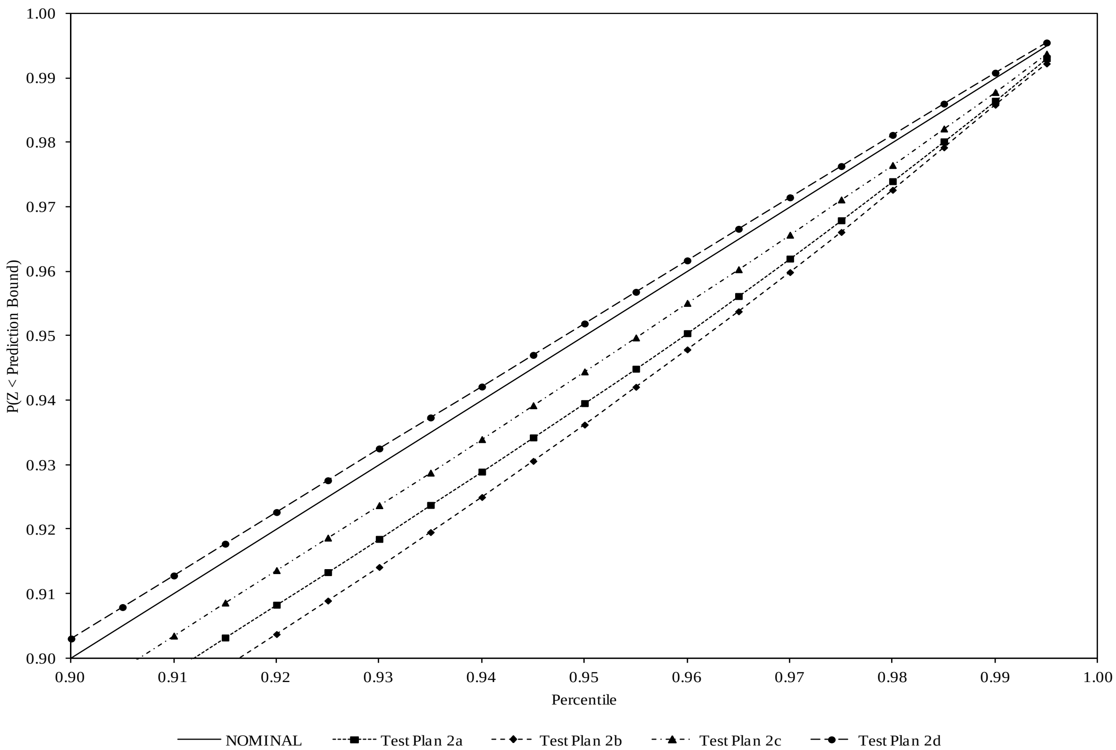

Figure 6.24 Upper Prediction Bound Coverage Probabilities for Different Test Plans

6.1.4 Discussion. From these results, it is apparent that the model-based bootstrap method (MODL-MLE1) is a robust method that produces prediction bounds with coverage probabilities that are slightly liberal, but still close to the nominal value, for situations where the standard deviation of the natural logarithm of the response variable increases, decreases, or remains constant with respect to time.

In addition, it can be seen that the performance of this method is affected by some of the model parameters. Surprisingly, the method produces better results for the lower percentiles when the mean life at the design stress is increased. As seen below, this is opposite of the performance of the confidence bounds. In addition, the method seems relatively unaffected by changes in the ratio of the mean life at the design stress level to the mean life at the highest accelerating stress level. As expected, this method improves as the sample size increases.

It can also be seen that the bootstrap calibration technique has the potential to improve the results for prediction bounds whose coverage probability is liberal, but still relatively close to the nominal coverage probability. This technique is unable to improve the scenarios where the coverage probability was extremely liberal.

6.2 CONFIDENCE BOUND RESULTS

This section displays the lifetime confidence bound results for situations where the standard deviation of the natural logarithm of the response variable increases, decreases, or remains constant with respect to time. For each situation, the performance of the various techniques is plotted for a representative scenario. Representative tables are provided that display statistics from the empirical distribution of the 0.05 and 0.95 confidence bounds for the different methods. This information is used to make a recommendation for the best method. The next six figures display the performance of the recommended method as a function of the mean life at the design stress level (α_1), the ratio of the mean life at the design stress level to the mean life at the highest accelerating stress level (α_2), and the sample size (test plan).

The following nomenclature is used for the confidence bound results:

- NOMINAL denotes the nominal coverage probability.
- MLE0 denotes the results obtained using the delta method with the traditional constant variance model.
- MLE1 denotes the results obtained using the delta method with the generalized non-constant variance model.
- MODL-MLE0-PERC denotes the results obtained using the percentile method with the traditional constant variance model.

- MODL-MLE0-BIAS denotes the results obtained using the bias-corrected percentile method with the traditional constant variance model.
- MODL-MLE0-NORM denotes the results obtained using the normal theory method with the traditional constant variance model.
- MODL-MLE1-PERC denotes the results obtained using the percentile method with the generalized non-constant variance model.
- MODL-MLE1-BIAS denotes the results obtained using the bias-corrected percentile method with the generalized non-constant variance model.
- MODL-MLE1-NORM denotes the results obtained using the normal theory method with the generalized non-constant variance model.

6.2.1 Increasing Standard Deviation. The first set of results is associated with situations where the standard deviation of the natural logarithm of the response variable increases with respect to time. Since product performance is assumed to degrade (as evidenced by a decreasing mean response variable) over time, this situation is not expected to occur in practice. However, the results from this situation do provide an indication of the robustness of the various methods. The results included below are obtained from Scenario 1 (Test Plan 1).

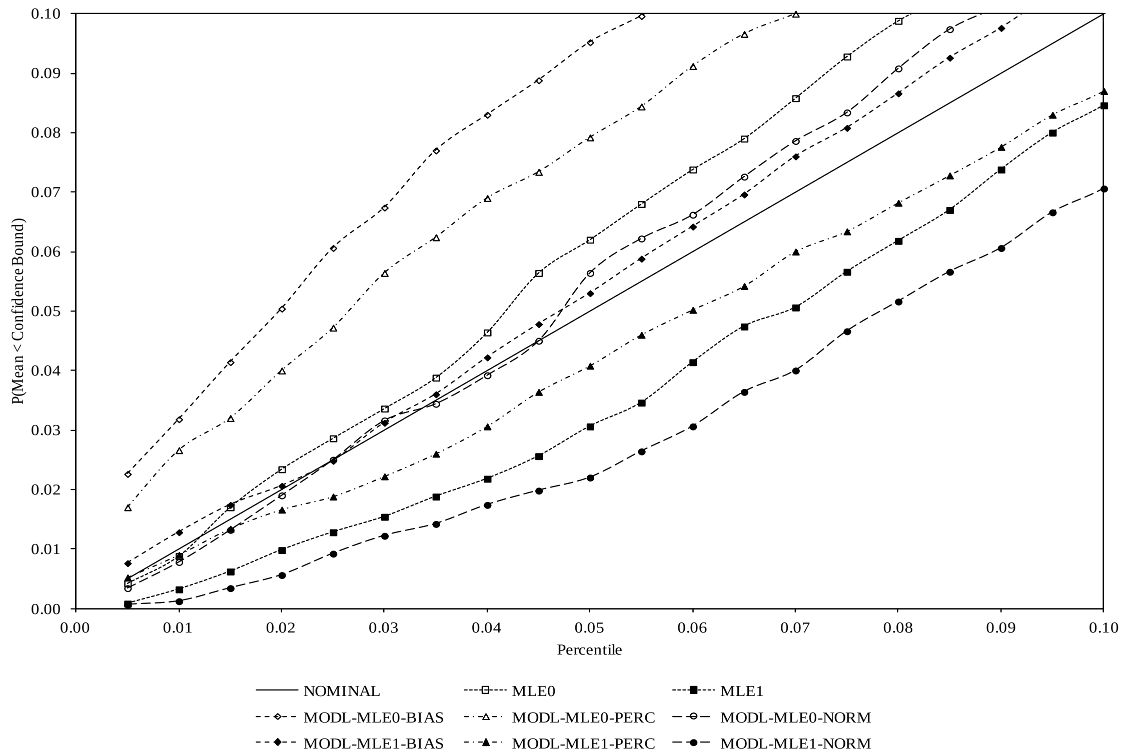

Figure 6.25 Lower Confidence Bound Coverage Probabilities

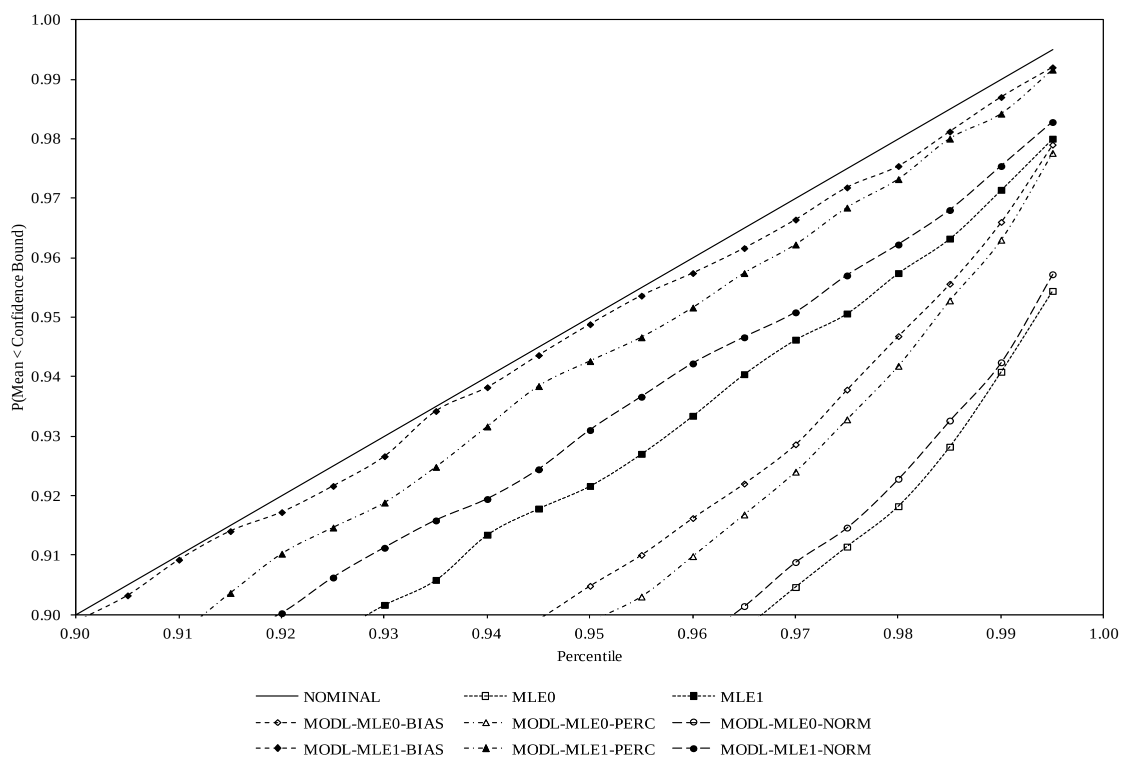

Figure 6.26 Upper Confidence Bound Coverage Probabilities

Table 6.7 Statistics for the 95 Percent Lower Confidence Bounds (Test Plan 1, Scenario 1)

Method	Average	25th Percentile	50th Percentile	75th Percentile	Standard Deviation	Coverage Probability
MLE0	46.66	42.22	46.10	50.43	6.33	0.0620
MLE1	47.16	43.67	46.80	50.20	5.00	0.0306
MODL-MLE0-BIAS	48.11	43.44	47.52	52.03	6.70	0.0952
MODL-MLE0-PERC	47.50	42.92	46.91	51.38	6.54	0.0792
MODL-MLE0-NORM	46.33	41.95	45.81	50.05	6.25	0.0564
MODL-MLE1-BIAS	48.25	44.60	47.87	51.46	5.25	0.0530
MODL-MLE1-PERC	47.68	44.11	47.33	50.83	5.11	0.0408
MODL-MLE1-NORM	46.61	43.20	46.29	49.64	4.89	0.0220

Table 6.8 Statistics for the 95 Percent Upper Confidence Bounds (Test Plan 1, Scenario 1)

Method	Average	25th Percentile	50th Percentile	75th Percentile	Standard Deviation	Coverage Probability
MLE0	69.47	61.64	68.28	75.99	11.29	0.8800
MLE1	68.53	62.51	67.77	73.70	8.70	0.9216
MODL-MLE0-BIAS	71.35	63.10	70.06	78.16	11.88	0.9048
MODL-MLE0-PERC	70.73	62.58	69.41	77.45	11.68	0.8986
MODL-MLE0-NORM	69.80	61.85	68.57	76.35	11.41	0.8850
MODL-MLE1-BIAS	70.53	64.09	69.69	75.98	9.26	0.9488
MODL-MLE1-PERC	69.98	63.71	69.11	75.27	9.06	0.9426
MODL-MLE1-NORM	69.08	62.92	68.29	74.27	8.84	0.9310

These results indicate that the confidence bounds obtained using the percentile and bias-corrected percentile methods have coverage probabilities close to the nominal value when using the generalized non-constant variance model. In general, it is better to have confidence bounds whose coverage probabilities are conservative rather than liberal. Therefore, the model-based bootstrap percentile method (MODL-MLE1-PERC) is the recommended method for obtaining confidence bounds for the mean lifetime at the design stress level in situations where the standard deviation of the natural logarithm of the response variable increases with respect to time.

The next six figures display the performance of this method as a function of the mean life at the design stress level (α_1), the ratio of the mean life at the design stress level to the mean life at the highest accelerating stress level (α_2), and the sample sizes (test plan). These figures are obtained using the data from the second part of the simulation. The first two figures were produced using the results from Scenarios 1, 10, and 19 (Test Plan 2a). The next two figures were produced using the results from Scenarios 1, 4, and 7 (Test Plan 2a). The last two figures were produced using the results from Scenario 1 (Test Plans 2a, 2b, 2c, and 2d).

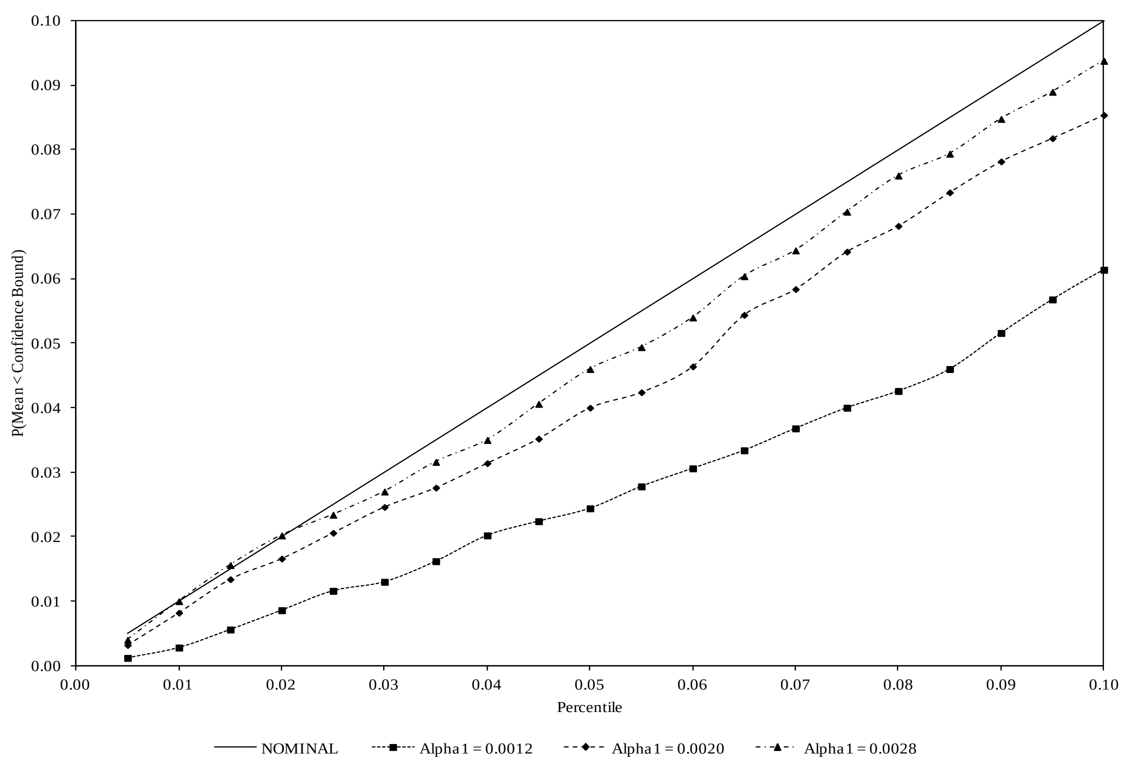

Figure 6.27 Lower Confidence Bound Coverage Probabilities for Different Values of Alpha1

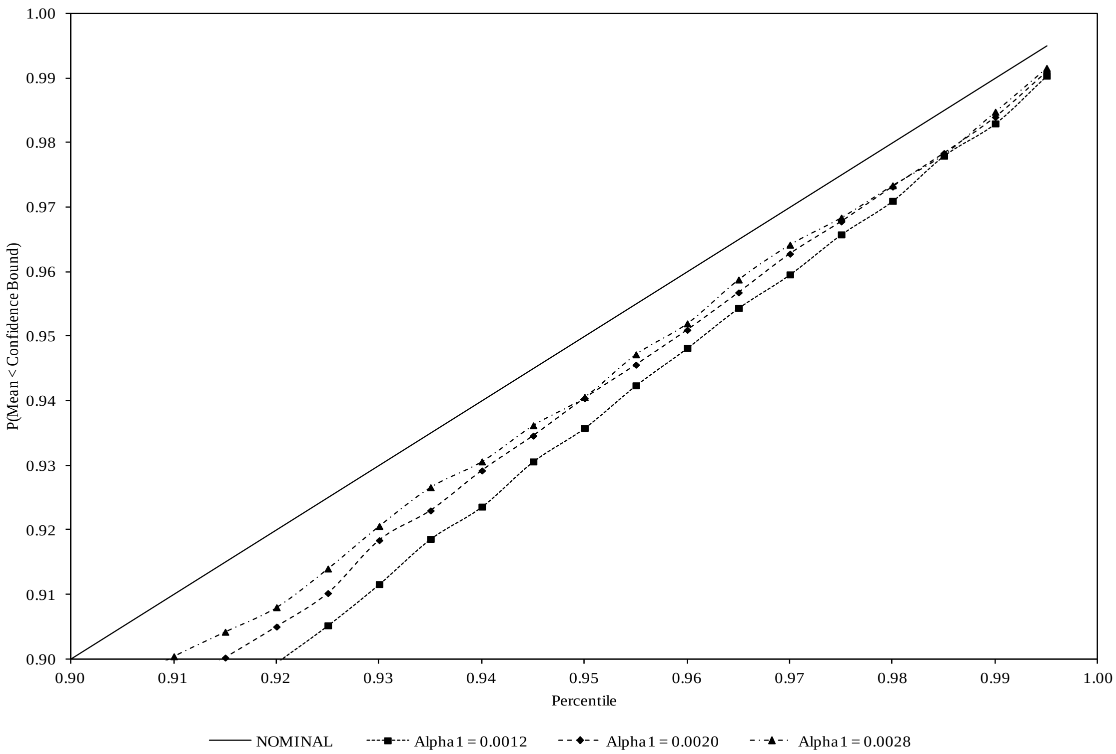

Figure 6.28 Upper Confidence Bound Coverage Probabilities for Different Values of Alpha1

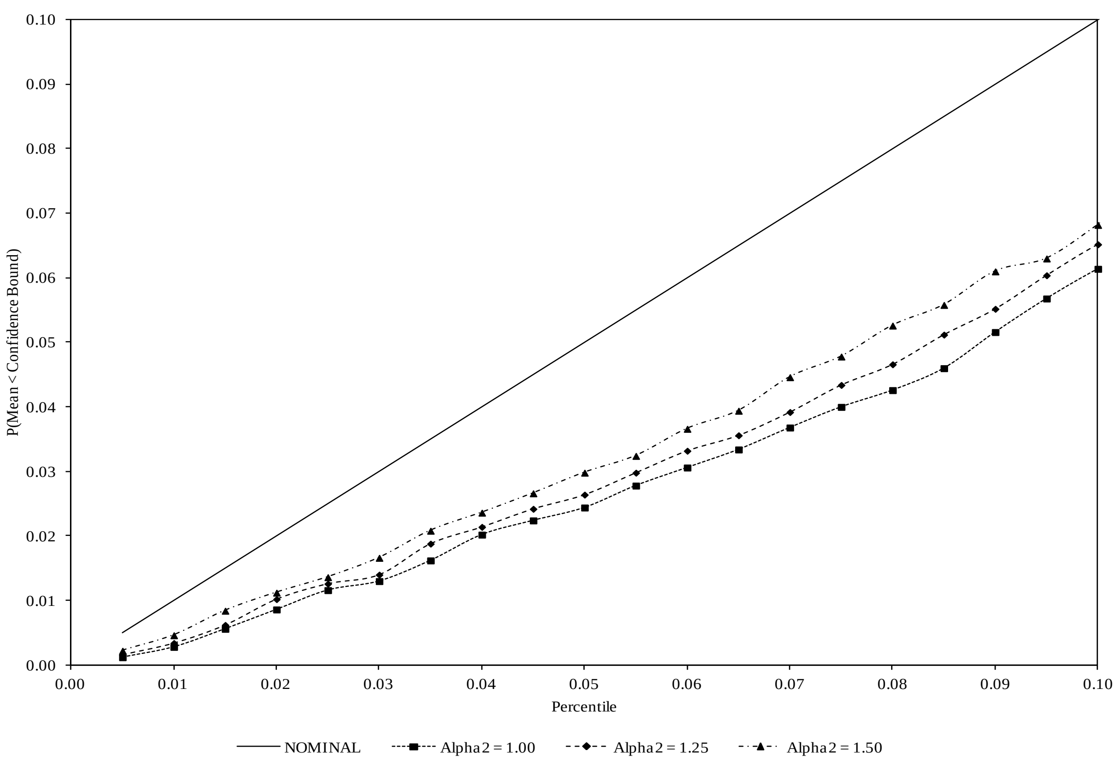

Figure 6.29 Lower Confidence Bound Coverage Probabilities for Different Values of Alpha2

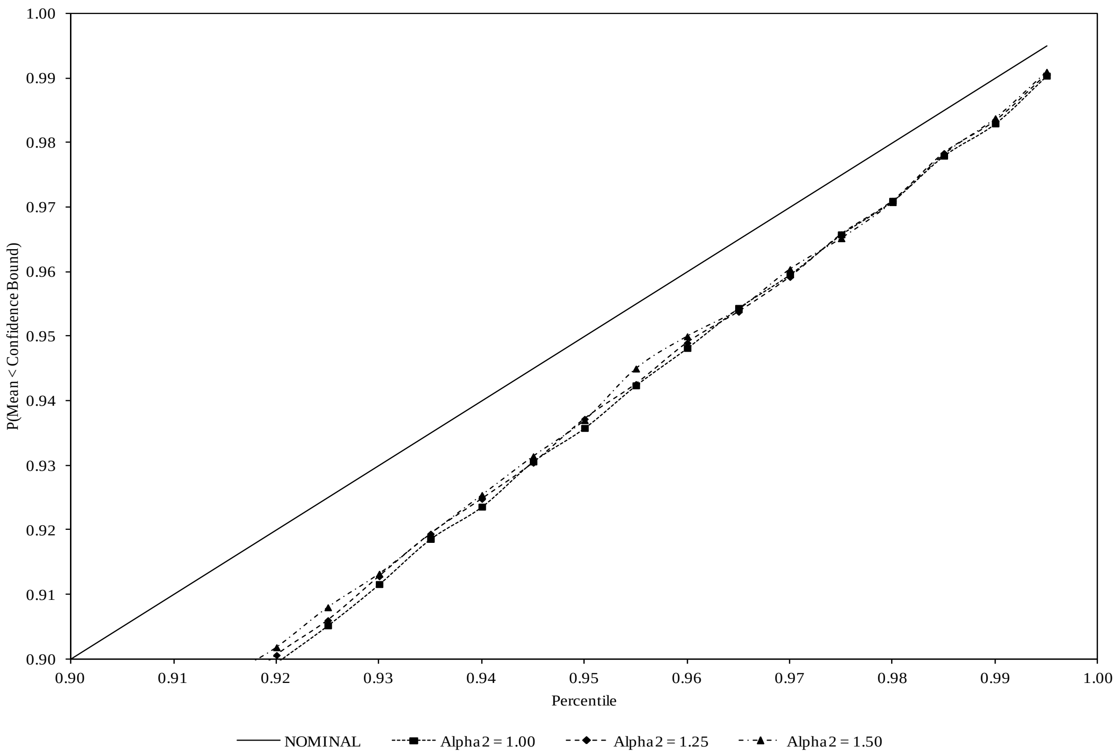

Figure 6.30 Upper Confidence Bound Coverage Probabilities for Different Values of Alpha2

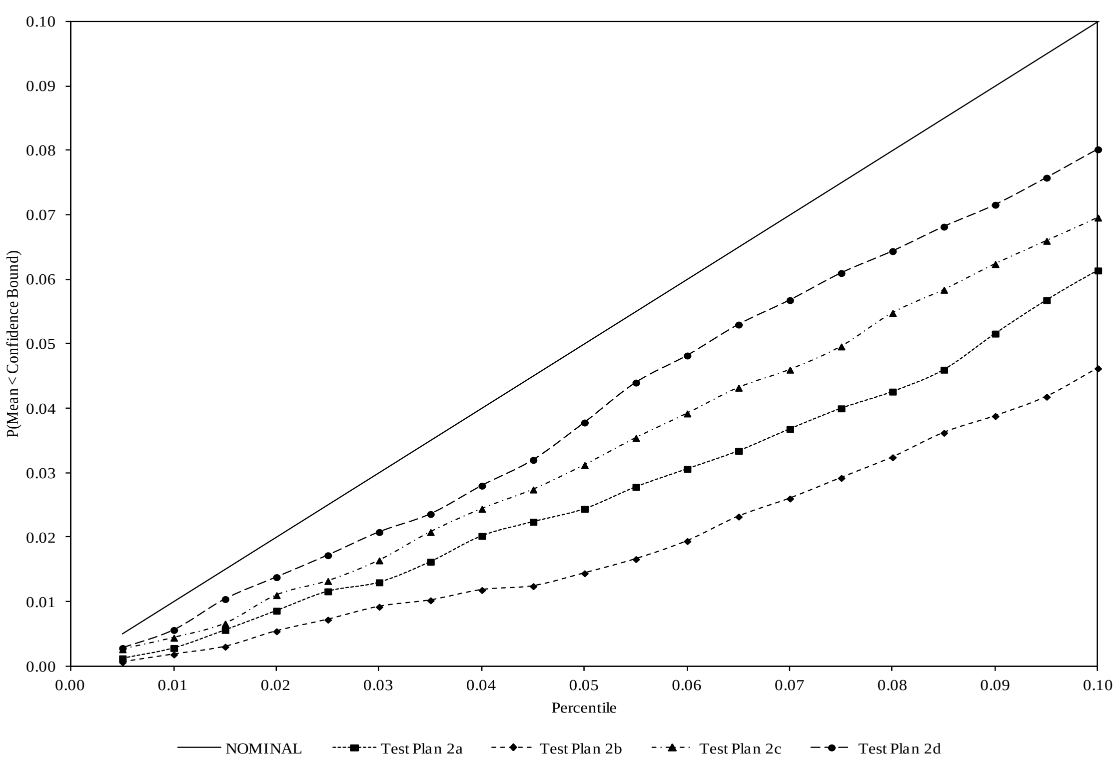

Figure 6.31 Lower Confidence Bound Coverage Probabilities for Different Test Plans

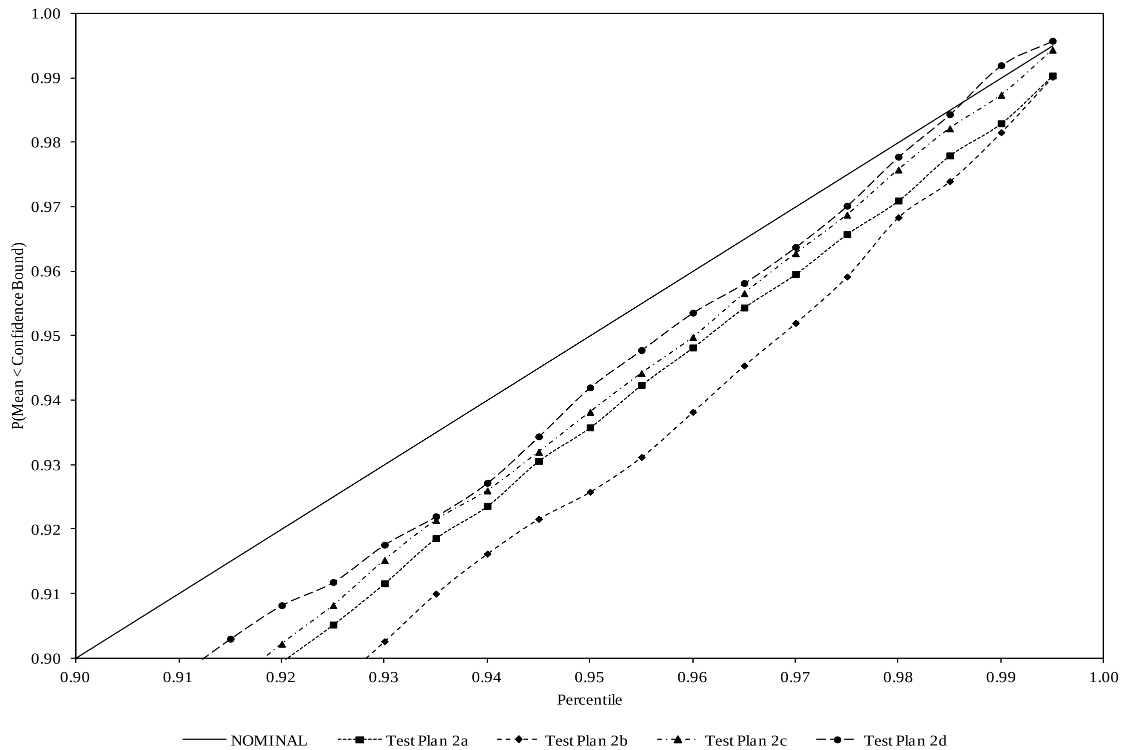

Figure 6.32 Upper Confidence Bound Coverage Probabilities for Different Test Plans

6.2.2 Decreasing Standard Deviation. The second set of results is associated with situations where the standard deviation of the natural logarithm of the response variable decreases with respect to time. The results included below are obtained from Scenario 2 (Test Plan 1).

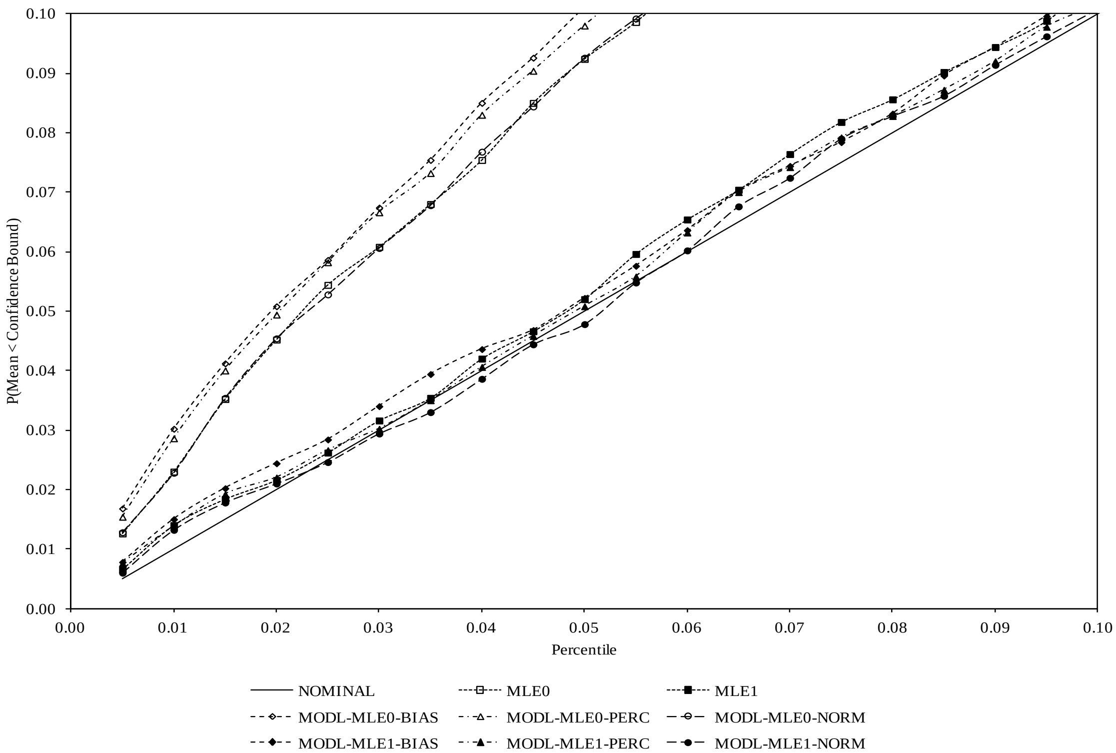

Figure 6.33 Lower Confidence Bound Coverage Probabilities

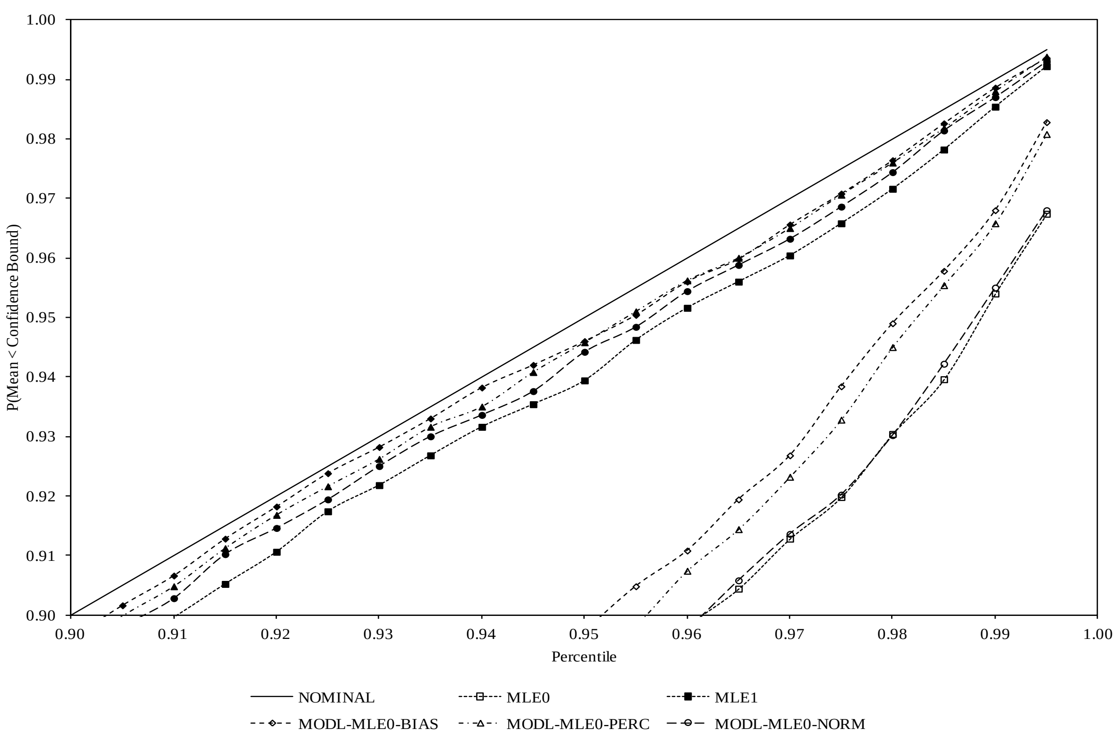

Figure 6.34 Upper Confidence Bound Coverage Probabilities

Table 6.9 Statistics for the 95 Percent Lower Confidence Bounds (Test Plan 1, Scenario 2)

Method	Average	25th Percentile	50th Percentile	75th Percentile	Standard Deviation	Coverage Probability
MLE0	53.60	51.78	53.52	55.41	2.63	0.0924
MLE1	55.83	55.27	55.82	56.37	0.81	0.0520
MODL-MLE0-BIAS	53.76	51.96	53.66	55.53	2.60	0.1010
MODL-MLE0-PERC	53.70	51.89	53.60	55.49	2.62	0.0980
MODL-MLE0-NORM	53.59	51.77	53.51	55.40	2.64	0.0926
MODL-MLE1-BIAS	55.83	55.27	55.82	56.37	0.81	0.0522
MODL-MLE1-PERC	55.82	55.26	55.82	56.37	0.81	0.0508
MODL-MLE1-NORM	55.81	55.24	55.80	56.35	0.81	0.0478

Table 6.10 Statistics for the 95 Percent Upper Confidence Bounds (Test Plan 1, Scenario 2)

Method	Average	25th Percentile	50th Percentile	75th Percentile	Standard Deviation	Coverage Probability
MLE0	60.82	58.55	60.62	62.88	3.22	0.8806
MLE1	58.46	57.87	58.45	59.04	0.87	0.9394
MODL-MLE0-BIAS	61.00	58.75	60.78	63.04	3.20	0.8972
MODL-MLE0-PERC	60.93	58.67	60.72	63.00	3.22	0.8910
MODL-MLE0-NORM	60.83	58.55	60.64	62.88	3.22	0.8806
MODL-MLE1-BIAS	58.51	57.92	58.50	59.10	0.87	0.9460
MODL-MLE1-PERC	58.50	57.91	58.49	59.09	0.87	0.9458
MODL-MLE1-NORM	58.49	57.90	58.47	59.07	0.87	0.9442

These results indicate that the confidence bounds obtained using any of the methods with the generalized non-constant variance model have coverage probabilities that are slightly liberal, but still close to the nominal value. For consistency the model-based bootstrap percentile method (MODL-MLE1-PERC) is the recommended method since it performs well in situations where the standard deviation of the natural logarithm of the response variable increases as well as decreases with respect to time.

The next six figures display the performance of this method as a function of the mean life at the design stress level (α_1), the ratio of the mean life at the design stress level to the mean life at the highest accelerating stress level (α_2), and the sample sizes (test plan). These figures are obtained using the data from the second part of the simulation. The first two figures were produced using the results from Scenarios 2, 11, and 20 (Test Plan 2a). The next two figures were produced using the results from Scenarios 2, 5, and 8 (Test Plan 2a). The last two figures were produced using the results from Scenario 2 (Test Plans 2a, 2b, 2c, and 2d).

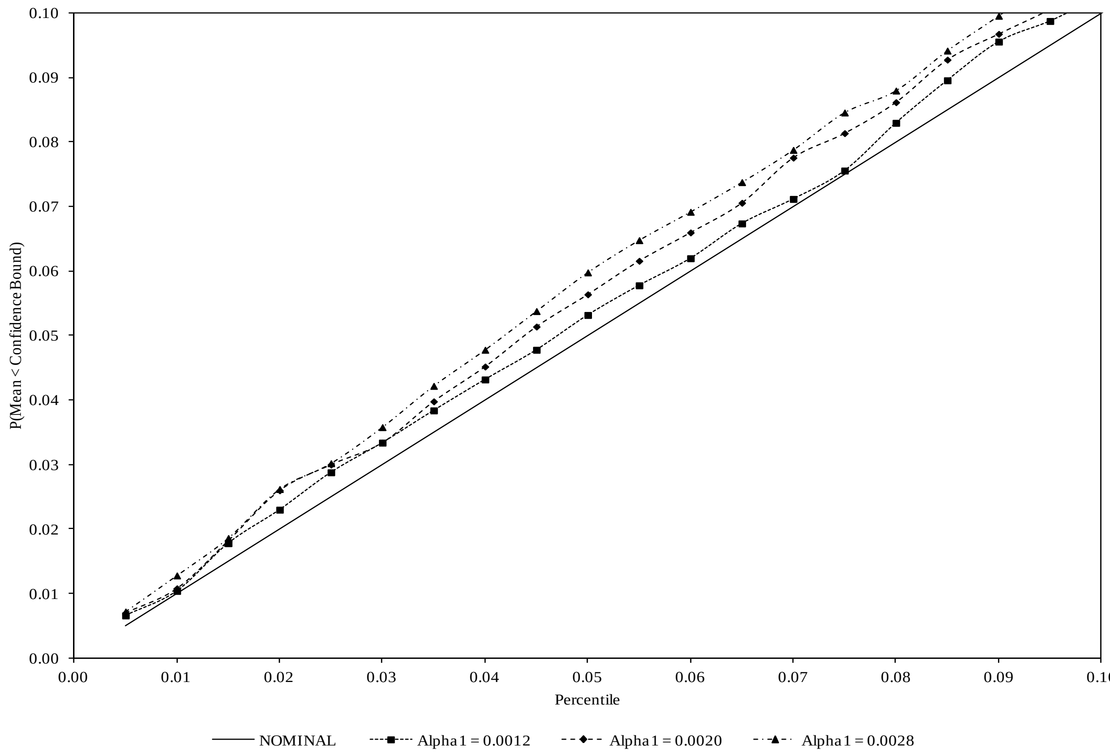

Figure 6.35 Lower Confidence Bound Coverage Probabilities for Different Values of Alpha1

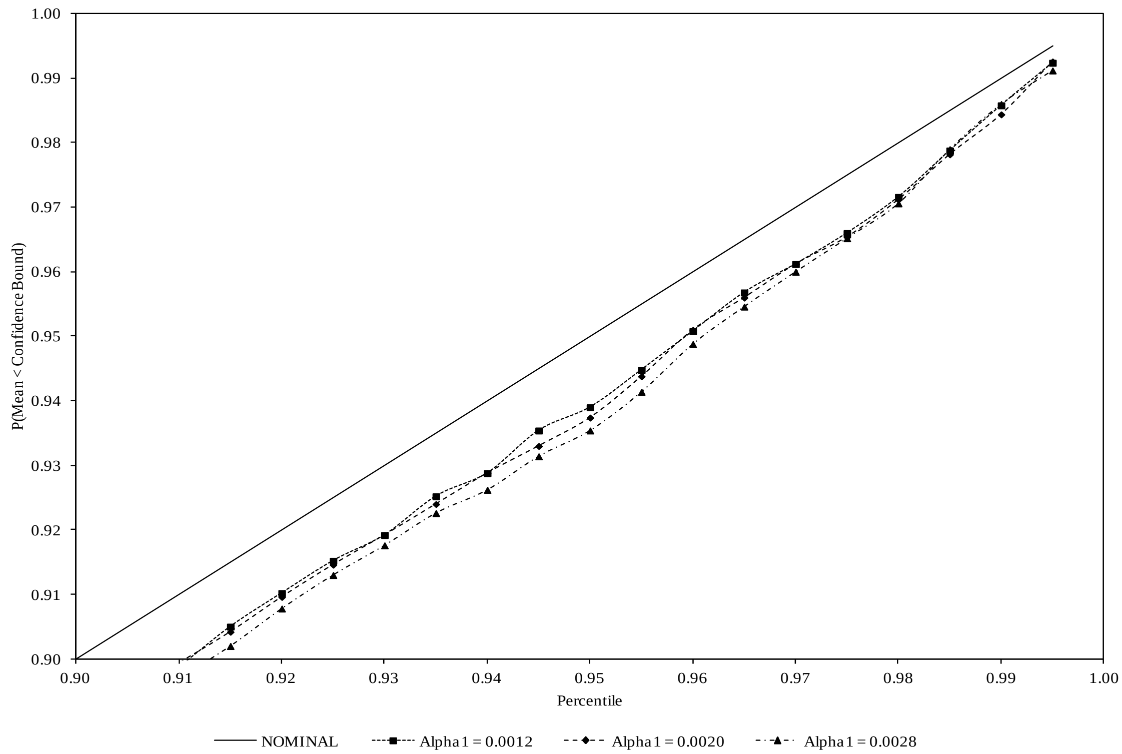

Figure 6.36 Upper Confidence Bound Coverage Probabilities for Different Values of Alpha1

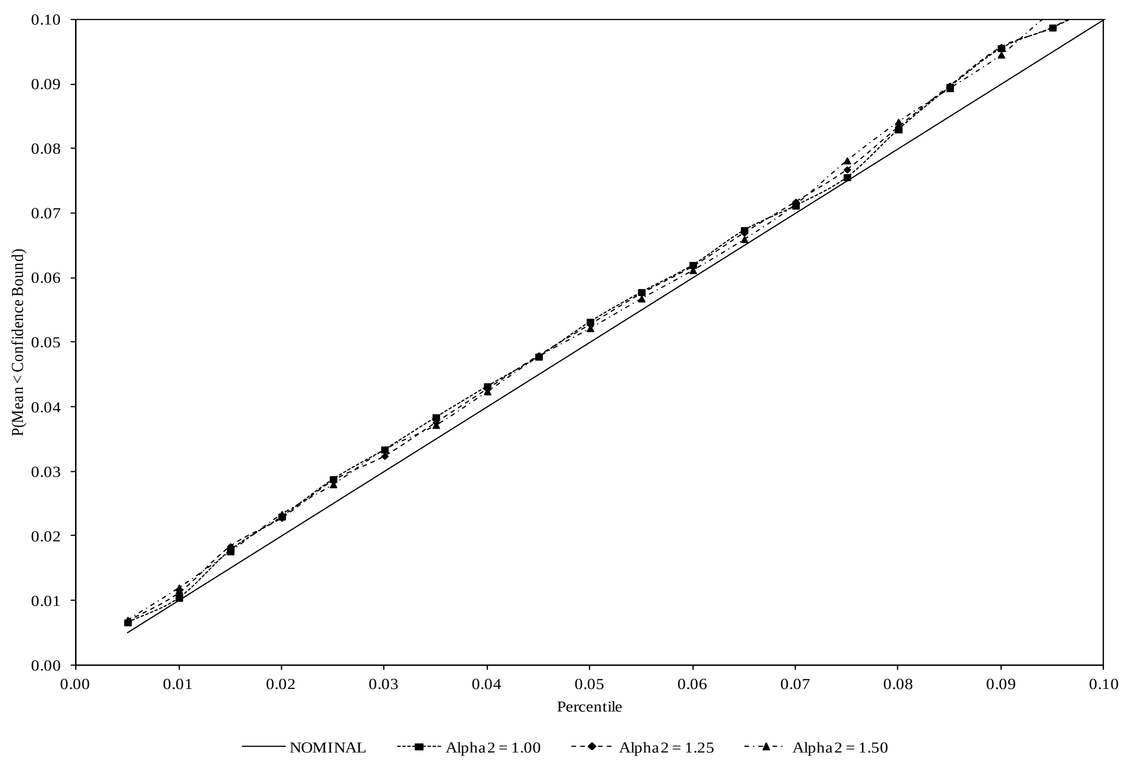

Figure 6.37 Lower Confidence Bound Coverage Probabilities for Different Values of Alpha2

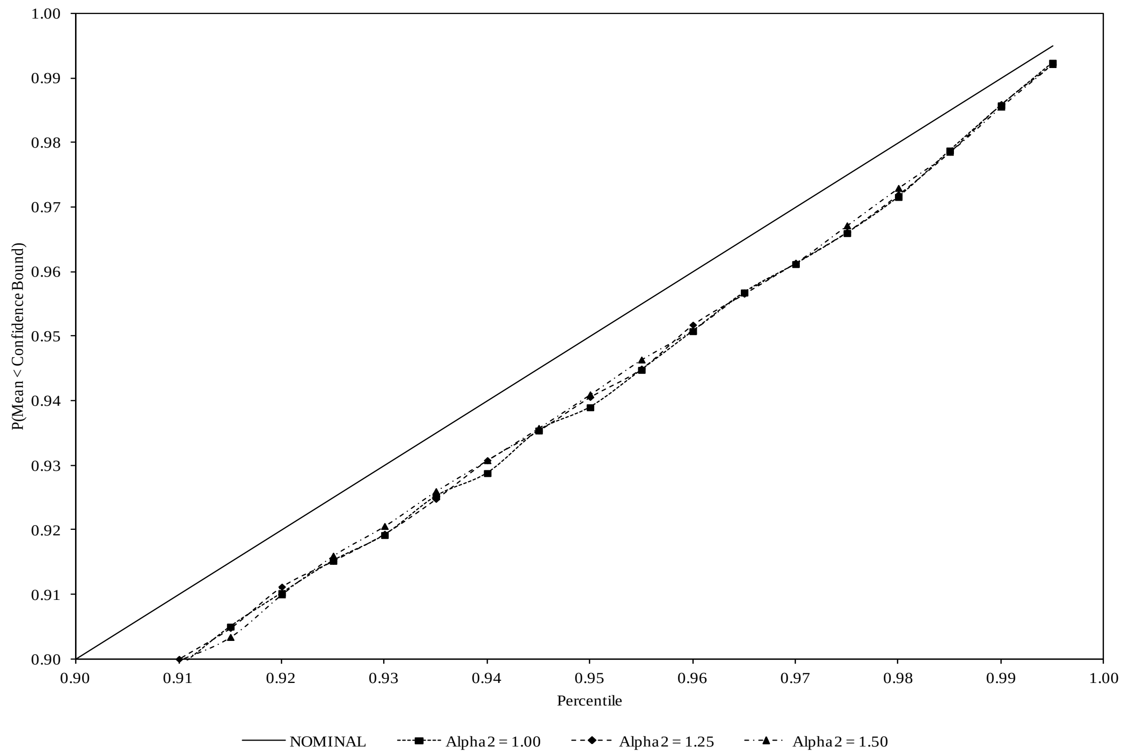

Figure 6.38 Upper Confidence Bound Coverage Probabilities for Different Values of Alpha2

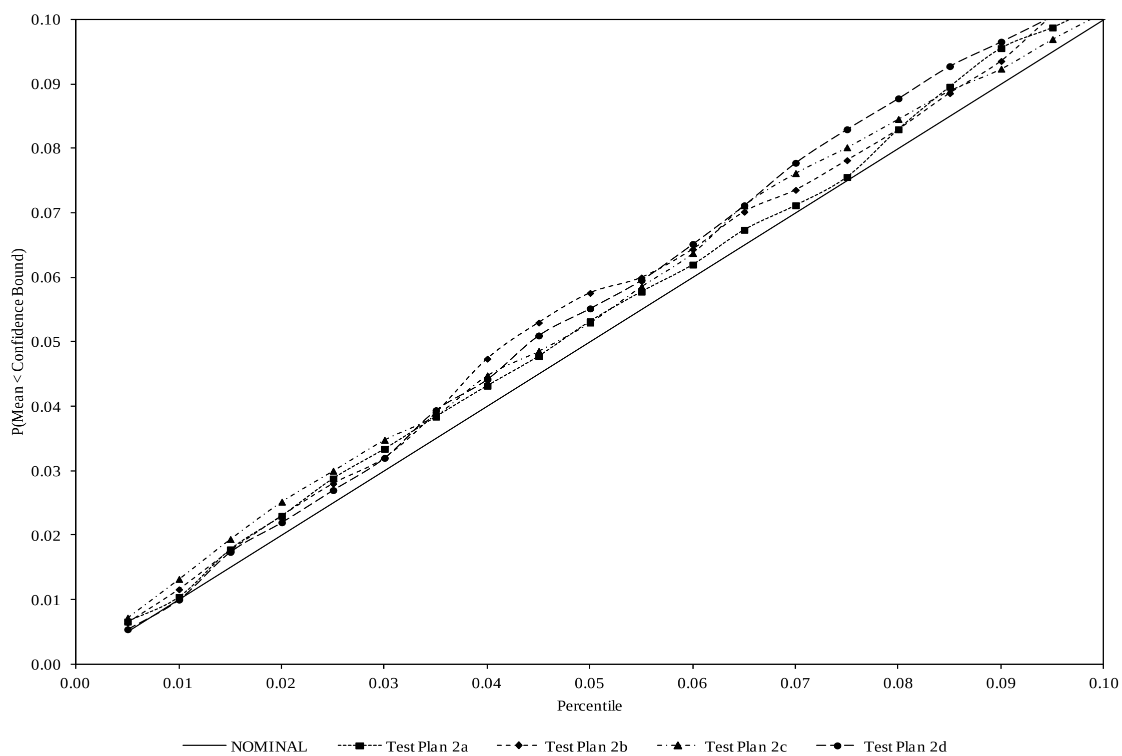

Figure 6.39 Lower Confidence Bound Coverage Probabilities for Different Test Plans

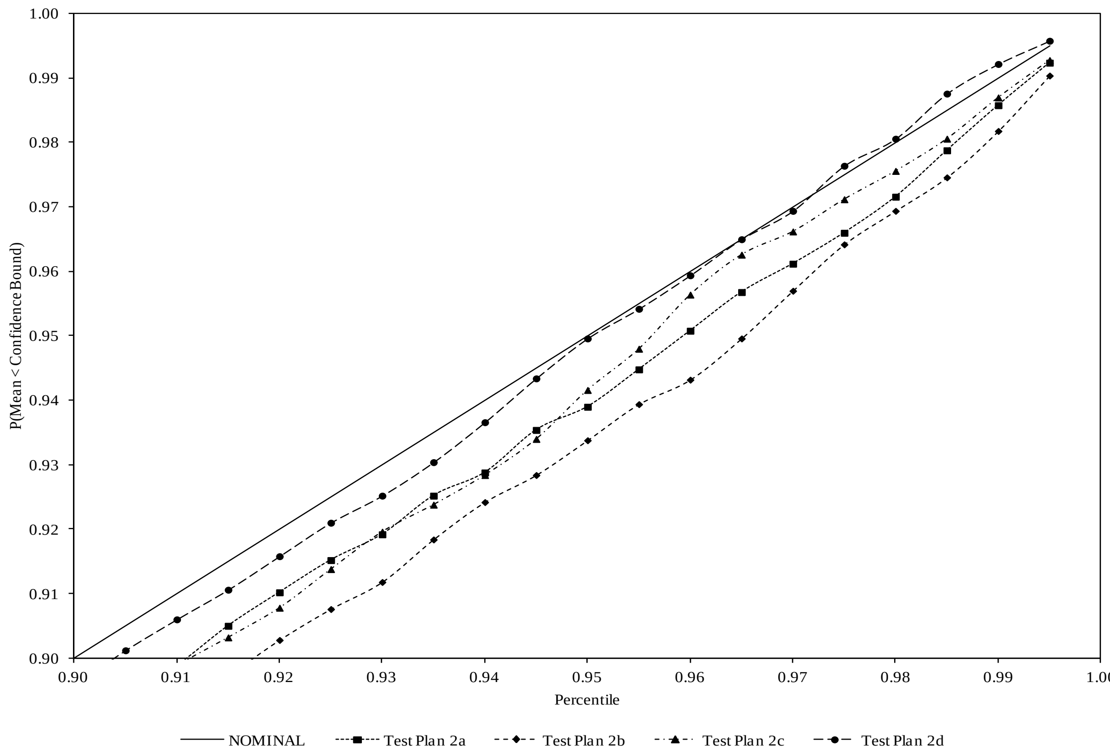

Figure 6.40 Upper Confidence Bound Coverage Probabilities for Different Test Plans

6.2.3 Constant Standard Deviation. The third set of results is associated with situations where the standard deviation of the natural logarithm of the response variable remains constant with respect to time. This is a common assumption in accelerated degradation analysis. The results included below are obtained from Scenario 3 (Test Plan 1).

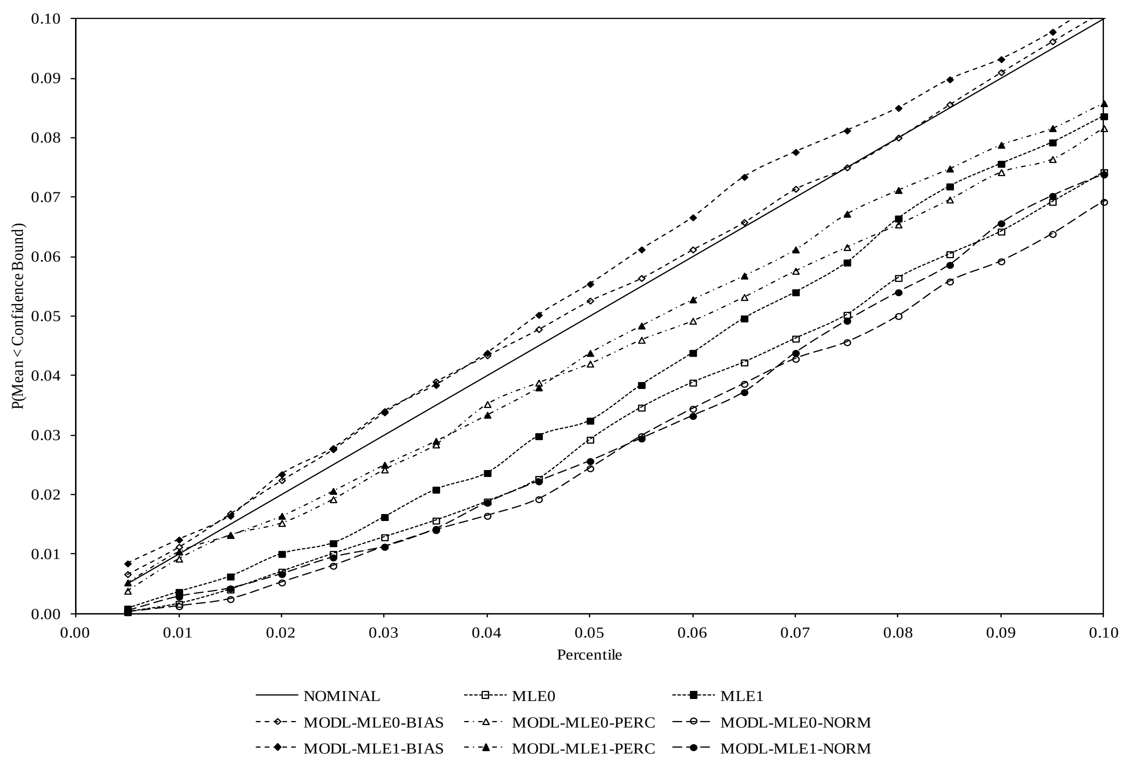

Figure 6.41 Lower Confidence Bound Coverage Probabilities

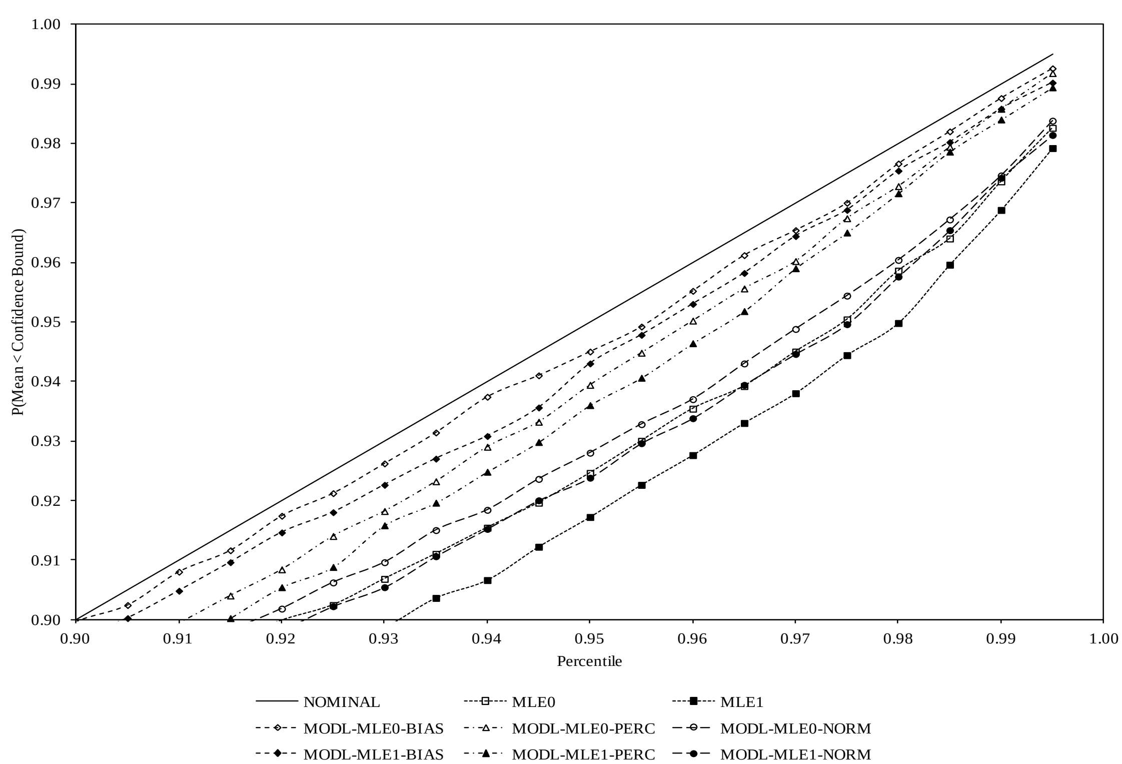

Figure 6.42 Upper Confidence Bound Coverage Probabilities

Table 6.11 Statistics for the 95 Percent Lower Confidence Bounds (Test Plan 1, Scenario 3)

Method	Average	25th Percentile	50th Percentile	75th Percentile	Standard Deviation	Coverage Probability
MLE0	46.79	43.39	46.40	49.87	4.92	0.0292
MLE1	47.04	43.47	46.67	50.24	5.10	0.0324
MODL-MLE0-BIAS	48.13	44.54	47.72	51.35	5.20	0.0526
MODL-MLE0-PERC	47.57	44.05	47.17	50.73	5.08	0.0420
MODL-MLE0-NORM	46.51	43.17	46.15	49.56	4.87	0.0244
MODL-MLE1-BIAS	48.12	44.40	47.67	51.43	5.32	0.0554
MODL-MLE1-PERC	47.56	43.93	47.12	50.80	5.21	0.0438
MODL-MLE1-NORM	46.50	42.99	46.08	49.63	5.00	0.0256

Table 6.12 Statistics for the 95 Percent Upper Confidence Bounds (Test Plan 1, Scenario 3)

Method	Average	25th Percentile	50th Percentile	75th Percentile	Standard Deviation	Coverage Probability
MLE0	68.65	62.69	67.88	73.85	8.61	0.9246
MLE1	68.45	62.33	67.63	73.73	8.76	0.9172
MODL-MLE0-BIAS	70.37	64.07	69.52	75.81	9.03	0.9450
MODL-MLE0-PERC	69.81	63.60	69.00	75.21	8.89	0.9394
MODL-MLE0-NORM	68.93	62.90	68.15	74.18	8.69	0.9280
MODL-MLE1-BIAS	70.45	63.98	69.60	76.03	9.26	0.9430
MODL-MLE1-PERC	69.88	63.58	69.09	75.38	9.11	0.9360
MODL-MLE1-NORM	69.00	62.80	68.18	74.39	8.90	0.9238

These results indicate that the confidence bounds obtained using the percentile and bias-corrected percentile methods have coverage probabilities close to the nominal value when using the generalized non-constant variance model. In general, it is better to have confidence bounds whose coverage probabilities are conservative rather than liberal. Therefore, the model-based bootstrap percentile method (MODL-MLE1-PERC) is the recommended method for obtaining confidence bounds for the mean lifetime at the design stress level in situations where the standard deviation of the natural logarithm of the response variable remains constant with respect to time.

The next six figures display the performance of this method as a function of the mean life at the design stress level (α_1), the ratio of the mean life at the design stress level to the mean life at the highest accelerating stress level (α_2), and the sample sizes (test plan). These figures are obtained using the data from the second part of the simulation. The first two figures were produced using the results from Scenarios 3, 12, and 21 (Test Plan 2a). The next two figures were produced using the results from Scenarios 3, 6, and 9 (Test Plan 2a). The last two figures were produced using the results from Scenario 3 (Test Plans 2a, 2b, 2c, and 2d).

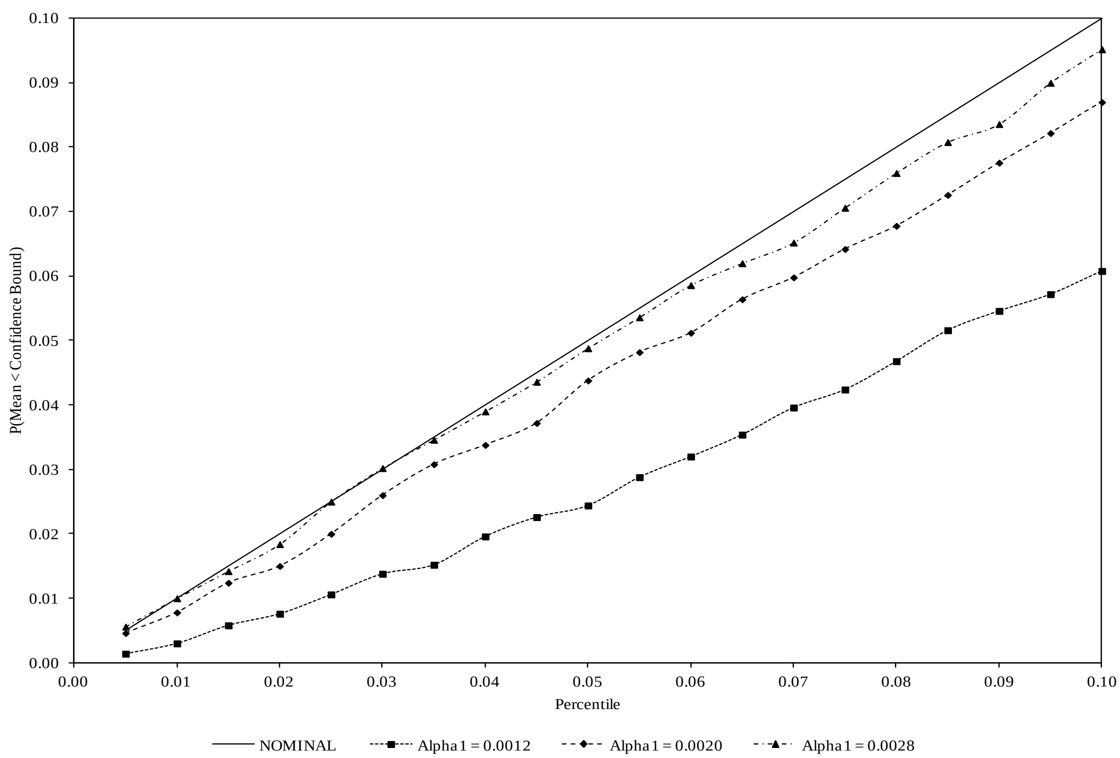

Figure 6.43 Lower Confidence Bound Coverage Probabilities for Different Values of Alpha1

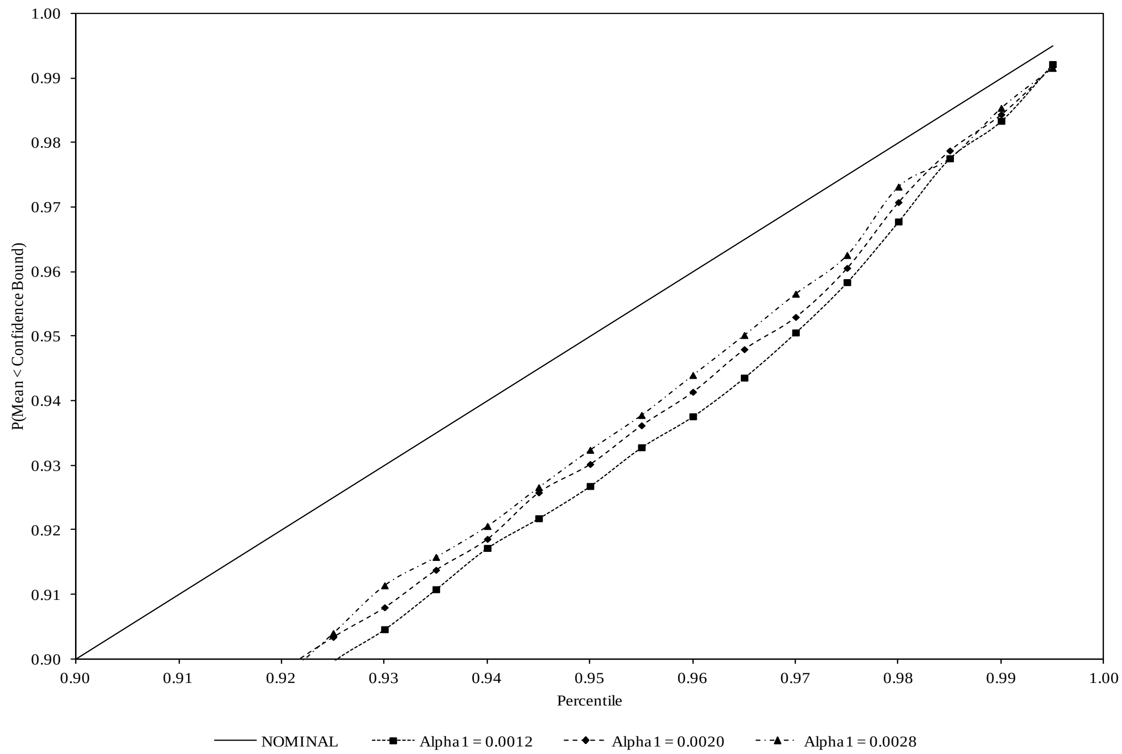

Figure 6.44 Upper Confidence Bound Coverage Probabilities for Different Values of Alpha1

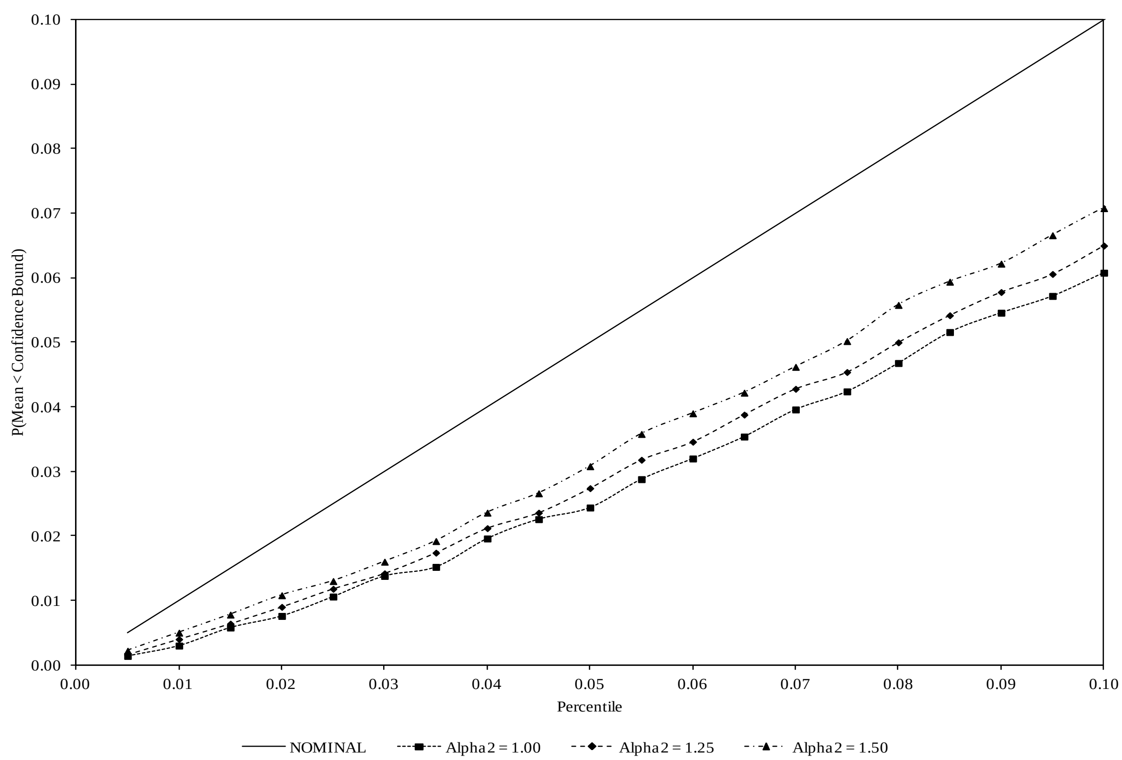

Figure 6.45 Lower Confidence Bound Coverage Probabilities for Different Values of Alpha2

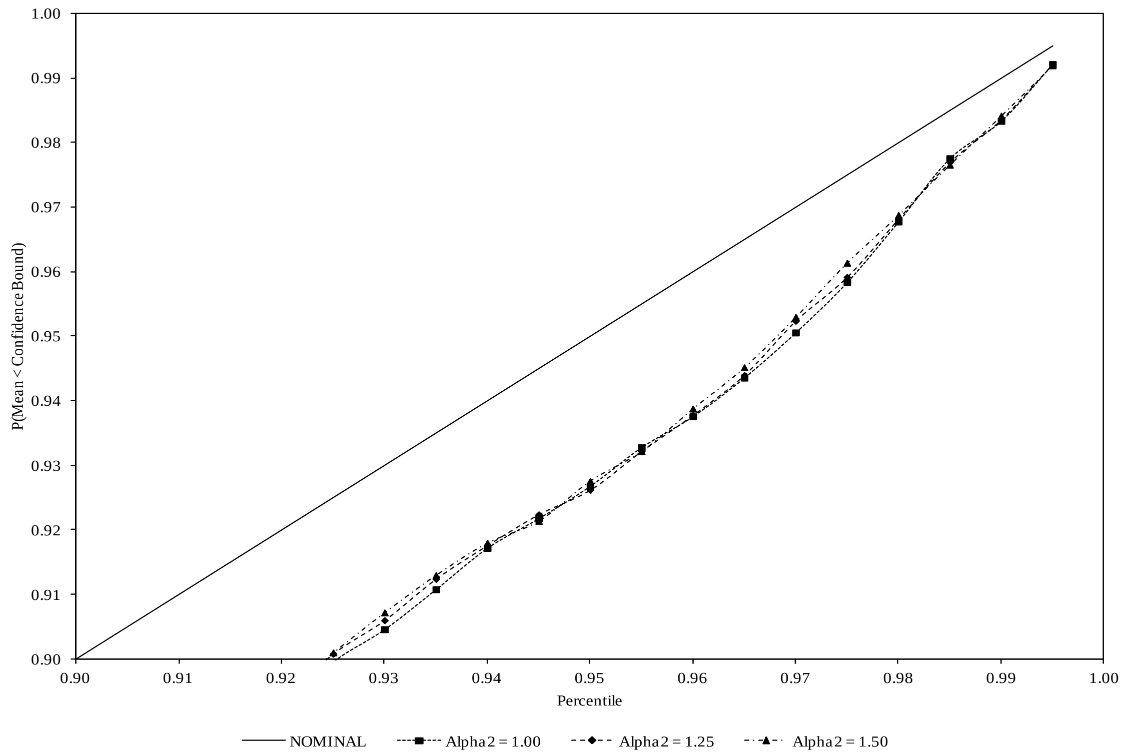

Figure 6.46 Upper Confidence Bound Coverage Probabilities for Different Values of Alpha2

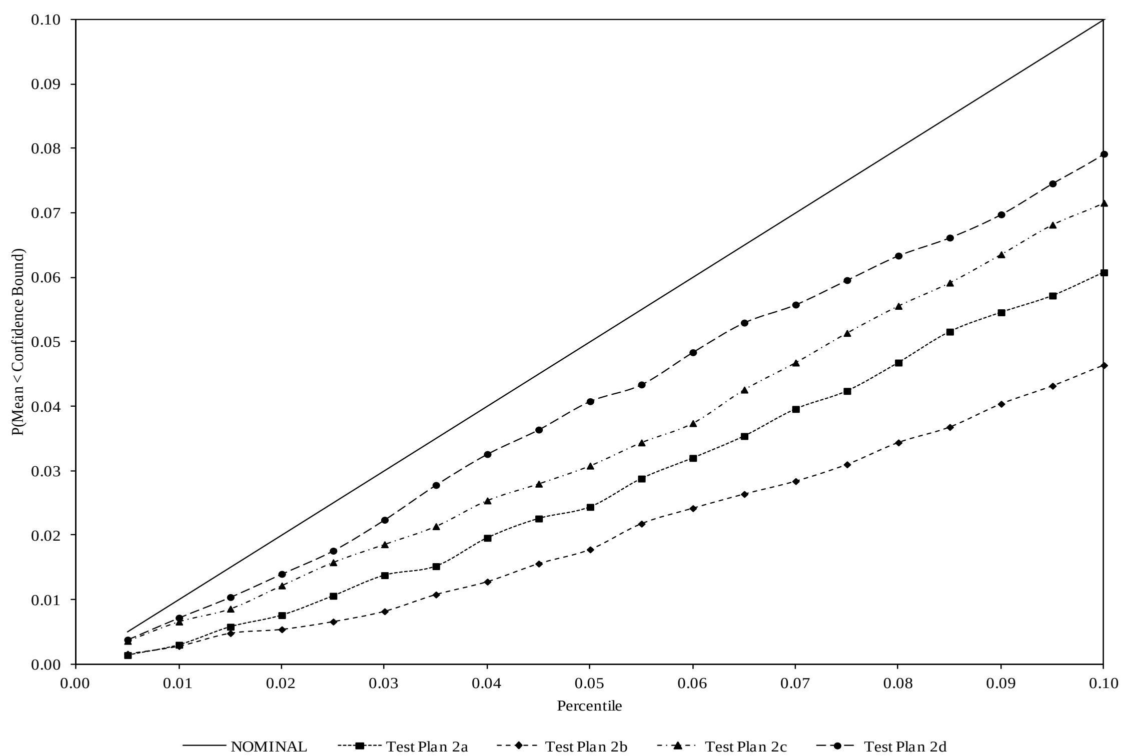

Figure 6.47 Lower Confidence Bound Coverage Probabilities for Different Test Plans

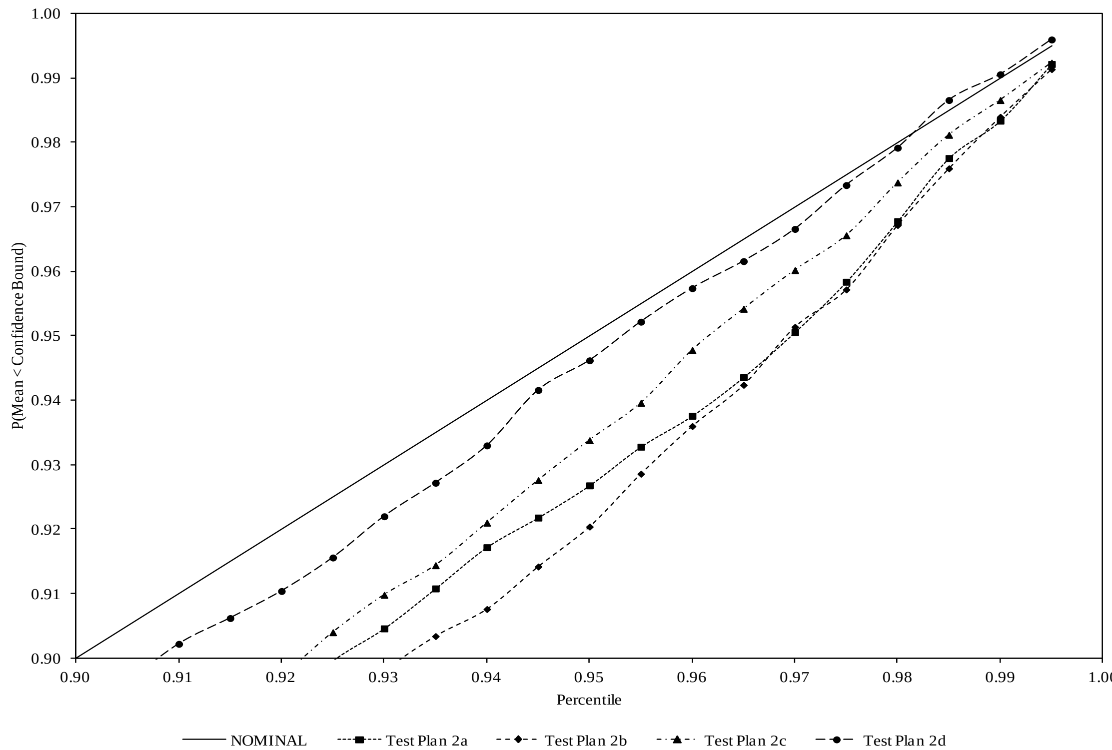

Figure 6.48 Upper Confidence Bound Coverage Probabilities for Different Test Plans

6.2.4 Discussion. From these results, it is apparent that the model-based bootstrap percentile method (MODL-MLE1-PERC) is a robust method that produces confidence bounds with coverage probabilities close to the nominal value for situations where the standard deviation of the natural logarithm of the response variable increases, decreases, or remains constant with respect to time.

In addition, it can be seen that the performance of this method is affected by the model parameters. In general, the method produces better results when the mean life at the design stress level is reduced, the ratio of the mean life at the design stress level to the mean life at the highest accelerating stress level increases, and the sample size increases. This is expected as it reduces the amount of extrapolation required to estimate the life distribution at the design stress level.

7. CONCLUSION

In this dissertation, three methods are presented for obtaining prediction bounds for the lifetime of a future product at the design stress level and two methods are presented for obtaining confidence bounds for the mean lifetime at the design stress level in accelerated degradation testing. The accelerated degradation model assumes the natural logarithm of the response variable has a normal distribution with a mean that follows an Arrhenius rate relationship and a standard deviation whose natural logarithm follows a quadratic function of the time.

The methods presented for obtaining prediction bounds use the maximum likelihood, model-based bootstrap, and maximum likelihood predictive density approaches. The first two methods extend existing techniques to the case where the standard deviation of the response variable is affected by the accelerating stress and time, while the third method provides a new approach. The methods presented for obtaining confidence bound use the delta method and three different variations of the model-based nonparametric bootstrap approach (the percentile, bias-corrected percentile, and normal theory methods). Both of these methods extend existing techniques.

The performance of the various methods for obtaining lifetime prediction and confidence bounds is studied and compared using a Monte Carlo simulation study. The simulation results indicate that the model-based bootstrap method is a robust method that produces prediction bounds with coverage probabilities that are slightly liberal, but still close to the nominal value, for situations where the standard deviation of the natural logarithm of the response variable increases, decreases, or remains constant with respect to time. The simulation results also indicate that the model-based bootstrap percentile method is a robust method that produces confidence bounds with coverage probabilities close to the nominal value for situations where the standard deviation of the natural logarithm of the response variable increases, decreases, or remains constant with respect to time.

8. FUTURE RESEARCH

In this section, several different topics for future research are discussed. The first area of future research involves a comparison of the results obtained using the model-based bootstrap approach with the parametric bootstrap approach described by Meeker and Escobar (1998) and Meeker, Escobar, and Lu (1998). A second area of future research involves the use of the bootstrap technique to calibrate the bootstrap prediction bounds. This technique was shown to work well in some cases for the maximum likelihood approach prediction bounds.

Two methods are presented in this dissertation for obtaining confidence bounds for the mean lifetime at the design stress level. A third area of future research involves the extension of these two methods to obtain confidence bounds for other percentiles of the life distribution at the design stress level. For example, these techniques can be extended to obtain confidence bounds for the 10^{th} or 20^{th} percentiles of the life distribution. A fourth area of future research involves the use of the bias-corrected and accelerated, or BC_a, method for obtaining confidence bounds using bootstrap data. This technique was developed by Efron (1987) as an improvement over previous bootstrap techniques, but it requires significantly more computing resources and time.

As described in Section 5.3, the second part of the Monte Carlo simulation was performed using four test plans. A fifth area of future research involves the expansion of the Monte Carlo simulation to compare the performance of the various techniques over a greater variety of test plans. One possible test plan is the compromise test plan described by Shi, Escobar, and Meeker (2009). Another possible test plan is the original unequal sample size test plan described by Escobar, Meeker, Kugler, and Kramer (2003).

Finally, the concepts in this dissertation can be extended to other accelerated degradation models. In particular, the bootstrap approach and maximum likelihood predictive density technique can be used on accelerated degradation models that involve different distributions, response-stress relationships, and functional forms for the standard deviation of the response variable as well as repeated measurements of the products.

APPENDIX A

FINAL SIMULATION (PART 1) PARAMETER COMBINATIONS

Table A-1 Final Parameter Combinations (Part 1)

Scenario	α_1	α_2	β_0	β_1	β_2	Mean Life (Design)	Mean Life (High)
1	0.0035	7.5	-4.0	-2.0	0.60	3265	4
2	0.0035	7.5	-4.0	-2.0	0.00	3265	4
3	0.0035	7.5	-4.0	0.0	0.00	3265	4
4	0.0030	6.0	-3.0	-2.0	0.00	4444	23
5	0.0030	6.0	-3.0	-2.0	0.25	4444	23
6	0.0030	6.0	-3.0	-2.0	0.50	4444	23
7	0.0030	6.0	-3.0	-1.0	0.00	4444	23
8	0.0030	6.0	-3.0	-1.0	0.25	4444	23
9	0.0030	6.0	-3.0	0.0	0.00	4444	23
10	0.0030	6.0	-4.0	-2.0	0.00	4444	23
11	0.0030	6.0	-4.0	-2.0	0.25	4444	23
12	0.0030	6.0	-4.0	-2.0	0.50	4444	23
13	0.0030	6.0	-4.0	-1.0	0.00	4444	23
14	0.0030	6.0	-4.0	-1.0	0.25	4444	23
15	0.0030	6.0	-4.0	0.0	0.00	4444	23
16	0.0030	7.0	-3.0	-2.0	0.00	4444	9
17	0.0030	7.0	-3.0	-2.0	0.25	4444	9
18	0.0030	7.0	-3.0	-2.0	0.50	4444	9
19	0.0030	7.0	-3.0	-1.0	0.00	4444	9
20	0.0030	7.0	-3.0	-1.0	0.25	4444	9
21	0.0030	7.0	-3.0	0.0	0.00	4444	9
22	0.0030	7.0	-4.0	-2.0	0.00	4444	9
23	0.0030	7.0	-4.0	-2.0	0.25	4444	9
24	0.0030	7.0	-4.0	-2.0	0.50	4444	9
25	0.0030	7.0	-4.0	-1.0	0.00	4444	9
26	0.0030	7.0	-4.0	-1.0	0.25	4444	9
27	0.0030	7.0	-4.0	0.0	0.00	4444	9
28	0.0030	8.0	-3.0	-2.0	0.00	4444	4
29	0.0030	8.0	-3.0	-2.0	0.25	4444	4
30	0.0030	8.0	-3.0	-2.0	0.50	4444	4
31	0.0030	8.0	-3.0	-1.0	0.00	4444	4

Scenario	α_1	α_2	β_0	β_1	β_2	Mean Life (Design)	Mean Life (High)
32	0.0030	8.0	-3.0	-1.0	0.25	4444	4
33	0.0030	8.0	-3.0	0.0	0.00	4444	4
34	0.0030	8.0	-4.0	-2.0	0.00	4444	4
35	0.0030	8.0	-4.0	-2.0	0.25	4444	4
36	0.0030	8.0	-4.0	-2.0	0.50	4444	4
37	0.0030	8.0	-4.0	-1.0	0.00	4444	4
38	0.0030	8.0	-4.0	-1.0	0.25	4444	4
39	0.0030	8.0	-4.0	0.0	0.00	4444	4
40	0.0040	6.0	-3.0	-2.0	0.00	2500	13
41	0.0040	6.0	-3.0	-2.0	0.25	2500	13
42	0.0040	6.0	-3.0	-2.0	0.50	2500	13
43	0.0040	6.0	-3.0	-1.0	0.00	2500	13
44	0.0040	6.0	-3.0	-1.0	0.25	2500	13
45	0.0040	6.0	-3.0	0.0	0.00	2500	13
46	0.0040	6.0	-4.0	-2.0	0.00	2500	13
47	0.0040	6.0	-4.0	-2.0	0.25	2500	13
48	0.0040	6.0	-4.0	-2.0	0.50	2500	13
49	0.0040	6.0	-4.0	-1.0	0.00	2500	13
50	0.0040	6.0	-4.0	-1.0	0.25	2500	13
51	0.0040	6.0	-4.0	0.0	0.00	2500	13
52	0.0040	7.0	-3.0	-2.0	0.00	2500	5
53	0.0040	7.0	-3.0	-2.0	0.25	2500	5
54	0.0040	7.0	-3.0	-2.0	0.50	2500	5
55	0.0040	7.0	-3.0	-1.0	0.00	2500	5
56	0.0040	7.0	-3.0	-1.0	0.25	2500	5
57	0.0040	7.0	-3.0	0.0	0.00	2500	5
58	0.0040	7.0	-4.0	-2.0	0.00	2500	5
59	0.0040	7.0	-4.0	-2.0	0.25	2500	5
60	0.0040	7.0	-4.0	-2.0	0.50	2500	5
61	0.0040	7.0	-4.0	-1.0	0.00	2500	5
62	0.0040	7.0	-4.0	-1.0	0.25	2500	5
63	0.0040	7.0	-4.0	0.0	0.00	2500	5

Scenario	α_1	α_2	β_0	β_1	β_2	Mean Life (Design)	Mean Life (High)
64	0.0040	8.0	-3.0	-2.0	0.00	2500	2
65	0.0040	8.0	-3.0	-2.0	0.25	2500	2
66	0.0040	8.0	-3.0	-1.0	0.00	2500	2
67	0.0040	8.0	-4.0	-2.0	0.00	2500	2
68	0.0040	8.0	-4.0	-2.0	0.25	2500	2
69	0.0040	8.0	-4.0	-2.0	0.50	2500	2
70	0.0040	8.0	-4.0	-1.0	0.00	2500	2
71	0.0040	8.0	-4.0	-1.0	0.25	2500	2
72	0.0040	8.0	-4.0	0.0	0.00	2500	2
73	0.0050	6.0	-3.0	-2.0	0.00	1600	8
74	0.0050	6.0	-3.0	-2.0	0.25	1600	8
75	0.0050	6.0	-3.0	-2.0	0.50	1600	8
76	0.0050	6.0	-3.0	-1.0	0.00	1600	8
77	0.0050	6.0	-3.0	-1.0	0.25	1600	8
78	0.0050	6.0	-3.0	0.0	0.00	1600	8
79	0.0050	6.0	-4.0	-2.0	0.00	1600	8
80	0.0050	6.0	-4.0	-2.0	0.25	1600	8
81	0.0050	6.0	-4.0	-2.0	0.50	1600	8
82	0.0050	6.0	-4.0	-1.0	0.00	1600	8
83	0.0050	6.0	-4.0	-1.0	0.25	1600	8
84	0.0050	6.0	-4.0	0.0	0.00	1600	8
85	0.0050	7.0	-3.0	-2.0	0.00	1600	3
86	0.0050	7.0	-3.0	-2.0	0.25	1600	3
87	0.0050	7.0	-3.0	-2.0	0.50	1600	3
88	0.0050	7.0	-3.0	-1.0	0.00	1600	3
89	0.0050	7.0	-3.0	-1.0	0.25	1600	3
90	0.0050	7.0	-3.0	0.0	0.00	1600	3
91	0.0050	7.0	-4.0	-2.0	0.00	1600	3
92	0.0050	7.0	-4.0	-2.0	0.25	1600	3
93	0.0050	7.0	-4.0	-2.0	0.50	1600	3
94	0.0050	7.0	-4.0	-1.0	0.00	1600	3
95	0.0050	7.0	-4.0	-1.0	0.25	1600	3

Scenario	α_1	α_2	β_0	β_1	β_2	Mean Life (Design)	Mean Life (High)
96	0.0050	7.0	-4.0	0.0	0.00	1600	3
97	0.0050	8.0	-3.0	-2.0	0.00	1600	1
98	0.0050	8.0	-3.0	-2.0	0.25	1600	1
99	0.0050	8.0	-3.0	-1.0	0.00	1600	1
100	0.0050	8.0	-4.0	-2.0	0.00	1600	1
101	0.0050	8.0	-4.0	-2.0	0.25	1600	1
102	0.0050	8.0	-4.0	-2.0	0.50	1600	1
103	0.0050	8.0	-4.0	-1.0	0.00	1600	1
104	0.0050	8.0	-4.0	-1.0	0.25	1600	1
105	0.0050	8.0	-4.0	0.0	0.00	1600	1

APPENDIX B

ADDITIONAL PREDICTION BOUND RESULTS

Table B-1 Coverage Probabilities for the 99 Percent Lower Prediction Bounds (Part 1)

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
1	1	0.1380	0.1326	0.0315	0.0890	0.0739	0.0237	0.0219	0.0231	0.0127
2	1	0.0322	0.0060	0.0049	0.2502	0.0179	0.1686	0.0099	0.1448	0.0124
3	1	0.1075	0.0915	0.0326	0.0626	0.0757	0.0117	0.0230	0.0122	0.0138
4	1	0.0550	0.0083	0.0054	0.3114	0.0192	0.2272	0.0094	0.1109	0.0129
5	1	0.0898	0.0446	0.0077	0.2792	0.0280	0.1835	0.0053	0.0804	0.0129
6	1	0.1381	0.1093	0.0310	0.2103	0.0869	0.0978	0.0192	0.0397	0.0122
7	1	0.0951	0.0498	0.0093	0.2374	0.0333	0.1334	0.0056	0.0523	0.0132
8	1	0.1324	0.1212	0.0461	0.1842	0.1178	0.0590	0.0296	0.0266	0.0139
9	1	0.1453	0.1225	0.0600	0.1274	0.1378	0.0163	0.0404	0.0131	0.0130
10	1	0.0887	0.0432	0.0058	0.3028	0.0203	0.2282	0.0082	0.0910	0.0122
11	1	0.1351	0.1282	0.0132	0.2743	0.0386	0.1925	0.0083	0.0637	0.0122
12	1	0.1936	0.2081	0.0650	0.2322	0.1256	0.1422	0.0507	0.0354	0.0121
13	1	0.1410	0.1385	0.0177	0.2403	0.0482	0.1527	0.0114	0.0388	0.0124
14	1	0.1957	0.2126	0.0877	0.2056	0.1555	0.1133	0.0720	0.0226	0.0126
15	1	0.1998	0.2202	0.1106	0.1728	0.1826	0.0806	0.0942	0.0119	0.0129
16	1	0.0345	0.0044	0.0048	0.2772	0.0178	0.1887	0.0098	0.1358	0.0124
17	1	0.0637	0.0191	0.0060	0.2375	0.0223	0.1404	0.0065	0.1006	0.0129
18	1	0.1057	0.0608	0.0150	0.1576	0.0529	0.0526	0.0084	0.0477	0.0128
19	1	0.0681	0.0203	0.0063	0.1954	0.0240	0.0950	0.0055	0.0703	0.0130
20	1	0.1048	0.0661	0.0193	0.1135	0.0655	0.0196	0.0114	0.0268	0.0117
21	1	0.1076	0.0651	0.0254	0.0704	0.0835	0.0028	0.0155	0.0137	0.0124
22	1	0.0534	0.0141	0.0052	0.2736	0.0187	0.1940	0.0094	0.1164	0.0123
23	1	0.0935	0.0658	0.0087	0.2383	0.0279	0.1524	0.0061	0.0825	0.0125
24	1	0.1451	0.1447	0.0346	0.1773	0.0794	0.0879	0.0242	0.0387	0.0123
25	1	0.0976	0.0736	0.0106	0.1996	0.0325	0.1113	0.0067	0.0527	0.0127
26	1	0.1481	0.1496	0.0488	0.1472	0.1013	0.0615	0.0359	0.0243	0.0128
27	1	0.1529	0.1568	0.0642	0.1114	0.1232	0.0350	0.0493	0.0119	0.0134
28	1	0.0220	0.0030	0.0047	0.2507	0.0174	0.1635	0.0101	0.1608	0.0125
29	1	0.0440	0.0079	0.0052	0.2068	0.0194	0.1147	0.0084	0.1222	0.0127
30	1	0.0714	0.0294	0.0087	0.1094	0.0327	0.0269	0.0053	0.0509	0.0130
31	1	0.0439	0.0093	0.0056	0.1603	0.0206	0.0707	0.0076	0.0863	0.0133
32	1	0.0748	0.0319	0.0111	0.0717	0.0401	0.0116	0.0065	0.0306	0.0134

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
33	1	0.0757	0.0341	0.0141	0.0322	0.0488	0.0054	0.0084	0.0130	0.0140
34	1	0.0321	0.0059	0.0049	0.2505	0.0179	0.1689	0.0099	0.1441	0.0124
35	1	0.0609	0.0285	0.0066	0.2093	0.0224	0.1235	0.0072	0.1049	0.0127
36	1	0.1031	0.0830	0.0181	0.1283	0.0490	0.0493	0.0118	0.0429	0.0126
37	1	0.0638	0.0324	0.0074	0.1674	0.0246	0.0832	0.0063	0.0703	0.0131
38	1	0.1057	0.0879	0.0249	0.0975	0.0620	0.0289	0.0169	0.0262	0.0131
39	1	0.1093	0.0938	0.0328	0.0631	0.0760	0.0119	0.0231	0.0121	0.0138
40	1	0.0358	0.0046	0.0048	0.2770	0.0178	0.1884	0.0097	0.1356	0.0124
41	1	0.0638	0.0197	0.0061	0.2381	0.0225	0.1409	0.0064	0.1009	0.0130
42	1	0.1056	0.0622	0.0159	0.1559	0.0523	0.0513	0.0095	0.0463	0.0131
43	1	0.0659	0.0223	0.0068	0.1938	0.0249	0.0937	0.0055	0.0691	0.0134
44	1	0.1054	0.0692	0.0218	0.1175	0.0682	0.0218	0.0131	0.0282	0.0130
45	1	0.1040	0.0685	0.0290	0.0699	0.0862	0.0030	0.0185	0.0136	0.0138
46	1	0.0544	0.0150	0.0052	0.2727	0.0187	0.1929	0.0094	0.1156	0.0123
47	1	0.0926	0.0655	0.0088	0.2381	0.0282	0.1521	0.0061	0.0823	0.0126
48	1	0.1440	0.1439	0.0345	0.1775	0.0797	0.0881	0.0244	0.0388	0.0123
49	1	0.0971	0.0737	0.0108	0.1994	0.0330	0.1111	0.0068	0.0525	0.0128
50	1	0.1470	0.1488	0.0486	0.1475	0.1017	0.0618	0.0362	0.0244	0.0129
51	1	0.1522	0.1567	0.0642	0.1117	0.1238	0.0354	0.0499	0.0120	0.0134
52	1	0.0230	0.0032	0.0047	0.2517	0.0174	0.1643	0.0101	0.1605	0.0124
53	1	0.0427	0.0090	0.0054	0.2077	0.0198	0.1150	0.0083	0.1218	0.0130
54	1	0.0727	0.0304	0.0096	0.1101	0.0341	0.0273	0.0059	0.0504	0.0136
55	1	0.0441	0.0097	0.0057	0.1617	0.0209	0.0716	0.0074	0.0863	0.0134
56	1	0.0745	0.0332	0.0123	0.0732	0.0422	0.0114	0.0074	0.0307	0.0141
57	1	0.0767	0.0355	0.0155	0.0336	0.0512	0.0048	0.0095	0.0131	0.0149
58	1	0.0332	0.0063	0.0049	0.2510	0.0179	0.1694	0.0099	0.1435	0.0124
59	1	0.0608	0.0289	0.0067	0.2103	0.0228	0.1244	0.0071	0.1046	0.0128
60	1	0.1023	0.0826	0.0186	0.1299	0.0499	0.0503	0.0121	0.0430	0.0127
61	1	0.0637	0.0328	0.0076	0.1685	0.0250	0.0840	0.0062	0.0700	0.0131
62	1	0.1048	0.0873	0.0255	0.0990	0.0633	0.0297	0.0174	0.0262	0.0132
63	1	0.1087	0.0935	0.0337	0.0645	0.0777	0.0124	0.0239	0.0122	0.0139
64	1	0.0169	0.0027	0.0047	0.2356	0.0173	0.1510	0.0102	0.1818	0.0125
65	1	0.0296	0.0056	0.0050	0.1886	0.0185	0.1052	0.0094	0.1399	0.0129

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
66	1	0.0303	0.0058	0.0052	0.1428	0.0191	0.0768	0.0090	0.1014	0.0134
67	1	0.0217	0.0037	0.0048	0.2363	0.0175	0.1546	0.0101	0.1694	0.0125
68	1	0.0397	0.0129	0.0057	0.1914	0.0200	0.1074	0.0088	0.1268	0.0129
69	1	0.0694	0.0404	0.0110	0.0949	0.0334	0.0293	0.0070	0.0471	0.0131
70	1	0.0413	0.0143	0.0061	0.1480	0.0211	0.0683	0.0080	0.0884	0.0134
71	1	0.0716	0.0436	0.0140	0.0656	0.0403	0.0144	0.0090	0.0283	0.0136
72	1	0.0743	0.0471	0.0176	0.0356	0.0481	0.0044	0.0117	0.0123	0.0143
73	1	0.0258	0.0035	0.0048	0.2563	0.0175	0.1684	0.0100	0.1550	0.0124
74	1	0.0467	0.0107	0.0055	0.2138	0.0204	0.1197	0.0078	0.1174	0.0131
75	1	0.0788	0.0365	0.0108	0.1202	0.0377	0.0313	0.0065	0.0499	0.0137
76	1	0.0484	0.0117	0.0059	0.1680	0.0217	0.0754	0.0069	0.0827	0.0135
77	1	0.0815	0.0362	0.0128	0.0823	0.0455	0.0118	0.0075	0.0305	0.0133
78	1	0.0818	0.0416	0.0179	0.0398	0.0575	0.0032	0.0109	0.0133	0.0147
79	1	0.0374	0.0077	0.0050	0.2546	0.0181	0.1731	0.0098	0.1367	0.0124
80	1	0.0666	0.0350	0.0071	0.2156	0.0239	0.1294	0.0067	0.0994	0.0129
81	1	0.1103	0.0951	0.0212	0.1397	0.0554	0.0573	0.0141	0.0420	0.0127
82	1	0.0701	0.0399	0.0082	0.1744	0.0266	0.0888	0.0060	0.0658	0.0132
83	1	0.1129	0.1001	0.0295	0.1088	0.0707	0.0353	0.0205	0.0258	0.0132
84	1	0.1175	0.1074	0.0393	0.0737	0.0871	0.0160	0.0285	0.0122	0.0138
85	1	0.0183	0.0028	0.0047	0.2388	0.0173	0.1535	0.0102	0.1773	0.0124
86	1	0.0321	0.0062	0.0051	0.1926	0.0188	0.1043	0.0092	0.1361	0.0130
87	1	0.0538	0.0163	0.0074	0.0860	0.0268	0.0343	0.0054	0.0522	0.0138
88	1	0.0329	0.0065	0.0053	0.1467	0.0195	0.0661	0.0086	0.0982	0.0135
89	1	0.0554	0.0178	0.0087	0.0532	0.0313	0.0214	0.0056	0.0313	0.0143
90	1	0.0572	0.0192	0.0102	0.0215	0.0367	0.0086	0.0063	0.0127	0.0150
91	1	0.0242	0.0043	0.0048	0.2392	0.0176	0.1574	0.0101	0.1635	0.0124
92	1	0.0435	0.0154	0.0059	0.1954	0.0206	0.1108	0.0084	0.1218	0.0130
93	1	0.0758	0.0479	0.0124	0.1023	0.0367	0.0332	0.0079	0.0462	0.0131
94	1	0.0453	0.0173	0.0064	0.1523	0.0220	0.0714	0.0075	0.0842	0.0134
95	1	0.0779	0.0513	0.0161	0.0724	0.0449	0.0170	0.0105	0.0279	0.0136
96	1	0.0809	0.0556	0.0206	0.0411	0.0541	0.0054	0.0139	0.0124	0.0143
97	1	0.0151	0.0026	0.0047	0.2290	0.0172	0.1674	0.0102	0.1941	0.0125
98	1	0.0239	0.0047	0.0049	0.1809	0.0181	0.1348	0.0098	0.1507	0.0129

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
99	1	0.0243	0.0049	0.0051	0.1355	0.0185	0.0983	0.0096	0.1103	0.0134
100	1	0.0176	0.0031	0.0047	0.2298	0.0173	0.1527	0.0102	0.1853	0.0125
101	1	0.0301	0.0081	0.0053	0.1831	0.0189	0.1167	0.0095	0.1411	0.0129
102	1	0.0503	0.0224	0.0083	0.0785	0.0269	0.0389	0.0061	0.0497	0.0135
103	1	0.0309	0.0087	0.0056	0.1391	0.0197	0.0824	0.0091	0.1006	0.0134
104	1	0.0520	0.0243	0.0099	0.0509	0.0310	0.0225	0.0065	0.0296	0.0140
105	1	0.0541	0.0263	0.0118	0.0245	0.0357	0.0088	0.0077	0.0124	0.0146

Table B-2 Coverage Probabilities for the 95 Percent Lower Prediction Bounds (Part 1)

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
1	1	0.2311	0.2519	0.1193	0.1788	0.1557	0.0647	0.0346	0.0800	0.0560
2	1	0.0864	0.0518	0.0393	0.3182	0.0606	0.2124	0.0504	0.2299	0.0551
3	1	0.1957	0.2089	0.1205	0.1476	0.1570	0.0443	0.0341	0.0554	0.0574
4	1	0.1395	0.0999	0.0420	0.3736	0.0646	0.2272	0.0502	0.1973	0.0560
5	1	0.1937	0.2115	0.0602	0.3521	0.0907	0.1835	0.0411	0.1613	0.0567
6	1	0.2515	0.2867	0.1453	0.3012	0.1895	0.0979	0.0211	0.1077	0.0572
7	1	0.1987	0.2187	0.0699	0.3213	0.1036	0.1334	0.0360	0.1232	0.0576
8	1	0.2501	0.2956	0.1820	0.2874	0.2277	0.0590	0.0300	0.0869	0.0607
9	1	0.2568	0.2954	0.2007	0.2415	0.2455	0.0165	0.0406	0.0574	0.0586
10	1	0.1809	0.1888	0.0436	0.3601	0.0663	0.2282	0.0492	0.1773	0.0545
11	1	0.2305	0.2529	0.0726	0.3393	0.1025	0.1925	0.0435	0.1427	0.0546
12	1	0.2851	0.3122	0.1744	0.3083	0.2148	0.1422	0.0515	0.1007	0.0549
13	1	0.2366	0.2590	0.0860	0.3136	0.1180	0.1527	0.0402	0.1067	0.0550
14	1	0.2870	0.3145	0.2032	0.2875	0.2442	0.1133	0.0721	0.0776	0.0550
15	1	0.2907	0.3191	0.2276	0.2608	0.2681	0.0806	0.0942	0.0542	0.0560
16	1	0.0977	0.0487	0.0394	0.3464	0.0611	0.1887	0.0501	0.2202	0.0551
17	1	0.1509	0.1390	0.0487	0.3176	0.0747	0.1409	0.0464	0.1818	0.0563
18	1	0.2096	0.2231	0.1023	0.2592	0.1433	0.0589	0.0233	0.1181	0.0587
19	1	0.1573	0.1464	0.0528	0.2855	0.0808	0.0966	0.0444	0.1448	0.0572
20	1	0.2083	0.2265	0.1218	0.2246	0.1662	0.0290	0.0177	0.0861	0.0561
21	1	0.2167	0.2359	0.1458	0.1859	0.1919	0.0141	0.0184	0.0604	0.0605
22	1	0.1274	0.1018	0.0407	0.3373	0.0625	0.1940	0.0500	0.2028	0.0548
23	1	0.1805	0.1902	0.0562	0.3106	0.0825	0.1524	0.0470	0.1643	0.0552
24	1	0.2389	0.2600	0.1256	0.2625	0.1624	0.0879	0.0347	0.1059	0.0551
25	1	0.1853	0.1966	0.0634	0.2797	0.0913	0.1113	0.0453	0.1258	0.0557
26	1	0.2415	0.2637	0.1501	0.2366	0.1883	0.0615	0.0396	0.0810	0.0556
27	1	0.2455	0.2696	0.1729	0.2035	0.2116	0.0350	0.0501	0.0548	0.0566
28	1	0.0686	0.0298	0.0386	0.3228	0.0599	0.2252	0.0505	0.2427	0.0552
29	1	0.1163	0.0810	0.0429	0.2891	0.0665	0.1867	0.0489	0.2033	0.0562
30	1	0.1627	0.1607	0.0693	0.2130	0.1040	0.1018	0.0380	0.1236	0.0575
31	1	0.1156	0.0862	0.0451	0.2509	0.0695	0.1455	0.0479	0.1629	0.0571
32	1	0.1664	0.1648	0.0813	0.1762	0.1194	0.0714	0.0320	0.0928	0.0576

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
33	1	0.1691	0.1693	0.0946	0.1274	0.1364	0.0400	0.0267	0.0586	0.0587
34	1	0.0864	0.0514	0.0393	0.3183	0.0606	0.2114	0.0504	0.2293	0.0551
35	1	0.1354	0.1260	0.0472	0.2859	0.0711	0.1734	0.0489	0.1882	0.0556
36	1	0.1904	0.2009	0.0873	0.2171	0.1199	0.0982	0.0409	0.1121	0.0556
37	1	0.1389	0.1319	0.0507	0.2507	0.0755	0.1341	0.0479	0.1479	0.0564
38	1	0.1935	0.2052	0.1041	0.1867	0.1389	0.0721	0.0366	0.0847	0.0561
39	1	0.1978	0.2113	0.1210	0.1483	0.1575	0.0444	0.0343	0.0552	0.0572
40	1	0.0999	0.0517	0.0395	0.3465	0.0612	0.1885	0.0501	0.2200	0.0551
41	1	0.1506	0.1397	0.0492	0.3183	0.0754	0.1416	0.0462	0.1822	0.0567
42	1	0.2064	0.2249	0.1012	0.2582	0.1425	0.0570	0.0222	0.1159	0.0572
43	1	0.1538	0.1463	0.0539	0.2842	0.0820	0.0954	0.0438	0.1435	0.0577
44	1	0.2079	0.2270	0.1238	0.2264	0.1683	0.0295	0.0185	0.0884	0.0592
45	1	0.2044	0.2369	0.1482	0.1880	0.1963	0.0118	0.0209	0.0592	0.0603
46	1	0.1289	0.1047	0.0409	0.3368	0.0627	0.1929	0.0500	0.2021	0.0548
47	1	0.1794	0.1888	0.0568	0.3105	0.0832	0.1521	0.0469	0.1641	0.0554
48	1	0.2381	0.2594	0.1253	0.2629	0.1628	0.0881	0.0342	0.1062	0.0554
49	1	0.1848	0.1960	0.0641	0.2797	0.0922	0.1111	0.0451	0.1258	0.0560
50	1	0.2406	0.2633	0.1497	0.2370	0.1889	0.0618	0.0394	0.0811	0.0558
51	1	0.2450	0.2699	0.1726	0.2039	0.2123	0.0354	0.0505	0.0549	0.0568
52	1	0.0708	0.0313	0.0387	0.3238	0.0599	0.2235	0.0505	0.2427	0.0551
53	1	0.1135	0.0833	0.0435	0.2904	0.0671	0.1847	0.0488	0.2030	0.0564
54	1	0.1610	0.1606	0.0708	0.2132	0.1052	0.0989	0.0366	0.1229	0.0580
55	1	0.1159	0.0876	0.0456	0.2526	0.0703	0.1442	0.0477	0.1632	0.0575
56	1	0.1637	0.1657	0.0838	0.1766	0.1220	0.0694	0.0309	0.0927	0.0590
57	1	0.1670	0.1711	0.0975	0.1281	0.1391	0.0384	0.0259	0.0588	0.0601
58	1	0.0884	0.0541	0.0394	0.3189	0.0607	0.2090	0.0504	0.2287	0.0550
59	1	0.1349	0.1258	0.0477	0.2869	0.0717	0.1718	0.0488	0.1880	0.0558
60	1	0.1896	0.2001	0.0885	0.2188	0.1214	0.0969	0.0404	0.1123	0.0559
61	1	0.1386	0.1319	0.0514	0.2518	0.0764	0.1325	0.0478	0.1478	0.0566
62	1	0.1926	0.2044	0.1056	0.1884	0.1407	0.0708	0.0359	0.0848	0.0565
63	1	0.1973	0.2111	0.1228	0.1501	0.1596	0.0434	0.0339	0.0554	0.0575
64	1	0.0536	0.0242	0.0383	0.3081	0.0594	0.2476	0.0507	0.2618	0.0553
65	1	0.0851	0.0516	0.0407	0.2706	0.0630	0.2081	0.0500	0.2211	0.0563

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
66	1	0.0866	0.0537	0.0417	0.2306	0.0646	0.1675	0.0495	0.1806	0.0574
67	1	0.0634	0.0328	0.0386	0.3062	0.0597	0.2405	0.0506	0.2526	0.0552
68	1	0.1002	0.0782	0.0429	0.2698	0.0654	0.2002	0.0499	0.2106	0.0561
69	1	0.1450	0.1406	0.0646	0.1815	0.0931	0.1082	0.0456	0.1183	0.0566
70	1	0.1025	0.0820	0.0447	0.2318	0.0679	0.1592	0.0493	0.1694	0.0571
71	1	0.1479	0.1449	0.0744	0.1483	0.1051	0.0792	0.0436	0.0885	0.0573
72	1	0.1517	0.1503	0.0849	0.1073	0.1176	0.0477	0.0414	0.0558	0.0584
73	1	0.0773	0.0352	0.0388	0.3283	0.0602	0.2077	0.0504	0.2377	0.0551
74	1	0.1212	0.0944	0.0447	0.2964	0.0689	0.1717	0.0483	0.1988	0.0567
75	1	0.1700	0.1756	0.0771	0.2241	0.1133	0.0898	0.0330	0.1222	0.0586
76	1	0.1238	0.0993	0.0473	0.2593	0.0727	0.1335	0.0470	0.1592	0.0578
77	1	0.1789	0.1804	0.0903	0.1905	0.1305	0.0625	0.0252	0.0928	0.0578
78	1	0.1760	0.1856	0.1072	0.1402	0.1501	0.0337	0.0215	0.0591	0.0600
79	1	0.0971	0.0638	0.0397	0.3220	0.0611	0.1862	0.0504	0.2225	0.0550
80	1	0.1436	0.1387	0.0496	0.2916	0.0741	0.1510	0.0485	0.1827	0.0560
81	1	0.2000	0.2136	0.0956	0.2284	0.1298	0.0829	0.0383	0.1110	0.0561
82	1	0.1480	0.1456	0.0540	0.2573	0.0797	0.1143	0.0472	0.1428	0.0566
83	1	0.2030	0.2180	0.1145	0.1990	0.1508	0.0599	0.0338	0.0841	0.0565
84	1	0.2082	0.2253	0.1333	0.1617	0.1712	0.0362	0.0347	0.0555	0.0576
85	1	0.0578	0.0260	0.0383	0.3115	0.0595	0.2428	0.0506	0.2578	0.0552
86	1	0.0908	0.0576	0.0413	0.2751	0.0640	0.2033	0.0498	0.2174	0.0564
87	1	0.1318	0.1130	0.0571	0.1832	0.0868	0.1091	0.0431	0.1258	0.0582
88	1	0.0924	0.0600	0.0426	0.2355	0.0659	0.1624	0.0492	0.1771	0.0576
89	1	0.1341	0.1175	0.0649	0.1452	0.0977	0.0783	0.0397	0.0942	0.0593
90	1	0.1368	0.1221	0.0735	0.0970	0.1094	0.0449	0.0362	0.0581	0.0606
91	1	0.0689	0.0371	0.0388	0.3088	0.0599	0.2352	0.0506	0.2472	0.0551
92	1	0.1070	0.0873	0.0440	0.2736	0.0669	0.1949	0.0497	0.2056	0.0562
93	1	0.1540	0.1532	0.0695	0.1899	0.0991	0.1063	0.0447	0.1172	0.0567
94	1	0.1096	0.0917	0.0462	0.2361	0.0698	0.1539	0.0490	0.1646	0.0572
95	1	0.1569	0.1576	0.0810	0.1573	0.1129	0.0777	0.0421	0.0878	0.0574
96	1	0.1613	0.1638	0.0931	0.1166	0.1270	0.0470	0.0392	0.0558	0.0584
97	1	0.0476	0.0225	0.0382	0.3013	0.0592	0.2595	0.0507	0.2731	0.0553
98	1	0.0713	0.0410	0.0397	0.2620	0.0615	0.2205	0.0504	0.2320	0.0563

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
99	1	0.0722	0.0422	0.0404	0.2212	0.0626	0.1800	0.0501	0.1913	0.0574
100	1	0.0533	0.0267	0.0383	0.3005	0.0594	0.2543	0.0507	0.2669	0.0553
101	1	0.0815	0.0565	0.0410	0.2620	0.0630	0.2144	0.0504	0.2247	0.0563
102	1	0.1164	0.1014	0.0542	0.1616	0.0803	0.1131	0.0476	0.1225	0.0574
103	1	0.0830	0.0588	0.0422	0.2225	0.0646	0.1733	0.0500	0.1833	0.0574
104	1	0.1188	0.1050	0.0603	0.1274	0.0882	0.0826	0.0464	0.0910	0.0583
105	1	0.1218	0.1092	0.0669	0.0860	0.0966	0.0491	0.0452	0.0561	0.0595

Table B-3 Coverage Probabilities for the 90 Percent Lower Prediction Bounds (Part 1)

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
1	1	0.2874	0.3143	0.1931	0.2419	0.2189	0.1212	0.0891	0.1373	0.1085
2	1	0.1382	0.1216	0.0886	0.3571	0.1093	0.2716	0.1006	0.2836	0.1065
3	1	0.2531	0.2759	0.1936	0.2126	0.2194	0.0938	0.0884	0.1071	0.1094
4	1	0.2085	0.2260	0.0941	0.4070	0.1159	0.2277	0.1007	0.2570	0.1077
5	1	0.2639	0.3020	0.1280	0.3916	0.1545	0.1846	0.0921	0.2227	0.1094
6	1	0.3167	0.3559	0.2303	0.3511	0.2587	0.1015	0.0464	0.1677	0.1094
7	1	0.2692	0.3055	0.1433	0.3675	0.1708	0.1352	0.0871	0.1836	0.1106
8	1	0.3169	0.3633	0.2669	0.3438	0.2953	0.0634	0.0422	0.1473	0.1150
9	1	0.3177	0.3608	0.2813	0.3054	0.3084	0.0213	0.0462	0.1111	0.1119
10	1	0.2448	0.2802	0.0955	0.3917	0.1170	0.2282	0.0996	0.2375	0.1056
11	1	0.2868	0.3131	0.1372	0.3757	0.1617	0.1925	0.0954	0.2035	0.1059
12	1	0.3327	0.3605	0.2475	0.3518	0.2742	0.1422	0.0771	0.1599	0.1075
13	1	0.2920	0.3176	0.1538	0.3554	0.1787	0.1527	0.0927	0.1665	0.1062
14	1	0.3345	0.3616	0.2733	0.3351	0.2997	0.1133	0.0817	0.1340	0.1077
15	1	0.3384	0.3643	0.2935	0.3134	0.3194	0.0806	0.0964	0.1051	0.1084
16	1	0.1578	0.1359	0.0895	0.3844	0.1106	0.2528	0.1003	0.2760	0.1065
17	1	0.2189	0.2440	0.1078	0.3625	0.1319	0.2157	0.0971	0.2402	0.1083
18	1	0.2759	0.3087	0.1869	0.3181	0.2162	0.1395	0.0762	0.1785	0.1127
19	1	0.2235	0.2476	0.1159	0.3373	0.1411	0.1769	0.0951	0.2044	0.1098
20	1	0.2747	0.3121	0.2104	0.2919	0.2403	0.1023	0.0619	0.1448	0.1097
21	1	0.2834	0.3201	0.2348	0.2605	0.2638	0.0697	0.0564	0.1145	0.1153
22	1	0.1883	0.1974	0.0909	0.3732	0.1119	0.2433	0.1003	0.2601	0.1061
23	1	0.2402	0.2628	0.1148	0.3521	0.1379	0.2087	0.0980	0.2237	0.1064
24	1	0.2935	0.3193	0.1995	0.3139	0.2254	0.1470	0.0878	0.1656	0.1073
25	1	0.2447	0.2671	0.1248	0.3271	0.1484	0.1703	0.0963	0.1858	0.1069
26	1	0.2959	0.3217	0.2242	0.2924	0.2498	0.1187	0.0815	0.1378	0.1077
27	1	0.2998	0.3259	0.2455	0.2642	0.2706	0.0862	0.0766	0.1062	0.1088
28	1	0.1169	0.0822	0.0878	0.3636	0.1086	0.2793	0.1006	0.2946	0.1067
29	1	0.1782	0.1758	0.0969	0.3371	0.1195	0.2435	0.0996	0.2586	0.1082
30	1	0.2308	0.2539	0.1446	0.2791	0.1734	0.1627	0.0903	0.1850	0.1115
31	1	0.1774	0.1811	0.1007	0.3063	0.1239	0.2037	0.0983	0.2205	0.1091
32	1	0.2342	0.2571	0.1620	0.2485	0.1918	0.1285	0.0843	0.1526	0.1114

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
33	1	0.2370	0.2617	0.1800	0.2058	0.2107	0.0874	0.0797	0.1128	0.1127
34	1	0.1384	0.1213	0.0886	0.3572	0.1093	0.2712	0.1006	0.2831	0.1065
35	1	0.1933	0.2049	0.1012	0.3312	0.1233	0.2352	0.0996	0.2455	0.1070
36	1	0.2484	0.2696	0.1563	0.2747	0.1816	0.1600	0.0941	0.1720	0.1074
37	1	0.1968	0.2093	0.1065	0.3021	0.1290	0.1965	0.0986	0.2073	0.1079
38	1	0.2512	0.2730	0.1758	0.2481	0.2014	0.1297	0.0913	0.1421	0.1080
39	1	0.2551	0.2779	0.1940	0.2132	0.2198	0.0939	0.0885	0.1069	0.1091
40	1	0.1611	0.1420	0.0896	0.3847	0.1108	0.2503	0.1003	0.2760	0.1066
41	1	0.2186	0.2432	0.1086	0.3632	0.1328	0.2134	0.0968	0.2407	0.1089
42	1	0.2711	0.3060	0.1864	0.3176	0.2165	0.1315	0.0712	0.1765	0.1111
43	1	0.2226	0.2481	0.1171	0.3364	0.1424	0.1722	0.0943	0.2028	0.1103
44	1	0.2757	0.3104	0.2115	0.2920	0.2411	0.0980	0.0598	0.1469	0.1136
45	1	0.2734	0.3210	0.2398	0.2641	0.2697	0.0625	0.0519	0.1143	0.1160
46	1	0.1898	0.2001	0.0911	0.3728	0.1121	0.2421	0.1003	0.2594	0.1061
47	1	0.2391	0.2613	0.1155	0.3522	0.1387	0.2080	0.0980	0.2237	0.1068
48	1	0.2930	0.3190	0.1992	0.3144	0.2258	0.1458	0.0873	0.1659	0.1078
49	1	0.2442	0.2664	0.1257	0.3273	0.1494	0.1695	0.0962	0.1858	0.1074
50	1	0.2954	0.3215	0.2239	0.2930	0.2504	0.1173	0.0805	0.1381	0.1083
51	1	0.2995	0.3263	0.2452	0.2649	0.2713	0.0845	0.0755	0.1064	0.1093
52	1	0.1199	0.0865	0.0879	0.3647	0.1087	0.2786	0.1006	0.2946	0.1066
53	1	0.1750	0.1773	0.0976	0.3386	0.1202	0.2425	0.0993	0.2586	0.1083
54	1	0.2296	0.2529	0.1455	0.2790	0.1738	0.1598	0.0881	0.1838	0.1114
55	1	0.1776	0.1820	0.1017	0.3080	0.1250	0.2029	0.0981	0.2210	0.1096
56	1	0.2322	0.2567	0.1641	0.2482	0.1936	0.1256	0.0829	0.1517	0.1124
57	1	0.2355	0.2620	0.1821	0.2057	0.2124	0.0845	0.0776	0.1123	0.1139
58	1	0.1408	0.1254	0.0887	0.3577	0.1094	0.2705	0.1006	0.2825	0.1064
59	1	0.1927	0.2042	0.1020	0.3321	0.1242	0.2347	0.0996	0.2454	0.1073
60	1	0.2476	0.2690	0.1578	0.2763	0.1833	0.1596	0.0938	0.1723	0.1080
61	1	0.1965	0.2089	0.1076	0.3031	0.1301	0.1960	0.0985	0.2072	0.1082
62	1	0.2504	0.2724	0.1775	0.2499	0.2033	0.1293	0.0908	0.1425	0.1086
63	1	0.2546	0.2778	0.1960	0.2151	0.2220	0.0934	0.0878	0.1073	0.1097
64	1	0.0933	0.0635	0.0871	0.3500	0.1077	0.2974	0.1008	0.3104	0.1068
65	1	0.1390	0.1234	0.0919	0.3200	0.1135	0.2624	0.1004	0.2741	0.1081

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
66	1	0.1407	0.1265	0.0938	0.2867	0.1159	0.2246	0.0998	0.2369	0.1094
67	1	0.1058	0.0817	0.0875	0.3469	0.1081	0.2914	0.1008	0.3030	0.1067
68	1	0.1529	0.1498	0.0944	0.3172	0.1158	0.2559	0.1004	0.2656	0.1077
69	1	0.2023	0.2146	0.1268	0.2422	0.1511	0.1683	0.0971	0.1785	0.1085
70	1	0.1554	0.1535	0.0972	0.2851	0.1189	0.2180	0.0998	0.2276	0.1089
71	1	0.2052	0.2183	0.1398	0.2116	0.1648	0.1363	0.0954	0.1465	0.1092
72	1	0.2091	0.2234	0.1528	0.1711	0.1785	0.0974	0.0938	0.1076	0.1104
73	1	0.1295	0.0981	0.0882	0.3688	0.1091	0.2732	0.1006	0.2906	0.1066
74	1	0.1841	0.1920	0.1000	0.3441	0.1229	0.2370	0.0989	0.2551	0.1088
75	1	0.2393	0.2653	0.1545	0.2888	0.1834	0.1549	0.0847	0.1834	0.1124
76	1	0.1870	0.1971	0.1049	0.3143	0.1286	0.1967	0.0974	0.2174	0.1102
77	1	0.2483	0.2732	0.1739	0.2625	0.2043	0.1210	0.0764	0.1531	0.1119
78	1	0.2451	0.2745	0.1935	0.2179	0.2239	0.0790	0.0705	0.1128	0.1141
79	1	0.1518	0.1417	0.0892	0.3605	0.1100	0.2648	0.1006	0.2772	0.1063
80	1	0.2022	0.2164	0.1049	0.3362	0.1272	0.2294	0.0993	0.2407	0.1075
81	1	0.2577	0.2807	0.1663	0.2849	0.1923	0.1573	0.0926	0.1711	0.1084
82	1	0.2066	0.2218	0.1114	0.3081	0.1342	0.1906	0.0980	0.2025	0.1083
83	1	0.2604	0.2841	0.1874	0.2596	0.2137	0.1272	0.0889	0.1417	0.1089
84	1	0.2651	0.2900	0.2069	0.2263	0.2333	0.0918	0.0851	0.1074	0.1101
85	1	0.0998	0.0689	0.0872	0.3533	0.1079	0.2933	0.1008	0.3071	0.1067
86	1	0.1465	0.1345	0.0932	0.3243	0.1150	0.2582	0.1002	0.2711	0.1084
87	1	0.1949	0.2070	0.1230	0.2505	0.1495	0.1694	0.0939	0.1868	0.1112
88	1	0.1484	0.1379	0.0956	0.2916	0.1179	0.2199	0.0995	0.2338	0.1097
89	1	0.1977	0.2110	0.1358	0.2167	0.1639	0.1351	0.0907	0.1533	0.1125
90	1	0.2011	0.2161	0.1489	0.1704	0.1783	0.0927	0.0876	0.1114	0.1140
91	1	0.1138	0.0912	0.0877	0.3492	0.1083	0.2867	0.1008	0.2984	0.1065
92	1	0.1609	0.1610	0.0961	0.3205	0.1177	0.2513	0.1003	0.2612	0.1078
93	1	0.2118	0.2266	0.1336	0.2502	0.1582	0.1664	0.0965	0.1774	0.1087
94	1	0.1637	0.1651	0.0995	0.2891	0.1215	0.2131	0.0995	0.2232	0.1089
95	1	0.2147	0.2303	0.1483	0.2205	0.1736	0.1348	0.0945	0.1459	0.1094
96	1	0.2191	0.2359	0.1628	0.1812	0.1887	0.0966	0.0926	0.1078	0.1107
97	1	0.0831	0.0576	0.0868	0.3435	0.1074	0.3078	0.1009	0.3198	0.1068
98	1	0.1190	0.0992	0.0897	0.3115	0.1110	0.2735	0.1008	0.2837	0.1081

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
99	1	0.1201	0.1011	0.0910	0.2770	0.1126	0.2365	0.1004	0.2468	0.1095
100	1	0.0908	0.0669	0.0870	0.3419	0.1076	0.3037	0.1008	0.3151	0.1068
101	1	0.1295	0.1185	0.0913	0.3102	0.1125	0.2688	0.1008	0.2780	0.1080
102	1	0.1707	0.1736	0.1119	0.2229	0.1353	0.1732	0.0988	0.1827	0.1093
103	1	0.1312	0.1212	0.0931	0.2766	0.1145	0.2314	0.1004	0.2406	0.1094
104	1	0.1733	0.1772	0.1206	0.1901	0.1448	0.1401	0.0975	0.1493	0.1103
105	1	0.1766	0.1816	0.1295	0.1469	0.1546	0.0990	0.0963	0.1079	0.1117

Table B-4 Coverage Probabilities for the 90 Percent Upper Prediction Bounds (Part 1)

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
1	1	0.6889	0.6689	0.8067	0.7536	0.7848	0.8655	0.9031	0.8662	0.9015
2	1	0.8338	0.8298	0.9107	0.6449	0.8900	0.7328	0.8997	0.7253	0.8938
3	1	0.7224	0.7021	0.8003	0.7829	0.7780	0.8970	0.9017	0.8989	0.8966
4	1	0.7019	0.6797	0.8975	0.6272	0.8770	0.7620	0.8992	0.7848	0.8966
5	1	0.6831	0.6640	0.8528	0.6474	0.8319	0.7922	0.8999	0.8207	0.9044
6	1	0.6529	0.6385	0.7507	0.6601	0.7249	0.8122	0.8749	0.8516	0.8984
7	1	0.6732	0.6552	0.8325	0.6655	0.8117	0.8213	0.8954	0.8550	0.9026
8	1	0.6579	0.6421	0.7398	0.6821	0.7129	0.8378	0.8683	0.8815	0.9053
9	1	0.6380	0.6242	0.7098	0.6857	0.6807	0.8494	0.8395	0.8998	0.8967
10	1	0.7146	0.6832	0.9019	0.6160	0.8809	0.7646	0.9009	0.7745	0.8963
11	1	0.6843	0.6610	0.8584	0.6344	0.8361	0.7965	0.9032	0.8098	0.9010
12	1	0.6431	0.6244	0.7632	0.6581	0.7383	0.8297	0.9002	0.8481	0.9024
13	1	0.6771	0.6549	0.8392	0.6556	0.8168	0.8306	0.9013	0.8465	0.8996
14	1	0.6411	0.6226	0.7370	0.6736	0.7112	0.8521	0.8888	0.8724	0.8999
15	1	0.6374	0.6190	0.7139	0.6924	0.6876	0.8766	0.8672	0.8991	0.8965
16	1	0.7606	0.7391	0.9058	0.6416	0.8852	0.7764	0.9001	0.7641	0.8956
17	1	0.7264	0.7076	0.8751	0.6636	0.8546	0.8089	0.9016	0.8018	0.9013
18	1	0.6908	0.6753	0.7873	0.6930	0.7663	0.8432	0.8861	0.8476	0.8986
19	1	0.7274	0.7118	0.8583	0.6856	0.8378	0.8420	0.8970	0.8378	0.8979
20	1	0.6776	0.6623	0.7715	0.7162	0.7504	0.8682	0.8882	0.8764	0.9003
21	1	0.6774	0.6638	0.7480	0.7293	0.7266	0.8866	0.8801	0.8994	0.8973
22	1	0.7763	0.7536	0.9075	0.6316	0.8867	0.7664	0.9002	0.7512	0.8947
23	1	0.7332	0.7108	0.8810	0.6547	0.8594	0.8009	0.9032	0.7900	0.8989
24	1	0.6832	0.6622	0.8023	0.6926	0.7799	0.8497	0.9030	0.8445	0.9026
25	1	0.7268	0.7051	0.8680	0.6799	0.8462	0.8381	0.9023	0.8288	0.8978
26	1	0.6802	0.6593	0.7774	0.7122	0.7548	0.8744	0.9035	0.8707	0.9005
27	1	0.6753	0.6544	0.7543	0.7365	0.7318	0.9019	0.9005	0.8999	0.8972
28	1	0.8159	0.8045	0.9096	0.6509	0.8891	0.7402	0.8996	0.7368	0.8941
29	1	0.7760	0.7644	0.8891	0.6768	0.8685	0.7756	0.8991	0.7764	0.8956
30	1	0.7275	0.7123	0.8342	0.7321	0.8143	0.8389	0.8994	0.8468	0.9043
31	1	0.7684	0.7531	0.8828	0.7056	0.8622	0.8135	0.9009	0.8173	0.8971
32	1	0.7260	0.7084	0.8115	0.7524	0.7916	0.8622	0.8950	0.8722	0.9006

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
33	1	0.7204	0.7028	0.7925	0.7775	0.7727	0.8888	0.8934	0.9009	0.8982
34	1	0.8330	0.8287	0.9106	0.6444	0.8900	0.7329	0.8996	0.7254	0.8937
35	1	0.7835	0.7670	0.8960	0.6720	0.8748	0.7704	0.9022	0.7661	0.8965
36	1	0.7298	0.7097	0.8400	0.7279	0.8181	0.8389	0.9040	0.8382	0.9014
37	1	0.7785	0.7620	0.8883	0.7011	0.8668	0.8090	0.9019	0.8061	0.8952
38	1	0.7264	0.7062	0.8194	0.7518	0.7973	0.8661	0.9031	0.8666	0.8997
39	1	0.7210	0.7007	0.7993	0.7820	0.7772	0.8974	0.9021	0.8991	0.8969
40	1	0.7605	0.7388	0.9058	0.6436	0.8853	0.7772	0.9002	0.7666	0.8961
41	1	0.7277	0.7089	0.8751	0.6654	0.8543	0.8086	0.9014	0.8036	0.9016
42	1	0.6790	0.6630	0.7971	0.6959	0.7747	0.8425	0.8896	0.8493	0.9019
43	1	0.7196	0.7015	0.8611	0.6889	0.8405	0.8424	0.8994	0.8408	0.9007
44	1	0.6734	0.6587	0.7692	0.7096	0.7459	0.8600	0.8837	0.8708	0.8970
45	1	0.6763	0.6640	0.7536	0.7349	0.7297	0.8879	0.8817	0.9023	0.8995
46	1	0.7756	0.7528	0.9075	0.6332	0.8867	0.7674	0.9003	0.7531	0.8950
47	1	0.7343	0.7121	0.8808	0.6561	0.8590	0.8010	0.9032	0.7912	0.8990
48	1	0.6830	0.6620	0.8042	0.6936	0.7807	0.8479	0.9024	0.8444	0.9023
49	1	0.7268	0.7052	0.8677	0.6813	0.8458	0.8378	0.9023	0.8299	0.8979
50	1	0.6800	0.6590	0.7794	0.7131	0.7554	0.8721	0.9025	0.8702	0.8999
51	1	0.6744	0.6537	0.7564	0.7371	0.7322	0.8991	0.8995	0.8990	0.8965
52	1	0.8149	0.8033	0.9096	0.6519	0.8891	0.7417	0.8997	0.7389	0.8945
53	1	0.7746	0.7592	0.8912	0.6786	0.8707	0.7775	0.9018	0.7793	0.8986
54	1	0.7233	0.7066	0.8327	0.7299	0.8121	0.8366	0.8982	0.8456	0.9041
55	1	0.7685	0.7533	0.8820	0.7062	0.8614	0.8141	0.9009	0.8189	0.8976
56	1	0.7200	0.7031	0.8122	0.7508	0.7914	0.8607	0.8954	0.8721	0.9022
57	1	0.7139	0.6969	0.7925	0.7765	0.7716	0.8879	0.8931	0.9017	0.8992
58	1	0.8313	0.8264	0.9106	0.6448	0.8899	0.7342	0.8998	0.7269	0.8939
59	1	0.7842	0.7680	0.8954	0.6722	0.8742	0.7713	0.9023	0.7672	0.8966
60	1	0.7296	0.7095	0.8396	0.7275	0.8174	0.8387	0.9038	0.8385	0.9013
61	1	0.7786	0.7622	0.8874	0.7012	0.8659	0.8097	0.9020	0.8072	0.8954
62	1	0.7261	0.7059	0.8189	0.7513	0.7965	0.8656	0.9026	0.8667	0.8994
63	1	0.7201	0.6998	0.7986	0.7811	0.7761	0.8965	0.9014	0.8989	0.8964
64	1	0.8601	0.8617	0.9116	0.6572	0.8911	0.7187	0.8994	0.7112	0.8935
65	1	0.8179	0.8088	0.9016	0.6879	0.8811	0.7564	0.9012	0.7527	0.8959

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
66	1	0.8138	0.8045	0.8961	0.7190	0.8755	0.7949	0.9008	0.7932	0.8945
67	1	0.8746	0.8852	0.9122	0.6532	0.8916	0.7122	0.8994	0.7027	0.8933
68	1	0.8287	0.8222	0.9043	0.6842	0.8833	0.7498	0.9012	0.7431	0.8947
69	1	0.7780	0.7630	0.8688	0.7580	0.8470	0.8347	0.9043	0.8307	0.8990
70	1	0.8250	0.8179	0.8998	0.7162	0.8786	0.7887	0.9011	0.7831	0.8932
71	1	0.7746	0.7593	0.8538	0.7858	0.8317	0.8644	0.9039	0.8615	0.8976
72	1	0.7693	0.7535	0.8385	0.8212	0.8159	0.8993	0.9027	0.8975	0.8950
73	1	0.8031	0.7887	0.9089	0.6516	0.8884	0.7478	0.8999	0.7468	0.8950
74	1	0.7649	0.7485	0.8880	0.6771	0.8674	0.7824	0.9018	0.7862	0.8994
75	1	0.7126	0.6955	0.8270	0.7240	0.8055	0.8357	0.8966	0.8473	0.9045
76	1	0.7574	0.7412	0.8779	0.7039	0.8573	0.8181	0.9007	0.8252	0.8986
77	1	0.7172	0.6995	0.8012	0.7436	0.7792	0.8580	0.8896	0.8718	0.8981
78	1	0.7037	0.6869	0.7857	0.7679	0.7633	0.8848	0.8911	0.9013	0.8988
79	1	0.8191	0.8097	0.9100	0.6435	0.8894	0.7404	0.8999	0.7339	0.8943
80	1	0.7739	0.7560	0.8925	0.6699	0.8712	0.7767	0.9026	0.7736	0.8972
81	1	0.7182	0.6975	0.8330	0.7207	0.8102	0.8390	0.9032	0.8401	0.9015
82	1	0.7670	0.7490	0.8835	0.6981	0.8619	0.8147	0.9022	0.8133	0.8960
83	1	0.7147	0.6939	0.8112	0.7434	0.7880	0.8650	0.9018	0.8675	0.8993
84	1	0.7080	0.6873	0.7900	0.7718	0.7667	0.8947	0.9012	0.8987	0.8961
85	1	0.8501	0.8485	0.9113	0.6568	0.8908	0.7248	0.8996	0.7185	0.8939
86	1	0.8092	0.7986	0.8994	0.6866	0.8789	0.7620	0.9014	0.7597	0.8966
87	1	0.7587	0.7438	0.8557	0.7524	0.8352	0.8366	0.9011	0.8401	0.9024
88	1	0.8041	0.7933	0.8931	0.7169	0.8725	0.8001	0.9010	0.8002	0.8955
89	1	0.7552	0.7400	0.8388	0.7764	0.8181	0.8630	0.8989	0.8684	0.9007
90	1	0.7488	0.7334	0.8219	0.8062	0.8011	0.8933	0.8961	0.9008	0.8980
91	1	0.8649	0.8722	0.9119	0.6519	0.8913	0.7177	0.8996	0.7088	0.8936
92	1	0.8197	0.8109	0.9024	0.6821	0.8814	0.7551	0.9015	0.7491	0.8952
93	1	0.7669	0.7505	0.8627	0.7514	0.8408	0.8359	0.9042	0.8328	0.8996
94	1	0.8152	0.8059	0.8971	0.7135	0.8759	0.7940	0.9014	0.7892	0.8937
95	1	0.7633	0.7465	0.8463	0.7783	0.8240	0.8648	0.9035	0.8629	0.8979
96	1	0.7573	0.7400	0.8295	0.8123	0.8069	0.8985	0.9021	0.8978	0.8952
97	1	0.8850	0.8947	0.9125	0.6599	0.8920	0.7038	0.8993	0.6943	0.8933
98	1	0.8461	0.8432	0.9063	0.6926	0.8857	0.7413	0.9007	0.7353	0.8944

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
99	1	0.8430	0.8397	0.9027	0.7256	0.8820	0.7800	0.9005	0.7753	0.8929
100	1	0.8961	0.9127	0.9128	0.6575	0.8923	0.6989	0.8993	0.6884	0.8932
101	1	0.8560	0.8573	0.9081	0.6903	0.8872	0.7358	0.9006	0.7281	0.8937
102	1	0.8127	0.8037	0.8846	0.7762	0.8630	0.8307	0.9037	0.8249	0.8968
103	1	0.8534	0.8539	0.9051	0.7240	0.8841	0.7743	0.9005	0.7673	0.8920
104	1	0.8095	0.8001	0.8739	0.8066	0.8518	0.8622	0.9037	0.8573	0.8954
105	1	0.8049	0.7947	0.8624	0.8453	0.8398	0.9000	0.9031	0.8961	0.8931

Table B-5 Coverage Probabilities for the 95 Percent Upper Prediction Bounds (Part 1)

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
1	1	0.7348	0.7164	0.8681	0.8050	0.8369	0.9350	0.9538	0.9208	0.9491
2	1	0.8878	0.9048	0.9600	0.6821	0.9386	0.8075	0.9500	0.7819	0.9453
3	1	0.7726	0.7566	0.8624	0.8370	0.8305	0.9590	0.9523	0.9476	0.9455
4	1	0.7503	0.7300	0.9489	0.6545	0.9260	0.7620	0.9498	0.8447	0.9469
5	1	0.7247	0.7059	0.9084	0.6777	0.8812	0.7922	0.9503	0.8788	0.9518
6	1	0.6880	0.6727	0.8068	0.6935	0.7682	0.8124	0.8955	0.9072	0.9460
7	1	0.7133	0.6954	0.8893	0.6993	0.8608	0.8213	0.9488	0.9106	0.9503
8	1	0.6930	0.6766	0.7928	0.7172	0.7521	0.8379	0.8745	0.9334	0.9510
9	1	0.6724	0.6576	0.7626	0.7237	0.7179	0.8495	0.8412	0.9493	0.9460
10	1	0.7730	0.7476	0.9537	0.6456	0.9309	0.7646	0.9514	0.8358	0.9470
11	1	0.7330	0.7103	0.9179	0.6677	0.8896	0.7965	0.9539	0.8703	0.9499
12	1	0.6832	0.6621	0.8230	0.6952	0.7864	0.8297	0.9226	0.9039	0.9491
13	1	0.7243	0.7025	0.9006	0.6930	0.8708	0.8306	0.9544	0.9043	0.9487
14	1	0.6811	0.6601	0.7952	0.7135	0.7565	0.8521	0.8961	0.9251	0.9469
15	1	0.6767	0.6560	0.7696	0.7354	0.7296	0.8766	0.8688	0.9467	0.9443
16	1	0.8135	0.8010	0.9558	0.6731	0.9338	0.7935	0.9505	0.8233	0.9466
17	1	0.7733	0.7575	0.9293	0.6989	0.9042	0.8269	0.9515	0.8615	0.9500
18	1	0.7302	0.7156	0.8436	0.7321	0.8126	0.8622	0.9321	0.9047	0.9478
19	1	0.7715	0.7594	0.9141	0.7245	0.8878	0.8584	0.9482	0.8965	0.9473
20	1	0.7165	0.7019	0.8253	0.7569	0.7939	0.8849	0.9147	0.9286	0.9467
21	1	0.7156	0.7033	0.8012	0.7723	0.7683	0.9012	0.8937	0.9480	0.9463
22	1	0.8354	0.8315	0.9578	0.6653	0.9359	0.7966	0.9505	0.8107	0.9460
23	1	0.7873	0.7706	0.9371	0.6929	0.9116	0.8344	0.9535	0.8506	0.9486
24	1	0.7293	0.7087	0.8638	0.7365	0.8318	0.8821	0.9516	0.9013	0.9498
25	1	0.7798	0.7629	0.9264	0.7227	0.8994	0.8709	0.9531	0.8886	0.9476
26	1	0.7261	0.7052	0.8386	0.7589	0.8053	0.9045	0.9381	0.9243	0.9479
27	1	0.7201	0.6994	0.8143	0.7862	0.7803	0.9278	0.9193	0.9477	0.9453
28	1	0.8673	0.8711	0.9589	0.6863	0.9375	0.8160	0.9499	0.7945	0.9455
29	1	0.8237	0.8198	0.9416	0.7167	0.9179	0.8543	0.9497	0.8366	0.9461
30	1	0.7714	0.7592	0.8890	0.7765	0.8619	0.9077	0.9513	0.9030	0.9507
31	1	0.8173	0.8082	0.9361	0.7497	0.9118	0.8906	0.9512	0.8780	0.9472
32	1	0.7705	0.7555	0.8670	0.7984	0.8387	0.9263	0.9462	0.9255	0.9480

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
33	1	0.7644	0.7490	0.8474	0.8246	0.8185	0.9445	0.9356	0.9483	0.9460
34	1	0.8872	0.9042	0.9600	0.6815	0.9386	0.8092	0.9499	0.7820	0.9452
35	1	0.8387	0.8338	0.9490	0.7145	0.9254	0.8494	0.9525	0.8256	0.9470
36	1	0.7807	0.7656	0.9005	0.7778	0.8713	0.9147	0.9563	0.8963	0.9494
37	1	0.8333	0.8272	0.9430	0.7485	0.9183	0.8895	0.9524	0.8669	0.9459
38	1	0.7770	0.7614	0.8811	0.8041	0.8505	0.9376	0.9569	0.9217	0.9480
39	1	0.7711	0.7548	0.8614	0.8361	0.8297	0.9600	0.9521	0.9478	0.9456
40	1	0.8135	0.8010	0.9557	0.6754	0.9338	0.7964	0.9506	0.8259	0.9469
41	1	0.7749	0.7592	0.9292	0.7008	0.9039	0.8292	0.9513	0.8631	0.9501
42	1	0.7203	0.7041	0.8525	0.7350	0.8204	0.8639	0.9343	0.9047	0.9481
43	1	0.7654	0.7499	0.9166	0.7281	0.8902	0.8616	0.9497	0.8987	0.9493
44	1	0.7142	0.6994	0.8244	0.7506	0.7897	0.8815	0.9137	0.9258	0.9456
45	1	0.7157	0.7031	0.8076	0.7776	0.7714	0.9051	0.8964	0.9505	0.9479
46	1	0.8347	0.8305	0.9577	0.6671	0.9358	0.7991	0.9507	0.8127	0.9462
47	1	0.7885	0.7721	0.9369	0.6944	0.9112	0.8361	0.9534	0.8518	0.9486
48	1	0.7295	0.7088	0.8657	0.7374	0.8325	0.8826	0.9516	0.9011	0.9496
49	1	0.7799	0.7630	0.9261	0.7242	0.8990	0.8724	0.9530	0.8895	0.9476
50	1	0.7262	0.7053	0.8407	0.7596	0.8058	0.9047	0.9382	0.9238	0.9475
51	1	0.7195	0.6987	0.8165	0.7865	0.7804	0.9278	0.9192	0.9472	0.9448
52	1	0.8664	0.8697	0.9588	0.6872	0.9374	0.8168	0.9501	0.7966	0.9458
53	1	0.8242	0.8158	0.9434	0.7184	0.9198	0.8550	0.9519	0.8393	0.9484
54	1	0.7680	0.7538	0.8885	0.7743	0.8604	0.9054	0.9507	0.9020	0.9508
55	1	0.8174	0.8083	0.9354	0.7501	0.9110	0.8904	0.9512	0.8794	0.9475
56	1	0.7644	0.7498	0.8683	0.7970	0.8390	0.9248	0.9466	0.9253	0.9492
57	1	0.7576	0.7426	0.8483	0.8239	0.8179	0.9443	0.9359	0.9491	0.9468
58	1	0.8856	0.9018	0.9599	0.6820	0.9385	0.8117	0.9500	0.7837	0.9454
59	1	0.8394	0.8347	0.9486	0.7146	0.9249	0.8515	0.9526	0.8268	0.9471
60	1	0.7806	0.7655	0.9001	0.7771	0.8706	0.9147	0.9560	0.8964	0.9494
61	1	0.8333	0.8273	0.9423	0.7485	0.9176	0.8910	0.9525	0.8680	0.9460
62	1	0.7769	0.7612	0.8806	0.8033	0.8495	0.9372	0.9564	0.9216	0.9478
63	1	0.7703	0.7538	0.8607	0.8349	0.8284	0.9594	0.9514	0.9475	0.9454
64	1	0.9066	0.9228	0.9605	0.6955	0.9393	0.7716	0.9497	0.7661	0.9451
65	1	0.8670	0.8682	0.9522	0.7315	0.9298	0.8137	0.9514	0.8118	0.9466

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
66	1	0.8626	0.8627	0.9476	0.7671	0.9246	0.8548	0.9512	0.8550	0.9455
67	1	0.9210	0.9457	0.9611	0.6927	0.9399	0.7646	0.9496	0.7558	0.9449
68	1	0.8809	0.8889	0.9553	0.7296	0.9328	0.8070	0.9514	0.8007	0.9458
69	1	0.8310	0.8257	0.9264	0.8119	0.8996	0.8930	0.9540	0.8898	0.9482
70	1	0.8772	0.8838	0.9519	0.7668	0.9288	0.8487	0.9515	0.8437	0.9445
71	1	0.8275	0.8214	0.9134	0.8413	0.8850	0.9197	0.9545	0.9177	0.9468
72	1	0.8220	0.8148	0.8995	0.8766	0.8696	0.9478	0.9556	0.9469	0.9448
73	1	0.8554	0.8551	0.9583	0.6863	0.9368	0.8161	0.9503	0.8051	0.9462
74	1	0.8144	0.8042	0.9407	0.7161	0.9167	0.8527	0.9518	0.8462	0.9489
75	1	0.7566	0.7414	0.8830	0.7671	0.8534	0.8987	0.9491	0.9031	0.9508
76	1	0.8060	0.7951	0.9318	0.7469	0.9069	0.8867	0.9508	0.8852	0.9480
77	1	0.7604	0.7441	0.8576	0.7882	0.8260	0.9174	0.9396	0.9251	0.9463
78	1	0.7465	0.7311	0.8415	0.8144	0.8088	0.9370	0.9290	0.9486	0.9464
79	1	0.8750	0.8872	0.9596	0.6802	0.9381	0.8190	0.9502	0.7914	0.9457
80	1	0.8292	0.8218	0.9463	0.7115	0.9222	0.8593	0.9528	0.8334	0.9474
81	1	0.7685	0.7516	0.8939	0.7691	0.8632	0.9157	0.9561	0.8977	0.9493
82	1	0.8218	0.8130	0.9392	0.7445	0.9139	0.8966	0.9527	0.8738	0.9464
83	1	0.7648	0.7473	0.8730	0.7942	0.8406	0.9364	0.9545	0.9220	0.9475
84	1	0.7573	0.7392	0.8519	0.8247	0.8182	0.9570	0.9464	0.9473	0.9450
85	1	0.8980	0.9116	0.9602	0.6945	0.9390	0.7790	0.9498	0.7742	0.9454
86	1	0.8586	0.8577	0.9503	0.7294	0.9277	0.8202	0.9516	0.8192	0.9471
87	1	0.8058	0.7961	0.9107	0.8004	0.8842	0.8943	0.9510	0.8975	0.9501
88	1	0.8532	0.8512	0.9450	0.7641	0.9217	0.8608	0.9513	0.8616	0.9460
89	1	0.8021	0.7918	0.8947	0.8257	0.8669	0.9187	0.9515	0.9228	0.9486
90	1	0.7953	0.7842	0.8781	0.8557	0.8493	0.9446	0.9501	0.9488	0.9464
91	1	0.9134	0.9368	0.9609	0.6910	0.9397	0.7704	0.9498	0.7627	0.9451
92	1	0.8728	0.8782	0.9539	0.7268	0.9312	0.8121	0.9517	0.8072	0.9460
93	1	0.8199	0.8121	0.9211	0.8044	0.8935	0.8933	0.9541	0.8917	0.9484
94	1	0.8683	0.8722	0.9499	0.7633	0.9264	0.8535	0.9518	0.8499	0.9449
95	1	0.8161	0.8075	0.9065	0.8330	0.8773	0.9194	0.9550	0.9187	0.9470
96	1	0.8099	0.8000	0.8910	0.8674	0.8604	0.9468	0.9562	0.9471	0.9448
97	1	0.9270	0.9478	0.9612	0.6998	0.9401	0.7557	0.9495	0.7465	0.9449
98	1	0.8932	0.9016	0.9561	0.7383	0.9342	0.7985	0.9509	0.7927	0.9457

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
99	1	0.8901	0.8974	0.9531	0.7761	0.9308	0.8407	0.9508	0.8366	0.9444
100	1	0.9370	0.9620	0.9615	0.6982	0.9405	0.7499	0.9495	0.7388	0.9448
101	1	0.9048	0.9198	0.9580	0.7372	0.9362	0.7919	0.9508	0.7837	0.9451
102	1	0.8648	0.8680	0.9397	0.8323	0.9145	0.8900	0.9535	0.8845	0.9468
103	1	0.9023	0.9162	0.9559	0.7761	0.9335	0.8342	0.9509	0.8270	0.9438
104	1	0.8617	0.8640	0.9308	0.8634	0.9042	0.9186	0.9536	0.9143	0.9456
105	1	0.8573	0.8583	0.9211	0.9004	0.8929	0.9492	0.9534	0.9462	0.9436

Table B-6 Coverage Probabilities for the 99 Percent Upper Prediction Bounds (Part 1)

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
1	1	0.8152	0.8072	0.9499	0.8793	0.9068	0.9433	0.9604	0.9759	0.9882
2	1	0.9522	0.9814	0.9949	0.7464	0.9817	0.8230	0.9905	0.8713	0.9879
3	1	0.8555	0.8542	0.9461	0.9099	0.9017	0.9649	0.9569	0.9879	0.9865
4	1	0.8329	0.8289	0.9909	0.7023	0.9735	0.7620	0.9926	0.9283	0.9883
5	1	0.7994	0.7866	0.9715	0.7297	0.9402	0.7922	0.9783	0.9511	0.9898
6	1	0.7559	0.7418	0.8973	0.7490	0.8332	0.8124	0.8957	0.9675	0.9868
7	1	0.7862	0.7726	0.9599	0.7559	0.9233	0.8213	0.9681	0.9709	0.9891
8	1	0.7627	0.7474	0.8840	0.7744	0.8126	0.8379	0.8745	0.9816	0.9882
9	1	0.7442	0.7299	0.8590	0.7842	0.7772	0.8495	0.8412	0.9895	0.9871
10	1	0.8658	0.8765	0.9933	0.6980	0.9776	0.7646	0.9931	0.9217	0.9886
11	1	0.8198	0.8084	0.9798	0.7256	0.9510	0.7965	0.9860	0.9461	0.9894
12	1	0.7602	0.7398	0.9153	0.7577	0.8575	0.8297	0.9229	0.9659	0.9882
13	1	0.8092	0.7962	0.9711	0.7564	0.9368	0.8306	0.9790	0.9679	0.9889
14	1	0.7587	0.7376	0.8913	0.7793	0.8267	0.8521	0.8961	0.9779	0.9871
15	1	0.7525	0.7317	0.8675	0.8043	0.7972	0.8766	0.8688	0.9880	0.9858
16	1	0.8927	0.9060	0.9935	0.7275	0.9787	0.7935	0.9921	0.9104	0.9884
17	1	0.8508	0.8472	0.9828	0.7582	0.9585	0.8269	0.9881	0.9396	0.9895
18	1	0.7994	0.7905	0.9266	0.7947	0.8782	0.8622	0.9353	0.9672	0.9888
19	1	0.8444	0.8431	0.9747	0.7883	0.9459	0.8584	0.9816	0.9634	0.9883
20	1	0.7871	0.7780	0.9082	0.8202	0.8570	0.8849	0.9150	0.9793	0.9865
21	1	0.7870	0.7786	0.8890	0.8374	0.8315	0.9012	0.8937	0.9890	0.9877
22	1	0.9174	0.9473	0.9943	0.7242	0.9803	0.7966	0.9915	0.8994	0.9882
23	1	0.8728	0.8775	0.9878	0.7581	0.9660	0.8344	0.9922	0.9314	0.9891
24	1	0.8108	0.7996	0.9470	0.8074	0.9023	0.8821	0.9573	0.9644	0.9886
25	1	0.8653	0.8669	0.9835	0.7934	0.9580	0.8709	0.9891	0.9584	0.9886
26	1	0.8077	0.7954	0.9281	0.8319	0.8775	0.9045	0.9391	0.9773	0.9875
27	1	0.8013	0.7871	0.9081	0.8602	0.8526	0.9278	0.9193	0.9879	0.9861
28	1	0.9348	0.9589	0.9945	0.7468	0.9808	0.8182	0.9908	0.8848	0.9880
29	1	0.8946	0.9067	0.9881	0.7827	0.9682	0.8562	0.9920	0.9210	0.9880
30	1	0.8438	0.8413	0.9579	0.8439	0.9224	0.9091	0.9666	0.9655	0.9889
31	1	0.8911	0.8969	0.9859	0.8196	0.9640	0.8916	0.9906	0.9523	0.9885
32	1	0.8440	0.8389	0.9425	0.8658	0.9018	0.9272	0.9523	0.9779	0.9879

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
33	1	0.8384	0.8313	0.9271	0.8900	0.8824	0.9449	0.9372	0.9879	0.9870
34	1	0.9518	0.9813	0.9949	0.7457	0.9816	0.8222	0.9905	0.8715	0.9878
35	1	0.9157	0.9341	0.9918	0.7855	0.9744	0.8647	0.9941	0.9108	0.9886
36	1	0.8631	0.8653	0.9703	0.8538	0.9364	0.9252	0.9784	0.9620	0.9888
37	1	0.9108	0.9269	0.9899	0.8244	0.9703	0.9022	0.9934	0.9439	0.9881
38	1	0.8596	0.8603	0.9586	0.8800	0.9192	0.9453	0.9683	0.9763	0.9879
39	1	0.8538	0.8524	0.9454	0.9092	0.9010	0.9644	0.9564	0.9879	0.9866
40	1	0.8929	0.9064	0.9935	0.7302	0.9786	0.7964	0.9922	0.9124	0.9885
41	1	0.8527	0.8493	0.9828	0.7604	0.9583	0.8292	0.9880	0.9404	0.9895
42	1	0.7950	0.7828	0.9322	0.7974	0.8838	0.8639	0.9380	0.9662	0.9874
43	1	0.8423	0.8368	0.9763	0.7920	0.9478	0.8616	0.9827	0.9643	0.9890
44	1	0.7885	0.7781	0.9110	0.8148	0.8541	0.8815	0.9143	0.9789	0.9871
45	1	0.7898	0.7796	0.8969	0.8421	0.8345	0.9051	0.8965	0.9891	0.9874
46	1	0.9169	0.9467	0.9943	0.7264	0.9803	0.7991	0.9916	0.9009	0.9883
47	1	0.8740	0.8790	0.9877	0.7598	0.9658	0.8361	0.9921	0.9321	0.9891
48	1	0.8116	0.8002	0.9485	0.8080	0.9027	0.8826	0.9576	0.9645	0.9885
49	1	0.8655	0.8670	0.9834	0.7950	0.9577	0.8724	0.9889	0.9588	0.9886
50	1	0.8087	0.7959	0.9301	0.8323	0.8777	0.9047	0.9393	0.9773	0.9874
51	1	0.8016	0.7866	0.9105	0.8602	0.8525	0.9278	0.9193	0.9880	0.9862
52	1	0.9341	0.9580	0.9944	0.7476	0.9808	0.8190	0.9909	0.8865	0.9881
53	1	0.8979	0.9060	0.9890	0.7842	0.9695	0.8573	0.9927	0.9228	0.9890
54	1	0.8426	0.8381	0.9584	0.8418	0.9219	0.9074	0.9665	0.9647	0.9889
55	1	0.8912	0.8971	0.9856	0.8198	0.9634	0.8917	0.9903	0.9530	0.9886
56	1	0.8394	0.8337	0.9441	0.8645	0.9025	0.9261	0.9528	0.9777	0.9879
57	1	0.8324	0.8249	0.9287	0.8898	0.8825	0.9449	0.9375	0.9884	0.9867
58	1	0.9509	0.9803	0.9949	0.7461	0.9816	0.8225	0.9906	0.8729	0.9879
59	1	0.9162	0.9345	0.9917	0.7854	0.9741	0.8645	0.9941	0.9116	0.9886
60	1	0.8633	0.8653	0.9701	0.8529	0.9357	0.9244	0.9780	0.9621	0.9888
61	1	0.9109	0.9268	0.9896	0.8243	0.9698	0.9019	0.9933	0.9444	0.9881
62	1	0.8598	0.8602	0.9583	0.8790	0.9183	0.9445	0.9678	0.9763	0.9877
63	1	0.8535	0.8513	0.9450	0.9080	0.8997	0.9637	0.9556	0.9879	0.9864
64	1	0.9604	0.9836	0.9949	0.7606	0.9819	0.8359	0.9903	0.8565	0.9878
65	1	0.9323	0.9487	0.9923	0.8025	0.9760	0.8787	0.9935	0.8998	0.9884

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
66	1	0.9284	0.9432	0.9906	0.8416	0.9727	0.9144	0.9936	0.9364	0.9879
67	1	0.9701	0.9922	0.9951	0.7603	0.9823	0.8391	0.9901	0.8437	0.9877
68	1	0.9461	0.9688	0.9936	0.8043	0.9786	0.8845	0.9927	0.8877	0.9881
69	1	0.9081	0.9221	0.9831	0.8894	0.9576	0.9537	0.9886	0.9582	0.9887
70	1	0.9433	0.9650	0.9927	0.8457	0.9764	0.9222	0.9936	0.9257	0.9876
71	1	0.9051	0.9176	0.9770	0.9158	0.9470	0.9702	0.9838	0.9747	0.9878
72	1	0.9004	0.9113	0.9696	0.9437	0.9352	0.9843	0.9776	0.9880	0.9868
73	1	0.9262	0.9490	0.9943	0.7458	0.9804	0.8162	0.9912	0.8941	0.9883
74	1	0.8896	0.8954	0.9879	0.7807	0.9674	0.8529	0.9920	0.9280	0.9892
75	1	0.8319	0.8251	0.9550	0.8334	0.9155	0.8994	0.9622	0.9653	0.9888
76	1	0.8812	0.8845	0.9839	0.8154	0.9605	0.8869	0.9890	0.9563	0.9887
77	1	0.8348	0.8258	0.9373	0.8548	0.8905	0.9178	0.9443	0.9779	0.9877
78	1	0.8220	0.8120	0.9242	0.8802	0.8733	0.9372	0.9300	0.9882	0.9866
79	1	0.9444	0.9750	0.9948	0.7435	0.9814	0.8194	0.9908	0.8805	0.9880
80	1	0.9084	0.9245	0.9910	0.7813	0.9725	0.8599	0.9939	0.9171	0.9887
81	1	0.8520	0.8505	0.9666	0.8439	0.9296	0.9164	0.9746	0.9627	0.9886
82	1	0.9018	0.9150	0.9885	0.8194	0.9675	0.8970	0.9927	0.9484	0.9883
83	1	0.8485	0.8453	0.9536	0.8695	0.9104	0.9370	0.9627	0.9765	0.9875
84	1	0.8413	0.8351	0.9388	0.8983	0.8900	0.9573	0.9488	0.9880	0.9863
85	1	0.9552	0.9791	0.9948	0.7587	0.9817	0.8332	0.9904	0.8646	0.9879
86	1	0.9260	0.9410	0.9916	0.7992	0.9747	0.8747	0.9938	0.9061	0.9886
87	1	0.8793	0.8825	0.9724	0.8705	0.9422	0.9333	0.9792	0.9626	0.9889
88	1	0.9212	0.9343	0.9896	0.8375	0.9708	0.9100	0.9931	0.9410	0.9881
89	1	0.8759	0.8779	0.9625	0.8942	0.9278	0.9506	0.9704	0.9768	0.9880
90	1	0.8695	0.8694	0.9513	0.9198	0.9123	0.9669	0.9600	0.9883	0.9868
91	1	0.9662	0.9902	0.9951	0.7579	0.9822	0.8363	0.9903	0.8511	0.9878
92	1	0.9407	0.9630	0.9932	0.8007	0.9777	0.8807	0.9932	0.8938	0.9882
93	1	0.8989	0.9105	0.9807	0.8817	0.9533	0.9478	0.9868	0.9592	0.9886
94	1	0.9372	0.9582	0.9921	0.8416	0.9750	0.9183	0.9940	0.9307	0.9877
95	1	0.8957	0.9056	0.9735	0.9080	0.9412	0.9653	0.9808	0.9751	0.9878
96	1	0.8902	0.8980	0.9648	0.9363	0.9277	0.9806	0.9734	0.9880	0.9866
97	1	0.9718	0.9914	0.9951	0.7674	0.9823	0.8449	0.9901	0.8351	0.9877
98	1	0.9511	0.9699	0.9936	0.8122	0.9788	0.8900	0.9922	0.8815	0.9881

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
99	1	0.9486	0.9664	0.9926	0.8533	0.9767	0.9262	0.9931	0.9217	0.9876
100	1	0.9777	0.9952	0.9952	0.7674	0.9826	0.8473	0.9900	0.8246	0.9877
101	1	0.9610	0.9825	0.9944	0.8137	0.9803	0.8942	0.9915	0.8707	0.9878
102	1	0.9343	0.9532	0.9885	0.9093	0.9675	0.9674	0.9925	0.9550	0.9883
103	1	0.9593	0.9805	0.9938	0.8565	0.9790	0.9317	0.9922	0.9115	0.9873
104	1	0.9319	0.9499	0.9850	0.9352	0.9608	0.9813	0.9899	0.9731	0.9877
105	1	0.9285	0.9455	0.9807	0.9613	0.9530	0.9919	0.9865	0.9880	0.9867

Table B-7 Coverage Probabilities for the 99 Percent Lower Prediction Bounds (Part 2)

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
1	2A	0.2480	0.2790	0.0597	0.1988	0.1591	0.1047	0.0754	0.0247	0.0114
	2B	0.2398	0.2806	0.0595	0.2286	0.1940	0.1409	0.1094	0.0269	0.0115
	2C	0.2641	0.2814	0.0534	0.1566	0.1181	0.0687	0.0455	0.0231	0.0116
	2D	0.2392	0.2474	0.0364	0.0896	0.0636	0.0236	0.0137	0.0180	0.0108
2	2A	0.0839	0.0365	0.0055	0.2702	0.0200	0.1894	0.0089	0.0683	0.0127
	2B	0.0914	0.0332	0.0043	0.2909	0.0243	0.2115	0.0068	0.0545	0.0135
	2C	0.0846	0.0412	0.0068	0.2552	0.0171	0.1734	0.0101	0.0859	0.0122
	2D	0.0609	0.0376	0.0082	0.2398	0.0132	0.1559	0.0101	0.1248	0.0109
3	2A	0.2026	0.2253	0.0782	0.1616	0.1732	0.0713	0.0879	0.0115	0.0121
	2B	0.2013	0.2328	0.0773	0.1985	0.2045	0.1051	0.1190	0.0119	0.0133
	2C	0.2124	0.2236	0.0707	0.1258	0.1354	0.0462	0.0565	0.0122	0.0129
	2D	0.1855	0.1886	0.0459	0.0696	0.0731	0.0146	0.0176	0.0110	0.0112
4	2A	0.2409	0.2719	0.0572	0.1872	0.1492	0.0938	0.0677	0.0244	0.0115
	2B	0.2198	0.2630	0.0564	0.2185	0.1791	0.1268	0.0968	0.0256	0.0118
	2C	0.2552	0.2729	0.0505	0.1455	0.1095	0.0600	0.0399	0.0227	0.0117
	2D	0.2284	0.2366	0.0341	0.0813	0.0581	0.0196	0.0118	0.0176	0.0109
5	2A	0.0777	0.0305	0.0055	0.2676	0.0197	0.1865	0.0090	0.0753	0.0127
	2B	0.0855	0.0282	0.0042	0.2880	0.0239	0.2080	0.0070	0.0612	0.0135
	2C	0.0779	0.0346	0.0068	0.2532	0.0170	0.1713	0.0102	0.0933	0.0122
	2D	0.0549	0.0319	0.0081	0.2385	0.0131	0.1547	0.0101	0.1316	0.0109
6	2A	0.1954	0.2163	0.0740	0.1505	0.1626	0.0625	0.0792	0.0116	0.0121
	2B	0.1917	0.2212	0.0743	0.1862	0.1952	0.0935	0.1106	0.0115	0.0133
	2C	0.2037	0.2134	0.0662	0.1159	0.1256	0.0396	0.0496	0.0123	0.0129
	2D	0.1743	0.1764	0.0423	0.0631	0.0665	0.0120	0.0149	0.0111	0.0112
7	2A	0.2294	0.2595	0.0529	0.1698	0.1348	0.0785	0.0572	0.0241	0.0118
	2B	0.2213	0.2559	0.0519	0.2018	0.1652	0.1095	0.0843	0.0242	0.0108
	2C	0.2409	0.2585	0.0461	0.1294	0.0973	0.0483	0.0326	0.0220	0.0119
	2D	0.2112	0.2188	0.0307	0.0700	0.0508	0.0147	0.0094	0.0169	0.0110
8	2A	0.0689	0.0230	0.0054	0.2637	0.0193	0.1823	0.0093	0.0859	0.0127
	2B	0.0766	0.0219	0.0042	0.2833	0.0234	0.2027	0.0072	0.0713	0.0135
	2C	0.0682	0.0264	0.0067	0.2502	0.0167	0.1682	0.0102	0.1041	0.0121
	2D	0.0466	0.0249	0.0081	0.2367	0.0131	0.1529	0.0101	0.1410	0.0109

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
9	2A	0.1836	0.2019	0.0672	0.1342	0.1471	0.0504	0.0670	0.0117	0.0123
	2B	0.1811	0.2060	0.0680	0.1690	0.1796	0.0782	0.0965	0.0119	0.0135
	2C	0.1900	0.1969	0.0592	0.1017	0.1116	0.0310	0.0405	0.0123	0.0130
	2D	0.1572	0.1575	0.0373	0.0543	0.0578	0.0090	0.0117	0.0111	0.0114
10	2A	0.1753	0.1907	0.0256	0.0949	0.0749	0.0260	0.0222	0.0216	0.0126
	2B	0.1709	0.1862	0.0244	0.1230	0.0983	0.0431	0.0366	0.0234	0.0123
	2C	0.1802	0.1857	0.0225	0.0670	0.0519	0.0138	0.0113	0.0189	0.0121
	2D	0.1409	0.1412	0.0169	0.0330	0.0276	0.0094	0.0055	0.0136	0.0112
11	2A	0.0344	0.0061	0.0050	0.2386	0.0181	0.1565	0.0100	0.1266	0.0127
	2B	0.0387	0.0054	0.0038	0.2492	0.0216	0.1669	0.0086	0.1102	0.0137
	2C	0.0323	0.0073	0.0064	0.2316	0.0160	0.1495	0.0105	0.1438	0.0122
	2D	0.0212	0.0090	0.0079	0.2250	0.0127	0.1446	0.0102	0.1725	0.0109
12	2A	0.1322	0.1321	0.0331	0.0698	0.0847	0.0146	0.0271	0.0122	0.0133
	2B	0.1354	0.1362	0.0331	0.0941	0.1107	0.0257	0.0443	0.0126	0.0137
	2C	0.1335	0.1268	0.0286	0.0506	0.0602	0.0080	0.0142	0.0122	0.0130
	2D	0.0959	0.0886	0.0196	0.0273	0.0308	0.0078	0.0052	0.0110	0.0115
13	2A	0.1660	0.1778	0.0238	0.0860	0.0691	0.0216	0.0196	0.0211	0.0127
	2B	0.1629	0.1736	0.0227	0.1125	0.0910	0.0368	0.0325	0.0230	0.0126
	2C	0.1695	0.1723	0.0209	0.0602	0.0478	0.0112	0.0100	0.0183	0.0122
	2D	0.1295	0.1280	0.0160	0.0298	0.0259	0.0100	0.0060	0.0132	0.0113
14	2A	0.0320	0.0055	0.0050	0.2374	0.0180	0.1554	0.0100	0.1335	0.0127
	2B	0.0360	0.0048	0.0038	0.2477	0.0215	0.1653	0.0087	0.1176	0.0137
	2C	0.0299	0.0067	0.0063	0.2308	0.0159	0.1487	0.0105	0.1499	0.0121
	2D	0.0198	0.0084	0.0079	0.2245	0.0127	0.1547	0.0102	0.1767	0.0109
15	2A	0.1239	0.1199	0.0301	0.0630	0.0779	0.0121	0.0238	0.0123	0.0135
	2B	0.1276	0.1244	0.0301	0.0853	0.1025	0.0214	0.0393	0.0127	0.0139
	2C	0.1240	0.1148	0.0261	0.0457	0.0551	0.0066	0.0124	0.0122	0.0131
	2D	0.0870	0.0785	0.0182	0.0252	0.0286	0.0085	0.0055	0.0110	0.0115
16	2A	0.1518	0.1576	0.0212	0.0737	0.0612	0.0162	0.0163	0.0203	0.0131
	2B	0.1507	0.1536	0.0202	0.0978	0.0810	0.0287	0.0273	0.0225	0.0129
	2C	0.1533	0.1517	0.0187	0.0512	0.0425	0.0083	0.0083	0.0174	0.0124
	2D	0.1129	0.1085	0.0147	0.0258	0.0236	0.0104	0.0069	0.0126	0.0114
17	2A	0.0286	0.0049	0.0049	0.2357	0.0179	0.1537	0.0101	0.1432	0.0127

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
	2B	0.0323	0.0041	0.0037	0.2453	0.0213	0.1630	0.0089	0.1285	0.0136
	2C	0.0268	0.0059	0.0063	0.2296	0.0158	0.1476	0.0105	0.1584	0.0121
	2D	0.0181	0.0076	0.0079	0.2238	0.0127	0.1690	0.0102	0.1823	0.0109
18	2A	0.1117	0.1020	0.0261	0.0540	0.0686	0.0090	0.0195	0.0123	0.0139
	2B	0.1161	0.1067	0.0260	0.0733	0.0910	0.0162	0.0328	0.0129	0.0142
	2C	0.1102	0.0972	0.0227	0.0392	0.0484	0.0050	0.0101	0.0121	0.0132
	2D	0.0748	0.0646	0.0165	0.0224	0.0257	0.0092	0.0063	0.0110	0.0116
19	2A	0.1248	0.1181	0.0149	0.0502	0.0456	0.0081	0.0105	0.0184	0.0136
	2B	0.1262	0.1133	0.0137	0.0681	0.0599	0.0150	0.0178	0.0208	0.0134
	2C	0.1229	0.1124	0.0137	0.0350	0.0322	0.0095	0.0059	0.0156	0.0126
	2D	0.0855	0.0764	0.0121	0.0189	0.0194	0.0102	0.0087	0.0115	0.0114
20	2A	0.0208	0.0034	0.0049	0.2296	0.0177	0.1479	0.0102	0.1617	0.0127
	2B	0.0236	0.0026	0.0037	0.2359	0.0210	0.1543	0.0092	0.1487	0.0137
	2C	0.0199	0.0043	0.0062	0.2253	0.0157	0.1440	0.0105	0.1741	0.0122
	2D	0.0144	0.0060	0.0078	0.2210	0.0126	0.1853	0.0102	0.1920	0.0109
21	2A	0.0903	0.0719	0.0181	0.0375	0.0512	0.0048	0.0126	0.0125	0.0144
	2B	0.0952	0.0758	0.0173	0.0501	0.0680	0.0081	0.0214	0.0130	0.0146
	2C	0.0869	0.0683	0.0163	0.0279	0.0363	0.0077	0.0067	0.0120	0.0133
	2D	0.0563	0.0445	0.0133	0.0178	0.0209	0.0099	0.0083	0.0110	0.0117
22	2A	0.1160	0.1050	0.0139	0.0450	0.0426	0.0070	0.0096	0.0178	0.0138
	2B	0.1178	0.1005	0.0127	0.0613	0.0557	0.0124	0.0161	0.0203	0.0136
	2C	0.1130	0.0995	0.0129	0.0316	0.0303	0.0103	0.0056	0.0150	0.0127
	2D	0.0770	0.0666	0.0117	0.0176	0.0186	0.0100	0.0089	0.0112	0.0115
23	2A	0.0197	0.0033	0.0048	0.2290	0.0176	0.1474	0.0102	0.1669	0.0127
	2B	0.0223	0.0025	0.0037	0.2350	0.0209	0.1535	0.0093	0.1549	0.0137
	2C	0.0190	0.0041	0.0062	0.2249	0.0156	0.1481	0.0106	0.1784	0.0122
	2D	0.0139	0.0058	0.0078	0.2207	0.0126	0.1883	0.0102	0.1944	0.0109
24	2A	0.0835	0.0626	0.0165	0.0341	0.0475	0.0046	0.0113	0.0126	0.0146
	2B	0.0881	0.0659	0.0157	0.0452	0.0629	0.0068	0.0191	0.0131	0.0148
	2C	0.0793	0.0592	0.0151	0.0257	0.0338	0.0085	0.0062	0.0120	0.0134
	2D	0.0508	0.0388	0.0127	0.0169	0.0199	0.0099	0.0087	0.0110	0.0117
25	2A	0.1032	0.0864	0.0126	0.0384	0.0386	0.0080	0.0084	0.0169	0.0140
	2B	0.1053	0.0825	0.0114	0.0523	0.0502	0.0094	0.0139	0.0194	0.0140

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
	2C	0.0988	0.0811	0.0119	0.0273	0.0278	0.0106	0.0056	0.0143	0.0128
	2D	0.0656	0.0537	0.0111	0.0159	0.0176	0.0097	0.0092	0.0109	0.0115
26	2A	0.0183	0.0031	0.0048	0.2281	0.0175	0.1466	0.0102	0.1741	0.0126
	2B	0.0207	0.0024	0.0036	0.2338	0.0208	0.1524	0.0094	0.1636	0.0137
	2C	0.0179	0.0039	0.0062	0.2244	0.0156	0.1610	0.0106	0.1841	0.0121
	2D	0.0133	0.0056	0.0078	0.2204	0.0126	0.1921	0.0102	0.1978	0.0109
27	2A	0.0739	0.0503	0.0146	0.0298	0.0426	0.0067	0.0097	0.0126	0.0149
	2B	0.0781	0.0524	0.0136	0.0390	0.0562	0.0052	0.0163	0.0132	0.0152
	2C	0.0689	0.0474	0.0135	0.0229	0.0307	0.0092	0.0058	0.0120	0.0135
	2D	0.0438	0.0316	0.0119	0.0157	0.0187	0.0100	0.0091	0.0110	0.0118

Table B-8 Coverage Probabilities for the 95 Percent Lower Prediction Bounds (Part 2)

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
1	2A	0.3285	0.3536	0.1617	0.2820	0.2460	0.1047	0.0754	0.0827	0.0537
	2B	0.3296	0.3682	0.1695	0.3036	0.2722	0.1409	0.1094	0.0862	0.0545
	2C	0.3425	0.3567	0.1433	0.2440	0.2041	0.0687	0.0459	0.0790	0.0532
	2D	0.3205	0.3281	0.1137	0.1795	0.1461	0.0508	0.0340	0.0699	0.0520
2	2A	0.1786	0.1833	0.0425	0.3356	0.0655	0.1894	0.0500	0.1488	0.0558
	2B	0.1898	0.1863	0.0392	0.3534	0.0711	0.2115	0.0489	0.1329	0.0571
	2C	0.1803	0.1820	0.0455	0.3227	0.0619	0.1734	0.0510	0.1682	0.0555
	2D	0.1536	0.1535	0.0474	0.3111	0.0555	0.1925	0.0503	0.2092	0.0525
3	2A	0.2923	0.3203	0.1849	0.2528	0.2598	0.0713	0.0879	0.0530	0.0551
	2B	0.3042	0.3418	0.1904	0.2822	0.2843	0.1051	0.1190	0.0536	0.0565
	2C	0.2974	0.3139	0.1679	0.2149	0.2220	0.0462	0.0567	0.0545	0.0555
	2D	0.2775	0.2854	0.1292	0.1556	0.1583	0.0385	0.0322	0.0526	0.0528
4	2A	0.3238	0.3499	0.1589	0.2726	0.2370	0.0938	0.0678	0.0825	0.0543
	2B	0.3177	0.3581	0.1628	0.2963	0.2594	0.1268	0.0968	0.0824	0.0551
	2C	0.3360	0.3510	0.1399	0.2342	0.1953	0.0600	0.0406	0.0785	0.0534
	2D	0.3127	0.3204	0.1100	0.1701	0.1388	0.0558	0.0369	0.0692	0.0523
5	2A	0.1693	0.1675	0.0421	0.3334	0.0649	0.1865	0.0500	0.1574	0.0558
	2B	0.1805	0.1701	0.0389	0.3511	0.0703	0.2080	0.0491	0.1418	0.0571
	2C	0.1707	0.1675	0.0453	0.3211	0.0615	0.1713	0.0511	0.1764	0.0555
	2D	0.1440	0.1417	0.0473	0.3101	0.0553	0.2063	0.0503	0.2159	0.0525
6	2A	0.2858	0.3144	0.1804	0.2426	0.2500	0.0625	0.0792	0.0534	0.0556
	2B	0.2970	0.3362	0.1876	0.2721	0.2768	0.0935	0.1106	0.0537	0.0574
	2C	0.2903	0.3070	0.1628	0.2053	0.2126	0.0396	0.0500	0.0548	0.0559
	2D	0.2680	0.2755	0.1241	0.1474	0.1501	0.0427	0.0351	0.0528	0.0530
7	2A	0.3160	0.3433	0.1537	0.2578	0.2232	0.0785	0.0576	0.0821	0.0550
	2B	0.3174	0.3558	0.1591	0.2834	0.2468	0.1095	0.0844	0.0819	0.0537
	2C	0.3253	0.3415	0.1340	0.2192	0.1824	0.0484	0.0345	0.0775	0.0537
	2D	0.2998	0.3077	0.1043	0.1565	0.1285	0.0581	0.0404	0.0681	0.0527
8	2A	0.1553	0.1439	0.0417	0.3302	0.0640	0.1823	0.0502	0.1697	0.0557
	2B	0.1664	0.1461	0.0384	0.3475	0.0693	0.2027	0.0494	0.1546	0.0571
	2C	0.1560	0.1455	0.0449	0.3186	0.0609	0.1682	0.0511	0.1881	0.0554
	2D	0.1299	0.1243	0.0471	0.3084	0.0550	0.2190	0.0503	0.2251	0.0525

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
9	2A	0.2754	0.3043	0.1727	0.2271	0.2352	0.0504	0.0671	0.0539	0.0562
	2B	0.2871	0.3264	0.1812	0.2577	0.2630	0.0782	0.0965	0.0543	0.0579
	2C	0.2788	0.2952	0.1544	0.1908	0.1985	0.0310	0.0414	0.0551	0.0563
	2D	0.2528	0.2597	0.1163	0.1357	0.1385	0.0451	0.0395	0.0531	0.0533
10	2A	0.2701	0.2983	0.1058	0.1860	0.1560	0.0551	0.0329	0.0783	0.0565
	2B	0.2775	0.3160	0.1113	0.2148	0.1802	0.0438	0.0395	0.0801	0.0565
	2C	0.2757	0.2909	0.0927	0.1517	0.1258	0.0611	0.0389	0.0722	0.0550
	2D	0.2389	0.2457	0.0741	0.1031	0.0891	0.0558	0.0463	0.0611	0.0530
11	2A	0.0931	0.0573	0.0397	0.3088	0.0612	0.1864	0.0507	0.2116	0.0559
	2B	0.1032	0.0564	0.0360	0.3186	0.0653	0.1669	0.0505	0.1962	0.0576
	2C	0.0932	0.0624	0.0434	0.3025	0.0589	0.2185	0.0514	0.2274	0.0554
	2D	0.0764	0.0625	0.0463	0.2976	0.0541	0.2485	0.0504	0.2539	0.0525
12	2A	0.2262	0.2489	0.1204	0.1570	0.1675	0.0394	0.0343	0.0558	0.0579
	2B	0.2385	0.2710	0.1290	0.1848	0.1945	0.0261	0.0456	0.0559	0.0586
	2C	0.2269	0.2366	0.1063	0.1295	0.1380	0.0465	0.0386	0.0554	0.0573
	2D	0.1894	0.1922	0.0810	0.0922	0.0954	0.0486	0.0464	0.0527	0.0537
13	2A	0.2616	0.2897	0.1016	0.1760	0.1484	0.0600	0.0335	0.0773	0.0569
	2B	0.2688	0.3069	0.1070	0.2045	0.1719	0.0405	0.0367	0.0795	0.0568
	2C	0.2659	0.2807	0.0891	0.1429	0.1197	0.0603	0.0404	0.0710	0.0553
	2D	0.2276	0.2340	0.0718	0.0973	0.0856	0.0551	0.0467	0.0601	0.0531
14	2A	0.0877	0.0520	0.0396	0.3078	0.0610	0.2019	0.0507	0.2185	0.0558
	2B	0.0974	0.0510	0.0359	0.3172	0.0651	0.1655	0.0506	0.2040	0.0576
	2C	0.0879	0.0572	0.0433	0.3018	0.0587	0.2242	0.0514	0.2332	0.0554
	2D	0.0723	0.0585	0.0462	0.2971	0.0540	0.2523	0.0504	0.2577	0.0525
15	2A	0.2175	0.2383	0.1147	0.1482	0.1590	0.0434	0.0333	0.0559	0.0583
	2B	0.2298	0.2602	0.1230	0.1750	0.1854	0.0247	0.0413	0.0562	0.0590
	2C	0.2171	0.2253	0.1012	0.1223	0.1309	0.0469	0.0402	0.0554	0.0576
	2D	0.1785	0.1804	0.0778	0.0879	0.0911	0.0489	0.0468	0.0528	0.0538
16	2A	0.2481	0.2750	0.0954	0.1614	0.1377	0.0618	0.0356	0.0757	0.0575
	2B	0.2550	0.2916	0.1002	0.1890	0.1598	0.0475	0.0337	0.0784	0.0572
	2C	0.2502	0.2640	0.0838	0.1306	0.1113	0.0594	0.0421	0.0692	0.0557
	2D	0.2101	0.2155	0.0685	0.0896	0.0809	0.0540	0.0473	0.0586	0.0533
17	2A	0.0802	0.0452	0.0393	0.3062	0.0607	0.2155	0.0507	0.2280	0.0557

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
	2B	0.0890	0.0440	0.0356	0.3151	0.0647	0.1761	0.0507	0.2151	0.0575
	2C	0.0804	0.0506	0.0432	0.3007	0.0585	0.2318	0.0514	0.2413	0.0554
	2D	0.0668	0.0533	0.0461	0.2965	0.0539	0.2574	0.0504	0.2628	0.0524
18	2A	0.2039	0.2214	0.1062	0.1359	0.1470	0.0456	0.0341	0.0562	0.0588
	2B	0.2163	0.2426	0.1140	0.1608	0.1722	0.0337	0.0368	0.0566	0.0596
	2C	0.2019	0.2076	0.0939	0.1124	0.1210	0.0475	0.0425	0.0553	0.0579
	2D	0.1625	0.1629	0.0734	0.0822	0.0855	0.0492	0.0474	0.0528	0.0540
19	2A	0.2199	0.2418	0.0776	0.1300	0.1138	0.0609	0.0418	0.0720	0.0584
	2B	0.2272	0.2568	0.0799	0.1536	0.1317	0.0609	0.0343	0.0758	0.0579
	2C	0.2195	0.2290	0.0701	0.1056	0.0937	0.0576	0.0453	0.0654	0.0563
	2D	0.1778	0.1804	0.0607	0.0747	0.0713	0.0518	0.0484	0.0554	0.0535
20	2A	0.0629	0.0319	0.0389	0.3007	0.0601	0.2331	0.0508	0.2455	0.0558
	2B	0.0689	0.0297	0.0352	0.3064	0.0639	0.2187	0.0510	0.2342	0.0578
	2C	0.0638	0.0373	0.0429	0.2969	0.0582	0.2464	0.0515	0.2557	0.0554
	2D	0.0551	0.0428	0.0460	0.2937	0.0537	0.2659	0.0504	0.2711	0.0524
21	2A	0.1774	0.1871	0.0863	0.1103	0.1220	0.0481	0.0405	0.0567	0.0599
	2B	0.1902	0.2070	0.0910	0.1296	0.1428	0.0454	0.0333	0.0571	0.0602
	2C	0.1743	0.1746	0.0776	0.0926	0.1013	0.0490	0.0457	0.0551	0.0583
	2D	0.1357	0.1333	0.0642	0.0713	0.0748	0.0498	0.0484	0.0526	0.0543
22	2A	0.2100	0.2296	0.0745	0.1222	0.1088	0.0600	0.0429	0.0707	0.0588
	2B	0.2176	0.2441	0.0763	0.1446	0.1255	0.0602	0.0352	0.0747	0.0583
	2C	0.2085	0.2163	0.0677	0.0995	0.0901	0.0567	0.0458	0.0642	0.0565
	2D	0.1668	0.1683	0.0593	0.0715	0.0695	0.0511	0.0486	0.0546	0.0536
23	2A	0.0601	0.0302	0.0389	0.3001	0.0600	0.2379	0.0508	0.2503	0.0558
	2B	0.0656	0.0279	0.0351	0.3056	0.0638	0.2248	0.0510	0.2402	0.0577
	2C	0.0612	0.0355	0.0428	0.2965	0.0581	0.2502	0.0515	0.2596	0.0554
	2D	0.0533	0.0413	0.0459	0.2935	0.0537	0.2681	0.0504	0.2734	0.0524
24	2A	0.1682	0.1749	0.0820	0.1044	0.1162	0.0485	0.0418	0.0568	0.0602
	2B	0.1811	0.1941	0.0861	0.1222	0.1358	0.0458	0.0339	0.0573	0.0606
	2C	0.1645	0.1628	0.0742	0.0882	0.0969	0.0492	0.0463	0.0551	0.0585
	2D	0.1271	0.1236	0.0624	0.0691	0.0725	0.0498	0.0487	0.0526	0.0544
25	2A	0.1948	0.2102	0.0700	0.1116	0.1020	0.0586	0.0442	0.0689	0.0592
	2B	0.2031	0.2240	0.0711	0.1320	0.1171	0.0593	0.0366	0.0732	0.0588

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
	2C	0.1919	0.1966	0.0643	0.0914	0.0852	0.0553	0.0465	0.0624	0.0568
	2D	0.1509	0.1504	0.0574	0.0672	0.0670	0.0501	0.0489	0.0535	0.0537
26	2A	0.0564	0.0281	0.0387	0.2993	0.0598	0.2443	0.0508	0.2569	0.0557
	2B	0.0612	0.0257	0.0349	0.3045	0.0636	0.2324	0.0511	0.2483	0.0577
	2C	0.0578	0.0333	0.0427	0.2960	0.0580	0.2553	0.0515	0.2648	0.0553
	2D	0.0510	0.0394	0.0459	0.2931	0.0536	0.2710	0.0504	0.2763	0.0524
27	2A	0.1546	0.1566	0.0760	0.0965	0.1083	0.0489	0.0433	0.0569	0.0607
	2B	0.1675	0.1744	0.0791	0.1121	0.1261	0.0466	0.0352	0.0576	0.0613
	2C	0.1503	0.1454	0.0696	0.0823	0.0910	0.0494	0.0469	0.0550	0.0588
	2D	0.1151	0.1102	0.0599	0.0661	0.0696	0.0499	0.0489	0.0526	0.0545

Table B-9 Coverage Probabilities for the 90 Percent Lower Prediction Bounds (Part 2)

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
1	2A	0.3685	0.3883	0.2319	0.3302	0.3009	0.1050	0.0830	0.1411	0.1054
	2B	0.3720	0.4037	0.2387	0.3460	0.3196	0.1409	0.1113	0.1421	0.1071
	2C	0.3820	0.3922	0.2095	0.2971	0.2615	0.0934	0.0703	0.1353	0.1029
	2D	0.3640	0.3699	0.1793	0.2423	0.2096	0.1127	0.0889	0.1258	0.1029
2	2A	0.2450	0.2800	0.0937	0.3725	0.1158	0.1894	0.1004	0.2103	0.1073
	2B	0.2584	0.3003	0.0904	0.3883	0.1213	0.2115	0.0995	0.1970	0.1087
	2C	0.2496	0.2697	0.0970	0.3613	0.1126	0.1984	0.1017	0.2275	0.1072
	2D	0.2259	0.2360	0.0981	0.3525	0.1059	0.2584	0.1005	0.2649	0.1035
3	2A	0.3402	0.3642	0.2540	0.3082	0.3128	0.0714	0.0913	0.1035	0.1067
	2B	0.3524	0.3872	0.2603	0.3305	0.3312	0.1051	0.1194	0.1046	0.1064
	2C	0.3448	0.3587	0.2335	0.2723	0.2777	0.0679	0.0731	0.1049	0.1065
	2D	0.3295	0.3371	0.1957	0.2197	0.2219	0.0920	0.0895	0.1031	0.1038
4	2A	0.3648	0.3858	0.2298	0.3226	0.2932	0.0956	0.0786	0.1409	0.1062
	2B	0.3648	0.3959	0.2330	0.3408	0.3084	0.1268	0.1003	0.1396	0.1059
	2C	0.3772	0.3881	0.2065	0.2890	0.2538	0.1019	0.0722	0.1348	0.1034
	2D	0.3578	0.3641	0.1756	0.2337	0.2025	0.1126	0.0899	0.1251	0.1033
5	2A	0.2356	0.2676	0.0932	0.3707	0.1150	0.1867	0.1004	0.2184	0.1073
	2B	0.2490	0.2858	0.0898	0.3864	0.1203	0.2080	0.0997	0.2057	0.1087
	2C	0.2397	0.2579	0.0966	0.3599	0.1120	0.2183	0.1017	0.2352	0.1071
	2D	0.2159	0.2249	0.0979	0.3515	0.1056	0.2645	0.1005	0.2709	0.1034
6	2A	0.3352	0.3599	0.2504	0.2996	0.3046	0.0634	0.0847	0.1042	0.1074
	2B	0.3479	0.3843	0.2587	0.3225	0.3255	0.0935	0.1117	0.1047	0.1077
	2C	0.3391	0.3536	0.2292	0.2639	0.2696	0.0778	0.0739	0.1052	0.1070
	2D	0.3217	0.3294	0.1907	0.2118	0.2141	0.0929	0.0906	0.1035	0.1042
7	2A	0.3584	0.3811	0.2256	0.3107	0.2813	0.0891	0.0744	0.1404	0.1072
	2B	0.3629	0.3958	0.2305	0.3308	0.2974	0.1096	0.0892	0.1394	0.1053
	2C	0.3689	0.3809	0.2013	0.2763	0.2421	0.1114	0.0768	0.1339	0.1040
	2D	0.3476	0.3543	0.1697	0.2210	0.1922	0.1123	0.0913	0.1238	0.1038
8	2A	0.2209	0.2469	0.0924	0.3679	0.1139	0.1895	0.1005	0.2300	0.1072
	2B	0.2342	0.2621	0.0889	0.3834	0.1188	0.2027	0.1000	0.2181	0.1088
	2C	0.2242	0.2387	0.0961	0.3578	0.1112	0.2354	0.1018	0.2458	0.1070
	2D	0.2007	0.2076	0.0976	0.3501	0.1052	0.2729	0.1005	0.2791	0.1034

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
9	2A	0.3266	0.3525	0.2438	0.2863	0.2918	0.0595	0.0783	0.1051	0.1084
	2B	0.3402	0.3774	0.2537	0.3108	0.3142	0.0782	0.0987	0.1055	0.1085
	2C	0.3296	0.3448	0.2219	0.2512	0.2572	0.0873	0.0774	0.1056	0.1075
	2D	0.3091	0.3167	0.1829	0.2003	0.2027	0.0943	0.0920	0.1038	0.1047
10	2A	0.3211	0.3465	0.1770	0.2486	0.2186	0.1186	0.0873	0.1363	0.1090
	2B	0.3340	0.3715	0.1847	0.2739	0.2390	0.1152	0.0777	0.1386	0.1085
	2C	0.3278	0.3427	0.1584	0.2155	0.1872	0.1152	0.0909	0.1283	0.1062
	2D	0.2976	0.3048	0.1348	0.1667	0.1492	0.1088	0.0964	0.1155	0.1041
11	2A	0.1493	0.1362	0.0892	0.3496	0.1101	0.2550	0.1009	0.2674	0.1075
	2B	0.1595	0.1398	0.0847	0.3586	0.1135	0.2395	0.1008	0.2549	0.1094
	2C	0.1523	0.1401	0.0937	0.3439	0.1085	0.2713	0.1019	0.2805	0.1071
	2D	0.1362	0.1321	0.0964	0.3402	0.1038	0.2985	0.1005	0.3036	0.1033
12	2A	0.2825	0.3092	0.1924	0.2221	0.2294	0.0931	0.0856	0.1078	0.1104
	2B	0.2984	0.3358	0.2038	0.2472	0.2530	0.0887	0.0762	0.1080	0.1110
	2C	0.2839	0.2982	0.1741	0.1933	0.2002	0.0957	0.0925	0.1064	0.1092
	2D	0.2533	0.2594	0.1435	0.1541	0.1566	0.0985	0.0967	0.1039	0.1052
13	2A	0.3142	0.3403	0.1725	0.2394	0.2111	0.1181	0.0886	0.1352	0.1095
	2B	0.3269	0.3648	0.1802	0.2649	0.2312	0.1152	0.0790	0.1379	0.1088
	2C	0.3195	0.3348	0.1543	0.2070	0.1809	0.1144	0.0917	0.1270	0.1065
	2D	0.2880	0.2952	0.1318	0.1603	0.1450	0.1079	0.0968	0.1142	0.1042
14	2A	0.1419	0.1259	0.0889	0.3487	0.1097	0.2612	0.1009	0.2735	0.1075
	2B	0.1517	0.1283	0.0844	0.3574	0.1131	0.2463	0.1009	0.2620	0.1094
	2C	0.1450	0.1307	0.0935	0.3433	0.1083	0.2765	0.1019	0.2856	0.1071
	2D	0.1303	0.1254	0.0963	0.3398	0.1037	0.3018	0.1005	0.3069	0.1033
15	2A	0.2743	0.3007	0.1863	0.2137	0.2212	0.0939	0.0872	0.1081	0.1108
	2B	0.2904	0.3274	0.1979	0.2383	0.2447	0.0896	0.0773	0.1084	0.1114
	2C	0.2751	0.2889	0.1686	0.1860	0.1929	0.0962	0.0933	0.1065	0.1096
	2D	0.2431	0.2487	0.1396	0.1491	0.1517	0.0988	0.0971	0.1039	0.1054
16	2A	0.3027	0.3297	0.1654	0.2259	0.2002	0.1173	0.0906	0.1335	0.1101
	2B	0.3152	0.3534	0.1729	0.2513	0.2197	0.1150	0.0812	0.1367	0.1093
	2C	0.3062	0.3217	0.1482	0.1947	0.1719	0.1131	0.0928	0.1250	0.1070
	2D	0.2727	0.2798	0.1276	0.1515	0.1393	0.1064	0.0974	0.1124	0.1044
17	2A	0.1314	0.1119	0.0886	0.3473	0.1093	0.2696	0.1009	0.2819	0.1074

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
	2B	0.1405	0.1128	0.0840	0.3555	0.1126	0.2560	0.1010	0.2718	0.1093
	2C	0.1346	0.1179	0.0933	0.3423	0.1080	0.2836	0.1020	0.2926	0.1070
	2D	0.1220	0.1161	0.0961	0.3392	0.1035	0.3062	0.1005	0.3112	0.1033
18	2A	0.2614	0.2868	0.1772	0.2014	0.2092	0.0952	0.0893	0.1085	0.1114
	2B	0.2778	0.3135	0.1886	0.2251	0.2322	0.0911	0.0796	0.1089	0.1120
	2C	0.2613	0.2739	0.1604	0.1756	0.1827	0.0969	0.0943	0.1066	0.1100
	2D	0.2275	0.2325	0.1341	0.1424	0.1450	0.0992	0.0977	0.1040	0.1056
19	2A	0.2773	0.3040	0.1436	0.1949	0.1744	0.1158	0.0944	0.1290	0.1109
	2B	0.2896	0.3265	0.1489	0.2180	0.1914	0.1155	0.0867	0.1336	0.1101
	2C	0.2795	0.2936	0.1314	0.1686	0.1523	0.1109	0.0957	0.1206	0.1080
	2D	0.2429	0.2491	0.1171	0.1336	0.1272	0.1033	0.0985	0.1082	0.1046
20	2A	0.1068	0.0823	0.0879	0.3424	0.1086	0.2851	0.1010	0.2968	0.1075
	2B	0.1134	0.0798	0.0832	0.3475	0.1116	0.2726	0.1012	0.2880	0.1095
	2C	0.1113	0.0910	0.0928	0.3389	0.1075	0.2964	0.1020	0.3051	0.1071
	2D	0.1043	0.0969	0.0959	0.3366	0.1033	0.3134	0.1005	0.3182	0.1033
21	2A	0.2359	0.2575	0.1537	0.1745	0.1828	0.0984	0.0934	0.1090	0.1126
	2B	0.2520	0.2835	0.1624	0.1942	0.2030	0.0949	0.0851	0.1094	0.1130
	2C	0.2352	0.2446	0.1411	0.1540	0.1611	0.0988	0.0967	0.1065	0.1107
	2D	0.2002	0.2035	0.1220	0.1289	0.1317	0.0999	0.0988	0.1037	0.1058
22	2A	0.2682	0.2945	0.1395	0.1869	0.1688	0.1146	0.0951	0.1276	0.1114
	2B	0.2803	0.3166	0.1443	0.2093	0.1849	0.1147	0.0877	0.1324	0.1106
	2C	0.2694	0.2830	0.1282	0.1620	0.1480	0.1096	0.0962	0.1192	0.1083
	2D	0.2324	0.2381	0.1152	0.1295	0.1248	0.1024	0.0987	0.1071	0.1047
23	2A	0.1024	0.0778	0.0878	0.3418	0.1084	0.2893	0.1010	0.3010	0.1075
	2B	0.1084	0.0749	0.0830	0.3468	0.1114	0.2779	0.1012	0.2932	0.1095
	2C	0.1072	0.0868	0.0927	0.3386	0.1074	0.2998	0.1020	0.3084	0.1071
	2D	0.1013	0.0937	0.0958	0.3364	0.1032	0.3154	0.1005	0.3201	0.1032
24	2A	0.2269	0.2466	0.1485	0.1680	0.1765	0.0988	0.0942	0.1092	0.1130
	2B	0.2427	0.2722	0.1565	0.1866	0.1958	0.0955	0.0862	0.1096	0.1135
	2C	0.2256	0.2337	0.1369	0.1489	0.1561	0.0990	0.0972	0.1065	0.1110
	2D	0.1908	0.1934	0.1195	0.1260	0.1288	0.1000	0.0990	0.1036	0.1059
25	2A	0.2538	0.2790	0.1337	0.1756	0.1611	0.1128	0.0961	0.1254	0.1119
	2B	0.2656	0.3002	0.1375	0.1966	0.1757	0.1134	0.0891	0.1305	0.1111

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
	2C	0.2538	0.2661	0.1237	0.1528	0.1422	0.1078	0.0968	0.1171	0.1087
	2D	0.2165	0.2213	0.1126	0.1241	0.1216	0.1011	0.0990	0.1057	0.1048
26	2A	0.0966	0.0722	0.0876	0.3411	0.1082	0.2951	0.1010	0.3067	0.1074
	2B	0.1017	0.0687	0.0828	0.3458	0.1111	0.2850	0.1012	0.3002	0.1094
	2C	0.1017	0.0814	0.0925	0.3381	0.1072	0.3043	0.1020	0.3129	0.1070
	2D	0.0973	0.0897	0.0958	0.3361	0.1031	0.3179	0.1005	0.3226	0.1032
27	2A	0.2131	0.2299	0.1410	0.1591	0.1677	0.0993	0.0952	0.1092	0.1136
	2B	0.2285	0.2543	0.1479	0.1758	0.1855	0.0963	0.0878	0.1099	0.1142
	2C	0.2112	0.2172	0.1309	0.1420	0.1492	0.0992	0.0978	0.1064	0.1114
	2D	0.1775	0.1790	0.1162	0.1222	0.1250	0.1001	0.0993	0.1036	0.1060

Table B-10 Coverage Probabilities for the 90 Percent Upper Prediction Bounds (Part 2)

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
1	2A	0.6221	0.6076	0.7970	0.6687	0.7126	0.8394	0.8867	0.8510	0.8977
	2B	0.6322	0.6079	0.7725	0.6374	0.6624	0.8009	0.8417	0.8468	0.8851
	2C	0.6189	0.6131	0.7932	0.6931	0.7243	0.8732	0.8952	0.8648	0.8951
	2D	0.6562	0.6512	0.8239	0.7561	0.7846	0.8740	0.8972	0.8795	0.8998
2	2A	0.7346	0.7026	0.9062	0.6409	0.8837	0.8098	0.9008	0.8081	0.8955
	2B	0.7453	0.7131	0.9073	0.6367	0.8762	0.7952	0.8997	0.8254	0.8934
	2C	0.7432	0.7272	0.9020	0.6456	0.8861	0.8113	0.8984	0.7874	0.8943
	2D	0.7792	0.7723	0.9017	0.6613	0.8938	0.7567	0.8999	0.7558	0.8977
3	2A	0.6454	0.6279	0.7648	0.6986	0.6935	0.8810	0.8695	0.8914	0.8881
	2B	0.6625	0.6383	0.7540	0.6658	0.6638	0.8440	0.8305	0.8877	0.8836
	2C	0.6556	0.6473	0.7727	0.7186	0.7147	0.9041	0.8939	0.8955	0.8934
	2D	0.6848	0.6791	0.8105	0.7787	0.7767	0.8980	0.8999	0.9038	0.9030
4	2A	0.6229	0.6079	0.7972	0.6771	0.7207	0.8513	0.8918	0.8529	0.8983
	2B	0.6356	0.6118	0.7773	0.6448	0.6764	0.8151	0.8569	0.8498	0.8883
	2C	0.6213	0.6150	0.7947	0.7020	0.7327	0.8696	0.8954	0.8661	0.8954
	2D	0.6607	0.6555	0.8265	0.7649	0.7918	0.8758	0.8975	0.8808	0.9000
5	2A	0.7409	0.7098	0.9066	0.6420	0.8846	0.8121	0.9007	0.8000	0.8953
	2B	0.7499	0.7192	0.9079	0.6382	0.8774	0.7981	0.8996	0.8176	0.8932
	2C	0.7496	0.7340	0.9024	0.6465	0.8868	0.7932	0.8984	0.7795	0.8942
	2D	0.7856	0.7790	0.9019	0.6617	0.8941	0.7504	0.8999	0.7491	0.8977
6	2A	0.6480	0.6301	0.7665	0.7067	0.7017	0.8914	0.8777	0.8922	0.8889
	2B	0.6654	0.6420	0.7550	0.6753	0.6716	0.8568	0.8425	0.8886	0.8851
	2C	0.6595	0.6510	0.7753	0.7271	0.7231	0.8976	0.8960	0.8957	0.8936
	2D	0.6910	0.6853	0.8142	0.7865	0.7844	0.8984	0.9000	0.9037	0.9030
7	2A	0.6258	0.6099	0.7983	0.6897	0.7326	0.8641	0.8970	0.8554	0.8991
	2B	0.6366	0.6159	0.7712	0.6586	0.6825	0.8351	0.8645	0.8520	0.8874
	2C	0.6264	0.6193	0.7976	0.7154	0.7451	0.8630	0.8948	0.8678	0.8958
	2D	0.6686	0.6631	0.8306	0.7776	0.8020	0.8784	0.8982	0.8828	0.9001
8	2A	0.7523	0.7234	0.9073	0.6436	0.8858	0.8139	0.9006	0.7882	0.8951
	2B	0.7590	0.7317	0.9089	0.6404	0.8792	0.8026	0.8996	0.8062	0.8930
	2C	0.7609	0.7467	0.9030	0.6479	0.8877	0.7718	0.8983	0.7682	0.8941
	2D	0.7966	0.7906	0.9022	0.6624	0.8945	0.7415	0.8998	0.7398	0.8976

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
9	2A	0.6532	0.6346	0.7701	0.7190	0.7140	0.9024	0.8871	0.8932	0.8902
	2B	0.6676	0.6441	0.7566	0.6878	0.6835	0.8735	0.8570	0.8896	0.8862
	2C	0.6666	0.6577	0.7800	0.7398	0.7355	0.8899	0.8971	0.8961	0.8938
	2D	0.7014	0.6956	0.8202	0.7976	0.7954	0.8991	0.9005	0.9037	0.9029
10	2A	0.6598	0.6409	0.8334	0.7454	0.7870	0.8610	0.9030	0.8613	0.8992
	2B	0.6673	0.6437	0.8139	0.7186	0.7495	0.8580	0.8983	0.8571	0.8903
	2C	0.6649	0.6553	0.8358	0.7751	0.8007	0.8732	0.8973	0.8734	0.8953
	2D	0.7154	0.7090	0.8618	0.8287	0.8439	0.8889	0.9008	0.8891	0.8989
11	2A	0.8313	0.8284	0.9110	0.6565	0.8901	0.7543	0.9000	0.7470	0.8937
	2B	0.8294	0.8365	0.9141	0.6546	0.8853	0.7744	0.8989	0.7651	0.8910
	2C	0.8345	0.8364	0.9059	0.6581	0.8911	0.7347	0.8981	0.7287	0.8934
	2D	0.8570	0.8571	0.9036	0.6659	0.8962	0.7104	0.8997	0.7069	0.8972
12	2A	0.6925	0.6715	0.8102	0.7752	0.7696	0.8925	0.8997	0.8944	0.8916
	2B	0.6996	0.6738	0.7942	0.7457	0.7393	0.8892	0.8974	0.8905	0.8879
	2C	0.7085	0.6991	0.8219	0.7970	0.7915	0.8952	0.8978	0.8967	0.8939
	2D	0.7510	0.7457	0.8548	0.8417	0.8392	0.9015	0.9027	0.9023	0.9010
13	2A	0.6650	0.6456	0.8363	0.7545	0.7940	0.8634	0.9030	0.8633	0.8993
	2B	0.6717	0.6475	0.8168	0.7277	0.7577	0.8588	0.8990	0.8587	0.8907
	2C	0.6715	0.6617	0.8391	0.7836	0.8073	0.8750	0.8974	0.8748	0.8952
	2D	0.7231	0.7167	0.8644	0.8352	0.8484	0.8904	0.9009	0.8902	0.8988
14	2A	0.8374	0.8368	0.9112	0.6569	0.8904	0.7478	0.8999	0.7401	0.8937
	2B	0.8348	0.8443	0.9145	0.6553	0.8858	0.7667	0.8988	0.7576	0.8910
	2C	0.8403	0.8437	0.9061	0.6585	0.8913	0.7291	0.8981	0.7229	0.8934
	2D	0.8619	0.8625	0.9037	0.6660	0.8963	0.7066	0.8997	0.7031	0.8971
15	2A	0.6994	0.6784	0.8149	0.7831	0.7775	0.8934	0.8996	0.8948	0.8919
	2B	0.7049	0.6792	0.7986	0.7544	0.7476	0.8892	0.8990	0.8908	0.8882
	2C	0.7163	0.7069	0.8264	0.8043	0.7986	0.8956	0.8979	0.8967	0.8938
	2D	0.7597	0.7545	0.8582	0.8467	0.8441	0.9015	0.9026	0.9021	0.9007
16	2A	0.6740	0.6541	0.8412	0.7677	0.8041	0.8670	0.9032	0.8661	0.8994
	2B	0.6795	0.6544	0.8217	0.7413	0.7695	0.8621	0.8995	0.8610	0.8911
	2C	0.6826	0.6725	0.8441	0.7957	0.8166	0.8776	0.8977	0.8768	0.8949
	2D	0.7354	0.7290	0.8682	0.8440	0.8545	0.8924	0.9009	0.8919	0.8986
17	2A	0.8474	0.8503	0.9115	0.6576	0.8909	0.7387	0.8998	0.7305	0.8936

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
	2B	0.8439	0.8571	0.9150	0.6562	0.8865	0.7570	0.8988	0.7468	0.8910
	2C	0.8495	0.8552	0.9064	0.6590	0.8916	0.7214	0.8981	0.7149	0.8934
	2D	0.8692	0.8708	0.9038	0.6662	0.8964	0.7015	0.8997	0.6978	0.8971
18	2A	0.7107	0.6899	0.8222	0.7946	0.7889	0.8946	0.8999	0.8952	0.8922
	2B	0.7139	0.6887	0.8057	0.7670	0.7599	0.8907	0.9004	0.8912	0.8886
	2C	0.7287	0.7195	0.8332	0.8145	0.8087	0.8961	0.8982	0.8966	0.8935
	2D	0.7731	0.7682	0.8632	0.8536	0.8509	0.9016	0.9025	0.9018	0.9002
19	2A	0.6986	0.6786	0.8592	0.7955	0.8268	0.8739	0.9045	0.8698	0.8977
	2B	0.7021	0.6758	0.8430	0.7706	0.7969	0.8689	0.9014	0.8637	0.8902
	2C	0.7093	0.6990	0.8612	0.8217	0.8376	0.8834	0.8990	0.8803	0.8936
	2D	0.7626	0.7567	0.8792	0.8618	0.8676	0.8964	0.9010	0.8946	0.8976
20	2A	0.8774	0.8902	0.9123	0.6609	0.8917	0.7221	0.8996	0.7124	0.8931
	2B	0.8732	0.8971	0.9161	0.6593	0.8877	0.7377	0.8986	0.7254	0.8903
	2C	0.8764	0.8887	0.9070	0.6616	0.8923	0.7074	0.8980	0.7001	0.8932
	2D	0.8886	0.8926	0.9041	0.6666	0.8967	0.6917	0.8997	0.6876	0.8970
21	2A	0.7365	0.7168	0.8431	0.8195	0.8134	0.8970	0.9018	0.8949	0.8916
	2B	0.7361	0.7128	0.8283	0.7951	0.7868	0.8940	0.9026	0.8908	0.8879
	2C	0.7546	0.7461	0.8523	0.8371	0.8308	0.8979	0.8997	0.8963	0.8926
	2D	0.7979	0.7939	0.8753	0.8675	0.8647	0.9017	0.9024	0.9007	0.8988
22	2A	0.7062	0.6863	0.8624	0.8036	0.8322	0.8761	0.9045	0.8717	0.8975
	2B	0.7086	0.6824	0.8468	0.7793	0.8036	0.8710	0.9013	0.8653	0.8902
	2C	0.7181	0.7079	0.8642	0.8285	0.8423	0.8850	0.8989	0.8816	0.8934
	2D	0.7712	0.7655	0.8811	0.8662	0.8703	0.8975	0.9009	0.8956	0.8973
23	2A	0.8820	0.8960	0.9124	0.6611	0.8919	0.7173	0.8996	0.7074	0.8931
	2B	0.8777	0.9027	0.9163	0.6596	0.8880	0.7320	0.8986	0.7194	0.8904
	2C	0.8805	0.8937	0.9071	0.6618	0.8924	0.7037	0.8980	0.6962	0.8932
	2D	0.8917	0.8960	0.9042	0.6667	0.8968	0.6894	0.8996	0.6853	0.8970
24	2A	0.7453	0.7263	0.8478	0.8259	0.8197	0.8974	0.9020	0.8951	0.8915
	2B	0.7436	0.7213	0.8335	0.8027	0.7941	0.8945	0.9027	0.8909	0.8878
	2C	0.7635	0.7557	0.8562	0.8424	0.8360	0.8981	0.8997	0.8962	0.8923
	2D	0.8063	0.8026	0.8777	0.8707	0.8678	0.9016	0.9022	0.9005	0.8984
25	2A	0.7186	0.6990	0.8672	0.8150	0.8396	0.8793	0.9045	0.8743	0.8970
	2B	0.7193	0.6937	0.8526	0.7918	0.8131	0.8741	0.9013	0.8676	0.8899

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
	2C	0.7321	0.7223	0.8686	0.8378	0.8486	0.8874	0.8989	0.8836	0.8929
	2D	0.7844	0.7791	0.8838	0.8720	0.8740	0.8990	0.9008	0.8968	0.8970
26	2A	0.8888	0.9042	0.9126	0.6614	0.8921	0.7108	0.8996	0.7006	0.8931
	2B	0.8844	0.9108	0.9166	0.6600	0.8883	0.7242	0.8985	0.7112	0.8904
	2C	0.8866	0.9008	0.9072	0.6620	0.8926	0.6986	0.8980	0.6910	0.8932
	2D	0.8961	0.9009	0.9042	0.6667	0.8969	0.6864	0.8996	0.6822	0.8970
27	2A	0.7590	0.7414	0.8547	0.8348	0.8285	0.8981	0.9023	0.8952	0.8913
	2B	0.7555	0.7351	0.8412	0.8133	0.8044	0.8953	0.9026	0.8910	0.8874
	2C	0.7772	0.7703	0.8619	0.8496	0.8432	0.8983	0.8997	0.8960	0.8918
	2D	0.8184	0.8154	0.8811	0.8749	0.8720	0.9015	0.9020	0.9001	0.8979

Table B-11 Coverage Probabilities for the 95 Percent Upper Prediction Bounds (Part 2)

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
1	2A	0.6649	0.6476	0.8632	0.7070	0.7572	0.8395	0.8952	0.9080	0.9459
	2B	0.6892	0.6591	0.8502	0.6722	0.7031	0.8009	0.8447	0.9076	0.9383
	2C	0.6571	0.6502	0.8599	0.7388	0.7748	0.8865	0.9220	0.9213	0.9470
	2D	0.6969	0.6908	0.8842	0.8086	0.8393	0.9432	0.9548	0.9337	0.9496
2	2A	0.8001	0.7844	0.9569	0.6757	0.9333	0.8098	0.9512	0.8703	0.9464
	2B	0.8046	0.8004	0.9582	0.6689	0.9252	0.7952	0.9503	0.8869	0.9440
	2C	0.8057	0.7990	0.9533	0.6824	0.9364	0.8223	0.9491	0.8494	0.9457
	2D	0.8397	0.8369	0.9519	0.7008	0.9436	0.8360	0.9499	0.8140	0.9481
3	2A	0.6919	0.6715	0.8295	0.7412	0.7355	0.8810	0.8733	0.9423	0.9396
	2B	0.7130	0.6870	0.8237	0.7053	0.7019	0.8440	0.8318	0.9397	0.9362
	2C	0.6993	0.6908	0.8365	0.7677	0.7627	0.9164	0.9080	0.9465	0.9445
	2D	0.7299	0.7242	0.8705	0.8333	0.8307	0.9613	0.9574	0.9527	0.9519
4	2A	0.6640	0.6464	0.8628	0.7168	0.7663	0.8520	0.9040	0.9095	0.9463
	2B	0.6876	0.6597	0.8526	0.6809	0.7194	0.8151	0.8611	0.9087	0.9394
	2C	0.6595	0.6521	0.8608	0.7490	0.7841	0.8973	0.9294	0.9224	0.9470
	2D	0.7019	0.6957	0.8865	0.8182	0.8468	0.9395	0.9535	0.9347	0.9496
5	2A	0.8055	0.7919	0.9572	0.6771	0.9340	0.8121	0.9511	0.8621	0.9463
	2B	0.8084	0.8061	0.9586	0.6708	0.9263	0.7981	0.9502	0.8794	0.9439
	2C	0.8116	0.8064	0.9535	0.6836	0.9369	0.8243	0.9491	0.8412	0.9456
	2D	0.8459	0.8438	0.9521	0.7015	0.9439	0.8175	0.9499	0.8066	0.9481
6	2A	0.6938	0.6735	0.8308	0.7507	0.7450	0.8916	0.8836	0.9428	0.9401
	2B	0.7141	0.6889	0.8245	0.7163	0.7112	0.8568	0.8446	0.9399	0.9369
	2C	0.7034	0.6948	0.8388	0.7774	0.7722	0.9252	0.9167	0.9466	0.9445
	2D	0.7370	0.7314	0.8740	0.8415	0.8388	0.9565	0.9580	0.9527	0.9519
7	2A	0.6654	0.6475	0.8631	0.7314	0.7795	0.8699	0.9162	0.9117	0.9469
	2B	0.6866	0.6598	0.8469	0.6971	0.7274	0.8351	0.8720	0.9100	0.9403
	2C	0.6650	0.6567	0.8629	0.7642	0.7977	0.9124	0.9386	0.9239	0.9471
	2D	0.7108	0.7043	0.8902	0.8318	0.8574	0.9339	0.9511	0.9361	0.9496
8	2A	0.8159	0.8064	0.9577	0.6793	0.9350	0.8157	0.9510	0.8501	0.9462
	2B	0.8165	0.8184	0.9592	0.6736	0.9278	0.8026	0.9501	0.8680	0.9438
	2C	0.8224	0.8201	0.9539	0.6855	0.9377	0.8272	0.9490	0.8291	0.9456
	2D	0.8565	0.8556	0.9523	0.7024	0.9443	0.7983	0.9498	0.7962	0.9480

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
9	2A	0.6988	0.6783	0.8338	0.7648	0.7590	0.9067	0.8983	0.9435	0.9409
	2B	0.7148	0.6898	0.8251	0.7308	0.7250	0.8735	0.8609	0.9407	0.9377
	2C	0.7111	0.7023	0.8431	0.7916	0.7861	0.9372	0.9285	0.9468	0.9447
	2D	0.7487	0.7432	0.8796	0.8532	0.8503	0.9501	0.9559	0.9527	0.9518
10	2A	0.7051	0.6857	0.8961	0.7955	0.8390	0.9325	0.9536	0.9174	0.9473
	2B	0.7156	0.6888	0.8838	0.7658	0.8008	0.9106	0.9336	0.9139	0.9420
	2C	0.7108	0.7007	0.8984	0.8299	0.8565	0.9284	0.9524	0.9284	0.9464
	2D	0.7646	0.7585	0.9186	0.8845	0.8991	0.9404	0.9507	0.9408	0.9490
11	2A	0.8891	0.9098	0.9603	0.6960	0.9387	0.8366	0.9502	0.8061	0.9452
	2B	0.8832	0.9163	0.9629	0.6925	0.9332	0.8335	0.9492	0.8256	0.9425
	2C	0.8913	0.9098	0.9561	0.6986	0.9405	0.7908	0.9488	0.7856	0.9450
	2D	0.9120	0.9192	0.9535	0.7078	0.9457	0.7621	0.9498	0.7589	0.9477
12	2A	0.7430	0.7228	0.8738	0.8278	0.8211	0.9572	0.9470	0.9444	0.9420
	2B	0.7484	0.7254	0.8624	0.7969	0.7882	0.9390	0.9230	0.9417	0.9388
	2C	0.7589	0.7509	0.8842	0.8532	0.8463	0.9463	0.9541	0.9471	0.9449
	2D	0.8039	0.8001	0.9120	0.8975	0.8943	0.9506	0.9520	0.9515	0.9503
13	2A	0.7107	0.6912	0.8986	0.8055	0.8464	0.9307	0.9550	0.9190	0.9474
	2B	0.7195	0.6929	0.8860	0.7762	0.8095	0.9203	0.9389	0.9152	0.9420
	2C	0.7182	0.7081	0.9012	0.8388	0.8632	0.9285	0.9515	0.9296	0.9463
	2D	0.7731	0.7671	0.9209	0.8908	0.9033	0.9416	0.9507	0.9418	0.9488
14	2A	0.8939	0.9158	0.9604	0.6966	0.9389	0.8200	0.9501	0.7984	0.9452
	2B	0.8874	0.9215	0.9631	0.6934	0.9336	0.8350	0.9492	0.8174	0.9425
	2C	0.8960	0.9154	0.9563	0.6991	0.9407	0.7835	0.9487	0.7789	0.9450
	2D	0.9159	0.9235	0.9536	0.7080	0.9458	0.7577	0.9497	0.7543	0.9477
15	2A	0.7503	0.7307	0.8781	0.8364	0.8295	0.9539	0.9505	0.9447	0.9423
	2B	0.7538	0.7316	0.8663	0.8064	0.7974	0.9464	0.9298	0.9420	0.9390
	2C	0.7674	0.7597	0.8883	0.8606	0.8537	0.9456	0.9534	0.9471	0.9448
	2D	0.8132	0.8098	0.9151	0.9023	0.8990	0.9507	0.9520	0.9513	0.9501
16	2A	0.7206	0.7012	0.9027	0.8200	0.8568	0.9243	0.9559	0.9213	0.9476
	2B	0.7268	0.7007	0.8898	0.7914	0.8220	0.9326	0.9452	0.9171	0.9422
	2C	0.7307	0.7209	0.9055	0.8515	0.8724	0.9305	0.9504	0.9312	0.9461
	2D	0.7866	0.7811	0.9242	0.8993	0.9089	0.9433	0.9508	0.9430	0.9486
17	2A	0.9016	0.9250	0.9606	0.6975	0.9393	0.7977	0.9500	0.7875	0.9451

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
	2B	0.8945	0.9298	0.9634	0.6947	0.9342	0.8365	0.9491	0.8055	0.9425
	2C	0.9033	0.9239	0.9565	0.6999	0.9410	0.7749	0.9487	0.7696	0.9450
	2D	0.9217	0.9299	0.9537	0.7083	0.9459	0.7518	0.9497	0.7481	0.9477
18	2A	0.7625	0.7441	0.8850	0.8487	0.8416	0.9465	0.9538	0.9451	0.9426
	2B	0.7632	0.7426	0.8728	0.8202	0.8107	0.9555	0.9386	0.9424	0.9393
	2C	0.7809	0.7741	0.8946	0.8711	0.8640	0.9460	0.9518	0.9471	0.9445
	2D	0.8273	0.8246	0.9195	0.9088	0.9054	0.9508	0.9520	0.9511	0.9497
19	2A	0.7489	0.7312	0.9189	0.8501	0.8799	0.9269	0.9554	0.9248	0.9467
	2B	0.7519	0.7276	0.9085	0.8239	0.8503	0.9253	0.9542	0.9195	0.9417
	2C	0.7612	0.7525	0.9205	0.8779	0.8928	0.9360	0.9503	0.9340	0.9450
	2D	0.8164	0.8123	0.9337	0.9160	0.9210	0.9466	0.9510	0.9452	0.9479
20	2A	0.9251	0.9513	0.9612	0.7019	0.9400	0.7759	0.9498	0.7668	0.9448
	2B	0.9184	0.9550	0.9642	0.6993	0.9352	0.7954	0.9488	0.7818	0.9421
	2C	0.9249	0.9477	0.9569	0.7032	0.9416	0.7596	0.9486	0.7522	0.9449
	2D	0.9369	0.9464	0.9539	0.7091	0.9462	0.7405	0.9497	0.7361	0.9476
21	2A	0.7905	0.7755	0.9046	0.8747	0.8669	0.9460	0.9550	0.9451	0.9424
	2B	0.7871	0.7710	0.8940	0.8504	0.8393	0.9457	0.9524	0.9422	0.9391
	2C	0.8086	0.8042	0.9120	0.8934	0.8859	0.9480	0.9509	0.9470	0.9439
	2D	0.8530	0.8520	0.9301	0.9216	0.9182	0.9510	0.9520	0.9503	0.9486
22	2A	0.7571	0.7401	0.9215	0.8584	0.8851	0.9291	0.9549	0.9264	0.9466
	2B	0.7587	0.7354	0.9115	0.8333	0.8571	0.9251	0.9552	0.9208	0.9415
	2C	0.7706	0.7627	0.9229	0.8845	0.8972	0.9374	0.9502	0.9351	0.9448
	2D	0.8254	0.8219	0.9352	0.9199	0.9234	0.9474	0.9509	0.9460	0.9478
23	2A	0.9283	0.9544	0.9613	0.7022	0.9401	0.7707	0.9498	0.7610	0.9448
	2B	0.9216	0.9579	0.9643	0.6997	0.9355	0.7871	0.9488	0.7750	0.9421
	2C	0.9279	0.9506	0.9570	0.7035	0.9417	0.7552	0.9486	0.7476	0.9449
	2D	0.9391	0.9487	0.9539	0.7092	0.9462	0.7378	0.9497	0.7333	0.9476
24	2A	0.7996	0.7862	0.9088	0.8811	0.8733	0.9467	0.9544	0.9453	0.9424
	2B	0.7948	0.7807	0.8985	0.8582	0.8468	0.9446	0.9544	0.9423	0.9390
	2C	0.8178	0.8146	0.9155	0.8984	0.8909	0.9482	0.9508	0.9469	0.9437
	2D	0.8613	0.8609	0.9322	0.9245	0.9210	0.9510	0.9518	0.9502	0.9484
25	2A	0.7705	0.7550	0.9255	0.8701	0.8923	0.9319	0.9544	0.9286	0.9463
	2B	0.7700	0.7487	0.9161	0.8465	0.8665	0.9271	0.9554	0.9228	0.9412

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
	2C	0.7856	0.7790	0.9265	0.8937	0.9031	0.9394	0.9501	0.9366	0.9445
	2D	0.8391	0.8364	0.9375	0.9252	0.9267	0.9486	0.9508	0.9470	0.9476
26	2A	0.9329	0.9587	0.9614	0.7026	0.9403	0.7633	0.9497	0.7531	0.9448
	2B	0.9264	0.9620	0.9645	0.7003	0.9358	0.7778	0.9488	0.7654	0.9422
	2C	0.9322	0.9547	0.9571	0.7039	0.9418	0.7494	0.9486	0.7413	0.9449
	2D	0.9422	0.9519	0.9540	0.7093	0.9463	0.7342	0.9497	0.7296	0.9476
27	2A	0.8136	0.8029	0.9148	0.8900	0.8820	0.9473	0.9537	0.9454	0.9423
	2B	0.8070	0.7962	0.9052	0.8691	0.8573	0.9450	0.9560	0.9424	0.9387
	2C	0.8316	0.8304	0.9205	0.9053	0.8978	0.9485	0.9506	0.9468	0.9433
	2D	0.8733	0.8738	0.9351	0.9282	0.9247	0.9510	0.9516	0.9500	0.9480

Table B-12 Coverage Probabilities for the 99 Percent Upper Prediction Bounds (Part 2)

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
1	2A	0.7690	0.7546	0.9552	0.7696	0.8263	0.8395	0.8953	0.9725	0.9870
	2B	0.8255	0.8156	0.9599	0.7313	0.7704	0.8009	0.8447	0.9707	0.9847
	2C	0.7424	0.7324	0.9501	0.8115	0.8512	0.8865	0.9224	0.9773	0.9891
	2D	0.7713	0.7649	0.9577	0.8846	0.9131	0.9494	0.9681	0.9836	0.9901
2	2A	0.9002	0.9308	0.9943	0.7363	0.9789	0.8098	0.9924	0.9487	0.9884
	2B	0.9019	0.9461	0.9950	0.7254	0.9726	0.7952	0.9928	0.9594	0.9869
	2C	0.8989	0.9242	0.9927	0.7461	0.9816	0.8223	0.9902	0.9327	0.9882
	2D	0.9235	0.9338	0.9914	0.7684	0.9861	0.8469	0.9899	0.9003	0.9892
3	2A	0.7902	0.7715	0.9308	0.8093	0.8027	0.8810	0.8733	0.9878	0.9865
	2B	0.8263	0.8139	0.9403	0.7707	0.7637	0.8440	0.8318	0.9866	0.9859
	2C	0.7846	0.7777	0.9299	0.8434	0.8365	0.9164	0.9081	0.9887	0.9878
	2D	0.8092	0.8054	0.9475	0.9083	0.9050	0.9659	0.9627	0.9913	0.9908
4	2A	0.7611	0.7453	0.9541	0.7811	0.8360	0.8520	0.9041	0.9731	0.9872
	2B	0.8159	0.8062	0.9589	0.7425	0.7884	0.8151	0.8612	0.9717	0.9854
	2C	0.7421	0.7322	0.9499	0.8229	0.8607	0.8973	0.9301	0.9778	0.9890
	2D	0.7762	0.7699	0.9588	0.8939	0.9197	0.9561	0.9720	0.9841	0.9900
5	2A	0.9028	0.9344	0.9943	0.7382	0.9793	0.8121	0.9922	0.9428	0.9884
	2B	0.9027	0.9476	0.9950	0.7279	0.9732	0.7981	0.9929	0.9544	0.9869
	2C	0.9027	0.9288	0.9927	0.7478	0.9819	0.8243	0.9902	0.9260	0.9882
	2D	0.9277	0.9386	0.9915	0.7693	0.9862	0.8479	0.9899	0.8932	0.9892
6	2A	0.7893	0.7708	0.9307	0.8200	0.8133	0.8916	0.8836	0.9879	0.9865
	2B	0.8209	0.8071	0.9386	0.7835	0.7752	0.8568	0.8446	0.9867	0.9847
	2C	0.7878	0.7810	0.9310	0.8536	0.8466	0.9252	0.9169	0.9887	0.9878
	2D	0.8164	0.8129	0.9497	0.9158	0.9124	0.9705	0.9674	0.9913	0.9908
7	2A	0.7548	0.7378	0.9530	0.7982	0.8499	0.8699	0.9164	0.9739	0.9874
	2B	0.8033	0.7856	0.9564	0.7616	0.7987	0.8351	0.8723	0.9721	0.9864
	2C	0.7451	0.7354	0.9501	0.8394	0.8742	0.9124	0.9404	0.9785	0.9890
	2D	0.7854	0.7792	0.9608	0.9068	0.9286	0.9647	0.9770	0.9846	0.9899
8	2A	0.9089	0.9419	0.9944	0.7412	0.9799	0.8157	0.9919	0.9335	0.9883
	2B	0.9064	0.9520	0.9951	0.7316	0.9741	0.8026	0.9929	0.9464	0.9869
	2C	0.9100	0.9374	0.9928	0.7502	0.9823	0.8272	0.9901	0.9159	0.9881
	2D	0.9348	0.9464	0.9915	0.7706	0.9864	0.8495	0.9899	0.8830	0.9892

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
9	2A	0.7910	0.7731	0.9316	0.8358	0.8288	0.9067	0.8983	0.9881	0.9866
	2B	0.8160	0.7999	0.9368	0.8001	0.7910	0.8735	0.8609	0.9867	0.9847
	2C	0.7948	0.7882	0.9334	0.8683	0.8610	0.9372	0.9290	0.9888	0.9878
	2D	0.8284	0.8255	0.9533	0.9259	0.9225	0.9764	0.9735	0.9912	0.9907
10	2A	0.7951	0.7811	0.9708	0.8693	0.9087	0.9365	0.9618	0.9761	0.9878
	2B	0.8170	0.7993	0.9712	0.8387	0.8737	0.9106	0.9360	0.9736	0.9863
	2C	0.7969	0.7900	0.9700	0.9051	0.9275	0.9632	0.9753	0.9806	0.9885
	2D	0.8444	0.8415	0.9769	0.9506	0.9603	0.9881	0.9915	0.9862	0.9895
11	2A	0.9559	0.9856	0.9950	0.7634	0.9817	0.8418	0.9906	0.8954	0.9878
	2B	0.9499	0.9874	0.9959	0.7574	0.9772	0.8335	0.9917	0.9123	0.9864
	2C	0.9567	0.9827	0.9935	0.7677	0.9837	0.8475	0.9897	0.8748	0.9880
	2D	0.9696	0.9815	0.9920	0.7787	0.9870	0.8594	0.9899	0.8439	0.9891
12	2A	0.8341	0.8231	0.9575	0.9011	0.8927	0.9600	0.9512	0.9877	0.9865
	2B	0.8422	0.8351	0.9572	0.8721	0.8596	0.9390	0.9240	0.9865	0.9849
	2C	0.8446	0.8426	0.9607	0.9261	0.9182	0.9764	0.9698	0.9887	0.9878
	2D	0.8839	0.8848	0.9730	0.9602	0.9568	0.9921	0.9901	0.9906	0.9900
13	2A	0.7998	0.7865	0.9718	0.8795	0.9152	0.9446	0.9661	0.9767	0.9879
	2B	0.8180	0.8006	0.9715	0.8499	0.8820	0.9204	0.9423	0.9742	0.9863
	2C	0.8042	0.7982	0.9712	0.9132	0.9328	0.9684	0.9781	0.9811	0.9884
	2D	0.8529	0.8506	0.9780	0.9552	0.9631	0.9900	0.9924	0.9866	0.9894
14	2A	0.9581	0.9869	0.9950	0.7643	0.9819	0.8429	0.9905	0.8880	0.9878
	2B	0.9518	0.9884	0.9959	0.7586	0.9775	0.8350	0.9916	0.9049	0.9864
	2C	0.9591	0.9843	0.9935	0.7684	0.9838	0.8483	0.9897	0.8678	0.9880
	2D	0.9714	0.9830	0.9920	0.7790	0.9871	0.8598	0.9898	0.8388	0.9891
15	2A	0.8407	0.8312	0.9599	0.9092	0.9006	0.9654	0.9567	0.9878	0.9866
	2B	0.8463	0.8406	0.9588	0.8817	0.8689	0.9464	0.9314	0.9866	0.9849
	2C	0.8525	0.8517	0.9630	0.9324	0.9245	0.9797	0.9735	0.9887	0.9877
	2D	0.8924	0.8939	0.9747	0.9635	0.9601	0.9933	0.9914	0.9905	0.9899
16	2A	0.8088	0.7970	0.9734	0.8938	0.9241	0.9552	0.9716	0.9777	0.9880
	2B	0.8221	0.8063	0.9724	0.8659	0.8936	0.9337	0.9506	0.9750	0.9862
	2C	0.8166	0.8121	0.9731	0.9243	0.9401	0.9751	0.9818	0.9818	0.9883
	2D	0.8663	0.8650	0.9795	0.9611	0.9668	0.9921	0.9934	0.9871	0.9894
17	2A	0.9617	0.9888	0.9951	0.7656	0.9820	0.8444	0.9904	0.8771	0.9878

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
	2B	0.9553	0.9899	0.9960	0.7604	0.9778	0.8371	0.9914	0.8939	0.9864
	2C	0.9628	0.9865	0.9936	0.7694	0.9839	0.8495	0.9896	0.8580	0.9880
	2D	0.9741	0.9851	0.9920	0.7794	0.9871	0.8556	0.9898	0.8316	0.9891
18	2A	0.8517	0.8451	0.9635	0.9203	0.9115	0.9723	0.9640	0.9878	0.9866
	2B	0.8540	0.8510	0.9615	0.8951	0.8818	0.9562	0.9414	0.9866	0.9847
	2C	0.8649	0.8663	0.9665	0.9408	0.9330	0.9839	0.9782	0.9888	0.9876
	2D	0.9049	0.9073	0.9770	0.9677	0.9644	0.9945	0.9929	0.9904	0.9898
19	2A	0.8392	0.8330	0.9810	0.9219	0.9431	0.9736	0.9820	0.9792	0.9879
	2B	0.8467	0.8397	0.9800	0.8984	0.9186	0.9582	0.9671	0.9764	0.9860
	2C	0.8482	0.8489	0.9802	0.9456	0.9550	0.9859	0.9886	0.9832	0.9880
	2D	0.8950	0.8966	0.9840	0.9718	0.9742	0.9899	0.9931	0.9879	0.9890
20	2A	0.9734	0.9940	0.9952	0.7715	0.9824	0.8513	0.9902	0.8556	0.9877
	2B	0.9684	0.9946	0.9961	0.7672	0.9784	0.8454	0.9909	0.8708	0.9862
	2C	0.9739	0.9923	0.9937	0.7739	0.9842	0.8547	0.9895	0.8388	0.9879
	2D	0.9812	0.9904	0.9921	0.7810	0.9873	0.8260	0.9898	0.8179	0.9891
21	2A	0.8770	0.8781	0.9740	0.9423	0.9333	0.9842	0.9770	0.9877	0.9864
	2B	0.8748	0.8802	0.9722	0.9229	0.9084	0.9741	0.9602	0.9865	0.9845
	2C	0.8898	0.8964	0.9758	0.9575	0.9499	0.9911	0.9864	0.9887	0.9874
	2D	0.9264	0.9310	0.9822	0.9756	0.9724	0.9915	0.9941	0.9901	0.9894
22	2A	0.8469	0.8425	0.9820	0.9291	0.9471	0.9777	0.9840	0.9798	0.9879
	2B	0.8522	0.8473	0.9808	0.9070	0.9242	0.9640	0.9704	0.9770	0.9859
	2C	0.8571	0.8593	0.9812	0.9506	0.9580	0.9881	0.9898	0.9837	0.9879
	2D	0.9030	0.9054	0.9847	0.9742	0.9756	0.9896	0.9925	0.9883	0.9890
23	2A	0.9747	0.9944	0.9952	0.7720	0.9824	0.8519	0.9902	0.8494	0.9877
	2B	0.9698	0.9950	0.9962	0.7678	0.9785	0.8462	0.9908	0.8638	0.9862
	2C	0.9752	0.9928	0.9937	0.7743	0.9842	0.8551	0.9895	0.8336	0.9879
	2D	0.9821	0.9910	0.9921	0.7812	0.9873	0.8213	0.9898	0.8146	0.9891
24	2A	0.8847	0.8882	0.9760	0.9474	0.9383	0.9866	0.9797	0.9877	0.9864
	2B	0.8812	0.8888	0.9740	0.9296	0.9149	0.9778	0.9643	0.9866	0.9844
	2C	0.8976	0.9058	0.9775	0.9610	0.9535	0.9924	0.9880	0.9887	0.9873
	2D	0.9328	0.9381	0.9832	0.9772	0.9741	0.9911	0.9936	0.9901	0.9893
25	2A	0.8592	0.8580	0.9835	0.9387	0.9524	0.9826	0.9865	0.9807	0.9878
	2B	0.8616	0.8606	0.9822	0.9189	0.9318	0.9714	0.9747	0.9779	0.9857

Scenario	Test Plan	MLP1	MLP2	MLP3	MLE0	MLE1	MODL-MLC0	MODL-MLC1	MODL-MLE0	MODL-MLE1
	2C	0.8708	0.8754	0.9827	0.9572	0.9620	0.9908	0.9912	0.9844	0.9877
	2D	0.9147	0.9182	0.9857	0.9772	0.9774	0.9896	0.9918	0.9887	0.9890
26	2A	0.9766	0.9950	0.9952	0.7726	0.9825	0.8526	0.9901	0.8405	0.9877
	2B	0.9721	0.9955	0.9962	0.7687	0.9787	0.8473	0.9907	0.8537	0.9862
	2C	0.9770	0.9936	0.9937	0.7748	0.9843	0.8542	0.9895	0.8264	0.9879
	2D	0.9832	0.9917	0.9921	0.7814	0.9873	0.8158	0.9898	0.8102	0.9891
27	2A	0.8963	0.9034	0.9787	0.9541	0.9451	0.9894	0.9831	0.9877	0.9864
	2B	0.8912	0.9023	0.9767	0.9385	0.9238	0.9825	0.9697	0.9866	0.9842
	2C	0.9089	0.9193	0.9798	0.9656	0.9583	0.9939	0.9900	0.9887	0.9871
	2D	0.9417	0.9476	0.9845	0.9793	0.9762	0.9906	0.9927	0.9900	0.9892

APPENDIX C

ADDITIONAL CONFIDENCE BOUND RESULTS

Table C-1 Coverage Probabilities for the 99 Percent Lower Confidence Bounds (Part 1)

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
1	1	0.0088	0.0032	0.0318	0.0266	0.0078	0.0128	0.0090	0.0012
2	1	0.0230	0.0140	0.0302	0.0286	0.0228	0.0150	0.0138	0.0132
3	1	0.0016	0.0036	0.0112	0.0092	0.0012	0.0124	0.0104	0.0028
4	1	0.0000	0.0054	0.0308	0.0090	0.0000	0.0128	0.0106	0.0040
5	1	0.0000	0.0002	0.0272	0.0028	0.0000	0.0120	0.0046	0.0002
6	1	0.0000	0.0000	0.0250	0.0000	0.0000	0.0116	0.0000	0.0000
7	1	0.0000	0.0000	0.0140	0.0002	0.0000	0.0126	0.0032	0.0000
8	1	0.0000	0.0000	0.0172	0.0000	0.0000	0.0132	0.0000	0.0000
9	1	0.0000	0.0000	0.0104	0.0000	0.0000	0.0126	0.0000	0.0000
10	1	0.0170	0.0106	0.0340	0.0310	0.0156	0.0128	0.0122	0.0094
11	1	0.0100	0.0052	0.0296	0.0240	0.0076	0.0132	0.0104	0.0046
12	1	0.0028	0.0006	0.0312	0.0194	0.0012	0.0120	0.0066	0.0002
13	1	0.0024	0.0056	0.0160	0.0112	0.0018	0.0130	0.0100	0.0040
14	1	0.0002	0.0002	0.0200	0.0100	0.0002	0.0124	0.0052	0.0002
15	1	0.0000	0.0002	0.0116	0.0018	0.0000	0.0126	0.0034	0.0000
16	1	0.0028	0.0074	0.0324	0.0188	0.0018	0.0150	0.0118	0.0064
17	1	0.0006	0.0022	0.0256	0.0108	0.0002	0.0126	0.0076	0.0006
18	1	0.0000	0.0000	0.0300	0.0000	0.0000	0.0118	0.0000	0.0000
19	1	0.0000	0.0004	0.0148	0.0036	0.0000	0.0148	0.0076	0.0000
20	1	0.0000	0.0000	0.0146	0.0000	0.0000	0.0096	0.0000	0.0000
21	1	0.0000	0.0000	0.0122	0.0000	0.0000	0.0130	0.0000	0.0000
22	1	0.0226	0.0124	0.0336	0.0328	0.0218	0.0144	0.0128	0.0114
23	1	0.0146	0.0072	0.0280	0.0254	0.0132	0.0128	0.0110	0.0062
24	1	0.0086	0.0022	0.0308	0.0246	0.0066	0.0134	0.0086	0.0012
25	1	0.0050	0.0074	0.0156	0.0126	0.0044	0.0122	0.0106	0.0066
26	1	0.0028	0.0016	0.0198	0.0142	0.0018	0.0126	0.0084	0.0008
27	1	0.0002	0.0006	0.0112	0.0066	0.0002	0.0122	0.0076	0.0004
28	1	0.0080	0.0114	0.0290	0.0208	0.0068	0.0158	0.0132	0.0096
29	1	0.0028	0.0034	0.0244	0.0172	0.0014	0.0124	0.0096	0.0022
30	1	0.0002	0.0002	0.0312	0.0116	0.0002	0.0124	0.0022	0.0000
31	1	0.0006	0.0040	0.0122	0.0054	0.0002	0.0130	0.0096	0.0026
32	1	0.0000	0.0000	0.0206	0.0020	0.0000	0.0120	0.0006	0.0000

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
33	1	0.0000	0.0000	0.0114	0.0000	0.0000	0.0122	0.0000	0.0000
34	1	0.0242	0.0138	0.0294	0.0294	0.0240	0.0158	0.0140	0.0132
35	1	0.0166	0.0092	0.0250	0.0224	0.0166	0.0122	0.0122	0.0078
36	1	0.0148	0.0046	0.0312	0.0264	0.0138	0.0130	0.0102	0.0036
37	1	0.0066	0.0096	0.0146	0.0118	0.0058	0.0128	0.0120	0.0084
38	1	0.0070	0.0036	0.0200	0.0160	0.0068	0.0128	0.0098	0.0026
39	1	0.0016	0.0038	0.0116	0.0086	0.0012	0.0122	0.0096	0.0026
40	1	0.0024	0.0068	0.0298	0.0162	0.0018	0.0132	0.0114	0.0062
41	1	0.0002	0.0016	0.0264	0.0100	0.0002	0.0134	0.0060	0.0006
42	1	0.0000	0.0000	0.0304	0.0008	0.0000	0.0114	0.0000	0.0000
43	1	0.0002	0.0002	0.0142	0.0022	0.0000	0.0122	0.0064	0.0002
44	1	0.0000	0.0000	0.0188	0.0000	0.0000	0.0124	0.0000	0.0000
45	1	0.0000	0.0000	0.0096	0.0000	0.0000	0.0118	0.0000	0.0000
46	1	0.0200	0.0112	0.0322	0.0296	0.0190	0.0130	0.0122	0.0106
47	1	0.0136	0.0070	0.0282	0.0246	0.0120	0.0128	0.0108	0.0062
48	1	0.0088	0.0020	0.0310	0.0228	0.0068	0.0126	0.0082	0.0010
49	1	0.0054	0.0068	0.0148	0.0120	0.0042	0.0126	0.0106	0.0058
50	1	0.0020	0.0012	0.0202	0.0140	0.0014	0.0124	0.0078	0.0004
51	1	0.0002	0.0004	0.0112	0.0066	0.0002	0.0124	0.0076	0.0004
52	1	0.0064	0.0098	0.0280	0.0210	0.0054	0.0150	0.0126	0.0080
53	1	0.0022	0.0044	0.0242	0.0154	0.0018	0.0132	0.0094	0.0030
54	1	0.0002	0.0002	0.0298	0.0090	0.0000	0.0132	0.0018	0.0000
55	1	0.0004	0.0036	0.0128	0.0050	0.0002	0.0124	0.0092	0.0024
56	1	0.0000	0.0000	0.0196	0.0012	0.0000	0.0140	0.0004	0.0000
57	1	0.0000	0.0000	0.0118	0.0000	0.0000	0.0122	0.0002	0.0000
58	1	0.0224	0.0136	0.0290	0.0288	0.0218	0.0144	0.0134	0.0124
59	1	0.0172	0.0094	0.0260	0.0238	0.0162	0.0138	0.0124	0.0076
60	1	0.0140	0.0044	0.0304	0.0266	0.0130	0.0136	0.0098	0.0030
61	1	0.0062	0.0088	0.0146	0.0126	0.0058	0.0124	0.0110	0.0076
62	1	0.0066	0.0036	0.0200	0.0160	0.0052	0.0126	0.0102	0.0020
63	1	0.0014	0.0032	0.0114	0.0084	0.0010	0.0124	0.0100	0.0018
64	1	0.0108	0.0130	0.0228	0.0194	0.0096	0.0156	0.0142	0.0118
65	1	0.0056	0.0064	0.0202	0.0160	0.0040	0.0124	0.0108	0.0058

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
66	1	0.0014	0.0054	0.0104	0.0064	0.0014	0.0126	0.0106	0.0050
67	1	0.0208	0.0150	0.0230	0.0228	0.0208	0.0152	0.0144	0.0142
68	1	0.0174	0.0112	0.0208	0.0200	0.0166	0.0130	0.0124	0.0092
69	1	0.0184	0.0074	0.0314	0.0276	0.0190	0.0130	0.0116	0.0054
70	1	0.0068	0.0100	0.0124	0.0110	0.0068	0.0124	0.0124	0.0096
71	1	0.0096	0.0068	0.0206	0.0178	0.0098	0.0134	0.0118	0.0048
72	1	0.0038	0.0058	0.0116	0.0098	0.0032	0.0120	0.0114	0.0044
73	1	0.0048	0.0080	0.0268	0.0196	0.0036	0.0138	0.0120	0.0080
74	1	0.0018	0.0032	0.0238	0.0144	0.0006	0.0132	0.0072	0.0024
75	1	0.0000	0.0000	0.0300	0.0066	0.0000	0.0130	0.0010	0.0000
76	1	0.0002	0.0030	0.0132	0.0044	0.0002	0.0130	0.0080	0.0006
77	1	0.0000	0.0000	0.0188	0.0002	0.0000	0.0110	0.0000	0.0000
78	1	0.0000	0.0000	0.0108	0.0000	0.0000	0.0124	0.0000	0.0000
79	1	0.0200	0.0122	0.0282	0.0260	0.0192	0.0138	0.0128	0.0114
80	1	0.0152	0.0086	0.0256	0.0234	0.0138	0.0134	0.0110	0.0076
81	1	0.0120	0.0040	0.0300	0.0252	0.0108	0.0126	0.0098	0.0020
82	1	0.0058	0.0076	0.0140	0.0120	0.0058	0.0128	0.0112	0.0068
83	1	0.0056	0.0028	0.0206	0.0162	0.0044	0.0128	0.0086	0.0016
84	1	0.0006	0.0024	0.0114	0.0088	0.0002	0.0124	0.0090	0.0006
85	1	0.0092	0.0112	0.0234	0.0190	0.0076	0.0146	0.0134	0.0096
86	1	0.0046	0.0052	0.0210	0.0158	0.0034	0.0132	0.0104	0.0044
87	1	0.0008	0.0002	0.0308	0.0172	0.0002	0.0130	0.0056	0.0002
88	1	0.0012	0.0050	0.0110	0.0062	0.0004	0.0124	0.0100	0.0042
89	1	0.0002	0.0002	0.0204	0.0088	0.0002	0.0140	0.0034	0.0000
90	1	0.0000	0.0000	0.0116	0.0006	0.0000	0.0124	0.0018	0.0000
91	1	0.0200	0.0144	0.0244	0.0246	0.0200	0.0144	0.0138	0.0132
92	1	0.0168	0.0108	0.0228	0.0202	0.0160	0.0132	0.0124	0.0088
93	1	0.0170	0.0066	0.0308	0.0278	0.0170	0.0124	0.0104	0.0050
94	1	0.0068	0.0092	0.0124	0.0116	0.0062	0.0126	0.0114	0.0080
95	1	0.0092	0.0052	0.0210	0.0172	0.0090	0.0136	0.0112	0.0042
96	1	0.0030	0.0052	0.0114	0.0100	0.0022	0.0122	0.0100	0.0038
97	1	0.0102	0.0138	0.0152	0.0146	0.0102	0.0160	0.0154	0.0128
98	1	0.0074	0.0082	0.0164	0.0144	0.0068	0.0130	0.0118	0.0068

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
99	1	0.0024	0.0068	0.0088	0.0058	0.0022	0.0128	0.0120	0.0064
100	1	0.0174	0.0152	0.0164	0.0166	0.0168	0.0162	0.0156	0.0146
101	1	0.0148	0.0114	0.0174	0.0170	0.0146	0.0128	0.0132	0.0098
102	1	0.0210	0.0088	0.0302	0.0288	0.0210	0.0140	0.0114	0.0076
103	1	0.0064	0.0120	0.0096	0.0084	0.0064	0.0126	0.0124	0.0102
104	1	0.0132	0.0094	0.0218	0.0196	0.0130	0.0138	0.0128	0.0072
105	1	0.0054	0.0080	0.0120	0.0108	0.0052	0.0124	0.0114	0.0066

Table C-2 Coverage Probabilities for the 95 Percent Lower Confidence Bounds (Part 1)

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
1	1	0.0620	0.0306	0.0952	0.0792	0.0564	0.0530	0.0408	0.0220
2	1	0.0924	0.0520	0.1010	0.0980	0.0926	0.0522	0.0508	0.0478
3	1	0.0292	0.0324	0.0526	0.0420	0.0244	0.0554	0.0438	0.0256
4	1	0.0290	0.0386	0.1054	0.0612	0.0076	0.0522	0.0448	0.0342
5	1	0.0060	0.0138	0.0894	0.0288	0.0002	0.0518	0.0266	0.0034
6	1	0.0000	0.0000	0.0874	0.0000	0.0000	0.0522	0.0000	0.0000
7	1	0.0002	0.0068	0.0612	0.0042	0.0000	0.0538	0.0178	0.0002
8	1	0.0000	0.0000	0.0740	0.0000	0.0000	0.0572	0.0000	0.0000
9	1	0.0000	0.0000	0.0510	0.0000	0.0000	0.0540	0.0000	0.0000
10	1	0.0864	0.0462	0.1082	0.0998	0.0840	0.0520	0.0472	0.0416
11	1	0.0650	0.0412	0.0918	0.0794	0.0612	0.0526	0.0474	0.0356
12	1	0.0460	0.0196	0.0888	0.0662	0.0334	0.0536	0.0336	0.0112
13	1	0.0410	0.0404	0.0622	0.0540	0.0360	0.0538	0.0446	0.0340
14	1	0.0232	0.0162	0.0708	0.0442	0.0136	0.0526	0.0298	0.0048
15	1	0.0074	0.0112	0.0530	0.0242	0.0006	0.0556	0.0244	0.0014
16	1	0.0560	0.0416	0.1052	0.0816	0.0410	0.0524	0.0448	0.0370
17	1	0.0302	0.0258	0.0874	0.0552	0.0138	0.0520	0.0390	0.0192
18	1	0.0002	0.0000	0.0892	0.0132	0.0000	0.0572	0.0010	0.0000
19	1	0.0092	0.0238	0.0626	0.0298	0.0018	0.0558	0.0350	0.0116
20	1	0.0000	0.0000	0.0682	0.0008	0.0000	0.0494	0.0002	0.0000
21	1	0.0000	0.0000	0.0528	0.0000	0.0000	0.0572	0.0002	0.0000
22	1	0.0934	0.0492	0.1068	0.1034	0.0922	0.0526	0.0484	0.0460
23	1	0.0714	0.0466	0.0900	0.0822	0.0696	0.0534	0.0490	0.0422
24	1	0.0580	0.0296	0.0880	0.0758	0.0528	0.0516	0.0390	0.0230
25	1	0.0454	0.0444	0.0614	0.0554	0.0438	0.0544	0.0490	0.0400
26	1	0.0376	0.0256	0.0704	0.0550	0.0324	0.0548	0.0394	0.0190
27	1	0.0174	0.0238	0.0524	0.0368	0.0126	0.0560	0.0358	0.0128
28	1	0.0670	0.0464	0.0990	0.0852	0.0614	0.0522	0.0490	0.0432
29	1	0.0486	0.0366	0.0798	0.0654	0.0412	0.0574	0.0464	0.0314
30	1	0.0224	0.0080	0.0900	0.0506	0.0058	0.0552	0.0208	0.0006
31	1	0.0230	0.0326	0.0590	0.0410	0.0136	0.0562	0.0432	0.0264
32	1	0.0064	0.0020	0.0726	0.0272	0.0000	0.0534	0.0132	0.0000

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
33	1	0.0000	0.0002	0.0550	0.0036	0.0000	0.0578	0.0062	0.0000
34	1	0.0930	0.0522	0.1012	0.0992	0.0934	0.0518	0.0514	0.0500
35	1	0.0748	0.0492	0.0848	0.0816	0.0726	0.0536	0.0506	0.0454
36	1	0.0704	0.0380	0.0876	0.0800	0.0680	0.0512	0.0428	0.0296
37	1	0.0466	0.0500	0.0600	0.0554	0.0460	0.0560	0.0512	0.0452
38	1	0.0474	0.0340	0.0714	0.0624	0.0450	0.0530	0.0442	0.0278
39	1	0.0294	0.0332	0.0528	0.0416	0.0242	0.0562	0.0434	0.0258
40	1	0.0524	0.0392	0.1010	0.0776	0.0354	0.0530	0.0450	0.0356
41	1	0.0278	0.0254	0.0862	0.0544	0.0110	0.0526	0.0374	0.0178
42	1	0.0012	0.0002	0.0854	0.0072	0.0000	0.0524	0.0016	0.0000
43	1	0.0060	0.0186	0.0592	0.0272	0.0010	0.0556	0.0334	0.0084
44	1	0.0000	0.0000	0.0678	0.0004	0.0000	0.0572	0.0000	0.0000
45	1	0.0000	0.0000	0.0502	0.0000	0.0000	0.0558	0.0000	0.0000
46	1	0.0872	0.0506	0.1022	0.0956	0.0872	0.0524	0.0506	0.0458
47	1	0.0690	0.0466	0.0876	0.0796	0.0678	0.0530	0.0494	0.0434
48	1	0.0568	0.0294	0.0894	0.0742	0.0520	0.0540	0.0408	0.0218
49	1	0.0458	0.0444	0.0616	0.0554	0.0432	0.0546	0.0486	0.0406
50	1	0.0366	0.0270	0.0708	0.0558	0.0312	0.0538	0.0378	0.0174
51	1	0.0186	0.0236	0.0528	0.0332	0.0128	0.0558	0.0354	0.0128
52	1	0.0644	0.0462	0.0984	0.0844	0.0602	0.0524	0.0480	0.0440
53	1	0.0438	0.0342	0.0838	0.0642	0.0374	0.0538	0.0446	0.0290
54	1	0.0186	0.0064	0.0876	0.0482	0.0028	0.0514	0.0196	0.0004
55	1	0.0212	0.0328	0.0574	0.0394	0.0108	0.0544	0.0414	0.0232
56	1	0.0052	0.0010	0.0706	0.0236	0.0002	0.0542	0.0118	0.0002
57	1	0.0002	0.0002	0.0536	0.0026	0.0000	0.0560	0.0042	0.0000
58	1	0.0904	0.0522	0.1000	0.0962	0.0900	0.0528	0.0510	0.0488
59	1	0.0736	0.0494	0.0850	0.0790	0.0718	0.0536	0.0512	0.0466
60	1	0.0690	0.0370	0.0882	0.0800	0.0646	0.0520	0.0438	0.0314
61	1	0.0472	0.0484	0.0594	0.0556	0.0470	0.0540	0.0506	0.0456
62	1	0.0488	0.0354	0.0710	0.0612	0.0448	0.0546	0.0432	0.0270
63	1	0.0270	0.0328	0.0524	0.0420	0.0230	0.0572	0.0414	0.0252
64	1	0.0672	0.0522	0.0894	0.0810	0.0650	0.0546	0.0526	0.0480
65	1	0.0516	0.0416	0.0776	0.0670	0.0486	0.0540	0.0480	0.0378

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
66	1	0.0290	0.0394	0.0538	0.0436	0.0256	0.0554	0.0472	0.0356
67	1	0.0870	0.0568	0.0904	0.0888	0.0868	0.0544	0.0542	0.0532
68	1	0.0704	0.0514	0.0778	0.0758	0.0704	0.0538	0.0532	0.0486
69	1	0.0756	0.0412	0.0884	0.0844	0.0742	0.0528	0.0464	0.0366
70	1	0.0468	0.0522	0.0552	0.0514	0.0474	0.0550	0.0526	0.0480
71	1	0.0544	0.0418	0.0710	0.0660	0.0524	0.0538	0.0464	0.0348
72	1	0.0368	0.0406	0.0522	0.0446	0.0350	0.0562	0.0474	0.0334
73	1	0.0596	0.0444	0.0946	0.0812	0.0542	0.0524	0.0488	0.0394
74	1	0.0390	0.0308	0.0838	0.0630	0.0294	0.0530	0.0426	0.0260
75	1	0.0116	0.0028	0.0894	0.0390	0.0008	0.0526	0.0146	0.0002
76	1	0.0168	0.0272	0.0580	0.0370	0.0064	0.0554	0.0404	0.0188
77	1	0.0006	0.0000	0.0712	0.0134	0.0000	0.0516	0.0032	0.0000
78	1	0.0000	0.0002	0.0532	0.0006	0.0000	0.0554	0.0008	0.0000
79	1	0.0858	0.0540	0.0952	0.0912	0.0856	0.0524	0.0526	0.0502
80	1	0.0706	0.0496	0.0840	0.0784	0.0700	0.0536	0.0508	0.0454
81	1	0.0648	0.0366	0.0892	0.0778	0.0616	0.0546	0.0440	0.0290
82	1	0.0474	0.0484	0.0596	0.0550	0.0474	0.0554	0.0518	0.0444
83	1	0.0448	0.0338	0.0710	0.0596	0.0404	0.0544	0.0418	0.0254
84	1	0.0254	0.0314	0.0528	0.0394	0.0216	0.0554	0.0406	0.0210
85	1	0.0666	0.0508	0.0890	0.0812	0.0640	0.0538	0.0518	0.0470
86	1	0.0500	0.0400	0.0784	0.0664	0.0454	0.0544	0.0462	0.0350
87	1	0.0372	0.0180	0.0884	0.0616	0.0234	0.0520	0.0282	0.0060
88	1	0.0286	0.0392	0.0552	0.0438	0.0220	0.0552	0.0466	0.0322
89	1	0.0178	0.0116	0.0704	0.0406	0.0060	0.0542	0.0230	0.0012
90	1	0.0036	0.0076	0.0532	0.0170	0.0002	0.0554	0.0192	0.0004
91	1	0.0846	0.0558	0.0898	0.0890	0.0850	0.0542	0.0548	0.0518
92	1	0.0710	0.0510	0.0800	0.0760	0.0698	0.0552	0.0520	0.0482
93	1	0.0728	0.0408	0.0886	0.0828	0.0712	0.0520	0.0466	0.0356
94	1	0.0470	0.0516	0.0568	0.0536	0.0478	0.0556	0.0534	0.0480
95	1	0.0542	0.0400	0.0714	0.0634	0.0510	0.0542	0.0460	0.0342
96	1	0.0328	0.0392	0.0526	0.0446	0.0316	0.0556	0.0458	0.0322
97	1	0.0638	0.0560	0.0770	0.0734	0.0618	0.0564	0.0554	0.0534
98	1	0.0538	0.0458	0.0716	0.0636	0.0522	0.0552	0.0510	0.0432

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
99	1	0.0326	0.0458	0.0502	0.0428	0.0284	0.0548	0.0500	0.0414
100	1	0.0780	0.0576	0.0786	0.0790	0.0780	0.0556	0.0560	0.0556
101	1	0.0664	0.0526	0.0726	0.0704	0.0664	0.0550	0.0530	0.0504
102	1	0.0796	0.0452	0.0914	0.0864	0.0776	0.0532	0.0490	0.0394
103	1	0.0442	0.0564	0.0522	0.0480	0.0440	0.0558	0.0540	0.0512
104	1	0.0590	0.0446	0.0702	0.0658	0.0580	0.0542	0.0488	0.0396
105	1	0.0384	0.0444	0.0522	0.0460	0.0380	0.0554	0.0498	0.0384

Table C-3 Coverage Probabilities for the 90 Percent Lower Confidence Bounds (Part 1)

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
1	1	0.1194	0.0846	0.1500	0.1296	0.1118	0.1102	0.0870	0.0706
2	1	0.1556	0.1056	0.1658	0.1618	0.1546	0.1046	0.1014	0.1008
3	1	0.0742	0.0836	0.1012	0.0816	0.0692	0.1034	0.0858	0.0738
4	1	0.1076	0.0872	0.1716	0.1236	0.0622	0.1048	0.0902	0.0808
5	1	0.0634	0.0596	0.1498	0.0750	0.0116	0.1058	0.0648	0.0298
6	1	0.0004	0.0000	0.1428	0.0002	0.0000	0.1050	0.0000	0.0000
7	1	0.0186	0.0480	0.1168	0.0210	0.0004	0.1046	0.0526	0.0122
8	1	0.0000	0.0000	0.1308	0.0000	0.0000	0.1096	0.0000	0.0000
9	1	0.0000	0.0000	0.1026	0.0000	0.0000	0.1072	0.0000	0.0000
10	1	0.1518	0.0994	0.1722	0.1608	0.1500	0.1046	0.0972	0.0964
11	1	0.1266	0.0902	0.1500	0.1344	0.1224	0.1050	0.0928	0.0846
12	1	0.1042	0.0698	0.1480	0.1180	0.0898	0.1086	0.0734	0.0496
13	1	0.0922	0.0892	0.1194	0.1006	0.0830	0.1038	0.0904	0.0818
14	1	0.0784	0.0612	0.1244	0.0890	0.0596	0.1058	0.0660	0.0354
15	1	0.0466	0.0548	0.0988	0.0576	0.0230	0.1026	0.0596	0.0220
16	1	0.1262	0.0962	0.1700	0.1400	0.1104	0.1042	0.0960	0.0908
17	1	0.0952	0.0754	0.1484	0.1078	0.0716	0.1044	0.0812	0.0602
18	1	0.0402	0.0182	0.1468	0.0436	0.0004	0.1080	0.0150	0.0000
19	1	0.0590	0.0698	0.1196	0.0688	0.0266	0.1084	0.0766	0.0506
20	1	0.0066	0.0030	0.1200	0.0050	0.0000	0.0990	0.0016	0.0000
21	1	0.0004	0.0004	0.1092	0.0002	0.0000	0.1090	0.0004	0.0000
22	1	0.1578	0.1036	0.1712	0.1658	0.1570	0.1044	0.1006	0.1000
23	1	0.1320	0.0998	0.1488	0.1394	0.1304	0.1044	0.0986	0.0916
24	1	0.1182	0.0830	0.1446	0.1290	0.1118	0.1076	0.0876	0.0694
25	1	0.1006	0.0960	0.1176	0.1066	0.0960	0.1054	0.0964	0.0904
26	1	0.0902	0.0762	0.1236	0.0986	0.0832	0.1066	0.0796	0.0612
27	1	0.0628	0.0748	0.1014	0.0722	0.0520	0.1032	0.0778	0.0554
28	1	0.1358	0.0994	0.1658	0.1478	0.1282	0.1044	0.0970	0.0942
29	1	0.1078	0.0920	0.1442	0.1192	0.0988	0.1104	0.0954	0.0830
30	1	0.0852	0.0488	0.1484	0.0974	0.0482	0.1124	0.0546	0.0160
31	1	0.0718	0.0836	0.1132	0.0824	0.0602	0.1062	0.0868	0.0730
32	1	0.0534	0.0344	0.1264	0.0632	0.0124	0.1096	0.0360	0.0036

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
33	1	0.0176	0.0236	0.1028	0.0210	0.0000	0.1066	0.0220	0.0004
34	1	0.1574	0.1054	0.1658	0.1620	0.1572	0.1044	0.1004	0.1006
35	1	0.1326	0.1028	0.1450	0.1384	0.1332	0.1054	0.1012	0.0978
36	1	0.1260	0.0916	0.1464	0.1304	0.1236	0.1090	0.0938	0.0836
37	1	0.1018	0.1018	0.1148	0.1072	0.1000	0.1076	0.1012	0.0962
38	1	0.0994	0.0882	0.1246	0.1076	0.0958	0.1078	0.0906	0.0768
39	1	0.0744	0.0848	0.0992	0.0818	0.0676	0.1036	0.0870	0.0746
40	1	0.1230	0.0950	0.1666	0.1346	0.1036	0.1046	0.0944	0.0888
41	1	0.0924	0.0738	0.1462	0.1072	0.0660	0.1056	0.0800	0.0572
42	1	0.0330	0.0134	0.1442	0.0302	0.0010	0.1062	0.0084	0.0000
43	1	0.0532	0.0682	0.1142	0.0654	0.0176	0.1036	0.0734	0.0452
44	1	0.0050	0.0024	0.1276	0.0036	0.0000	0.1064	0.0014	0.0000
45	1	0.0002	0.0010	0.1050	0.0002	0.0000	0.1074	0.0006	0.0000
46	1	0.1520	0.1016	0.1668	0.1584	0.1512	0.1036	0.0984	0.0988
47	1	0.1302	0.0956	0.1470	0.1366	0.1280	0.1050	0.0958	0.0906
48	1	0.1190	0.0812	0.1492	0.1296	0.1098	0.1088	0.0840	0.0696
49	1	0.0976	0.0956	0.1148	0.1022	0.0936	0.1026	0.0952	0.0882
50	1	0.0922	0.0742	0.1246	0.1018	0.0822	0.1064	0.0774	0.0602
51	1	0.0638	0.0718	0.1000	0.0718	0.0500	0.1040	0.0764	0.0518
52	1	0.1322	0.0984	0.1628	0.1452	0.1250	0.1046	0.0990	0.0952
53	1	0.1082	0.0854	0.1442	0.1166	0.0978	0.1034	0.0888	0.0764
54	1	0.0808	0.0444	0.1438	0.0926	0.0380	0.1092	0.0480	0.0134
55	1	0.0698	0.0824	0.1126	0.0816	0.0580	0.1064	0.0858	0.0712
56	1	0.0476	0.0318	0.1248	0.0578	0.0072	0.1066	0.0320	0.0016
57	1	0.0146	0.0236	0.1010	0.0180	0.0000	0.1034	0.0198	0.0006
58	1	0.1528	0.1040	0.1632	0.1588	0.1540	0.1046	0.1020	0.1018
59	1	0.1342	0.1016	0.1446	0.1386	0.1324	0.1048	0.0998	0.0966
60	1	0.1280	0.0902	0.1466	0.1344	0.1242	0.1092	0.0920	0.0812
61	1	0.1012	0.1008	0.1142	0.1052	0.0982	0.1052	0.0990	0.0942
62	1	0.1016	0.0848	0.1238	0.1074	0.0960	0.1060	0.0878	0.0744
63	1	0.0734	0.0834	0.1006	0.0806	0.0692	0.1028	0.0844	0.0708
64	1	0.1324	0.1020	0.1522	0.1428	0.1296	0.1044	0.1012	0.0984
65	1	0.1140	0.0938	0.1384	0.1208	0.1092	0.1044	0.0946	0.0884

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
66	1	0.0794	0.0936	0.1076	0.0874	0.0734	0.1070	0.0934	0.0848
67	1	0.1466	0.1052	0.1542	0.1512	0.1472	0.1042	0.1024	0.1018
68	1	0.1296	0.1042	0.1406	0.1344	0.1284	0.1038	0.1014	0.0988
69	1	0.1306	0.0996	0.1474	0.1364	0.1302	0.1082	0.0990	0.0896
70	1	0.0992	0.1032	0.1078	0.1022	0.0974	0.1064	0.1024	0.0998
71	1	0.1064	0.0944	0.1248	0.1128	0.1056	0.1074	0.0956	0.0866
72	1	0.0832	0.0910	0.1008	0.0874	0.0794	0.1042	0.0910	0.0838
73	1	0.1274	0.0972	0.1590	0.1374	0.1172	0.1046	0.0964	0.0924
74	1	0.1044	0.0816	0.1430	0.1150	0.0904	0.1056	0.0856	0.0712
75	1	0.0694	0.0364	0.1486	0.0788	0.0192	0.1090	0.0382	0.0030
76	1	0.0668	0.0780	0.1104	0.0790	0.0474	0.1022	0.0816	0.0634
77	1	0.0336	0.0216	0.1252	0.0374	0.0014	0.1048	0.0202	0.0002
78	1	0.0068	0.0122	0.1012	0.0046	0.0000	0.1040	0.0082	0.0000
79	1	0.1494	0.1036	0.1610	0.1538	0.1490	0.1050	0.1004	0.1008
80	1	0.1304	0.0986	0.1428	0.1350	0.1298	0.1062	0.0978	0.0936
81	1	0.1262	0.0870	0.1498	0.1340	0.1224	0.1090	0.0894	0.0772
82	1	0.0966	0.0986	0.1110	0.1030	0.0954	0.1032	0.0968	0.0926
83	1	0.0994	0.0818	0.1244	0.1076	0.0942	0.1080	0.0846	0.0708
84	1	0.0712	0.0828	0.0992	0.0780	0.0658	0.1052	0.0846	0.0664
85	1	0.1312	0.1000	0.1528	0.1404	0.1276	0.1050	0.0990	0.0964
86	1	0.1118	0.0902	0.1368	0.1206	0.1062	0.1050	0.0922	0.0858
87	1	0.0972	0.0620	0.1462	0.1090	0.0762	0.1098	0.0678	0.0344
88	1	0.0772	0.0894	0.1086	0.0856	0.0694	0.1060	0.0928	0.0808
89	1	0.0696	0.0532	0.1260	0.0820	0.0414	0.1062	0.0582	0.0222
90	1	0.0374	0.0446	0.1018	0.0466	0.0074	0.1040	0.0472	0.0114
91	1	0.1474	0.1046	0.1538	0.1522	0.1468	0.1056	0.1016	0.1014
92	1	0.1302	0.1018	0.1384	0.1336	0.1302	0.1048	0.0996	0.0972
93	1	0.1316	0.0936	0.1480	0.1376	0.1302	0.1090	0.0968	0.0868
94	1	0.0984	0.1024	0.1096	0.1024	0.0970	0.1050	0.1006	0.0972
95	1	0.1064	0.0914	0.1254	0.1108	0.1026	0.1060	0.0928	0.0814
96	1	0.0800	0.0902	0.1012	0.0860	0.0754	0.1042	0.0916	0.0800
97	1	0.1236	0.1040	0.1380	0.1306	0.1230	0.1060	0.1036	0.1010
98	1	0.1118	0.0968	0.1292	0.1184	0.1088	0.1048	0.0964	0.0914

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
99	1	0.0800	0.0968	0.1008	0.0864	0.0766	0.1072	0.0972	0.0916
100	1	0.1358	0.1066	0.1390	0.1398	0.1344	0.1062	0.1048	0.1030
101	1	0.1244	0.1026	0.1310	0.1278	0.1252	0.1048	0.1022	0.0998
102	1	0.1368	0.1008	0.1474	0.1408	0.1366	0.1082	0.1002	0.0938
103	1	0.0928	0.1046	0.1008	0.0962	0.0932	0.1068	0.1026	0.1006
104	1	0.1136	0.0996	0.1266	0.1172	0.1108	0.1080	0.0998	0.0916
105	1	0.0866	0.0962	0.1020	0.0912	0.0844	0.1048	0.0964	0.0898

Table C-4 Coverage Probabilities for the 90 Percent Upper Confidence Bounds (Part 1)

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
1	1	0.8290	0.8770	0.8500	0.8356	0.8330	0.8988	0.8904	0.8862
2	1	0.8192	0.8884	0.8278	0.8212	0.8204	0.8960	0.8938	0.8922
3	1	0.8830	0.8738	0.8996	0.8914	0.8870	0.8968	0.8864	0.8818
4	1	0.7828	0.8774	0.8180	0.7992	0.7986	0.8968	0.8892	0.8838
5	1	0.7990	0.8634	0.8434	0.8188	0.8190	0.9000	0.8836	0.8792
6	1	0.7820	0.8198	0.8488	0.8068	0.8358	0.8918	0.8434	0.8864
7	1	0.8248	0.8548	0.8744	0.8462	0.8494	0.8974	0.8792	0.8762
8	1	0.8050	0.8230	0.8798	0.7756	0.8738	0.9022	0.7510	0.9048
9	1	0.8110	0.8024	0.8992	0.6100	0.9092	0.8946	0.5810	0.9078
10	1	0.8066	0.8892	0.8210	0.8100	0.8078	0.9004	0.8962	0.8934
11	1	0.8242	0.8814	0.8428	0.8318	0.8270	0.9000	0.8912	0.8858
12	1	0.8248	0.8670	0.8506	0.8362	0.8314	0.8992	0.8858	0.8812
13	1	0.8516	0.8790	0.8760	0.8626	0.8572	0.8984	0.8894	0.8848
14	1	0.8404	0.8630	0.8734	0.8572	0.8520	0.8994	0.8830	0.8786
15	1	0.8612	0.8534	0.8970	0.8774	0.8754	0.8960	0.8772	0.8728
16	1	0.7944	0.8816	0.8214	0.8034	0.8008	0.8970	0.8902	0.8866
17	1	0.8120	0.8712	0.8442	0.8250	0.8228	0.9010	0.8866	0.8806
18	1	0.7968	0.8338	0.8468	0.8224	0.8246	0.8874	0.8650	0.8692
19	1	0.8368	0.8546	0.8786	0.8596	0.8574	0.8926	0.8754	0.8698
20	1	0.8176	0.8360	0.8734	0.8490	0.8548	0.8960	0.8682	0.8786
21	1	0.8272	0.8228	0.8944	0.8600	0.8810	0.8910	0.8594	0.8804
22	1	0.8104	0.8876	0.8230	0.8138	0.8112	0.8966	0.8952	0.8920
23	1	0.8322	0.8848	0.8458	0.8378	0.8330	0.9012	0.8940	0.8898
24	1	0.8310	0.8764	0.8534	0.8390	0.8356	0.9028	0.8908	0.8868
25	1	0.8598	0.8824	0.8776	0.8680	0.8624	0.8964	0.8918	0.8870
26	1	0.8534	0.8710	0.8756	0.8616	0.8590	0.9004	0.8894	0.8840
27	1	0.8750	0.8646	0.8980	0.8878	0.8828	0.8992	0.8834	0.8772
28	1	0.8056	0.8816	0.8258	0.8136	0.8102	0.8942	0.8888	0.8874
29	1	0.8262	0.8682	0.8528	0.8390	0.8334	0.8900	0.8800	0.8760
30	1	0.8190	0.8574	0.8540	0.8362	0.8330	0.8968	0.8790	0.8774
31	1	0.8510	0.8726	0.8808	0.8642	0.8604	0.8980	0.8866	0.8814
32	1	0.8356	0.8478	0.8770	0.8570	0.8554	0.9000	0.8790	0.8782

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
33	1	0.8518	0.8426	0.8974	0.8780	0.8792	0.8946	0.8740	0.8754
34	1	0.8190	0.8868	0.8258	0.8220	0.8196	0.8942	0.8924	0.8914
35	1	0.8414	0.8894	0.8526	0.8446	0.8418	0.9010	0.8952	0.8936
36	1	0.8394	0.8836	0.8538	0.8454	0.8406	0.9032	0.8938	0.8900
37	1	0.8712	0.8846	0.8832	0.8756	0.8718	0.8976	0.8928	0.8906
38	1	0.8618	0.8780	0.8776	0.8674	0.8636	0.9018	0.8936	0.8888
39	1	0.8840	0.8736	0.8992	0.8920	0.8884	0.8968	0.8874	0.8816
40	1	0.7998	0.8834	0.8270	0.8106	0.8072	0.8984	0.8928	0.8880
41	1	0.8104	0.8706	0.8466	0.8260	0.8232	0.8992	0.8848	0.8800
42	1	0.8028	0.8384	0.8486	0.8264	0.8294	0.8962	0.8710	0.8760
43	1	0.8368	0.8642	0.8780	0.8578	0.8538	0.8978	0.8824	0.8778
44	1	0.8064	0.8222	0.8676	0.8404	0.8474	0.8910	0.8602	0.8734
45	1	0.8274	0.8186	0.8996	0.8564	0.8876	0.8970	0.8514	0.8882
46	1	0.8158	0.8912	0.8278	0.8200	0.8172	0.8988	0.8972	0.8946
47	1	0.8324	0.8856	0.8476	0.8390	0.8344	0.8998	0.8940	0.8896
48	1	0.8302	0.8750	0.8502	0.8392	0.8342	0.8994	0.8888	0.8840
49	1	0.8616	0.8820	0.8792	0.8708	0.8648	0.8972	0.8922	0.8886
50	1	0.8492	0.8688	0.8728	0.8602	0.8552	0.8990	0.8852	0.8800
51	1	0.8700	0.8634	0.8952	0.8810	0.8778	0.8960	0.8776	0.8752
52	1	0.8080	0.8844	0.8304	0.8156	0.8124	0.8956	0.8912	0.8886
53	1	0.8234	0.8756	0.8490	0.8350	0.8316	0.9008	0.8894	0.8848
54	1	0.8156	0.8562	0.8522	0.8314	0.8290	0.9002	0.8834	0.8794
55	1	0.8534	0.8718	0.8814	0.8642	0.8596	0.8974	0.8878	0.8824
56	1	0.8328	0.8482	0.8746	0.8546	0.8536	0.9006	0.8798	0.8794
57	1	0.8494	0.8418	0.8962	0.8762	0.8798	0.8968	0.8736	0.8776
58	1	0.8198	0.8896	0.8294	0.8244	0.8222	0.8966	0.8946	0.8936
59	1	0.8416	0.8892	0.8508	0.8428	0.8414	0.9008	0.8970	0.8926
60	1	0.8358	0.8818	0.8534	0.8422	0.8394	0.9012	0.8934	0.8894
61	1	0.8706	0.8862	0.8820	0.8762	0.8726	0.8980	0.8940	0.8908
62	1	0.8586	0.8780	0.8756	0.8656	0.8618	0.9016	0.8928	0.8884
63	1	0.8812	0.8718	0.8972	0.8900	0.8860	0.8970	0.8850	0.8812
64	1	0.8222	0.8856	0.8376	0.8260	0.8242	0.8928	0.8914	0.8896
65	1	0.8382	0.8832	0.8584	0.8466	0.8410	0.8976	0.8930	0.8896

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
66	1	0.8680	0.8780	0.8890	0.8756	0.8724	0.8976	0.8890	0.8846
67	1	0.8298	0.8886	0.8384	0.8318	0.8306	0.8930	0.8940	0.8922
68	1	0.8510	0.8916	0.8592	0.8542	0.8516	0.8980	0.8966	0.8952
69	1	0.8434	0.8862	0.8536	0.8472	0.8452	0.9004	0.8962	0.8924
70	1	0.8810	0.8882	0.8912	0.8852	0.8808	0.8968	0.8944	0.8922
71	1	0.8660	0.8844	0.8780	0.8712	0.8662	0.9018	0.8966	0.8932
72	1	0.8878	0.8788	0.8990	0.8922	0.8900	0.8956	0.8894	0.8852
73	1	0.8100	0.8852	0.8326	0.8198	0.8160	0.8974	0.8922	0.8894
74	1	0.8214	0.8748	0.8508	0.8352	0.8308	0.8988	0.8884	0.8828
75	1	0.8126	0.8506	0.8498	0.8312	0.8294	0.8984	0.8798	0.8780
76	1	0.8496	0.8710	0.8820	0.8664	0.8600	0.8976	0.8852	0.8796
77	1	0.8268	0.8384	0.8718	0.8494	0.8500	0.8910	0.8684	0.8708
78	1	0.8442	0.8372	0.8942	0.8712	0.8762	0.8942	0.8708	0.8758
79	1	0.8244	0.8912	0.8338	0.8260	0.8248	0.8982	0.8978	0.8950
80	1	0.8408	0.8894	0.8508	0.8446	0.8410	0.9010	0.8954	0.8928
81	1	0.8354	0.8786	0.8512	0.8404	0.8368	0.8988	0.8910	0.8868
82	1	0.8708	0.8852	0.8838	0.8754	0.8718	0.8964	0.8922	0.8906
83	1	0.8536	0.8742	0.8726	0.8626	0.8572	0.8990	0.8886	0.8840
84	1	0.8754	0.8694	0.8948	0.8820	0.8796	0.8950	0.8806	0.8788
85	1	0.8200	0.8868	0.8374	0.8252	0.8236	0.8956	0.8922	0.8910
86	1	0.8352	0.8810	0.8574	0.8436	0.8398	0.9010	0.8932	0.8878
87	1	0.8234	0.8646	0.8498	0.8356	0.8322	0.9004	0.8850	0.8804
88	1	0.8644	0.8758	0.8874	0.8748	0.8700	0.8982	0.8880	0.8844
89	1	0.8402	0.8576	0.8738	0.8572	0.8540	0.9018	0.8830	0.8788
90	1	0.8590	0.8526	0.8956	0.8802	0.8774	0.8946	0.8772	0.8766
91	1	0.8304	0.8912	0.8386	0.8308	0.8302	0.8956	0.8950	0.8942
92	1	0.8492	0.8910	0.8594	0.8510	0.8490	0.9006	0.8978	0.8960
93	1	0.8406	0.8854	0.8530	0.8432	0.8424	0.9016	0.8962	0.8914
94	1	0.8806	0.8866	0.8888	0.8854	0.8820	0.8984	0.8928	0.8910
95	1	0.8630	0.8836	0.8752	0.8674	0.8640	0.9024	0.8952	0.8910
96	1	0.8848	0.8768	0.8962	0.8902	0.8870	0.8954	0.8862	0.8830
97	1	0.8356	0.8856	0.8512	0.8398	0.8366	0.8922	0.8902	0.8898
98	1	0.8514	0.8844	0.8676	0.8570	0.8524	0.8982	0.8934	0.8906

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
99	1	0.8794	0.8808	0.8986	0.8882	0.8830	0.8978	0.8902	0.8866
100	1	0.8432	0.8882	0.8528	0.8442	0.8426	0.8918	0.8924	0.8920
101	1	0.8626	0.8928	0.8700	0.8644	0.8624	0.8984	0.8962	0.8964
102	1	0.8468	0.8884	0.8522	0.8488	0.8470	0.9030	0.8964	0.8938
103	1	0.8918	0.8886	0.8992	0.8950	0.8922	0.8982	0.8956	0.8930
104	1	0.8684	0.8880	0.8766	0.8716	0.8690	0.9018	0.8984	0.8946
105	1	0.8910	0.8790	0.8992	0.8946	0.8912	0.8956	0.8892	0.8858

Table C-5 Coverage Probabilities for the 95 Percent Upper Confidence Bounds (Part 1)

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
1	1	0.8800	0.9216	0.9048	0.8986	0.8850	0.9488	0.9426	0.9310
2	1	0.8806	0.9394	0.8972	0.8910	0.8806	0.9460	0.9458	0.9442
3	1	0.9246	0.9172	0.9450	0.9394	0.9280	0.9430	0.9360	0.9238
4	1	0.8354	0.9292	0.8834	0.8714	0.8492	0.9444	0.9402	0.9348
5	1	0.8508	0.9090	0.9038	0.8878	0.8702	0.9456	0.9372	0.9230
6	1	0.8282	0.8660	0.9054	0.8796	0.8728	0.9408	0.9142	0.9188
7	1	0.8738	0.8990	0.9324	0.9160	0.8980	0.9420	0.9330	0.9168
8	1	0.8480	0.8672	0.9334	0.8648	0.9070	0.9494	0.8440	0.9312
9	1	0.8530	0.8476	0.9474	0.7348	0.9358	0.9444	0.7022	0.9316
10	1	0.8632	0.9376	0.8872	0.8786	0.8644	0.9454	0.9446	0.9400
11	1	0.8816	0.9298	0.9068	0.8980	0.8834	0.9466	0.9402	0.9334
12	1	0.8748	0.9142	0.9060	0.8972	0.8812	0.9468	0.9392	0.9250
13	1	0.9080	0.9240	0.9326	0.9252	0.9098	0.9430	0.9366	0.9286
14	1	0.8906	0.9084	0.9250	0.9140	0.8986	0.9440	0.9352	0.9196
15	1	0.9088	0.9010	0.9462	0.9366	0.9214	0.9420	0.9322	0.9170
16	1	0.8444	0.9338	0.8898	0.8720	0.8530	0.9452	0.9412	0.9368
17	1	0.8644	0.9186	0.9080	0.8944	0.8732	0.9462	0.9372	0.9260
18	1	0.8450	0.8764	0.9102	0.8930	0.8686	0.9434	0.9294	0.9110
19	1	0.8908	0.9114	0.9306	0.9184	0.9016	0.9398	0.9334	0.9210
20	1	0.8628	0.8784	0.9294	0.9162	0.8964	0.9416	0.9310	0.9176
21	1	0.8716	0.8670	0.9452	0.9258	0.9168	0.9418	0.9264	0.9166
22	1	0.8700	0.9390	0.8906	0.8822	0.8706	0.9450	0.9440	0.9420
23	1	0.8900	0.9324	0.9092	0.9056	0.8910	0.9460	0.9408	0.9360
24	1	0.8850	0.9236	0.9074	0.9010	0.8882	0.9460	0.9414	0.9292
25	1	0.9156	0.9288	0.9332	0.9284	0.9180	0.9432	0.9396	0.9332
26	1	0.9024	0.9192	0.9258	0.9188	0.9062	0.9448	0.9376	0.9246
27	1	0.9168	0.9096	0.9462	0.9372	0.9240	0.9422	0.9346	0.9206
28	1	0.8602	0.9354	0.8942	0.8824	0.8648	0.9450	0.9446	0.9384
29	1	0.8822	0.9174	0.9088	0.9000	0.8880	0.9388	0.9338	0.9246
30	1	0.8656	0.9030	0.9076	0.8974	0.8792	0.9478	0.9370	0.9206
31	1	0.9052	0.9210	0.9346	0.9270	0.9124	0.9422	0.9362	0.9262
32	1	0.8804	0.8964	0.9244	0.9144	0.8982	0.9448	0.9334	0.9182

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
33	1	0.8950	0.8864	0.9424	0.9316	0.9168	0.9398	0.9300	0.9130
34	1	0.8796	0.9396	0.8958	0.8896	0.8792	0.9446	0.9458	0.9426
35	1	0.8996	0.9340	0.9128	0.9082	0.9016	0.9464	0.9428	0.9382
36	1	0.8920	0.9288	0.9078	0.9022	0.8950	0.9460	0.9406	0.9340
37	1	0.9256	0.9322	0.9378	0.9340	0.9276	0.9436	0.9404	0.9348
38	1	0.9094	0.9238	0.9260	0.9212	0.9116	0.9452	0.9384	0.9292
39	1	0.9268	0.9168	0.9446	0.9380	0.9296	0.9428	0.9352	0.9236
40	1	0.8494	0.9314	0.8914	0.8794	0.8594	0.9448	0.9426	0.9356
41	1	0.8662	0.9174	0.9104	0.8962	0.8770	0.9464	0.9380	0.9250
42	1	0.8448	0.8890	0.9038	0.8876	0.8692	0.9436	0.9334	0.9156
43	1	0.8888	0.9086	0.9342	0.9236	0.9048	0.9416	0.9342	0.9210
44	1	0.8554	0.8704	0.9278	0.9130	0.8924	0.9448	0.9264	0.9146
45	1	0.8758	0.8740	0.9500	0.9290	0.9240	0.9448	0.9218	0.9222
46	1	0.8742	0.9390	0.8932	0.8856	0.8756	0.9450	0.9446	0.9412
47	1	0.8918	0.9322	0.9122	0.9070	0.8942	0.9466	0.9414	0.9352
48	1	0.8838	0.9214	0.9062	0.8984	0.8868	0.9472	0.9410	0.9298
49	1	0.9174	0.9280	0.9358	0.9308	0.9192	0.9412	0.9380	0.9318
50	1	0.8966	0.9154	0.9250	0.9166	0.9026	0.9444	0.9368	0.9246
51	1	0.9180	0.9104	0.9454	0.9370	0.9246	0.9422	0.9340	0.9198
52	1	0.8620	0.9360	0.8970	0.8838	0.8676	0.9464	0.9426	0.9384
53	1	0.8788	0.9236	0.9146	0.9052	0.8852	0.9452	0.9394	0.9284
54	1	0.8618	0.9060	0.9056	0.8946	0.8766	0.9460	0.9366	0.9222
55	1	0.9054	0.9174	0.9366	0.9276	0.9120	0.9424	0.9350	0.9246
56	1	0.8774	0.8980	0.9258	0.9136	0.8964	0.9454	0.9330	0.9172
57	1	0.8946	0.8856	0.9454	0.9356	0.9180	0.9426	0.9312	0.9138
58	1	0.8818	0.9402	0.8976	0.8914	0.8826	0.9466	0.9448	0.9428
59	1	0.9014	0.9342	0.9146	0.9104	0.9028	0.9452	0.9418	0.9380
60	1	0.8908	0.9264	0.9068	0.9030	0.8908	0.9456	0.9414	0.9330
61	1	0.9262	0.9312	0.9378	0.9344	0.9276	0.9426	0.9396	0.9344
62	1	0.9072	0.9226	0.9264	0.9196	0.9096	0.9452	0.9374	0.9282
63	1	0.9236	0.9166	0.9458	0.9390	0.9276	0.9418	0.9352	0.9242
64	1	0.8804	0.9386	0.9054	0.8970	0.8840	0.9476	0.9440	0.9408
65	1	0.8956	0.9290	0.9194	0.9134	0.9006	0.9456	0.9410	0.9344

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
66	1	0.9194	0.9254	0.9436	0.9366	0.9230	0.9432	0.9382	0.9294
67	1	0.8954	0.9420	0.9064	0.9012	0.8952	0.9478	0.9462	0.9442
68	1	0.9136	0.9390	0.9210	0.9188	0.9144	0.9458	0.9442	0.9408
69	1	0.8962	0.9320	0.9078	0.9034	0.8970	0.9432	0.9416	0.9354
70	1	0.9368	0.9330	0.9442	0.9418	0.9378	0.9426	0.9414	0.9362
71	1	0.9122	0.9284	0.9260	0.9214	0.9130	0.9442	0.9378	0.9314
72	1	0.9300	0.9206	0.9466	0.9412	0.9316	0.9418	0.9362	0.9276
73	1	0.8634	0.9328	0.8990	0.8872	0.8704	0.9446	0.9426	0.9364
74	1	0.8782	0.9212	0.9142	0.9050	0.8866	0.9452	0.9394	0.9264
75	1	0.8566	0.9018	0.9054	0.8926	0.8734	0.9458	0.9360	0.9192
76	1	0.9034	0.9156	0.9364	0.9304	0.9110	0.9418	0.9356	0.9226
77	1	0.8726	0.8866	0.9198	0.9098	0.8918	0.9412	0.9296	0.9126
78	1	0.8862	0.8814	0.9444	0.9320	0.9186	0.9428	0.9288	0.9148
79	1	0.8856	0.9396	0.8994	0.8928	0.8844	0.9458	0.9460	0.9426
80	1	0.9012	0.9342	0.9150	0.9120	0.9024	0.9456	0.9428	0.9384
81	1	0.8860	0.9262	0.9054	0.8994	0.8884	0.9468	0.9418	0.9322
82	1	0.9258	0.9306	0.9374	0.9334	0.9278	0.9420	0.9396	0.9328
83	1	0.9024	0.9190	0.9260	0.9178	0.9050	0.9438	0.9374	0.9266
84	1	0.9226	0.9154	0.9446	0.9382	0.9272	0.9416	0.9346	0.9222
85	1	0.8784	0.9386	0.9044	0.8960	0.8816	0.9478	0.9448	0.9412
86	1	0.8946	0.9264	0.9174	0.9122	0.8982	0.9450	0.9398	0.9316
87	1	0.8700	0.9138	0.9070	0.8954	0.8794	0.9458	0.9364	0.9254
88	1	0.9172	0.9218	0.9420	0.9346	0.9218	0.9422	0.9356	0.9272
89	1	0.8860	0.9052	0.9258	0.9140	0.8972	0.9454	0.9340	0.9188
90	1	0.9028	0.8946	0.9448	0.9342	0.9180	0.9422	0.9316	0.9144
91	1	0.8934	0.9418	0.9048	0.9016	0.8936	0.9470	0.9462	0.9446
92	1	0.9124	0.9356	0.9180	0.9166	0.9120	0.9454	0.9440	0.9400
93	1	0.8926	0.9312	0.9066	0.9022	0.8934	0.9448	0.9408	0.9348
94	1	0.9344	0.9318	0.9420	0.9390	0.9350	0.9416	0.9396	0.9354
95	1	0.9090	0.9252	0.9264	0.9208	0.9100	0.9444	0.9378	0.9316
96	1	0.9290	0.9206	0.9452	0.9404	0.9300	0.9414	0.9354	0.9278
97	1	0.8972	0.9386	0.9178	0.9088	0.8994	0.9448	0.9448	0.9404
98	1	0.9116	0.9314	0.9274	0.9212	0.9136	0.9448	0.9418	0.9348

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
99	1	0.9328	0.9272	0.9480	0.9438	0.9348	0.9426	0.9392	0.9324
100	1	0.9084	0.9406	0.9186	0.9144	0.9086	0.9450	0.9450	0.9436
101	1	0.9214	0.9386	0.9286	0.9242	0.9216	0.9456	0.9446	0.9408
102	1	0.8948	0.9350	0.9068	0.9036	0.8962	0.9432	0.9408	0.9366
103	1	0.9436	0.9342	0.9496	0.9476	0.9444	0.9426	0.9416	0.9384
104	1	0.9148	0.9310	0.9248	0.9212	0.9148	0.9432	0.9396	0.9348
105	1	0.9328	0.9234	0.9470	0.9424	0.9338	0.9424	0.9368	0.9296

Table C-6 Coverage Probabilities for the 99 Percent Lower Confidence Bounds (Part 1)

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
1	1	0.9408	0.9714	0.9660	0.9630	0.9424	0.9870	0.9842	0.9754
2	1	0.9540	0.9854	0.9680	0.9658	0.9550	0.9886	0.9880	0.9870
3	1	0.9736	0.9688	0.9876	0.9858	0.9746	0.9858	0.9840	0.9742
4	1	0.9088	0.9748	0.9630	0.9568	0.9190	0.9862	0.9846	0.9766
5	1	0.9182	0.9572	0.9674	0.9624	0.9296	0.9886	0.9862	0.9664
6	1	0.8886	0.9208	0.9654	0.9554	0.9236	0.9854	0.9756	0.9526
7	1	0.9340	0.9512	0.9818	0.9778	0.9490	0.9876	0.9852	0.9628
8	1	0.9072	0.9218	0.9826	0.9488	0.9504	0.9874	0.9300	0.9602
9	1	0.9128	0.9018	0.9880	0.8624	0.9656	0.9868	0.8436	0.9596
10	1	0.9374	0.9830	0.9628	0.9598	0.9404	0.9892	0.9880	0.9848
11	1	0.9480	0.9768	0.9692	0.9668	0.9510	0.9878	0.9868	0.9796
12	1	0.9332	0.9616	0.9668	0.9638	0.9394	0.9872	0.9854	0.9676
13	1	0.9628	0.9730	0.9832	0.9798	0.9658	0.9878	0.9872	0.9774
14	1	0.9452	0.9582	0.9794	0.9744	0.9512	0.9862	0.9840	0.9670
15	1	0.9568	0.9512	0.9878	0.9858	0.9640	0.9848	0.9818	0.9630
16	1	0.9212	0.9802	0.9624	0.9578	0.9274	0.9888	0.9874	0.9820
17	1	0.9302	0.9646	0.9708	0.9656	0.9388	0.9884	0.9858	0.9714
18	1	0.9128	0.9396	0.9688	0.9648	0.9298	0.9870	0.9854	0.9610
19	1	0.9480	0.9600	0.9822	0.9790	0.9566	0.9864	0.9856	0.9668
20	1	0.9230	0.9320	0.9798	0.9772	0.9430	0.9858	0.9810	0.9548
21	1	0.9278	0.9240	0.9886	0.9854	0.9590	0.9868	0.9846	0.9568
22	1	0.9446	0.9842	0.9640	0.9604	0.9464	0.9886	0.9876	0.9858
23	1	0.9546	0.9806	0.9720	0.9694	0.9562	0.9888	0.9870	0.9832
24	1	0.9404	0.9684	0.9674	0.9636	0.9428	0.9870	0.9854	0.9734
25	1	0.9692	0.9780	0.9838	0.9824	0.9706	0.9870	0.9864	0.9808
26	1	0.9528	0.9642	0.9798	0.9748	0.9576	0.9864	0.9848	0.9708
27	1	0.9652	0.9608	0.9876	0.9862	0.9698	0.9854	0.9836	0.9682
28	1	0.9342	0.9824	0.9666	0.9628	0.9388	0.9884	0.9876	0.9840
29	1	0.9446	0.9698	0.9720	0.9696	0.9508	0.9852	0.9844	0.9732
30	1	0.9240	0.9550	0.9680	0.9624	0.9358	0.9864	0.9848	0.9636
31	1	0.9596	0.9678	0.9852	0.9840	0.9646	0.9870	0.9854	0.9738
32	1	0.9334	0.9458	0.9804	0.9770	0.9442	0.9842	0.9834	0.9594

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
33	1	0.9436	0.9382	0.9872	0.9858	0.9590	0.9844	0.9824	0.9576
34	1	0.9530	0.9854	0.9678	0.9656	0.9536	0.9886	0.9878	0.9866
35	1	0.9628	0.9822	0.9742	0.9732	0.9624	0.9880	0.9874	0.9844
36	1	0.9470	0.9744	0.9664	0.9636	0.9486	0.9876	0.9856	0.9778
37	1	0.9776	0.9806	0.9858	0.9852	0.9776	0.9868	0.9860	0.9820
38	1	0.9604	0.9720	0.9796	0.9770	0.9630	0.9862	0.9844	0.9760
39	1	0.9736	0.9696	0.9878	0.9862	0.9758	0.9858	0.9832	0.9736
40	1	0.9252	0.9780	0.9664	0.9610	0.9308	0.9898	0.9876	0.9812
41	1	0.9322	0.9638	0.9704	0.9662	0.9406	0.9882	0.9870	0.9704
42	1	0.9058	0.9396	0.9672	0.9620	0.9248	0.9842	0.9816	0.9552
43	1	0.9488	0.9596	0.9832	0.9792	0.9578	0.9870	0.9860	0.9682
44	1	0.9192	0.9290	0.9790	0.9768	0.9442	0.9854	0.9814	0.9582
45	1	0.9354	0.9274	0.9884	0.9806	0.9632	0.9854	0.9764	0.9578
46	1	0.9478	0.9844	0.9672	0.9640	0.9500	0.9898	0.9878	0.9860
47	1	0.9552	0.9800	0.9712	0.9686	0.9562	0.9884	0.9876	0.9814
48	1	0.9406	0.9684	0.9676	0.9638	0.9428	0.9868	0.9860	0.9722
49	1	0.9700	0.9772	0.9840	0.9820	0.9708	0.9876	0.9868	0.9800
50	1	0.9530	0.9660	0.9798	0.9756	0.9570	0.9868	0.9848	0.9708
51	1	0.9646	0.9596	0.9876	0.9858	0.9682	0.9844	0.9820	0.9686
52	1	0.9358	0.9814	0.9682	0.9640	0.9400	0.9894	0.9880	0.9836
53	1	0.9434	0.9700	0.9730	0.9700	0.9490	0.9872	0.9860	0.9754
54	1	0.9204	0.9528	0.9666	0.9624	0.9308	0.9866	0.9846	0.9616
55	1	0.9584	0.9680	0.9844	0.9822	0.9636	0.9870	0.9862	0.9736
56	1	0.9338	0.9452	0.9786	0.9738	0.9438	0.9866	0.9848	0.9604
57	1	0.9438	0.9386	0.9878	0.9852	0.9606	0.9850	0.9830	0.9574
58	1	0.9542	0.9852	0.9690	0.9668	0.9560	0.9894	0.9888	0.9870
59	1	0.9620	0.9822	0.9740	0.9728	0.9624	0.9878	0.9868	0.9840
60	1	0.9464	0.9738	0.9668	0.9646	0.9488	0.9866	0.9856	0.9768
61	1	0.9758	0.9794	0.9854	0.9850	0.9764	0.9874	0.9868	0.9814
62	1	0.9600	0.9706	0.9786	0.9766	0.9626	0.9862	0.9850	0.9756
63	1	0.9720	0.9684	0.9872	0.9860	0.9744	0.9854	0.9838	0.9728
64	1	0.9512	0.9824	0.9744	0.9698	0.9530	0.9882	0.9876	0.9848
65	1	0.9576	0.9762	0.9768	0.9744	0.9598	0.9874	0.9864	0.9794

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
66	1	0.9694	0.9736	0.9870	0.9860	0.9732	0.9864	0.9856	0.9770
67	1	0.9628	0.9862	0.9756	0.9730	0.9632	0.9880	0.9880	0.9874
68	1	0.9684	0.9832	0.9766	0.9762	0.9698	0.9874	0.9870	0.9846
69	1	0.9516	0.9782	0.9660	0.9642	0.9532	0.9872	0.9864	0.9798
70	1	0.9814	0.9810	0.9876	0.9870	0.9820	0.9864	0.9862	0.9828
71	1	0.9664	0.9754	0.9792	0.9770	0.9672	0.9868	0.9850	0.9780
72	1	0.9778	0.9742	0.9880	0.9860	0.9782	0.9860	0.9846	0.9772
73	1	0.9360	0.9794	0.9698	0.9666	0.9426	0.9890	0.9878	0.9824
74	1	0.9432	0.9696	0.9728	0.9686	0.9482	0.9880	0.9870	0.9752
75	1	0.9174	0.9506	0.9674	0.9636	0.9288	0.9870	0.9848	0.9618
76	1	0.9574	0.9646	0.9850	0.9816	0.9618	0.9868	0.9860	0.9716
77	1	0.9266	0.9392	0.9806	0.9766	0.9424	0.9860	0.9830	0.9554
78	1	0.9416	0.9346	0.9874	0.9854	0.9588	0.9848	0.9820	0.9550
79	1	0.9562	0.9848	0.9704	0.9686	0.9570	0.9896	0.9888	0.9868
80	1	0.9598	0.9806	0.9734	0.9720	0.9614	0.9882	0.9878	0.9824
81	1	0.9462	0.9716	0.9674	0.9646	0.9478	0.9870	0.9866	0.9756
82	1	0.9734	0.9788	0.9862	0.9834	0.9750	0.9874	0.9870	0.9812
83	1	0.9580	0.9692	0.9790	0.9770	0.9606	0.9870	0.9852	0.9734
84	1	0.9700	0.9654	0.9882	0.9854	0.9730	0.9844	0.9826	0.9714
85	1	0.9488	0.9824	0.9730	0.9698	0.9522	0.9892	0.9880	0.9840
86	1	0.9536	0.9750	0.9764	0.9748	0.9564	0.9878	0.9866	0.9788
87	1	0.9286	0.9592	0.9672	0.9626	0.9344	0.9864	0.9846	0.9670
88	1	0.9660	0.9714	0.9866	0.9842	0.9698	0.9874	0.9860	0.9756
89	1	0.9410	0.9542	0.9786	0.9746	0.9478	0.9866	0.9848	0.9640
90	1	0.9544	0.9474	0.9870	0.9844	0.9640	0.9850	0.9828	0.9610
91	1	0.9622	0.9856	0.9742	0.9720	0.9628	0.9892	0.9888	0.9870
92	1	0.9672	0.9822	0.9772	0.9762	0.9680	0.9876	0.9868	0.9840
93	1	0.9506	0.9760	0.9668	0.9656	0.9516	0.9866	0.9858	0.9796
94	1	0.9802	0.9802	0.9870	0.9854	0.9814	0.9872	0.9868	0.9816
95	1	0.9642	0.9736	0.9780	0.9766	0.9658	0.9868	0.9850	0.9784
96	1	0.9760	0.9728	0.9872	0.9858	0.9774	0.9860	0.9840	0.9768
97	1	0.9638	0.9830	0.9818	0.9786	0.9648	0.9876	0.9868	0.9852
98	1	0.9660	0.9786	0.9810	0.9782	0.9674	0.9866	0.9864	0.9806

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
99	1	0.9778	0.9760	0.9884	0.9878	0.9792	0.9868	0.9862	0.9776
100	1	0.9716	0.9856	0.9824	0.9804	0.9718	0.9874	0.9878	0.9868
101	1	0.9746	0.9820	0.9812	0.9798	0.9760	0.9870	0.9868	0.9836
102	1	0.9550	0.9790	0.9664	0.9650	0.9558	0.9868	0.9856	0.9818
103	1	0.9848	0.9814	0.9892	0.9886	0.9850	0.9864	0.9868	0.9832
104	1	0.9688	0.9774	0.9788	0.9776	0.9692	0.9874	0.9862	0.9812
105	1	0.9796	0.9764	0.9874	0.9862	0.9806	0.9856	0.9848	0.9792

Table C-7 Coverage Probabilities for the 99 Percent Lower Confidence Bounds (Part 2)

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
1	2A	0.0002	0.0000	0.0266	0.0104	0.0000	0.0130	0.0028	0.0000
	2B	0.0000	0.0000	0.0286	0.0058	0.0000	0.0128	0.0018	0.0000
	2C	0.0012	0.0000	0.0272	0.0144	0.0000	0.0112	0.0044	0.0000
	2D	0.0038	0.0012	0.0260	0.0190	0.0024	0.0104	0.0056	0.0008
2	2A	0.0012	0.0088	0.0034	0.0026	0.0012	0.0122	0.0104	0.0078
	2B	0.0006	0.0102	0.0040	0.0028	0.0006	0.0128	0.0116	0.0082
	2C	0.0024	0.0106	0.0038	0.0028	0.0024	0.0138	0.0132	0.0096
	2D	0.0028	0.0094	0.0062	0.0058	0.0028	0.0108	0.0100	0.0088
3	2A	0.0000	0.0000	0.0122	0.0030	0.0000	0.0112	0.0030	0.0000
	2B	0.0000	0.0000	0.0110	0.0014	0.0000	0.0134	0.0028	0.0000
	2C	0.0000	0.0000	0.0140	0.0050	0.0000	0.0130	0.0066	0.0000
	2D	0.0008	0.0016	0.0122	0.0078	0.0006	0.0112	0.0072	0.0004
4	2A	0.0002	0.0000	0.0260	0.0110	0.0000	0.0130	0.0034	0.0000
	2B	0.0000	0.0000	0.0264	0.0066	0.0000	0.0126	0.0014	0.0000
	2C	0.0016	0.0002	0.0274	0.0158	0.0000	0.0118	0.0054	0.0000
	2D	0.0044	0.0016	0.0266	0.0186	0.0026	0.0104	0.0062	0.0010
5	2A	0.0016	0.0088	0.0046	0.0036	0.0018	0.0132	0.0112	0.0082
	2B	0.0012	0.0106	0.0052	0.0038	0.0006	0.0134	0.0116	0.0088
	2C	0.0028	0.0106	0.0042	0.0040	0.0026	0.0140	0.0132	0.0100
	2D	0.0036	0.0092	0.0070	0.0068	0.0036	0.0118	0.0100	0.0086
6	2A	0.0000	0.0000	0.0116	0.0040	0.0000	0.0114	0.0040	0.0000
	2B	0.0000	0.0000	0.0106	0.0016	0.0000	0.0128	0.0028	0.0000
	2C	0.0000	0.0000	0.0136	0.0060	0.0000	0.0126	0.0070	0.0000
	2D	0.0014	0.0018	0.0118	0.0078	0.0008	0.0112	0.0074	0.0010
7	2A	0.0006	0.0002	0.0262	0.0132	0.0002	0.0126	0.0046	0.0000
	2B	0.0002	0.0000	0.0250	0.0096	0.0000	0.0100	0.0012	0.0000
	2C	0.0022	0.0002	0.0274	0.0174	0.0000	0.0116	0.0062	0.0000
	2D	0.0054	0.0020	0.0260	0.0196	0.0036	0.0104	0.0070	0.0012
8	2A	0.0020	0.0092	0.0054	0.0050	0.0024	0.0126	0.0120	0.0084
	2B	0.0016	0.0108	0.0062	0.0056	0.0018	0.0126	0.0114	0.0090
	2C	0.0034	0.0098	0.0048	0.0042	0.0034	0.0138	0.0134	0.0098
	2D	0.0058	0.0096	0.0080	0.0072	0.0052	0.0116	0.0108	0.0094

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
9	2A	0.0000	0.0000	0.0114	0.0050	0.0000	0.0116	0.0050	0.0000
	2B	0.0000	0.0000	0.0110	0.0020	0.0000	0.0126	0.0042	0.0000
	2C	0.0000	0.0002	0.0130	0.0064	0.0000	0.0128	0.0078	0.0000
	2D	0.0016	0.0022	0.0118	0.0082	0.0010	0.0110	0.0074	0.0016
10	2A	0.0066	0.0018	0.0280	0.0208	0.0046	0.0132	0.0082	0.0012
	2B	0.0056	0.0016	0.0274	0.0186	0.0022	0.0116	0.0078	0.0008
	2C	0.0100	0.0030	0.0292	0.0240	0.0074	0.0114	0.0082	0.0022
	2D	0.0134	0.0038	0.0270	0.0232	0.0126	0.0106	0.0092	0.0036
11	2A	0.0012	0.0110	0.0020	0.0018	0.0012	0.0114	0.0108	0.0106
	2B	0.0008	0.0134	0.0018	0.0014	0.0004	0.0142	0.0134	0.0116
	2C	0.0020	0.0110	0.0024	0.0024	0.0020	0.0132	0.0130	0.0112
	2D	0.0022	0.0102	0.0024	0.0024	0.0022	0.0114	0.0106	0.0096
12	2A	0.0016	0.0026	0.0112	0.0080	0.0008	0.0120	0.0078	0.0014
	2B	0.0012	0.0030	0.0102	0.0050	0.0004	0.0130	0.0084	0.0012
	2C	0.0028	0.0048	0.0136	0.0094	0.0020	0.0128	0.0098	0.0032
	2D	0.0040	0.0046	0.0120	0.0106	0.0036	0.0116	0.0098	0.0040
13	2A	0.0074	0.0024	0.0280	0.0214	0.0052	0.0134	0.0086	0.0014
	2B	0.0066	0.0018	0.0264	0.0192	0.0034	0.0120	0.0078	0.0008
	2C	0.0118	0.0030	0.0290	0.0242	0.0084	0.0112	0.0088	0.0028
	2D	0.0146	0.0040	0.0272	0.0228	0.0136	0.0110	0.0094	0.0036
14	2A	0.0014	0.0110	0.0024	0.0024	0.0014	0.0114	0.0112	0.0104
	2B	0.0010	0.0138	0.0024	0.0016	0.0010	0.0144	0.0138	0.0116
	2C	0.0024	0.0114	0.0024	0.0024	0.0022	0.0132	0.0126	0.0112
	2D	0.0024	0.0104	0.0030	0.0030	0.0024	0.0114	0.0106	0.0100
15	2A	0.0018	0.0030	0.0110	0.0078	0.0014	0.0122	0.0082	0.0014
	2B	0.0014	0.0032	0.0106	0.0054	0.0006	0.0130	0.0088	0.0016
	2C	0.0032	0.0056	0.0136	0.0100	0.0028	0.0134	0.0100	0.0042
	2D	0.0042	0.0050	0.0122	0.0106	0.0040	0.0114	0.0098	0.0042
16	2A	0.0086	0.0026	0.0282	0.0224	0.0070	0.0134	0.0092	0.0020
	2B	0.0078	0.0020	0.0270	0.0202	0.0062	0.0128	0.0086	0.0012
	2C	0.0126	0.0040	0.0282	0.0246	0.0104	0.0116	0.0088	0.0030
	2D	0.0156	0.0042	0.0270	0.0242	0.0152	0.0110	0.0094	0.0038
17	2A	0.0022	0.0112	0.0026	0.0024	0.0022	0.0118	0.0112	0.0106

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
	2B	0.0012	0.0136	0.0028	0.0026	0.0012	0.0142	0.0142	0.0120
	2C	0.0030	0.0116	0.0028	0.0026	0.0028	0.0134	0.0134	0.0116
	2D	0.0028	0.0104	0.0036	0.0040	0.0030	0.0114	0.0104	0.0102
18	2A	0.0022	0.0034	0.0114	0.0080	0.0020	0.0124	0.0088	0.0022
	2B	0.0016	0.0034	0.0108	0.0060	0.0012	0.0134	0.0094	0.0020
	2C	0.0034	0.0060	0.0134	0.0100	0.0032	0.0130	0.0108	0.0050
	2D	0.0046	0.0050	0.0122	0.0098	0.0046	0.0112	0.0102	0.0046
19	2A	0.0136	0.0044	0.0300	0.0250	0.0128	0.0130	0.0100	0.0030
	2B	0.0134	0.0038	0.0280	0.0218	0.0120	0.0114	0.0086	0.0026
	2C	0.0164	0.0050	0.0314	0.0286	0.0152	0.0114	0.0098	0.0046
	2D	0.0184	0.0062	0.0274	0.0260	0.0190	0.0114	0.0102	0.0050
20	2A	0.0002	0.0128	0.0010	0.0006	0.0004	0.0130	0.0128	0.0112
	2B	0.0004	0.0150	0.0006	0.0006	0.0004	0.0160	0.0156	0.0138
	2C	0.0006	0.0138	0.0004	0.0004	0.0008	0.0142	0.0138	0.0126
	2D	0.0014	0.0098	0.0014	0.0016	0.0014	0.0114	0.0102	0.0096
21	2A	0.0042	0.0050	0.0108	0.0090	0.0032	0.0124	0.0100	0.0040
	2B	0.0028	0.0056	0.0092	0.0070	0.0022	0.0132	0.0104	0.0038
	2C	0.0058	0.0074	0.0140	0.0108	0.0044	0.0124	0.0102	0.0066
	2D	0.0056	0.0070	0.0122	0.0112	0.0056	0.0112	0.0098	0.0064
22	2A	0.0146	0.0046	0.0302	0.0254	0.0134	0.0130	0.0112	0.0032
	2B	0.0140	0.0040	0.0276	0.0224	0.0126	0.0112	0.0092	0.0032
	2C	0.0174	0.0052	0.0306	0.0280	0.0160	0.0118	0.0102	0.0046
	2D	0.0186	0.0062	0.0278	0.0262	0.0194	0.0112	0.0102	0.0052
23	2A	0.0002	0.0128	0.0008	0.0006	0.0004	0.0132	0.0128	0.0116
	2B	0.0004	0.0152	0.0008	0.0006	0.0004	0.0162	0.0154	0.0138
	2C	0.0008	0.0132	0.0004	0.0004	0.0008	0.0140	0.0144	0.0126
	2D	0.0018	0.0104	0.0014	0.0016	0.0018	0.0106	0.0102	0.0094
24	2A	0.0050	0.0054	0.0108	0.0086	0.0040	0.0126	0.0100	0.0044
	2B	0.0030	0.0062	0.0088	0.0074	0.0024	0.0136	0.0108	0.0042
	2C	0.0060	0.0080	0.0134	0.0108	0.0052	0.0126	0.0108	0.0066
	2D	0.0058	0.0072	0.0122	0.0108	0.0064	0.0108	0.0100	0.0066
25	2A	0.0156	0.0054	0.0298	0.0260	0.0146	0.0134	0.0114	0.0044
	2B	0.0148	0.0050	0.0278	0.0228	0.0134	0.0114	0.0094	0.0036

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
	2C	0.0194	0.0060	0.0300	0.0274	0.0180	0.0118	0.0110	0.0050
	2D	0.0198	0.0062	0.0274	0.0266	0.0200	0.0108	0.0102	0.0054
26	2A	0.0006	0.0130	0.0008	0.0008	0.0006	0.0132	0.0126	0.0116
	2B	0.0006	0.0156	0.0012	0.0008	0.0004	0.0162	0.0158	0.0136
	2C	0.0012	0.0136	0.0004	0.0006	0.0010	0.0150	0.0142	0.0124
	2D	0.0018	0.0104	0.0016	0.0018	0.0018	0.0106	0.0100	0.0096
27	2A	0.0058	0.0068	0.0110	0.0092	0.0050	0.0122	0.0096	0.0052
	2B	0.0036	0.0066	0.0092	0.0076	0.0028	0.0132	0.0110	0.0050
	2C	0.0066	0.0080	0.0134	0.0112	0.0060	0.0124	0.0110	0.0072
	2D	0.0062	0.0076	0.0116	0.0112	0.0066	0.0110	0.0102	0.0068

Table C-8 Coverage Probabilities for the 95 Percent Lower Confidence Bounds (Part 2)

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
1	2A	0.0226	0.0120	0.0906	0.0454	0.0050	0.0512	0.0244	0.0020
	2B	0.0132	0.0072	0.0926	0.0338	0.0022	0.0576	0.0144	0.0010
	2C	0.0332	0.0158	0.0872	0.0562	0.0156	0.0534	0.0312	0.0060
	2D	0.0446	0.0240	0.0810	0.0636	0.0394	0.0524	0.0378	0.0186
2	2A	0.0236	0.0520	0.0356	0.0316	0.0234	0.0558	0.0532	0.0490
	2B	0.0246	0.0550	0.0390	0.0332	0.0230	0.0614	0.0576	0.0516
	2C	0.0264	0.0524	0.0334	0.0310	0.0260	0.0554	0.0530	0.0494
	2D	0.0330	0.0534	0.0388	0.0374	0.0322	0.0568	0.0552	0.0526
3	2A	0.0086	0.0120	0.0516	0.0250	0.0018	0.0552	0.0244	0.0022
	2B	0.0038	0.0066	0.0516	0.0146	0.0000	0.0562	0.0178	0.0008
	2C	0.0170	0.0172	0.0516	0.0312	0.0072	0.0542	0.0308	0.0064
	2D	0.0272	0.0272	0.0526	0.0384	0.0202	0.0526	0.0408	0.0196
4	2A	0.0250	0.0136	0.0902	0.0496	0.0076	0.0516	0.0264	0.0038
	2B	0.0154	0.0082	0.0878	0.0370	0.0026	0.0574	0.0216	0.0008
	2C	0.0358	0.0182	0.0868	0.0586	0.0198	0.0526	0.0324	0.0080
	2D	0.0458	0.0264	0.0794	0.0644	0.0412	0.0526	0.0396	0.0202
5	2A	0.0290	0.0526	0.0384	0.0348	0.0272	0.0548	0.0528	0.0490
	2B	0.0274	0.0552	0.0422	0.0368	0.0260	0.0610	0.0572	0.0522
	2C	0.0296	0.0520	0.0372	0.0352	0.0286	0.0564	0.0544	0.0500
	2D	0.0370	0.0544	0.0424	0.0410	0.0362	0.0580	0.0554	0.0536
6	2A	0.0092	0.0136	0.0516	0.0272	0.0028	0.0552	0.0274	0.0038
	2B	0.0044	0.0094	0.0522	0.0188	0.0006	0.0588	0.0226	0.0024
	2C	0.0194	0.0190	0.0514	0.0320	0.0096	0.0544	0.0332	0.0094
	2D	0.0282	0.0288	0.0538	0.0396	0.0230	0.0536	0.0414	0.0218
7	2A	0.0292	0.0158	0.0904	0.0556	0.0126	0.0524	0.0298	0.0058
	2B	0.0194	0.0106	0.0866	0.0432	0.0046	0.0560	0.0230	0.0018
	2C	0.0396	0.0220	0.0866	0.0618	0.0262	0.0532	0.0344	0.0118
	2D	0.0500	0.0280	0.0798	0.0658	0.0448	0.0532	0.0424	0.0218
8	2A	0.0344	0.0530	0.0436	0.0396	0.0322	0.0548	0.0522	0.0498
	2B	0.0334	0.0566	0.0484	0.0422	0.0326	0.0612	0.0578	0.0528
	2C	0.0346	0.0526	0.0436	0.0386	0.0338	0.0572	0.0546	0.0514
	2D	0.0424	0.0542	0.0490	0.0454	0.0416	0.0574	0.0556	0.0528

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
9	2A	0.0132	0.0176	0.0526	0.0292	0.0054	0.0566	0.0308	0.0068
	2B	0.0068	0.0140	0.0520	0.0228	0.0016	0.0578	0.0254	0.0038
	2C	0.0210	0.0214	0.0514	0.0342	0.0126	0.0552	0.0366	0.0136
	2D	0.0302	0.0312	0.0532	0.0408	0.0264	0.0546	0.0436	0.0250
10	2A	0.0538	0.0296	0.0930	0.0736	0.0454	0.0516	0.0400	0.0246
	2B	0.0472	0.0282	0.0896	0.0654	0.0336	0.0596	0.0418	0.0172
	2C	0.0574	0.0334	0.0910	0.0762	0.0536	0.0536	0.0434	0.0288
	2D	0.0648	0.0354	0.0838	0.0746	0.0612	0.0510	0.0450	0.0324
11	2A	0.0194	0.0564	0.0232	0.0228	0.0194	0.0592	0.0564	0.0542
	2B	0.0218	0.0574	0.0268	0.0254	0.0218	0.0592	0.0574	0.0550
	2C	0.0230	0.0552	0.0228	0.0234	0.0224	0.0564	0.0554	0.0542
	2D	0.0218	0.0536	0.0254	0.0248	0.0230	0.0582	0.0542	0.0534
12	2A	0.0276	0.0330	0.0512	0.0406	0.0230	0.0560	0.0438	0.0234
	2B	0.0230	0.0302	0.0524	0.0340	0.0156	0.0588	0.0430	0.0208
	2C	0.0316	0.0334	0.0512	0.0412	0.0284	0.0544	0.0430	0.0292
	2D	0.0372	0.0382	0.0520	0.0442	0.0352	0.0528	0.0472	0.0366
13	2A	0.0554	0.0308	0.0930	0.0766	0.0476	0.0520	0.0402	0.0258
	2B	0.0476	0.0302	0.0904	0.0670	0.0390	0.0600	0.0434	0.0192
	2C	0.0596	0.0346	0.0896	0.0774	0.0552	0.0536	0.0436	0.0302
	2D	0.0656	0.0376	0.0822	0.0746	0.0620	0.0520	0.0466	0.0350
14	2A	0.0230	0.0560	0.0250	0.0260	0.0228	0.0596	0.0552	0.0534
	2B	0.0234	0.0582	0.0300	0.0270	0.0234	0.0592	0.0586	0.0556
	2C	0.0240	0.0552	0.0242	0.0248	0.0236	0.0562	0.0554	0.0544
	2D	0.0254	0.0540	0.0280	0.0266	0.0256	0.0576	0.0548	0.0532
15	2A	0.0284	0.0340	0.0518	0.0422	0.0244	0.0564	0.0452	0.0254
	2B	0.0242	0.0312	0.0534	0.0366	0.0184	0.0604	0.0442	0.0228
	2C	0.0322	0.0346	0.0518	0.0424	0.0296	0.0552	0.0440	0.0300
	2D	0.0376	0.0390	0.0522	0.0454	0.0364	0.0530	0.0474	0.0368
16	2A	0.0594	0.0330	0.0922	0.0782	0.0534	0.0522	0.0412	0.0272
	2B	0.0494	0.0328	0.0892	0.0702	0.0432	0.0596	0.0454	0.0234
	2C	0.0630	0.0358	0.0900	0.0772	0.0584	0.0530	0.0430	0.0316
	2D	0.0648	0.0400	0.0830	0.0752	0.0628	0.0520	0.0482	0.0372
17	2A	0.0254	0.0558	0.0288	0.0282	0.0262	0.0588	0.0556	0.0536

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
	2B	0.0272	0.0582	0.0318	0.0306	0.0274	0.0590	0.0584	0.0554
	2C	0.0260	0.0562	0.0264	0.0274	0.0262	0.0562	0.0560	0.0548
	2D	0.0310	0.0542	0.0324	0.0304	0.0298	0.0570	0.0546	0.0536
18	2A	0.0300	0.0360	0.0522	0.0430	0.0264	0.0572	0.0452	0.0282
	2B	0.0254	0.0358	0.0538	0.0384	0.0214	0.0586	0.0448	0.0256
	2C	0.0336	0.0358	0.0530	0.0444	0.0308	0.0564	0.0456	0.0318
	2D	0.0386	0.0396	0.0530	0.0468	0.0374	0.0526	0.0482	0.0386
19	2A	0.0680	0.0386	0.0966	0.0838	0.0658	0.0526	0.0460	0.0322
	2B	0.0628	0.0396	0.0948	0.0794	0.0566	0.0584	0.0488	0.0316
	2C	0.0728	0.0420	0.0926	0.0830	0.0686	0.0528	0.0458	0.0380
	2D	0.0710	0.0408	0.0858	0.0794	0.0698	0.0512	0.0460	0.0382
20	2A	0.0114	0.0594	0.0126	0.0108	0.0114	0.0602	0.0598	0.0580
	2B	0.0150	0.0596	0.0170	0.0170	0.0150	0.0606	0.0600	0.0584
	2C	0.0136	0.0582	0.0148	0.0148	0.0136	0.0578	0.0572	0.0566
	2D	0.0136	0.0542	0.0148	0.0148	0.0140	0.0578	0.0554	0.0546
21	2A	0.0360	0.0408	0.0532	0.0444	0.0338	0.0578	0.0488	0.0368
	2B	0.0318	0.0412	0.0530	0.0408	0.0294	0.0586	0.0490	0.0328
	2C	0.0376	0.0412	0.0510	0.0462	0.0364	0.0538	0.0476	0.0386
	2D	0.0414	0.0430	0.0512	0.0464	0.0406	0.0510	0.0486	0.0410
22	2A	0.0692	0.0390	0.0962	0.0852	0.0678	0.0524	0.0458	0.0336
	2B	0.0638	0.0410	0.0950	0.0802	0.0584	0.0590	0.0496	0.0338
	2C	0.0730	0.0418	0.0928	0.0830	0.0698	0.0526	0.0462	0.0390
	2D	0.0708	0.0420	0.0854	0.0796	0.0704	0.0514	0.0462	0.0398
23	2A	0.0124	0.0608	0.0138	0.0122	0.0124	0.0604	0.0588	0.0580
	2B	0.0164	0.0602	0.0178	0.0184	0.0166	0.0612	0.0604	0.0580
	2C	0.0148	0.0574	0.0156	0.0160	0.0146	0.0582	0.0580	0.0564
	2D	0.0144	0.0550	0.0160	0.0160	0.0150	0.0576	0.0552	0.0554
24	2A	0.0368	0.0416	0.0524	0.0452	0.0352	0.0562	0.0484	0.0374
	2B	0.0330	0.0428	0.0528	0.0410	0.0304	0.0586	0.0504	0.0342
	2C	0.0392	0.0414	0.0520	0.0462	0.0382	0.0544	0.0478	0.0384
	2D	0.0418	0.0434	0.0514	0.0462	0.0404	0.0518	0.0490	0.0420
25	2A	0.0718	0.0402	0.0976	0.0866	0.0702	0.0528	0.0456	0.0354
	2B	0.0658	0.0432	0.0940	0.0800	0.0618	0.0598	0.0508	0.0362

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
	2C	0.0734	0.0422	0.0940	0.0840	0.0708	0.0526	0.0460	0.0400
	2D	0.0726	0.0430	0.0852	0.0794	0.0718	0.0516	0.0470	0.0414
26	2A	0.0144	0.0614	0.0148	0.0142	0.0146	0.0596	0.0602	0.0584
	2B	0.0176	0.0616	0.0192	0.0192	0.0184	0.0602	0.0606	0.0588
	2C	0.0170	0.0576	0.0166	0.0166	0.0162	0.0580	0.0578	0.0566
	2D	0.0158	0.0554	0.0176	0.0170	0.0164	0.0558	0.0548	0.0548
27	2A	0.0378	0.0430	0.0524	0.0456	0.0370	0.0572	0.0506	0.0388
	2B	0.0340	0.0448	0.0536	0.0432	0.0318	0.0584	0.0510	0.0374
	2C	0.0400	0.0438	0.0528	0.0472	0.0402	0.0550	0.0488	0.0400
	2D	0.0426	0.0436	0.0516	0.0464	0.0420	0.0518	0.0490	0.0424

Table C-9 Coverage Probabilities for the 90 Percent Lower Confidence Bounds (Part 2)

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
1	2A	0.0830	0.0550	0.1508	0.0948	0.0400	0.1070	0.0614	0.0230
	2B	0.0662	0.0462	0.1466	0.0742	0.0190	0.1114	0.0462	0.0094
	2C	0.0960	0.0652	0.1446	0.1076	0.0660	0.1036	0.0696	0.0424
	2D	0.1062	0.0744	0.1394	0.1154	0.0952	0.0992	0.0802	0.0672
2	2A	0.0724	0.1034	0.0858	0.0778	0.0722	0.1066	0.1026	0.1008
	2B	0.0732	0.1082	0.0890	0.0810	0.0710	0.1130	0.1058	0.1006
	2C	0.0720	0.1014	0.0844	0.0784	0.0708	0.1034	0.1012	0.0974
	2D	0.0764	0.1042	0.0824	0.0798	0.0754	0.1076	0.1052	0.1036
3	2A	0.0478	0.0568	0.1010	0.0570	0.0222	0.1056	0.0608	0.0244
	2B	0.0366	0.0480	0.1034	0.0424	0.0074	0.1058	0.0464	0.0110
	2C	0.0584	0.0660	0.1058	0.0704	0.0404	0.1078	0.0716	0.0416
	2D	0.0700	0.0730	0.0994	0.0784	0.0626	0.0986	0.0792	0.0644
4	2A	0.0886	0.0600	0.1508	0.1002	0.0478	0.1068	0.0652	0.0286
	2B	0.0688	0.0526	0.1450	0.0784	0.0240	0.1058	0.0538	0.0130
	2C	0.0974	0.0674	0.1462	0.1104	0.0736	0.1040	0.0724	0.0464
	2D	0.1080	0.0752	0.1382	0.1182	0.0992	0.1008	0.0818	0.0688
5	2A	0.0770	0.1040	0.0914	0.0824	0.0760	0.1060	0.1036	0.1010
	2B	0.0788	0.1100	0.0940	0.0848	0.0762	0.1126	0.1070	0.1012
	2C	0.0772	0.1006	0.0868	0.0826	0.0764	0.1044	0.1018	0.0982
	2D	0.0808	0.1044	0.0888	0.0838	0.0810	0.1070	0.1052	0.1040
6	2A	0.0510	0.0610	0.1012	0.0614	0.0284	0.1056	0.0650	0.0312
	2B	0.0400	0.0548	0.1028	0.0492	0.0104	0.1064	0.0528	0.0148
	2C	0.0612	0.0670	0.1060	0.0730	0.0456	0.1076	0.0750	0.0476
	2D	0.0708	0.0740	0.1000	0.0800	0.0646	0.0986	0.0812	0.0672
7	2A	0.0940	0.0630	0.1490	0.1052	0.0628	0.1082	0.0682	0.0368
	2B	0.0796	0.0542	0.1444	0.0892	0.0354	0.1048	0.0576	0.0214
	2C	0.1018	0.0702	0.1460	0.1134	0.0808	0.1028	0.0754	0.0528
	2D	0.1110	0.0774	0.1374	0.1206	0.1040	0.1008	0.0828	0.0704
8	2A	0.0842	0.1042	0.0980	0.0906	0.0814	0.1064	0.1048	0.1026
	2B	0.0856	0.1112	0.1008	0.0922	0.0840	0.1128	0.1078	0.1046
	2C	0.0840	0.1018	0.0932	0.0890	0.0834	0.1050	0.1008	0.0974
	2D	0.0874	0.1044	0.0956	0.0916	0.0870	0.1072	0.1052	0.1046

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
9	2A	0.0564	0.0664	0.1012	0.0644	0.0376	0.1062	0.0708	0.0374
	2B	0.0472	0.0610	0.1032	0.0564	0.0174	0.1082	0.0610	0.0222
	2C	0.0656	0.0706	0.1056	0.0752	0.0518	0.1072	0.0782	0.0534
	2D	0.0744	0.0752	0.0992	0.0826	0.0696	0.1008	0.0836	0.0704
10	2A	0.1184	0.0816	0.1566	0.1290	0.1102	0.1060	0.0854	0.0712
	2B	0.1122	0.0818	0.1512	0.1242	0.0956	0.1088	0.0856	0.0640
	2C	0.1230	0.0838	0.1468	0.1316	0.1178	0.1038	0.0866	0.0736
	2D	0.1242	0.0858	0.1428	0.1308	0.1216	0.1008	0.0896	0.0836
11	2A	0.0596	0.1072	0.0664	0.0638	0.0608	0.1072	0.1050	0.1046
	2B	0.0610	0.1096	0.0684	0.0668	0.0612	0.1116	0.1074	0.1052
	2C	0.0560	0.1060	0.0618	0.0586	0.0552	0.1056	0.1046	0.1040
	2D	0.0634	0.1064	0.0654	0.0656	0.0634	0.1072	0.1064	0.1056
12	2A	0.0736	0.0824	0.1010	0.0804	0.0666	0.1060	0.0870	0.0704
	2B	0.0722	0.0802	0.1044	0.0806	0.0584	0.1096	0.0834	0.0650
	2C	0.0804	0.0866	0.1072	0.0900	0.0752	0.1082	0.0906	0.0760
	2D	0.0828	0.0858	0.0988	0.0868	0.0804	0.1004	0.0896	0.0822
13	2A	0.1210	0.0824	0.1554	0.1298	0.1130	0.1064	0.0858	0.0730
	2B	0.1140	0.0828	0.1508	0.1258	0.0996	0.1094	0.0858	0.0670
	2C	0.1240	0.0842	0.1468	0.1320	0.1206	0.1050	0.0880	0.0762
	2D	0.1266	0.0866	0.1434	0.1310	0.1232	0.1002	0.0906	0.0850
14	2A	0.0654	0.1074	0.0726	0.0690	0.0656	0.1064	0.1052	0.1052
	2B	0.0670	0.1102	0.0740	0.0718	0.0672	0.1118	0.1078	0.1058
	2C	0.0616	0.1058	0.0656	0.0648	0.0606	0.1054	0.1044	0.1032
	2D	0.0660	0.1062	0.0680	0.0676	0.0664	0.1074	0.1060	0.1056
15	2A	0.0748	0.0848	0.1018	0.0822	0.0680	0.1076	0.0868	0.0730
	2B	0.0740	0.0808	0.1042	0.0820	0.0628	0.1088	0.0836	0.0684
	2C	0.0818	0.0870	0.1076	0.0924	0.0774	0.1078	0.0920	0.0794
	2D	0.0832	0.0858	0.1000	0.0882	0.0808	0.0992	0.0906	0.0836
16	2A	0.1236	0.0846	0.1546	0.1316	0.1166	0.1092	0.0868	0.0758
	2B	0.1168	0.0868	0.1514	0.1284	0.1062	0.1092	0.0882	0.0700
	2C	0.1258	0.0858	0.1486	0.1340	0.1226	0.1036	0.0896	0.0778
	2D	0.1286	0.0888	0.1436	0.1330	0.1266	0.0998	0.0906	0.0856
17	2A	0.0710	0.1072	0.0762	0.0730	0.0710	0.1070	0.1056	0.1048

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
	2B	0.0740	0.1118	0.0794	0.0788	0.0738	0.1122	0.1088	0.1068
	2C	0.0660	0.1040	0.0714	0.0710	0.0666	0.1034	0.1044	0.1026
	2D	0.0712	0.1056	0.0748	0.0730	0.0708	0.1068	0.1062	0.1052
18	2A	0.0760	0.0860	0.1014	0.0832	0.0708	0.1066	0.0904	0.0768
	2B	0.0778	0.0838	0.1036	0.0842	0.0682	0.1088	0.0864	0.0714
	2C	0.0852	0.0898	0.1066	0.0928	0.0810	0.1064	0.0934	0.0826
	2D	0.0848	0.0878	0.0990	0.0900	0.0826	0.0994	0.0912	0.0850
19	2A	0.1326	0.0910	0.1604	0.1426	0.1274	0.1074	0.0938	0.0830
	2B	0.1270	0.0934	0.1532	0.1396	0.1210	0.1092	0.0946	0.0836
	2C	0.1344	0.0892	0.1516	0.1398	0.1326	0.1042	0.0934	0.0848
	2D	0.1316	0.0912	0.1448	0.1366	0.1312	0.1008	0.0938	0.0898
20	2A	0.0466	0.1106	0.0478	0.0484	0.0478	0.1124	0.1106	0.1098
	2B	0.0482	0.1098	0.0508	0.0502	0.0472	0.1110	0.1074	0.1068
	2C	0.0408	0.1052	0.0434	0.0426	0.0408	0.1032	0.1030	0.1016
	2D	0.0444	0.1068	0.0464	0.0462	0.0450	0.1070	0.1056	0.1044
21	2A	0.0830	0.0934	0.1042	0.0902	0.0804	0.1080	0.0952	0.0854
	2B	0.0844	0.0932	0.1064	0.0896	0.0804	0.1112	0.0936	0.0810
	2C	0.0900	0.0938	0.1064	0.0952	0.0876	0.1064	0.0974	0.0902
	2D	0.0882	0.0894	0.0986	0.0920	0.0876	0.1002	0.0940	0.0882
22	2A	0.1348	0.0912	0.1590	0.1452	0.1306	0.1062	0.0938	0.0848
	2B	0.1292	0.0962	0.1536	0.1402	0.1244	0.1082	0.0962	0.0852
	2C	0.1354	0.0906	0.1502	0.1400	0.1338	0.1040	0.0954	0.0856
	2D	0.1326	0.0928	0.1458	0.1380	0.1322	0.1014	0.0940	0.0908
23	2A	0.0494	0.1106	0.0494	0.0502	0.0488	0.1118	0.1100	0.1096
	2B	0.0506	0.1098	0.0526	0.0534	0.0494	0.1104	0.1082	0.1062
	2C	0.0442	0.1050	0.0444	0.0450	0.0436	0.1038	0.1028	0.1012
	2D	0.0468	0.1072	0.0486	0.0492	0.0470	0.1064	0.1062	0.1058
24	2A	0.0844	0.0942	0.1040	0.0906	0.0818	0.1080	0.0956	0.0864
	2B	0.0846	0.0944	0.1042	0.0900	0.0804	0.1102	0.0938	0.0828
	2C	0.0910	0.0950	0.1062	0.0956	0.0886	0.1066	0.0978	0.0906
	2D	0.0890	0.0910	0.0980	0.0920	0.0884	0.1002	0.0940	0.0902
25	2A	0.1368	0.0912	0.1596	0.1464	0.1346	0.1064	0.0934	0.0866
	2B	0.1314	0.0966	0.1536	0.1418	0.1278	0.1098	0.0972	0.0874

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
	2C	0.1362	0.0936	0.1500	0.1402	0.1358	0.1046	0.0964	0.0880
	2D	0.1350	0.0926	0.1464	0.1388	0.1338	0.1002	0.0958	0.0906
26	2A	0.0512	0.1124	0.0526	0.0532	0.0516	0.1118	0.1118	0.1100
	2B	0.0534	0.1108	0.0550	0.0560	0.0532	0.1082	0.1080	0.1062
	2C	0.0456	0.1046	0.0466	0.0462	0.0454	0.1046	0.1034	0.1020
	2D	0.0506	0.1076	0.0520	0.0528	0.0512	0.1060	0.1056	0.1066
27	2A	0.0852	0.0952	0.1052	0.0922	0.0836	0.1072	0.0966	0.0894
	2B	0.0860	0.0946	0.1054	0.0912	0.0822	0.1114	0.0950	0.0850
	2C	0.0922	0.0974	0.1052	0.0970	0.0898	0.1066	0.0986	0.0916
	2D	0.0894	0.0922	0.0978	0.0914	0.0874	0.1012	0.0952	0.0914

Table C-10 Coverage Probabilities for the 90 Percent Upper Confidence Bounds (Part 2)

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
1	2A	0.8098	0.8566	0.8452	0.8278	0.8264	0.8964	0.8776	0.8732
	2B	0.7992	0.8364	0.8430	0.8166	0.8192	0.8864	0.8630	0.8602
	2C	0.8236	0.8620	0.8592	0.8396	0.8354	0.8950	0.8776	0.8716
	2D	0.8400	0.8756	0.8616	0.8500	0.8446	0.8984	0.8858	0.8816
2	2A	0.8968	0.8818	0.9078	0.9008	0.8982	0.8928	0.8892	0.8866
	2B	0.8996	0.8760	0.9140	0.9036	0.9018	0.8852	0.8818	0.8796
	2C	0.8996	0.8818	0.9104	0.9022	0.9004	0.8912	0.8880	0.8850
	2D	0.9134	0.8932	0.9228	0.9156	0.9148	0.8996	0.8958	0.8938
3	2A	0.8516	0.8448	0.8906	0.8696	0.8664	0.8880	0.8658	0.8610
	2B	0.8472	0.8334	0.8880	0.8654	0.8654	0.8806	0.8562	0.8558
	2C	0.8642	0.8584	0.8948	0.8756	0.8712	0.8910	0.8742	0.8700
	2D	0.8798	0.8780	0.9022	0.8908	0.8848	0.9036	0.8896	0.8832
4	2A	0.8128	0.8584	0.8466	0.8284	0.8282	0.8960	0.8776	0.8740
	2B	0.8034	0.8418	0.8460	0.8234	0.8246	0.8890	0.8690	0.8670
	2C	0.8240	0.8612	0.8588	0.8420	0.8364	0.8938	0.8770	0.8726
	2D	0.8402	0.8760	0.8622	0.8492	0.8460	0.8982	0.8846	0.8810
5	2A	0.8918	0.8842	0.9028	0.8944	0.8938	0.8938	0.8904	0.8878
	2B	0.8966	0.8764	0.9118	0.9010	0.8994	0.8858	0.8816	0.8796
	2C	0.8950	0.8816	0.9058	0.8992	0.8958	0.8902	0.8876	0.8856
	2D	0.9104	0.8928	0.9186	0.9124	0.9112	0.9004	0.8952	0.8932
6	2A	0.8540	0.8466	0.8918	0.8702	0.8672	0.8886	0.8672	0.8620
	2B	0.8508	0.8364	0.8862	0.8680	0.8666	0.8814	0.8580	0.8562
	2C	0.8654	0.8596	0.8930	0.8750	0.8724	0.8894	0.8746	0.8706
	2D	0.8810	0.8778	0.9032	0.8904	0.8850	0.9020	0.8902	0.8842
7	2A	0.8140	0.8608	0.8474	0.8308	0.8270	0.8968	0.8794	0.8754
	2B	0.8094	0.8414	0.8492	0.8294	0.8282	0.8866	0.8702	0.8634
	2C	0.8278	0.8628	0.8570	0.8440	0.8372	0.8948	0.8782	0.8720
	2D	0.8428	0.8766	0.8628	0.8492	0.8456	0.8976	0.8868	0.8810
8	2A	0.8858	0.8852	0.8964	0.8884	0.8884	0.8928	0.8904	0.8886
	2B	0.8922	0.8764	0.9072	0.8958	0.8934	0.8856	0.8828	0.8802
	2C	0.8896	0.8820	0.9018	0.8932	0.8904	0.8904	0.8880	0.8854
	2D	0.9046	0.8930	0.9122	0.9062	0.9060	0.9000	0.8960	0.8938

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
9	2A	0.8554	0.8478	0.8924	0.8700	0.8658	0.8900	0.8684	0.8646
	2B	0.8536	0.8402	0.8870	0.8676	0.8654	0.8804	0.8612	0.8578
	2C	0.8658	0.8600	0.8930	0.8772	0.8734	0.8916	0.8764	0.8712
	2D	0.8818	0.8792	0.9040	0.8920	0.8852	0.9026	0.8914	0.8850
10	2A	0.8208	0.8724	0.8434	0.8320	0.8278	0.8956	0.8842	0.8802
	2B	0.8182	0.8562	0.8412	0.8300	0.8264	0.8880	0.8742	0.8690
	2C	0.8354	0.8730	0.8574	0.8462	0.8412	0.8970	0.8836	0.8792
	2D	0.8484	0.8870	0.8604	0.8542	0.8510	0.8974	0.8916	0.8888
11	2A	0.9210	0.8842	0.9288	0.9230	0.9230	0.8902	0.8902	0.8872
	2B	0.9222	0.8792	0.9344	0.9254	0.9240	0.8872	0.8844	0.8836
	2C	0.9208	0.8858	0.9294	0.9226	0.9218	0.8912	0.8894	0.8882
	2D	0.9378	0.8936	0.9450	0.9390	0.9372	0.8958	0.8948	0.8940
12	2A	0.8644	0.8576	0.8880	0.8756	0.8706	0.8874	0.8702	0.8664
	2B	0.8638	0.8488	0.8878	0.8744	0.8696	0.8826	0.8674	0.8632
	2C	0.8748	0.8688	0.8928	0.8824	0.8778	0.8914	0.8804	0.8736
	2D	0.8882	0.8868	0.9026	0.8944	0.8900	0.9022	0.8944	0.8894
13	2A	0.8220	0.8738	0.8450	0.8322	0.8282	0.8948	0.8842	0.8794
	2B	0.8210	0.8592	0.8398	0.8314	0.8282	0.8872	0.8738	0.8690
	2C	0.8356	0.8732	0.8576	0.8476	0.8418	0.8968	0.8848	0.8800
	2D	0.8494	0.8864	0.8620	0.8534	0.8512	0.8986	0.8912	0.8888
14	2A	0.9190	0.8860	0.9256	0.9196	0.9202	0.8898	0.8914	0.8876
	2B	0.9196	0.8786	0.9300	0.9220	0.9214	0.8866	0.8848	0.8826
	2C	0.9186	0.8852	0.9264	0.9196	0.9176	0.8916	0.8880	0.8870
	2D	0.9344	0.8922	0.9396	0.9352	0.9342	0.8970	0.8954	0.8930
15	2A	0.8666	0.8578	0.8888	0.8766	0.8722	0.8874	0.8730	0.8678
	2B	0.8656	0.8506	0.8874	0.8756	0.8706	0.8838	0.8686	0.8634
	2C	0.8738	0.8700	0.8926	0.8820	0.8780	0.8916	0.8812	0.8748
	2D	0.8884	0.8876	0.9018	0.8948	0.8912	0.9024	0.8950	0.8898
16	2A	0.8258	0.8762	0.8454	0.8352	0.8308	0.8950	0.8854	0.8822
	2B	0.8238	0.8612	0.8428	0.8318	0.8292	0.8868	0.8762	0.8718
	2C	0.8384	0.8750	0.8558	0.8458	0.8418	0.8960	0.8854	0.8802
	2D	0.8492	0.8862	0.8612	0.8538	0.8508	0.8974	0.8924	0.8880
17	2A	0.9130	0.8856	0.9210	0.9156	0.9148	0.8920	0.8910	0.8892

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
	2B	0.9158	0.8790	0.9272	0.9176	0.9178	0.8860	0.8846	0.8820
	2C	0.9140	0.8860	0.9208	0.9154	0.9148	0.8908	0.8886	0.8874
	2D	0.9306	0.8912	0.9336	0.9306	0.9304	0.8972	0.8966	0.8934
18	2A	0.8684	0.8610	0.8892	0.8762	0.8722	0.8868	0.8746	0.8694
	2B	0.8670	0.8526	0.8876	0.8762	0.8714	0.8816	0.8700	0.8638
	2C	0.8756	0.8706	0.8920	0.8820	0.8786	0.8918	0.8806	0.8758
	2D	0.8912	0.8892	0.9034	0.8966	0.8918	0.9020	0.8952	0.8904
19	2A	0.8242	0.8798	0.8406	0.8314	0.8272	0.8958	0.8908	0.8860
	2B	0.8238	0.8650	0.8402	0.8316	0.8270	0.8892	0.8792	0.8742
	2C	0.8420	0.8820	0.8536	0.8458	0.8426	0.8980	0.8904	0.8868
	2D	0.8502	0.8910	0.8602	0.8536	0.8518	0.8994	0.8944	0.8908
20	2A	0.9430	0.8806	0.9494	0.9436	0.9434	0.8870	0.8854	0.8840
	2B	0.9436	0.8792	0.9492	0.9438	0.9434	0.8868	0.8856	0.8828
	2C	0.9456	0.8894	0.9520	0.9468	0.9474	0.8930	0.8914	0.8910
	2D	0.9582	0.8944	0.9614	0.9594	0.9594	0.8948	0.8952	0.8950
21	2A	0.8720	0.8646	0.8868	0.8786	0.8742	0.8848	0.8774	0.8720
	2B	0.8712	0.8580	0.8868	0.8792	0.8738	0.8830	0.8736	0.8682
	2C	0.8810	0.8754	0.8918	0.8846	0.8818	0.8918	0.8826	0.8796
	2D	0.8928	0.8918	0.9020	0.8978	0.8942	0.9034	0.8970	0.8944
22	2A	0.8254	0.8802	0.8400	0.8324	0.8282	0.8954	0.8896	0.8874
	2B	0.8246	0.8656	0.8422	0.8314	0.8286	0.8888	0.8796	0.8746
	2C	0.8420	0.8826	0.8536	0.8452	0.8426	0.8988	0.8904	0.8864
	2D	0.8516	0.8908	0.8608	0.8558	0.8530	0.9004	0.8950	0.8922
23	2A	0.9412	0.8824	0.9476	0.9410	0.9412	0.8876	0.8864	0.8848
	2B	0.9426	0.8784	0.9474	0.9434	0.9424	0.8856	0.8850	0.8826
	2C	0.9436	0.8878	0.9502	0.9460	0.9456	0.8930	0.8910	0.8904
	2D	0.9568	0.8946	0.9602	0.9584	0.9572	0.8958	0.8962	0.8954
24	2A	0.8734	0.8650	0.8882	0.8782	0.8744	0.8858	0.8774	0.8732
	2B	0.8720	0.8606	0.8872	0.8796	0.8750	0.8830	0.8722	0.8686
	2C	0.8818	0.8752	0.8912	0.8852	0.8822	0.8914	0.8828	0.8790
	2D	0.8932	0.8926	0.9022	0.8980	0.8948	0.9032	0.8978	0.8934
25	2A	0.8282	0.8826	0.8402	0.8332	0.8304	0.8956	0.8902	0.8866
	2B	0.8272	0.8668	0.8402	0.8318	0.8296	0.8880	0.8810	0.8740

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
	2C	0.8412	0.8834	0.8522	0.8456	0.8418	0.8978	0.8898	0.8872
	2D	0.8522	0.8914	0.8610	0.8542	0.8524	0.9006	0.8940	0.8922
26	2A	0.9382	0.8828	0.9446	0.9392	0.9392	0.8876	0.8864	0.8870
	2B	0.9422	0.8794	0.9468	0.9418	0.9416	0.8848	0.8852	0.8830
	2C	0.9408	0.8886	0.9466	0.9426	0.9412	0.8926	0.8906	0.8884
	2D	0.9548	0.8952	0.9596	0.9562	0.9556	0.8952	0.8966	0.8962
27	2A	0.8742	0.8664	0.8854	0.8776	0.8756	0.8846	0.8778	0.8730
	2B	0.8738	0.8614	0.8882	0.8806	0.8752	0.8822	0.8760	0.8692
	2C	0.8814	0.8762	0.8916	0.8860	0.8832	0.8902	0.8842	0.8794
	2D	0.8936	0.8924	0.9024	0.8982	0.8940	0.9022	0.8976	0.8942

Table C-11 Coverage Probabilities for the 95 Percent Upper Confidence Bounds (Part 2)

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
1	2A	0.8552	0.9062	0.9012	0.8854	0.8674	0.9458	0.9358	0.9212
	2B	0.8474	0.8904	0.9052	0.8884	0.8688	0.9388	0.9258	0.9124
	2C	0.8780	0.9142	0.9160	0.9032	0.8878	0.9470	0.9382	0.9240
	2D	0.8944	0.9228	0.9218	0.9122	0.9000	0.9486	0.9420	0.9260
2	2A	0.9458	0.9342	0.9624	0.9564	0.9480	0.9428	0.9390	0.9372
	2B	0.9454	0.9248	0.9622	0.9542	0.9476	0.9352	0.9338	0.9290
	2C	0.9452	0.9356	0.9590	0.9540	0.9460	0.9428	0.9416	0.9380
	2D	0.9620	0.9448	0.9708	0.9666	0.9634	0.9514	0.9496	0.9460
3	2A	0.9026	0.8974	0.9434	0.9304	0.9130	0.9368	0.9268	0.9120
	2B	0.8916	0.8824	0.9404	0.9276	0.9096	0.9346	0.9204	0.9044
	2C	0.9130	0.9066	0.9462	0.9378	0.9216	0.9456	0.9338	0.9172
	2D	0.9272	0.9274	0.9520	0.9472	0.9330	0.9524	0.9462	0.9326
4	2A	0.8570	0.9076	0.9006	0.8864	0.8680	0.9454	0.9372	0.9214
	2B	0.8526	0.8918	0.9042	0.8894	0.8716	0.9380	0.9268	0.9106
	2C	0.8816	0.9142	0.9156	0.9038	0.8884	0.9466	0.9378	0.9244
	2D	0.8946	0.9232	0.9212	0.9124	0.9012	0.9476	0.9418	0.9278
5	2A	0.9418	0.9346	0.9600	0.9538	0.9436	0.9426	0.9406	0.9374
	2B	0.9432	0.9256	0.9594	0.9530	0.9452	0.9352	0.9338	0.9300
	2C	0.9432	0.9352	0.9556	0.9502	0.9442	0.9426	0.9426	0.9374
	2D	0.9584	0.9450	0.9674	0.9642	0.9598	0.9508	0.9496	0.9460
6	2A	0.9052	0.8994	0.9434	0.9308	0.9154	0.9364	0.9262	0.9138
	2B	0.8928	0.8862	0.9394	0.9282	0.9086	0.9358	0.9226	0.9050
	2C	0.9150	0.9076	0.9466	0.9376	0.9226	0.9454	0.9332	0.9168
	2D	0.9296	0.9288	0.9528	0.9464	0.9334	0.9536	0.9458	0.9338
7	2A	0.8600	0.9100	0.9004	0.8886	0.8708	0.9450	0.9370	0.9224
	2B	0.8562	0.8946	0.9064	0.8910	0.8740	0.9376	0.9274	0.9108
	2C	0.8838	0.9166	0.9154	0.9028	0.8904	0.9456	0.9372	0.9250
	2D	0.8960	0.9254	0.9204	0.9140	0.9024	0.9484	0.9418	0.9304
8	2A	0.9380	0.9348	0.9546	0.9476	0.9398	0.9434	0.9410	0.9378
	2B	0.9392	0.9258	0.9556	0.9488	0.9412	0.9358	0.9336	0.9300
	2C	0.9398	0.9358	0.9500	0.9460	0.9408	0.9436	0.9426	0.9376
	2D	0.9548	0.9460	0.9630	0.9602	0.9562	0.9502	0.9502	0.9478

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
9	2A	0.9086	0.9016	0.9436	0.9318	0.9160	0.9362	0.9276	0.9162
	2B	0.8972	0.8886	0.9408	0.9280	0.9088	0.9384	0.9234	0.9058
	2C	0.9170	0.9080	0.9462	0.9388	0.9224	0.9450	0.9332	0.9194
	2D	0.9302	0.9294	0.9524	0.9446	0.9342	0.9524	0.9456	0.9340
10	2A	0.8700	0.9218	0.8996	0.8872	0.8746	0.9464	0.9404	0.9284
	2B	0.8694	0.9080	0.9046	0.8914	0.8774	0.9400	0.9328	0.9188
	2C	0.8912	0.9274	0.9142	0.9048	0.8944	0.9470	0.9414	0.9314
	2D	0.9030	0.9326	0.9218	0.9150	0.9064	0.9484	0.9454	0.9352
11	2A	0.9656	0.9346	0.9746	0.9704	0.9652	0.9388	0.9374	0.9370
	2B	0.9652	0.9278	0.9744	0.9722	0.9650	0.9344	0.9334	0.9306
	2C	0.9658	0.9390	0.9720	0.9698	0.9664	0.9446	0.9426	0.9406
	2D	0.9762	0.9476	0.9800	0.9780	0.9768	0.9486	0.9494	0.9476
12	2A	0.9172	0.9102	0.9432	0.9338	0.9234	0.9358	0.9302	0.9194
	2B	0.9100	0.9026	0.9398	0.9298	0.9166	0.9330	0.9240	0.9130
	2C	0.9270	0.9188	0.9458	0.9410	0.9282	0.9444	0.9392	0.9254
	2D	0.9392	0.9392	0.9532	0.9494	0.9420	0.9532	0.9490	0.9414
13	2A	0.8706	0.9218	0.8992	0.8884	0.8754	0.9456	0.9404	0.9288
	2B	0.8712	0.9108	0.9056	0.8930	0.8774	0.9392	0.9348	0.9194
	2C	0.8922	0.9284	0.9144	0.9058	0.8942	0.9476	0.9410	0.9318
	2D	0.9052	0.9334	0.9228	0.9152	0.9074	0.9476	0.9450	0.9356
14	2A	0.9642	0.9350	0.9730	0.9688	0.9644	0.9394	0.9382	0.9372
	2B	0.9628	0.9288	0.9726	0.9700	0.9626	0.9342	0.9338	0.9304
	2C	0.9638	0.9394	0.9700	0.9674	0.9638	0.9434	0.9418	0.9400
	2D	0.9750	0.9472	0.9784	0.9766	0.9750	0.9494	0.9488	0.9468
15	2A	0.9188	0.9114	0.9434	0.9346	0.9244	0.9352	0.9300	0.9200
	2B	0.9118	0.9038	0.9388	0.9312	0.9180	0.9336	0.9246	0.9132
	2C	0.9272	0.9204	0.9462	0.9418	0.9292	0.9446	0.9390	0.9270
	2D	0.9406	0.9392	0.9526	0.9498	0.9416	0.9516	0.9490	0.9418
16	2A	0.8738	0.9232	0.8986	0.8908	0.8766	0.9454	0.9410	0.9310
	2B	0.8726	0.9116	0.9060	0.8936	0.8796	0.9376	0.9348	0.9190
	2C	0.8940	0.9290	0.9140	0.9058	0.8956	0.9458	0.9412	0.9326
	2D	0.9058	0.9344	0.9210	0.9136	0.9080	0.9476	0.9456	0.9366
17	2A	0.9618	0.9360	0.9706	0.9662	0.9620	0.9406	0.9392	0.9378

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
	2B	0.9604	0.9290	0.9704	0.9662	0.9600	0.9350	0.9342	0.9314
	2C	0.9610	0.9378	0.9664	0.9642	0.9616	0.9430	0.9404	0.9404
	2D	0.9738	0.9468	0.9762	0.9750	0.9734	0.9490	0.9488	0.9476
18	2A	0.9218	0.9132	0.9438	0.9362	0.9254	0.9364	0.9300	0.9202
	2B	0.9146	0.9066	0.9390	0.9316	0.9200	0.9366	0.9268	0.9136
	2C	0.9284	0.9208	0.9466	0.9430	0.9304	0.9456	0.9398	0.9280
	2D	0.9414	0.9394	0.9516	0.9494	0.9430	0.9518	0.9492	0.9420
19	2A	0.8788	0.9288	0.8972	0.8900	0.8806	0.9450	0.9406	0.9334
	2B	0.8772	0.9184	0.9032	0.8944	0.8812	0.9404	0.9344	0.9244
	2C	0.8950	0.9330	0.9126	0.9062	0.8984	0.9474	0.9436	0.9372
	2D	0.9072	0.9382	0.9192	0.9158	0.9086	0.9484	0.9448	0.9400
20	2A	0.9812	0.9322	0.9854	0.9842	0.9818	0.9380	0.9354	0.9336
	2B	0.9794	0.9310	0.9848	0.9828	0.9790	0.9362	0.9346	0.9330
	2C	0.9808	0.9404	0.9838	0.9826	0.9808	0.9440	0.9440	0.9426
	2D	0.9864	0.9458	0.9884	0.9874	0.9860	0.9490	0.9496	0.9476
21	2A	0.9254	0.9170	0.9424	0.9364	0.9260	0.9368	0.9324	0.9228
	2B	0.9180	0.9104	0.9388	0.9320	0.9226	0.9350	0.9278	0.9182
	2C	0.9346	0.9282	0.9478	0.9450	0.9360	0.9452	0.9416	0.9322
	2D	0.9438	0.9440	0.9526	0.9512	0.9446	0.9530	0.9516	0.9456
22	2A	0.8780	0.9290	0.8982	0.8892	0.8798	0.9452	0.9418	0.9334
	2B	0.8782	0.9192	0.9038	0.8954	0.8816	0.9398	0.9356	0.9250
	2C	0.8954	0.9336	0.9128	0.9062	0.8982	0.9480	0.9448	0.9370
	2D	0.9078	0.9388	0.9206	0.9176	0.9090	0.9488	0.9448	0.9406
23	2A	0.9796	0.9322	0.9852	0.9832	0.9804	0.9388	0.9368	0.9344
	2B	0.9788	0.9312	0.9848	0.9816	0.9784	0.9364	0.9354	0.9334
	2C	0.9794	0.9414	0.9828	0.9818	0.9790	0.9442	0.9434	0.9422
	2D	0.9848	0.9456	0.9870	0.9870	0.9854	0.9492	0.9496	0.9472
24	2A	0.9260	0.9176	0.9434	0.9366	0.9276	0.9358	0.9330	0.9224
	2B	0.9190	0.9118	0.9400	0.9322	0.9236	0.9344	0.9280	0.9186
	2C	0.9336	0.9288	0.9480	0.9446	0.9360	0.9454	0.9416	0.9326
	2D	0.9448	0.9430	0.9524	0.9512	0.9450	0.9526	0.9514	0.9446
25	2A	0.8788	0.9288	0.8980	0.8920	0.8788	0.9456	0.9436	0.9336
	2B	0.8802	0.9202	0.9040	0.8946	0.8846	0.9378	0.9352	0.9250

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
	2C	0.8978	0.9342	0.9122	0.9070	0.8998	0.9464	0.9444	0.9364
	2D	0.9102	0.9386	0.9204	0.9172	0.9108	0.9468	0.9458	0.9404
26	2A	0.9782	0.9324	0.9840	0.9826	0.9784	0.9388	0.9370	0.9352
	2B	0.9778	0.9308	0.9828	0.9806	0.9776	0.9354	0.9360	0.9338
	2C	0.9780	0.9418	0.9818	0.9804	0.9772	0.9448	0.9426	0.9424
	2D	0.9832	0.9468	0.9862	0.9854	0.9836	0.9492	0.9496	0.9474
27	2A	0.9274	0.9190	0.9440	0.9372	0.9280	0.9358	0.9318	0.9240
	2B	0.9206	0.9134	0.9392	0.9330	0.9240	0.9340	0.9290	0.9194
	2C	0.9350	0.9296	0.9478	0.9430	0.9370	0.9446	0.9420	0.9334
	2D	0.9452	0.9430	0.9518	0.9502	0.9454	0.9520	0.9506	0.9442

Table C-12 Coverage Probabilities for the 99 Percent Upper Confidence Bounds (Part 2)

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
1	2A	0.9188	0.9602	0.9692	0.9648	0.9290	0.9862	0.9830	0.9678
	2B	0.9154	0.9478	0.9684	0.9632	0.9318	0.9844	0.9816	0.9596
	2C	0.9368	0.9670	0.9758	0.9700	0.9432	0.9902	0.9874	0.9734
	2D	0.9552	0.9766	0.9800	0.9776	0.9582	0.9938	0.9920	0.9796
2	2A	0.9892	0.9806	0.9966	0.9956	0.9898	0.9870	0.9858	0.9820
	2B	0.9868	0.9750	0.9942	0.9932	0.9872	0.9838	0.9818	0.9778
	2C	0.9892	0.9828	0.9952	0.9946	0.9896	0.9864	0.9870	0.9832
	2D	0.9932	0.9904	0.9964	0.9956	0.9932	0.9926	0.9922	0.9904
3	2A	0.9572	0.9506	0.9882	0.9858	0.9634	0.9868	0.9834	0.9616
	2B	0.9502	0.9436	0.9866	0.9838	0.9620	0.9864	0.9840	0.9592
	2C	0.9682	0.9642	0.9890	0.9880	0.9712	0.9878	0.9866	0.9696
	2D	0.9786	0.9768	0.9930	0.9914	0.9822	0.9918	0.9906	0.9814
4	2A	0.9218	0.9612	0.9694	0.9652	0.9314	0.9866	0.9834	0.9684
	2B	0.9176	0.9490	0.9714	0.9648	0.9322	0.9850	0.9822	0.9602
	2C	0.9394	0.9672	0.9758	0.9700	0.9452	0.9902	0.9874	0.9748
	2D	0.9562	0.9776	0.9802	0.9772	0.9594	0.9938	0.9928	0.9800
5	2A	0.9882	0.9810	0.9960	0.9948	0.9892	0.9868	0.9860	0.9824
	2B	0.9856	0.9752	0.9930	0.9922	0.9862	0.9838	0.9818	0.9786
	2C	0.9878	0.9822	0.9938	0.9924	0.9880	0.9872	0.9868	0.9830
	2D	0.9926	0.9904	0.9958	0.9950	0.9922	0.9922	0.9918	0.9902
6	2A	0.9588	0.9524	0.9886	0.9868	0.9646	0.9872	0.9836	0.9624
	2B	0.9520	0.9468	0.9870	0.9844	0.9628	0.9846	0.9810	0.9598
	2C	0.9688	0.9646	0.9888	0.9882	0.9718	0.9880	0.9856	0.9706
	2D	0.9804	0.9776	0.9930	0.9920	0.9826	0.9918	0.9906	0.9822
7	2A	0.9244	0.9622	0.9702	0.9656	0.9324	0.9866	0.9838	0.9686
	2B	0.9224	0.9522	0.9694	0.9642	0.9322	0.9862	0.9838	0.9638
	2C	0.9422	0.9700	0.9758	0.9720	0.9480	0.9894	0.9874	0.9758
	2D	0.9588	0.9786	0.9806	0.9778	0.9614	0.9930	0.9918	0.9810
8	2A	0.9864	0.9814	0.9942	0.9934	0.9868	0.9868	0.9856	0.9824
	2B	0.9844	0.9762	0.9922	0.9916	0.9852	0.9832	0.9816	0.9784
	2C	0.9856	0.9828	0.9930	0.9916	0.9852	0.9872	0.9870	0.9836
	2D	0.9918	0.9902	0.9942	0.9938	0.9910	0.9924	0.9914	0.9904

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
9	2A	0.9604	0.9566	0.9892	0.9872	0.9660	0.9874	0.9842	0.9642
	2B	0.9550	0.9506	0.9870	0.9846	0.9644	0.9846	0.9812	0.9610
	2C	0.9700	0.9666	0.9890	0.9882	0.9736	0.9876	0.9860	0.9714
	2D	0.9820	0.9800	0.9932	0.9924	0.9836	0.9922	0.9910	0.9830
10	2A	0.9364	0.9708	0.9680	0.9656	0.9408	0.9868	0.9840	0.9742
	2B	0.9354	0.9660	0.9672	0.9626	0.9404	0.9870	0.9846	0.9724
	2C	0.9506	0.9776	0.9748	0.9704	0.9528	0.9892	0.9882	0.9792
	2D	0.9634	0.9844	0.9786	0.9758	0.9654	0.9940	0.9918	0.9858
11	2A	0.9958	0.9818	0.9978	0.9974	0.9958	0.9860	0.9844	0.9830
	2B	0.9946	0.9786	0.9978	0.9974	0.9944	0.9820	0.9818	0.9796
	2C	0.9964	0.9846	0.9976	0.9974	0.9960	0.9864	0.9864	0.9844
	2D	0.9964	0.9904	0.9976	0.9980	0.9966	0.9916	0.9920	0.9908
12	2A	0.9694	0.9660	0.9876	0.9868	0.9712	0.9864	0.9844	0.9724
	2B	0.9658	0.9622	0.9872	0.9852	0.9706	0.9846	0.9824	0.9682
	2C	0.9778	0.9758	0.9892	0.9888	0.9800	0.9886	0.9876	0.9782
	2D	0.9854	0.9848	0.9926	0.9914	0.9858	0.9922	0.9910	0.9860
13	2A	0.9368	0.9712	0.9678	0.9660	0.9416	0.9874	0.9844	0.9748
	2B	0.9372	0.9682	0.9674	0.9626	0.9416	0.9868	0.9848	0.9728
	2C	0.9520	0.9780	0.9744	0.9704	0.9540	0.9896	0.9880	0.9796
	2D	0.9642	0.9844	0.9788	0.9752	0.9658	0.9938	0.9924	0.9852
14	2A	0.9950	0.9814	0.9974	0.9974	0.9952	0.9856	0.9852	0.9828
	2B	0.9938	0.9784	0.9974	0.9974	0.9936	0.9834	0.9824	0.9792
	2C	0.9954	0.9846	0.9970	0.9972	0.9954	0.9868	0.9866	0.9852
	2D	0.9962	0.9908	0.9972	0.9974	0.9962	0.9920	0.9918	0.9910
15	2A	0.9700	0.9672	0.9878	0.9866	0.9732	0.9866	0.9844	0.9728
	2B	0.9674	0.9642	0.9870	0.9848	0.9718	0.9850	0.9820	0.9684
	2C	0.9786	0.9760	0.9890	0.9886	0.9804	0.9884	0.9876	0.9786
	2D	0.9856	0.9848	0.9924	0.9914	0.9860	0.9920	0.9914	0.9862
16	2A	0.9396	0.9722	0.9686	0.9660	0.9422	0.9872	0.9846	0.9754
	2B	0.9390	0.9686	0.9662	0.9628	0.9428	0.9868	0.9850	0.9728
	2C	0.9532	0.9780	0.9744	0.9708	0.9554	0.9896	0.9884	0.9798
	2D	0.9652	0.9850	0.9782	0.9752	0.9666	0.9932	0.9920	0.9862
17	2A	0.9938	0.9814	0.9974	0.9974	0.9942	0.9856	0.9856	0.9836

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
	2B	0.9924	0.9788	0.9968	0.9964	0.9932	0.9832	0.9836	0.9802
	2C	0.9946	0.9850	0.9964	0.9964	0.9946	0.9866	0.9866	0.9858
	2D	0.9952	0.9910	0.9970	0.9964	0.9954	0.9916	0.9918	0.9914
18	2A	0.9714	0.9690	0.9880	0.9868	0.9748	0.9866	0.9856	0.9736
	2B	0.9694	0.9650	0.9870	0.9850	0.9728	0.9848	0.9826	0.9704
	2C	0.9798	0.9774	0.9886	0.9880	0.9814	0.9878	0.9870	0.9796
	2D	0.9866	0.9860	0.9932	0.9922	0.9862	0.9922	0.9916	0.9870
19	2A	0.9452	0.9752	0.9666	0.9642	0.9476	0.9870	0.9848	0.9770
	2B	0.9462	0.9732	0.9654	0.9626	0.9482	0.9868	0.9852	0.9768
	2C	0.9562	0.9810	0.9722	0.9692	0.9574	0.9892	0.9888	0.9824
	2D	0.9664	0.9872	0.9770	0.9762	0.9674	0.9928	0.9918	0.9876
20	2A	0.9982	0.9820	0.9992	0.9988	0.9980	0.9860	0.9860	0.9828
	2B	0.9978	0.9792	0.9994	0.9994	0.9984	0.9824	0.9828	0.9802
	2C	0.9982	0.9854	0.9992	0.9990	0.9982	0.9876	0.9872	0.9864
	2D	0.9986	0.9904	0.9996	0.9996	0.9986	0.9914	0.9912	0.9910
21	2A	0.9762	0.9736	0.9872	0.9848	0.9770	0.9874	0.9854	0.9770
	2B	0.9736	0.9698	0.9870	0.9860	0.9768	0.9848	0.9824	0.9730
	2C	0.9816	0.9796	0.9892	0.9884	0.9830	0.9892	0.9884	0.9820
	2D	0.9870	0.9854	0.9916	0.9912	0.9872	0.9908	0.9898	0.9864
22	2A	0.9462	0.9750	0.9666	0.9646	0.9488	0.9870	0.9850	0.9776
	2B	0.9466	0.9738	0.9654	0.9622	0.9488	0.9862	0.9852	0.9766
	2C	0.9578	0.9812	0.9730	0.9698	0.9590	0.9888	0.9888	0.9834
	2D	0.9676	0.9866	0.9766	0.9760	0.9682	0.9926	0.9920	0.9880
23	2A	0.9978	0.9818	0.9990	0.9988	0.9980	0.9858	0.9858	0.9830
	2B	0.9976	0.9798	0.9994	0.9994	0.9978	0.9830	0.9828	0.9806
	2C	0.9980	0.9858	0.9992	0.9990	0.9982	0.9876	0.9872	0.9864
	2D	0.9982	0.9902	0.9996	0.9996	0.9982	0.9910	0.9912	0.9908
24	2A	0.9766	0.9752	0.9870	0.9854	0.9776	0.9870	0.9858	0.9776
	2B	0.9746	0.9698	0.9866	0.9860	0.9770	0.9848	0.9828	0.9736
	2C	0.9830	0.9802	0.9890	0.9886	0.9836	0.9890	0.9878	0.9824
	2D	0.9870	0.9858	0.9920	0.9912	0.9876	0.9908	0.9906	0.9868
25	2A	0.9466	0.9758	0.9666	0.9650	0.9488	0.9872	0.9850	0.9774
	2B	0.9472	0.9740	0.9644	0.9618	0.9498	0.9868	0.9856	0.9770

Scenario	Test Plan	MLE0	MLE1	MODL-MLE0-BIAS	MODL-MLE0-PERC	MODL-MLE0-NORM	MODL-MLE1-BIAS	MODL-MLE1-PERC	MODL-MLE1-NORM
	2C	0.9580	0.9820	0.9722	0.9694	0.9592	0.9896	0.9884	0.9828
	2D	0.9670	0.9868	0.9770	0.9756	0.9678	0.9932	0.9930	0.9878
26	2A	0.9974	0.9818	0.9990	0.9988	0.9974	0.9856	0.9854	0.9832
	2B	0.9974	0.9800	0.9994	0.9990	0.9972	0.9828	0.9824	0.9806
	2C	0.9980	0.9862	0.9990	0.9988	0.9982	0.9872	0.9876	0.9866
	2D	0.9982	0.9902	0.9994	0.9992	0.9984	0.9912	0.9912	0.9906
27	2A	0.9776	0.9766	0.9872	0.9864	0.9786	0.9868	0.9862	0.9778
	2B	0.9766	0.9708	0.9864	0.9860	0.9782	0.9846	0.9830	0.9748
	2C	0.9842	0.9808	0.9890	0.9884	0.9846	0.9884	0.9876	0.9834
	2D	0.9876	0.9866	0.9916	0.9914	0.9878	0.9914	0.9916	0.9872

APPENDIX D

MONTE CARLO SIMULATION PROGRAMS ON CD

Included with this dissertation is a CD which contains the main simulation program, global parameter files, and two programs used to generate the scenario specific parameter and Numerical Intensive Computing Cluster job files for the two parts of the simulation. All of the files are Fortran 90 programs. The following programs are contained on the CD:

1. f90_logn_mod3.f90
2. f90_logn_mod3_setup_set1.f90
3. f90_logn_mod3_setup_set2.f90
4. mod_glob_parm_logn_mod3_set1.f90
5. mod_glob_parm_logn_mod3_set2a.f90
6. mod_glob_parm_logn_mod3_set2b.f90
7. mod_glob_parm_logn_mod3_set2c.f90
8. mod_glob_parm_logn_mod3_set2d.f90

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