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Modified Weibull model: A Bayes study using MCMC approach based on progressive censoring data

Ahmed A. Soliman[a, b], Ahmed H. Abd-Ellah[b], Naser A. Abou-Elheggag[b], Essam A. Ahmed[b]

[a] Faculty of Science, Islamic University, Madinah, Saudi Arabia

[b] Mathematics Department, Sohag University, Sohag 82524, Egypt

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Abstract

In this paper, we investigate the problem of point and interval estimations for the modified Weibull distribution (MWD) using progressively type-II censored sample. The maximum likelihood (ML), Bayes, and parametric bootstrap methods are used for estimating the unknown parameters as well as some lifetime parameters (reliability and hazard functions). Also, we propose to apply Markov chain Monte Carlo (MCMC) technique to carry out a Bayesian estimation procedure. Bayes estimates and the credible intervals are obtained under the assumptions of informative and noninformative priors. The results of Bayes method are obtained under both the balanced squared error loss (bSEL) and balanced linear-exponential (bLINEX) loss. We show that these loss functions are more general, which include the MLE and both symmetric and asymmetric Bayes estimates as special cases. Finally, Two real data sets have been analyzed for illustrative purposes.

Keywords

Modified Weibull distribution; Progressive type-II censoring; Balanced loss; Maximum likelihood estimation; Bayesian estimation; Gibbs and Metropolis–Hasting samplers; Hybrid MCMC approach; Bootstrap

Figures and tables from this article:

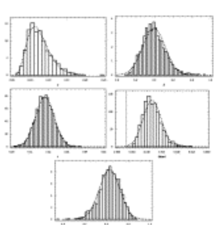

Fig. 1. Histogram and kernel density estimates of α, β, γ, $S(t)$ and $H(t)$ from Example 1.

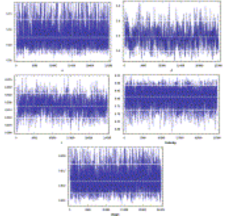

Fig. 2. MCMC output of α, β, γ, $S(t)$ and $H(t)$. Dashed lines (…) represent the posterior means and soled lines (—) represent lower, and upper bounds 90% probability interval from Example 1.

Figure options

Table 1. Progressively censored sample generated from data in Aarset [1].

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Table 2. Two-sided 90% and 95% BCIs of α, β, λ, $S(t)$ and $H(t)$ for Example 1.

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Table 3. 90% and 95% MCMC confidence intervals of α, β, λ, $S(t)$ and $H(t)$ for Example 1.

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Table 4. MCMC results for some posterior characteristics for Example 1.

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Table 5. MLE and Bayes MCMC estimates under balanced square loss function (bSEL) and balanced LINEX loss function (bLINEX) for Example 1.

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Table 6. Progressively censored sample based on data from Example 2.

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Table 7. Two-sided 90% and 95% BCIs of α, β, λ, $S(t)$ and $H(t)$ for Example 2.

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Table 8. 90% and 95% MCMC confidence intervals of α, β, λ, $S(t)$ and $H(t)$ for Example 2.

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Table 9. MCMC results for some posterior characteristics for Example 2.

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Table 10. MLE and Bayes MCMC estimates under balanced square loss function (bSEL) and balanced LINEX loss function (bLINEX).

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Corresponding author. Tel.: +2 173597859; fax: +2 934601159.