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Classical and Bayesian Inferential Approaches Using Lomax Model Under Progressively Type-I Hybrid Censoring

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Abstract: In this article, we consider the problem of estimation and prediction on unknown parameters of a Lomax distribution when the lifetime data are observed in the presence of progressively type-I hybrid censoring scheme. In the classical scenario, the Expectation-Maximization (EM) algorithm is utilized to derive the maximum likelihood estimates (MLEs) for the unknown parameters and associated confidence intervals. Under the Bayesian framework, the point estimates of unknown parameters with respect to different symmetric, asymmetric and balanced loss functions are obtained using Tierney-Kadane's approximation and Markov Chain Monte Carlo (MCMC) technique. Also, the highest posterior density (HPD) credible intervals for the parameters are reckoned using importance sampling procedure. Simulation experiments are performed to compare the different proposed methods. Further, the predictive estimates of censored observations and the corresponding prediction intervals are also provided. One real-life data example is presented to illustrate the derived results.

Keywords: Bayesian estimation; EM algorithm; Balanced loss; Tierney-Kadane's approximation; Prediction; Progressively type-I hybrid censoring.

AMS SUBJECT CLASSIFICATION: 62F10; 62N01; 62N05.

1 Introduction

In the field of reliability and life-testing experiments, due to the time limitations and/or other restrictions on data collection, observing failure times of test items is non-conventional. In addition, sometimes the lowest and/or highest few observations in a sample could be due to some negligence or some other extraordinary reasons. These constraints are manoeuvred by an experimenter which results in censoring of data arising in an experiment. There are several types of censoring schemes. Due to its simplicity and applicability, the two most common and widely used censoring schemes are type-I and type-II censoring. The hybrid censoring scheme which is a mixture of type-I and type-II censoring schemes was first introduced by [8]. These three conventional censoring schemes remove the units only at the terminal time point of the experiment. The progressively hybrid censoring (PHC) will allow such intermediate removals of units. This type of censoring includes conventional censoring schemes as a special case. The type-I progressively hybrid censoring scheme (type-I PHCS) introduced by [11] is a mixture of type-I progressive and hybrid censoring schemes. Recently, this censoring scheme has become quite popular for analyzing highly reliable data in the area of reliability and survival analysis. Lifetime data under this censoring can be collected in the following way. Suppose that a sample of n independent and identical units whose lifetimes follow probability density function (pdf) $f(x;\eta)$ and cumulative distribution function (cdf) $F(x;\eta)$ is put on an experiment. Here η represent an unknown or a vector of unknown parameters of the distribution. Then, under this censoring the experiment is

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