Simple and multiple step-stress models for Lehmann family of distributions

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Abstract: In this article, we consider a flexible simple and multiple step-stress models for the Lehmann family of distributions. At each stress level, it is assumed that the lifetime distribution of the experimental units follows a member of the Lehmann family of distributions with different shape and scale parameters. The distribution under each stress level is connected through a failure rate based step-stress accelerated life testing (SSALT) model. We obtain the maximum likelihood estimators (MLEs)of the unknown model parameters. It is observed that the MLEs of the unknown parameters do not always exist and whenever they exist, they are not in closed form. However, the failure rate based SSALT model assumption simplifies the inference problem to a significant extent. It is not possible to obtain the exact distribution of the MLEs, and hence, we have constructed the asymptotic confidence intervals (CIs) based on the observed Fisher information matrix. We have also obtained the bootstrap CIs for model parameters. Extensive simulation study is carried out when the lifetime distribution is a two-parameter generalized exponential(GE) distribution, an important member of the Lehmann family. A real data set has been analyzed for illustrative purposes.