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Exponentiated Extended Chen Distribution: Regression Model and Estimations

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Abstract In this paper, we introduce a new four-parameter generalized version of the Chen model called the exponentiated extended Chen distribution. Some results about the reliability characteristics of hazard rate function as well as some mathematical properties are provided. The maximum likelihood estimators and five approaches based on the concept of minimum spacing distance estimators are given for estimation of the model parameters and their performances in estimating of parameters are compared by means of Monte Carlo simulations. Also, a multiple regression model with the censored data based on proposed distribution is introduced.

Keywords Chen distribution; Maximum likelihood estimator; Multiple regression; Characterizations

AMS 2010 subject classifications 62E15, 60E05, 62F10

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1. Introduction

[13] proposed an extension of the generalized exponential (GE) distribution, which is very flexible, positively skewed, and has increasing, decreasing, unimodal and bathtub shaped hazard rate functions (hrf). It includes GE, exponential, generalized Pareto [9], and Pareto distributions. Recently, a generalization of Chen distribution [3], is introduced in [2] with the following cumulative distribution function (cdf):

$$F_{ECh}(x) = \left(1 - e^{\lambda(1-e^{x^\beta})}\right)^\alpha, \quad x \geq 0, \quad \alpha > 0, \; \lambda > 0, \; \beta > 0. \tag{1}$$

It is called the exponentiated Chen (ECh) family. For $\alpha = 1$, the ECh distribution is reduced to the Chen distribution. Various properties of the ECh distribution and estimation methods for the parameters of this distributions are studied in [6]. [11] generalized a class of extended-Weibull distributions. According to Table 1 of their paper, by changing the generator function $\Phi(x; \boldsymbol{\eta})$, a lot of extension of distributions in the class of extended-Weibull distributions can be obtained. Based on [11], we introduce the exponentiated extended Chen (EE-Ch) distribution with support $S_x = (0, \infty)$ if $\gamma < 0$ and $S_x = (0, \psi)$ if $\gamma > 0$ where $\psi = \left[\log(\frac{1}{\gamma\lambda} + 1)\right]^{\frac{1}{\beta}}$ via

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