A novel approach for constructing distributions with an example of the Rayleigh distribution

Aijaz Ahmad[1], Muzamil jallal[2] and Afaq Ahmad[3]

[1,2]Department of Mathematics, Bhagwant University, Ajmer, India
[3]Department of Mathematical Science, IUST, Awantipora, Kashmir
Email: [1]ahmadaijaz4488@gmail.com, Email: [2]muzamiljallal@gmail.com
Email: [3]baderaafaq@gmail.com

Abstract

In this paper, we describe a novel technique for creating distributions based on logarithmic functions, which we referred the Log Exponentiated Transformation (LET). The LET technique is then applied to Rayleigh distributions, resulting in a new distribution known as the Log Exponentiated Rayleigh distribution (LERD). Several distributional properties of the formulated distribution have been discussed. The expressions for ageing properties have been derived and discussed explicitly. The behaviour of the pdf, cdf and hazard rate function has been illustrated through different graphs. The parameters are estimated through the technique of MLE. A simulation analysis was conducted to measure the effectiveness of all estimators. Eventually the versatility and the efficacy of the formulated distribution have been examined through real life data set.

Keywords: Log Exponentiated Transformation, Rayleigh distribution, Moments, reliability measures, maximum likelihood function.

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I. Introduction

The adoption of an efficient statistical model is critical in a variety of practical analyses. This is especially inconvenient for specific data studies, because the typically employed distributional models are inadequate for producing a plausible fit. Several approaches, such as the generation of families of adaptable distributions, have been presented in recent times. Most of them attempt to increase the effectiveness of a baseline distribution by utilising diverse mathematical expansion approaches. As a result, the related models may incorporate some extra characteristics that provide sufficient flexibility to examine real-life data in many areas of study, such as reliability, survival analysis, computer science, finance, biological research, medicine, and so on. Academics have recently been concerned with developing new techniques for creating new families of distributions so that real data can be adequately analysed and explored. Among them are Marshall and Olkin [9], Eugene et al.[4] , Mudholkar et al. [11], Nadrajah and Kotz [12], Alzaatreh et al. [2], Mahdavi and Kundu [9], Ijaz et al. [8], Anwar Hassan et al.[3]. Based on the argumentation stated above, we suggest a novel family of distributions that adds versatility to the provided family and entitles it Log Exponentiated Transformation (LET). We give a thorough explanation of its fundamental mathematical characteristics, and subsequently employ the Rayleigh distribution as an application.