Journal of Radiation Research and Applied Sciences 17 (2024) 101116

Contents lists available at ScienceDirect

Journal of Radiation Research and Applied Sciences

journal homepage: www.journals.elsevier.com/journal-of-radiation-research-and-applied-sciences

Statistical inference on the exponentiated moment exponential distribution and its discretization

Kaisar Ahmad [a], Bilal Ahmad Para [b], Rana Muhammad Usman [c], Aafaq A. Rather [d], Najwan Alsadat [e], Eslam Hussam [f], Ahmed M. Gemeay [g,*]

[a] Department of Statistics, University of Kashmir, Srinagar, J&K, India
[b] Department of Mathematical Sciences, IUST, Kashmir, J&K, India
[c] College of Statistical and Acturial Sciences, University of the Punjab, Lahore, Pakistan
[d] Symbiosis Statistical Institute, Symbiosis International (Deemed University), Pune, 411008, India
[e] Department of Quantitative Analysis, College of Business Administration, King Saud University, P.O. Box 71115, Riyadh, 11587, Saudi Arabia
[f] Department of Mathematics, Faculty of Science, Helwan University, Cairo, Egypt
[g] Department of Mathematics, Faculty of Science, Tanta University, Tanta, 31527, Egypt

ARTICLE INFO

Keywords:
Exponentiated moment distribution
Quartile estimation: discretization
Discrete exponentiated moment exponential distribution

ABSTRACT

Hasnain and Ahmad (2013) propose a two-parameter Exponentiated Moment Exponential (EME) Distribution and investigate its some characteristics. In this paper we study its additional properties in the context of its applications. The study classifies the EME distribution to homogeneous subfamilies with respect to hazard rate. A simulation study is conducted for EME distribution to observe the parameters for maximum likelihood and quartile estimates based on bias and mean square error. Based on EME distribution, we develop a discretized model that gives its importance in the industry. However, some important structural properties are studied for discrete Exponentiated moment exponential distribution with useful characterizations. Shapes of density and failure rate function of new discrete model are studied. Moreover, we provide justifications for the usefulness of the model and its enhanced scope as compared to the existing discretized model with the help of real-life data sets.

1. Introduction

The importance of weighted distributions in statistical analysis has long been recognized, beginning with Fisher (1934), who laid the groundwork for understanding how these distributions can account for biases in data collection. Fisher's work emphasized the necessity of adjusting probability distributions when sampling is non-random or influenced by external factors.

Building on Fisher's foundational ideas, Patil and Rao (1978) explored size-biased distributions, specifically focusing on Beta, Lognormal, Pareto, Gamma, and Binomial distributions. Their work introduced practical methods for dealing with real-world data where larger units are more likely to be sampled. However, their approach primarily dealt with continuous distributions, leaving a gap in understanding how these concepts could be applied to discrete data.

Patil et al. (1986) further expanded the field by proposing general forms of weight functions, which have since become essential tools in both statistical theory and applied sciences. Their contributions highlighted the versatility of weighted distributions, but their methods often required complex calculations, making them less accessible for practitioners without a strong mathematical background.

Khattree (1989) and George and Olyede (2002) advanced this area by developing more specialized weighted distributions, focusing on specific applications in areas such as reliability engineering and risk analysis. These studies underscored the need for tailored approaches depending on the context of the data, yet they also pointed to the challenges in estimating parameters accurately, a theme that has persisted in the literature.

Kundu and Gupta (2008) and Shahbaz et al. (2010, p. pp53), Gove (2003), Kersey (2010) introduced new families of weighted distributions, such as the Weighted Weibull distribution, which addressed some of the estimation challenges identified by earlier researchers. Their work

* Corresponding author.
E-mail addresses: ahmadkaisar31@gmail.com (K. Ahmad), parabilal@gmail.com (B.A. Para), usmanrana0331@gmail.com (R.M. Usman), aafaq7741@gmail.com (A.A. Rather), nalsadat@ksu.edu.sa (N. Alsadat), eslamhussam@science.helwan.edu.eg (E. Hussam), ahmed.gemeay@science.tanta.edu.eg (A.M. Gemeay).

https://doi.org/10.1016/j.jrras.2024.101116
Received 2 June 2024; Received in revised form 1 September 2024; Accepted 11 September 2024
Available online 19 September 2024