The Topp-Leone Exponentiated Inverted Kumaraswamy Distribution and Its Application on Environmental Data

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Abstract:

This study introduces a new statistical distribution, the Topp-Leone Exponentiated Inverted Kumaraswamy (TLEIK) distribution, designed for analyzing environmental data. The TLEIK distribution generalizes the Topp-Leone Exponentiated-G (TLE-G) family by incorporating an additional shape parameter from the inverted Kumaraswamy distribution. The methodology involves defining the new probability density function, deriving its structural properties, and estimating model parameters using Maximum Likelihood Estimation (MLE). Simulation studies with sample sizes from 20 to 300 demonstrate that the TLEIK distribution's parameter estimates are consistent, as evidenced by decreasing biases and Root Mean Square Errors (RMSE) with increasing sample sizes. Comparisons of the TLEIK distribution's performance with the inverse Kumaraswamy and Kumaraswamy distributions on environmental dataset, such as flood level data, indicate superior fitting capabilities. The model's flexibility is showcased through its ability to accommodate various shapes, including symmetric, skewed, and different hazard function profiles. Results suggest that the TLEIK distribution is highly adaptable for environmental data modeling, as it consistently achieved lower AIC and BIC values compared to baseline distributions. The study concludes that the TLEIK distribution provides a robust framework for environmental research and contributes to statistical modeling by extending the inverted Kumaraswamy distribution offering a versatile tool for real-world data analysis.

Keywords:

Topp-Leone Exponentiated Inverted Kumaraswamy, Environmental, Maximum Likelihood Estimation, Simulation.