ABSTRACT

This research developed a unique ratio-type estimator to enhance population parameter estimation using unequal probability sampling by efficiently including auxiliary data. The proposed estimator reports the limits of traditional methods, for instance the Horvitz-Thompson (HT) estimator known relations between the study variable and auxiliary variable. The method focuses specifically on enhancing precision measurements in difficult sampling plans.

To assess the effectiveness of the proposed estimator, we perform comprehensive empirical analyses using various real-world datasets, such as fuel consumption, food production, student performance, weather prediction etc. These datasets display varying degrees of correlation high, moderate, and low between the study and auxiliary variables, enabling a thorough evaluation of their performance. The performance of our proposed estimator stands out as we evaluate it using the Midzuno selection method and Thompson selection method across different populations with multiple sample sizes. The comparative findings prove that the proposed estimator constantly outclasses from existing estimators in terms of lower mean squared error across all datasets. Additionally, we expand our analysis to neutrosophic data, which takes into account uncertainty and imprecision in real-world observations. The findings indicate that the suggested estimator, when used in a neutrosophic environment, demonstrates enhanced efficiency and a further reduction in estimation error compared to simple random sampling.

In addition to its experiential justification, the thesis summaries theoretical properties of the proposed estimator, highlighting its strength and flexibility. For future research include applying the estimator to more real-world datasets, spreading its application to other sampling designs, and optimizing its parameters for wider use. This work contributes in the area of survey sampling by presenting an efficient and applied estimator for complex sampling design.