**Comparing Robust Estimators with an Application to Environmental Data**

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**Background:**

Sanaullah et al. (2019) and Ahmad et al. (2023) recently used a Best Linear Unbiased Estimator (BLUE) that is based on order statistics to introduce innovative ratio-type estimators. Although they examined the properties of the proposed ratio estimators within the survey-sampling framework, the robustness characteristics of the BLUE-type estimators they employed have yet to undergo thorough investigation.

**Objectives:**

Our primary objective was to evaluate the robustness properties of the BLUE-type location estimator and compare it with other established robust estimators, such as Tiku’s modified maximum likelihood estimator (MMLE). Additionally, we aimed to demonstrate the performance of these estimators through the analysis of environmental data.

**Methods:**

We assumed that the underlying distribution of interest follows a long-tailed symmetric (LTS) family distribution. Utilizing the LTS distribution, we theoretically derived the BLUE-type location estimator. We then empirically compared its robustness properties to Tiku’s MMLE through an extensive simulation study conducted using R. Specifically, we examined several outlier, mixture, and contaminated models, comparing the Mean Square Errors and weight functions across various sample sizes under these models.

**Results:**

We observed that, overall, the BLUE-type location estimator is more efficient than the MML estimator for small sample sizes. As the sample size increases, the efficiencies of both estimators converge towards each other. We also made similar observations for the weight functions.

**Conclusions:**

Our simulation study and demonstration with real-life datasets indicate that, for small sample sizes, the BLUE-type location estimator demonstrates superior efficiency compared to the MML estimator, primarily due to its weight function. Our findings suggest that researchers should carefully consider the specific characteristics of their dataset, particularly for small sample sizes when selecting an appropriate robust estimator for their analysis.

No IRB was needed for this project.