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Cumulative residual extropy of minimum ranked set sampling with unequal samples

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ABSTRACT

Recently, an alternative measure of uncertainty called cumulative residual extropy (CREX) was proposed by Jahanshahi et al. (2019). In this paper, we consider uncertainty measures of minimum ranked set sampling procedure with unequal samples (MinRSSU) in terms of CREX and its dynamic version and we compare the uncertainty and information content of CREX based on MinRSSU and simple random sampling (SRS) designs. Also, using simulation, we study new estimators of CREX for MinRSSU and SRS designs in terms of bias and mean square error. Finally, we provide a new discrimination measure of disparity between the distribution of MinRSSU and parental data SRS.

1. Introduction

Ranked set sampling (RSS) design is a cost-effective sampling for situations where taking actual measurements on units is expensive but ranking units is easy. For the first time, based on the RSS sampling design, McIntyre [1] provided a more efficient estimator of the population mean comparing to the simple random sampling (SRS) counterpart. To learn more about this concept, the readers can refer to Patil et al. [2]. There are many available studies that have developed and generalized the method of sampling used in RSS scheme and they efficiently estimate the population parameter comparing to the SRS scheme. Recently, Qiu and Eftekharian [3] studied information content of minimum ranked set sampling procedure with unequal samples (MinRSSU) as useful modification of RSS procedure in terms of extropy. In the MinRSSU, we draw m simple random samples, where the size of the ith samples is i, $i = 1, \ldots, m$. The one-cycle MinRSSU involves an initial ranking of m samples of size m as follows:

$$\begin{array}{lccccccc}
1: & \underline{\boldsymbol{X_{(1:1)1}}} & & & & \rightarrow & \tilde{X}_1 = X_{(1:1)1} \\
2: & \underline{\boldsymbol{X_{(1:2)2}}} & X_{(2:2)2} & & & \rightarrow & \tilde{X}_2 = X_{(1:2)2} \\
\vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots \\
m: & \underline{\boldsymbol{X_{(1:m)m}}} & X_{(2:m)m} & \cdots & X_{(m:m)m} & \rightarrow & \tilde{X}_m = X_{(1:m)m}
\end{array}$$

where $X_{(i:i)j}$ denotes the ith order statistic from the jth SRS of size i. The resulting sample is called one-cycle MinRSSU of size m and denoted by $\boldsymbol{X}_{MinRSSU}^{(m)} = \{\tilde{X}_i, i = 1, \ldots, m\}$. The parameter m should be kept small because the ranking should

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