

Estimation of Variance of Normal Distribution using Ranked Set Sampling

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Extended Abstract

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Introduction

In some biological, environmental or ecological studies, there are situations in which obtaining exact measurements of sample units are much harder than ranking them in a set of small size without referring to their precise values. In these situations, ranked set sampling (RSS), proposed by McIntyre (1952), can be regarded as an alternative to the usual simple random sampling (SRS) to draw a more representative sample from the population of interest than what is possible in SRS.

To draw a ranked set sample, one first draws n simple random samples, each of size n , from the population of interest and ranks them in an increasing magnitude. The ranking process is done without measuring sample units and therefore it need not to be accurate. One then identifies the i th sample unit from the i th sample for actual quantification (for $i=1, \dots, n$). Finally, he repeats this process m times (cycle) if he/she is required to obtain a sample of size mn . Since a ranked set sample contains information from both measured sample units and their corresponding ranks, one intuitively expects that statistical inference based on RSS to be more accurate than what is possible to obtain based on SRS.

This paper is concerned with problem of estimating variance of the normal distribution in RSS. Several methods of estimation of variance of the normal distribution are described and compared via a Monte Carlo simulation study.

Material and methods

All simulation studies in this paper have been done using R statistical software version R-3.3.1

Results and discussion

In this paper, we consider estimation of the normal variance based on a ranked set sample with single (multiple) cycle(s) and propose different unbiased estimators for each case. Our simulation results indicate that the mean square error (MSE) of each estimator is decreased as the values of n or m increases while the other parameters are kept fixed. It is also found that the estimator based on combining variance estimators of within and between ranking classes has typically better performance than the others.

Conclusion

The following results can be obtained based on our simulation study:

- If there is a single cycle in RSS, then the proposed estimator in the case of single cycle beats Stokes-modified unbiased estimator.

- In the multiple cycle case in RSS, the estimator based on combining variance estimators of within and between ranking classes is the best one.

Keywords: Normal distribution, Ranked set sampling, Simple random sampling, Efficiency, Monte Carlo simulation.

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