Using Judgment Post Stratification in Two Stage Cluster Sampling

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Extended Abstract

Introduction

In statistical surveys, the most important and simple method for gathering data is Simple Random Sampling (SRS) method. In this method a frame of all population units must be exist and these units have equal chance to select in the sample. In some cases, the population have been clustered into subpopulations, especially for agricultural and household surveys, and we have only access to a frame of these clusters. In these cases, two-stage cluster sampling can be used and has a great variety of applications. This sampling method has two stages. In the first stage, samples are selected from Primary Sampling Units (PSUs), and in the second stage, samples are selected from Secondary Sampling Units (SSUs) within each selected PSU. This method is denoted by TSCSRS.

In SRS method, there is no control on the selection of the units and if we want to increase the efficiency of sampling, we must increase the sample size which results the increase of cost and error. In situations where the measurement of survey variable is costly and/or time consuming, but ranking of sample items relating to the survey variable can be easily done, a sampling method called Ranked Set Sampling (RSS) can be used. It has been shown that the RSS method is more efficient to estimate population mean than SRS. In the past two decades, many researchers used the RSS method (and its extensions) in second stage of two stage cluster sampling and called it TSCRSS. They have been shown that TSCRSS is more efficient than TSCSRS, when it is applicable.

In some statistical surveys, the researcher wants to analyze the collected simple random sample and if necessary, used the rank information of this sample to increase the efficiency. In such cases, the Judgment Post Stratification (JPS) was suggested. The JPS is a method of stratification of observation by using a key variable, such that stratification will be done after selecting the sample. In this paper, this method will use in two stage cluster sampling. In other words, instead of simple random sampling without replacement, we use the judgment post stratification method and the generalized judgment post stratification method in second stage of two stage cluster sampling (TSCJPS), and obtain new estimators of the population mean. Finally, the proposed estimators are compared to usual TSCSRS estimator of the population mean by Monte Carlo simulation studies on a set of real data and generated data from symmetric and asymmetric distributions. The results of simulation study show that, in most cases, the proposed estimators have better performance than the mean of two stage cluster simple random sample.

Material and methods

In this section we introduce the JPS method and notations that are needed for next sections. Also, the JPS estimator of the population mean is introduced and some theorems are presented to show the properties of this estimator. Especially, this estimator is unbiased for population mean.

Results and discussion

We introduce the TSCJPS estimator of the population mean and show that it is unbiased. The variance of this estimator is obtained. Also, we use two new generalized JPS method in the second stage of two stage cluster sampling to obtain two new estimators of the population mean. Since, the variance of these estimators and TSCSRS cannot be compared theoretically, we use Monte Carlo simulation studies on a set of real data and generated data from symmetric and asymmetric distributions to compare the efficiency of proposed estimators and usual TSCSRS estimator of the population mean.

Conclusion

The following conclusions were drawn from simulation studies.

- The mean estimator from TSCJPS and TSCSRS methods have almost the same efficiency.
- In most cases, the mean estimator from generalized TSCJPS method is more efficient than mean estimators of TSCJPS and usual TSCSRS methods.
- When the ranking procedure of the units is strong (i.e. the correlation between study variable and rank variable is large), with increasing the set size H, the efficiency of TSCJPS estimator does not change but the efficiency of generalized TSCJPS estimators are increased.

Keywords: Judgment post stratification method; Ranked set sampling; Two-stage cluster sampling.

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