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ALTERNATE PROOFS FOR VARIANCE OF MEAN AND DIFFERENCE BETWEEN MEANS

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ABSTRACT

The purpose of this article is to present a unified simple approach based on covariance to prove two well known formulas for the variance of mean and the difference of means in case of simple random samples drawn without replacement from finite populations.

INTRODUCTION

The objective of the survey sampling is to draw inferences about a population from information contained in samples. One way to make inferences is to estimate certain population parameters by utilizing the sample information. The sampling variance provides a measure of the precision of the estimators in finite population surveys. The role of sampling covariance is different; however it is constructive in the sense that it generally enhances the precision of estimators. This can be seen from the fact that the variance of the sample mean estimator in case of simple random samples drawn with replacement is multiplied by a factor

$$(1-f)N/N-1$$

where $f=n/N$, the sampling fraction; in order to obtain the variance of the sample mean estimator in situations where the samples have been drawn without replacement from a finite population of size N. The improvement in precision comes due to the fact that the above factor is less than unity for $n > 1$, n being the sample size. Despite a role of covariance in sampling, one is rather surprised to note from the literature on sampling that less attention has been paid to explore how sampling covariances are at work, and how these can be used to simplify and prove the existing well-known results.

In this paper two well-known results of simple random sampling under without replacement scheme are proved using sampling covariances.

FORMULAS AND METHOD OF PROOF

If we select a simple random sample of size n ($n \leq N$) without replacement from a population of size N and X denote the characteristic associated with ith unit, then the variance (Var.) of the sample mean estimator is