Study of Improved Estimator(s) of Population Parameter(s) Using Auxiliary Information In Survey Sampling

Abstract

Doctor of Philosophy in Statistics

By Prayas Sharma

Under the Supervision of Dr. Rajesh Singh

DEPARTMENT OF STATISTICS
FACULTY OF SCIENCE
BANARAS HINDU UNIVERSITY
VARANASI - 221 005
INDIA

Enrolment No. : 313742

June, 2015
ABSTRACT

Sampling is advantageous not only in the field of Arts, Science and Technology but also useful in our daily life. The aim of sampling is to draw inferences about the population on the basis of the sample. Researchers often interested to use sample survey methodology to obtain information about a large population by selecting and analyzing a part (sample) of that population. Due to variability among samples, researchers apply scientific probability-based designs to select the sample. This reduces the risk of a distorted view of the population and allows statistically valid inferences to be made from the sample. The basic purpose of sampling is to obtain consistent, efficient and unbiased estimates of the desired population parameters considering cost, time and effort saving. It is emphasized that a sample survey is usually less expensive than a census survey and the desired information may be obtained with a greater degree of accuracy. But there may be contrariety between estimated value and parametric value. This contrariety may arise because of two reasons. (i) Sampling error and (ii) non-sampling error. In sampling theory the emphasis laid on the efficient use of suitable auxiliary information is for elevating the precision of estimates or reducing the sampling errors.

The details of the work presented in the thesis are as follows:

The work done in present thesis is primarily concerned with the development of some improved and efficient estimation procedures of population mean proportion, median and variance by utilizing the suitable auxiliary information at estimation stage which are readily available at estimation stage. This thesis comprises of six chapters the details of the subsequent chapters are:

Chapter one covers the introductory part and extensive review of literatures related to seven important problems discussed in this thesis. Chronological developments in these areas with their motivational factors have been discussed. This chapter may provide a consolidated source of literatures to the researchers who intend to work further in the areas of present studies.
Chapter two is divided into two parts. First part of the chapter deals with the problem of estimation of finite population mean when study variable is qualitative in nature using auxiliary information. Three different kinds of estimators have been proposed. Bias and mean square error expressions are derived up to the first order of approximation. Results have been supported with suitable empirical study. Mutual comparisons of some estimators are also made. In the second part of the chapter, we address the problem of estimating the population mean with known population proportion of an auxiliary variable in stratified random sampling. Two families of estimators are proposed along with its several existing and new members. Bias and mean square error expressions are derived up to first order of approximation. Under theoretical and empirical studies it has been shown that the proposed estimator is more efficient than the usual estimator, ratio-product, exponential ratio and exponential product type estimators and estimators due to Solanki and Singh (2013) and Koyuncu (2013) in stratified random sampling using auxiliary attribute.

Chapter three, discusses the problems of variance estimation in the presence of measurement errors. In the first part of the chapter three estimators are proposed in which two are motivated by Koyuncu and Kadilar (2010), Singh and Solanki (2012) assuming the known information of mean of auxiliary variable. Bias and mean square error expressions are derived with and without measurement errors up to the first order of approximation. It has been shown that the measurement errors affect the performance of the estimators and it should be taken under consideration. It has also been shown that proposed estimator is more efficient than the wider class of estimators proposed by Singh and Karpe (2009). Results are well supported with the help of empirical study to show the effect of measurement errors at estimation stage and well analysed with realistic point of view. In second part of the chapter the same three estimators are discussed using the known variance of auxiliary variable. Bias and mean square error expressions are derived, comparisons are made using empirical example.

Chapter four deals with the problem of estimation of population mean using two auxiliary variables and two auxiliary attributes separately into two parts of the chapter. In first part following Abu-Dayeh et al. (2003) and Lu and Yan (2014) a generalized class of estimators is suggested along with its several members when information is available on two
auxiliary variables. After studying the properties of the suggested estimator it has been shown empirically that the suggested estimator is more efficient than the usual estimator, regression estimator using two auxiliary variables, traditional multivariate estimator using two auxiliary variables, estimator due to Abu-Dayeh et al. (2003) and the estimator envisaged by Lu and Yan (2014). In second part of the chapter the properties of the same generalized class of estimators of part one is studied when auxiliary information is available in the form of attributes. In real life, there are many situations when auxiliary information is available in qualitative form then only the need is to devise a suitable mechanism for its proper utilization. It has been shown that the proposed generalized class of estimators is more efficient than the which utilize information on single attribute and the estimators proposed by Verma et al. (2013) and Malik and Singh (2013).

In Chapter five, the discussion has been made about the estimation of median using efficient use of suitable auxiliary information at estimation stage. We propose the generalized ratio cum difference class of estimators using auxiliary information. The suggested estimators generate several members including the estimators of Robson (1957), Murthy (1964), Reddy (1973, 1974), Walsh (1970), Vos (1980), Kuk and Mak (1989) and Singh et al. (2003). The Bias and mean square error expressions have been derived up to first order of approximation. Asymptotical optimal estimators along with the mean square error have also been derived. Use of the suggested estimators, when parameters of auxiliary variable is not known, are also discussed. It has been shown that the suggested generalized class of estimators is better than the other existing estimators for the estimation of median and equal efficient to the estimator due to Singh and Solanki (2013) under certain conditions. The theoretical findings are well supported by the empirical studies using two real population data sets.

Chapter six presents the comparisons of the estimators at the second order of approximation when they have the same mean square errors up to the first order of approximation. In first part of the chapter we adapted the estimators proposed by Singh and Solanki (2012) and koyuncu (2012) and studied the properties of the estimators up to the second order of approximation in simple random sampling and stratified random sampling and found that the adapted version of Koyuncu (2012) estimator is more efficient in both the sampling scheme up to the second order of approximation. In second part we adapted the
estimators of Chakrabarty (1979), Sahai and Ray (1980), Khoshnevisan et al. (2007), Singh et al. (2007, 2008) and Solangi et al. (2012) when auxiliary information is available in form of attributes. Bias and mean square error formulae are derived up to the second order of approximation. A comparative study is also made among these estimators and found that the attribute version of the Khoshnevisan et al. (2007) estimator is more efficient than the aforesaid estimators up to the second order of approximation.