Preface

In many sample survey studies, the information on several auxiliary variables correlated with the principal variable under study is either readily available or may be made available by diverting a part of the survey resources. This information may be used to improve the precision of estimation of parameters such as population mean, total, variance or coefficient of variation of the survey variable. The problems of estimation of the population mean (or total) of the survey variable in the situations where population means (or total) of all the auxiliary variables under consideration are known have been considered by several authors including Olkin(1958), Raj(1965), Srivastava(1971), Singh(1969) and Tripathi(1970, 1989). In case none of the auxiliary variable means are known, the estimation procedures based on two phase sampling schemes have been considered by Khan and Tripathi(1967), Tripathi(1970, 1976) Srivastava(1970) and Adhvaryu(1978) to cite a few.

However, in many socio-economic and agricultural surveys, the population means (totals) of some of the auxiliary variables may be known while those of the other may not be readily available. For example, to estimate the total number of agricultural labourers in a rural block, the information about the area and population of the village may be known from the recent District Census Hand Book while the information about the number of cultivators and cultivated area of the village in the block may not be readily available.

The estimation of population mean of a survey variable under the partial knowledge of the auxiliary means has been considered by Chand(1975), Kiregyera(1980, 1984), Mukerjee et al.(1987), Srivenkataraman and Tracy(1989), Srivastava et al.(1990), Upadhyaya et al.(1990, 1992), Singh(1993), Sahoo and Sahoo(1993), and Sahoo et al.(1994). However, their results are confined to the use of two auxiliary variables only, the mean of one being known while that of other unknown. The two phase sampling scheme considered by them consists of simple random sampling without replacement (SRSWOR) at both the phases.

We have extended the above study to the situation of several auxiliary variables by considering some of the population means of the auxiliary variables are known while those of others are unknown for estimating unknown population mean of the study variable. Tripathi and Ahmed
(1993) and Ahmed et al. (1993a, 1993b) initiated the use of multiple auxiliary variables in the above set up.

The work contained in this thesis is spread over in five chapters. A comprehensive bibliography has been given at the end, which we have consulted during our research.

In Chapter one, the historical background of survey sampling has been given. Some prominent survey statisticians, who played the important role to make the survey sampling as a different discipline of statistics have been also introduced. Some initial works are mentioned, where auxiliary variables are properly used to increase the efficiency of the estimators. In case of univariate as well as multivariate situations, some important works by using ratio and regression estimator are also discussed.

In Chapter two, Chain ratio, product and ratio-product mixed estimators both weighted as well as unweighted by utilizing several correlated variables are considered. We propose the two classes of estimators and their improved versions. The properties of these estimators for the general sampling scheme are studied. Detail results are given for the sampling scheme simple random sample without replacement (SRSWOR) along with cost function. A comparison is made with some known well established estimators in case of two auxiliary variables. The relative gain in efficiency of the optimum estimator of these estimators over the other estimators is shown for the natural population data.

In Chapter three, a class of estimators is proposed, which includes several known and unknown estimators as particular members. The properties of this class for a general sampling scheme are studied. Results for the simple random sampling without replacement (SRSWOR) are studied and the optimum sample sizes are given for the suitable cost function. The class is defined for two auxiliary variables where the population mean of one is known while that of other is unknown and it is shown that most of the recently developed estimators are the members of this class. A comparison has been given with respect to mean square error. We have given the percentage gain in efficiency of the optimum estimator of the proposed class over the other known estimators for three natural population data.

In Chapter four, the above study has been extended for stratified sampling. The combined and separate class of estimators two different cases along with their properties for the general sampling design. Detail results for the simple random sampling without replacement (SRSWOR)
and the allocation problems have been discussed. Numerical illustrations have been given for the natural population data set in case of proportional allocation.

In Chapter five, we have carried forward to estimate the population means of several study variables simultaneously by considering general set up of multiple auxiliary variables. The class of estimators has been proposed and its properties for the general sampling design are studied. We have given the detailed results for the simple random sampling without replacement (SRSWOR) scheme and the optimum sample sizes are given for a suitable cost function. Numerical illustrations have been given for two natural population data set.