PREFACE

This proposed book provides a chronological development of survey sampling theory and applications from the basic level of concepts, theories, principles, and their practical applications to the very advanced level. The book covers a wide spectrum of topics on the subject. Some of the topics discussed here are not available in other text books. Theories are illustrated with appropriate theoretical and numerical examples for further clarity. This book will be useful for the graduate students and researchers in the field of survey sampling. It will also serve practitioners engaged in surveys because it contains almost every aspect of survey sampling.

DESCRIPTIONS OF CHAPTERS

The book comprises 26 chapters. The first 15 chapters are devoted to the basic concepts of survey sampling, which may be considered as a text for graduate students. Theories of each of the chapters are developed whenever possible in a unified setup—that can be generalized for wider classes of estimators and sampling designs. The remaining chapters 16–26 consist of advanced materials useful for researchers and practitioners engaged in the field of survey sampling.

Chapter 1 introduces terminologies and basic concepts such as sampling designs, inclusion probabilities, and sampling schemes. It also contains equivalency of sampling designs and sampling schemes—Hanurav's algorithm, sampling from finite and various types of infinite populations.

Chapter 2 is devoted to inferential problems for finite population sampling, e.g., various classes of unbiased estimators, uniformly minimum variance of unbiased estimation, nonexistence theorem, admissibility, sufficiency, and Rao-Blackwellization technique.

Chapters 3–5 comprise details of simple random sampling, and systematic and unequal probability sampling.

Chapter 6 introduces superpopulation model, model-based inference, and model/design-based (model-assisted) inferences; optimal sampling strategies for various superpopulation models, e.g., product-measure, equicorrelated, transformation, exchangeable, and random permutation models; and robustness of various sampling designs, Bayesian inferences and

comparisons under various superpopulation models, and comparisons of various sampling strategies under superpopulation models.

Chapters 7–9 discuss stratified sampling, ratio method, regression, product, and calibrated method–based estimation in detail. The expressions of the bias and mean square error of the proposed estimators are derived under various sampling designs.

Chapter 10 deals with two-phase sampling where data collected in the first phase sample are used at the stages of estimation, selection of sample, and stratification, along with their combinations.

Chapter 11 provides repetitive sampling under various sampling schemes such as simple random, probability proportional to size with replacement, and Rao–Hartley–Cochran sampling schemes, which are not available in other text books.

Chapters 12 and 13 provide various aspects of cluster and multistage sampling designs such as general method of estimation of the population total, mean, and proportion and methods of estimation of their variances.

Chapter 14 presents unbiased estimation of mean square errors of homogeneous unbiased estimators based on various sampling designs and conditions of nonnegativity of the proposed mean-squared estimators.

Chapter 15 discusses various aspects of nonsampling errors and methods of controlling such errors, e.g., poststratification, use of response probabilities, various types of imputations, measurement errors, and interpenetrating subsamples.

Chapter 16 gives a comprehensive review of randomized response techniques for qualitative and quantitative characteristics and unified theory of estimation of population characteristics, e.g., mean and proportions. Methods of variance estimation are also discussed in detail. Various methods of optional randomized response techniques and measure of protection of privacy are also discussed. Optimal sampling strategies under various superpopulation models are also established.

Chapter 17 introduces methods of estimation of population characteristics for domain (larger areas) and small areas. Various methods of small area estimation have been proposed. This includes symptomatic accounting techniques and direct, synthetic, and composite methods. Methods of borrowing strength, use of various superpopulation models, empirical best linear unbiased prediction (EBLUP), empirical Bayes (EB), and hierarchical Bayes (HB) approach have also been explained.

Chapter 18 gives various methods of estimation of variance/mean square errors of estimators originated from complex survey design. Methods of linearization, jackknife, balanced repeated replication, and bootstrap methods are discussed for various sampling designs. The method of generalized variance functions is also included.

Chapters 19 and 20 describe various adjustments that are needed for the traditional chi-square test statistics for categorical data and regression analysis when data are obtained from complex survey designs.

Chapter 21 introduces the methods of ranked set sampling for estimating finite population characteristics based on SRSWR and SRSWOR, judgment ranking, ranking based on concomitant variables, moments of judgment order statistics, size-based probability of selections, etc.

Chapter 22 introduces concepts of estimating functions and estimating equations, optimal estimating function, estimating function for survey populations, and interval estimation, among others.

Chapter 23 gives different methods of estimating distribution function from finite population. The design-based, model-based, model-assisted, nonparametric regression method and calibration methods are also introduced. The methods of estimation of quantiles and medians are treated as a special case.

Chapter 24 gives various methods of controlled sampling such as experimental design and application of linear and nonlinear programming. The methods nearest proportional to size and coordination of samples over time are also discussed.

Chapter 25 introduces concepts of empirical likelihood in survey sampling. The concept of pseudo—empirical likelihood and model-calibrated pseudo—empirical likelihood and their applications are also introduced. Empirical likelihood methods for estimation of confidence interval are also given.

Chapter 26 comprises the different methods of collection of data for rare and mobile populations. The methods include methods of screening, disproportionate sampling, multiplicity or network sampling, multiframe sampling, snowball sampling, location sampling, adapted sampling, and capture—recapture methods.

Overall, the book addresses itself to a wide spectrum of survey sampling theory and applications. The book will be useful for graduate students, researchers, and practitioners in the field of survey sampling theory and applications.