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Book Review

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Richard Valliant, Jill A. Dever and Frauke Kreuter. *Practical Tools for Designing and Weighting Survey Samples.* New York: Springer, 2013. ISBN 978-1-4614-6448-8, 670 pp. \$68.34.

This book is directed at students, survey statisticians, social scientists, and other survey practitioners, presenting statistical thought and steps taken to design, select, and weight random survey samples. Following a first chapter on "An Overview of Sample Design and Weighting", which contains the background and the basic terminology used, the book is divided into four parts: I: Designing Single-Stage Sample Surveys (Ch. 2-7), II: Multistage Designs (Ch. 8-11), III: Survey Weights and Analyses (Ch. 12-16), and IV: Other Topics (Ch. 17-18).

Parts I-III describe examples of projects similar to those that might be encountered in practice. After introducing each project, the authors present the tools for accomplishing their work in the subsequent chapters. The last chapters in Parts I-III, Chapters 7, 11, and 16, provide one way of meeting the goals of the example project but with solutions that are not unique. The authors explain that "there are likely to be many ways of designing a sample and creating weights that will, at least approximately, achieve the stated goals... Practitioners need to be comfortable with the solutions they propose. They need to be able to defend decisions made along the way and understand the consequences that alternative design decisions would have. This book will prepare you for such tasks."

Part I addresses techniques that are valuable in designing single-stage samples. Chapter 2 presents a straightforward project to design a personnel survey. The subsequent chapters concentrate on methods for determining the sample size and allocating it among different groups in the population. Chapter 3 presents a variety of ways of calculating a sample size to meet stated precision goals for estimates for the full population. Chapter 4 covers various methods of computing sample sizes based on power requirements, which is common in epidemiological applications when the goal is to find a sample size that will detect with a high probability some prespecified difference in means, and so on, between subgroups or between groups at two different time periods. All of these goals substitute inference criteria or make deliberate use of approximations that can be seen as pragmatic or arbitrary and not scientific criteria or principles (for these, see Cochran 1977; Ruiz Espejo 1986, 1987, 2013).

Chapters 3 and 4 focus on sample-size decisions made based on optimizing precision and power for one single variable at a time. To meet multiple goals and respect cost constraints, the authors suggest that the methods in Chapters 3 and 4 could be applied by

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trial and error in the hopes of finding an acceptable solution. A better approach is to use mathematical programming techniques that allow optimization across multiple variables.

Chapter 5 presents some multicriteria programming methods that can be used to solve these more complicated problems. These algorithms are better known to operations researchers and management scientists than to survey statisticians, and they allow more realistic treatment of complicated allocation problems involving multiple response variables and constraints on costs, precision, and sample sizes for subgroups. In Chapter 6, adjustments need to be made to the initial sample size to account for such circumstances.

Part II concerns the design of clustered samples in order to efficiently collect data, and therefore sample-design decisions are required in multiple stages. Chapter 8 begins with a moderately complex project to design an area sample and allocate units to geographic clusters in such a way that the size of the sample of persons is controlled relative to some important demographic groups. Chapters 9 and 10 cover the design of samples of those geographic clusters. Chapter 11 gives a solution to the area sample design.

Part III discusses the computation of survey weights and their use in some analyses. Chapter 12 begins with a project on calculating weights for a personnel survey, like the one designed in Project 1 of Chapter 2. Chapters 13 and 14 describe the steps for calculating base weights, making adjustments for ineligible units, nonresponse, and other sample losses, and for using auxiliary data to adjust for deficient frame coverage and to reduce variances. Some of the important techniques for using auxiliary data are the general regression estimator and calibration estimation, which provide biased estimators and their variances are not usually unbiasedly estimable. But software is now available to do some of the computations. Chapter 13 sketches the rationale behind the nonresponse weight-adjustment methods, which requires thinking about models for response and other methods that omit some units. Applications of calibration estimation, including poststratification, raking, and general regression estimation are covered in Chapter 14. More discussion of objective unbiased variance estimation could have been included here (Ruiz Espejo et al. 2006; Ruiz Espejo 2013, 2015). Weight trimming using quadratic programming and other more ad hoc methods are also dealt with in this chapter. Chapter 15 covers the major approaches to variance estimation in surveys. Chapter 16 gives a solution to weighting the personnel survey.

Part IV covers the specialized topics of multiphase sampling (Ch. 17) and quality control (Ch. 18).

My opinion of the book is that, while it does not resolve inference problems which arise in survey sampling theory, it does provide pragmatic ideas and solutions in applied designs and statistical weighting in sample surveys. Many examples of useful code written in R are provided throughout the book. The book is oriented towards practice but without the developed pure science behind it. For this reason, I believe that it is more useful for survey statisticians and social survey practitioners interested in practical solutions in the survey design than those interested in development of sampling theory.

References

Cochran, W.G. 1977. Sampling Techniques, 3rd ed. New York, NY: Wiley.
Ruiz Espejo, M. 1986. "Estimable Parametric Functions in Sampling Theory." Estadística Española 28(112–113): 69–73.

- Ruiz Espejo, M. 1987. "On UMV and UMMSE Estimators in Finite Populations." *Estadística Española* 29(115): 105–111.
- Ruiz Espejo, M. 2013. Exactness of Inference in Finite Populations. Madrid: Bubok.
- Ruiz Espejo, M. 2015. "Objective Unbiased Estimation for Nonresponse." *Estadística Española*, 57(186): 29–37.
- Ruiz Espejo, M., M. Delgado Pineda, and H.P. Singh. 2006. "Postgrouped Sampling Method of Estimation." *Test* 15: 209–226.