

Sampling for Natural Resource Monitoring

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Reviewed by Jeffrey E. Herrick

Sampling for Natural Resource Monitoring provides a comprehensive introduction to natural resource sampling design for students, scientists, and managers. Following a brief introduction, the book begins with a section summarizing the principles and major decisions required to develop an effective sampling strategy. The remainder of the book is divided among three sections addressing sampling in space (for surveys), and in time and space-time (for monitoring). Each of these sections includes chapters on sampling for global and local quantities in space. Within each chapter, the authors describe both "design-based" approaches of classical survey sampling and "model-based" approaches associated with geostatistics and time series analysis. Inclusion of both types of approaches in a single volume allows the authors to show how they can complement each other. For example spatial models can be used to optimize sample sizes for design-based sampling strategies. Detailed appendices provide additional information on optimization algorithms, kriging, and time-series modeling.

The emphasis on cost analysis and optimization throughout the book is perhaps one of its greatest strengths. The sections on design-based methods include clear explanations of the relative benefits of different basic types of sampling designs, including simple, stratified, cluster and systematic random sampling as well as compound designs that include combinations of the basic designs and nesting. The explanations of two-phase and sequential designs suggest how these approaches could be used to reduce both sampling and analysis costs for many environmental studies. Figures, including decision trees, are useful and clearly drawn. Those who learn visually may wish that more of these excellent supplements to the text had been included.

While some knowledge of statistics, including geostatistics, is necessary to understand the entire volume, much of the text is accessible and relevant even to those with little statistical training. For example, the chapter addressing major design decisions includes an excellent discussion of composite sampling that provides simple recommendations while referring the reader

to other parts of the book for more detail. Similarly, the decision trees and the introductory section on optimization for multiple target variables or locations are particularly worthwhile reading for anyone involved in the development of a large, multidisciplinary study. Consideration of even the simplest recommendations, such as how to avoid bias when selecting replacement samples in a simple random design, apply different sampling designs in monitoring-based research, and decide whether to synchronize monitoring measurements in space, time or both would significantly improve the quality and efficiency of many studies.

It is impossible, however, for any book to comprehensively address this broad topic. There is little reference to the challenges associated with integrating remote sensing and ground-based sampling. Remote sensing is addressed only occasionally and there is relatively little consideration of how to deal with the unique characteristics of different types of imagery. One of the most significant limitations of the book is that it includes few quantitative examples. Consequently, it is virtually impossible to test one's understanding of a particular formula and its component variables by independently working through it and comparing the results with those of the authors. Finally, the index is somewhat limited and emphasizes statistical terms, making it difficult to locate the examples that are included. The tendency to generalize across disciplines instead of focusing on specific examples is also one of the book's strengths: it should be equally useful for individuals concerned with soil fertility, soil quality, environmental contamination, biodiversity conservation and many other natural resource issues.

In summary, even a cursory review of the material presented in this book has the potential to significantly increase the quality of both new and ongoing studies while reducing their cost. If used as the primary text for a sampling course, prerequisites should include an introduction to probability theory and at least a basic understanding of geostatistics. Instructors should also be prepared to develop examples to supplement the general explanations provided in the text.

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