



Statistical Methods for Spatial Data Analysis

**Oliver Schabenberger and Carol A. Gotway
(Chapman & Hall/CRC Press) 2005, 488 pages. ISBN
1-58488-322-7. Hard cover only.**

Statistical Methods for Spatial Data Analysis offers plenty of information for the analysis of spatial data in a variety of disciplines. It is clearly written and well organized. The chapters are highly topical and come at a time when the literature on statistical methods for spatial data analysis is steadily growing. Interesting and relevant to the readership of the *URISA Journal*, this book is a valuable resource for educators, students, geographic information system (GIS) practitioners, and spatial scientists from varying disciplines.

The aim of the book is ambitious: comprehensive and illustrative compilation of the basic statistical theory and methods for spatial data analysis. Few books on the subject of statistical methods for spatial data analysis describe the methods in a thorough yet accessible manner. This text stands out because of its comprehensive coverage of a wide range of statistical methods and spatial analysis techniques.

One of the book's main strengths is the clear organization of its chapters. Each chapter starts with an explanation of the theory with well-chosen examples explaining the statistical method. Most of the examples use simplified real-world datasets and sometimes hypothetical datasets with a few exceptions. For example, the woodpecker data, lightning-strikes data, rainfall data, and low-birth-weight data represent a variety of disciplines, which makes the book very useful for scientists across disciplines. Necessary equations are provided for each method with a wealth of informative figures, which contribute substantially to developing a better understanding of the methods described. As could be expected for a book of this nature, it includes a fair amount of

mathematics. Each chapter ends with problems that encourage the readers/students to apply the statistical methods described to a specific problem.

The book contains nine chapters. The introductory chapter provides the needed background on the characteristics and types of spatial data, and the nature of spatial processes and patterns such as autocorrelation functions and the effects of autocorrelation on statistical inference. Chapter 2 describes the theoretical framework of random fields necessary for subsequent chapters, particularly Chapters 4 and 5. Chapter 3 covers point-pattern analysis with a well-named title, "Mapped Point Patterns." The authors should be congratulated on doing such a solid job of including the relevant spatial processes and techniques applicable to point-pattern analysis. Chapter 4 primarily deals with semivariogram, estimation, and modeling of the covariance function. Chapter 5 covers spatial prediction and kriging. In this chapter, the authors elaborate on general details of the spatial prediction problem and give an extensive overview of kriging, with comparisons such as local versus global kriging. They also cover trend surface models with illustrations. Chapter 6 is a comprehensive coverage of spatial regression models, beginning with linear models with uncorrelated errors and ending with a succinct discussion of Bayesian hierarchical models for spatial data. Chapter 7 describes simulation of random fields, followed by Chapter 8 on nonstationary covariance. The final chapter on spatiotemporal processes primarily deals with separable and nonseparable covariance functions and spatiotemporal point processes.

Each of the various statistical methods is described in consid-

erable depth. The book's main strength is that it describes basic statistical concepts for spatial data analysis and explains them and their relevance clearly in a single volume in a consistent manner. Most spatial analysis textbooks do not cover the relevant statistical concepts. This book demonstrates that spatial analysis requires a consistent recognition of basic statistical theory and methods for spatial data analysis. Including simulation techniques as one solid chapter in the book is a very good addition for this subject is often overlooked in most other textbooks on spatial statistics. The subject index of the book serves as a glossary of spatial methods in alphabetical order.

While applying the statistical methods to a specific problem at the end of each chapter is a very meaningful and helpful way of better understanding the concepts, especially when worked into course material, unfortunately, having no answer key makes it harder for readers, when they are not using the book in a class setting. Maybe the answer key could be provided in the CRC Press Web Site along with the other materials in the book.

A shortcoming of the book is that other than SAS/STAT and S+ software, there is little reference made to software that might be used to carry out the spatial statistics described. When used in a course setting, this would be the task of the instructor, but for others using the book as a reference, it will take considerable effort to identify how GIS and related software has implemented the various techniques. Although most commercial GIS software does not include many of the statistical techniques referred to in the text, the use of a statistical software package is pretty much a requirement to carry out many of the techniques covered in the book. This is not really a weakness of the book itself, but simply the reality of how most spatial statistics software has been developed on and with a GIS platform. But it is promising and encouraging that the material in the book will be supplemented with the CRC Press Web site, which will provide many of the

datasets used in the text and the software codes to implement the principal methods described.

Although the GIS may not be absolutely necessary for spatial analysis and spatial statistics, it can facilitate such an analysis and moreover can provide insights that might otherwise be missed. The way this book is structured, it misses the issues associated with mathematical modeling and GIS and research oriented towards the linkages between spatial analysis and GIS. A chapter just dedicated to the integration of spatial analysis and GIS could stimulate the interest of readers in quantitative spatial science, particularly exploratory and visual types of analysis. This would diverge from the main goal of the book, which is covering the common spatial theories and statistical methods in detail. But it could definitely help the GIS-user readers to strengthen their spatial analysis skills by using the concepts explained in this book.

This book will be most useful as a textbook for graduate spatial statistics courses. I highly recommend it for educators. It can be used as a textbook in a variety of disciplines. Schabenberger and Gotway are to be congratulated on bringing together a valuable addition to the spatial statistics and spatial analysis literature. Production by publishers Chapman & Hall/CRC Press is to a high standard, with an attractive cover and a high quality of print. No doubt, this book will make statistical methods for spatial data analysis useful for scientists across many disciplines.

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