

approach, but also the tests that detect higher-order moment differences. It also presents a comprehensive treatment of modeling ties. Although its subject is highly technical, the book somehow maintains a good balance between theories and applications. The excellent Appendix is self-contained and very easy to read. Due to the nature of the book, it may not be suitable as a textbook for any graduate courses. But it would be suitable as a reference book for such graduate courses as categorical data analysis, as well as nonparametric statistics at the doctorate level.

Chapter 1 serves as an introductory chapter, including an interesting discussion on parametric or nonparametric tests, a worked instructor's example, the outline and scope of the book, and applications of nonparametric methods to sensory evaluation. The instructor's example is quite interesting, illustrating points concerning standard nonparametric tests and the detection of linear and quadratic effects. Analysis of sensory data is extremely important, particularly in consumer market research and food science. I would have liked to see an expanded discussion on this topic, covering statistical methods as well as applications.

Chapter 2 focuses on ties, how they have been traditionally treated and how different models lead to different treatments. The context is mainly what is for many the first nonparametric test, the sign test. The novel idea of decomposing a test statistic into its components to give a more detailed scrutiny of the data is also introduced.

Chapters 3–8 focus on tests for which the data may be given in two-way contingency tables. Standard tests presented assess mean or correlation departures from the null. Because the traditional correlation is the (1, 1)th bivariate moment, all are essentially first-order moment tests. All these tests are extended to detect higher-moment departures from the null. In these chapters, several standard nonparametric tests, including Pearson's chi-squared test, the Kruskal–Wallis test, the generalized median test, Page's test, Yates's test, sign test, Gart's test, Friedman and Cochran tests, Stuart's test, Durbin's test, and Spearman's test, are overviewed and linked to the tests based on models for data presented in contingency tables. Extensions to these nonparametric tests are also provided. The idea of decomposing a test statistic into its components is further explored and illustrated using various real data examples. These chapters would be easier to read and follow if some of the mathematical symbols such as the square root had been displayed better.

Chapter 9 gives an overview of one- and S-sample smooth tests of goodness of fit. Chapter 10 includes a discussion of recent work on partially parametric testing. This has grown out of the work on one-sample smooth tests of goodness of fit. The probability function of the distribution tested for is nested in a rich family of distributions. Extensions of some current two-way table work to multiway tables are also included.

Overall, this book is an excellent addition to the statistical literature. It contains a large number of examples and applications. The book could be greatly enhanced by introducing a set of exercises at the end of each chapter and by providing statistical computing codes in either SAS or StatXact for the worked examples. Another area needing more coverage is the power study of the tests presented in the book.

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**Sequential Monte Carlo Methods in Practice**, edited by  
Arnaud DOUCET, Nando DE FREITAS, and Neil GORDON,  
New York: Springer-Verlag, 2001, ISBN 0-387-95146-6,  
xxvii+581 pp., \$79.95.

This book is an edited volume in Springer's Statistics for Engineering and Information Science series. Kalman filter and hidden Markov models are the two most traditional filters that produce analytical solutions for updating posterior distributions. However, in real life, the assumptions to ensure mathematical tractability and analytical expressions are rarely satisfied; rather, we have non-Gaussian observations, nonlinearity, and high-dimensional problems. In such areas as aircraft navigation, robot navigation, econometrics, finance, communications, missile applications, computer vision and many other fields, the observations often arrive sequentially in time, necessitating updating in real time. Tremendous progress in computing power in recent years has made such sequential computing feasible. Sequential Monte Carlo

techniques are simulation-based methods that provide a convenient, attractive approach to computing posterior distributions. These methods can handle complicated high-dimensional, nonlinear, non-Gaussian models.

This book attempts to compile some of the most important developments in the area of sequential Monte Carlo methods. The book is organized into 26 chapters, each written by one or more authors from a group of 57 who are experts in this area. Chapter 1 is an introduction to the topic of sequential Monte Carlo methods, providing motivation for using such techniques. The editors introduce the basic topic of importance sampling and its modification and the bootstrap filter to perform computations sequentially. They discuss the advantages of Monte Carlo methods over such methods as deterministic numerical integration techniques. This chapter must be read first. The remaining chapters are organized into three parts: Theoretical Issues (Chaps. 2 and 3), Strategies for Improving Sequential Monte Carlo Methods (Chaps. 4–14), and Applications (Chaps. 15–26). These three parts are independent of each other and may be read out of order. A practitioner who is not too interested in the theoretical details can easily skip the part on Theoretical Issues and proceed to the next two parts. Also, the chapters within the last two parts are mostly independent of one another and can be read out of order as well.

Chapters 2 and 3 provide a rigorous theoretical basis for sequential Monte Carlo methods. Chapters 4–14 deal with several algorithmic developments that allow significant performance improvement over standard methods. Most of the materials are of an in-depth theoretical nature and will serve as good references.

Chapters 15–26 deal with a wide range of applications including using Cramér–Rao bounds as a handy tool to evaluate different sequential Monte Carlo algorithms (Chap. 15); probabilistic modeling of shapes of objects in motion and their visual observations (Chap. 16); different sequential Monte Carlo techniques for neural networks in the context of parameter estimation and model selection (Chap. 17); using sequential Monte Carlo techniques in signal processing scenarios when the observed data record over a period of length  $t$  is generated by a mixture distribution with  $2^t$  components (with each data record coming from one of two hypotheses, either there is a signal or there is no signal) (Chap. 18); applications in different types of mobile robot localization problems, including position tracking, global localization, multi-robot localization and kidnapped robot problem (Chap. 19); applications in time series modeling (Chap. 20); dynamic Bayesian networks (Chap. 21); the use of Rao–Blackwellized particle filtering to exploit tractable substructures in dynamic Bayesian networks (Chap. 24); a real life on-line process control application for semiconductor composition (Chap. 22); and applications in target tracking (Chap. 23), target recognition (Chap. 26), and guidance algorithm of a missile system (Chap. 25).

As claimed on the back cover, "this book presents the first comprehensive and coherent treatment of these techniques ...." Overall, this book provides a very good overview of the sequential Monte Carlo methods and contains many ideas on further research on methodologies and newer areas of application. The book assumes some previous exposure to the topic and also requires knowledge of advanced probability theory (measure theoretic), stochastic process, and statistical inference. Some of the chapters are easy to follow, but a few others are not so easy reading. This is so probably because it is an edited volume compiling the contributions of many authors, each of whom has a different writing style. The book often uses complicated mathematical notations that are hard to digest. Also, some chapters are high-speed review tours of a huge amount of technical material. It will be certainly a valuable reference book for students and researchers working in the area of on-line data analysis. But I will hesitate to recommend the book to an average practitioner in industry, primarily because such an applied statistician or engineer may find the level of the book too high. Nonetheless, the techniques discussed in this book are of great relevance to practitioners dealing with real time data. Probably a follow-up book that will bring the materials presented in this volume to a level that can be digested easily by the average applied statistician will be of greater value to the larger statistical community.

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Sequential Monte Carlo Methods in Practice

Doucet, A.; Freitas, N. de; Gordon, N. (Eds.)

2001, XXVIII, 582 p., Hardcover

ISBN: 978-0-387-95146-1