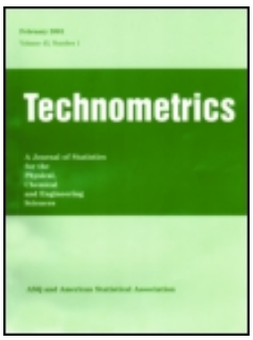

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Numerical Methods of Statistics

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2 covers the basic mathematics and statistics that are necessary for acceptance sampling. Chapter 3 does a very nice job of developing the language and concepts of acceptance sampling.

Part II, which consists of Chapter 4, covers how to choose parameters for various sampling plans. The development is very clear with numerous examples and exercises. Single, double, multiple, and sequential sampling schemes are covered. The section on sequential sampling is particularly nice.

Part III has two chapters (5 and 6) that cover acceptance sampling for attributes. Chapter 5 is essentially a discussion and analysis of the ANSI/ASQC Z1.4-1993 standard. Chapter 6 extends acceptance sampling for attributes to cover the LTPD and AOQL indices. These are covered for both single and double sampling. Also included in this chapter are discussions of special sampling schemes including TNT, quick switching, lot sensitive, MIL-STD-1916, and a very brief discussion of sampling plans for ppm.

Part IV, containing Chapters 7 and 8, covers special forms of acceptance sampling. Chapter 7 covers continuous sampling plans along with many of the various stopping rules. Chapter 8 covers the various skip-lot and chaining sampling schemes.

Part V (Chap. 9) is devoted to variables acceptance sampling. A motivation for variables acceptance sampling is given as well as an in-depth discussion of the ANSI/ASQC Z1.9-1993 standard. Also discussed are narrow-gauge-limit sampling schemes and the use of variables control charts as a tool for accepting and rejecting processes.

Finally, Part VI (Chap. 10) covers how to put all of the various schemes together into a complete, successful inspection program. Particularly nice are the sections on measurement error and its effect on acceptance sampling and gauge studies.

This is an excellent book and should be on the reference book shelf of everyone who works in manufacturing quality control. It would also be a very useful textbook for undergratuate students of statistics or a graduate level course for industrial engineers.

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Applied Stochastic Modelling, by Byron J. T. MORGAN, New York: Oxford University Press, 2000, ISBN 0-340-74041-8, xxii+297 pp., $34.95 (paper).

There is almost universal agreement that statistics courses can be improved by more emphasis on real data analysis. Many recent introductory statistics textbooks are taking this to heart, including in their pages more and more real world examples and case studies. However, for the instructor of a higher-level stats course who wants to make their course application-centered, there are still too few textbooks to choose from. This book is an attempt to remedy that problem.

This text is geared for a course in statistical modelling and/or data analysis for upper-level undergraduates and beginning graduate students. It is also intended as a reference for researchers using modern statistical methods. Its strength is unquestionably the varied and numerous examples taken from applications in mostly biology, but also psychology, geology, sociology, and economics. The book is heavily geared to using the computer for simulation and for data analysis, and over 50 Matlab programs are included throughout the book. S-Plus versions are available at the book's website at www.arnoldpublishers.com/support/stochastic.

The book begins by introducing 10 varied data sets and posing questions of statistical inference and modelling. A few of these examples are fertility cycles to conception for smokers and non-smokers; incubation periods for streptococcal sore throat gotten from drinking contaminated milk; mortality of flour beetles sprayed with insecticides; and incidence of diseased trees in a forest.

Chapter 2 presents basic material on model fitting using the method of maximum likelihood. Three examples are treated in depth, fitting a geometric, beta-geometric, and Poisson process model. The next chapter treats question of functional optimization in the context of maximizing the likelihood function. Both deterministic (Newton–Raphson, steepest descent, simplex search) and stochastic (simulated annealing) methods are presented, with many computer-based examples. Chapters 4 and 5 contain the bulk of the more theoretical material in the book, focusing on likelihood-based issues in statistical inference. Topics here include Fisher information, estimating errors and correlations, confidence regions, hypothesis testing, parametrization, and the EM algorithm. Chapter 6 is devoted to simulation techniques, including Monte Carlo and the bootstrap. Chapter 7 presents materials on Bayesian methods and Markov chain Monte Carlo. And the final chapter discusses general families of models, including generalized linear, linear mixed, and additive models.

The text contains three appendices: (i) a basic probability and statistics reference section, with subsections on distributions, the Poisson process, normal quadratic forms, and Markov chains, (ii) Matlab primer, and (iii) material on kernel density estimation. There are numerous exercises, many involving some programming, at the end of each section. Solutions and comments are provided for selected problems.

The book is based on lecture notes given to a 30-hour lecture course for third-year undergraduates, statistics MSc students, and first-year statistics Ph.D. students at the University of Kent in England.

There is a wealth of material in this book, and even were it not adopted for a course, it could be an excellent reference. One hesitation in adopting this book for a course is that the theoretical material is somewhat thin. For use in a course, several sections might need supplementation. For instance, there is little motivation or development of the likelihood function. The book "hits the ground running" in its assumption that the reader is well versed on its use and applications. Also several examples are quite involved and could warrant more motivation and explanation. Nevertheless, I found the book very well written, fresh in it style, with lots of wonderful examples and problems. It is well referenced with almost 200 cited papers. An additional strength are the exercises at the end of each chapter, which are well thought out with a nice mix of routine questions, theoretical problems, programming assignments, and problems posed from current statistics papers. The solutions and comments section at the back of the book makes an attempt to lead students to the right answer by providing hints and suggestions on how to approach the problem, rather than just presenting the correct answer.

In the introduction the author writes that "[t]he construction, fitting and evaluation of statistical and stochastic models are not only vitally important... they are also great fun. It is hoped that some of the enjoyment and fascination of the subject will be gained by readers of this book." They were certainly gained by this reviewer.

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Numerical Methods of Statistics, by John F. MONAHAN, New York: Cambridge University Press, 2001, ISBN 0-521-79168-5, xiv+428 pp.+disk, $74.95.

Considering the wide variety of statistical software packages available for data analysis, how important is it for today's practicing statistician to understand the details of programming in low level languages like C or FORTRAN? In *Numerical Methods of Statistics*, this question is answered by a balanced presentation of topics ranging from computer arithmetic to Markov chain Monte Carlo methods. The author explains that higher level statistical software packages have usually been rigorously tested and produce accurate computations, but when "pushed to their limits" for research purposes, time and memory use becomes inefficient, even with the increasing availability of computing resources. At that point, the statistician who needs to implement new or modified methods requires knowledge of numerical techniques to develop new software or to optimize the needed building blocks of existing software. In this text, algorithms are presented as pseudocode, along with examples of FORTRAN code, and a disk with programs and demonstrations is included inside the back cover.

This text is intended for classroom use, includes exercises at the end of each chapter, and is based on the author's 20 years experience of teaching statistical computing for doctoral students. The first chapter introduces the concept of

computing algorithms and ends with general strategies for programming complicated problems and having confidence in the results. Chapter 2 is devoted to the topic of computer arithmetic and includes discussion of binary number representations and floating point precision. Chapter 3 addresses the traditional areas of linear algebra and solving systems of linear equations. Chapter 4 includes alternative and specialized topics in solving linear equations, a time series application, and consideration of sparse matrices.

Statistical themes dominate the remaining chapters of the book. Chapter 5 presents least-squares numerical methods for regression, including regression diagnostics and hypothesis tests. Eigenvalues and eigenvectors are discussed in Chapter 6, with application to principal components analysis and canonical correlation. Nonarithmetic functions are presented in terms of interpolation, smoothing, approximation, and computing probability distribution functions in Chapter 7. Chapter 8 introduces root finding and univariate and multivariate optimization as a prelude to the Chapter 9 topics of maximum likelihood (both theory and application), profile likelihood, and the EM algorithm. For the more complex computing tasks described in Chapters 8 and 9 the author recommends that users need to understand the basic principles but generally should rely on software which has been tested and verified to be accurate.

Chapter 10 covers numerical integration in one and multiple dimensions and Monte Carlo methods (uniform random number generation) "as methods to spread points in space toward the overall goal of computing an integral." Chapter 11 returns to the traditional topic of generating continuous and discrete random variates from common statistical distributions, including random permutations and sampling with a discussion of accuracy and discretization error. Chapter 12 presents the application of statistical methods to the results of Monte Carlo studies. Chapter 13 presents Markov Chain Monte Carlo and the related methods of Gibbs sampling and the Metropolis–Hastings algorithm. An application involving time series data is presented and diagnostic techniques are described. Chapter 14 returns to the traditional numerical methods topic of sorting but also covers the fast Fourier transform and computing for combinatorial problems.

In summary, this textbook seems ideally suited for its intended purpose of providing graduate students with the knowledge necessary to write programs to implement new methods in statistics. To use the examples and demonstration software requires prerequisite knowledge and the ability to compile and execute FORTRAN program code. Object-oriented programming is mentioned but generally ignored in this textbook. While the emphasis is on low-level general-purpose computer languages, some additional consideration of higher-level interpreted languages, considering their more widespread use, would have been a useful addition. Otherwise, this textbook would be a good choice for teaching statistical computing.

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Editor Reports on New Editions, Proceedings, Collections, and Other Books

This section reports on new editions of books previously reviewed in *Technometrics*, collections of papers and conference proceedings, and other statistics books that should have some interest for the readership. Selections and comments do not represent any perspective of the editor's employer or of the sponsoring societies.

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Statistical Thinking, by Roger HOERL and Ronald SNEE, Pacific Grove, CA: Duxbury, 2001, ISBN 0-534-38158-8, xvii + 526 pp., $67.95.

The term "statistical thinking" seemingly originated somewhere in the mid-1990s, although credit the creativity and literacy of the authors for uncovering the H. G. Wells quote, "statistical thinking will one day be as necessary for effective citizenship as the ability to write." The authors cite a definition for statistical thinking from a small ASQ booklet, Statistics Division (1996), reported by Ziegel (1997). Their definition considers business activities as processes subject to variation which must be understood and controlled if the business is going to be successful.

An enterprising group at the University of Tennessee, Leitnaker, Sanders, and Hild (1996), got out the first book on statistical thinking. See the review by Berry (1997) for a description of that book. Hildebrand and Ott (1998), reported in Ziegel (1999), added the "thinking" part to the 4th edition of their book on statistics for managers. The first author, Hoerl, helped produce another ASQ booklet on statistical thinking (Britz et al. 2000). See the review for this book Lawson (2001).

This new book by Hoerl and Snee moves the methodology for statistical thinking forward in a couple of ways. First, it is the first book to reflect the impact of the considerable interest in recent years for Six Sigma; e.g., see Hahn, Hill, Hoerl, and Zinkgraf (1999), another project for the first author. Second, despite the extensive industrial background for these two authors, e.g. Hoerl, Hooper, Jacobs, and Lucas (1993) or Snee, Hare, and Trout (1985), the book carries the subtitle "Improving Business Performance." The Preface (p. xiii) begins, "This book offers a new approach to introductory business statistics."

The book begins with a three-chapter, 100-page presentation on the various aspects of statistical thinking. There are no equations in this part. The first chapter presents a methodology for business improvement. This discussion draws on concepts from organizational development, total quality, business reengineering, and Six Sigma, all of which are processes that should be familiar to most business students. The second chapter integrates the components of statistical thinking—planning and experimentation, collection and analysis of data, updating and checking of hypotheses, considering always the variation that will occur—with the business processes. Two case studies are used to dramatize the value of statistical thinking. The third chapter presents material on some business processes: interacting with suppliers and customers, assessing customer satisfaction, and benchmarking. The last part of this chapter is concerned with the measurement process.

The second part of the book, another 100 pages or so, is about the strategies and tools that are used for business improvement. The first of the two chapters presents the strategies: a process improvement strategy with eight steps, a problem solving strategy whose five steps subsume the requisite techniques from statistics and quality engineering, and a brief Six Sigma appendage to the introduction from the first chapter. Most of the long chapter involves four case studies. Following a brief introduction to Excel, which the students probably do not need, the second chapter in this part deals with data collection tools, data analysis tools, and knowledge-based tools. Nothing more technically complicated than graphics appears in this material.

Two hundred pages of information on statistical tools make up the third part of the book, "Formal Statistical Methods." It is preceded by a brief introduction to Minitab and JMP software. Chapter 6, "Building and Using Models," presents a methodology for regression analysis. The steps are reasonably comprehensive, and the discussion, developed entirely as text and illustration, emphasizes graphics and interpretation. Chapter 7, "Using Process Experimentation to Build Models," is about the design of experiments. Following an introductory case study, there is a lot of discussion about planning for experimentation. Two factor and three factor experiments are presented. There is more technical detail than there was for the regression chapter.

The last two methods chapters, "Applications of Statistical Inference Tools" and "The Underlying Theory of Statistical Inference," belie the authors' classical training in statistics. "Inference" is one of the quintessential turn-off words in statistical training. Having successfully turned business statistics education upside down or at least backward through the first seven chapters, the authors' approach somewhat spoiled the whole mood for me. However, I really liked the content in first of the chapters. It has nice explanations about intervals and tests. Mostly I liked the material in the other chapter too. It has good discussions about data types, probability distributions, and transformations. There is just some stuff I would have cut.

The usual prescriptive postlude chapter, "Summary and Path Forward," has a couple more case studies, a nice recapitulation of the whole book, and a few messages. Ten appendices provide more information on a number of topics. A few criticisms aside, this is probably the most practical basic statistics textbook that has ever been written within a business context. It is a revolutionary approach to statistics training in any context. It has a reasonable price and is highly recommend for individual purchase.

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