(p. 217). He also advocates routinely reporting the median unbiased point estimator on the grounds that it is in every confidence interval obtained from the evidence function, a property not shared by the (conditional) maximum likelihood estimator.

The sampling schemes (Poisson, product multinomial, etc.) and models considered all yield a sufficient statistic, T, for the parameter of interest, which (conditionally) has a polynomial-based distribution of the form

$$P(T=t;\phi)=\frac{c(t)\phi^t}{f(\phi)},$$

where $\phi^t=\prod_k \phi_k^{t_k}$ if T is multivariate and f is some function. Of course, this is equivalent to saying that T comes from a discrete exponential family with natural parameter $\beta=\log(\phi)$. However, a unifying theme of the book is that the polynomial form facilitates exact computation. To quote the author, "computing the product of a series of polynomials is central to the exact analysis of common discrete data models" (p. 323). In particular, the recursive polynomial (RPM) algorithm that uses exponential checks (which reduce the number of required multiplications) is described in detail as a unifying method for exact computation. The network algorithm used in the seminal work of Mehta and Patel (1983) can be regarded as a pictorial representation of an equivalent RPM algorithm, a fact that is stated as a theorem in the book.

Monte Carlo methods, which can extend the range of application of exact conditional inference beyond the models considered in this book, are only briefly mentioned. In particular, recent work on exact inference utilizing sophisticated Monte Carlo sampling schemes is considered outside the scope of this text, although a few references to such work are given.

However, in this text, the author has provided the statistical community with an extremely useful and potentially influential resource. Many examples are given to illustrate how various exact methods perform in practical settings. These, together with the author's general recommendations, such as the use of the mid-p value and the evidence function, and his reasoned arguments for doing so, make the book an extremely helpful reference for practicing statisticians. The book also contains a comprehensive literature review, a thorough discussion of theoretical issues relating to exact inference for discrete data, and a unified approach to computation. In addition, there are numerous exercises at the end of each chapter and the level of presentation is suitable for a graduate special topics course.

To the best of my knowledge, *Exact Analysis of Discrete Data* is the first book dedicated to this topic. In my opinion it is an invaluable resource for practitioners and teachers, and for researchers who are interested in making further advances in this area.

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A Modern Theory of Factorial Design.

Rahul MUKERJEE and C. F. Jeff WU. New York: Springer, 2006. ISBN 0-387-31991-3. x + 221 pp. $79.95.

Factorial and fractional factorial designs are some of the most popular designs used in practice. Two-level versions of these designs are very common for modeling first-order effects and interactions for a response with a large number of input variables. If more than two levels of each factor are considered, the designs can also be used for higher order models. Historically, these designs have been of primary importance for screening experiments when only two levels of each factor are considered. These situations are common when interest lies in identifying inputs with the largest magnitude of influence on the response. Factorial and fractional factorial designs have many desirable features, including simplicity of form, appealing geometric projections, and excellent economy for what they do.

This book examines historical and current research on factorial designs by identifying optimal designs based on resolution and minimum aberrations, complementary designs, and efficient search algorithms for high dimensional problems. In addition, strategies for adapting these designs to situations with more complicated underlying structures, such as mixed levels, blocking, split plots, and robust parameter design, are also presented.

The authors suggest that the book is suitable as a text for a graduate course in design theory for students in statistics or mathematics programs, or as a reference text for a graduate course in combinatorial mathematics. For these purposes, the book would be well suited. It would also make an excellent reference book for researchers and practitioners who want to understand the theory of constructing an ideal screening experiment with a large numbers of input factors. Readers of the book should be well acquainted with the basics of design and analysis of experiments. In addition, it is highly desirable to have a solid mathematical background, because the book is presented at quite a sophisticated level, with considerable theory presented quite compactly.

After an overview of the book in Chapter 1, the second chapter provides the statistical and mathematical background for the rest of the book. Chapter 3 presents details of the most common type of factorial design, the two-level fractional factorial design. Here, the basic definitions of main effects, interactions, resolution, confounding, aliasing, word length of defining equations, minimum aberration, and isomorphic designs are presented. Strategies for constructing designs are given, as well as an extensive catalogue of designs with 16, 32, 64, and 128 runs for a variety of input factors. This rich collection of designs and those presented in several other chapters are an important contribution. Although the compact notation makes it hard to extract details of the design, once understood, the tables provide valuable references for practitioners who are seeking a particular design.

Chapter 4 expands the class of fractional factorial designs to the general case where the number of levels of each factor is the same for all factors and exceeds two, allowing higher order models to be considered. Construction approaches as well as a catalogue of 27 and 81 run designs for three-level designs are presented. Chapter 5 considers designs with maximum estimation capacity, which is a criterion for model robustness. Chapter 6 presents methodology for minimum aberration designs for mixed factorials, where the number of factor levels is not all the same. Special cases for two- and four-level factors are presented in more detail, with general theory included for other cases.

Chapters 7–9 look at cases where the underlying structure of the experiment introduces new restrictions or objectives for the experiment. Chapter 7 examines how blocking can be incorporated into full and fractional factorial designs, and how optimal design criteria need to be adapted for this situation. In addition, a number of tables list admissible designs for 16, 32, 64, and 128 run experiments. Chapter 8 gives methodology and tables for optimal designs in the split-plot setting, where restrictions on randomization define two classes of factors: hard to change and easy to change. Finally, Chapter 9 examines factorial designs for robust parameters. Here, assessing and reducing variation through understanding of control and noise factors is the key interest.

Exercises are included at the end of each chapter that help reinforce the theory presented. The book provides a unified summary of current research on the assessment through optimality criteria and construction methods for factorial and fractional factorial designs. Although many readers will find the book technically challenging because of its mathematical and advanced theoretical presentation, it contains excellent insights into this important class of designs.

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Introductory Stochastic Analysis for Finance and Insurance.

X. Sheldon LIN. Hoboken, NJ: Wiley, 2006. ISBN 0-471-71642-1. xvi + 224 pp. $84.95.

This book is a positive addition to the introductory textbooks on stochastic calculus for financial applications. The intended audience is graduate students who have a nonmathematics background and practitioners. The book has emerged from a series of taught lectures. The overall feeling is indeed that the well-presented material is "tried and tested." The text manages to introduce students in a compact way to a variety of topics: the author not only provides an introduction to stochastic calculus, but also covers a range of interesting actuarial and financial applications. Among them are nonstandard topics that reflect the author's research interests like hitting times of nonhorizontal barriers and the valuation of insurance products like guaranteed or index-linked annuities.

This is not a mathematics textbook and maybe also should not be given the envision audience. In fact, the author has chosen a reasonable compromise.

While avoiding a rigorous but tedious exposition, the book focuses on the essential; more elaborate proofs are often sketched. It will not be difficult for students to move on to more advanced books after having digested the material here. As an example of a reasonable shortcut, the author does not discuss in depth the convergence theorem for discrete-time Markov chains, thus avoiding a lengthy discussion of periodicity, which is highly irrelevant for financial applications. Only a sketchy construction of the Itô integral is given and the Itô formula is motivated by the usual Taylor-approximation argument, ignoring the higher order terms. But again, this makes sense for the intended audience.

Illustrative examples are well chosen: for example, credit rating matrices in the context of Markov chains, the valuation of digital options via the optional sampling theorem, and forward risk measures and pricing of options on coupon-bearing bonds as an application of Girsanov's theorem. Moreover, the book contains a number of illuminating figures without hampering the flow of the main text.

The book starts with an overview of probability theory, including a discussion of various distributions like the inverse Gaussian, which is needed later for barrier options. This is followed by an introduction to discrete-time stochastic processes that contains change of measure techniques, illustrated in particular by the Esscher measures. The preceding processes are applied to option pricing with binomial models and to binomial interest rate models.

Moving on to continuous-time stochastic processes, Brownian motion and compound Poisson processes are first introduced. Stochastic calculus is then developed with respect to Brownian motion. It could be interesting, in case a second edition is planned, to include here an introduction to stochastic calculus with respect to Poisson processes as well, with insurance in view. More advanced topics like the Feynman–Kac formula and Girsanov's theorem are discussed in a separate chapter.

Regarding insurance applications, these are well motivated and the various complex products are carefully explained. The focus here is more on insurance derivatives. If an extension of the book is planned, one could even think about providing additional interesting examples, like Gerber's martingale approach to classical risk theory or continuous-time Markov chains and the multistate model in life insurance.

Overall, this is a well-crafted text, suitable as a base for an introductory course in stochastic calculus techniques of modern finance and insurance.

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Measures, Integrals and Martingales.

René L. SCHILLING. Cambridge, U.K.: Cambridge University Press, 2005. ISBN 0-521-85015-0. x + 381 pp. $90.00 (H). ISBN 0-521-61525-9. $50.00 (P).

This book is an elementary introduction to measure and integration theory aimed at both probabilists and analysts. The first part of the book, Chapters 1–13, forms a concise introduction to Lebegue's approach to measure and integration. The only prerequisite for this part is a rigorous course on real analysis. The second part of the book, Chapters 14–24, introduces martingales as an analysis tool and uses them to extend the theory in the first part to more advanced topics; examples of these topics include the Radon–Nikodým theorem, the Hardy–Littlewood maximal theorem, Lebegue's differentiation theorem, and orthonormal systems with various convergence results for series expansions with respect to different orthonormal systems (a detailed chapter).

The introduction to the standard topics of measure and integration theory presented in the first part of the book stems from a lecture course for mathematics undergraduates. Here, the presentation and structure differ from what one typically finds in classical (graduate) textbooks on the subject. The chapters contain nicely written short blocks of theory followed by good and meaningful exercises, solutions of which are available on the author's home page. This feature makes the book an attractive starting point for an undergraduate course on measure and integration theory. This book is well structured and the presentation is clear; arguments and proofs are detailed and easy to follow. The book starts with two introductory chapters and then presents the concepts via chapters named "σ Algebras," "Measures," "Uniqueness of Measures," "Existence of Measures," "Measurable Mappings," "Measurable Functions," "Integration of Positive Functions," "Integrals of Measurable Functions and Null Sets," "Convergence Theorems and Their Applications," "The Function Spaces $\mathcal{L}^p$, $1 \le p \le \infty$," "Product Measures," and "Fubini's Theorem." The inexperienced reader can learn the material step by step rather than struggling to understand the full abstract machinery before finding reasonably interesting examples to enforce the concepts. Clearly, the reason for this structure is the author's experience with the challenges of effectively teaching measure and integration theory to undergraduates.

Emphasizing martingales as a tool for developing the more advanced topics in the second part of the book enables natural "probabilistic" proofs of several results that are typically proved differently. The author has chosen to present martingales without conditional expectations, and the theory is developed for σ-finite measure spaces rather than for probability spaces. Conditional expectations are presented later, also in the more general setting of σ-finite measure spaces. Because the book is not about probabilistic measure theory, this choice makes perfect sense. However, I believe that many readers find martingales and conditional expectations more natural and easier to understand when these objects are given a probabilistic meaning.

The book contains five appendixes. The appendix titled "Non-Measurable Sets" provides interesting reading for anyone intrigued with the finer details of measurability. The last appendix, titled "A Summary of the Riemann Integral," contains a nice and detailed summary of results for the Riemann integral, and a comparison of Riemann and Lebesgue integration that most readers will find useful.

Although the presentation is clear and the book is well structured, I find the exposition dry at times. I would have preferred more passages with nontechnical interpretations of important results, discussions of the historical developments, and remarks to illustrate nontrivial aspects and interpretations. Such things would stimulate the curiosity of most potential readers/buyers of the book.

Given the amount of work and thought the author has put into this well written and carefully planned book, I wish the layout, typesetting, and choice of notation were better. The layout and typesetting resemble articles in journals more than classical books such as Rudin (1987). Moreover, there are occurrences of unnecessarily large parentheses, integral signs, subscripts, and so forth that force varying amounts of space between the lines. This unfortunately makes some pages look a bit messy and distracts from the nicely written content.

Overall, this well written and carefully structured book is an excellent choice for an undergraduate course on measure and integration theory. Most good books on measure and integration are graduate books and, therefore, are not optimal for undergraduate courses. For an undergraduate course containing probability and probabilistic measure theory, I would prefer Billingsley (1995); for those who do not want probabilistic roots, I recommend Stroock (1999). This book is aimed at both (future) analysts and (future) probabilists, and is therefore suitable for students from both these groups. The martingale approach and the selected topics in the second part are interesting and make the text good for self-study and use in a more advanced course on measure and integration theory.

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Advanced Statistics From an Elementary Point of View.

Michael J. PANIK. New York: Elsevier Science B.V., 2005. ISBN 0-12-088494-1. xvii + 802 pp. $99.95.

As the title suggests, this book is intended to discuss inferential or mathematical statistics, assuming no prior background in statistics. The author states in the preface that the book could be a foundation text for a semester- or year-long course for juniors, seniors, or beginning graduate students. Panik sets a lofty goal and, unfortunately, falls well short of achieving it. At times, he overreaches and, in doing so, misses critical details.

The title may well imply that this book is the Moore and Notz (2005) or Utts (2005) of mathematical statistics (and, from a statistics professor's point