This book can be used by researchers in stochastic approximation, recursive estimation, adaptive control, signal processing, and Monte Carlo optimization. It may also be used as an advanced graduate-level textbook for a topics course on stochastic processes, recursive estimation, or asymptotic statistics.

In conclusion, this book presents a treatise on stochastic approximation and recursive estimation with an illuminating introduction to the fields, and various theoretical and practical issues. It is a welcome addition to the literature pertaining to systems theory and control, signal processing, and other related fields. It is conceivable that this book will have a significant impact on these fields.

George YIN
Wayne State University

REFERENCES

Chen, H.-F., and Zhu, Y. M. (1986), "Stochastic Approximation Procedures With Randomly Varying Truncations," *Scientia Sinica*, Ser. A, 29, 914–926.
Kiefer, J., and Wolfowitz, J. (1952), "Stochastic Estimation of the Maximum of a Regression Function," *Annals of Mathematical Statistics*, 23, 462–466.
Robbins, H., and Monro, S. (1951), "A Stochastic Approximation Method," *Annals of Mathematical Statistics*, 22, 400–407.

Optimal Design of Blocked and Split-Plot Experiments.

Peter GOOS. New York: Springer-Verlag, 2002. ISBN 0-387-95515-1. xiii + 244 pp. $59.95 (P).

It could be argued that most industrial experiments are run as block designs or split-plot designs. However, until the last decade, most optimal design literature focused on completely randomized designs. Industrial split-plot and blocked designs have received a great deal of attention both in the literature and in national conferences in recent years. The attention has focused on their analysis and on optimal design principles, as well as on educating practitioners on the importance and benefits of using restricted randomization in experimentation and the "how tos" of analyzing these designs. This text offers almost everything that one could hope for in a review of this topic and is a must have resource for those doing research in this area. The target audience is applied and theoretical statisticians and those in academia. The text is more theoretical than intuitive, as a great deal of attention is devoted to derivations of D-optimality criteria.

Practically speaking, the types of designs used for split-plot and blocked experiments are the standard optimal designs that are used when one has the luxury of completely randomizing the experiment. The problem, as the author points out in numerous settings, is that these designs perform poorly when the data are correlated. Optimal design theory is important because one can tailor a design for a specific situation instead of forcing a situation into a standard design. The text by Goos is devoted solely to optimal design theory when there have been restrictions on randomization. It is considerably easier to read than the classic optimal design text by Silvey (1980), but not as intuitive as the response surface methods text by Myers and Montgomery (2002) or the experimental design text by Montgomery (2001). Silvey's text presents optimal design theory for continuous designs and thus is a measure-theoretic approach. Goos differentiates between discrete and continuous designs in the first chapter, and the treatment of continuous designs is fairly light throughout the text. Myers and Montgomery (2002) discussed design optimality in their text, but only for completely randomized designs. The appealing thing about Myers and Montgomery's approach to topics in their text is that they illustrated most points with examples. Goos does some illustration, but to be more appealing, it would be nice if more of the concepts and algorithms were illustrated with more detailed examples. I highly recommend the text by Goos as a supplement to the response-surface methods texts of Myers and Montgomery (2002) or Khuri and Cornell (1996).

The first chapter in the book is the longest, and the author does a great job of giving a broad overview of design of experiments. In this chapter, he differentiates between discrete and continuous designs, presents the standard response-surface designs, discusses blocking, and presents the various alphabetic optimality design criteria. In developing the D-optimality criterion, Goos demonstrates the fact that the information matrix can be written as a sum of outer products of vectors. The rationale for doing this is that when one expresses the information matrix in this manner, one has a simple expression for adding or deleting design points. The addition and deletion of design points is the mechanism by which exchange algorithms operate when determining the optimal design for a given setting. Throughout the text, as Goos presents various types of experimental situations, he begins by writing the information matrix in this manner and then describes exchange algorithms that can be used to find the optimal design. The first chapter is carefully written (as is the rest of the text) and serves as the cornerstone for the advanced topics discussed later in the book. The D-optimality criterion is the criterion used in the algorithms presented throughout the text.

In many experimental situations, the assumptions of homogenous variance and uncorrelated observations is not satisfied. An overview of these situations is presented in Chapter 2. Perhaps the most interesting component of this chapter is the discussion of orthogonal blocking as a D-optimal strategy. However, as the author points out, in most practical situations, the number of blocks and the block sizes make it impossible to block a design orthogonally. It would have been useful if the author had taken a set of design points and blocked them orthogonally as well as nonorthogonally, and then illustrated the extent of the advantage that orthogonal blocking offers. As I read through this chapter, I found myself wondering if there might be an advantage to "almost blocking orthogonally."

Chapter 3 introduces birandomized designs. Birandomized designs include split-plot and block designs. The remainder of the text, approximately 150 pages, is devoted to discussions of specific cases of birandomized designs. In birandomized designs, the number of groups and the group sizes are often fixed by practical considerations prior to running an experiment. Chapters 4–6 and part of Chapter 9 are devoted to these types of birandomized designs. Chapter 4 is devoted to optimal designs in this setting when the block effects are random. In Chapter 5, optimal design strategy is discussed for quadratic regression on one variable when the blocks are of size 2. This problem is motivated by an optometry experiment originally discussed by Chasalow (1992). In Chapter 6, the author provides an overview of industrial split-plot designs, and provides a general algorithm for the efficient design of split-plot experiments for any number of observations, number of whole plots, and whole-plot sizes specified by the researcher. A consequence of split-plot experimentation is that whole-plot factors are estimated less precisely and subplot factors are estimated more precisely than they would be in a completely randomized design. A nice illustration is provided.

In some experimental situations, the researcher has the flexibility to choose the number of groups as well as the group sizes, and wishes to optimally choose these parameters. These situations are the topics of Chapters 7 and 8, and part of Chapter 4. Industrial split-plot designs generally are used when one or more factors are difficult or costly to change or control. As a result, once the levels of the difficult or costly factors are set, the combinations of the levels of the other factors are run in random order before changing the levels of the difficult/costly factors. In this situation, the experimenter may wish to know the optimal number of whole-plot settings to run and the optimal number of observations to take on a given whole plot. This problem is detailed, and a design-construction algorithm is provided in Chapter 7. In Chapter 8, interesting comparisons are made regarding the D-efficiency of split-plot designs relative to completely randomized designs. The chapter also provides interesting insight regarding the improvement of split-plot designs when the number of whole plots is increased.

In Chapter 9, the author gives an overview of two-level factorial and fractional factorial blocked and split-plot designs, and discusses the concept of aberration. The text is summarized in Chapter 10, and Goos suggests areas of future research.

Overall, the book is very well organized and is a terrific resource on design optimality for blocked and split-plot experimentation. I highly recommend this text as a supplement to a text such as the one by Myers and Montgomery (2002) for an advanced design course. The text contains no exercises. The literature review provided on each topic is expansive. Although optimal design construction algorithms are outlined in each chapter, none of them is illustrated. The text would be improved immensely if one or two of these algorithms were illustrated point by point. An example of such a point-by-point illustration was provided by Borkowski (2003) in his manuscript that outlined the use of genetic algorithms to generate optimal response surface designs, complete with an example and the various steps used in the genetic algorithm. In summary, this text has a great deal to offer to anyone doing research in design optimality and the author should be commended for his solid treatment of this important area of industrial experimentation.

Timothy J. ROBINSON
University of Wyoming

REFERENCES

Borkowski, J. J. (2003), "Using a Genetic Algorithm to Generate Small Exact Response Surface Designs," *Journal of Probability and Statistical Science*, 1, 65–88.

Chasalow, S. D. (1992), "Exact Response Surface Designs With Random Block Effects," unpublished Ph.D. dissertation, University of California, Berkeley.

Khuri, A. I., and Cornell, J. A. (1996), *Response Surfaces: Designs and Analyses* (2nd ed.), New York: Dekker.

Montgomery, D. C. (2001), *Design and Analysis of Experiments* (5th ed.), New York: Wiley.

Myers, R. H., and Montgomery, D. C. (2002), *Response Surface Methodology: Process and Product Optimization Using Designed Experiments* (2nd ed.), New York: Wiley.

Silvey, S. D. (1980), *Optimal Design: An Introduction to the Theory for Parameter Estimation*, New York: Chapman&Hall.

Parametric and Nonparametric Inference From Record-Breaking Data.

Sneh GULATI and William J. PADGETT. New York: Springer-Verlag, 2003. ISBN 0-387-00138-7. viii + 113 pp. $49.95 (P).

The theory of sequences of record values has found application to wide-ranging disciplines such as quality control, financial analysis, and meteorology. Although formal study commenced barely a half-century ago, interest in the subject has expanded rapidly, especially during the last two decades. With a literature that consists of hundreds of articles and several book chapters, records have come into their own, so that they are no longer treated only as a special topic of order statistics. It seems appropriate, therefore, that there are now at least two recent books devoted entirely to their study. The book *Records*, by Arnold, Balakrishnan, and Nagaraja (1998), provides a comprehensive treatment of the subject. Now, *Parametric and Nonparametric Inference From Record-Breaking Data* (denoted hereafter as *IRBD*) supplements the literature by cataloging results for inference based on record values. The book is intended to serve as a supplemental resource on inference for a graduate-level course on record values or as a reference work on inference for researchers. As asymptotic results comprise a substantial portion of the material, the reader is presumed to have an understanding of graduate-level probability and stochastic convergence theory.

Records encompasses the broad subject of record values, especially their stochastic properties and the characterization of distributions of record values. Included is a chapter on inference that focuses on parameter estimation and prediction of future records in the parametric setting, but this chapter does not aim to survey all results for record value inference. Narrower in scope, *IRBD* seeks to "fill the inference gap" (p. v) that its authors perceive as existing in the literature by cataloging results in parametric and (especially) nonparametric inference based on record values.

After a short introduction, Chapter 2 provides some background and notation for record-breaking data, along with a very brief list of stochastic results for record values. No details are provided, because they can be found elsewhere.

Chapter 3 covers some topics in parametric inference; specifically, maximum likelihood estimation and prediction of future records based on observed records. Each topic is introduced by outlining a seminal work followed by extending works. All of the primary works are also described in *Records*, whereas most of the extending works are presented only in *IRBD*.

Throughout the book, topics covered are heavily influenced by those in *Records*. Because that book's chapter on inference deals mainly with the parametric setting, many topics of general interest are excluded from Chapter 3. For example, basic results on interval estimation and significance testing are omitted because they are treated comprehensively in *Records*. Regardless of this concern for duplication, several specific examples covered in *IRBD* are also detailed in *Records*. What is present in Chapter 3 is interesting, but the end result is a coverage of parametric inference that is rather sparse, merely supplementary to that provided by *Records*, and adjunctive to the rest of the book. The authors, of course, intend to focus on nonparametric inference. Still, in view of their intention to provide a reference work on the topic, a more comprehensive review of parametric inference would have enhanced the book's appeal.

The core of *IRBD* begins with Chapter 4, which reviews nonparametric maximum likelihood estimation (MLE) of the population distribution function based on a collection of observed records. Asymptotic properties of the MLE are derived. The authors have carried out extensive work in nonparametric maximum likelihood estimation using kernel density estimation methods. Hence, in Chapter 5, a kernel-smoothed function estimator of the distribution function is defined, along with analogs for the density function, quantile function, and hazard and hazard-rate functions. A thorough study of their asymptotic properties is included. Additionally, methods outlined in the chapter are applied to a sample of records in an example. Together, these chapters seem to provide a fairly thorough reference on nonparametric inference from observed record values.

The literature contains only a handful of works (three, apparently!) on Bayesian inference from record-breaking data, all of which are summarized in Chapter 6. As opposed to other chapters, here the authors are (rightly) not concerned with the fact that one of their examples is also detailed in *Records*. The result is a comprehensive chapter that stands alone as a reference.

The final chapter discusses record models that allow for a population that changes with time. In particular, the linear drift model is studied carefully. Again, the contents of this chapter are influenced by those of *Records*; models described comprehensively in that book are described only briefly in *IRBD*, although a section that reviews the applicability of these models is provided.

If you own *Records*, certainly this book will prove to be a valuable supplement. Even if you do not, Chapters 4–6 serve as comprehensive catalogs of nonparametric and Bayesian inference from record values. However, the chapters on parametric inference and (to a lesser extent) on models with trend are sparse enough that they only supplement the material in *Records*. Unfortunately, these topics are omitted from *IRBD* simply because they were covered in *Records*, whereas, simultaneously, detailed coverage of several particular works is common to both books.

Despite this criticism, there are a number of qualities worth mentioning. Material is presented clearly and with enough detail to make following much easier than reading most original references. Throughout the book, the authors admirably succeed in binding together the works they describe by providing commentary on intuition and motivation behind extending works. These qualities greatly enhance the readability of the book.

R. Scott LINDER
Ohio Wesleyan University

REFERENCE

Arnold, B. C., Balakrishnan, N., and Nagaraja, H. N. (1998), *Records*, New York: Wiley.

Generalized Estimating Equations.

James W. HARDIN and Joseph M. HILBE. Boca Raton, FL: CRC Press, 2002. ISBN 1-58488-307-3. xiii + 222 pp. $69.95 (H).

Generalized Estimating Equations is the first and only book to date dedicated exclusively to generalized estimating equations (GEE). I find it to be a good reference text for any researcher using generalized linear models (GLIM), although the book may contain too many technical and theoretical details for the introductory user of GEE models. The authors' main intention in publishing this book, however, is to provide a thorough presentation of the various GEE models along with a comparison with other competing models.

This book has several uses. First, it serves as a reference in the area of GLIM. No advanced study in GLIM is complete without at least an introduction to the GEE approach. Researchers using GLIM models should consider purchasing this text because it serves as a thorough reference on the basic theory behind GEE models. A survey of various correlation structures common to GEE model applications (i.e., longitudinal data) is provided, and various model and outlier diagnostics are given along with hypothesis testing specific to GEE models.

Second, it could serve as a supplemental textbook for a graduate course in GLIM. At the end of each chapter there are a limited number of exercises from which an instructor could assign homework problems. Some of the problems are theoretical derivations and others are the analysis of data using GEE models. Furthermore, these exercises could be used as a springboard to a number of classroom discussions on GEE topics like quasi-likelihood, correlation structure, and various model diagnostics.

Third, this book could serve as a data-analysis guide for a researcher collecting longitudinal data. Several examples using real data are presented throughout the book, and Chapter 5 provides detailed computer code that is useful for performing the analysis. Chapter 4 discusses model diagnostics, residual analysis,