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QUARTERLY OF APPLIED MATHEMATICS

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The editors will appreciate the authors' cooperation in taking note of the following directions for the preparation of manuscripts. These directions have been drawn up with a view toward eliminating unnecessary correspondence, avoiding the return of papers for changes, and reducing the charges made for "author's corrections."

Manuscripts: Manuscripts should be typewritten double-spaced on one side only. Marginal instructions to the typesetter should be written in pencil to distinguish them clearly from the body of the text. The author should keep a complete copy.

The papers should be submitted in final form. Only typographical errors should be corrected in proof; composition charges for any major deviations from the manuscript will be passed on to the author.

Titles: The title should be brief but express adequately the subject of the paper. The name and initials of the author should be written as he/she prefers; all titles and degrees or honors will be omitted. The name of the organization with which the author is associated should be given in a separate line following his/her name.

Mathematical Work: As far as possible, formulas should be typewritten; Greek letters and other symbols not available on the average typewriter should be inserted using either instant lettering or by careful insertion in ink. Manuscripts containing pencilled material other than marginal instructions to the typesetter will not be accepted.

The difference between capital and lower-case letters should be clearly shown; care should be taken to avoid confusion between zero (0) and the letter O, between the numeral one (1), the letter l and the prime ($'$), between alpha and a, kappa and k, mu and u, nu and v, eta and n.

The level of subscripts, exponents, subscripts to subscripts, and exponents to exponents should be clearly indicated.

Single embellishments over individual letters are allowed; the only embellishment allowed above groups of letters is the overbar.

Double embellishments are not allowed. These may be replaced by superscripts following the symbols.

Complicated exponents and subscripts should be avoided. Any complicated expression that recurs frequently should be represented by a special symbol.

For exponentials with lengthy or complicated exponents the symbol exp should be used, particularly if such exponentials appear in the body of the text. Thus,

$$\exp[(a^2+b^2)^{1/2}] \text{ is preferable to } e^{[a^2+b^2]^{1/2}}.$$

Fractions in the body of the text and fractions occurring in the numerators or denominators of fractions should be written with the solidus. Thus,

$$\frac{\cos(x/2b)}{\cos(a/2b)} \text{ is preferable to } \frac{\cos\frac{x}{2b}}{\cos\frac{a}{2b}}.$$

In many instances the use of negative exponents permits saving of space. Thus,

$$\int u^{-1}\sin u\,du \text{ is preferable to } \int \frac{\sin u}{u}\,du.$$

Whereas the intended grouping of symbols in handwritten formulas can be made clear by slight variations in spacing, this procedure is not acceptable in typeset formulas. To avoid misunderstanding, the order of symbols should therefore be carefully considered. Thus,

$$(a+bx)\cos t \text{ is preferable to } \cos t(a+bx).$$

Figures: Figures should be drawn in black ink with clean, unbroken lines; do not use ball point pen. The paper should be of a nonabsorbant quality so that the ink does not spread and produce fuzzy lines. If the figures are intended for reduction, they should be drawn with heavy enough lines so that they do not become flimsy at the desired reduction. The notation should be of professional quality and in proportion for the expected reduction size. Figures which are unsuitable for reproduction will be returned to the author for redrawing. Legends accompanying figures should be written on a separate sheet.

Bibliography: References should be grouped together in a Bibliography at the end of the manuscript. References in text to the Bibliography should be made by numerals between square brackets.

The following examples show the desired arrangements: (*for books*—S. Timoshenko, *Strength of materials*, vol. 2, Macmillan and Co., London, 1931, p. 237; *for periodicals*—Lord Rayleigh, *On the flow of viscous liquids, especially in three dimensions*, Phil. Mag. (5) 36, 354–372 (1893)). Note that the number of the series is not separated by commas from the name of the periodical or the number of the volume.

Authors' initials should precede their names rather than follow them.

In quoted titles of books or papers, capital letters should be used only where the language requires this. Thus, *On the flow of viscous fluids* is preferable to *On the Flow of Viscous Fluids*, but the corresponding German title would have to be rendered as *Über die Stromung zaher Flüssigkeiten*.

Titles of books or papers should be quoted in the original language (with an English translation added in parentheses, if this seems desirable), but only English abbreviations should be used for bibliographical details such as ed., vol., no., chap., p.

Footnotes: As far as possible, footnotes should be avoided. Footnotes containing mathematical formulas are not acceptable.

Abbreviations: Much space can be saved by the use of standard abbreviations such as Eq., Eqs., Fig., Sec., Art., etc. These should be used, however, only if they are followed by a reference number. Thus, "Eq. (25)" is acceptable but not "the preceding Eq." Moreover, if any one of these terms occurs as the first word of a sentence, it should be spelled out.

Special abbreviations should be avoided. Thus "boundary conditions" should always be spelled out and not be abbreviated as "b.c." even if this special abbreviation is defined somewhere in the text.

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An Introduction to Chaotic Dynamical Systems. By Robert L. Devaney. The Benjamin/Cummings Publishing Company, Inc. Menlo Park, California, 1986. pp. xii + 320.

This text emphasizes the mathematical aspects of discrete dynamical systems. It begins at a relatively unsophisticated level and progresses so as to require not much more than the typical mathematical education of an engineer or a physicist. Three quarters of the text is accessible to students with only an advanced calculus and linear algebra background. The first chapter, one-dimensional dynamics, is by far the longest. It is the author's belief that virtually all of the important ideas and techniques of nonlinear dynamics can be introduced in the setting of the real line or the circle. He manages to introduce such topics as structural stability, topological conjugacy, the shift map, homoclinic points, and bifurcation theory. To emphasize the point that chaotic dynamics occurs in the simplest of systems, he carries out most of the analysis in this section on a basic model, the quadratic mapping given by $F_u(x) = ux(1-x)$. This map illustrates virtually every concept he wishes to introduce. The second chapter is devoted to higher-dimensional dynamical systems. It discusses such higher-dimensional maps as Smale's horseshoe, the hyperbolic toral automorphisms and the solenoid. The last chapter presupposes a working knowledge of complex analysis. It describes some recent work on the dynamics of complex analytic maps and, in particular, the structure of the Julia set of polynomials. This gives a complementary view of the dynamics of maps such as the quadratic map, which receives so much attention in Chapter One.

Testing Statistical Hypotheses. By E. L. Lehmann, John Wiley & Sons, New York, 1986. pp. xx + 600. $45.95.

This is a volume in the Wiley Series on Probability and Mathematical Statistics. This is the second edition of a work that has, for 27 years, been *the* standard treatise and reference on the subject. In this new edition, optimality considerations continue to provide the organizing principle, but there is a stronger emphasis on the robustness properties of the resulting procedures. Other topics that receive greater attention are confidence intervals, simultaneous inference procedures, and admissibility. A new chapter on conditional inference discusses some of the issues that have been raised concerning the choice of the reference set with respect to which performance is to be evaluated. Chapter headings: 1. The general decision problem. 2. The probability background. 3. Uniformly most powerful tests. 4. Unbiasedness: theory and first applications. 5. Unbiasedness: applications to normal distributions; confidence intervals. 6. Invariance. 7. Linear hypotheses. 8. Multivariate linear hypotheses. 9. The minimax principle. 10. Conditional inference.

Empirical Processes with Applications to Statistics. By Galen R. Shorack and Jon A. Wellner. John Wiley & Sons, New York, 1986. pp. xxxvi + 938. $59.95.

This is a volume in the Wiley Series in Probability and Mathematical Statistics. The authors carefully develop inequalities for the empirical process throughout the text. An appendix reviews many of the classic inequalities of probability theory. In addition, because of the strong parallels between the empirical process and the partial sum process, many results for partial sums are also included. Chapter headings: 1. Introduction and survey of results. 2. Foundations, special spaces and special processes. 3. Convergence and distributions of empirical processes. 4. Alternatives and processes of residuals. 5. Integral tests of fit and estimated empirical processes. 6. Martingale methods. 7. Censored data; the product-limit estimator. 8. Poisson and exponential representations. 9. Some exact distributions. 10. Linear and nearly linear bounds on the empirical distribution functions $\mathbf{G}_n$. 11. Exponential inequalities and $\|./q\|$ metric convergence on $\mathbf{U}_n$ and $\mathbf{V}_n$. 12. The Hungarian constructions of $\mathbf{K}_n$, $\mathbf{U}_n$, $\mathbf{V}_n$. 13. Laws of the iterated logarithms associated with $\mathbf{U}_n$ and $\mathbf{V}_n$. 14. Oscillations of the empirical process. 15. The uniform empirical difference process $\mathbf{D}=\mathbf{U}_n+\mathbf{V}_n$. 16. The normalized uniform empirical process $\mathbf{Z}_n$ and the normalized uniform quantile process. 17. The uniform empirical process indexed by intervals and functions. 18. The standardized quantile process $\mathbf{Q}_n$. 19. L-statistics. 20. Rank statistics. 21. Spacing. 22. Symmetry. 23. Further applications. 24. Large deviations. 25. Independent but not identically distributed random variables. 26. Empirical measures and processes for general spaces.

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Statistical Inference in Linear Models. Edited by Helga and Olaf Bunke, John Wiley & Sons, New York, 1986. pp. 1 + 614. $72.95.

This is a volume in the Wiley Series in Probability and Mathematical Statistics. It is a translation, with slight modifications, of the first volume of a trilogy published in Germany in 1977. The second and third volumes, which have already appeared in German, are entitled: II. Nonlinear Regression, Functional Relations, and Robust Methods, and III. Statistical Inference for Variance Components and Covariances. The volume is encyclopaedic in extent and incorporates much material not previously published in book form. The book aims to describe the present state of the subject in a coherent, unified and fully rigorous fashion, thus assuming a sound background in probability theory in the reader. Chapter headings: 1. Statistical problems in modelling causal relationships. 2. Estimating linear parameters. 3. Estimating linear parameters using additional information. 4. Admissibility and improvements of the generalized least squares estimators. 5. Testing linear hypotheses. 6. Confidence regions for linear parameters and regression functions. 7. Bayesian methods and structural inference. 8. Experimental design methods.

Series of Irregular Observations: Forecasting and Model Building. By Robert Azencott and Didier Dacunha-Castelle. Springer-Verlag, New York, 1986. pp. vii + 236.

This is a volume in Applied Probability, a series of the Applied Probability Trust. It presents, in a compact and rigorous fashion, the essentials of spectral analysis and the modelling of finite autoregressive and moving average schemes (ARMA processes). Chapter headings: 1. Discrete time random processes. 2. Gaussian processes. 3. Stationary processes. 4. Forecasting and stationarity. 5. Random fields and stochastic integrals. 6. Spectral representation of stationary processes. 7. Linear filters. 8. ARMA processes and processes with rational spectrum. 9. Nonstationary ARMA processes and forecasting. 10. Empirical estimators and periodograms. 11. Empirical estimation of the parameters of ARMA processes with rational spectrum. 12. Efficient estimation of the parameters of a process with rational spectrum. 13. Asymptotic maximum likelihood. 14. Identification and compensated likelihood. 15. A few problems not studied here.

Classification Algorithms. By Mike James. John Wiley & Sons, New York, 1985. pp. xii + 209. $34.95.

By classification, the author means the assignment of an object to one of a number of predetermined groups (being also called "pattern recognition", "discriminant analysis", "supervised learning" in specific contexts). The theory presented is essentially concerned with the finding of an optimal classification rule, ways of assessing its performance and of understanding how it achieves its results. Most of this theory is traditional statistics but much of it comes from a newer area of pattern recognition and artificial intelligence. Chapter headings: 1. Classification. 2. Classification rules. 3. Practical classification—the normal case. 4. Classification in action. 5. Some practical considerations. 6. Evaluating rules—estimating error rates. 7. Feature selection—canonical analysis. 8. Feature selection—variable selection. 9. Categorical variables and non-parametric methods. 10. Artificial intelligence and pattern recognition.

Semi-Markov Models: Theory and Applications. Edited by Jacques Janssen. Plenum Press, New York, 1986. pp. x + 588. $95.00.

This book is the result of an International Symposium on the subject held in June, 1984 at the Free University of Brussels. The papers are divided into ten sections: 1. Markov additive processes and regenerative systems. 2. Semi-Markov decision processes. 3. Algorithmic and computer-oriented approach. 4. Semi-Markov models in economy and insurance. 5. Semi-Markov processes and reliability theory. 6. Simulation and statistics for semi-Markov processes. 7. Semi-Markov processes and queueing theory. 8. Branching. 9. Applications in medicine. 10. Applications in other fields.

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A Unified Theory of Nonlinear Operator and Evolution Equations with Applications. By Mieczyslaw Altman. Marcel Dekker, Inc., New York, 1986. pp. xiv + 292. $69.75.

This is volume 103 in the series Pure and Applied Mathematics. An important feature of the author's theory of nonlinear evolution equations in Banach spaces is that nonlinear problems can be solved via linearized evolution equations. From the standpoint of applications to nonlinear partial differential equations this means that such equations can be solved if the linearized problem can be treated as a linear evolution equation, based on the C_0-semigroup theory. Chapter headings: 1. Convex approximate linearization and global linearization iterative methods. 2. Smoothing operators combined with elliptic regularization and the degree of elliptic regularization. 3. Nonlinear equations in a scale of Hilbert–Sobolev spaces, I. 4. Nonlinear equations in a scale of Hilbert–Sobolev spaces, II. 5. Nonlinear equations in a scale of Hilbert–Sobolev spaces, III. 6. Elliptic regularization without smoothing operators. 7. Convex approximate linearization and global linearization iterative methods for nonlinear evolution equations. 8. Smoothing operators combined with elliptic regularization and the degree of elliptic regularization for nonlinear evolution equations. 9. Elliptic regularization without smoothing operators for nonlinear evolution equations. 10. Strongly quasilinear evolution equations. 11. Quasilinear evolution equations.

Extremal Methods of Operations Research. By Paul R. Gribik and Kenneth O. Kortanek. Marcel Dekker, Inc., New York, 1986. pp. viii + 312. $37.50.

This is volume 97 in the series Pure and Applied Mathematics. The material in this book is organized into three chapters: The distribution transportation problem, Introduction to network models, Linear programming. The first two present 13 sets of exercises, each associated with certain sections of a given chapter, the abstract treatment of the simplex method being postponed to Chapter 3. Computational problem solving skills are emphasized early, before the abstract analysis.

Probability Theory and Harmonic Analysis. Edited by J.-A. Chao and Wojbor A. Woyczyncki. Marcel Dekker, Inc., New York, 1986. pp. viii + 291.

This is volume 98 in the series Pure and Applied Mathematics. It is a collection of fifteen papers in probability theory and harmonic analysis, some of which are of an expository and survey nature while others present original results not previously published. Topics covered in the volume range from martingales, stochastic integrals, and diffusion processes on manifolds, through random walks and harmonic functions on graphs, and random Fourier series, to invariant differential and degenerate elliptic operators, and singular integral transforms.

Mathematical Programming: An Introduction to Optimization. By Melvyn W. Jeter. Marcel Dekker, Inc., New York, 1986. pp. vii + 342. $34.50.

This is volume 102 in the series Pure and Applied Mathematics. This book is intended to be an introductory text in mathematical programming and optimization for students having a mathematical background that includes one semester of linear algebra and a complete calculus sequence through multivariate calculus. Chapter headings: 1. An introduction to mathematical programming. 2. Subspaces, matrices, affine sets, cones, convex sets, and the linear programming problem. 3. The primal simplex procedure. 4. Duality and the linear complementary problem. 5. Other simplex procedures. 6. Network programming. 7. Convex and concave functions. 8. Optimality conditions. 9. Search techniques for unconstrained optimization problems. 10. Penalty function methods.

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Statistical Decision Theory and Bayesian Analysis. By James O. Berger. Springer-Verlag, New York, 1985. pp. xvi + 617. $39.00.

This is a volume in the Springer Series in Statistics, being the second edition of Statistical Decision Theory: Foundations, Concepts, and Methods, published in 1980. It looks upon Bayesian analysis and decision theory as providing a unified outlook towards statistics and as giving a foundational framework for thinking about statistics and for evaluating proposed statistical methods. Although the central thread of the book is Bayesian decision theory, both Bayesian inference and non-Bayesian decision theory are extensively discussed. The book contains a fair amount of material on both the very practical aspects of, and the difficult and elegant theoretical developments in Bayesian analysis and decision theory. There is extensive discussion on how to do Bayesian decision theory and Bayesian inference in practice, including how to construct prior distributions and loss functions, as well as how to utilize them. At the other extreme, introductions are given to some of the beautiful theoretical developments in these areas. Chapter headings: 1. Basic concepts. 2. Utility and loss. 3. Prior information and subjective probability. 4. Bayesian analysis. 5. Minimax analysis. 6. Invariance. 7. Preposterior and sequential analysis. 8. Complete and essentially complete classes.

Finite Group Theory. By M. Aschbacher. Cambridge University Press, Cambridge, 1986. pp. ix + 274. $32.50.

This is volume 10 in Cambridge Studies in Advanced Mathematics. The unifying notion in this text and basic reference is that of a group representation. Chapter headings: 1. Preliminary results. 2. Permutation representations. 3. Representations of groups on groups. 4. Linear representations. 5. Permutation groups. 6. Extensions of groups and modules. 7. Spaces with forms. 8. p-groups. 9. Change of field of a linear representation. 10. Presentations of groups. 11. The generalized Fitting subgroup. 12. Linear representations of finite subgroups. 13. Transfer and fusion. 14. The geometry of groups of Lie type. 15. Signalizer functors. 16. Finite simple groups.

An Introduction to Twistor Theory. By S. A. Huggett and K. P. Tod. Cambridge University Press, Cambridge, 1985. pp. 1 + 145. $39.50 Hardcover, $13.95 Paperback.

This is volume 4 of the series London Mathematical Society Student Text. It is an introduction to twistor theory and modern geometrical approaches to space-time structure at the graduate or advanced undergraduate level. Topics covered are indicated by the table of contents: 1. Introduction. 2. Review of tensor algebra and calculus. 3. Lorentzian spinors at a point. 4. Spinor fields. 5. Compactified Minkowski space. 6. The geometry of null congruences. 7. The geometry of twistor spaces. 8. Solving the zero rest mass equations I. 9. Sheaf cohomology. 10. Solving the zero rest mass equations II. 11. The twisted photon and Yang–Mills constructions. 12. The non-linear graviton. 13. Penrose's quasi-local momentum. 14. Further developments and conclusions.

Pictorial Information Systems in Medicine. Edited by Karl Heinz Höhne. Springer-Verlag, New York, 1986. pp. xii + 524. $142.50.

This is volume 19 in Series F: Computer and Systems Science, of the NATO Advanced Science Institutes Series. It contains the proceedings of the Institute held August 27–September 7, 1984, in Braunlage/Harz, Federal Republic of Germany. The disciplines represented were medicine, data base technology, computer graphics, man-machine interaction, hardware technology, and others. It was the aim of the meeting to get experts in the different fields together to review the fundamentals, to identify the problems and to discuss the possible solutions. There were two long papers on the radiological background, two on information system aspects, three on aspects of image presentation, four on computer science tools, one on "first experiences", and thirteen short papers on the above topics.

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Stochastic Modelling and Analysis: A Computational Approach. By Henk C. Tijms. John Wiley & Sons, New York, 1986, pp. xii + 418. $39.95.

This is a volume in the Wiley Series in Probability and Mathematical Statistics. The main concern of this text is the application of stochastic models to practical situations involving uncertainty and dynamism. A feature is the integrated treatment of models and computational methods for stochastic design and stochastic optimization problems. Another feature is a careful discussion of robustness results for stochastic service systems, including queueing networks. The book uses realistic examples to explore a wide variety of applications such as inventory and production control, reliability, maintenance, queueing, and computer and communication systems. Chapter headings: 1. Renewal processes with applications to inventory/production reliability. 2. Markov chains with operations research and computer science applications. 3. Markovian decision processes and their applications. 4. Algorithms and approximations for queueing models.

Deterministic Aspects of Mathematical Demography. By John Impagliazzo. Springer-Verlag, New York, 1985. pp. xi + 186. $34.00.

This is volume 13 in the series Biomathematics, being an investigation of the stable theory of population including an analysis of the population statistics of Denmark. The discussion starts with the life table as the earliest deterministic demographic model and proceeds to a generalized matrix model. Chapter headings: 1. The development of Mathematical Demography. 2. An overview of the stable theory of population. 3. The discrete time recurrence model. 4. The continuous time model. 5. The discrete time matrix model. 6. Comparative aspects of stable population models. 7. Extensions of stable population theory. 8. The kingdom of Denmark—A demographic example.

Decision Theory: an Introduction to the Mathematics of Rationality. By Simon French. Ellis Horwood Limited, Chichester, 1986. pp. 1 + 448. $54.95.

This is a volume in the Ellis Horwood Series in Mathematics and its Applications. The aim of this book is not only to be a text for undergraduate courses in decision theory, but also one which would be suitable background reading for many disciplines: mathematics, statistics, economics, psychology, management science, etc. It should also be useful to persons in industry, commerce and government who advise on actual decision making. The mathematical background required is modest but some mathematical maturity is required to follow the proofs and the logical arguments. Chapter headings: 1. Decision problems. 2. Decisions under strict uncertainty. 3. Preference orders and value functions. 4. Multi-attribute value theory. 5. Utility theory. 6. Objective and subjective probability. 7. Decision trees and multi-stage problems. 8. Group decisions and social choice. 9. Measurement, modelling, and interpretation. 10. Some non-Bayesian approaches. 11. Hints and solutions to problems.

Analytic Methods of Probability Theory. By H. J. Rosenburg, B. Jesiac, and G. Seigel. Akademie-Verlag, Berlin, 1985. pp. 1 + 331.

This is volume 67 in the series Mathematische Monographien. It is divided into three parts: I. Foundations (Chapters 1–5), II. Special classes of distributions (Chapters 6–9), III. Limit theorems for independent random variables (Chapters 10–13). The chapter headings are: 1. Distribution functions. 2. Convergence of monotone functions. 3. Characteristic functions. 4. Characteristic functions analytic in a strip. 5. Concentration functions. 6. Analytic distribution functions. 7. Infinitely divisible distribution functions. 8. Stable distributions. 9. The normal distribution. 10. Basic ideas and concepts. 11. Limit theorems for triangular arrays. 12. The central limit theorem for triangular arrays. 13. Independent identically distributed random variables.

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Modern Probability Theory: An Introductory Textbook. By B. Ramdas Bhat. Wiley Eastern Limited, New Delhi, 1985. pp. xv + 270.

This is the second revised edition of a text first published in 1980. It is its aim to develop the subject presupposing only a good knowledge of mathematical analysis including Riemann integration, and some familiarity with probability theory. It does not assume any previous knowledge of measure theory. The book is written in the spirit of Loève's classical treatise.

Supersymmetry and its Applications: Superstrings, Anomalies, and Supergravity. Edited by G. W. Gibbons, S. W. Hawking, P. K. Townsend. Cambridge University Press, Cambridge, 1986. pp. xiv + 481. $49.50.

These are the Proceedings of a Workshop held at Cambridge, 23 June to 14 July, 1985. The papers are divided into three parts, corresponding to the three weeks of the workshop: 1. Anomalies (six papers), 2. Strings (eleven papers on string theory), 3. Supergravity and Supersymmetry (eleven papers on supersymmetric gauge theories and supergravity theories, an interesting theme of many of these being the unification of algebra and geometry).

Stability of Parallel Gas Flows. By Bhimsen K. Shivamoggi. Ellis Horwood Ltd., Chichester, 1986. pp. 1 + 169. $39.95.

This is a volume in the Ellis Horwood Series in Mathematics and its Applications. Chapter headings: 1. Theory of hydrodynamic stability. 2. Stability of parallel incompressible flows. 3. Governing equations for linearised disturbances in parallel compressible flows. 4. Linearised inviscid disturbances. 5. An initial-value-problem approach. 6. Inviscid-stability theory. 7. Subsonic and supersonic disturbances. 8. Asymptotic analysis of viscous disturbances. 9. Effects of compressiblity upon stability characteristics of a free shear layer.

Multiple Criteria Optimization: Theory, Computation and Application. By Ralph E. Steuer. John Wiley & Sons, New York, 1986. pp. xix + 546. $39.95.

This is a volume in the Wiley Series in Probability and Mathematical Statistics. It is designed to serve both as a teaching text and as a comprehensive reference volume on the subject. Only a modest mathematical background is needed. There are two review chapters, on the mathematical background and simple objective linear programming. Chapters 4 through 9 develop the theory of multiple objective linear programming. In particular, Chapter 4 discusses the computation of all *optimal* extreme points in single objective linear programming. Chapter 5, which concerns objective row parametric programming, is essentially multiple objective programming with two objectives. Chapters 6, 7, and 8 discuss the subtleties involved with the solution set notion of efficiency (Pareto optimality), and Chapter 9 presents the theory of linear vector-maximization for computing all efficient points. Chapter 10 addresses goal programming, which is analyzed in terms of contours, and the usefulness of the deviational variable to multiple programming in general is stressed. Chapter 11 discusses filtering, or how representative subsets of larger sets can be obtained. Chapter 12 deals with multiple objective linear functional programming, in which the objectives are functional in the sense that they have linear numerators and linear denominators. The discussion of interactive procedures occupies Chapters 13, 14, and 15. Chapter 13 discusses STEM, the Geoffrion-Dyer-Feinberg procedure, and the Zionts-Wallenius procedure among others. Chapters 14 and 15 discuss the Tchebycheff procedure. Three interactive procedures are given in Chapter 16. Comments about the future, particularly in regard to the use of graphics at the computer/user interface, are made in Chapter 17.

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Group Structure of Gauge Theories. By L. O'Raifeartaigh. Cambridge University Press, Cambridge, 1986. pp. ix + 172. $34.50.

This is a volume in the series Cambridge Monographs on Mathematical Physics. It provides an account of the structure of gauge theories from a group theoretical point of view. The first part of the text is devoted to a review of those aspects of compact Lie groups (the Lie algebras, the representation theory, and the global structure) which are necessary for the application of group theory to physics of particles and fields. The second part describes the way in which compact Lie groups are used to construct gauge theories. Models that describe the known fundamental interactions and the proposed unification of these interactions (grand unified theories) are considered in some detail. The book concludes with an up-to-date description of the group structure of spontaneous symmetry breakdown, which plays a vital role in these interactions.

Non-Uniform Random Variate Generation. By Luc Devorye, Springer-Verlag, New York, 1986. pp. xvi + 843. $68.00.

The topic of this book is relevant to statistics, operations research, and computer science. Statisticians need random number generators to test and compare estimators before using them in real life. In operations research, random numbers are a key component in large scale simulations. Computer scientists need randomness in program testing, game playing, and comparisons of algorithms. In particular, the work revolves around the expected complexity of random variate generation algorithms. The authors set up an idealized computational model, introduce the notion of uniformly bounded expected complexity, and study upper and lower bounds for computational complexity. Chapter headings: 1. Introduction. 2. General principles in random variate generation. 3. Discrete random variates. 4. Specialized algorithms. 5. Uniform and exponential spacing. 6. The Poisson process. 7. Universal methods. 8. Table methods for continuous random variates. 9. Continuous univariate densities. 10. Discrete univariate distributions. 11. Multivariate distribution. 12. Random sampling. 13. Random combinatorial objects. 14. Probabilistic shortcuts and additional topics. 15. The random bit model.

Asymptotic Methods in Statistical Decision Theory. By Lucien LeCam, Springer-Verlag, New York, 1986. pp. xxvi + 742. $49.95.

This is a volume in the Springer Series in Statistics. It grew out of lectures delivered at the University of California, Berkeley. The subject is a part of asymptotics in statistics, organized around a few central ideas. The presentation proceeds from the general to the particular. The reader is expected to have been exposed to statistical thinking and methodology and to possess some mathematical maturity, but not a great deal of detailed mathematical knowledge. The ideas and techniques used in this book reflect principally the influence of Abraham Wald's writings, as well as those of Neyman, Hájek, and Charles Stein. The basic conceptual structures in the work are systems that Blackwell called "experiments" and "transitions between them". An experiment consists of a set of theories about what might happen in the observational process. Each theory specifies a probabilistic model for the observations, summarized by a probability measure. The goals of the statistician are described in the framework of Wald's decision theory, with loss functions, risk functions, etc. The notion of a distance between experiments is introduced. A special effort is made to transform limit theorems into practically useful approximation results. The main body of the theory makes no reference to independence, and is thus applicable to the many domains involving stochastic processes. Chapter headings: 1. Experiments-Decision spaces. 2. Some results from decision theory: Deficiencies. 3. Likelihood ratios and conical measures. 4. Some basic inequalities. 5. Sufficiency and insufficiency. 6. Domain, compactness, contiguity. 7. Some limit theorems. 8. Invariance properties. 9. Infinitely divisible, Gaussian, and Poisson experiments. 10. Asymptotically Gaussian experiments: Local theory. 11. Asymptotic normality-Global. 12. Posterior distributions and Bayes solutions. 13. An approximation theorem for certain sequential experiments. 14. Approximation of exponential families. 15. Sums of independent random variables. 16. Independent observations. 17. Independent identically distributed observations.