QUARTERLY

OF

APPLIED MATHEMATICS

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.

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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 that 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 Strömung 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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Vol. LIX, No. 1   **March 2001**

Combinatorial Designs and Tournaments. By Ian Anderson, Oxford University Press, 1997, xi + 237 pp.

This is volume 6 in the Oxford Lecture Series in Mathematics and its Applications and a considerably revised version of the author's book *Combinatorial Designs: Construction Methods*, published by Ellis Horwood in 1990. He has retained much of the basic material on block designs and Latin squares, but puts more emphasis on the construction of a variety of tournament designs. This involved the addition of a new chapter on league schedules, and the addition of extra material to the chapters on bridge and whist tournaments. The resulting book has two aims: to present some of the basic material on block designs and orthogonal Latin squares, and to give an account of the construction of league schedules, tournaments with various balance requirements, bridge tournaments and whist tournaments. Chapter headings: 1. Introduction to basics, 2. Difference methods, 3. Symmetric designs, 4. Orthogonal Latin squares, 5. Self-orthogonal Lation squares, 6. Steiner systems, 7. Kirkman triple systems, 8. League schedules, 9. Room squares and bridge tournaments, 10. Balanced tournament designs, 11. Whist tournaments.

Advances in Linear and Integer Programming. Edited by J. E. Beasley, Oxford University Press, 1996, xiii + 288 pp., $75.00

This is volume 4 in the Oxford Lecture Series in Mathematics and its Applications. There are 7 chapters by various authors: 1. Simplex algorithms, 2. Interior point methods, 3. A computational view of interior point methods, 4. Interior point algorithms for network flow problems, 5. Branch and cut algorithms, 6. Interior point algorithms for integer programming, 7. Computational logic and integer programming.

Fractured Fractals and Broken Dreams: Self-Similar Geometry through Metric and Measure. By Guy David and Stephen Semmes, Oxford University Press, 1997, ix + 212 pp., $65.00

This is volume 7 in the Oxford Lecture Series in Mathematics and its Applications. It proposes new notions of coherent geometric structure. Fractal patterns have emerged in many contexts, but there is confusion over what exactly is a "pattern" and what is not. The book addresses the question how the structures lying within objects and the relationships between them can be made precise.

Design and Analysis of Clinical Trials. By Shein-Chung Chow and Jen-Pei Liu, John Wiley and Sons, 1998, xi + 649 pp.

This is a volume in the Wiley Series in Probability and Statistics. The purpose of the book is to fill the gap between clinical and statistical disciplines, that is, to provide a comprehensive and unified presentation of clinical and scientific issues, statistical concepts, and methodologies. It is intended to give a well-balanced overview of current and emergent clinical issues and newly-developed statistical methodologies. It is written for readers with minimal mathematical and statistical backgrounds, since it is the authors' goal to provide a concise and comprehensive reference book for a wide circle of interested professionals. Chapter headings: 1. Introduction; 2. Basic statistical concepts; 3. Basic design consideration; 4. Randomization and blinding; 5. Designs for clinical trials; 6. Classification of clinical trials; 7. Analysis of continuous data; 8. Analysis of categorical data; 9. Censored data and interim analysis; 10. Sample size determination; 11. Issues in efficacy evaluation; 12. Safety assessment.

Fast Parallel Algorithms for Graph Matching Problems. By Marek Karpinsky and Wojciech Rytter, Oxford University Press, 1998, xi + 212 pp.

This is volume 9 in the Oxford Lecture Series in Mathematics and its Applications. It is a comprehensive and self-contained introduction to the subject. The authors' main aim is to bring together combinatorial, algebraic and probabilistic algorithms and show their use in the development of efficient parallel algorithms for the graph matching problem. Many of the algorithms are illustrated by means of examples. The text should be accessible to students.

Records. By Barry C. Arnold, N. Balakrishnan, and H. N. Nagaraja, John Wiley and Sons, 1998, xi + 312 pp., $79.95

This is a volume in the Wiley Series in Probability and Statistics. It treats "records" in the sense "the hottest day ever", the longest winning streak in professional basketball, the lowest stock market figure, etc. It is, in a sense, a natural continuation of the authors' 1992 text *A First Course in Order Statistics.* Chapter headings: 1. Introduction; 2. Basic distributional results; 3. Moment relations, bounds and approximations; 4. Characterizations; 5. Inference; 6. General record models; 7. Random and point process record models; 8. Higher dimensional problems.

Methods in Theoretical Quantum Optics. By Stephen M. Barnett and Paul M. Radmore, Oxford University Press, 1997, viii + 284 pp., $85.00

This is volume 15 in the Oxford Series in Optical and Imaging Sciences. It is not primarily about the physics of quantum optics, but rather presents the mathematical methods widely used by workers in the field. It does, however, also discuss the physical assumptions that lead to the models and approximations employed. Chapter headings: 1. Foundations; 2. Coherent interactions; 3. Operators and states; 4. Quantum statistics of fields; 5. Dissipative processes; 6. Dressed states. There are also 14 appendices on various mathematical methods.

The Quantum Theory of Fields, Volume III: Supersymmetry. By Steven Weinberg, Cambridge University Press, 2000, xxii + 419 pp., $49.95

This volume deals with quantum field theories that are governed by supersymmetry, a symmetry that unites particles of integer and half-integer spin in common symmetry multiples. These theories offer a possible way of solving the mystery of the enormous ratio of the Planck mass to the 300 GeV energy scale of electroweak symmetry breaking. Unfortunately, there is no direct evidence for supersymmetry since no pair of particles related by a supersymmetry transformation has yet been discovered. However, the author and many other physicists are reasonably confident that supersymmetry will be found relevant to the real world, and perhaps soon. It is the primary target of high energy experiments presently planned. After a historical introduction, three chapters present the essential machinery of supersymmetric field theories: the structure of supersymmetry algebra and supersymmetry multiplets and the construction of supersymmetric Lagrangians in general, and in particular for theories of chiral and gauge superfields. The next chapter then uses this machinery to incorporate supersymmetry in the standard model of electroweak and strong interactions, and reviews experimental difficulties and opportunities. The last four chapters deal with topics that are mathematically more advanced: non-purturbative results, supergraphs, supergravity, and supersymmetry in higher dimensions. The author aimed to make the treatment of supersymmetry as clear and self-contained as possible. Several topics not covered in earlier books have been included.

Derivatives in Financial Markets with Stochastic Volatility. By Jean-Pierre Fouque, George Papanicolaou, and K. Ronnie Sircar, Cambridge University Press, 2000, xiv + 201 pp., $49.95

This book addresses problems in financial mathematics of pricing and hedging derivative securities in an environment of uncertain and changing market volatility. The authors describe a method for modeling, analysis and estimation that exploits the "fast mean reversion of the volatility": the Black-Scholes model is extended by modifying the specification of volatility to make it a *hidden* stochastic process, and by exploiting the observation that volatility tends to fluctuate between high and low levels for similar periods, "mean reverting" many times during the life of a derivative contract. Chapter headings: 1. The Black-Scholes theory of derivative pricing; 2. Introduction to stochastic volatility models; 3. Scales in mean-reverting stochastic volatility; 4. Tools for estimating the rate of mean reversion; 5. Asymptotics for pricing European derivatives; 6. Implementation and stability; 7. Hedging strategies; 8. Application to exotic derivatives; 9. Application to American derivatives; 10. Generalizations; 11. Applications to interest-rate models.

High Speed Flow. By C. J. Chapman, Cambridge University Press, 2000, xii + 258 pp., $29.95 (paper), $74.95 (cloth)

This is a volume in the series Cambridge Texts in Applied Mathematics, and covers topics such as subsonic and supersonic flight, shock waves, high-speed airfoils, and thermodynamics. It is a textbook suitable for undergraduate and graduate courses, and for research workers. There are many exercises and a bibliography of nearly 500 entries, providing access to the literature of the subject from 1860 to the present day, including over 200 items published since 1990. It contains the most extensive set of formulae on oblique shock waves ever assembled. Chapter headings: 1. Preliminaries; 2. Governing equations; 3. Thermodynamics; 4. Smooth flow of an ideal fluid; 5. Characteristic surfaces and rays; 6. Shocks; 7. Steady one-dimensional flow; 8. Prandtl-Meyer expansion; 9. Airfoils; 10. Characteristics for steady two-dimensional flow; 11. Shock reflections and intersections; 12. The hodograph method; 13. Guide to high-speed flow.

Statistics and Neural Networks Advances at the Interface. Edited by J. W. Kay and D. M. Titterington, Oxford University Press, 2000, xvii + 260 pp., $70.00 (cloth)

In Chapter 1 (Flexible discriminant and mixture problems) Hastie, Tibshirani and Buja use standard linear discriminant analysis as a springboard for the development of more versatile and nonparametric alternatives. In Chapter 2 (Neural networks for unsupervised learning based on information theory) Kay uses information theory to define a class of objective functions for the contextual guidance of learning and processing in multilayer, multistream networks. Lowe's contribution, in Chapter 3 (Radial basis function networks and statistics), reviews the methodology and scope for applications of radial basis networks. In Chapter 4 (Robust prediction in many-parameter models) Intrator examines in detail aspects of the need to compromise between bias and variance in modeling complex relationships using an inevitably finite amount of data. Bishop and Tipping's contribution (Chapter 6: Latent variable models and data visualization) shows that principal components have a direct probabilistic interpretation along the same lines as standard Gaussian-based factor analysis, allowing likelihood based inference. MacKay and Gibbs (Chapter 5: Density networks) carry on the theme of latent structure modeling. Their density network model involves categorical observables and continuous latent variables. In Chapter 7 (Analysis of latent structure models with multidimensional latent variables) Dunmur and Titterington concentrate on the general topic of latent structure models. The foundation of the contribution of Martin and Morris in Chapter 8 (Artificial neural networks and multivariate statistics) is a range of practical problems in the area of industrial processing.

Nonlinear Waves in Elastic Crystals. By Gerard Maugin, Oxford University Press, 2000, ix + 314 pp., $95.00

This is a volume in the series Oxford Mathematical Monographs. The author intended the book to be neither on crystallography per se nor on mathematical methods. Rather, it is devoted to applied mathematics in the context of a specific physical field of interest to scientists and engineers. There are two reasons for not discussing hyperbolic systems in the text: first, to avoid duplication with existing books, and secondly, because the focus is primarily on the interesting phenomenon of dispersion, which has its origin in both the discreteness of the substratum of propagation (the crystal lattice) and the critical appearance of a length scale when accounting for long-range interactions. Chapter headings: 1. Different types of crystals; 2. Discrete and continuum descriptions: general introduction; 3. Elasticity and anelasticity: continuous viewpoint; 4. Elasticity and anelasticity: discrete viewpoint; 5. Coupled fields in elasticity; 6. Nonlinear waves in elastic chains; 7. Nonlinear waves in elastic crystals with a microstructure; 8. Nonlinear waves in martensite structures; 9. Nonlinear acoustic surface waves in crystals; 10. Shock waves and phase-transition fronts in thermoelastic crystals; 11. Miscellany; 12. Summary and conclusions. There are six appendices on various relevant mathematical techniques.

Optimization—Foundations and Applications. By Ronald E. Miller, John Wiley and Sons, 2000, xvii + 653 pp.

The material covered in this book is intended for students and practitioners in a wide variety of disciplines outside the natural sciences—especially the social sciences, management, information and decision sciences, city and regional planning, urban studies, public policy analysis, and certain kinds of engineering programs. The author has tried wherever possible to accompany algebraic results with geometric interpretations. Mathematical details are often given in end-of-chapter appendices. The eleven chapters are divided into five parts: I. Foundations: Linear Methods (matrix algebra, systems of linear equations). II. Foundations: Nonlinear Methods (unconstrained and constrained maximization and minimization), III. Applications: Iterative Methods for Nonlinear Problems (solving nonlinear equations, solving unconstrained maximization and minimization problems), IV. Applications: Constrained Optimization in Linear Models (linear programming: fundamentals, extensions, and interior point methods), V. Applications: Constrained Optimization in Nonlinear Models (nonlinear programming: fundamentals, duality and computational methods).

Statistical Learning Theory. By Vladimir N. Vapnik, John Wiley and Sons, 1998, xxiv + 736 pp., $105.00

This is a volume in the series Adaptive and Learning Systems for Signal Processing, Communications, and Control. It is devoted to the theory that explores ways of estimating functional dependency from a given collection of data. It covers important topics of classical statistics—in particular, discriminant analysis, regression analysis, and density estimation problems. The book considers a new paradigm for solving these problems: the so-called learning paradigm that was developed over the last thirty years. This theory was developed for small samples and does not rely on a priori knowledge about a problem to be solved. Instead, it considers a structure on the set of functions implemented by the learning machine (a set of nested subsets of functions) where a specific measure of subset capacity is defined. One has to take account of the quality of approximation of given data by the chosen function and the capacity of the subset of functions from which the approximating function was chosen. The book presents a comprehensive study of this type of inference. The sixteen chapters are divided into a Preface and three parts: I. Theory of Learning and Generalization; II. Support Vector Estimation of Functions; III. Statistical Foundation of Learning Theory.

Engineering Rheology. By Roger I. Tanner, Oxford University Press, 2000, xx + 559 pp., $95.00

This is a volume in the Oxford Engineering Science Series. It is the second edition of the book first published in 1984. It contains much new material on the behaviour of non-Newtonian materials in engineering. In particular, amongst many other additions: the question of fluid slip at solid walls is discussed; more discussion of materials modeled with yield stress is included, as is a section on the suspension of particles; the chapter on computational rheology has been completely revised, in the light of progress in this field; and additions to the stability section have been made. There are ten chapters: 1. Introduction to rheology; 2. Review of continuum mechanics; 3. Viscometric and elongational flows; 4. Continuum-derived theories and experimental data; 5. Microstructural theories; 6. Lubrication, calendaring and related flows; 7. Fibre spinning and film blowing; 8. Computational rheology and applications; 9. Temperature and pressure effects; 10. Stability of flow and turbulence.

Modeling Survival Data—Extending the Cox Model. By Terry M. Therneau and Patricia M. Grambsch, Springer-Verlag, 2000, viii + 350 pp., $69.95

This is a volume in the series Statistics for Biology and Health. It is designed to be a book for statistical practitioners who analyze survival and event history data and wish to take advantage of recent developments in data analysis methods motivated by counting processes and martingale theory, methods which extend the Cox model to multiple event data using both marginal and frailty approaches. Chapter headings: 1. Introduction; 2. Estimating the survival and hazard functions; 3. The Cox model; 4. Residuals; 5. Functional form; 6. Testing proportional hazards; 7. Influence; 8. Multiple events per subject; 9. Frailty models; 10. Expected survival. There are appendices giving an introduction to SAS and S-Plus, as well as SAS macros and S-Plus functions implementing the methods presented in the book.

Asymptotic Theory of Statistical Inference for Time Series. By Masanobu Taniguchi and Yoshihide Kakizawa, Springer-Verlag, 2000, xvii + 661 pp., $69.95

This is a volume in the Springer Series in Statistics. It is designed to be a professional reference book on the statistical analysis of stochastic processes or a specialized textbook. It deals with a wide variety of stochastic processes, for example, non-Gaussian linear processes, long-memory processes, nonlinear processes, orthogonal increment processes, and continuous time processes. For them, the authors develop not only the usual estimate and testing theory, but also methods such as discriminant analysis, cluster analysis, nonparametric methods, higher-order asymptotic theory, large deviation theory, and saddlepoint approximation. Since exact distribution theory is unmanagable for these cases the discussion is based on asymptotic theory. Optimality is often shown by using local asymptotic normality, due to LeCam. Chapter headings: 1. Elements of stochastic processes; 2. Local asymptotic normality for stochastic processes; 3. Asymptotic theory of estimation and testing for stochastic processes; 4. Higher asymptotic theory for stochastic processes; 5. Asymptotic theory for long memory processes; 6. Statistical analysis based on functionals of spectra; 7. Discriminant analysis for stationary time series; 8. Large deviation theory and saddlepoint approximation for stochastic processes.

Asymptotics in Statistics—Some Basic Concepts. By Lucien LeCam and Grace Lo Yang, Springer-Verlag, 2000, xiii + 285 pp., $69.95

This is a volume in the Springer Series in Statistics. It is the second edition of the book first published in 1990. It is revised and enlarged, and the presentation has been made less concise. Among substantial changes, a chapter on Gaussian and Poisson experiments has been added. Chapter headings: 1. Introduction; 2. Experiments, deficiencies, distances; 3. Contiguity—Hellinger transforms; 4. Gaussian shift and Poisson experiments; 5. Limit laws for likelihood ratios; 6. Local asymptotic normality; 7. Independent, identically distributed observations; 8. On Bayes procedures.

Practical Geostatistics—Modeling and Spatial Analysis. By Simon W. Houlding, Springer-Verlag, 2000, xvi + 159 pp., +CD-ROM, $99.95

This book is designed as courseware to be viewed on a computer from the attached CD-ROM, to which the text represents only a reference companion—the CD-ROM contains much more material. Together, they provide an introductory course and application reference for students and practising geoscientists concerned with 3D characterization of subsurface conditions. It provides sufficient knowledge and background to allow useful application of geostatistics in practical situations, e.g., evaluation of a mineral deposit or oil reservoir, assessment of subsurface contamination, or characterization of geotechnical conditions. Chapter headings: 1. Introduction: Why Geostatistics? 2. Data Types and Structures for 3D Geostatistics; 3. Basic Concepts and Theory of Geostatistics; 4. Integration of Geology with Geostatistics; 5. Practical Application of Geostatistics; 6. Geostatistical Uncertainty and Probability; 7. Visualization and Spatial Analysis; 8. Practical Data Management for Geostatistics; 9. Practical Geostatistics.

Econometric Analysis of Count Data. By Rainer Winkelmann, Springer-Verlag, 2000, xii + 282 pp., $83.00

This is the third, revised and enlarged, edition of the book first published in 1994. A substantial amount of material has been added and the number of referenced articles and books has increased by about 50 percent. The new material includes methodological advances as well as an extended application section with examples from accident research, health studies, demography and marketing. Chapter headings: 1. Introduction; 2. Probability Models for Count Data; 3. Econometric Modeling—Basic Issues; 4. Econometric Modeling—Extensions; 5. Correlated Count Data; 6. Bayesian Analysis of Count Variables; 7. Applications.

An Introduction to Turbulent Flow. By Jean Mathieu and Julian Scott, Cambridge University Press, 2000, ix + 374 pp., $90.00 (hardback), $39.95 (paperback)

This book is intended as an introductory course in turbulence, assuming the reader to be well acquainted with basic fluid mechanics and to have a reasonable level of mathematical sophistication. A second volume is due to appear, building on the material developed here. Turbulence is treated using one-point statistics in the earlier chapters, while multi-point statistics, analyzed by spectral methods, are introduced later. Chapter headings: 1. An Introduction to Turbulence; 2. Statistical Tools; 3. Space and Time Scales of Turbulence; 4. Basic Theory and Illustrative Examples; 5. Classical Models of Jets, Wakes, and Boundary Layers; 6. Spectral Analysis of Homogeneous Turbulence; 7. Kolmogorov's and Other Theories Based on Spectral Analysis; 8. Numerical Simulation of Turbulent Flows.