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QUARTERLY OF APPLIED MATHEMATICS

The QUARTERLY prints original papers in applied mathematics which have an intimate connection with applications. It is expected that each paper will be of a high scientific standard; that the presentation will be of such character that the paper can be easily read by those to whom it would be of interest; and that the mathematical argument, judged by the standard of the field of application, will be of an advanced character.

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SUGGESTIONS CONCERNING THE PREPARATION OF MANUSCRIPTS FOR THE QUARTERLY OF APPLIED MATHEMATICS

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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0033-569X(199603)54:1;1-L

Deterministic Lotsizing Models for Production Planning. By Marc Salomon. Springer-Verlag, 1991. vii+158 pp., $30.00.

This is volume 355 in the series *Lecture Notes in Economics and Mathematical Systems.* It reports research done for a Ph.D. thesis at the Erasmus University of Rotterdam and deals with mathematical models to support optimal timing and sizing decisions for production lots. Such models are characterized by the fact that production lots are determined based on a trade-off between production costs and customer service. The thesis is divided into two parts, dealing with single-level and multilevel lotsizing problems, respectively.

Optimal Control of Nonsmooth Distributed Parameter Systems. By Dan Tiba. Springer-Verlag, 1990. iv+159 pp., $20.00.

This is volume 1459 in the series *Lecture Notes in Mathematics.* It is a contribution to research in nonsmooth optimization problems associated with nonlinear partial differential equations, more precisely the examination of distributed control problems governed by nonlinear evolution equations (parabolic or hyperbolic), in the absence of differentiability properties. In this setting emphasis is given to nonlinear hyperbolic problems that are less discussed in the literature.

Quantum Probability and Applications V. Edited by L. Accardi and W. von Waldenfels. Springer-Verlag, 1990. vi+413 pp., $45.00.

These are the Proceedings of the Fourth Workshop on Quantum Probability, held in Heidelberg, September 26–30, 1988. There are 32 papers.

Numerical Techniques in Finance. By Simon Benninga. The MIT Press. viii+244 pp.

The aim of this book is to present some important models in finance and to show how they can be solved numerically and/or simulated. The minimum background is a good introductory course in finance. It is divided into five parts: I. Corporate finance; II. Portfolio problems; III. Options; IV. Duration and immunization; V. The technical background.

Free Boundary Problems: Theory and Applications. Volumes I, II. Edited by K. H. Hoffmann and J. Sprekels. Longman and John Wiley & Sons, 1990. 901 pp., $49.00 each volume.

These are volumes 185 and 186 in the *Pitman Research Notes in Mathematics* series. They contain the proceedings of an international colloquium held in the Schwäbisches Bildungszentrum Irsee (West Germany) from June 11 to 20, 1987. Included are the texts of fifteen plenary lectures, and of the talks delivered at sessions on: solid mechanics, flow through porous media, optimal control, Stefan problems and applications, numerical methods, material science, phase change, fluid mechanics, phase transitions, mathematical methods, and reaction-diffusion.

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Numerical Solution of Markov Chains. Edited by William J. Stewart. Marcel Dekker, Inc., 1991, xvii+701 pp., $145.00.

This is volume 8 in the series *Probability: Pure and Applied*. It constitutes the proceedings (the first ever in this research area) of a workshop held at North Carolina State University with support of the N. S. F. and A. R. O. Examples of subjects discussed in the 40 papers (including 8 abstracts) are: matrix generation techniques and generalized stochastic Petri nets; computation of stationary distributions, including aggregation/disaggregation approaches, projection-type and conjugate gradient-based and recursive-type methods; sensitivity analysis; transient solutions; bounds and approximations; applications to various fields. There are also accounts of six software demonstrations.

Oscillation Theory of Delay Differential Equations, with Applications. By I. Györi and G. Ladas. Oxford University Press, 1992. xii+368 pp., $89.00.

This is a volume in the series *Oxford Mathematical Monographs*. It is its aim to present in a systematic way the most important recent contributions to the subject, and to apply it to several equations in mathematical biology to obtain the oscillatory character of their solutions. It is the authors' aim to expose the reader to the frontiers of the subject and to formulate some important open problems that remain to be solved in the area. Chapter headings: 1. Preliminaries; 2. Oscillations of linear scalar delay equations; 3. Generalized characteristic equation and existence of positive solutions; 4. Linearized oscillation theory and applications to mathematical biology; 5. Oscillations of systems of delay equations; 6. Oscillations of neutral differential equations; 7. Oscillations of delay difference equations; 8. Oscillations of equations with piecewise constant arguments; 9. Oscillations of integrodifferential equations; 10. Oscillations of second- and higher-order equations; 11. Applications of oscillation theory to the asymptotic behavior of solutions; 12. Miscellaneous topics.

An Introduction to Stochastic Processes and Their Applications. By Peter Todorovic. Springer-Verlag, 1992. xiii+289 pp., $49.95.

This is a volume in the Springer Series in Statistics. It is an introductory graduate course, requiring as prerequisites some rudiments of measure theory and an intermediate course in probability. There are more than 50 examples and applications and 243 problems and complements, but no answers or solutions. Chapter headings: 1. Introduction; 2. The Poisson process and its ramifications; 3. Elements of Brownian motion; 4. Gaussian processes; 5. L_2 space; 6. Second-order processes; 7. Spectral analysis of stationary processes; 8. Markov processes I; 9. Markov processes II: Application of semi-group theory; 10. Finite parameter martingales.

Hardy-type Inequalities. By B. Opic and A. Kufner. Longman and John Wiley & Sons, 1990.

This is volume 219 in the *Pitman Research Notes in Mathematics* series. The inequalities collected here involve integrals of a function and its derivatives. The first two chapters cover one- and N-dimensional Hardy inequalities, respectively, and the third chapter concerns imbedding theorems for weighted Sobolev spaces.

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Lectures on Mechanics. By Jerrold E. Marsden. Cambridge University Press, 1992. xi+254 pp., $34.95.

This is volume 174 in the *London Mathematical Society Lecture Notes Series.* It is based on the 1991 *London Mathematical Society Invited Lectures* and covers a selection of topics from recent developments in the geometric approach to mechanics and its applications. In particular, the author emphasizes methods based on symmetry, especially the action of Lie groups, both continuous and discrete, and their associated Noether conserved quantities viewed in the geometric context of momentum maps. Chapter headings: 1. Introduction; 2. A crash course in geometric mechanics; 3. Cotangent bundle reduction; 4. Relative equilibria; 5. The energy-momentum method; 6. Geometric phases; 7. Stabilization and control; 8. Discrete reduction; 9. Mechanical integrators; 10. Hamiltonian bifurcation.

Coding and Information Theory. By Steven Roman. Springer-Verlag, 1992. xvii+486 pp., $49.95.

This is a volume in the series *Graduate Texts in Mathematics.* Prerequisites to this introduction at the graduate or advanced undergraduate level include elementary probability and a foundation in modern and linear algebra. All material on finite fields is developed from scratch. The first quarter of the book (Chapters 1–3) is devoted to information theory—enough to discuss the basic aspects of the subject and to give a full statement of the Noisy Coding Theorem, as well as a complete proof in the case of the binary symmetric channel. Chapter headings: 1. Entropy; 2. Noiseless coding; 3. Noisy coding; 4. Remarks on codes; 5. Linear codes; 6. Some linear codes (Hamming, Goley and Reed-Muller codes); 7. Finite fields and cyclic codes; 8. Some cyclic codes. The appendix contains a review of topics from modern algebra along with a discussion of Möbius inversion and binomial inequalities.

Computing and Graphics in Statistics. Edited by Andreas Buja and Paul A. Tukey. Springer-Verlag, 1991, xii+279 pp., $39.50.

This is volume 36 in the series *The IMA Volumes in Mathematics and its Applications.* It is based on the proceedings of the last two weeks of the six-week Institute of Mathematics and Its Applications 1998 summer program "Robustness, Diagnostics, Computing and Graphics in Statistics". The major topics of statistical computing involve integrated software systems, visualization of high-dimensional data and mathematical functions, numerical and combinatorial algorithms, tools for data handling, and simulation. These topics are all represented in the seventeen papers of this volume.

Annual Review of Fluid Mechanics. Volume 24. Edited by John L. Lumley, Milton Van Dyke, and Helen L. Reed. Annual Reviews, Inc., 1992. vii+546 pp., $44.00.

The lead article this year, by Aref, Rott, and Thomann, takes its theme from the 1877 dissertation, on the solution of the three-vortex problem, of the Swiss applied mathematician Walther Gröbli; it provides also a frontispiece and an account of his intellectual contributions. Other articles in this volume of a perennially interesting series concern: two-phase slug flow, yield stress fluids, contour dynamics, Navier-Stokes computational techniques and finite-element methods, topological methods in hydrodynamics, atmospheric turbulence, vortex rings, helicity in flows, swimming microorganisms, mantle convection, wavelet transforms and turbulence, dynamo theory.

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Operator Theory: Proceedings of the 1988 *GPOTS-Wabash Conference.* Edited by J. B. Conway and B. B. Morrel. Longman and John Wiley & Sons, 1990. 183 pp., $34.00.

This is volume 225 in the *Pitman Research Notes in Mathematics* series. These are the proceedings of the combined meeting of the Great Plains Operator Theory Seminar and the Wabash Extramural Functional Analysis Seminar, which was held at Indiana University-Purdue University at Indianapolis from May 7 to May 10, 1988. There are two lectures, by W. Arveson and Gert K. Pederson, respectively, and five contributed papers.

Geometry in the Neighborhood of Invariant Manifolds of Maps and Flows and Linearization. By U. Kirchgraber and K. J. Palmer. Longman and John Wiley & Sons, 1990. 89 pp.

This is volume 233 in the *Pitman Research Notes in Mathematics* series. The goal of these notes is to give detailed proofs of linearization theorems. Part I (discrete dynamical systems) is by the first, part II (continuous dynamical systems) by the second author.

Pseudo-differential Operators. By S. R. Simanca. Longman and John Wiley & Sons, 1990. 123 pp., $32.00.

This is volume 236 in the *Pitman Research Notes in Mathematics* series. It provides an introduction to the subject from an invariant point of view. The goal is to discuss and elaborate on a subject contained in Hörmander's article, "Fourier Integral Operators I", emphasizing the geometric descriptions of the distributions that play a natural role in the theory, namely the Schwartz kernels of the operators under consideration.

Applied Multivariate Data Analysis. Volume II: *Categorical and Multivariate Methods.* By J. D. Jobson. Springer-Verlag, 1992. xxvii+731 pp., with 85 illustrations in 108 parts, with a diskette, $50.00.

This two-volume survey is designed to provide a second two-semester course in statistics. The first volume outlined univariate data analysis and provided an extended overview of regression models; it also surveyed the methods of analysis of variance and experimental design, including their relationship to the regression model. The second volume begins with a survey of techniques for analyzing multidimensional contingency tables and then outlines the traditional topics of multivariate methods. It also includes discussions of logistic regression, cluster analysis, multidimensional scaling, and correspondence analysis. In each volume an appendix is provided to review the basic concepts of linear and matrix algebra. The chapter headings in the second volume are: 6. Contingency tables; 7. Multidimensional distributions, inference, regression and canonical correlation; 8. MANOVA, discriminate analysis and qualitative response models; 9. Principal components, factors and correspondence analysis; 10. Cluster analysis and multidimensional scaling. The data appendix, also provided on a floppy disk, contains twenty-two data tables that are used in the chapter exercises.

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Advanced General Relativity. By John Stewart. Cambridge University Press, 1991. viii+228 pp., $49.50.

This is a volume of the *Cambridge Monographs on Mathematical Physics.* The opening chapter reviews the subject. The second chapter discusses 2-component spinor theory, its usefulness for describing zero-mass fields and its practical application via Newman-Penrose formalism, together with examples and applications. There follows an account of the asymptotic theory far from a strong gravitational source, describing the mathematical theory by which measurements of the far-field and gravitational radiation emanating from a source can be used to describe the source itself. Finally, the characteristic initial value problem is described, first in general terms, and then with particular reference to relativity, concluding with its relation to Arnol′d's singularity theory. Exercises are included throughout.

Topology and Category Theory in Computer Science. Edited by G. M. Reed, A. W. Roscoe, and R. F. Wachter. Oxford University Press, 1991. x+390 pp., $75.00.

This is a volume in the series *Oxford Science Publications.* It constitutes the proceedings of the Oxford Topology Symposium, held on 27–30 June 1989. There were 15 invited and 12 contributed presentations. This volume contains the 14 "applied" papers, the first, by A. W. Roscoe, providing an introductory survey of topology in computer science, entitled "Topology, computer science, and the mathematics of convergence".

Additive Number Theory of Polynomials over a Finite Field. By Gove W. Effinger and David R. Hayes. Oxford University Press, 1991. xvi+157 pp., $45.00.

This is a volume in the series *Oxford Science Publications.* Its scope is apparent from the table of contents: 1. The polynomial Waring and Goldbach problems; 2. Local singular series; 3. Local Gauss sums and local derivatives; 4. The adèle ring over k . 5. L-functions of Dirichlet type; 6. The polynomial 3-primes generating function; 7. The polynomial 3-primes problem: an asymptotic solution; 8. The polynomial Waring problem.

Handbook of the Logistic Distribution. Edited by N. Balakrishnan. Marcel Dekker, Inc., 1992. 624 pp., $115.00.

This is volume 123 in the series *Statistics: Textbooks and Monographs.* The authors of the chapters in this volume have stressed both theoretical developments and practical applications, including a detailed description of various univariate and multivariate generalizations of the logistic distribution and numerical illustrative examples. An up-to-date, comprehensive, and collective bibliography, encompassing approximately 600 items, is included. Chapter headings: 1. Introduction and historical remarks; 2. Logistic order statistics and their properties; 3. Maximum likelihood estimation based on complete and type II censored samples; 4. Linear estimation based on complete and censored samples; 5. Reliability estimation based on MLE's for complete and censored samples; 6. Ranking and selection procedures; 7. Characterizations; 8. Translated families of distributions; 9. Univariate generalized distributions; 10. Some related distributions; 11. Multivariate logistic distributions; 12. Outlier and robustness of estimators; 13. Goodness-of-fit tests; 14. Tolerance limits and sampling plans based on censored samples; 15. Logistic stochastic growth models and applications; 16. Logistic growth models and related problems; 17. Applications in health and social sciences; 18. Some other applications.

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Combinatorics of Partially Ordered Sets: Dimension Theory. By William T. Trotter. The Johns Hopkins University Press, 1992. xiv+307 pp., $45.00.

This is a volume in the *Johns Hopkins Series in the Mathematical Sciences.* The author intends this monograph to be a unified treatment of combinatorial aspects of posets, concentrating on topics in dimension theory. The treatment is almost exclusively combinatorial and is concerned only with finite sets.

The Computational Complexity of Differential and Integral Equations: An Information-Based Approach. By Arthur G. Werschulz. Oxford University Press, 1991, ix+331 pp., $55.00.

This is a volume in the series *Oxford Science Publications.* Its contents belong to the field known as *information-based complexity* and aim to answer the following questions: (i) What is the complexity of the problem? [For $\varepsilon > 0$, we wish to compute an approximation whose error is at most ε. What is the cost of doing this?] (ii) How can we find optimal complexity algorithms? (iii) To what extent are the usual algorithms optimal? The purpose of the book is to answer these questions for elliptic partial differential equations, elliptic systems, Fredholm integral equations of the first and second kind, and initial value problems for ordinary differential equations. Chapter headings: 1. Introduction; 2. Example: a two-point boundary value problem; 3. General formulation; 4. The worst case setting: general results; 5. Elliptic p.d.e.'s in the worst case setting; 6. Other problems in the worst case setting; 7. The average case setting; 8. Complexity in the asymptotic and randomized settings.

A Guide to Econometrics. Third Edition. By Peter Kennedy. The MIT Press, 1992. xi+410 pp., $13.95.

Although the changes from the second edition are numerous and extensive, the basic structure and flavor of the book remain unchanged. Following an introductory chapter, the second chapter discusses the criteria for choosing estimators. The third chapter provides an overview of the subject matter, presenting the five assumptions of the classical linear regression model. The fourth chapter discusses some concepts of inference to provide a foundation for later chapters. A new chapter has been added at this point to allow discussion of general approaches to the specification of an econometric model, setting the stage for the next six chapters, each of which deals with violations of an assumption of the classical linear regression model, describes their implications, discusses relevant tests, and suggests means of resolving resulting estimation problems. The remaining seven chapters, including two new chapters, address selected topics. Major additions to this edition include: Chapter 5 on econometric specification methodology; Chapter 16 on time series analysis; Chapter 18 on robust, including non-parametric, estimation; and some new appendices with background material and exercises.

The Dynamics of Numerics and the Numerics of Dynamics. Edited by D. S. Broomhead and A. Iserles. Oxford University Press, 1992. xii+258 pp., $65.00.

This is volume 34 of *The Institute of Mathematics and its Applications Conference Series* and is based on the proceedings of a conference held at the University of Bristol in August 1990. It deals with the interplay of the topics of numerical analysis and nonlinear dynamical systems. There are 11 papers by R. Temam, J. Carr, I. N. Stewart, D. S. Broomhead, J. M. Sanz-Serna, D. R. Moore and N. O. Weiss, H. B. Keller, R. S. Mackay, J. P. Keener, D. F. Griffiths and A. R. Mitchell, J. K. Hale.

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The Chronological Annotated Bibliography of Order Statistics. By H. Leon Harter. Volume VI: 1966–1967, vi+232 pp., Volume VII: 1968–1969, vi+292 pp. American Sciences Press, 1991 and 1992, resp. $95.00 each volume.

This bibliography will consist of eight volumes, the eighth being a supplement, with indices. The first, pre-1950, volume was published in 1978. The work covers not only books and journal articles, but also dissertations, theses, technical reports and notes, and papers from a great variety of sources. Publications in foreign languages are included. In addition to the bibliographical reference, a summary of each publication is given, sometimes including all or part of a previously published abstract or review and/or extensive quotations of the author's own words (or translations of them). About 5000 publications will be reviewed in all, including applications of order statistics.

Mathematical Approaches to Brain Functioning Diagnostics. Edited by Ivan Dvorák and Arun V. Holden. Manchester University Press, distributed by St. Martin's Press, 1991. xiv+463 pp., $120.00.

This is a volume in the series *Proceedings in Nonlinear Science.* It contains selected contributions of invited speakers at an International Symposium held in Prague, Czechoslovakia, September 3–7, 1990. There are 28 papers, including an introductory one entitled *Brain Functioning*, translated into English by the editors and V. Albrecht. The other papers are grouped into seven sections: 1. Mathematical approaches to modeling of brain functioning; 2. Analysis and mapping of EEG analysis; 3. Analysis of event related brain electrical activity; 4. Computer and mathematical modeling of brain activity; 5. Mathematical and computer techniques in brain functioning diagnosis; 6. Dynamical systems approach to brain functioning analysis; 7. Analysis and modeling of brain perception and cognitive processes.

Prediction Theory for Finite Populations. By Heleno Bolfarine and Shelemyahu Zacks. Springer-Verlag, 1992. xi+207 pp., $49.00.

This is a volume in the Springer Series in Statistics. It is designed to present current prediction theory for finite populations in a systematic and consistent manner. Theoretical examples, which illustrate concepts and provide formulae of predictors for special cases of common interest, are given in each chapter. In addition, a large number of problems for solution accompany each chapter. Chapter headings: 1. Basic ideas and principles; 2. Optimal predictors of population quantities; 3. Bayes and minimax predictors; 4. Maximum likelihood predictors; 5. Classical and Bayesian prediction intervals; 6. The effects of model misspecification, conditions for robustness, and Bayesian modeling; 7. Models with measurement errors; 8. Asymptotic properties in finite populations; 9. Design characteristics of predictors.

Selected Papers by Chia-Shun Yih. Edited by W. M. Lai and S.-P. Lin. In two volumes, World Scientific, 1991. 1023 pp., $153.00.

These are volumes in the *Advanced Series on Fluid Mechanics.* The papers are divided into the following parts: A. Stratified flows and internal waves (22 papers); B. Theory of hydrodynamic stability (26 papers); C. Gravity Waves (13 papers); D. Jets, plumes and diffusion (11 papers); E. General (25 papers). There is an introduction by C. C. Lin and there are reminiscences by friends, including George Batchelor.

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Introduction to Multiple Time Series Analysis. By Helmut Lütkepohl. Springer-Verlag, 1991. ix+545 pp., $59.00 (soft cover).

This textbook is written with graduate students in business and economics in mind, and prepared on a level appropriate for this audience. The issues and models covered in detail reflect the author's interests and omit spectral methods for this reason. Chapters 1–4 contain an introduction to the vector autoregressive methodology and Chapters 1–9 to vector autoregressive and mixed autoregressive moving average models. Chapter 10 reviews econometric dynamic simultaneous equation models and Chapter 11 the cointegration topic. In Chapter 12 models with systematically varying coefficients are treated and state space models are discussed in Chapter 13.

Statistical Methods for Survival Data Analysis. Second Edition. By Elisa T. Lee. John Wiley and Sons, 1992. xii+482 pp.

This is a volume in the Wiley Series in *Probability and Mathematical Statistics.* The first edition, out of print for some time, was published about ten years ago. The book is written for biomedical investigators, statisticians, epidemiologists, and researchers in other disciplines who are interested in analyzing survival data. It covers the most commonly used parametric and nonparametric methods, and provides guidelines for the planning and design of clinical trials, some of which are applicable, also, to epidemiological studies. This edition remains application oriented and the mathematical level has been kept to a minimum, only some knowledge of calculus and matrix algebra being needed in a few sections. In addition to a large number of real-life examples in the text, several large data sets are provided as exercises for the reader to use.

Mathematics in Medicine and the Life Sciences. By F. C. Hoppenstead and C. S. Peskin. Springer-Verlag, 1992. xii+252 pp., $39.95.

This is volume 10 in the series *Texts in Applied Mathematics.* There are two major parts to it: Chapters 1–4 introduce the mathematics of populations and Chapters 5–10 deal with models from physiology. The topics are presented at a level that is accessible to a wide audience, and they are indicated by the chapter headings: 1. The mathematics of populations: demographics; 2. Inheritance; 3. A theory of epidemics; 4. Biogeography; 5. The heart and circulation; 6. Gas exchange in the lungs; 7. Control of cell volume and the electrical properties of cell membranes; 8. The renal countercurrent mechanism; 9. Muscle mechanics; 10. Biological clocks and mechanisms of neural control. The authors' aim is not the systematic presentation of mathematical material, but the illustration of how mathematics can be used.

Bayes or Bust? A Critical Examination of Bayesian Confirmation Theory. By John Earman. The MIT Press, 1992. xiv+272 pp., $35.00.

This book explores the approach the author takes to be the best good hope for a comprehensive and unified treatment of induction, confirmation, and scientific inference, viz. Bayesianism. It is intended for students of the philosophy of scientific methodology. Chapter headings: 1. Bayes's Bayesianism; 2. The machinery of modern Bayesianism; 3. Success stories; 4. Challenges met; 5. The problem of old evidence; 6. The rationality and objectivity of scientific inference; 7. A plea for eliminative induction; 8. Normal science, scientific revolutions, and all that: Thomas Bayes versus Thomas Kuhn; 9. Bayesianism versus formal learning theory.

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Advances in Numerical Analysis. Volume II: *Wavelets, Subdivision Algorithms, and Radical Basis Functions.* Edited by Will Light. Oxford University Press, 1992. viii+210 pp., $49.95.

This is a volume in the series *Oxford Science Publications.* It is the second of a two-volume collection of proceedings of the Fourth Summer School in Numerical Analysis, which was held at Lancaster University from 15th July to 3rd August, 1990. There are three chapters: 1. Wavelets and spline interpolation, by Charles K. Chui, 2. Subdivision schemes in computer-aided geometric design, by N. Dyn; 3. The theory of radical basis function approximation in 1990, by M. J. D. Powell.

A Course in Integral Equations. By A. C. Pipkin. Springer-Verlag, 1991. xiii+269 pp., $39.00.

This is volume 9 in the series *Texts in Applied Mathematics.* It is based on a one-semester course for graduate students and requires as background some familiarity with the theory of analytic functions of a complex variable. The course's aim is problem solving, not theorem proving, so there are many examples. It is divided about equally into three parts: Fredholm and Hilbert-Schmidt theory (which stresses the analogy with linear algebra), one- and two-sided Laplace transforms, Cauchy principal value integrals. Chapter headings: 1. Fredholm theory; 2. Fredholm theory with integral norms; 3. Hilbert-Schmidt theory; 4. Laplace transforms; 5. Volterra equations; 6. Reciprocal kernels; 7. Smoothing and unsmoothing; 8. Wiener-Hopf equations; 9. Evaluation of principal value integrals; 10. Cauchy principal value equations on a finite interval; 11. Principal value equations on a semi-infinite interval; 12. Principal value equations on an infinite interval. There are also solutions to selected problems.

Multidimensional Inverse Scattering Problems. By A. G. Ramm. Longman Scientific and Technical, and John Wiley and Sons, 1992. 379 pp.

This is volume 51 in the series *Pitman Monographs and Surveys in Pure and Applied Mathematics.* It deals with multidimensional inverse problems which, in many cases, consist in finding the unknown coefficients of a differential equation from the knowledge of a family of solutions to this equation on a certain manifold. The important examples of such problems include the inverse scattering problems, the inverse problems of geophysics, and similar problems that arise in nondestructive evaluation and remote sensing in medicine, technology, ocean acoustics, physics of atmosphere, and many other areas. This book presents in detail and essentially in a self-contained way the author's results and methods, based on the notion of completeness of the set of products of solutions to partial differential equations. Another method, based on the low frequency inversion of the surface data, is also described in detail.

Modern Geometry—Methods and Applications, Part I. *The Geometry of Surfaces, Transformation Groups, and Fields.* Second Edition. By B. A. Dubrovin, A. T. Fomenko, and S. P. Novikov. Springer-Verlag, 1992. xv+468 pp., $59.80.

This is volume 93 in the series *Graduate Texts in Mathematics.* Parts II and II have been published as volumes 104 and 124, respectively, of this series. The first edition of this text was published in 1984, and it was a translation of the Russian edition published in Moscow in 1979. It is based on a course given in the mechanics division of the Faculty of Mechanics and Mathematics of Moscow State University. The chapter headings are: 1. Geometry in regions of space. Basic concepts; 2. The theory of surfaces; 3. Tensors: the algebraic theory; 4. The differential calculus of tensors; 5. The elements of the calculus of variations; 6. The calculus of variations in several dimensions. Fields and their geometric invariants.

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The Riccati Equation. Edited by S. Bittanti, A. J. Laub, and J. C. Willems. Springer-Verlag, 1991. x+338 pp., $98.00.

This book has its origin in a *Workshop on the Riccati Equation in Control, Systems, and Signals*, held in Como, Italy, June 26–28, 1989. It is its purpose to present a self-contained treatment of the main issues evolving around the Riccati equation, in particular, theory, applications, and numerical algorithms. The book consists of coordinated tutorial chapters written by different authors and is intended as a graduate text and reference. Chapter 1 (by S. Bittani) is devoted to the history and pre-history of the Riccati equation. Chapters 2 and 3 (by P. Lancaster, L. Rodman, and V. Kucera) supply a comprehensive view of the algebraic Riccati equation, mainly based on a linear algebra approach. A geometric analysis of the equation is carried out in Chapters 4 and 5 (by A. Shayman, C. Martin, and G. Ammar). Chapters 2 to 5 deal with the constant coefficient case. The periodically time-varying Riccati equation is the subject of Chapter 6 (by S. Bittani, P. Colaneri, and G. DeNicolao). The leading numerical techniques are overviewed in Chapter 7 (by A. J. Laub). The remaining four chapters (by H. L. Trentelman, J. C. Willems, F. M. Callier, R. R. Bitmead, M. Gevers, and T. Baser) address connections between the Riccati equation and some important problems in systems and control.

Probability—The Mathematics of Uncertainty. By Dorian Feldman and Martin Fox. Marcel Dekker, 1992. xv+404 pp., $135.00.

This is volume 9 in *Probability: Pure and Applied—A Series of Textbooks and Reference Books.* It uses an approach that the authors believe to be a more natural one than the one based on sets. They begin with the idea that probability measures, on a 0–1 scale, the "likelihood" that a given statement is true, not imposing any particular form or structure on the nature of statements or on the determination of truth or falsity. Ultimately, experiments and sample spaces emerge as important applications of the general concepts, and ultimately all the usual results, including those regarding random variables and expectations, are derived without reference to sets. They are based solely on event relations and the rules of probability. The material in the book has been used for a senior-graduate level course for students who have taken, or are taking, a course in advanced calculus.

Modeling Biological Populations in Space and Time. By Eric Renshaw. Cambridge University Press, 1991. xvii+403 pp., $110.00.

This is volume 11 in the series *Cambridge Studies in Mathematical Biology.* In this book, the author aims to develop a unified approach between that of theoreticians, often modeling purely in terms of mathematical equations, and that of biologists, developing vaguely plausible deterministic models that reflect mathematical hope rather than biological reality. He first shows that both deterministic and stochastic models have an important role to play and should therefore be considered together. Second, he constructs model-based computer simulation procedures that can highlight hitherto unforeseen features of a process and thereby suggest further profitable lines of biological investigation. His third approach is recognition that the environment has a spatial dimension, and he develops models that highlight the effects that geographic restrictions and species' mobility may have on population development. Only relatively simple population models for single species and two interacting species are used, but these are extremely important in their own right and result in mathematical analyses sufficiently translucent to enable useful biological conclusions to be drawn from them. Chapter headings: Introductory remarks; 2. Simple birth-death processes; 3. General birth-death processes; 4. Time-lag models of population growth; 5. Competition processes; 6. Predator-prey processes; 7. Spatial predator-prey systems; 8. Fluctuating environments; 9. Spatial population dynamics; 10. Epidemic processes; 11. Linear and branching architectures.