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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.

Manuscripts (two copies) submitted for publication in the QUARTERLY OF APPLIED MATHEMATICS should be sent to the Editorial Office, Box F, Brown University, Providence, RI 02912, either directly or through any one of the Editors. The final decision on acceptance of a manuscript for publication is made by the Managing Editor. In accordance with their general policy, the Editors welcome particularly contributions which will be of interest both to mathematicians and to scientists or engineers. Authors will receive galley proof only. The author's institution will be requested to pay a publication charge of \$30 per page which, if honored, entitles the author to 100 free reprints. Detailed instructions will be sent with galley proofs.

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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 type-setter 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 α , kappa and k , mu and μ , nu and ν , eta and η .

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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Asymptotics in Statistics: Some Basic Concepts. By Lucien Le Cam and Grace Lo Yang. Springer-Verlag, 1990. viii+180 pages, \$29.00.

These are translated and updated lecture notes first published in French by the Presses of the University of Montreal in 1968. The authors have deleted obsolete material and sketched some of the results acquired during the past twenty years. They have attempted to present a few concepts and tools in an elementary manner, referring the reader to the general literature for further information. Chapter headings: 1. Introduction; 2. Experiments, deficiencies, distances; 3. Contiguity—Hellinger transforms; 4. Limit laws for likelihood ratios obtained from independent observations; 5. Locally asymptotically normal families; 6. Independent, identically distributed observations; 7. On Bayes procedures.

Boundary Value Problems for Elliptic Equations and Systems. By Guo Chun Wen and Heinrich G. W. Begehr. Longman Scientific & Technical and John Wiley, 1990. xii+411 pages.

This is volume 46 in the series Pitman Monographs and Surveys in Pure and Applied Mathematics. It deals with boundary value problems for linear and nonlinear elliptic equations and systems by using function theoretic approaches. Amongst methods used to prove existence theorems are transformations of the general elliptic equations and systems into complex form, and integral representations of solutions to various boundary value problems are established. The book contains many recent results which have so far only appeared in the Chinese literature. The six chapters treat boundary value problems for: (1) simple complex equations, (2) elliptic first order complex equations, (3) elliptic second order equations, (4) elliptic equations and systems with piecewise continuous coefficients, (5) elliptic systems of two second order equations, (6) elliptic systems of several equations.

Finite Element Approximation of Variational Problems and Applications. By M. Krížek and P. Neittaanmäki. Longman Scientific & Technical and John Wiley, 1990. 239 pages.

This is volume 50 in the series Pitman Monographs and Surveys in Pure and Applied Mathematics. It is a practical guide to the theory and application of the finite element (FE) method for solving various problems of mathematical physics. It extends the method to cover results in fields such as: superconvergence, FE-approximation to hyperbolic systems, nonlinear problems, bifurcation problems and dimensional reduction. The first half of the book is concerned with the solution of elliptic problems such as variational formulation in Sobolev spaces, discretization by FE, approximation of the boundary, numerical integration, assembling the stiffness matrix and solving the resulting system of linear algebraic equations; it also presents several methods for increasing the accuracy of the FE-solution. The second half of the book is concerned with the FE-approximation of time-dependent problems, contact problems in linear elasticity, Maxwell's and Helmholtz's equations, eigenvalue and bifurcation problems. Special emphasis is given to solving nonlinear problems with monotone operators. Numerical examples are given.

Elementary Theory of Numbers. By William J. LeVeque. Dover Publications, 1990. 144 pages, \$4.95.

This is an unabridged, slightly corrected republication of the work originally published by Addison-Wesley Publishing Company in 1962. It introduces number theory to readers with only a sound background in high-school mathematics. It is filled with simple problems to stimulate the readers' interest and challenge their abilities.

Continued from page 242

Introduction to Topology. Third Edition. By Bert Mendelson. Dover Publications, 1990. 224 pages, \$5.95.

This is an unabridged, unaltered republication of the work originally published by Allyn and Bacon, Inc., in 1975 (first edition 1962, second edition 1968). Originally prepared from lecture notes used at Smith College, it is directed to undergraduate students who have had a calculus sequence in which some attention has been paid to definitions and proofs of theorems.

Functional Analysis. By Frigyes Riesz and Béla Sz.-Nagy. Dover Publications, 1990. 480 pages, \$11.95.

This translation, by Leo F. Boron, of the second French edition, is an unabridged republication of the work first published by Frederick Ungar Publishing Co. in 1955. The first French edition is from 1952. The appendix, separately published by Ungar in 1960, has been added to this edition. The book developed from courses the authors had taught for several years at the Universities of Szeged and Budapest. It is in two parts: I. Modern theories of differentiation and integration (Chapters 1–3); II. Integral equations and linear transformations (Chapters 4–11). Chapter headings: 1. Differentiation; 2. The Lebesgue integral; 3. The Stieltjes integral and its generalizations; 4. Integral equations; 5. Hilbert and Banach spaces; 6. Completely continuous symmetric transformations of Hilbert space; 7. Bounded symmetric, unitary, and normal transformations of Hilbert space; 8. Unbounded linear transformations of Hilbert space; 9. Self-adjoint transformations. Functional calculus, spectrum, perturbations; 10. Groups and semigroups of transformations; 11. Spectral theories for linear transformations of general type. Appendix: *Extensions of linear transformations in Hilbert space which extend beyond this space.*

Modern Algebra. By Seth Warner. Dover Publications, 1990. 832 pages, \$16.95.

This is an unabridged, corrected republication in one volume of the work originally published in two volumes by Prentice-Hall, Inc., in 1965. It is written for junior and senior undergraduates, and suitable for graduate students unprepared in modern algebra. It opens with a study of algebraic structures in general. The first part then carries the development from natural numbers through rings and fields, vector spaces, and polynomials. The second part (originally published as a separate volume) is made up of five chapters on the real and complex number fields, linear operators, inner product spaces, and the axiom of choice. There are over 1300 exercises.

Aspects of Risk Theory. By Jan Grandell. Springer-Verlag, 1991. x+175 pages, \$39.00.

This is a volume in the Springer Series in Statistics—Probability and Its Applications. It is a monograph on certain aspects of risk theory and not a comprehensive textbook (quoting Gerber's text as a prerequisite). It summarizes the classical risk model (Poisson claim times, claim amounts i.i.d., claim times and amounts independent, rate of premium income constant), and discusses the generalization where the claim occurrences are not necessarily Poisson but described by a more general point process. It is addressed to actuaries and probabilists. Chapter headings: 1. The classical risk model; 2. Generalizations of the classical risk model; 3. Renewal models; 4. Cox models; 5. Stationary models. There is an appendix on finite time ruin probabilities, and surveys are inserted in the text on the following subjects: basic martingale theory, weak convergence, point processes and martingales, point processes and random measures, basic Markov process theory, stationary point processes.

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Generalized Multivariate Analysis. By Fang Kai-Tai and Zhang Yao-Ting. Science Press, Beijing, and Springer-Verlag, 1990. xi+220 pages, \$59.00.

This monograph develops a theory and methodology for multivariate analysis based on the elliptically contoured distributions, parallel to that for the multivariate normal distribution, a subject which has become known as generalized multivariate analysis. The mathematical tools are the same as those used in classical multivariate analysis, so that this text can be used as an introduction to both. Chapter headings: 1. Some matrix theory and invariance; 2. Elliptically contoured distributions; 3. Spherical matrix distributions; 4. Estimation of parameters; 5. Testing of hypotheses; 6. Linear models.

Linear Models for Multivariate, Time Series, and Spatial Data. By Ronald Christensen. Springer-Verlag, 1991. xii+317 pages.

This is a volume in the series Springer Texts in Statistics. It is a companion volume to the author's *Plane Answers to Complex Questions: The Theory of Linear Models* (Springer-Verlag, 1987). It is its purpose to develop a unified approach, in terms of linear models, to the analysis of multivariate, time-series and spatial data. Chapter headings: 1. Multivariate linear models; 2. Discrimination and allocation; 3. Principal components and factor analysis; 4. Frequency analysis of time series; 5. Time domain analysis; 6. Linear models for spatial data: kriging.

Log-Linear Models. By Ronald Christensen. Springer-Verlag, 1990. xi+408 pages, \$49.00.

This is a volume in the series Springer Texts in Statistics, and examines log-linear models for contingency tables. Logistic regression and logistic discrimination are treated as special cases and generalized linear models (in the sense of GLIM) are also discussed. The primary theme of the book is using previous knowledge of ANOVA and regression to motivate and explicate the use of log-linear models. Chapter headings: 1. Introduction; 2. Two-dimensional tables; 3. Three-dimensional tables; 4. Higher-dimensional tables; 5. Models for factors with quantitative levels; 6. The matrix approach to log-linear models; 7. Response factors and logistic discrimination; 8. The matrix approach to logit models; 9. Fixed and random zeros; 10. Generalized linear models; 11. Maximum likelihood theory for log-linear models.

Nonlinear Estimation. By Gavin J. S. Ross. Springer-Verlag, 1990. viii+189 pages, \$39.00.

This is a volume in the Springer Series in Statistics. The author, a member of the staff of the Rothamsted Experimental Station, describes research based on computing experience arising from the development of the Maximum Likelihood Program for fitting nonlinear models to data. The models discussed are mainly curves, surfaces, frequency distributions, discrete probability models, with appropriate assumptions about error distributions. The unifying framework is maximum likelihood theory. Chapter headings: 1. Models, parameters, and estimation; 2. Transformation of parameters; 3. Inference and stable transformations; 4. The geometry of nonlinear inference; 5. Computing methods for nonlinear modeling; 6. Practical applications of nonlinear modeling; 7. A program for fitting nonlinear models (MLP).

Continued from page 288

Non-Standard Rank Tests. By Arnold Janssen and David M. Mason. Springer-Verlag, 1990. 252 pages, \$34.00.

This monograph is volume 65 of the series Lecture Notes in Statistics. It develops a methodology to construct rank tests for models where the standard regularity assumptions do not hold and studies their asymptotic properties. Chapter headings: 1. Locally most powerful rank tests—finite sample results; 2. Asymptotic results for locally most powerful rank tests; 3. Asymptotic results for rank tests under alternatives; 4. Tests based on minimum ranks; 5. Parametric results for almost regular models; 6. Semiparametric models and Monte Carlo results.

The Econometric Analysis of Transition Data. By Tony Lancaster. Cambridge University Press, 1990. ix+352 pages, \$49.50.

This is volume 17 in the series Econometric Society Monographs. It is its aim to exposit in a systematic way the field, now about a decade old, known as the econometric analysis of the duration of events. It treats the analysis of the duration of single events, and also transition data—the case where one observes both the duration of an event and the destination entered at its end. The primary focus is on models for *single-spell data* (called *survival data* in biostatistics), events in which individual agents are observed for a single duration, but some attention is also given to *multiple-spell* or *multiple-destination* data; these arise in situations in which one observes both the duration of stay in a state, or sequence of states, and the states to which exit took place—for example, spells of employment, unemployment and nonparticipation in the labour market. The first part of the book covers model specification, including both structural and reduced form models and models with and without neglected heterogeneity. The two fundamental tools, the hazard function and the exponential distribution, are examined, as well as the distribution of the observable data when the model includes regressor variables, including time-varying regressors. In the second part (Chapters 7–11) the book deals with likelihood-based inference about such models, with sections on full and semiparametric specification, including the important problem of ascertaining whether the unknown parameters and functions are identifiable from a particular class of data. A final section treats graphical and numerical methods of specification testing. Although the book is addressed principally to econometricians with examples largely chosen from that field, it will be of great interest, also, to statisticians, biometricians and sociologists who have to analyse transition, duration and survival data. This is so particularly since the monograph contains many results available only in the recent journal literature, many due to the author and his collaborators. The scope of the work is apparent from the table of contents: Part I. Model Building; 1. Some basic results; 2. Covariates and the hazard function; 3. Parametric families of duration distributions; 4. Mixture models; 5. Some important processes; 6. Some structural transition models; Part II. Inference; 7. Identifiability issues; 8. Fully parametric inference; 9. Limited information inference; 10. Misspecification analysis; 11. Residual analysis. There are two appendices, on the Gamma function and distribution, and on the Laplace transform, and a bibliography of some 270 items.

Stochastic Finite Elements: A Spectral Approach. By Roger G. Ghanem and Pol D. Spanos. Springer-Verlag, 1991. x+214 pages, \$49.50.

This monograph considers engineering systems with random parameters, which are modeled as second order stochastic processes defined by their mean and covariance functions. The Karhunen-Loève expansion is used to represent these processes in terms of a countable set of uncorrelated random variables, the problem thus being cast in a finite dimensional setting and leading to an explicit expression for the response process as a multivariate polynomial functional of a set of uncorrelated random variables. Chapter headings: 1. Introduction; 2. Representation of stochastic processes; 3. Stochastic finite element method: Response representation; 4. Stochastic finite elements: Response statistics; 5. Numerical examples.

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Continuous Martingales and Brownian Motion. By Daniel Revuz and Marc Yor. Springer-Verlag, 1991. ix+533 pages, \$89.00.

This is volume 293 of the series *Grundlehren der mathematischen Wissenschaften—A Series of Comprehensive Studies in Mathematics*. It focuses on the probabilistic theory of Brownian motion. It is introduced in the first chapter, and each of the following chapters is devoted to a new technique or notion and to some of its applications to Brownian motion. Among these techniques the most important are stochastic calculus and the powerful extension theory. Instead of working towards abstract generality, the authors study precisely some important examples and carry through the computations of the laws of various functionals or random variables. The later chapters of the book are addressed to the advanced reader. At the end of each section there is a large selection of exercises, of various degrees of difficulty, which are indicated by single or double asterisks. The text is practically self-contained except for a few results on measure theory and the basic notions of integration and probability theory. Chapter headings: 0. Preliminaries; 1. Introduction; 2. Martingales; 3. Markov processes; 4. Stochastic integration; 5. Representation of martingales; 6. Local times; 7. Generators and time reversal; 8. Girsanov's theorem and first applications; 9. Stochastic differential equations; 10. Additive functionals of Brownian motion; 11. Bessel processes and Ray-Knight theorems; 12. Excursions; 13. Limit theorems in distribution.

Plant and Crop Modelling: A Mathematical Approach to Plant and Crop Physiology. By John H. M. Thornley and Ian R. Johnson. Oxford University Press, 1990. xv+669 pages.

The authors' aim in this book is to show plant scientists how to express their physiological ideas mathematically, and how to deduce the appropriate quantitative conclusions, which can then be compared with experiments. The book is designed for possible self-study; it is suitable for research and advisory workers, graduates, and students in the plant sciences who are interested in quantitative methods. The material in Part I is of general relevance to biological modelling, not only to the area of plant and crop physiology, which is the main thrust of the book. The scope of the book is best revealed by the list of contents: Part I, General Topics. 1. Dynamic modelling; 2. Some subjects of general importance; 3. Plant growth functions; 4. Transport processes; 5. Temperature effects on plant and crop processes; 6. Biological switches; 7. Development; Part II. 8. Light relations in canopies; 9. Leaf photosynthesis; 10. Canopy photosynthesis; 11. Whole-plant respiration and growth energetics; 12. Biochemical and chemical approaches to plant growth; 13. Partitioning during vegetative growth; 14. Transpiration by a crop canopy; 15. Crop water relations; 16. Crop responses; 17. Root growth; Part III. 18. Branching; 19. Phyllotaxis.

Entropy and Information Theory. By Robert M. Gray. Springer-Verlag, 1990. xxiii+332 pages.

This monograph is devoted to the theory of probabilistic information measures and their application to coding theorems for information sources and noisy channels. The eventual goal is a general development of Shannon's mathematical theory of communication, but much of the space is devoted to the tools and methods required to prove the Shannon coding theorems. These tools form an area common to ergodic theory and information theory and comprise several quantitative notions of the information in random variables, random processes, and dynamical systems. The book is especially concerned with the long term asymptotic behaviour of sample information and expected information. Chapter headings: 1. Information sources; 2. Entropy and information; 3. The entropy ergodic theorem; 4. Information rates I; 5. Relative entropy; 6. Entropy rates II; 7. Relative entropy rates; 8. Ergodic theorem for densities; 9. Channels and codes; 10. Distortion; 11. Source coding theorems; 12. Coding for noisy channels.

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Rank Correlation Methods, Fifth edition. By Sir Maurice Kendall and Jean Dickinson Gibbons. Oxford University Press, 1990. vii+260 pages, \$49.95.

This revision of Kendall's classic book, first published in 1948, has retained his original material as well as his style of writing. The primary change in this edition is an attempt to update the references by expanding the notes and reference sections at the end of each chapter. Chapter headings: 1. The measurement of rank correlation; 2. Introduction to the general theory of rank correlation; 3. Tied ranks; 4. and 5. Tests of significance; 6. and 7. The problem of m ranking; 8. Partial rank correlation; 9. and 10. Ranks and variate values; 11. and 12. Paired comparisons; 13. Some further applications.

The Geometry of Four-Manifolds. By S. K. Donaldson and P. B. Kronheimer. Oxford University Press, 1990. vi+440 pages, \$75.00.

This is a volume in the series Oxford Mathematical Monographs. It has two aims. The primary aim is to give a self-contained and comprehensive treatment of the applications of Yang-Mills theory to the study of 4-manifolds. The second aim is to bring together some of the developments in Yang-Mills theory itself, placed in the framework of contemporary differential and algebraic geometry, since, leaving aside the topological applications, ideas from Yang-Mills theory have played a large part in fixing the direction of modern research in geometry. The authors have tried to present some of these ideas at a level which bridges the gap between general text books and research papers. Chapter headings: 1. Four-manifolds; 2. Connections; 3. The Fourier transform and Atiyah-Drinfeld-Hitchin-Manin (ADHM) constructions; 4. Yang-Mills moduli spaces; 5. Topology and connections; 6. Stable holomorphic bundles over Kaehler surfaces; 7. Excision and gluing; 8. Non-existence results; 9. Invariants of smooth four-manifolds; 10. The differential topology of algebraic surfaces.

Hamiltonian Systems: Chaos and Quantization. By Alfredo M. Ozorio de Almeida. Cambridge University Press, 1990. ix+238 pages, \$24.95.

This is a volume in the Cambridge Monographs on Mathematical Physics. The author has aimed to provide a concise introduction to the basic concepts of the field in unsophisticated mathematical language. Most of the classical theory in the first six chapters (Part I) deals with local motion. Periodic orbits, the fixed points of a Poincaré map, provide the unifying theme. Part II (Chapters 7-9) is devoted to the semiclassical limit of quantum mechanics. Chapter headings: 1. Linear dynamical systems; 2. Nonlinear systems; 3. Chaotic motion; 4. Normal forms; 5. Maps on the circle; 6. Integrable and quasi-integrable systems; 7. Torus quantization; 8. Quantization of ergodic systems; 9. Periodic orbits in quantum mechanics.

Matrices and Linear Transformations, Second Edition. By Charles G. Cullen. Dover Publications, 1990. 336 pages, \$7.95.

This is an unabridged, corrected republication of the second edition (1972) of the work originally published in 1966 by Addison-Wesley Publishing Company. It is directed to sophomore/junior undergraduates in mathematics, engineering and the physical sciences. The major objects of study are matrices over an arbitrary field. Among the key features are coverage of spectral decomposition, the Jordan canonical form, the solution of the matrix equation $AX = XB$, and over 375 problems, many with answers.

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Non-linear Time Series: A Dynamical Systems Approach. By Howell Tong. Oxford University Press, 1990. xvi+563 pages, \$110.00.

This is volume 6 in the Oxford Statistical Science Series. It represents a comprehensive account of the subject, covering the fundamentals of probability theory, statistical inference, model building, and prediction of non-linear time series, emphasizing whenever possible links with dynamical systems. The author aims to keep the level of mathematics as modest as possible. He includes real data sets from animal populations, solar activities, economics, finance, medical sciences, hydrology, environmental sciences, and others. A user-friendly package is available which implements a fair proportion of the modelling and forecasting techniques described in the book. Chapter headings: 1. Introduction; 2. An introduction to dynamical systems; 3. Some non-linear time series models; 4. Probability structure; 5. Statistical aspects; 6. Non-linear least-squares prediction based on non-linear models; 7. Case studies.

Time Series, Third edition, By Sir Maurice Kendall and J. Keith Ord. Oxford University Press, 1990. x+296 pages.

This well-known work was first published in 1973, and a second edition in 1976. This third edition is quite distinct from its predecessors, except for the classical elements retained in the opening chapters. Its role as a companion volume to *Kendall's Advanced Theory of Statistics* is, however, preserved, and cross-references are given where necessary. The central part of the book develops univariate models in the time domain and includes an extensive discussion of forecasting. The chapter on the frequency domain has been extended and updated. Chapter headings: 1. General ideas; 2. Test of randomness; 3. Trend; 4. Seasonality; 5. Stationary series; 6. Serial correlations and model identification; 7. Estimation and model checking; 8. Forecasting; 9. State-space models; 10. Spectrum analysis; 11. Transfer functions: models and identification; 12. Transfer functions: estimation, diagnostics and forecasting; 13. Intervention analysis and structural modelling; 14. Multivariate series; 15. Other recent developments.

Introduction to Complex Analysis, Revised edition. By H. A. Priestly. Oxford University Press, 1990. xi+214 pages, \$24.00.

This is a volume in the series Oxford Science Publications, first published in 1985. The major change in this edition is in the exercises, many new ones having been added, some to introduce new topics.

Introduction to Statistics: The Nonparametric Way. By Gottfried E. Noether, with the assistance of Marilyn Dueker. Springer-Verlag, 1991. xii+414 pages, \$49.50.

This is a volume in the series Springer Texts in Statistics. It is the successor to the author's 1976 text *Introduction to Statistics: A Nonparametric Approach*. Early on, estimation and hypothesis testing are discussed in terms of the two-sample problem, exploiting nonparametric ideas to define the Wilcoxon-Mann-Whitney test statistics and the related point and interval estimates. These ideas are then applied to the one-sample problem and to linear regression and rank correlation, followed by a discussion of the Kruskal-Wallis and Friedman procedures for the k -sample problem. The concluding chapters provide a discussion of chi-square tests for the analysis of categorical data and an introduction to the analysis of binomial data, including the computation of power and sample size.

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Two-Sided Matching: A Study in Game-theoretic Modeling and Analysis. By Alvin E. Roth and Marilda A. Oliviera Sotomayor. Cambridge University Press, 1990. x+265 pages, \$54.50.

This is a volume in the series Econometric Society Monographs. It provides a comprehensive account of recent results concerning the game-theoretic analysis of two-sided matching such as between firms and workers in labour markets, and between buyers and sellers in auctions. The book begins with a discussion of empirical results concerning behaviour in such markets and then proceeds to analyze a variety of related models. Among the discrete and continuous models considered are those with complete or incomplete information, money or barter, single or multiple workers, and simple to complex preferences. The book examines the stability of outcomes, the modification of incentives to agents under different organizational rules, and the constraints imposed on market organization by the incentives, leading to clarifications whose conclusions are robust and which depend on particular modeling assumptions. Seven chapters of the book are, in addition to an introductory chapter and an epilogue, divided into 3 parts: 1. One-to-one matching: the marriage model; 2. Many-to-one matching: models in which firms may employ many workers; 3. Models of one-to-one matching with money as a continuous variable.

A World Ruled by Number—William Stanley Jevons and the Rise of Mathematical Economics. By Margaret Schabas. Princeton University Press, 1990. xii+192 pages, \$29.95.

In this monograph, the author demonstrates that the advent of mathematical economics in late Victorian England resulted more from new currents in logic and the philosophy of science than from problems specific to the classical theory of value and distribution. She shows that Jevons's *Principles of Science* (1874) was the first book to take issue with John Stuart Mill's faith in inductive reasoning, to assimilate George Boole's mathematical logic, and to discern many of the limitations that beset scientific inquiry, and she demonstrates that together with a renewed appreciation of Bentham's utility calculus, these philosophical insights served to convince Jevons and his followers that the economic world is fundamentally quantitative and thus amenable to mathematical analysis. There are eight chapters: 1. Mathematical pursuits; 2. Jevon's life; 3. The mathematical theory of economics; 4. Logic and scientific method; 5. Markets and mechanics; 6. Response to the *Theory*; 7. Mathematical economics takes hold; 8. Mathematical hegemony.

Finsler Geometry and Applications. By Aurel Bejancu. Ellis Horwood Limited, 1990. 198 pages, \$59.50.

This is a volume in the Ellis Horwood Series in Mathematics and Its Applications. It is a translation from the Romanian, edited by David E. Blair. The study of spaces endowed with generalized metrics was initiated by P. Finsler in 1918, and since then many important results have been achieved with respect to both the differential geometry of Finsler spaces and its application to variational problems, theoretical physics and engineering. The present book has a twofold purpose: to show that Finsler geometry is in fact mainly based on the geometry of the vertical vector bundle and to explain some of its applications to physics and continuum mechanics. Chapter headings: 1. Finsler geometry on the tangent bundle of a manifold; 2. Submanifolds of Riemann–Finsler manifolds; 3. Gauge theory on the tangent bundle; 4. Gauge theory on a fibre bundle; 5. Multi-dimensional physical theories as gauge theories on a fibre bundle; 6. A new geometrical framework for a multi-dimensional relativity theory; 7. Differential geometry of a supermanifold as a Finsler geometry; 8. Finsler geometry and deformation of oriented media.

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Mathematical Methods in Kinetic Theory, Second Edition. By Carlo Cercignani. Plenum Press, 1990. xi+252 pages, \$39.50.

This is a revised edition of the book first published in 1969. Literature has been updated and an introduction is also given to the important developments concerning the purely mathematical theory (existence and uniqueness theorems), since this part of kinetic theory has reached a mature stage in the last few years and is relevant for both the physical foundations of the subject (validity of the Boltzmann equations) and the application of kinetic theory to rarefied gas dynamics. The headings of the eight chapters are: 1. Basic principles; 2. Basic properties; 3. The linearized collision operator; 4. Model equations; 5. The Hilbert and Chapman-Enskog theories; 6. Basic results on the solutions of the Boltzmann equation; 7. Analytic methods of solution; 8. Other methods of solution.

Combinatorial Algorithms for Integrated Circuit Layout. By Thomas Lengauer. B. G. Teubner, Stuttgart, and John Wiley and Sons, 1990. xxviii+697 pages.

This is a volume in the series *Applicable Theory in Computer Science*. The two difficult aspects of building a layout system are the combinatorial aspect and the systems aspect. This book deals only with the former, which labors under the difficulty that most of the optimization problems that have to be solved during integrated-circuit layout are intractable since they are usually NP-hard or harder. The purpose of this book is to give an overview of these problems and to describe their solutions. The author discusses algorithms used in layout systems today, as well as new algorithmic developments that as of now only exist as theoretical proposals but that bear some promise of stimulating the improvement of layout systems in the future.

Lectures in Applied Mathematics and Informatics. Edited by Luigi M. Ricciardi. Manchester University Press (distributed in the USA and Canada by St. Martin's Press), 1990. xi+362 pages, \$120.00.

These are the texts of some of the lecture courses given in connection with a new doctoral program in applied mathematics and informatics at the University of Naples. It contains the following lectures: 1. Analysis of algorithms, by Paul Cull; 2. Rational and recognizable languages, by Jean Enric Pin; 3. On generalized entropies with applications, by Inder Jeet Taneja; 4. On the spatial distribution of dispersing animals, by Nanako Shigesada; 5. Diffusion processes and first-passage-time problems, by Luigi M. Ricciardi and Shunsuke Sato; 6. Functionals of Brownian motion, by Takeyuki Hida; 7. Random semicontinuous functions, by Gabriella Salinetti and Roger J.-B. Wetts.

Functional Analysis, Optimization and Mathematical Economics. A Collection of Papers Dedicated to the Memory of Leonid Vital'evich Kantorovich, with a foreword by Wassily Leontief. Edited by Lev J. Leifman. Oxford University Press, 1990. xiv+341 pages.

This is a memorial volume to Kantorovich, the great mathematician who won a Nobel Memorial Prize in Economics and died in 1986, and also to the editor, who died in 1989 whilst completing work on this volume. Each of the 21 papers falls into one of the following four categories, although there is no sharp division into sections: 1. L. V. Kantorovich and his work; 2. Functional analysis; 3. Optimization; 4. Mathematical economics. The contributors are all former colleagues of Kantorovich whose roster spreads through three generations in time and around the globe in space; fifteen of the twenty-six authors are from the USSR.