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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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The Mathematical Theory of Quantitative Genetics. By M. G. Bulmer. Clarendon Press, Oxford, 1985. pp. x + 255.

This is a volume in the series Oxford Science Publications. The purpose of this book is to develop a logical account of the underlying theory of quantitative genetics. This theory provides the bridge between the observable statistical properties of the character and genetic factors which, together with environmental factors, are postulated to determine the expression of the character. The structure of the book is as follows: a brief account of classical, Mendelian genetics and of the pioneer experiments in quantitative genetics (Chapter 1); statistical description of the role of genotype and environment and their interaction in determining the observed phenotypic value of a character (Chapter 2); derivation of the statistical model for decomposing the genotype value into components representing different types of gene action (Chapters 3 and 4); estimation of the components of variance and similar quantities generated by this model from biometric analysis of different types of experiments and observations in inbreeding and outbreeding populations (Chapters 5–7); the role of the normal distribution in quantitative genetics (Chapter 8); the effect of selection on a quantitative character, and the applications of selection theory in animal and plant breeding and in evolutionary theory (Chapters 9–11); stochastic effects due to finite population size (Chapter 12).

Proceedings Seminar 1983–1985: Mathematical Structures in Field Theories, Vol. 2. By M. J. Bergvelt, G. M. Tuynman, and A. P. E. ten Kroode. Centrum voor Wiskunde en Informatica–Centre for Mathematics and Computer Science, Amsterdam, 1987. pp. iii + 206.

This is volume 13 in the series CWI Syllabus. There are three lectures: 1. An introduction to classical mechanics and symplectic geometry, by G. M. Tuynmann. 2. The Hamiltonian structure of Yang–Mills theories, by M. J. Bergvelt. 3. Geometrical description of the Toda lattice, by A. P. E. ten Kroode.

Proceedings of the First International Conference on Industrial and Applied Mathematics (ICIAM 87). Edited by A. H. P. van der Burgh and R. M. M. Mattheij. Stitching Mathematisch Centrum, Amsterdam, 1987. pp. 1 + 433.

This is volume 36 of the series CWI Tract. It contains the contributions to the conference from the Netherlands, arranged under seven headings: 1. Applied mathematical analysis. 2. Scientific computing. 3. Control theory and signal processing. 4. Computational geometry. 5. Applied probability and statistics. 6. Mathematics of the natural sciences. 7. Software and hardware aspects.

Hamilton's Principle in Continuum Mechanics. By A. Bedford. Pitman Advanced Publishing Program and John Wiley & Sons, Boston, 1985. pp. 1 + 106. £12.50.

This is volume 139 of Research Notes in Mathematics. The objective of this monograph is to give a comprehensive account of the use of Hamilton's principle to derive the equations which govern the mechanical behavior of continuous media. The classical theories of fluid and solid mechanics are discussed as well as two generalizations of those theories for which Hamilton's principle is particularly suited—materials with microstructure and mixtures. The application of Hamilton's principle to systems of particles is discussed briefly in Chapter 1. Chapter 2 provides a brief survey of the mathematics and elements of continuum mechanics that are required in the following chapters. Applications of Hamilton's principle to a continuous medium are described in Chapter 3. Ideal fluids, elastic solids, the general case of a continuum which does not exhibit microstructure effects, and two particular theories of materials with microstructure are treated. As another example of the use of Hamilton's principle to develop generalized continuum theories, applications to mixtures are described in Chapter 4. In Chapter 5, a discussion is given of the application of Hamilton's principle to a continuous medium containing a surface across which the fields which characterize the medium, or their derivates, suffer jump discontinuities. The results presented in this monograph are expressed in a modern framework.

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Distribution Theorems of L-Functions. By David Joyner. Longman Scientific & Technical, and John Wiley & Sons, New York, 1986. pp. 1 + 247. $44.95.

This is volume 142 in the Pitman Research Notes in Mathematics Series. Chapter headings: 1. Examples of some L-functions and density theorems. 2. Distribution theorems for $\zeta(s)$. 3. The horizontal and vertical distribution of zeta zeros with applications to prime numbers. 4. Selberg's moment method–basic elements. 5. Distribution theorems for the values of L-functions: off the critical line. 6. Distribution theorems for the values of L-functions: on the critical line. 7. Prime number theorems for automorphic l-adic motives.

Numerical Modeling in Science and Engineering. By Myron B. Allen III, Ismael Herrera, and George F. Pinter. John Wiley & Sons, New York, 1988. pp. x + 418. $39.95.

This text aims to mold three aspects of modeling—continuum mechanics, differential equations and numerical analysis—into a unified treatment. Chapter headings: 1. Basic equations of macroscopic systems. 2. Introduction to numerical methods. 3. Steady-state systems. 4. Dissipative systems. 5. Nondissipative systems. 6. High-order, nonlinear, and coupled systems.

Buildings and the Geometry of Diagrams. Edited by L. A. Rosati. Springer-Verlag, New York, 1986. pp. vi + 277.

This is volume 1181 of Lecture Notes in Mathematics. It represents the proceedings of the 3rd 1984 Session of the Centro Internazionale Matematico Estiro held in Como. The aim of the session was to describe some of the principal aspects of a field of geometry which is worthy of consideration both for its intrinsic interest, and for its applications to the theory of groups.

Computability and Logic. By Daniel E. Cohen. John Wiley & Sons, New York, 1987. pp. 1 + 243. $64.95.

This is a volume in the Ellis Horwood Series Mathematics and Its Applications. It is a text dealing with the theory of computable functions—the pure mathematics of computer science—written by a pure mathematician and intended for mathematicians and computer scientists. The 14 chapters are divided into two parts: I. Computability (Chapters 1–10); II. Logic (Chapters 11–14). Chapter headings: 1. Epimenides, Gödel, Russell, and Cantor. 2. Informal theory of computable functions. 3. Primitive recursive functions. 4. Partial recursive functions. 5. Abacus machines. 6. Turing machines. 7. Modular machines. 8. Church's thesis and Gödel numberings. 9. Hilbert's tenth problem. 10. Indexings and the recursion theorem. 11. Propositional logic. 12. Predicate logic. 13. Undecidability and incompleteness. 14. The natural numbers under addition.

Recent Developments in Structured Continua. Edited by D. De Kee and P. N. Kaloni. Longman Scientific & Technical, and John Wiley & Sons, New York, 1986. pp. 1 + 283. $49.95.

This is volume 143 in the Pitman Research Notes in Mathematics Series. It contains the full texts of the invited lectures presented at a conference held at the University of Windsor, Ontario, May 29–31, 1985. The technical content of the eight papers is roughly divided into four broad categories: transport phenomena, polymer mechanics, flow properties of biological fluids, and structured fluid theories.

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Spinors and Space-Time, Volume 1: Two-Spinor Calculus and Relativistic Fields. By R. Penrose and W. Rindler. Cambridge University Press, New York, 1987. pp. x + 458. $29.95.

This is a volume in the Cambridge Monographs on Mathematical Physics. The authors develop the 2-spinor calculus in considerable detail, assuming no prior knowledge of the subject, and show how it may be viewed either as a useful supplement or as a practical alternative to the more familiar world-tensor calculus. They concentrate, here, entirely on 2-spinors, rather than the 4-spinors that have become more familiar tools for theoretical physicists. The reason for this is that only with 2-spinors does one obtain a practical alternative to the standard vector-tensor calculus, 2-spinors being the more primitive elements out of which 4-spinors (as well as world-tensors) can be readily built. Spinor calculus can be regarded as applying at a deeper level of structure of space-time than that described by the standard world-tensor calculus. By comparison, world-tensors are less refined, fail to make transparent some of the subtler properties of space-time brought particularly to light by quantum mechanics and make certain types of mathematical calculations inordinately heavy. Their strength lies in a general applicability to manifolds of arbitrary dimension, rather than in supplying a specific space-time calculus. Chapter headings: 1. The geometry of world-vectors and spin-vectors. 2. Abstract indices and spinor algebras. 3. Spinors and world-tensors. 4. Differentiation and curvature. 5. Fields in space-time.

Spinors and Space-Time, Volume 2: Spinor and Twistor Methods in Space-Time Geometry. By R. Penrose and W. Rindler. Cambridge University Press, New York, 1987. pp. ix + 501. $34.50.

This is a volume in the Cambridge Monographs on Mathematical Physics. It is a companion volume to the authors' introductory work *Spinors and Space-Time, Volume 1: Two-Spinor Calculus and Relativistic Fields.* There they attempted to demonstrate something of the power, utility and elegance of 2-spinor techniques in the study of space-time structure and physical fields, and to advocate the viewpoint that spinors may lie closer to the heart of (even macroscopic) physical laws than the vectors and tensors of the standard formalism. Here they carry these ideas further and discuss some important new areas of application. They introduce the theory of twistors and show how it sheds light on a number of important physical questions, one of the most noteworthy being the structure of energy-momentum/angular momentum of gravitating systems. They believe that the illumination that twistor theory brings to the discussion of such physical problems should lend further support to the viewpoint of an underlying spinorial structure in basic physical laws. Chapter headings of this volume: 6. Twistors. 7. Null congruences. 8. Classification of curvature tensors. 9. Conformal infinity.

Theory of Recursive Functions and Effective Computability. By Hartley Rogers, Jr. MIT Press, Cambridge, Mass., 1987. pp. xxi + 482.

This is a paperback edition of the classic first published in 1967.

System Identification: Theory for the User. By Lennart Ljung. Prentice-Hall, Inc., N.J., 1987. pp. xxi + 519.

This is a volume in the Prentice-Hall Information and System Science Series. The focus of the book is on theory that has direct consequences for the understanding and practical use of available techniques. The author's goal has been to give the reader a firm grip on basic principles so that he can confidently approach a practical problem.

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Mathematical Cryptology for Computer Scientists and Mathematicians. By Wayne Patterson. Rowman & Littlefield, Totowwa, N.J., 1987. pp. xxii + 312. $37.50.

The author's purpose in writing this book is twofold: first, to encourage the systematic study of cryptology, in either the context of computer science or of mathematics, by producing one reference book that both introduces and specializes on the topic; second, to provide a source for the discussion of contemporary results, essentially up to the beginning of 1986. In addition to information about the Data Encryption Standard, public-key cryptology and the RSA algorithm, he also provides details about more recent research results such as the Shamir, the Lagarias–Odlyzko, and the Brickell attacks on the Knapsack methods; the new Knapsack method using Galois fields by Chor and Rivest; and the recent analysis by Kaliski, Rivest, and Sherman of group-theoretic properties of the Data Encryption Standard.

Reflections on Kurt Gödel. By Hao Wang. The MIT Press, Cambridge, Mass., 1987. pp. xxvi + 336. $25.00.

The subject which the author, who was in close contact with Gödel in his last years, covers in this fascinating volume includes the completeness of elementary logic, the limits of formalization, the problem of evidence, the concept of set, the philosophy of mathematics, time and relativity theory, metaphysics and religion, as well as general ideas on philosophy as a world view. The book also provides a wealth of information on and interpretation of the two main phases of Gödel's career—the years between 1924 and 1939 at the University of Vienna, which were marked with intense mathematical creativity, and the period from 1940 to his death in 1978, during which he was affiliated with the Institute for Advanced Studies in Princeton, a time in which Gödel's interests steadily shifted from questions of logic to metaphysics. The author tells the dramatic story of how Gödel discovered his great theorems on the completeness and consistency of logical and mathematical axiomatic systems and explains the conceptual core and philosopnical significance of the 1930 proof of the completeness of elementary logic, the 1931 method of constructing—for any formalized axiom system—a question of number theory undecidable in that system, the 1931 proof that the consistency of any of the classical systems of mathematics cannot be proved within that same system, and 1938 and later work on consistency and independence of Cantor's continuum hypothesis and the axiom of choice. Chapter headings: 1. A life of fundamental theoretical work. 2. Some facts about Kurt Gödel. 3. A chronological account: Central Europe (1909–1939). 4. Account continued: the Princeton years (1940–1978). 5. Introductory observations. 6. Concepts in science and technology. 7. Gödel and philosophy. 8. Auseinandersetzungen. 9. To fit all the parts together. 10. Mathematical papers. 11. Philosophical papers.

Seminar in Stochastic Processes, 1986. Edited by E. Çinlar, K. L. Chung, and R. K. Getoor. Birkhäuser, Boston, 1987. pp. 1+215. $29.00.

This is volume 13 of Progress in Probability and Statistics. The seminar was held at the University of Virginia, Charlottesville. Some of the topics discussed are: Potential theory, Markov processes with random times of birth and death, Hausdorff measure of Brownian multiple points, Packing measure of planar Brownian motion, Schrödinger operator with both given sign values, and local non-determinism and Hausdorff dimension.

Unitary Representations of Reductive Lie Groups. By David A. Vogan, Jr. Princeton University Press, New Jersey, 1987. pp. x + 308. $60.00 hardcover, $19.95 paperback.

This is volume 118 of Annals of Mathematics Studies.

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A Course in Density Estimation. By Luc Devroye. Birkhäuser, Boston, 1987. pp. xix + 183. $28.00.

This is volume 14 of Progress in Probability and Statistics. This book studies the problem of estimating an unknown density from independent, identically distributed data points. Its goal is to develop a well-rounded theory of density estimation in L_1 while maintaining a level of exposition suitable for a first approach to this field. Classical topics, such as consistency, rate of convergence, and minimax theory, are covered together with more modern subjects such as robustness, minimum distance estimation, and relative stability. A case study on monotone density estimation as well as an in-depth look at the kernel estimate illustrate some finer problems in density estimation. Chapter headings: 1. Distances between densities. 2. Density estimation and derivation of measures. 3. Consistency of the kernel estimate. 4. Robustness. 5. Minimax bonus. 6. Minimum distance estimators. 7. Rate of convergence of kernel estimates. 8. A case study: Monotone densities on [0, 1]. 9. Relative stability.

Numerical Methods of Approximation Theory, Vol. 8. Edited by L. Collatz, G. Meinardus, and G. Nürnberger. Birkhäuser, Boston, 1987. pp. 1 + 261. $47.00.

This is volume 81 in the International Series of Numerical Mathematics. It is the proceedings of a workshop held at Oberwolfach, September 28–October 4, 1986. The topics covered range from classical approximation theory to modern applications in the natural and engineering sciences, and include investigations into questions of existence and uniqueness, error estimation, spline approximation, bivariate approximation, rational approximation, and data fitting, with applications to such fields as plasmaphysics, electro-chemical machines, maximally-integrated circuits, and radar technology. There are 21 lectures.

Finite Difference Methods on Irregular Networks. By Bernd Heinrich. Birkhäuser, Boston, 1987. pp. 1 + 206. $49.00.

This is volume 82 in the International Series of Numerical Mathematics. The monograph contains a systematic treatment of the finite-difference method on irregular networks for solving numerically elliptic boundary-value problems, where linear elliptic differential equations of second order in plane domains, various kinds of boundary conditions and curvilinear boundaries are taken into account. The main topics are: the construction of FD-Approximations on networks which consist of triangles (rectangles) and may be irregular in the whole domain; the proof of symmetry, definitions and monotonicity (maximum principles) of the difference operators; a priori and error estimates with "discrete norms" in Hilbert spaces; convergence results for solutions belonging to Sobolev spaces.

Computer Simulation of Liquids. By M. P. Allen and D. J. Tildesley. Oxford University Press, New York, 1988. pp. xix + 385. $95.00.

This is a volume in the series Oxford Science Publications. This is a book for people who want to use computers to simulate the behavior of atomic and molecular liquids. The authors hope that it will be useful to first-year graduate students, research workers in industry and academia, and to teachers and lecturers who want to use the computer to illustrate the way liquids behave. Chapters 1–6 gather together details, such as methods for improving the speed of the simulation program, and present a clear account of the techniques of Monte Carlo and molecular dynamics. Chapters 7–10 present advances merged into the new field of stochastic simulations and extended to cover quantum mechanical as well as classical systems. Chapter 11 contains a brief account of some interesting problems to which the methods have been applied. Chapter headings: 1. Introduction. 2. Statistical mathematics. 3. Molecular dynamics. 4. Monte Carlo methods. 5. Some tricks of the trade. 6. How to analyze the results. 7. Advanced simulation techniques. 8. Non-equilibrium molecular dynamics. 9. Brownian dynamics. 10. Quantum simulations. 11. Some applications.

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Stability and Perfection of Nash Equilibria. By Eric van Damme. Springer-Verlag, New York, 1987. pp. xvii + 318. $99.00.

Games are divided into two classes: cooperative games and noncooperative games. A noncooperative game is a game in which there are no possibilities for communication, correlation, or precommitment, except for those that are explicitly allowed by the rules. Hence, all relevant aspects should be captured by the rules of the game. A solution of such a game is a set of recommendations, which tell each player how to behave in every situation that may arise. This solution should be consistent, i.e., no player should have an incentive to deviate from his recommendation. Hence, a solution must be self-enforcing: As long as the others obey their recommendations, it should not be in any players' interest to deviate. This means that the solution should be a Nash equilibrium, i.e., a strategy combination with the property that no player can gain by unilaterally deviating from it. The book consists of four parts: Part 1 (Chap. 1) provides a general introduction. It is argued that a solution of a noncooperative game should be a Nash equilibrium but that not every Nash equilibrium is eligible for the solution. Part 2 (Chapters 2–5) deals with normal form games. A great many refined equilibrium concepts are introduced and relationships between these refinements are derived, as well as characterizations of several of them. A main result is that for normal form games there is little need to refine Nash's concept since generically all Nash equilibria satisfy all properties one could hope for. Part 3 (Chap. 6) provides an introduction to extensive form games. The main result is that a proper equilibrium of the normal form induces a sequential equilibrium in the extensive form. Part 4 (Chapters 7–10) is devoted to specific applications, illustrating the strength and weakness of the various concepts. Chapter headings: 1. Introduction. 2. Games in normal form. 3. Matrix and bimatrix games. 4. Control costs. 5. Incomplete information. 6. Extensive form games. 7. Bargaining and fair division. 8. Repeated games. 9. Evolutionary game theory. 10. Strategic stability and applications.

An Introduction to Signal Detection and Estimation. By H. Vincent Poor. Springer-Verlag, New York, 1988. pp. x + 549. $58.00.

This is a volume in the series Springer Texts in Electrical Engineering. It is its purpose to introduce the reader to the basic theory of signal detection and estimation. A working knowledge of applied probability and random processes is assumed, and more advanced concepts are introduced as needed, primarily in the last two chapters which treat continuous-time problems. Chapter headings: 1. Introduction. 2. Elements of hypothesis testing. 3. Signal detection in discrete time. 4. Elements of parameter estimation. 5. Elements of signal estimation. 6. Signal detection in continuous time. 7. Signal estimation in continuous time.

Structured Hereditary Systems. By James A. Reneke, Robert E. Fennell, and Roland B. Milton. Marcel Dekker, New York, 1987. pp. viii + 217. $39.75.

This is volume 107 in the series Pure and Applied Mathematics. Within a Hilbert space setting, the authors present methods for analysis and control of linear hereditary systems. Such systems arise naturally in the description of biological, physical, and mechanical processes. Viewing system variables as time varying functions leads to two equivalent operator descriptions of linear hereditary systems. Operators from one class provide an input/output description while operators from other classes provide a local description of the system dynamics. Restrictions placed upon the underlying function spaces allow the authors to describe hereditary systems by operator equations defined on a reproducing kernel Hilbert space. The structure of such spaces facilitates the description of systems concepts and the solution of optimization and approximation problems. The approach is based upon integral equations rather than differential equations and does not require state space descriptions of system dynamics. This approach may be contrasted with semigroup or abstract evolution equation descriptions. Chapter headings: 1. Introduction to structured systems. 2. Optimal control. 3. Operator approximation and related problems. 4. Optimal control of stochastic hereditary systems. 5. Large scale systems.

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Transforms for Engineers: A Guide to Signal Processing. Oxford University Press, New York, 1987. pp. xv + 269. $75.00.

This is a volume in the Oxford Science Publications. It aims to provide a guide to signal-processsing methods used in a wide variety of applications and to introduce readers to the range and use of the many alternative fast orthogonal-transform algorithms now becoming available. Chapters 1 and 2 provide the basic essentials of digital signal processing methods including a brief survey of the processes of signal representation, data acquisition, filtering, correlation, and spectral analysis. A range of orthogonal transformations is discussed and an introduction given to two-dimensional transformations. Before fast transformation is considered an introductory mathematics tutorial is given in Chapter 3, which aims to equip the reader with the essential tools of linear mathematics and matrix algebra needed to follow recent developments in discrete transform theory and application. Characteristics of a range of sinusoidal (Fourier) and nonsinusoidal (Walsh and other) fast transformations are given in Chapters 4 and 5, which consider methods and suitability for a variety of signal-processing tasks. Chapter 6 is intended to indicate the hardware choices available for transformation and to show where they may be usefully employed. Particular interest is centered on VLSI methods and the programmable signal processor. The remaining Chapters 7 to 10 are application reviews of a number of signal-processing areas where transformation methods are dominant. These include speech processing, communications, sonar, seismology, radar, biomedicine, and image processing. The emphasis here is on description and selection of methods and includes brief mention of some of the alternative statistical and regression methods with which the transform techniques may be compared.

The Numerical Solution of Nonlinear Stiff Initial Value Problems: An Analysis of One Step Methods. By W. H. Hundsdorfer. Mathematisch Centrum, Amsterdam, 1985. pp. 1 + 138. Dfl. 20.30.

This is volume 12 of the series CWI Tract. The subject of this monograph is the numerical solution of initial value problems for systems of ordinary differential equations. Chapter headings: 1. Introduction. 2. Preliminaries. 3. Runge-Kutta methods and generalizations. 4. The existence of unique solutions to the algebraic equations in implicit and semi-implicit methods. 5. Contractivity and error propagation per step. 6. B-Convergence for several B-methods.

Mixed Elliptic-Hyperbolic Partial Differential Operators: A Case-Study in Fourier Integral Operators. By R. J. P. Groothuizen. Mathematisch Centrum, Amsterdam, 1985. pp. iii + 147.

This is volume 16 of the series CWI Tract. In it, the author tests the utility of Fourier integral operators for the study of the Tricomi operator and a generalization of it.

Introduction to Supersymmetry. By Peter G. O. Freund. Cambridge University Press, New York, 1988. pp. x + 152. $14.95.

This is a volume in the Cambridge Monographs on Mathematical Physics. It is designed as a brief introductory text, sacrificing completeness and rigor in order to achieve a freely flowing exposition of the basic ideas and techniques. The author has therefore aimed, first of all, at making the mathematics (superspace included) as simple and as clear as possible. On the other hand, the construction of supersymmetric action principles and the discussion of how many of the relevant ideas have deliberately been made in low space-dimensionalities where the formulae do not crowd out the concepts. Chapter headings: 1. Supersymmetry: the physical and mathematical foundations. 2. Globally supersymmetric theories. 3. Supergravities: locally supersymmetric theories. 4. Conclusion.

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Matrix Differential Calculus with Applications in Statistics and Econometrics. By Jan R. Magnus and Heinz Neudecker. John Wiley & Sons, New York, 1988. pp. xvii + 393. $51.95.

This is a volume in the Wiley Series in Probability and Mathematical Statistics. It provides a self-contained and unified treatment of matrix differential calculus, specifically written for econometricians and statisticians. The book falls into six parts. Part one deals with matrix algebra. It lists items like the Schur, Jordan and singular-value decompositions, concepts like the Hadamard and Kronecker products, the vec operator, the commutation and duplication matrices, the More–Penrose inverse, and results on bordered matrices (and their determinants) and (linearly restricted) quadratic forms. Part two, which forms the theoretical heart of the book, is entirely devoted to a thorough development of the theory of differentials. It presents the essentials of calculus but geared to the phrased in terms of differentials. A separate chapter gives the theory of (constrained) optimization in terms of differentials. Part three is the practical core of the book. It contains the rules for working with differentials, lists the differentials of important scalar, vector, and matrix functions and supplies "identification" tables for Jacobian and Hessian matrices. Part four (one chapter on inequalities) owes its existence to the author's feeling that econometricians should be conversant with inequalities like the Cauchy–Schwarz and Minkowski, but should also master a powerful result like Poincaré's separation theorem. Part five is entirely devoted to applications of matrix differential calculus to the linear regression model. Part six deals with maximum likelihood estimation. In the first of three chapters, several models are being analyzed, e.g., the multivariate normal distribution, the errors-in-variables model and the nonlinear regression model. Special attention is given to the information matrix. The second chapter in this part deals with simultaneous equations under normality conditions. It investigates both identification and estimation problems, subject to various (non)linear constraints on the parameters. The final chapter addresses itself to various psychometric problems, e.g., principal components, multimode component analysis, factor analysis, and canonical correlation.

Numerical Solution of Partial Differential Equations by the Finite Element Method. By Claes Johnson. Cambridge University Press, New York, 1987. pp. 1 + 278. $69.50 hardcover, $24.95 paperback.

The purpose of this book is to give an easily accessible introduction to the finite element method as a general method for the numerical solution of partial differential equations in mechanics and physics covering all the three main types of equations, namely elliptic, parabolic and hyperbolic equations. The main part of the text is concerned with linear problems, but a chapter indicating extensions to some nonlinear problems is also included. There is also a chapter on finite element methods for integral equations connected with elliptic problems. The emphasis of the text is on mathematical and numerical aspects of the finite element method but many applications to important problems in mechanics and physics are also given.

Oscillation Theory of Differential Equations with Deviating Arguments. By G. S. Ladde, V. Lakshmikantham, and B. G. Zhang. Marcel Dekker, New York, 1987. pp. vi + 308. $89.75.

This is volume 110 in the series Pure and Applied Mathemtics. This book offers a systematic treatment of oscillation and nonoscillation theory of differential equations with deviating arguments. The book is divided into six chapters. The first chapter consists of preliminary material that is essential for the rest of the book. Chapters 2 and 3 deal with first-order linear and nonlinear differential equations with deviating arguments. Chapter 4 is devoted to second-order equations. Chapter 5 extends the study to higher-order equations. In Chapter 6, the authors introduce the oscillation theory to systems of differential equations with deviating arguments. There is a bibliography with 309 items.

Banach Algebras with Symbol and Singular Integral Operators. By Naum Ya. Krupnik. Birkhäuser, Boston, 1987. pp. vii + 205. $65.00.

This is volume 26 of the series Operator Theory: Advances and Applications. It is a revised translation by A. Iacob of a Russian monograph published in 1984, and presents the theory of one-dimensional singular integral operators and algebras of such operators. The first part contains the Fredholm theory (including F. Noether's theorems, index, and essential spectrum). Precise computation of norms plays an important role here. Fredholm properties of singular integral operators are often described in terms of their symbols, which are scalar-valued or matrix-valued functions. The second part of the book analyzes the question of why some Banach algebras of singular integral operators have a symbol and why some of them do not. This analysis is based on the theory of Banach algebras, which is developed in the book. This is a natural generalization of the theory of commutative Banach algebras. The book gives also the matrix generalization of the Gel'fand transform.

Laurent Series and their Padé Approximations. By Adhemar Bultheel. Birkhäuser, Boston, 1987. pp. xi + 274. $65.00.

This is volume 26 of the series Operator Theory: Advances and Applications. The main part of this monograph studies algebraic properties and algorithms for the computation of Laurent–Padé approximations for formal power series. This is a two-sided extension of the classical Padé approximation problem which treats only one-sided power series. Related topics like continued fractions, orthogonal polynomials, quadrature, Toeplitz matrix factorization and inversion are treated. In the analytic part of the monograph, Laurent series of meromorphic functions are considered. Results about the asymptotics of Toeplitz and Hankel determinants are used to prove convergence of the approximants and methods to find poles and zeros of a meromorphic function are treated. Connections with classical theories of Carathéodory and Schur classes, prediction theory, digital filtering and inverse scattering are given.

Large Scale Scientific Computing. Edited by P. Deuflhard, B. Engquist. Birkhäuser, Boston, 1987. pp. xii + 388. $30.00.

This is volume 7 in the series Progress in Scientific Computing. It contains the proceedings of a conference at Oberwolfach dealing with recent issues in the computational solutions of initial and boundary value problems for ordinary and partial differential equations, inverse problems for integral equations, and real-life optimization problems. One of the features of the book is that it informs the reader about the recent intrusion of sophisticated ODE techniques into the PDE domain. Fields of application touched on include, among others, semi-conductor design, chemical combustion, seismology, climatology, and fluid dynamics.

A Primer of Diffusion Problems. By Richard Ghez. John Wiley & Sons, New York, 1988. pp. xiii + 243. $22.95.

This book seeks to bridge the gap between physico-chemical statements of certain kinetic problems. It also attempts to introduce the reader to the many lines of attack, both analytic and numerical, on the diffusion equation. The author has chosen to teach through physically significant examples taken mainly from his experience in the areas of metallurgy and of semiconductor technology. The book is an introductory text, whose prerequisites are a year of calculus, through ordinary differential equations and one semester of thermodynamics. The text consists of seven chapters and three appendices. These appendices contain more advanced material. Chapter headings: 1. The diffusion equation. 2. Steady-state examples. 3. Diffusion under external forces. 4. Simple time-dependent examples. 5. An introduction to similarity. 6. A user's guide to the Laplace transform. 7. Further time-dependent examples.

Mathematics Applied to Science. Edited by Jerome Goldstein, Steven Rosencrans, and Gary Sod. Academic Press, New York, 1988. pp. xx + 309. $34.50.

This volume is the proceedings of a conference held at Tulane University as a tribute to Edward D. Conway III who died on July 15, 1985. These are the texts of twelve lectures; the applications include meteorology, combustion, lattice dynamics, Hartree–Fock theory, electron physics, cell biology, continuum mechanics, gas dynamics, and quantum chemistry.

Linear Estimation and Design of Experiments. By D. D. Joshi. John Wiley & Sons, New York, 1987. pp. xv + 288. $24.95.

This text is intended to serve as an introduction to the theory of linear estimation (or the theory of least squares) and its application to the analysis of experimental designs based on fixed-effects linear models. Random-effects or mixed-effects are not considered but a discussion of recovery of inter-block information in balanced incomplete block designs has been included. The text may be found useful for a first course in experimental design.

Algorithms for Clustering Data. By Anil K. Jain and Richard C. Dubes. Prentice Hall, New Jersey, 1988. pp. xiv + 320.

This is a volume in the Prentice Hall Reference Series. It can serve as a reference for scientists in a variety of disciplines and as a textbook for a graduate course in exploratory data analysis as well as a supplemental text in courses on research methodology, pattern recognition, image processing, and remote sensing. The book emphasizes informal algorithms for clustering data, and interpreting results. Graphical procedures and other tools for visually representing data are introduced both to evaluate the results of clustering and to explore data. Mathematical and statistical theory are introduced only when necessary. Chapter headings: 1. Introduction. 2. Data representation. 3. Clustering methods and algorithms. 4. Cluster validity. 5. Applications.

Factorization of Measurable Matrix Functions. By Georgiĭ S. Litvinchuk and Illia M. Spitkovskiĭ. Birkhäuser, Boston, 1987. pp. 1 + 372. $56.50.

This is volume 25 of the series Operator Theory: Advances and Applications, a translation from the Russian by Bernd Luderer, and edited by Georg Heining. It is devoted to the problem of factorization of matrix functions on closed contours in the complex plane (Wiener–Hopf factorization). This problem appears in connection with the study of singular integral equation systems and boundary value problems for analytic matrix functions, but also in linear system and transport theory, probability theory and other fields of applied mathematics. The volume presents the general theory (including discontinuous and unbounded matrix functions and nonsmooth contours), and also the factorization of special classes.

Numerical Methods for Partial Differential Equations. Edited by S. I. Hariharan and T. H. Moulden. Longman Scientific & Technical, and John Wiley & Sons, New York, 1986, pp. 1 + 299. $47.95.

This is volume 145 in the Pitman Research Notes in Mathematics Series. The eight papers—which constitute the substance of a short course offered at the University of Tennessee Space Institute in March, 1985—are divided into four groups: 1. Elliptic equations. 2. Hyperbolic equations. 3. Equations of mixed type. 4. Special topics. There is also an appendix giving an introduction to the equations of continuum mechanics.

Mathematical Foundations for Communication Engineering: Volume 1—Determinate Theory of Signal Waves. By Kenneth W. Cattermole. John Wiley & Sons, New York, 1985. pp. x + 287.

This is a volume in the series Mathematical Foundations for Communication Engineering. It is the authors' attempt to provide a unified treatment of the mathematical foundations and his general theme is the common theoretical substratum underlying diverse problems and practices. The common features of Chapters 2–4 are the analysis of patterns in time and space, primarily by means of the Fourier transform and its derivatives; and the use of probabilistic methods. Chapter 5, on finite mathematics, shows that superficially different applications such as digital signal processing and error control coding have a common basis in the theory of Galois fields. Volume I contains Chapters 1 to 3, entitled: Modelling of signals and systems. 2. Time and frequency: the one-dimensional analysis of signals. 3. Spatial and spatio-temporal patterns: multi-dimensional analysis. Volume II will contain Chapters 4 and 5, entitled: 4. Distributions: statistical analysis. 5. Finite groups and fields: structural analysis.

Design and Analysis of Coalesced Hashing. By Jeffrey Scott Vitter and Wen-Chin Chen. Oxford University Press, New York, 1987. pp. xii + 160. $29.95.

This is a volume in the International Series of Monographs on Computer Sciences. The authors consider the classical problem of information storage and retrieval. Their goal is to explore one solution—the coalesced hashing method—from both theoretical and practical points of view. They organized the book to appeal to as wide an audience as possible. The introductory material in Chapter 1 is meant to give all the readers a basic understanding of the algorithms and issues. The remaining chapters can be covered more or less independently. For example, a systems programmer may dwell on the practical aspects of Chapters 3 and 4, while Chapters 2, 5, and 6 can be used as supplementary material in an algorithms course. The algorithms are given in both English and in a variant of the well-known language Pascal. Their extensions to Pascal are described in Appendix A, along with the rest of the notation they use in this book. Chapter headings: 1. Coalesced hashing. 2. Searching. 3. Optimum tuning. 4. Comparisons. 5. Lower bounds. 6. Deletions. 7. Implementations and variations.

Lecture Notes on Bucket Algorithms. By Luc Devroye. Birkhäuser, Boston, 1986. pp. 1 + 146.

This is volume 6 in the series Progress in Computer Science. Hashing algorithms scramble data and create pseudo-uniform data distributions. Bucket algorithms operate on raw untransformed data which are partitioned into groups according to membership in equi-sized d-dimensional hyperrectangles, called cells or buckets. The bucket data structure is sensitive to the distribution of the data. These lecture notes discuss the connections between the expected time of various bucket algorithms and the distribution of data. The results are illustrated on standard searching, sorting, and selection of problems, as well as on a variety of problems in computational geometry and operations research.

On Knots. By Louis H. Kauffman. Princeton University Press, New Jersey, 1987. pp. xv + 480. $50.00 hardcover, $18.00 paperback.

This is volume 155 of Annals of Mathematics Studies. These notes on the theory of knots comprise an expanded version of a seminar held in the Departmento de Geometria y Topologia at the Universidad de Zaragoza, Zaragoza, Spain during the winter of 1984.

The Theory and Applications of Statistical Inference Functions. By D. L. McLeish and Christopher G. Small. Springer-Verlag, New York, 1988. pp. vi + 124. $25.00.

This is volume 44 of Lecture Notes in Statistics. It arose out of a desire to develop an approach to statistical inference that would be both comprehensive in its treatment of statistical principles and sufficiently powerful to be applicable to a variety of important problems, e.g., the problems of inference for stochastic processes. The monograph examines some of the consequences of extending standard concepts of ancillarity, sufficiency and completeness into this setting. Chapter headings: 1. Introduction. 2. The space of inference functions: ancillarity, sufficiency and projection. 3. Selecting an inference function for 1-parameter models. 4. Nuisance parameters. 5. Inference under restrictions. 6. Inference for stochastic processes.

Introduction to Finite Fields and their Applications. By Rudolf Lidl and Harald Niederreiter. Cambridge University Press, New York, 1986. pp. viii + 407. $29.95.

This book is designed as a textbook edition of the authors' monograph Finite Fields which appeared in 1983 as Volume 20 of the Encyclopedia of Mathematics and Its Applications. Several changes have been made in order to tailor the book to the needs of the student. The historical and bibliographical notes at the end of each chapter and the long bibliography have been omitted as they are mainly of interest to researchers. There are also changes in the text proper, with the present book having an even stronger emphasis on applications. The increasingly important role of finite fields in cryptology is reflected by a new chapter on this topic. There is now a separate chapter on algebraic coding theory containing material from the original edition together with a new section on Goppa codes. New material on pseudo-random sequences has also been added. On the other hand, topics in the original edition that are mainly of theoretical interest have been omitted. Chapter headings: 1. Algebraic foundations. 2. Structure of finite fields. 3. Polynomials over finite fields. 4. Factorization of polynomials. 5. Exponential sums. 6. Linear recurring sequences. 7. Theoretical applications of finite fields. 8. Algebraic coding theory. 9. Cryptology. 10. Tables.

Functional Analysis and Boundary-Value Problems: An Introductory Treatment. By B. Dayanand Reddy. John Wiley & Sons, New York, 1986. pp. xii + 333. $120.00.

This is volume 30 of the Pitman Monographs and Surveys in Pure and Applied Mathematics. It is addressed to senior undergraduate and graduate students in mathematics, engineering, and the physical sciences, and the prerequisites are undergraduate courses in differential equations, vector analysis, and linear algebra. The book is divided into two parts. Part I, consisting of Chapters 1 to 7, constitutes an introduction to functional analysis, while part II, Chapters 8 to 11, treats elliptic boundary-value problems and their approximation. Each chapter ends with bibliographical remarks. Chapter headings: 1. Sets. 2. The spaces $C^m(\Omega)$ and $L_p(\Omega)$. 3. Linear spaces. 4. Properties of normed spaces. 5. Linear operators. 6. Orthonormal bases and Fourier series. 7. Distributions and the Sobolev spaces $H^m(\Omega)$. 8. Elliptic boundary-value problems. 9. Variational boundary-value problems. 10. Approximate methods of solution. 11. The finite element method.

Nonlinear Conical Flow. By B. M. Bulakh. Delft University Press, Delft, The Netherlands, 1985. pp. xi + 326. Dfl. 60.00.

This is a translation, by J. W. Reyn and W. J. Bannik, of the Russian edition, first published in 1970. It is a description of the analytical techniques available for the study of nonlinear flows of compressible fluids past conical bodies, a subject first introduced by A. Busemann some fifty years ago. Chapter headings: 1. General properties and some particular types of conical flow. 2. Supersonic conical gas flows. 3. Hypersonic conical flows of gas.

Topological Graph Theory. By Jonathan L. Gross and Thomas W. Tucker. John Wiley & Sons, New York, 1987. pp. xv + 351. $59.95.

This is a volume in the Wiley Interscience Series in Discrete Mathematics and Optimization. The primitive objective of topological graph theory is to draw a graph on a surface so that no two edges cross, an intuitive geometric problem that can be enriched by specifying symmetries or combinatorial side-conditions. To solve the problem and its variants, techniques are adapted from a broad range of mathematics, especially from algebraic topology and group theory, and more recently from enumerative combinatorics and the analysis of algorithms. The present monograph is intended as a historically sensitive, comprehensive introduction to the foundations and central concerns of topological graph theory, with bridges to the frontier topics and to other areas of mathematics, wherever they fit naturally. It is sufficiently self-contained that it can serve as a first-year graduate text or a self-guided approach for ambitious persons having a background in undergraduate discrete mathematics, in particular, some acquaintance with graphs and with elementary facts about groups and permutation groups. No point-set topology is necessary, beyond what one might see in an honors calculus course. Chapter headings: 1. Introduction. 2. Voltage graphs and covering spaces. 3. Surfaces and graph imbeddings. 4. Imbedded voltage graphs and current graphs. 5. Map colorings. 6. The genus of a group.

Le Calcul Simplifié: Graphical and Mechanical Methods for Simplifying Calculation. By Maurice d'Ocagne. MIT Press, Cambridge, 1986. pp. x + 167. $35.00.

This volume, translated by J. Howlett and M. R. Williams, is volume II in the Charles Babbage Institute reprint series for the History of Computing. It is a classic work of the art of computation. It was initially written, in the early 1890's, at a time before commercial mechanical calculating machines were readily available. There are six chapters: 1. Mechanical calculation. 2. Graphical calculation. 3. Grapho-mechanical calculation. 4. Nomographical calculation. 5. Nomo-mechanical calculation, and there are three appendices: I. Tchebichef's continuous movement arithmetical machine. II. A note on the Scheutz difference machine. III. A summary of the history of logarithms. Of these, Chapter 4, on nomography, is the central one in that the author was considered the founder and world expert in this field.

Water Waves and Ship Hydrodynamics. By R. Timman, A. J. Hermans, and G. C. Hsiao. Delft University Press, Delft, The Netherlands, 1985. pp. ix + 145. $35.50.

This is a volume in the series Mechanics of Fluids and Transport Processes. The first five chapters are based on notes which grew from a series of lectures the late Reinier Timman gave at the University of Delaware in 1971. The fifth chapter and the appendices have been added. Chapter headings: 1. Linear theory of water waves. 4. Deep water ship hydrodynamics. 5. Shallow water ship hydrodynamics.

Analysis of a Finite Element Method: PDE/PROTRAN. By Granville Sewell. Springer-Verlag, New York, 1985. pp. x + 154. $24.00.

PDE/PROTRAN is a program published by IMSL, Inc. This text can be used as a reference book for the PDE/PROTRAN user who wishes to know more about the methods employed by PDE/PROTRAN Edition 1 (or its predecessor, TWODEPEP) in solving two-dimensional differential equations. It is also suitable as a text for an introductory graduate level finite element course. Algorithms which solve elliptic, parabolic, hyperbolic, and eigenvalue partial differential equation problems are presented, as are techniques appropriate for treatments for singularities, curved boundaries, nonsymmetric and nonlinear problems, and systems of PDE's. Direct and iterative linear equation solvers are studied. Chapter headings: 1. Partial differential equation applications. 2. Elliptic problems—Forming the algebraic equations. 3. Elliptic problems—Solving the algebraic equations. 4. Parabolic problems. 5. Hyperbolic problems. 6. Eigenvalue problems.

Resource Allocation Problems: Algorithmic Approaches. By Toshihide Ibaraki and Naoki Katoh. MIT Press, Cambridge, Mass., 1988. pp. xiv + 229. $37.50.

This is a volume in the MIT Press Series in the Foundation of Computing. The resource allocation problem addressed in this book is an optimization problem with a single simple constraint. Given a fixed amount of the resource (this is the constraint), one is asked to determine its allocation to n activities in such a way that the objective function under consideration is optimized. The amount of resource allocated to each activity is treated as a continuous or discrete (integer) variable, depending on the cases. This is a special case of the nonlinear programming problem or the nonlinear integer programming problem. This book discusses comprehensively the algorithmic aspects of the resource allocation problem and its variants. Included are the Lagrangian multiplier method, dynamic programming, greedy algorithms, and their generalizations. The analysis of the computational complexity, exploiting modern data structures, accompanies each algorithm description in the book. Extensions to more general problems involving more than one constraint and/or more than one resource type are also treated. Chapter headings: 1. Introduction. 2. Resource allocation and continuous variables. 3. Resource allocation with integer variables. 4. Minimizing a separable convex function. 5. Minimax and Maximin resource allocation problems. 6. The fair resource allocation problem. 7. The appointment problem. 8. Fundamentals of submodular systems. 9. Resource allocation problems under submodular constraints. 10. Further topics on resource allocation problems.

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