QUARTERLY

OF

APPLIED MATHEMATICS

VOLUME XLIV JANUARY · 1987 NUMBER 4

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. 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.

The current subscription price per volume (April through January) is $45. Single issues can be purchased, as far as they are available, at $12 and back volumes at $45 per volume. Subscriptions and orders for back volumes must be addressed to the American Mathematical Society, P.O. Box 1571, Providence, RI 02901. All orders must be accompanied by payment. Other subscription correspondence should be addressed to the American Mathematical Society, P.O. Box 6248, Providence, RI 02940. *Quarterly of Applied Mathematics* (ISSN 0033-569X) is published four times a year (April, July, October and January) by Brown University, Division of Applied Mathematics, 182 George Street, Providence, RI 02912. Second-class postage paid at Providence, RI. POSTMASTER: Send address changes to *Quarterly of Applied Mathematics*, Membership and Sales Department, American Mathematical Society, Post Office Box 6248, Providence, RI 02940.

Second-class postage paid at Providence, Rhode Island.
Publication number 808680. (ISSN 0033-569X).

QUARTERLY

OF

APPLIED MATHEMATICS

VOLUME XLIV 1986/87

CONTENTS

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.

CONTENTS

Applications of Discrete and Continuous Fourier Analysis. By H. Joseph Weaver. John Wiley and Sons, New York, 1983. vii + 375. pp. $34.95.

In this text, the author divides Fourier analysis into three analogous topics. First is the Fourier series—a mapping that converts a (periodic) function to a sequence of Fourier series coefficients, the Fourier transform which maps a function, finally the discrete Fourier transform which maps one sequence to another. The text is divided into two portions. The first, consisting of Chapters 1–5, presents the definition and properties of the Fourier series, Fourier transform, and discrete Fourier transform. The emphasis is placed on how their properties can be used to simplify their calculation and manipulation. Chapters 6–11 constitute the second portion which builds upon the material presented in the first portion and demonstrates various physical applications of Fourier analysis. Contents: 1. The Concept of Frequency Content. 2. The Fourier Series. 3. The Fourier Transform. 4. The Discrete Fourier Transform. 5. Fourier Analysis via a Digital Computer. 6. Systems and Transfer Functions. 7. Vibrational Systems. 8. Optics. 9. Numerical Analysis. 10. The Heat Equation. 11. Stochastic Analysis.

Harmonic Analysis on Free Groups. Alessandro Figa-Talamanca and Massimo A. Picardello. Marcel Dekker, New York, 1983. iii + 145 pp. $35.00.

This is volume 87 in the series Lecture Notes in Pure and Applied Mathematics. It contains an account of recent results on the theory of representations and the harmonic analysis of free groups. The choice and presentation of the material is aimed at emphasizing the analogy with the theory of representations of noncompact semisimple Lie groups.

Systems of Nonlinear Partial Differential Equations. edited by J. M. Ball. D. Reidel Publishing Company, Dordrecht, Holland, 1983. ix + 481 pp. $65.00.

This is a volume in the NATO Advanced Science Institutes Series, held at Oxford, July 25–August 7, 1982. There are expository lectures by C. C. Conley and J. A. Smoller, C. M. Dafermos, J. L. Ericksen, L. C. Evans, M. Giaquinta, E. Giusti, S. Hildebrandt, D. G. Schaeffer, and L. Tartar, and the contributed papers to special sessions under the headings: problems in nonlinear elasticity (organized by S. S. Antmann), applications of bifurcation theory to mechanics (J. E. Marsden), nonelliptic problems and phase transitions (J. M. Ball), dynamical systems and partial differential equations (J. K. Hale).

Chaos and Statistical Methods. edited by Y. Kuramoto. Springer-Verlag, New York, 1984, v + 272 pp. $32.00.

This is volume 24 of the Springer Series in Synergetics. It contains most of the lectures presented at the Sixth Kyoto Summer Institute, held in Kyoto, Japan, September 12–15, 1983. The meeting was aimed at "clarifying various aspects of chaotic systems appearing in different scientific disciplines, critically examining related mathematical methods developed so far, thus preparing for possible breakthroughs, among others, for the opening of a new period of statistical mechanics of deterministic systems." The 36 papers are divided into nine groups: 1. General Concepts; 2. Fractals in Dynamical and Stochastic Systems; 3. Onset of Chaos; 4. One-Dimensional Mappings; 5. Bifurcations and Normal Forms; 6. Soliton Systems; 7. Fluid Dynamics; 8. Chemical and Optimal Systems; 9. Anomalous Fluctuations.

Functional Relations, Random Coefficients, and Nonlinear Regression with Application to Kinetic Data. By Søren Johansen. Springer-Verlag, New York, 1984. 1 + 114 pp.

This is volume 22 of Lecture Notes in Statistics. It gives an introduction to some of the techniques in regression analysis which the author has found useful when working with various data sets. Chapter headings: 1. An example from physiology; 2. The general linear model; 3. The linear functional relation; 4. Random coefficient models; 5. Nonlinear regression; 6. Some examples of nonlinear regression problems.

Continued on page 638

Continued from page 628

Stochastic Phenomena and Chaotic Behaviour in Complex Systems. Edited by P. Schuster. Springer-Verlag, Berlin Heidelberg, 1984. v + 270 pp. $24.50.

This is volume 21 of the Springer Series in Synergetics. It contains all invited contributions to the fourth interdisciplinary workshop of the UNESCO working group on systems analysis of the European and North American regions, held at Flattnitz, Kärnten, Austria from June 6–10, 1983. This workshop brought together some 20 mathematicians, physicists, chemists, biologists, psychologists, and economists from different European and American countries who share a common interest in the dynamics of complex systems and their analysis by mathematical techniques. After introductory remarks by the editor, the papers are divided into five parts: 1. General concepts (three papers); 2. Chaotic dynamic theory (four papers); 3. Chaotic dynamics-real systems and experimental verification (five papers); 4. Stability and instability in dynamical networks (three papers); 5. Stochasticity in complex systems (five papers).

Uniform Convexity, Hyperbolic Geometry, and Nonexpansive Mappings. By K. Goebel. Marcel Dekker, Inc., New York, 1984. 1 + 160 pp. $35.00

This is volume 83 of the series Pure and Applied Mathematics. Its main purpose is to expose the surprising connections between two theories, the settings of both being complex, infinite-dimensional Banach spaces: nonexpansive mappings and holomorphic mappings. The text is divided into three chapters: 1. Banach spaces; 2. Hyperbolic geometry; 3. Spherical geometry.

Catastrophe Theory. By V. I. Arnold. Springer-Verlag, Berlin, 1984. 1 + 78 pp.

An introduction to catastrophe theory—including results from the mathematical theories of singularities and bifurcation—for readers having minimal mathematical background, but "an inquiring mind".

Finite Elements: an introduction for engineers. R. K. Livesley: Cambridge Univ. Press, Cambridge, 1983. ix + 189 pp. $29.95 Hardbound, $13.95 Paperbound.

This text is based on a course of lectures available to third-year students in the Cambridge University Engineering Department. It views the finite-element method as a general procedure for obtaining approximate solutions to elliptic partial differential equations. It emphasizes the relationship of the method to other techniques of approximate numerical analysis and uses variational ideas to establish convergence criteria. Chapter headings: 1. Preliminaries; 2. The finite-element method introduced; 3. Elastic stress analysis using linear triangular elements; 4. Higher-order approximations: (1) fixed element shapes; 5. Higher-order approximations: (2) generalizing the element geometry; 6. Axial symmetry and harmonic analysis; 7. The elastic analysis of beams, plates and shells; 8. Programming the finite-element method.

Introduction to Combinatorial Theory. By R. C. Bose & B. Manvel. John Wiley & Sons, New York, 1984. 1 + 231 pp. $29.95

This is a volume in the Wiley Series in Probability and Mathematical Statistics. The subjects covered fall naturally into four unequal classes. Chapters 1, 2, and 3 survey elementary counting techniques, with applications to probability. Chapter 4 is a brief introduction to graph theory. Chapters 5, 6, 7, and 8 introduce constructive combinatorics. Chapters 9 and 10 touch on problems of choice and optimization. Chapter headings: 1. Permutations and Combinations, 2. The Binomial Theorem, 3. Enumeration, 4. Graphs, 5. Finite Fields, 6. Finite Plane Geometries, 7. Orthogonal Latin Squares and Error Correcting Codes, 8. Balanced Incomplete Block Designs, 9. Problems of Choice, 10. Optimization.

Continued on page 658

Continued from page 638

Developments in the Theory of Turbulence. By D. C. Leslie. Clarendon Press, Oxford, 1983. 1 + 355 pp. $24.95

The aim of this book is to make the important developments of turbulence theory accessible to a wider circle of people—readers both with engineering and with mathematical backgrounds—and to show their relevance to practical problems. Chapter headings: 1. Introductory material; 2. Homogeneous isotropic turbulence; 3. The problem of closure; 4. The direct interaction approximation; 5. The justification of direct interaction; 6. The consequences of Eulerian direct interaction; 7. Alternative methods of closure; 8. Convection of a passive scalar in an Eulerian framework; 9. The need for a Lagrangian treatment; 10. Direct interaction in a Lagrangian framework; 11. Galilean-invariant calculations of the inertial range velocity field; 12. Diffusion of a passive scalar in the Ali approximation; 13. Description of a particular real flow; 14. Existing methods of calculation for engineering flows; 15. The application of the theory to real flows.

Lie Groups, Lie Algebras, and Their Representations. By V. S. Varadarajan. Springer-Verlag, New York, 1984. 1 + 416 pp.

This is volume 102 of Graduate Texts in Mathematics and is a corrected edition of a text originally published in the Prentice-Hall Series in Modern Analysis, 1974. Chapter headings: 1. Differentiable and analytic manifolds; 2. Lie Groups and Lie algebras; 3. Structure theory; 4. Complex semisimple Lie algebras and Lie groups: structure and representation.

Elastic Wave Propagation in Transversely Isotropic Media. By Robert F. Payton. Martinus Nijhoff Pub., The Hague, 1983. 1 + 185 pp. $42.50

This monograph records those parts of the theory of transverse isotropic elastic wave propagation which lend themselves to an exact treatment, within the framework of linear theory. Emphasis is placed on transient wave motion problems in two- and three-dimensional unbounded and semibounded solids for which explicit results can be obtained, without resort to approximate methods of integration. The results are relevant to applications such as crystal acoustics, crystal optics, magnetogasdynamics, dislocation theory, seismology and fibre wound composites. Chapter headings: 1. Basic equations; 2. Wave front shape caused by a point source in unbounded media; 3. Green's tensor for the displacement field in unbounded media; 4. Surface motion of a two-dimensional half-space (Lamb's problem); 5. Epicenter and epicentral-axis motion of a three-dimensional half-space.

Risk and Capital. Ed. By Gunter Bamberg and Klaus Spremann. Springer-Verlag, Heidelberg, 1984. 1 + 304 pp. $18.00

This is volume 227 of Lecture Notes in Economics and Mathematical Systems and constitutes the Proceedings of the 2nd Summer Workshop on Risk and Capital, held at the University of Ulm, West Germany, June 20–24, 1983. There is an opening address by Jost B. Walther drawing parallels for risk and capital in genetics and evolution, a lecture by Martin Beckmann asking and solving the question how risk affects saving, and seventeen papers grouped under two headings: 1. Information, risk aversion and capital market theory; 2. Management, policy and empirical evidence.

The Theory of Relational Databases. By David Maier. Computer Science Press, Rockville, Md., 1983. 1 + 591 pp. $28.95

This book is aimed at a second course in databases, normally at the graduate but possibly at the advanced undergraduate level. As mathematical prerequisites, acquaintance with set theory and the rudiments of formal logic should suffice. The work covers relational algebra, functional dependencies, multivalued and joint dependencies, normal forms, tableaux and the chase computation, representation theory, domain and tuple relational calculus, query modification, database semantics and null values, acyclic database schemes, template dependencies and computed relations. The final chapter is a brief survey of query languages in existing relational systems.

Continued on page 736

Continued from page 658

The Measurement of Visual Motion. By Ellan Catherine Hildreth. The MIT Press, Cambridge, MA, 1984. 1 + 187 pp. $27.50

This is a volume in the Distinguished Doctoral Dissertation Series, which is cosponsored by ACM and the MIT Press. The thesis, of which this book is the outgrowth, was supervised by Shimon Ullman. One of the functions of vision is to reconstruct a three-dimensional representation of the world from the two-dimensional image presented to the visual system by the projection of light onto the eye. A primary source of information, from which this reconstruction may take place, is given by the organization of movement in the changing image. The motion of elements in the image must, however, be inferred from the pattern of changing intensity that reaches the eye. This work presents a study of early motion analysis; it aims to understand the way in which this analysis takes place in the human visual system. The approach taken is a computational one, following the pioneering work of David Marr, in which the human system is viewed as an information processor, which performs computations on internal symbolic representations of visual information. Chapter headings: 1. Introduction; 2. Background; 3. Computation of the velocity field; 4. An algorithm to compute the velocity field; 5. The computation of motion discontinuities; 6. Perceptual studies of motion measurement; 7. The psychophysics of discontinuity detection; 8. Neurophysiological studies of motion; 9. Summaries and conclusions.

Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields. By John Guckenheimer and Philip Holmes. Springer-Verlag, New York, 1983. 1 + 421 pp.

This is volume 42 in the series Applied Mathematical Sciences. It is directed towards members of the engineering and applied science communities who do not have the necessary mathematical background to go straight to the research literature in strange attractors, chaos and dynamical systems theory, but are interested in their applications to solid, structural and fluid mechanics. The authors have selected for discussion only those results which they feel are applicable to physical problems, and have generally excluded proofs of theorems which they do not feel to be illustrative of the applicability. The approach to dynamical systems adopted is a geometric one (there are around 200 illustrations). The geometrical and topological properties of solutions of differential equations and iterated maps are stressed throughout. The book is essentially concerned with the application of methods from dynamical systems and bifurcation theories to the study of nonlinear oscillations. The mathematical models considered are sets of ordinary differential equations and mappings. Many of the results discussed can be extended to infinite-dimensional evolution systems arising from partial differential equations. Almost all the methods described also generalize to dynamical systems whose phase spaces are differentiable manifolds. Chapter 1 provides a review of basic results in the theory of dynamical systems, covering both ordinary differential equations (flows) and discrete mappings. Chapter 2 presents four examples from nonlinear oscillations: the oscillators of van der Pol and Duffing, the Lorenz equations, and a bouncing ball problem. It is shown that the solutions of these problems can be markedly chaotic and that they seem to possess strange attractors: attracting motions which are neither periodic nor even quasiperiodic. Chapter 3 contains a discussion of the methods of local bifurcation theory for flows and maps, including center manifolds and normal forms. Chapter 4 develops the analytical methods of averaging and perturbation theory for the study of periodically forced nonlinear oscillators; it shows that they can yield surprising global results. It ends with a brief discussion of chaos and nonintegrability in Hamiltonian systems and the Kolmogorov-Arnold-Moser theory. Chapter 5 returns to chaos, or rather to the close analysis of geometrically defined two-dimensional maps with complicated invariant sets. The horseshoe map of Smale is discussed at length, and the method of symbolic dynamics is described and illustrated. Chapter 6 discusses global homoclinic and heteroclinic bifurcations, bifurcations on one-dimensional maps. The final chapter shows how the global bifurcations, discussed previously, reappear in degenerate local bifurcations, and ends with several more models of physical problems which display these rich and beautiful behaviors.

Optimization Methods in Operations Research and Systems Analysis. By K. V. Mital. Wiley Eastern Limited, New Delhi, 1976. 1 + 319 pp. $17.95

This book is an elementary mathematical introduction to linear and nonlinear programming, dynamic programming, geometric programming, direct search methods and theory of games.

Continued on page 750

Continued from page 736

Introductory Applied Probability. By G. P. Beaumont. Ellis Horwood Lim., Chichester, Eng., 1983. 11 + 193 pp. $54.95

This is a volume in the Ellis Horwood Series, Mathematics and Its Applications. It discusses birth and death processes, queueing theory, renewal theory, reliability and inventory control. It presupposes a first-year course in calculus and the usual amount of probability provided in a first course in statistics.

Number Theory in Science and Communication. By M. R. Schroeder. Springer-Verlag, Heidelberg, 1984. 1 + 297 pp. $34.50.

This is volume 7 in the Springer Series in Information Sciences. It is the aim of the author not to write another treatise on number theory, but to present it in a manner that stresses intuition and interrelationships, as well as applications in physics, biology, computer science, digital communications, cryptography, and even in puzzles, teasers and artistic designs. The thirty chapters are divided into nine parts: 1. A few fundamentals (Chapters 1–4), 2. Some simple applications (Chapter 5), 3. Congruences and the like (Chapters 6–8), 4. Cryptography and Divisors (Chapters 9–14), 5. Residues and Diffraction (Chapter 15), 6. Chinese and other fast algorithms (Chapters 16–18), 7. Pseudoprimes, Möbius Transform, and Partitions (Chapter 19–21), 8. Cyclotomy and Polynomials (Chapters 22–24), 9. Galois Fields and more applications (Chapters 25–30).

A First Course in the Mathematical Foundations of Thermodynamics. By David R. Owen. Springer-Verlag, New York, 1984. 1 + 120 pp. $26.00

This is a volume in the series Undergraduate Texts in Mathematics. It is the author's goal to make some of the modern developments in thermodynamics available to undergraduate students in science and engineering. Chapter 1 presents the foundations of classical thermodynamics in which many aspects of modern treatments are introduced in the concrete and simple setting of homogeneous fluid bodies. Chapters 2–5 contain the basic material on the modern foundations in the form of parallel treatment of the First and Second Laws. Chapters 6 and 7 are devoted to a discussion of the main features of some important nonclassical systems: viscous filaments, elastic—perfectly plastic filaments, and homogeneous bodies with viscosity.

Asymptotic Analysis. By J. D. Murray. Springer-Verlag, New York, 1984. 1 + 160 pp.

This is volume 48 in the series Applied Mathematical Sciences. An earlier version of this book was published in 1974 by Clarendon Press, Oxford; for this edition, a further practical chapter 7 has been added on matched asymptotic methods in singular perturbation methods and suppression of secular terms. The work gives an introduction to the most frequently used methods for obtaining analytical approximations to functions defined by integrals or as solutions of ordinary differential equations. The emphasis is on the practical use of the techniques and heuristic reasoning, rather than mathematical rigor, is often used to justify a procedure. Chapter headings: 1. Asymptotic expansions; 2. Laplace's method for integrals; 3. Method of steepest descents; 4. Method of stationary phase; 5. Transform integrals; 6. Differential equations; 7. Singular perturbation methods.

Applications of the Monte Carlo Method in Statistical Physics. Ed. by K. Binder. Springer-Verlag, Heidelberg, 1984. 1 + 297 pp. $32.00

This is volume 36 of the series Topics in Current Physics. It complements a previous volume (#7), with the same title, in this series. The chapters are by various authors. Chapter headings: 1. A simple introduction to Monte Carlo simulation and some specialised topics; 2. Recent developments in the simulation of classical fluids; 3. Monte Carlo Studies of critical and multicritical phenomena; 4. Few- and Many-Fermion problems; 5. Simulations of Polymer models; 6. Simulation of diffusion in lattice gases and related kinetic phenomena; 7. Roughening and melting in two dimensions; 8. Monte Carlo studies of "Random" systems; 9. Monte Carlo calculations in lattice gauge theories.

Continued on page 756

Continued from page 750

An Introduction to Infinite Dimensional Dynamical Systems—Geometric Theory. By Jack Hale, Luis Magalhaes, Waldyr M. Oliva. Springer-Verlag, New York, 1984. 1 + 190 pp. $18.00

This is volume 47 in the series Applied Mathematical Sciences. The purpose of this monograph is to outline an approach to the development of a theory of dynamical systems in infinite dimensions which is analogous to the theory in finite dimensions. The discussion centers around retarded functional differential equations although the techniques and several of the results apply to more general equations, in particular to neutral functional differential equations, and parabolic as well as some other types of partial differential equations. Chapter headings: 1. Introduction; 2. Retarded functional differential equations on manifolds; 3. Examples of retarded functional differential equations on manifolds; 4. Generic properties. The theorem of Kupka-Smale; 5. Invariant sets, limit sets and the attractor; 6. The dimension of the attractor; 7. Attractor sets as c^1-manifolds; 8. Stability relative to $A(F)$ and bifurcation; 9. Compactification at infinity; 10. Stability of Morse-Smale maps.

Ordinary Differential Equations in R^n: Problems and Methods. By L. C. Piccinini. Springer-Verlag, New York, 1984. 1 + 381 pp. $32.00

This is volume 39 of the series Applied Mathematical Sciences. It is based on lecture notes prepared by the late G. Stampacchia in the fifties and aims to give a simple and rapid introduction to the various themes, problems, and methods of the theory of ordinary differential equations. It only requires a first course in calculus as a prerequisite to studying it. The author uses a discursive style to make the book accessible to a wide audience. Chapter headings: 1. Existence and uniqueness for the initial value problem under the hypothesis of Lipschitz; 2. Linear systems; 3. Existence and uniqueness for the Cauchy problem under the condition of continuity; 4. Boundary value problems; 5. Questions of stability.

Forecasting With Univariate Box-Jenkins Models Concepts and Cases. By Alan Pankratz. John Wiley & Sons, New York, 1983. 1 + 549 pp. $34.95

This is a volume in the Wiley Series in Probability and Mathematical Statistics. The purposes of this text are (1) to present the concepts of univariate Box-Jenkins/Auto-regressive integrated moving average (ARIMA) analysis in a manner that is accessible to readers lacking a sophisticated background in mathematical statistics, and (2) to help readers learn the art of ARIMA modeling by means of detailed case studies. Part I (Chapters 1–11) presents the essential concepts underlying the method. Part II (Chapter 12 and Cases 1–15) contains practical rules to guide the analyst, along with case studies showing how the technique is applied. Chapter headings: 1. Overview; 2. Introduction to Box-Jenkins analysis of a single data series; 3. Underlying statistical principles; 4. An introduction to the practice of ARIMA modeling; 5. Notation and the interpretation of ARIMA models; 6. Identification: stationary models; 7. Identification: nonstationary models; 8. Estimation; 9. Diagnostic checking; 10. Forecasting; 11. Seasonal and other periodic models.

Least Absolute Deviations: Theory, Applications and Algorithms. By P. Bloomfield. Birkhauser, Boston, 1983. 1 + 274 pp. $24.95

Although least squares is probably the best known method for fitting linear models and by far the most widely used, the least absolute deviations (LAD) criterion seems to have been considered first but forced into the background because of the computational difficulties associated with it. LAD estimates are, however, robust and make good starting points for other iterative robust procedures. The LAD criterion also has great utility. This monograph presents a unified treatment of the role of LAD techniques in several domains. There are three parts: one for theory (Chapters 1–3), one for applications (Chapters 4–5), one for algorithms (Chapters 6–7). Chapter headings: 1. Generalities; 2. LAD in linear regression; 3. LAD in autoregression; 4. LAD in multi-way tables; 5. LAD spline fitting; 6. LAD and linear programming; 7. Algorithms for LAD.

Continued on page 800

Continued from page 756

Optimization Over Time: Dynamic Programming and Stochastic Control, Volume II. By Peter Whittle. F. R. S. John Wiley & Sons Ltd., Chichester, 1983. 1 + 308 pp. $44.95

This book gives a unified account of the method of dynamic programming as an analytical tool for the solution of temporal optimization problems, with applications of this and related methods to major areas such as optimal control theory, operational research models, and sequential inference. Also a number of interesting special cases are investigated in detail. The subject is treated systematically from basic principles, presenting a wide range of theory and applications in an integrated and readable style. As well as covering such fundamental topics as the role of causality and minimax stochastic formulations as alternative ways of dealing with ignorance, the book introduces new material, for example, on multi-armed bandits (project evaluation), growth optimization, risk-sensitive control, and other relaxations of LQG structure. The first 21 chapters were divided into three parts: deterministic problems, the stochastic formulation, and linear/quadratic/Gaussian models, and published as volume 1. This volume 2 consists of Chapters 22 through 42, divided again into three parts: infinite-horizon problems, continuous time, and incompletely observed process states.

Kinetic Theories and the Boltzmann Equation. Ed. By C. Cerdignani. Springer-Verlag, Berlin, 1984. 1 + 241 pp.

This is volume 1048 of Lecture Notes in Mathematics. It contains the text of three of the four series of lectures, plus a few of the seminars presented at the first 1981 session of the Centro Internazionale Mathematico Estivo, held at Montecantiai, Italy, June 10–18, 1981. The unifying theme of the Summer School was the study of evolution equations whose unknown is a distribution function describing the probabilistic behavior of the underlying particle dynamics. The lecture notes presented in this volume deal with the time dependent linear transport equation (by Professor J. J. Hejtmanek of Vienna University), the existence theorems for the nonlinear Boltzmann equation (by Professor P. F. Zweifel of Virginia Polytechnic Institute and State University), the Boltzmann-Vlasov equation for ionized gases (by Professor H. Neunzert of the University of Kaiserslautern). The text of the seminars deals with half space problems for kinetic models, the Boltzmann equation for molecular forces of infinite range, a survey of recent results of the Cauchy problem for the Boltzmann equation, the Boltzmann hierarchy.

Information Technology and the Computer Network. Ed. by Kenneth G. Beauchamp. Springer-Verlag, Berlin, 1984. 3 + 268 pp. $34.50

This is volume 6 in Series F: Computer and System Sciences, of the NATO Advanced Science Institutes Series. It contains the papers presented at the NATO Advanced Study Institute held August 21 through September 2, 1983, at Bonas, France. The purpose of this meeting was to provide a study of the current achievements in network technology, the emerging needs for services and performance together with the theoretical and technological methods under development for the attack on the consequential problems. A background of tutorial information was given by lecturers concerned with the implementation and research into Information Technology Networks at both national and international levels. Attention was directed not only to existing and planned systems but also to the theoretical and mathematical developments in Information Technology Management upon which the future of the present development is based. Lectures and panel discussions included the subjects of wide-band communications, distributed computation, message handling, security, network management, integrated services digital networks, mathematical development and network performance. The 27 lectures are divided into seven parts: 1. Information technology; 2. Standardizing; 3. Information services; 4. Network development; 5. Network management; 6. Protocols and secure systems; 7. Delegates "short" papers.