QUARTERLY

OF

APPLIED MATHEMATICS

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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.

CONTENTS

Hamiltonian Systems: Chaos and Quantization. By Alfredo M. Ozorio de Almeida. Cambridge University Press, 1989. ix + 238 pp., $65.50.

This is a volume in the Cambridge Monographs on Mathematical Physics. It introduces the theory of Hamiltonian chaos, outlines the main results in the field, and considers the implications for quantum mechanics. In the first six chapters the theory of classical Hamiltonian systems is introduced. The main focus is on periodic orbits and their neighbourhoods, since this approach is a suitable introduction to the implications of the theory of chaos in quantum mechanics discussed in the last three chapters. Chapter headings: 1. Linear dynamical systems; 2. Nonlinear systems; 3. Chaotic motion; 4. Normal forms; 5. Maps on the circle; 6. Integrable and quasi-integrable systems; 7. Torus quantization; 8. Quantization of ergodic systems; 9. Periodic orbits in quantum mechanics.

Partial Differential Equations—Theory and Techniques. By George F. Carrier and Carl E. Pearson. Second Edition. Academic Press, 1988. ix + 340 pp., $34.95.

The major changes from the first edition are that a new chapter on transform methods has been added, and a section on integral equations has been included in the numerical methods chapter. The viewpoint remains that of the user of mathematics; the emphasis on the development of perspective and on the acquisition of practical technique. Illustrative examples chosen from a number of fields serve to motivate the discussion and to suggest directions for generalizations. A large number of exercises—some with answers—is provided.

Wave Interactions and Fluid Flows. By Alex D. D. Craik. Cambridge University Press, 1988. xii + 322 pp., $24.95.

This is a volume in the series Cambridge Monographs on Mechanics and Applied Mathematics. It is a comprehensive account of theory and experiment on wave-interaction phenomena, both in fluids at rest and in shear flows. On the one hand, this includes water waves, internal waves, their evolution and interaction, and associated wave-driven mean flows; on the other, phenomena of nonlinear hydrodynamic stability, especially those leading to the onset of turbulence. Chapter headings: 1. Introduction; 2. Linear wave interactions; 3. Introduction to nonlinear theory; 4. Waves and mean flows; 5. Three-wave resonance; 6. Evolution of a nonlinear wave-train; 7. Cubic three- and four-wave interactions; 8. Strong interactions, local instabilities, and turbulence: a postscript.

Computer Simulation in Cell Radiobiology. By Andrej Yu. Yakovlev and Aleksandr V. Zorin. Springer-Verlag, 1988. 133 pp., $16.50.

This is Volume 74 of Lecture Notes in Biomathematics. It has been translated from the Russian manuscript by Boris. I. Grudinko. It is the purpose of this monograph to demonstrate the possible ways of using simulation for exploring cell kinetics; it deals mainly with the authors' own experience in the field, the emphasis being on the effects of cell radiobiology. However, Chapter I also contains a brief review of the developments in devising specialized software for constructing simulation models of complex systems, as well as a survey of results of simulating the dynamics of cell populations of different tissues in vivo and in vitro. The subsequent chapters serve to illustrate concrete applications of the model. Chapter headings: 1. Simulation in cell population kinetics; 2. A simulation model for in vitro kinetics of normal and irradiated cells; 3. Simulation and analysis of radiobiological effects in cell cultures; 4. Simulation of controlled cell systems; 5. The properties of cell kinetics indicators.

The Averaged Moduli of Smoothness—With Applications in Numerical Methods and Approximation. By Blagovest Sendov and Vasil A. Popov. John Wiley & Sons, 1988. x + 180 pp., $57.95.

This is a volume in the series Pure and Applied Mathematics, founded by Richard Courant. The idea of writing it arose from a new method of estimating the error in a large number of numerical processes such as interpolation, approximation of functions by means of operators, quadrature formulas, and network methods for the numerical solution of integral and differential equations. The method is based on a new characteristic of functions (the *averaged moduli of smoothness*), used for the first time in the theory of Hausdorff approximations, and subsequently in the classical theory of approximation of functions by means of operators. These characteristics are defined for every bounded function and are an integral analogue of the classical moduli of continuity and smoothness for the uniform metric. The novelty in the authors' approach lies in the method of obtaining an analogue of the uniform case. The book shows by a number of examples the methods and results of applying the averaged moduli of smoothness in problems of error estimation in the numerical solution of integral equations, the Cauchy problem for ODE's, and the boundary value problem for ODE's of second error, amongst others.

Linear Algebra. By Serge Lang. Third Edition. Springer Verlag, 1987 (third corrected printing, 1989). ix + 289 pp., $39.80.

This is a volume in the series Undergraduate Texts in Mathematics. The first edition of the text was published under the title *Introduction to Linear Algebra* in 1970 and the second under the title *Linear Algebra* in 1971, both by Addison-Wesley. However, whereas *Introduction to Linear Algebra* provides a text for beginning students, the present book is meant to serve at the next level, essentially for a second course in linear algebra, where the emphasis is on the various structure theorems: eigenvalues and eigenvectors; symmetric, hermitian, and unitary operators, as well as their spectral theorem; triangulation of matrices and linear maps; Jordan canonical form; convex sets and the Krein-Milman theorem. The first part of the book, containing a quick treatment of the more basic material, is meant to make it selfcontained, but the emphasis is on the more advanced chapters.

Continuum Mechanics of Electromagnetic Solids. By Gérard A. Maugin. North Holland-Elsevier Science Publishing Company, 1988. xii + 598 pp., $184.25.

This volume is a rigorous cross-disciplinary theoretical treatment of electromechanical and magnetomechanical interactions in elastic solids. Linear and nonlinear static and dynamic problems in piezoelectric solids, electric conductors, ferromagnets, ferroelectrics, ionic crystals, ceramics, and other elastic solids, are treated. Chapters 1–3 are introductory, describing the essential properties of electromagnetic solids, the essentials of the thermomechanics of continua, and the general equations that govern the electrodynamics of nonlinear continua in the nonrelativistic framework (e.g., Maxwell's equations, the fundamental balance laws of continuum mechanics, basic thermodynamical inequalities for electromagnetic continua, jump relations for studying the propagation of shock waves, nonlinear constitutive equations for large classes of materials). The remainder of the text presents in detail special cases, applications, solved problems, and more complex aspects of electromagnetic matter. In particular, Chapters 6 and 7 are more advanced, reporting on recent progress in the field. Chapter headings: 0. Introduction: Continuum mechanics and electrodynamics; 1. Essential properties of electromagnetic solids; 2. Elements of continuum mechanics; 3. General equations of nonlinear electromagnetic continua; 4. Elastic dielectrics and piezoelectricity; 5. Elastic conductors; 6. Elastic ferromagnets; 7. Elastic ionic crystals, ferroelectrics, and ceramics.

Statistical Inference. By George Casella and Roger L. Berger. Wadsworth & Brooks/Cole, 1990. xviii + 650 pp., $53.95.

The purpose of this book is to build theoretical statistics (as different from mathematical statistics) from the first principles of probability theory. Starting from the basics of probability, the authors develop the theory of statistical inference using techniques, definitions, and concepts that are statistical and are natural extensions and consequences of previous concepts. The book is intended for first-year graduate students majoring in statistics. The first four chapters cover basics of probability theory. Chapter 5, on the random sample, is transitional; Chapter 6 details the principles of sufficiency, likelihood, and invariance and shows how these principles are important in modeling data. Chapters 7–9 present point and interval estimation, and hypothesis testing. The final three chapters contain special topics: a thorough introduction to decision theory, the analysis of variance, and the theory of regression.

Abstract and Concrete Categories. By Jiri Adamek, Horst Herrlich, and George E. Strecker. John Wiley & Sons, 1990. ix + 482, $54.95.

This is a volume in the series Pure and Applied Mathematics, founded by Richard Courant. The purpose of this book is to present a general theory of mathematical structures, expressed in the language of category theory, designed to be used both as a textbook and as a reference source. The only formal prerequisite is an elementary knowledge of set theory, but an additional acquaintance with some algebra, topology, or computer science will be helpful, since concepts and results are illustrated by various examples from these fields. Chapter headings: 0. Introduction; 1. Categories, functors and natural transformations; 2. Objects and morphisms; 3. Sources and sinks; 4. Factorization structures; 5. Adjoints and monads; 6. Topological and algebraic categories; 7. Cartesian closedness and partial morphisms.

The Complexity of Robot Motion Planning. By John F. Canny. The MIT Press, 1988. xii + 195 pp., $27.50.

This is a volume in the series ACM Doctoral Dissertation Awards. The main problem tackled in the monograph is the "generalized movers' problem," which is the problem of moving a general robot, which could be an arm or a mobile robot, in a three-dimensional environment filled with obstacles. The main contribution of the thesis is the roadmap algorithm which solves this problem in single exponential time, with exponent equal to the number of degrees of freedom. This algorithm equals or betters the asymptotic performance of most special purpose algorithms, and has dramatically lower constants.

Lexical Representation and Process. Edited by William Marslen-Wilson. A Bradford Book. The MIT Press, 1989. x + 575 pp., $25.00.

This book is based on a set of beliefs about what are the important issues in the study of human language comprehension and production. These beliefs situate the mental lexicon as the central link in language processing. The lexicon serves to relate the speech signal to mental representations of lexical form, and to relate lexical contents to the syntactic and semantic interpretation of the message being communicated. This means that the proper psycholinguistic study of the lexicon requires one to combine theories of the form and content of lexical representation with theories of lexical processing. These themes are realized in four different ways in the four parts of the book, which are entitled: I. Psychological models of lexical processing (five papers); II. The nature of the input (four papers); III. Lexical structure and process (five papers); IV. Parsing and interpretation (four chapters).

Elements of Bayesian Statistics. By Jean-Pierre Florens, Michel Mouchart, and Jean-Marie Rolin. Marcel Dekker, Inc., 1990. xxiii + 499 pp. $45.00 on orders of five or more copies for classroom use only; $99.75 U.S. and Canada; $119.50 all other countries.

This is a volume in the series Pure and Applied Mathematics. Although the first objective of this monograph is a systematic exposition of the Bayesian model, the authors also endeavour to get a deeper understanding of the role of prior probability by examining, for instance, how far a given property would be robust to a given modification of the prior probability or by comparing concepts and results in a Bayesian and in a sampling-theory approach; in particular, they give several theorems concerning the equivalence of the two approaches. The decision-theoretic flavour is introduced by means of σ-fields on the parameter space representing "parameters of interest." Chapter headings: 0. Basic tools and notation from probability theory; 1. Bayesian experiment; 2. Admissible reductions: sufficiency and ancillarity; 3. Admissible reductions in reduced experiments; 4. Optimal reductions: maximal ancillarity and minimal sufficiency; 5. Optimal reductions: further results; 6. Sequential experiments; 7. Asymptotic experiments; 8. Invariant experiments; 9. Invariance in stochastic processes.

Signal Processing: Part I—*Signal Processing Theory.* Edited by L. Auslander, T. Kailath, and S. Mitter. Springer-Verlag, 1900. 251 pp., $29.00.

This is Volume 22 of the IMA Volumes in Mathematics and its Applications. It is based on lectures delivered during a six week program at the IMA from June 27 to August 5, 1988. The first two weeks of the program dealt with general areas and methods of signal processing. The problem areas included imaging and analysis of recognition, x-ray crystallography, radar and sonar, signal analysis and 1-D signal processing, speech, vision, and VLSI implementation. The methods discussed included harmonic analysis and wavelets, operator theory, algorithm complexity, filtering and estimation, and inverse scattering. The topics of weeks three and four were digital filters, VLSI implementation, and integrable circuit modelling. In week five the concentration was on robust and nonlinear control with aerospace applications, and in week six the emphasis was on problems in radar, sonar and medical imaging. In the proceedings (this and the following review) the material is divided into two parts somewhat differently: part I deals with general signal process theory and part II with (i) application of signal processing, (ii) control theory related themes.

The Physics of Vibration. By Sir Brian Pippard. Cambridge University Press, 1989. x + 639 pp., $65.00.

This is an omnibus, one-volume, edition of the work originally published in two volumes, which examines the classical vibrator in Part 1 and the quantum vibrator in Part 2. The classical harmonic oscillator, and its response to periodic driving forces and to noise, are treated fully, with emphasis on the underlying unity of all linear oscillations in electrical, mechanical, and acoustic systems. In Part 2 the emphasis is on problems that demand quantum-mechanical treatment, particularly vibrations in atoms, molecules, and solids and the response of quantized systems to electromagnetic radiation. The impulse-response function is used extensively in both parts and serves to demonstrate the similarities of classical and quantum behaviour. As often as possible real examples are used as illustrations, and theory is compared with experiment. This is a book for advanced undergraduates and graduate students, as well as applied mathematicians, physicists, and engineers in university and industry.

Signal Processing: Part II—*Control Theory and Applications.* Edited by F. A. Gruen-baum, J. A. Helton, and P. Khargonekar. Springer-Verlag, 1990. 411 pp., $39.00.

This is Volume 23 of the IMA Volumes in Mathematics and its Applications. It is based on lectures delivered during a six week program at the IMA from June 27 to August 5, 1988 (see previous review). There are nine papers in Chapter 1, Control Theory, and eleven papers in Chapter 2, Applications to Signal Processing.

Probability for Applications. By Paul E. Pfeiffer. Springer-Verlag, 1990. xix + 679pp., $59.95.

This text, a volume in the series Springer Texts in Statistics, grew out of a first course in probability, taken at the junior or senior level by students in a variety of fields. The 23 chapters are divided into four parts: 1. Basic probability; 2. Random variables and distributions; 3. Mathematical expectation; 4. Conditional expectation. The latter includes chapters on counting and Poisson processes and Markov sequences. The author suggests that much of the theoretical material, particularly in the chapter appendices, can be omitted in a first course. It is included for readers interested in the basis for propositions stated without proof in the chapters.

The Multivariate Normal Distribution. By Y. L. Tong. Springer-Verlag, 1990. xii + 271 pp., $49.80.

This is a volume in the Springer Series in Statistics. It attempts to provide a comprehensive and coherent treatment of the classical and new results related to the multivariate normal distribution (m.n.d.). The material is organized in a unified modern approach, and the main themes are dependence, probability inequalities, and their roles in theory and applications. Some general properties of a multivariate normal density function are discussed, and results that follow from these properties are reviewed extensively. More attention is focused on a systematic presentation of results rather than on listing them exhaustively. Chapter headings: 1. Introduction; 2. The bivariate normal distribution; 3. Fundamental properties and sampling distributions of the m.n.d.; 4. Other related properties; 5. Positively dependent and exchangeable normal variables; 6. Order statistics of normal variables; 7. Related inequalities; 8. Statistical computing related to the m.n.d.; 8. The multivariate t-distribution.

Statistics for Lawyers. By Michael O. Finkelstein and Bruce Levin. Springer-Verlag, 1990. xxii + 608 pp., $59.00 (cloth), $39.00 (paper).

This is a volume in the series Springer Texts in Statistics. It is its aim to introduce lawyers and prospective lawyers to methods of statistical analysis used in legal disputes, by presenting a series of case studies interlaced with sections of mathematical exposition. The studies are drawn primarily from actual cases. Also included are some statistical studies of the legal system and of the impact of proposed legislation or regulation. The book could also serve as a source book of interesting and realistic problems for introductory statistics courses. The chapter headings are: 1. Descriptive statistics; 2. Methods of counting; 3. Elements of probability; 4. Some probability distributions; 5. Statistical inference for two proportions; 6. Comparing multiple proportions; 7. Comparing means; 8. Combining evidence across independent strata; 9. Sampling issues; 10. Survival analysis; 11. Nonparametric methods; 12. Regression methods.

Dynamic Fracture Mechanics. By L. B. Freund. Cambridge University Press, 1990. xvii + 563 pp., $59.50.

This is a volume in the series Cambridge Monographs on Mechanics and Applied Mathematics. This comprehensive treatise summarizes the current state of the mechanics of dynamic fracture. The emphasis is on fundamental concepts, the development of mathematical models of phenomena which are dominated by mechanical features, and the analysis of these models. Typical mathematical problems are stated formally, and they are also described in common language in an effort to make their features clear. The problems are solved using mathematical methods that are developed to the degree necessary to make the presentation more or less self-contained. Relevant results of experimental and computational approaches are cited. The overall organization of the book is evident from the chapter titles: 1. Background and overview; 2. Basic elastodynamic solutions for a stationary crack; 3. Further results for a stationary crack; 4. Asymptotic fields near a moving crack tip; 5. Energy concepts in dynamic fracture; 6. Elastic crack growth at constant speed; 7. Elastic crack growth at nonuniform speed; 8. Plasticity and rate effects during crack growth. There is a 37 page bibliography.

The Stable Marriage Problem—Structure and Algorithms. By Dan Gusfield and Robert W. Irving. The MIT Press, 1989. xvii +240 pp., $27.50.

The *Stable Marriage Problem* has its origin in a 1962 paper by David Gale and Lloyd Shapley. A stable marriage is a one-one pairing of a set of men to a set of women, containing no man and woman who would agree to leave their assigned partners in order to marry each other. The paper gave an algorithm for finding a stable matching in the monogamous as well as in the polygamous versions. Since the Gale-Shapley paper, many additional variants of the basic problem have been introduced and studied. In 1976 Donald Knuth wrote a monograph summarizing most of what was known about the problem up to that time. The present book presents in one coherent exposition most of the algorithmically and structurally interesting results that are known about stable matching problems. Many earlier proofs have been simplified and unified, and earlier results have been strengthened. Also, new results and efficient algorithms are published for the first time. Moreover, the book develops the structure of the set of stable matchings in the stable marriage problem in a more general and algebraic context than has been done previously. It also demonstrates the relationship between the structure of the stable marriage problem and the more general stable roommates problem, in which each person in a set of even cardinality ranks *all* of the others in order of preference.

The Penrose Transform—Its Interaction with Representation Theory. By Robert J. Baston and Michael G. Eastwood. Oxford University Press, 1990; xv + 213 pp., $47.50.

The isomorphism between a sheaf cohomology group on a region of projective space and solutions of a zero rest mass field equation on a region of spacetime has become known as the *Penrose transform*. The purpose of the present monograph is to construct an analogue of the *Penrose transform* when the conformal group is replaced by any complex semi-simple Lie group and to study its relation to the representation theory of reductive Lie groups and algebras. For the physicist, this means that the authors are able to give a systematic exploration of twistor theory in dimensions higher than four. Chapter headings: 1. Introduction; 2. Lie algebras and flag manifolds; 3. Homogeneous vector bundles on G/P; 4. The Weyl group, its actions, and Hasse diagrams; 5. The Bott-Borel-Weil theorem; 6. Realizations of G/P; 7. The Penrose transform in principle; 8. The Bernstein-Gelfand-Gelfand resolution; 9. The Penrose transform in practice; 10. Constructing unitary representations; 11. Module structures on cohomology; 12. Conclusions and outlook.

Categorical Data Analysis. By Alan Agresti. John Wiley & Sons, 1990. xv + 558 pp., $49.95.

This is a volume of the Wiley Series in Probability and Mathematical Statistics. It summarizes the methods for analyzing categorical data which have been developed this past quarter century. It gives special emphasis to loglinear and logit modeling techniques, which share many features with linear methods for continuous variables. It has been written with practicing statisticians and biostatisticians in mind but can also be used for courses in categorical data analysis. Chapters 1–3 cover traditional methods for two-way contingency tables, Chapters 4–7 introduce basic loglinear and logit models for two-way and multiway tables, Chapters 8–11 present applications and generalizations of these models, and Chapters 12–13 present the theoretical foundations for modeling categorical data. The headings of these chapters are: 1. Introduction; 2. Describing two-way contingency tables; 3. Inference for two-way contingency tables; 4. Models for binary response variables; 5. Loglinear models; 6. Fitting loglinear and logit models; 7. Building and applying loglinear models; 8. Loglinear-logit models for ordinal variables; 9. Multinomial response models; 10. Models for matched pairs; 11. Analyzing repeated categorical response data; 12. Asymptotic theory for parametric models; 13. Estimation theory for parametric models. There is a historical appendix, one on computer software and one giving tail probabilities for chi-squared distributions, as well as a 33-page bibliography.

Annual Review of Fluid Mechanics, Volume 22, 1990. Edited by John L. Lumley, Milton van Dyke, and Helen L. Reed. Annual Reviews, Inc., 1990. vi + 592 pp., $38.00.

In accordance with tradition, this volume, too, leads off with the portrait of a distinguished figure in the history of fluid dynamics and an article about his/her work. This time it is Osborne Reynolds, and the article on the Reynolds number is by N. Rott. There are 17 other review articles, on subjects such as viscoelastic fluids, wave loads on offshore structures, granular flows, human-powered flight, oceanography, forced surface waves, turbulence, numerical fluid dynamics, yacht design, optical rheometry, wakes, instabilities, and wind-tunnel problems.

Annual Review of Computer Science—Volume 3, 1988. Edited by Joseph F. Traub, Barbara J. Grosz, Butler W. Lampson, and Nils J. Nilsson. Annual Reviews, Inc., Palo Alto, CA, 1988. 420 pp., $45.00.

This year's volume contains review articles on: database security, expert systems, protein folding, geometric reasoning, image analysis, programming logics, LISP, common-sense physics, parallel combinatorial computation, theorem proving, complexity theory, computer applications in manufacturing, and computational geometry.

Partial Differential Equations—Analytic Solution Techniques. By J. Kevorkian. Wadsworth & Brooks/Cole, 1989. xiv + 547 pp., $54.95.

This is a text for a two-semester or three-quarter sequence of courses. It is assumed that the student has a good background in vector calculus and ordinary differential equations and has been introduced to separation of variables, Fourier series, and eigenfunction expansions. Chapter headings: 1. The diffusion equation; 2. The Laplace equation; 3. The wave equation; 4. Linear second-order equations with two independent variables; 5. Quasilinear first-order equations; 6. Nonlinear first-order equations; 7. Quasilinear hyperbolic systems; 8. Perturbation solutions.

The Algebraic Eigenvalue Problem. By J. H. Wilkinson, FRS. Oxford University Press, 1988. xviii + 662 pp., $39.95.

This is the first paperback edition of the treatise by the late John Wilkinson, which became a classic almost on its first publication in 1965; it has been reprinted several times, with corrections, since then. It concentrates on the computation of eigenvalues and eigenvectors of matrices and includes a study of those theoretical properties of matrices which are most important in practical applications. Questions of sensitivity, and the economy and stability of many numerical methods are treated in rigorous detail, but always in a manner accessible to engineers and scientists.

Mathematical Modelling in Non-Destructive Testing. Edited by Michael Blakemore and George A. Georgiou. Oxford University Press, 1988. xi + 365 pp., $75.00.

This is Volume 16 in The Institute of Mathematics and its Applications Conference Series, and is based on a conference held at Jesus College, Cambridge, in September 1986. Its main aim was to encourage dialogue between theoreticians on the one hand and practising NDT engineers on the other. There are two general papers—*Mathematical modelling in NDT, what it is and what it does*, by J. M. Coffey, and *The rôle of mathematical modelling in validation*, by D. Firth—and twelve papers grouped under the headings Ultrasonics, Electromagnetics, and Geophysics. There are also four poster session contributions.

Stably Stratified Flow and Dense Gas Dispersion. Edited by J. S. Puttock. Oxford University Press, 1988. xiv + 430 pp., $89.00.

This is Volume 15 in The Institute of Mathematics and its Applications Conference Series, and is based on a conference—one of several organised by the Institute on environmental mathematics—held in Chester in April 1986. The emphasis was on the dispersion of gases which are heavier than air, a topic important in the prediction of the consequences of accidental release of many toxic and flammable gases. There are sixteen papers: a review paper by R. E. Britter, papers related to turbulence in the stably-stratified boundary layer and turbulence simulation using second-order closure, several on grid-models for buoyancy-dominated flows, and some special models.

Schauder Bases: Behaviour and Stability. By P. K. Kamthan and M. Gupta. Longman Scientific & Technical, copublished in the U.S. with John Wiley & Sons, 1988. 514 pp., $83.95.

This is Volume 42 in the Pitman Monographs and Surveys in Pure and Applied Mathematics. It is the third and last part of a project on Schauder bases in topological vector spaces, initiated by the authors in 1972, the first two parts having already appeared (*Sequence Spaces and Series*, Marcel Dekker, 1981, and *Theory of Bases and Cones*, Pitman, 1985). The aim of the authors is twofold: to collect systematically all the significant work in the field and communicate it to graduate students, and to provide for experts a single source of reference on the heuristic development of the subject matter.

Coding Theory and Design Theory: Part II—*Design Theory.* Edited by Dijen Ray-Chaudhuri. Springer-Verlag, 1990. 378 pp., $39.00.

This is Volume 21 of the IMA Volumes in Mathematics and its Applications. It is based on the proceedings of a workshop which was an integral part of the 1987–88 IMA program on Applied Combinatorics. The purpose of the Year was to bring together coding theorists, design theorists, and statisticians in the area of experimental design. Combinatorial designs are generalisations of finite geometries. The history of design theory probably begins with the 1887 paper of Reverend T. P. Kirkman "On a problem of Combinatorics" in the Cambridge and Dublin Mathematical Journal. R. A. Fisher reinvented the concept of combinatorial 2-design in the twentieth century. There are 27 papers in this volume.

Wave Phenomena—Theoretical, Computational, and Practical Aspects. Edited by Lui Lam and Hedley C. Morris. Springer-Verlag, 1989. xii + 275 pp., $49.95.

This is the Proceedings of the First Woodward Conference at San Jose State University, June 2–3, 1988. Part I consists of six papers on theoretical aspects such as pseudodifferential operator techniques, inverse problems, and the mathematical foundations of wave propagation in random media. Part II consists of five papers that involve significant amounts of computation. Included are papers on the Fast Hartley Transform, computational algorithms for electromagnetic scattering problems, and nonlinear wave interaction problems in fluid mechanics. Part III contains six papers which illustrate the importance of wave phenomena in physics—waves in the atmosphere, viscous fingering in liquid crystals, solitons, and wave localisation.

Exercises in Probability. By T. Cacoullos. Springer-Verlag, 1989. ix + 248 pp., $49.80.

This is a volume in the series Problem Books in Mathematics. Its original Greek edition was published in two volumes in 1971 and 1972, respectively. It is designed to serve as a companion text for an introductory or intermediate-level one- or two-semester probability course to seniors or first year graduate students. In Part I (with 170 exercises) emphasis is given to elementary matters such as one-dimensional, discrete and continuous distributions and their moments, but including some challenging problems. Part II deals with more advanced topics such as multivariate distributions, characteristic functions, distributions of functions of random variables, Laws of Large Numbers and Central Limit Theorems, stochastic inequalities, geometrical probabilities, and application of difference equations.

Dynamics of Curved Fronts. Edited by Pierre Pelcé. Academic Press, 1988. xii + 514 pp., $69.50.

This is a volume in the series Perspectives in Physics. It is divided into two parts. The first (94 pp.) is an introduction to the problem of selection and stability of moving fronts, from the flat interface to the complex dendrite. The second part is a compendium of the relevant articles on the subject. The chapter headings in Part I are: 1. Introduction; 2. The Saffman-Taylor finger; 3. Stationary shapes of a needle crystal growing from a supercooled liquid; 4. Stationary shapes of a curved flame propagating in a channel; 5. Stability of curved fronts. There is a bibliography of 146 items. The papers in Part II are grouped under the headings: Planar front propagation, dragging of a liquid by a moving plate, Saffman-Taylor finger, dendrites, directional solidification, raising bubbles, and premixed flames.