QUARTERLY

OF

APPLIED MATHEMATICS

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VOLUME LVII **JUNE • 1999** **NUMBER 2**

QUARTERLY OF APPLIED MATHEMATICS

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

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

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."

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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 that 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

Vol. LVII, No. 2 **June 1999**

The Inverse Gaussian Distribution—A Case Study in Exponential Families. By V. Seshadri, Oxford University Press, 1994, 256 pp., $60.00

This is a volume in the series Oxford Science Publications. The inverse Gaussian distribution arises most naturally as the distribution of the first passage time of one-dimensional Brownian motion with positive drift, and it serves as a bridge between the domains of probability and statistics. The book begins with an enlightening historical survey, tracing many new results, discovered since the pioneering days of Bachelier, Schrödinger, and Smoluchowsky, and illuminating some hither-to unknown facts regarding the distribution's genesis. Chapter 2 contains basic theory of exponential families, focusing on the inverse Gaussian law. Chapter 3 is devoted to various characterization results and chapter 4 deals with the many ramifications that the distribution provides—the construction of multivariate distributions, combinations and finite mixtures. Chapter 5 introduces the new concept of inverse natural exponential families. The monograph concludes with a collection of useful statistical results in chapter 6. There are exercises at the end of each chapter, meant to complement the text.

Biostatistics—A Foundation for Analysis in the Health Sciences, Sixth Edition. By Wayne W. Daniel, John Wiley and Sons, 1994, xv+780 pp., $48.00

This is a volume in the Wiley Series in Probability and Mathematical Statistics. Like its predecessors, this edition requires only reasonable proficiency in algebra for an understanding of the methods and procedures underlying the calculations. The emphasis is again on an intuitive understanding of principles. Because of the widespread use of personal computers, this edition contains a greater emphasis on computer applications. For most of the statistical techniques covered, the author gives the MINITAB commands by which they can be applied. Also, computer printouts obtained by use of the SAS software package are provided for the first time in this edition. In addition, there are some major and minor specific improvements, many suggested by readers and reviewers.

Applied Discriminant Analysis. By Carl J. Huberty, John Wiley and Sons, 1994, xix+466 pp., $59.95

This is a volume in the Wiley Series in Probability and Mathematical Statistics. It is addressed to three types of readers: graduate students who want to expand their background in multivariate analysis methods; experienced applied researchers who want to enhance or update their quantitative background, and methodologists who want to learn about some of the details or unresolved problems in applied discriminant analysis. Four real data sets, contained in an accompanying diskette, are utilized to illustrate various analysis results, in both text examples and exercises; the illustrative results were obtained via the statistical computer packages BMDP, SAS, and SPSS. Two aspects of discriminant analysis are emphasized in this book: predictive discriminant analysis (PDA) and descriptive discriminant analysis (DDA). In the behavioral sciences DDA is prevalent, whereas researchers in most other fields, including statisticians, generally think of PDA. In this book, PDA is presented first (in Part Two). Part Three (i.e., DDA) may, however, be studied first. Chapter headings: Part I, Introduction; 1. Preliminaries; 2. Discriminant analysis in research; Part II, Prediction; 3. Basic ideas of classification; 4. Multivariate normal rules; 5. Classification results; 6. Hit rate estimation; 7. Effectiveness of classification rules; 8. Selecting and ordering predictors; 9. Two-group classification; 10. Nonnormal rules; 11. Reporting results of a PDA; 12. Applications of PDA; Part III, Description; 13. Group separation; 14. Assessing effects; 15. Describing effects; 16. Selecting and ordering variables; 17. Reporting results of a DDA; 18. Applications of DDA; Part IV, Issues and problems; 19. Issues; 20. Special problems.

Quantitative Methods in Biological and Medical Sciences—A Historical Essay. By H. O. Lancaster, Springer-Verlag, 1994, xvii+297 pp., $69.00

This volume surveys the impact that quantitative methods have had on the development of modern biological and medical science. Its range is indicated by its table of contents: 1. Greek science; 2. Later influences of the Greek authors; 3. Microscopic world and the structure of living organisms; 4. Genetics; 5. Human genetics; 6. Death rates and life tables; 7. Evolution; 8. Infectious diseases and microbiology; 9. Puerperal sepsis; 10. Wounds and hospital infections; 11. Epidemiological observations; 12. Mathematics and epidemiology; 13. Epidemiology of noninfectious diseases; 14. Metrical characterizations of individuals and populations; 15. Quantitative diagnostics and physiological methods; 16. Classification of diseases; 17. Numerical analysis of clinical experience; 18. Modern clinical trials; 19. Applications of mathematics to biology and medicine. There is a bibliography of close to 800 items.

Measurement, Regression and Calibration. By Philip J. Brown, Oxford University Press, 1994, ix+201 pp., $45.00

This is a volume in the Oxford Statistical Science Series. It has been designed as a research monograph for regression problems in which one set of variables is predicted from another. Chapters 6 and 7 refer mostly to methods that have been specifically developed for spectroscopy. The other chapters are quite general in their applicability. Likelihood and Bayesian inference features strongly. Chapter headings 1. Introduction; 2. Simple linear regression; 3. Multiple regression and calibration; 4. Regularized multiple regression; 5. Multivariate calibration; 6. Regression on curves; 7. Nonlinearity and selection; 8. Pattern recognition. There are two March appendices, on distribution theory and on conditional inference.

Markov Decision Processes—Discrete Stochastic Dynamic Programming. By Martin L. Puterman, John Wiley and Sons, 1994, xvii+649 pp., $79.95

This is a volume in the Wiley Series in Probability and Mathematical Statistics. It is intended to be a comprehensive reference for researchers, and also to serve as a text in an advanced undergraduate or graduate level course in operations research, economics, or control engineering. The material should be of interest, moreover, to management and computer scientists, economists, applied mathematicians, control and communications engineers, statisticians, and mathematical ecologists. The book has been kept self-contained by the inclusion of relevant appendices. Markov decision processes, also referred to as stochastic dynamic programs or stochastic control problems, are models for sequential decision making under uncertainty. The model consists of decision epochs, states, actions, rewards, and transition probabilities. Choosing an action in a state generates a reward and determines the state at the next decision epoch through a transition probability function. Policies are prescriptions of which action to choose under any eventuality at every future decision epoch. Decision makers seek policies that are optimal in some sense. The book chapters are organized on the basis of the optimality criterion. The primary focus of the book is infinite-horizon discrete-time models with discrete state spaces. The chapter headings are: 1. Introduction; 2. Model formulation; 3. Examples; 4. Finite-horizon Markov decision processes; 5. Infinite-horizon models: foundations; 6. Discounted Markov decision problems; 7. The expected total-reward criterion; 8. Average reward and related criteria; 9. The average reward criterion—multichain and communicating models; 10. Sensitive discount optimality; 11. Continuous-time models.

System Reliability Theory—Models and Statistical Methods. By Arnljot Hoyland and Marvin Rausand, John Wiley and Sons, 1994, x+518 pp.

This is a volume in the Wiley Series in Probability and Mathematical Statistics, Applied Probability and Statistics Section. In the first five chapters (Introduction, Failure Models, Qualitative Systems Analysis, Systems of Independent Components, Component Importance), the authors confine themselves to situations where the state variables of components and systems are binary and independent. These chapters constitute a fairly elementary, though comprehensive, introduction to systems reliability theory. The remaining part of the book is more advanced. In chapter 6 (Markov Models) situations where components and systems may be in two or more states are discussed. This situation is modeled by Markov processes. Renewal theory is treated in chapter 7 (Counting Processes), and dependent failures in chapter 8. A broad introduction to life data analysis is given in chapter 9, accelerated life testing in chapter 10, and Bayesian reliability analysis in chapter 11. The book concludes with information about reliability data in chapter 12. There is a large number of worked examples, and each chapter ends with a selection of problems, providing exercises and additional applications.

Stochastic Processes, Second Edition. By J. Medhi, John Wiley and Sons, 1994, xv+598 pp.

This is the second edition of a text published in 1981. Substantial additions and alterations have been effected in this edition, particularly, for instance, chapter 10, by the addition of networks of Markovian queues. Martingales have been added to chapter 2, reducible chains to chapter 3, randomization to chapter 4, renewal theory in discrete time and regenerative inventory systems to chapter 6, generalized Galton Watson processes to chapter 9. There are ten chapters: 1. Probability distributions; 2. Stochastic processes: some notions; 3. Markov chains; 4. Markov processes with discrete state space: Poisson process and its extensions; 5. Markov processes with continuous state space; 6. Renewal processes and theory; 7. Markov renewal and semi-Markov processes; 8. Stationary processes and time series; 9. Branching processes; 10. Stochastic processes in queuing and reliability.

Vorticity and Turbulence. By Alexandre J. Chorin, Springer-Verlag, 1994, viii+174 pp., $35.00

This is volume 103 in the series Applied Mathematical Sciences. It provides an introduction to the theory of turbulence in fluids based on the representation of the flow by means of its vorticity field. The first three chapters contain an introduction to homogeneous turbulence; a quick review of the fluid dynamics is followed by a summary of the appropriate Fourier theory and by a summary of Kolmogorov's theory of the inertial range, slanted so as to dovetail with later vortex-based arguments. The remainder of the book presents the vortex dynamics of turbulence. In chapter 4, the Onsager and Joyce-Montgomery discoveries in the two-dimensional case are presented from a contemporary point of view. Chapter 5 summarizes the fractal geometry of vortex stretching, and chapter 6 provides a brief but self-contained introduction to the tools needed for further analysis, in particular polymer statistics, percolation, and real-space renormalization. In chapter 7, these tools are used to analyze a simple model of three-dimensional vortex statistics. The Kolmorov theory is revisited; a rationale is provided for the effectiveness of some large-eddy approximations; and a contrast is drawn between classical and superfluid turbulence.

Aspects of Uncertainty—A Tribute to D. V. Lindley. Edited by P. R. Freeman and A. F. M. Smith, John Wiley and Sons, 1994, xviii+392 pp., $79.95

This is a volume in the Wiley Series in Probability and Mathematical Statistics. It contains a collection of 22 previously unpublished papers by 36 authors, offered as a tribute to Dennis Lindley on his 70th birthday. Most papers deal with aspects of Bayesian inference, in recognition of Lindley's seminal contributions to this approach to statistics, as well as with other areas in which Lindley has worked.

Mathematical Statistics and Data Analysis. By John A. Rice, Duxbury Press, 1995, xx+602 pp.

This is the second edition of a textbook first published in 1988. For this edition the author has expanded and revised discussions and, in particular, added an introduction to the bootstrap in several places: first the parametric bootstrap in connection with parameter estimation and sampling distributions. The nonparametric bootstrap is introduced in the context of estimating the standard error of a location estimate. It arises again as a method for assessing the variability of a shift estimate and of the estimate of an odds ratio. More than 150 new problems have been added. There is also a diskette containing the data sets used in the text.

Numerical Methods for Fluid Dynamics 4. Edited by M. J. Baines and K. W. Morton, Oxford University Press, 1993, xviii+604 pp., $90.00

These are the Proceedings of the International Conference on Numerical Methods for Fluid Dynamics held at Reading University in April 1992. It is one in a series that has been held alternately at Oxford and at Reading since the early eighties, most under the aegis of the Institute for Computational Fluid Dynamics, a joint research organization set up in 1983. There are the texts of 14 invited and 41 contributed papers, highlighting the following themes: implicit methods in CFD, mesh generation and error analysis (including mesh quality), numerical boundary conditions (particularly non-reflective), multigrid and alternative methods for hyperbolic systems.

GLIM 4—The Statistical System for Generalized Linear Interactive Modeling. I. Edited by Brian Francis, Mick Green, and Clive Payne, Oxford University Press, 1993, $93.00

This manual describes how Release 4 of GLIM may be used for statistical analysis of data in its most general sense, including data manipulation and display, model fitting, and prediction. The statistical models that can be fitted in GLIM are contained in the Generalized Linear Modeling (GLM) scheme originally developed by Neder and Wedderburn in 1972. The manual has three parts: 1. The User Guide (Chapters 1–9); 2. The Modeling Guide (Chapters 10–12); 3. The Reference Guide (Chapters 13–17). Of these, Part II is useful independently of GLIM. Chapter 10 provides an introduction to Generalized Linear Models (with reference to the GLIM4 system). It contains descriptions of the standard models subsumed in the GLM scheme and covers extensions to related types of models. Chapter 11 covers the theoretical basis of the GLM scheme. Chapter 12 contains complete and self-contained examples of the application of GLIM4 to a wide range of models applied to a variety of types of data.

An Introduction to Regression Graphics. By R. Dennis Cook and Sanford Weisberg, John Wiley and Sons, 1994, xx+253 pp.

This is a volume in the Wiley Series in Probability and Mathematical Statistics. It is about using graphs to understand how a response variable depends on one or more predictors, bringing two new sets of ideas to bear on the problem: first, the facilities and resources provided by modern computer technology, using motion to convey graphical information, and secondly an emerging theory that provides information on what to look for in graphs and how to interpret what is seen. This leads to a description of how to discover the structure of most regression problems and how to translate that structure into useful models. The book is written to be accessible to students who are currently learning linear regression for the first time. Since the ideas described in the book require an approach to statistical computing not currently available in standard statistical software, the software, called the R-code (short for regression code) is provided with the book, in the form of two diskettes, for Windows and the Macintosh, respectively. The R-code is a nearly complete system for linear regression analysis and could be used as the only program in a linear regression course, even without using its graphics capability. The book is the manual for the R-code, although most of the ideas are independent of the program. The chapter headings are: 1. Getting started; 2. Simple regression plots; 3. Two-dimensional plots; 4. Scatterplot matrices; 5. Three-dimensional plots; 6. Visualizing linear regression with two predictors; 7. Visualizing regression without linearity; 8. Finding dimension; 9. Predictor transformations; 10. Response transformations; 11. Checking models; 12. Assessing predictors; 13. Influence and outliers; 14. Confidence regions.

Statistics for the Environment. Edited by Vic Barnett and K. Feridun Turkman, John Wiley and Sons, 1993, xix+427 pp., $110.00

These are the proceedings of a conference held in the Calouste Gulbenkian Centre, Lisbon, Portugal, 7–10 April 1992, organized under the auspices of SPRUCE, an international initiative concerned with *Statistics in Public Resources, Utilities and in Care of the Environment.* The eighteen papers are divided into six parts: 1. Environmental monitoring and sampling; 2. Measuring levels and consequences of pollution and contamination; 3. Climatological and meteorological issues; 4. Water resources; 5. Dynamics of fish populations; 6. Forestry: supply and conservation.

Toward a History of Game Theory. Edited by E. Roy Weintraub, Duke University Press, 1993, vi+306 pp., $35.00

The eleven papers collected in this volume were presented at a conference on the history of game theory hosted by the economics department of Duke University in October 1990. They are divided into three parts. Part I (five papers) is entitled *Creating Game Theory* and presents the most interesting histiographic problems for the reconstruction of the history of the theory of games. Part II is entitled *The Diffusion of Game-Theoretic Ideas.* The three papers in it recount the particular ways that the new theory of games made its way into the literature of the time and the particular mechanisms by which game theory became known among the relevant community of scholars. The three papers in Part III (*Crossing Disciplinary Boundaries*) concern the transmission of the new game-theoretic ideas into areas and communities apart from mathematics and economics. The authors of the papers are: Robert W. and Mary Ann Dimand, Urs Rellstab, Andrew Schotter, Philip Mirowski, Martin Shubik, Howard Raiffa, Angela M. O'Rand, William H. Riker, Robin E. Rider, Vernon L. Smith. There is also an introduction by the editor, which sets the stage for the developments discussed in the articles.

Statistical Methods for Physical Science. Edited by John L. Stanford and Stephen B. Vardeman, Academic Press, 1994, xix+542 pp., $99.00

This is volume 28 in the series Methods of Experimental Physics. It is a readable, self-contained introduction to a variety of old and new methods, widely applicable and important in the physical sciences. There are seventeen chapters: 1. Introduction to probability modeling, by William R. Leo; 2. Common univariate distributions, by Laurent Hodges; 3. Random process models, by Christopher Chatfield; 4. Models for spatial processes, by Noel Cressie; 5. Monte Carlo methods, by Peter Clifford; 6. Basic statistical inference, by John Kitchin; 7. Methods for assessing distributional assumption in one- and two-sample problems, by Vijayan N. Nair and Anne E. Freeny; 8. Maximum likelihood methods for fitting parametric statistical models, by William Q. Meeker and Luis A. Escobar; 9. Least squares, by George A. F. Seber and Christopher J. Wild; 10. Filtering and data preparation for time series analysis, by William J. Randel; 11. Spectral analysis of univariate and bivariate time series, by Donald B. Percival; 12. Weak periodic signals in point process data, by David A. Lewis; 13. Statistical analysis of spatial data, by Dale Zimmerman; 14. Bayesian methods, by Harry F. Martz and Ray A. Waller; 15. Simulation of physical systems, by John M. Hauptman; 16. Field (map) statistics; 17. Modern statistical computing and graphics, by Frederick L. Hulting and Andrzej P. Jaworski.

Applied Nonlinear Dynamics. By Ali H. Nayfeh and Balakumar Balachandran, John Wiley and Sons, 1995, xv+685 pp., $64.95

This is a volume in the Wiley Series in Nonlinear Science. In it, the authors have aimed to give the reader a survey of the standard analytical, experimental and numerical methods available for nonlinear dynamics, as well as to include some of the recent developments in the area of control of nonlinear dynamics of systems. In chapter 1 they introduce dynamical systems. In chapters 2–5 they address equilibrium solutions, periodic and quasiperiodic solutions, and chaos. They present some relevant theorems and their implications in chapters 2 and 3. Proofs are not given, but references that provide them are listed. The chapters are not written with an aim towards mathematical rigor. Continuation methods for equilibrium and periodic solutions are given in chapter 6. The different tools that can be used to characterize nonlinear motions are examined in chapter 7. In chapter 8, methods for bifurcation control, chaos control, and synchronization to chaos are discussed.

Evolution and Optimum Seeking. By Hans-Paul Schwefel, John Wiley and Sons, 1995, ix+444 pp., $64.95

This is a volume in the Sixth-Generation Computer Technology Series. It offers a systematic overview of both new and classical approaches to computer-aided optimum system design methods, including the new class of Evolutionary Algorithms and other "Parallel Probe, Solving from Nature" methods. It presents numerical optimization methods and algorithms useful particularly for massively parallel computers, offering comparisons between classical direct optimization methods and the newer methods. The author's method consists essentially in the adaptation of simple evolutionary rules to a computer procedure in the search for optimal parameters within a simulation model of a technical device. There is a floppy disk accompanying the book, containing Fortran subroutines of the direct optimization procedures described in chapters 3, 5, and 7 of the book, as well as C source programs for these strategies. Chapter headings: 1. Introduction; 2. Problems and methods of optimization; 3. Hill climbing strategies; 4. Random strategies; 5. Evolution strategies for numerical optimization; 6. Comparison of direct search strategies for parameter optimization; 7. Summary and outlook; 8. References.

Partial Differential Equations in Classical Mathematical Physics. By Isaak Rubinstein and Lev Rubinstein, Cambridge University Press, 1994, xiv+676 pp., $94.95

This book represents an attempt to implement a general approach that in essence views the theory of partial differential equations of mathematical physics as the language of continuous processes, that is, an interdisciplinary science that considers the hierarchy of mathematical phenomena as a reflection of their physical counterparts. Thus, the authors trace the simultaneous origins of some basic mathematical objects in different natural contexts (continuum mechanics, electrodynamics, transport phenomena, thermodynamics, and chemical kinetics). In parallel, they trace the interrelation between different types of problems (elliptic, parabolic, and hyperbolic) as mathematical counterparts of their natural prototypes: steady-state and evolutionary processes (dissipative and conservative). This is done by an asymptotic analysis of the behavior of these processes in time and their dependence on the relevant governing parameters. The scope of the book is indicated by its chapter headings: 1. Introduction; 2. Typical equations of mathematical physics. Boundary conditions; 3. Cauchy problem for first-order partial differential equations; 4. Classification of second-order partial differential equations with linear principal part. Elements of the theory of characteristics; 5. Cauchy and mixed problems for the wave equation in R_1. Method of traveling waves; 6. Cauchy and Goursat problems for a second-order linear hyperbolic equation with two independent variables. Riemann's method; 7. Cauchy problem for a 2-dimensional wave equation. The Volterra-D'Adhemar solution; 8. Cauchy problem for the wave equation in R_3. Methods of averaging and descent. Huygens's principle; 9. Basic properties of harmonic functions; 10. Green's functions; 11. Sequences of harmonic functions. Perron's theorem. Schwarz alternating method; 12. Outer boundary-value problems. Elements of potential theory; 13. Cauchy problem for heat-conduction equation; 14. Maximum principle for parabolic equations; 15. Application of Green's formulas. Fundamental identity. Green's functions for Fourier equation; 16. Heat potentials; 17. Volterra integral equations and their application to solution of boundary-value problems in heat-conduction theory; 18. Sequences of parabolic functions; 19. Fourier method for bounded regions; 20. Integral transform method in unbounded regions; 21. Asymptotic expansions. Asymptotic solution of boundary-value problems. There are appendices on the elements of vector analysis and on the theory of Bessel functions, on Fourier's method and Sturm-Liouville equations, on the Fourier integral.

Introduction to Statistics and Econometrics. By Takeshi Amemiya, Harvard University Press, 1994, xiii+368 pp., $39.95

Chapters 1 through 9 cover probability and statistics, with emphasis on certain topics that are important in econometrics but often overlooked by statistics textbooks at this level: e.g., best prediction and best linear prediction, certain conditional densities, the joint distribution of continuous and discrete random variables, large sample theory, and the properties of the maximum likelihood estimator. A thorough analysis of the problem of choosing estimators is given, including a comparison of various criteria for ranking estimators. The author also presents a critical evaluation of the classical method of hypothesis testing, especially in the realistic case of testing two composite hypotheses against each other. In discussing this as well as other issues, frequent recourse to Bayesian methods is taken. Chapter 10 presents the bivariate classical regression model in subscript notation. Chapter 11 is a brief introduction to matrix analysis, which is used in chapter 12 to present the multiple classical regression model. Chapter 13 discusses various generalizations of the classical regression model, as well as certain other statistical models extensively used in econometrics and other social science applications: qualitative response models, censored and truncated regression models, and duration models. Chapters 1–12 conclude with numerous exercises, but no solutions are provided.