QUARTERLY

OF

APPLIED MATHEMATICS

VOLUME XXXVIII **JULY • 1980** **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.

Manuscripts (two copies) submitted for publication in the QUARTERLY OF APPLIED MATHEMATICS should be sent to the Editorial Office, Box F, Brown University, Providence, R.I. 02912, either directly or through any one of the Editors or Collaborators. 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 proofs only. The authors' institution will be requested to pay a publication charge of $30.00 per page which, if honored, entitles them to 100 free reprints. Instructions will be sent with galley proofs.

The 1979 subscription price for Volume 37 (April 1979–January 1980) is $30.00. Single issues can be purchased, as far as they are available, at $8.00 and back volumes at $25.00 per volume. Subscriptions and orders for back volumes must be addressed to: American Mathematical Society, P.O. Box 1571, Providence, R. I. 02901. All orders must be accompanied by payment. Other subscription correspondence should be addressed to American Mathematical Society, P.O. Box 6248, Providence, R. I. 02940.

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

WILLIAM BYRD PRESS, INC., RICHMOND, VIRGINIA

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: Papers should be submitted in original typewriting on one side only of white paper sheets and be double or triple spaced with wide margins. Marginal instructions to the printer should be written in pencil to distinguish them clearly from the body of the text.

The papers should be submitted in final form. Only typographical errors may be corrected in proofs; composition charges for all 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 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 to follow his name.

Mathematical Work: As far as possible, formulas should be typewritten; Greek letters and other symbols not available on the typewriter should be carefully inserted in ink. Manuscripts containing pencilled material other than marginal instructions to the printer 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 in exponents should be clearly indicated.

Dots, bars, and other markings to be set *above* letters should be strictly avoided because they require costly hand-composition; in their stead markings (such as primes or indices) which *follow* the letter should be used.

Square roots should be written with the exponent $\frac{1}{2}$ rather than with the sign $\sqrt{\ }$.

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,

$$\frac{\cos\,(\pi x/2b)}{\cos\,(\pi a/2b)} \text{ is preferable to } \frac{\cos\dfrac{\pi x}{2b}}{\cos\dfrac{\pi a}{2b}}$$

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 printed formulas. To avoid misunderstanding, the order of symbols should therefore be carefully considered. Thus,

$$(a + bx)\cos t \text{ is preferable to } \cos t(a + bx).$$

In handwritten formulas the size of parentheses, brackets and braces can vary more widely than in print. Particular attention should therefore be paid to the proper use of parentheses, brackets and braces. Thus,

$$\{[a + (b + cx)^n]\cos ky\}^2 \text{ is preferable to } ((a + (b + cx)^n)\cos ky)^2.$$

Cuts: Drawings should be made with black India ink on white paper or tracing cloth. It is recommended to submit drawings of at least double the desired size of the cut. The width of the lines of such drawings and the size of the lettering must allow for the necessary reduction. Drawings which are unsuitable for reproduction will be returned to the author for redrawing. Legends accompanying the drawings should be written on a separate sheet.

Bibliography: References should be grouped together in a Bibliography at the end of the manuscript. References 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 it.

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 Strömung zäher 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 like 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 like 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

—BOOKS RECEIVED—

Diffusions, Markov processes, and martingales, vol. 1: foundations. By David William. John Wiley & Sons, New York, 1979. xiii + 237 pp. $33.00.

This is a volume in the Wiley Series in Probability and Mathematical Statistics. It is the first volume of a two-volume work which attempts to give a global intuitive picture of the modern theory of diffusions, Markov processes, and martingales, with a view towards applications. This first volume is primarily classical. It is divided into three chapters: 1. Introduction to Brownian motion (Wiener measure, narrow convergence, Brownian motion in $\mathbb{R}^n$); 2. Some classical theory (basic measure theory, classical martingale theory, applications, regular conditional probability); 3. Markov processes (transition functions and resolvents, Feller transition functions, Feller–Dynkin processes, addition functionals, ray processes, applications). The second volume, containing more modern work, will particularly stress the power and versatility of stochastic integral theory. The author requests that the following printing error be noted: on the last line of page 73, $\{\omega: T(\omega) \geq t\}$ should read $\{\omega: T(\omega) \leq t\}$.

Stochastic models, estimation, and control, vol. 1. By Peter S. Maybeck. Academic Press, New York, 1979. xiii + 422 pp. $29.50.

This is volume 141 in the series *Mathematics in Science and Engineering.* It is written for engineers, so in addition to developing the fundamental concepts it also applies the theory to realistic practical problems. It avoids measure theory, functional analysis and other disciplines that may not be in an engineer's background. Table of contents: 1. Introduction; 2. Deterministic system models; 3. Probability theory and statistic models; 4. Stochastic processes and linear dynamic system models; 5. Optimal filtering with linear system models; 6. Design and performance analysis of Kalman filters; 7. Square root filtering.

The analysis of cross-tabulated data. By Graham J. G. Upton. John Wiley & Sons, New York, 1979. xii + 148 pp. $26.50.

This is a volume in the Wiley Series in Probability and Mathematical Statistics. Its intention is to provide an introduction to the complexities of the analysis of cross-classified data of the type known to the statistician as a contingency table and to the social scientist as a cross-tabulation. The book is aimed primarily at the social science research worker who has collected his data and must now analyze them. With multivariable data he has in the past conducted the analysis in terms of measures of association for two-way tables; armed with this book he should be able to contemplate a more subtle analysis.

Chapter 1 outlines the general problem and provides brief reminders of the essential statistical techniques. Chapters 2 through 4 are concerned with a resumé of the more useful of the "traditional" methods of analysis, in particular with methods of association. These chapters also provide an introduction to the use of the log-linear model, which is discussed at length in chapters 5 to 9. The final chapter is concerned with the special problems associated with panel data. The principal theme of the book is the central importance of the log-linear model and the associated techniques in the analysis of cross-tabulated data.

Annual review of fluid mechanics, vol. 11. Edited by Milton van Dyke, J. V. Wehausen and John L. Lumley. Annual Reviews, Inc., California, 1979. 556 pp.

This volume features an article "The Kármán years at the Guggenheim Aeronautics Laboratory at the California Institute of Technology" by William R. Sears and Mabel Rhodes Sears. There are seventeen other articles on the following subjects: nonlinear acoustics, cavitation in bearings, oscillations of free shear layers, vortex interactions, sound generation in wind instruments, baroclinic instability, ship boundary layers, drop formation in a jet, rotating masses, mechanics of animal joints, compressible viscous flows, wakes in stratified fluids, internal waves in the ocean, spreading of liquids on solid surfaces, geostrophic turbulence, turbulence measurement with the laser-doppler anemometer, and similarity laws for turbulent wall flows.

(Continued on p. 190)

Continued from page 178

Kinematic geometry of mechanisms. (Oxford Engineering Science Series.) By K. H. Hunt. Oxford University Press, New York, 1979. xvii + 465 pp. $89.00.

This book aims to relate classical two- and three-dimensional geometry to mechanisms. It is not a compendium of recipes for direct use by a designer to analyze and synthesize mechanical devices; rather, it sets down the principles and conditions with which such recipes must comply. The first half, while dealing mainly with familiar planar mechanisms, also prepares the ground for three-dimensional mechanical movements. Then, for the first time in any book, the potential of "screw theory" in the setting of mechanisms is developed in some depth. Chapter headings: 1. The components of mechanisms; 2. Freedom and structure in mechanisms; 3. Elementary planar and spatial displacements; 4. Planar algebraic curves; 5. Infinitesimal planar kinematics; 6. Planar displacements through three and more locations; 7. The four-bar linkage; coupler curves; 8. The geometrical capability of planar mechanics; 9. Three-dimensional geometry and spatial mechanisms; 10. Some spatial mechanisms; 11. Line geometry and spatial mechanisms; 12. Screw systems; 13. Screw systems applied to spatial mechanisms; 14. Body guidance in three dimensions; 15. Manipulator-arms and other linkage-connections.

Mathematical astronomy with a pocket calculator. By Aubrey Jones. John Wiley & Sons, New York, 1978. 254 pp.

Subjects covered in this book include: sidereal and mean time; reduction for precession; proper motion; reduction to apparent place; binary star orbits; coordinates of comets from parabolic and elliptical elements; least squares; equation of the equinoxes; planetary coordinates. Methods are demonstrated for both algebraic logic calculators and those employing reverse Polish notation. The appendix contains 57 fully documented programs for key- and magnetic-card-programmable calculators.

Ring theory: proceedings of the 1977 Antwerp conference. (Lecture notes in pure and applied mathematics, Volume 40.) Edited by F. Van Oystaeyen. Marcel Dekker, Inc., New York, 1978. vii + 207 pp. $22.50.

This volume brings together papers presented at a conference held at the University of Antwerp and papers which were invited specifically for this publication. There are papers surveying recent results and new trends in ring theory, torsion theory, and module theory.

Reflectors and localization: application to sheaf theory. (Lecture notes in pure and applied mathematics, Volume 41.) By F. Van Oystaeyen and A. Verschoren. Marcel Dekker, Inc., New York, 1979. vii + 166 pp. $23.50.

Table of contents: 1. The ring-theoretic scenery; 2. Reflections on reflectors and localization in Grothendieck categories; 3. Application to sheaf theory; 4. Applications; Appendix—odds and ends.

Mathematics of finite-dimensional control systems: theory and design. (Lecture notes in pure and applied mathematics, Volume 43.) By David L. Russell. Marcel Dekker, Inc., New York, 1979. viii + 553 pp. $45.00.

This volume analyzes the problems which control engineers meet and solve, and expresses the theory and methods which have been developed for control engineering in standard mathematical language that assumes only modest preparation in basic mathematical analysis and matrix algebra. Chapter headings: 1. Control systems: preliminaries; 2. Observability and controllability; 3. Algebraic theory of linear constant coefficient control systems; 4. Optimal control with quadratic performance criteria and related topics; 5. Computational methods; 6. Optimal control and estimation for linear stochastic systems; 7. Aspects of linear system design.

(Continued on p. 208)

Continued from page 190

Differential games and control theory III: proceedings of the Third Kingston Conference, Part A. (Lecture notes in pure and applied mathematics, Volume 44.) Edited by Pan-Tai Liu and Emilio Roxin. Marcel Dekker, Inc., New York, 1979. vii + 244 pp. $27.00.

The conference brought together an international group of mathematicians, scientists, and engineers from a variety of disciplines. About half of the eleven papers deal with deterministic systems and the rest with stochastic systems. The contents range from theoretical analysis to practical techniques for the control of dynamic systems.

Orthogonal designs: quadratic forms and Hadamard matrices. (Lecture notes in pure and applied mathematics, Volume 45.) Edited by Anthony V. Geramita and Jennifer Seberry. Marcel Dekker, Inc., New York, 1979. x + 460 pp. $35.00.

Problems concerned with the structure and existence of various kinds of matrices with entries from $(0, 1, -1)$, for example Hadamard matrices and their generalizations to weighing matrices, have long been the focus of researchers in combinatorics, as well as applied statisticians and other applied mathematicians. This book is devoted to the study of a new approach to these questions. The discovery of the intimate relationship between orthogonal designs and rational quadratic forms, as well as numerous new constructions and objects which appear fundamental to study of Hadamard matrices, prompted this reevaluation of past research. The new integrated approach, presenting both foundational material and heretofore unpublished results, draws from algebraic number, representation, coding, group, and ring theories, as well as quadratic forms, difference sets, finite geometry, and cyclotomy. There are over 100 unsolved problems.

Banach modules and functors on categories of Banach spaces. (Lecture notes in pure and applied mathematics, Volume 46.) Edited by Johann Cigler, Viktor Losert, and Peter Michor. Marcel Dekker, Inc., New York, 1979. xv + 282 pp. $29.50.

Many standard constructions in functional analysis have functorial and universal characteristics. This book reveals these characteristics, bases them on an axiomatic footing, and develops them in their own right. Among the topics considered are Waelbroeck spaces, tensor products, Banach algebra modules and construction with these, functors on categories of Banach spaces, duality theory for these, and Kan extensions from subcategories of certain classical Banach spaces.

Control theory in mathematical economics: proceedings of the Third Kingston Conference, Part B. (Lecture notes in pure and applied mathematics, Volume 47.) Edited by Pan-Tai Liu and Jon G. Sutinen. Marcel Dekker, Inc., New York, 1979. viii + 241 pp. $26.50.

This book brings together papers from the fields of socioeconomics and management science which have as a common concern the use of modern control theory and techniques as a tool for problem solving. Applications include the pure theory of production, exploitation of a fishery resource, advertising, etc.

Partial differential equations and geometry. (Lecture notes in pure and applied mathematics, Volume 48.) Edited by Christopher I. Byrnes. Marcel Dekker, Inc., New York, 1979. x + 319 pp. $35.00.

This book comprises the proceedings of a conference held in February, 1977 at Park City, Utah. The articles emphasize the beautiful and classical interconnections between potential theory, real and complex geometry, partial differential equations, and stochastic processes. The book also contains papers exploring the more recent developments which tie together nonlinear partial differential equations, linear differential equations, and geometry (both algebraic and differential).

(Continued on p. 224)

Continued from page 208

Mathematics for physical geographers. By Graham N. Sumner. John Wiley & Sons, New York, 1978. x + 236 pp. $15.95.

This book provides a basic mathematical text, making no assumption about prior mathematical knowledge. It thus treats mathematics from trigonometry and vector to differential equations, including some probability and statistics.

The algebra of random variables. By M. D. Springer. John Wiley and Sons, New York, 1979. xix + 470 pp. $26.95.

This is a volume in the Wiley Series in Probability and Mathematical Statistics. It uses integral transforms (i.e., characteristic functions) as the single method for solving distribution problems in theoretical and applied statistics. More specifically, it presents in self-contained form methods for using Fourier, Laplace and Mellin transforms in the addition, subtraction, multiplication and division of random variables and in the analysis of algebraic functions of random variables. There are nine chapters: 1. Introduction; 2. Differentiation and integration in the complex plane; 3. The distribution of sums and differences of random variables; 4. The distribution of products and quotients of random variables; 5. The distribution of algebraic functions of independent random variables; 6. The distribution of algebraic functions of independent H-function variables; 7. Analytical model for evaluation of the H-function inversion integral; 8. Approximating the distribution of an algebraic function of independent random variables; 9. Distribution problems in statistics.

Learning systems: decision, simulation and control. (Lecture notes in control and information sciences, No. 9.) By Yousri M. El-Fattah and Claude Foulard. Springer–Verlag, Berlin, 1978. vii + 119 pp. $9.00.

This monograph studies topics in using learning systems for decision, simulation, and control. Chapter I discusses what is meant by learning systems, and comments on their cybernetic modeling. Chapter II, concerning decision, is devoted to the problem of pattern recognition. Chapter III, concerning simulation, is devoted to the study of a certain class of problems of collective behavior. Chapter IV, concerning control, is devoted to a simple model of finite Markov chains. For each of the last three chapters, numerical examples are worked out entirely using computer simulations.

An introduction to probability and statistics using BASIC. (Statistics: textbooks and monographs series, Vol. 26.) By Richard A. Groeneveld. Marcel Dekker, Inc., New York, 1979. xiv + 446 pp. $17.50.

This book provides an introduction to probability and statistics for students who have completed the study of the calculus of functions of a single variable. A central theme throughout is the introduction of theoretical ideas in probability and statistics by examples. The interactive computing language BASIC is used to illustrate probabilistic and statistical ideas. A total of 56 programs appear in the text for student use and modification.

Fuzzy switching and automata: theory and applications. (Computer systems engineering series.) By Abraham Kandel and Samuel C. Lee. Crane, Russak & Co., New York, 1979. x + 303 pp. $27.50.

This book is intended for researchers in the field of fuzzy theory and applications. Chapter 1 presents a review of set theory and of two important algebraic systems—lattices and Boolean algebra—which are the foundations of switching and automata theory. Chapter 2 is a collection of basic results of fuzzy set theory, algebra and logic. Chapter 3 is concerned with the study of fuzzy switching functions, their minimization, decomposition, and other related topics. In chapter 4 the notions of automata and of formal languages are extended to fuzzy automata and fuzzy languages, and chapter 5 discusses various applications of the previously introduced concepts: fuzzy neural networks, approximation via fuzzy functions, transient analysis of binary switching systems, and applications to role theory and pattern recognition and classification.

(Continued on p. 261)

Statistics for technology: a course in applied statistics. Second edition. By Christopher Chatfield. Halsted Press Book, John Wiley & Sons, New York, 1978. 370 pp.

This book was first published by Penguin Books in 1970. Its purpose is to acquaint the reader with a number of applications of statistics in engineering and the applied sciences. An elementary knowledge of calculus is sufficient as a prerequisite.

The modelling of systems with small observations sets. (Lecture notes in control and information sciences, No. 10.) By Jan M. Maciejowski. Springer–Verlag, Berlin, 1978. vii + 241 pp. $12.50.

This monograph introduces and discusses the problem of assessing and interpreting models of systems when only small sets of observations are available. System identification is defined as the progression from a set of observations of the behavior of a system to a theory which accounts for that behavior. The concepts of algorithmic information theory are drawn on to develop a characterization of modelling which constitutes a partial solution to the problem of system identification, while taking account of the size of the set of available observations. A model is defined to be an algorithm for computing the output observation set of a system under specified restrictions.

Probability on Banach spaces. (Advances in probability and related topics, volume 4.) Edited by James Kuelbs. Marcel Dekker, New York, 1979. ix + 521 pp. $49.50.

This book brings together a global view of the recent work that has been done in this field of probability. Included are new developments in the general non-Gaussian central limit problem, Gaussian measures on Banach spaces, and the martingale convergence theorem for Banach space random variables. There are five papers: 1. On Poisson measures, Gaussian measures, and the central limit theorem in Banach spaces, by Alejandro de Acosta, Aloisio Araujo, and Evarist Gine; 2. Submartingale characterization of measurable cluster points, by Alexandra Bellow; 3. Continuity of subgaussian processes, by Naresh C. Jain and Michael B. Marcus; 4. On semiamarts, amarts, and processes with finite value, by Ulrich Krengel and Louis Sucheston; 5. Geometry and martingales in Banach spaces—part II: independent increments, by Wojbor A. Woyczynski.

Modern algebra (an introduction). By John R. Durbin. John Wiley and Sons, New York, 1979. xv + 329 pp. $15.95.

This is an introduction to modern abstract algebra for undergraduates who may not have had a previous course in linear algebra.

Modeling and analysis: an introduction to system performance evaluation methodology. By H. Kobayashi. Addison–Wesley Publishing Co., Reading, Mass., 1978. xvii + 446 pp.

This book provides a cohesive introduction to modeling and analysis techniques, applicable to modeling activities of complex systems in general, with special reference to computing systems. Chapter 1, "Computer performance evaluation: an introduction" is an overview of the subject; chapter 2, "Probability theory", is prerequisite material for the main subjects of this volume, namely analytic simulation and statistical techniques; chapter 3, "Basic queuing analysis", is an introduction to that field, with an application to a case study of an interactive system with multiprogramming in virtual storage; chapter 4, "The simulation method", introduces subjects such as trace-driven versus self-driven simulation, event scheduling, and data structure for simulation, and discusses statistical considerations in simulation. Chapter 5, "Data analysis", discusses how to apply statistical analysis methods to measurement data of real systems or simulation outputs.

Functional equations in economics. (Applied Mathematics and Computation Series, Vol. II.) By Wolfgang Eichhorn. Addison–Wesley Publishing Co., 1978. xviii + 260 pp. $28.50 hardcover; $16.50 paperback.

Mathematical economics abounds with functional equations. It is to the formulation and solution of such equations that this volume is devoted. The book is divided into four parts: 1. Functional equations for

scalar-valued functions of a single variable (two chapters); 2. Functional equations for scalar-valued functions of several variables (five chapters); 3. Systems of three or more functional equations for a single scalar-valued function of several variables (three chapters), 4. Functional equations for vector-valued and set-valued functions of several variables (three chapters). Applications to economics are interspersed through these chapters and include: business mathematics, price and advertising policies; the theories of production, of growth and technical progress, of index numbers, of the price index, of aggregation, of the price and quantity level and Fischer's equation of exchange, of multisector growth, of the budget equation.

Thermodynamics and statistical mechanics. By Peter T. Landsberg. Oxford University Press, Oxford, England, 1978. xii + 461 pp. $26.00.

The scope of this book is best indicated by its chapter headings: Part A: Thermodynamics: 1. Nature of and scope of thermodynamics; 2. Basic concepts; the laws of thermodynamics; 3. Thermodynamics of simple systems using the first law only; 4. Exact and inexact differentials; 5. The second law; 6. Absolute and empirical temperature scales; 7. Variable particle numbers; 8. The mass action law and the equilibrium constants. Part B: Statistical mechanics; 9. Two basic results in statistical mechanics; 10. Mean occupation numbers and negative temperatures; 11. The continuous spectrum approximation; 12. The density of states functions; 13. Bosons: blackbody radiation; 14. Heat capacities of oscillators and solids; 15. Fermi systems; 16. Fluctuations; 17. Simple transport properties; 18. Outlook. There are appendices on information theory, Lagrangian multipliers, solid angles and special relativistic thermodynamics, and worked solutions to 120 problems. The book is meant to be suitable for self-study and for undergraduate or first-year graduate work.

Solitons and condensed matter physics. (Springer series in solid-state sciences, No. 8.) Edited by A. R. Bishop and T. Schneider. Springer–Verlag, Berlin, Heidelberg, New York, 1978. xi + 341 pp. $29.50.

These are the proceedings of a symposium on nonlinear (soliton) structure and dynamics in condensed matter held at Oxford in June 1978. It contains a poem "Solitons in Oxford" and thirty-eight papers, arranged in these groups: 1. Introduction (Solitons in mathematics: brief history, by R. K. Bullough and R. K. Dodd, and Solitons in physics, by J. A. Krumhansl); 2. Mathematical aspects (six papers); 3. Statistical mechanics and solid-state physics (30 papers), and a summary: Where do solitons go from here? by S. E. Trullinger.

Computing methods in applied sciences and engineering, 1977, II. Third International IRIA Symposium, 1977. Edited by R. Glowinski and J. L. Lions. (Lecture Notes in Physics, Vol. 91.) Springer–Verlag, Berlin, 1979. vi + 359 pp. $17.80.

The papers are arranged in six groups: Foundations of numerical methods in fluid mechanics (five papers); Aeronautical fluid mechanics and transonic flows (four papers); Multiphase flows (one paper); Meteorology and oceanography (four papers); Numerical methods in plasma physics (seven papers); Energy transportation (one paper).

Using the mathematical literature: a practical guide. (Books in Library and Information Science, Vol. 25.) By Barbara Kirsch Schaefer. Marcel Dekker, Inc., New York, 1979. ix + 141 pp. Sfr. 45.—

This book provides information about mathematical literature and serves as a guide to its use. The emphasis is on describing the different types of publications and citing selected titles as illustrations of each type. Primary and secondary publications are regrouped into three divisions: journals, books, and reference books. Secondary access publications (such as abstracts, general reference works, and other compilations) are discussed in connection with the primary publications to which they provide access. The major portion of the guide is devoted to the current literature of pure mathematics. Other portions deal with the literature of the applied mathematical sciences, the history of the mathematical literature up to the present time, and the nature and uses of contemporary mathematics and its literature.

—BOOK REVIEWS—

The theory of stochastic processes III. By I. I. Gihman and A. V. Skorokhod. (A translation of the 1975 Russian edition.) Springer–Verlag, Berlin and New York, 1979. 387 pp. $49.80.

This is the third and apparently the last of the authors' sequence on the theory of stochastic processes. There is a wealth of interesting material.

Chapter 1 deals with general martingale problems. Meyer's theorem on the Doob decomposition is developed, as is the theory of square-integrable martingales and the path properties of both martingales and their associated natural (predictable) increasing functions. The stochastic integral with respect to martingales and martingale measures and the general Itô formula are given. The chapter ends with a discussion of representations (as stochastic integrals) and decompositions (continuous and discontinuous parts).

The second chapter deals with the general theory of stochastic differential equations, using the ideas on stochastic line integrals and stochastic differentials "without aftereffect" developed in the authors' *Stochastic differential equations* (Springer, 1972). Results on existence, uniqueness, moment bounds and the dependence of the solution on parameters are given. These results are then specialized to the equations where the stochastic integral is with respect to a martingale with independent increments, and the Kolmogorov equations are derived. There is an introduction to the theory of weak convergence, with applications to convergence to a diffusion process of the sequence determined by a family of interpolated Markov chains and also by more general difference equations whose driving terms are essentially martingale differences.

In Chapter 3, many of the ideas in Chapter 2 are specialized to the case in which the "driving" martingale is a Wiener process. Existence and uniqueness are developed for general Itô equations. Girsanov's measure transformation method is developed and existence, uniqueness (weak and strong sense) and path properties are discussed in detail. The chapter concludes with a development of the local structure of vector-valued continuous-parameter Markov processes and with (Feller's) complete characterization of one-dimensional diffusions.

The level of difficulty is about that of the two earlier volumes in the series.

H. J. KUSHNER (*Providence*)

An introduction to statistical signal processing with applications. By M. D. Srinath and P. K. Rajasekaran. John Wiley & Sons, New York, 1979. ix + 497 pp. $22.50.

This book is a well-written and well-motivated development of the basic ideas and techniques of detection and estimation theory. Discussions of the fundamentals of signal and noise modeling, detection and estimation theory are given. There are nice applications to a number of problems in analogue and digital communications and radar. The level is first- or second-year graduate electrical engineering. The mathematics is sound but accessible, and the topics are well selected to give a reasonably broad coverage.

H. J. KUSHNER (*Providence*)