

QUARTERLY
OF
APPLIED MATHEMATICS

EDITED BY

H. T. BANKS
G. F. CARRIER
H. COHEN
J. D. COWAN
C. DAFERMOS
P. J. DAVIS
D. C. DRUCKER

H. W. EMMONS
C. FERRARI
P. GERMAIN
U. GRENANDER
G. E. HAY
P. LE CORBEILLER
E. REISSNER

J. R. RICE
S. A. SCHELKUNOFF
W. R. SEARS
L. SIROVICH
J. J. STOKER
P. S. SYMONDS
J. L. SYNGE

W. F. FREIBERGER *Managing Editor*

FOUNDER, AND
MANAGING EDITOR 1943-1965
W. PRAGER

VOLUME XLVIII

DECEMBER · 1990

NUMBER 4

QUARTERLY OF APPLIED MATHEMATICS

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

Manuscripts (two copies) submitted for publication in the QUARTERLY OF APPLIED MATHEMATICS should be sent to the Editorial Office, Box F, Brown University, Providence, RI 02912, either directly or through any one of the Editors. The final decision on acceptance of a manuscript for publication is made by the Managing Editor. In accordance with their general policy, the Editors welcome particularly contributions which will be of interest both to mathematicians and to scientists or engineers. Authors will receive galley proof only. The author's institution will be requested to pay a publication charge of \$30 per page which, if honored, entitles the author to 100 free reprints. Detailed instructions will be sent with galley proofs.

The current subscription price per volume (March through December) is \$55. Single issues can be purchased, as far as they are available, at \$14 and back volumes at \$50 per volume. Subscriptions and orders for back volumes must be addressed to the American Mathematical Society, P.O. Box 1571, Providence, RI 02901-1571. All orders must be accompanied by payment. Other subscription correspondence should be addressed to the American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248. *Quarterly of Applied Mathematics* (ISSN 0033-569X) is published four times a year (March, June, September, and December) by Brown University, Division of Applied Mathematics, 182 George Street, Providence, RI 02912. Second-class postage paid at Providence, RI. POSTMASTER: Send address changes to *Quarterly of Applied Mathematics*, Membership and Sales Department, American Mathematical Society, Post Office Box 6248, Providence, RI 02940-6248.

©1990 Brown University

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

QUARTERLY
OF
APPLIED MATHEMATICS

EDITED BY

H. T. BANKS
G. F. CARRIER
H. COHEN
J. D. COWAN
C. DAFERMOS
P. J. DAVIS
D. C. DRUCKER

H. W. EMMONS
C. FERRARI
P. GERMAIN
U. GRENANDER
G. E. HAY
P. LE CORBEILLER
E. REISSNER

J. R. RICE
S. A. SCHELKUNOFF
W. R. SEARS
L. SIROVICH
J. J. STOKER
P. S. SYMONDS
J. L. SYNGE

W. F. FREIBERGER *Managing Editor*

FOUNDER, AND
MANAGING EDITOR 1943-1965
W. PRAGER

VOLUME XLVIII

1990

CONTENTS

E. C. AIFANTIS (<i>see</i> KUTTLER, K.)	
A. ALDROUBI: On the existence, regularity and large time behavior of a two-dimensional parabolic-elliptic eddy current problem	371
M. ARON: On the stability of Varley-Day solutions for harmonic materials.	455
G. A. ATHANASSOULIS AND C. G. POLITIS: On the solvability of a two-dimensional wave-body interaction problem	1
FRANK E. BAGINSKI: Upper and lower bounds for eigenvalues of the Laplacian on a spherical cap	569
B. S. BERGER AND M. ROKNI: Lyapunov exponents for discontinuous differential equations	549
M. BERTSCH AND R. DAL PASSO: A numerical treatment of a superdegenerate equation with applications to the porous media equation.	133
R. L. BISH: Temperatures in a thin metal plate traversed by an arc	491
M. I. G. BLOOR (<i>see</i> KING, A. C.)	
ELIO CABIB, CESARE DAVINI, AND CHONG-QING RU: A problem in the optimal design of networks under transverse loading	251
CONSTANTINE CALLIAS, XANTHIPPI MARKENSCOFF, AND LUQUN NI: A singular asymptotic expansion for the field near a moving dislocation loop	113
M. M. CARROLL AND C. O. HORGAN: Finite strain solutions for a compressible elastic solid	767
GIACOMO CAVIGLIA AND ANGELO MORRO: Conservation laws in viscoelasticity	503
O. P. CHANDNA AND F. LABROPULU: Finitely conducting aligned plane magnetohydrodynamic confluent flows	699
PIERLUIGI COLLI, MICHEL FRÉMOND, AND AUGUSTO VISINTIN: Thermo-mechanical evolution of shape memory alloys.	31
M. COSTABEL, V. J. ERVIN, AND E. P. STEPHAN: Symmetric coupling of finite elements and boundary elements for a parabolic-elliptic interface problem	265
R. DAL PASSO (<i>see</i> BERTSCH, M.)	
GEORGE DASSIOS AND FILARETI ZAFIROPOULOS: Equipartition of energy in linearized 3-D viscoelasticity	715
CESARE DAVINI (<i>see</i> CABIB, ELIO)	
W. A. DAY: Neither asymptotic stability nor nonrecurrence is a sufficient basis for the second law	441
R. W. DICKEY: Minimum energy solution for the spherical shell	321
KUI-CHEN DUAN (<i>see</i> ZHI-DONG TENG)	
PRAVIR DUTT (<i>see</i> TA'ASAN, SHLOMO)	
C. V. EASWARAN AND S. R. MAJUMDAR: A uniqueness theorem for incompressible micropolar flows	201
ELSAYED F. ELSHEHAWAY: Intervals of electrohydrodynamic Rayleigh-Taylor instability: Effect of a normal periodic field	225
V. J. ERVIN (<i>see</i> COSTABEL, M.)	
R. A. EVE, T. GÜLTOP, AND B. D. REDDY: An internal variable finite-strain theory of plasticity within the framework of convex analysis	625
R. A. EVE, B. D. REDDY, AND R. T. ROCKAFELLAR: An internal variable theory of elastoplasticity based on the maximum plastic work inequality	59

A. FASANO, M. PRIMICERIO, S. D. HOWISON, AND J. R. OCKENDON: Some remarks on the regularization of supercooled one-phase Stefan problems in one dimension	153
JAMES Q. FENG: A method of multiple-parameter perturbations with an application to drop oscillations in an electric field	555
MAREK FILA AND BERNHARD KAWOHL: Is quenching in infinite time possible?	531
MICHEL FRÉMOND (<i>see</i> COLLI, PIERLUIGI)	
YANG GAO: Dynamically loaded rigid-plastic analysis under large deformation	731
YANG GAO: On the extreme variational principles for nonlinear elastic plates .	361
J. M. GOLDEN AND G. A. C. GRAHAM: Energy balance criteria for viscoelastic fracture	401
K. GOPALSAMY AND G. LADAS: On the oscillation and asymptotic behavior of $\dot{N}(t) = N(t)[a + bN(t - \tau) - cN^2(t - \tau)]$	433
G. A. C. GRAHAM (<i>see</i> GOLDEN, J. M.)	
T. GÜLTOP (<i>see</i> EVE, R. A.)	
TIMOTHY J. HEALEY: Stability and bifurcation of rotating nonlinearly elastic loops	679
C. O. HORGAN, L. E. PAYNE, AND J. G. SIMMONDS: Existence, uniqueness, and decay estimates for solutions in the nonlinear theory of elastic, edge-loaded, circular tubes	341
C. O. HORGAN (<i>see</i> CARROLL, M. M.)	
S. D. HOWISON (<i>see</i> FASANO, A.)	
D. İEŞAN: On uniqueness and continuous dependence in nonlinear thermodynamics of electromagnetic materials.....	85
BERNHARD KAWOHL (<i>see</i> FILA, MAREK)	
A. C. KING AND M. I. G. BLOOR: Free streamline flow over curved topography	281
B. W. KNIGHT (<i>see</i> SIROVICH, L.)	
K. KUTTLER AND E. C. AIFANTIS: Existence, uniqueness, and long-time behavior of materials with nonmonotone equations of state and higher-order gradients	473
F. LABROPULU (<i>see</i> CHANDNA, O. P.)	
G. LADAS (<i>see</i> GOPALSAMY, K.)	
A. LIBIN AND G. SIVASHINSKY: Long wavelength instability of the ABC-flows .	611
ATHANASIOS N. LYBEROPOULOS: Asymptotic oscillations of solutions of scalar conservation laws with convexity under the action of a linear excitation.....	755
S. R. MAJUMDAR (<i>see</i> EASWARAN, C. V.)	
S. K. MALIK AND M. SINGH: Nonlinear evolution of wave packets in magnetic fluids.....	415
GERALD S. MANNING: Instability of a surface elastic line on an unnatural ramp	517
XANTHIPPI MARKENSCOFF (<i>see</i> CALLIAS, CONSTANTINE)	
BERNARD J. MATKOWSKY (<i>see</i> OLAGUNJU, DAVID O.)	
T. B. MOODIE (<i>see</i> ÖNCÜ, T. S.)	
ANGELO MORRO (<i>see</i> CAVIGLIA, GIACOMO)	
S. NEMAT-NASSER (<i>see</i> WILLIS, J. R.)	
LUQUN NI (<i>see</i> CALLIAS, CONSTANTINE)	
T. S. ÖNCÜ AND T. B. MOODIE: Boundary-initiated wave phenomena in thermoelastic materials	295
A. NOVICK-COHEN: Instability of periodic states for the Sivashinsky equation .	217
J. R. OCKENDON (<i>see</i> FASANO, A.)	

DAVID O. OLAGUNJU AND BERNARD J. MATKOWSKY: Burner-stabilized cellular flames	645
L. E. PAYNE (<i>see</i> HORGAN, C. O.)	
JEAN C. PIQUETTE: Uncoupling the differential equations arising from a technique for evaluating indefinite integrals containing special functions or their products	95
C. G. POLITIS (<i>see</i> ATHANASSOULIS, G. A.)	
M. PRIMICERIO (<i>see</i> FASANO, A.)	
K. B. RANGER: A conformally invariant Oseen equation for flow at small Reynolds numbers	189
B. D. REDDY (<i>see</i> EVE, R. A.)	
R. T. ROCKAFELLAR (<i>see</i> EVE, R. A.)	
J. D. RODRIGUEZ (<i>see</i> SIROVICH, L.)	
M. ROKNI (<i>see</i> BERGER, B. S.)	
CHONG-QING RU (<i>see</i> CABIB, ELIO)	
JULIO CESAR RUIZ-CLAEYSSEN AND TERESA TSUKAZAN: Dynamic solutions of linear matrix differential equations	169
GEORGE SEIFERT: Resonance in undamped second-order nonlinear equations with periodic forcing	527
J. G. SIMMONDS (<i>see</i> HORGAN, C. O.)	
M. SINGH (<i>see</i> MALIK, S. K.)	
L. SIROVICH, B. W. KNIGHT, AND J. D. RODRIGUEZ: Optimal low-dimensional dynamical approximations	535
G. SIVASHINSKY (<i>see</i> LIBIN, A.)	
W. R. SPILLERS: A note on some qualitative results for beams and rods	575
E. P. STEPHAN (<i>see</i> COSTABEL, M.)	
ANDREW J. SZERI: On the everted state of spherical and cylindrical shells	49
SHLOMO TA'ASAN AND PRAVIR DUTT: Parameter estimation problems for distributed systems using a multigrid method	387
ZHI-DONG TENG AND KUI-CHEN DUAN: Persistence in dynamical systems	463
WILLIAM C. TROY: Nonexistence of monotonic solutions in a model of dendritic growth	209
TERESA TSUKAZAN (<i>see</i> RUIZ-CLAEYSSEN, JULIO CESAR)	
AUGUSTO VISINTIN (<i>see</i> COLLI, PIERLUIGI)	
J. A. WALKER: Pseudodissipative systems III: Global behavior	665
C. Y. WANG: Liquid film on an unsteady stretching surface	601
WAN-XIAN WANG: Expansion of the Green's function in a cylindrical coordinate system	499
J. R. WILLIS AND S. NEMAT-NASSER: Singular perturbation solution of a class of singular integral equations	741
CHIEN H. WU: Asymptotic solution of a crack in a vanishingly thin elliptic inhomogeneity	233
NING-MAO XIA: Errata: The random eigenvalue problem for a differential equation containing small white noise	397
CHIA-SHUN YIH: Nonlinear groups of gravity-capillary waves	581
A. I. YOUNIS (<i>see</i> ZAYED, E. M. E.)	
FILARETI ZAFIROPOULOS (<i>see</i> DASSIOS, GEORGE)	
E. M. E. ZAYED AND A. I. YOUNIS: An inverse problem for a general convex domain with impedance boundary conditions	181

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

Vol. XLVIII, No. 4

December 1990

C. Y. WANG: Liquid film on an unsteady stretching surface	601
A. LIBIN AND G. SIVASHINSKY: Long wavelength instability of the ABC-flows	611
R. A. EVE, T. GÜLTOP, AND B. D. REDDY: An internal variable finite-strain theory of plasticity within the framework of convex analysis	625
DAVID O. OLAGUNJU AND BERNARD J. MATKOWSKY: Burner-stabilized cellular flames	645
J. A. WALKER: Pseudodissipative systems III: Global behavior	665
TIMOTHY J. HEALEY: Stability and bifurcation of rotating nonlinearly elastic loops	679
O. P. CHANDNA AND F. LABROPULU: Finitely conducting aligned plane magnetohydrodynamic confluent flows	699
GEORGE DASSIOS AND FILARETI ZAFIROPOULOS: Equipartition of energy in linearized 3-D viscoelasticity	715
YANG GAO: Dynamically loaded rigid-plastic analysis under large deformation	731
J. R. WILLIS AND S. NEMAT-NASSER: Singular perturbation solution of a class of singular integral equations	741
ATHANASIOS N. LYBEROPOULOS: Asymptotic oscillations of solutions of scalar conservation laws with convexity under the action of a linear excitation	755
M. M. CARROLL AND C. O. HORGAN: Finite strain solutions for a compressible elastic solid	767
NEW BOOKS	624, 644, 740, 754, 766, 781-784

Nonlinear Boundary Value Problems in Science and Engineering. By C. Rogers and W. F. Ames. Academic Press, New York, 1989. xiii+417 pp., \$69.95.

This is volume 183 of the series Mathematics in Science and Engineering. It is a continuation of work presented in earlier volumes by Ames on ordinary and partial differential equations, and Rogers and Shadwick on the Bäcklund Transformation. Here, the object is to give an up-to-date account of analytic methods available for the exact solution of nonlinear boundary value problems of physical interest. The nonlinearities to be considered may reside in the equations to be solved or in the prevailing boundary conditions. There are four chapters: 1. Bäcklund and involuntary transformations. 2. Bergman-type expansion methods. Nonlinear moving boundary and Stefan-Boltzmann problems. 3. Model constitutive laws. 4. Invariance group analysis and its applications, and three appendices: tables of symmetry group generators, and aspects of Lie group theory.

Approximation by Spline Functions. By Günther Nürnberger. Springer-Verlag, New York, 1989. xi+243 pp.

The aim of this book is to analyze in a unified approach basic theoretical and numerical aspects of interpolation and best approximation by polynomial splines in one variable. It begins by examining approximation-theoretic properties of spaces of polynomials (as prototypes of Chebyshev spaces). The appendix gives a brief introduction to spline collocation for differential equations. A large portion of the results and methods was developed and completed in the last decade, and cannot be found in earlier books on splines. The book is divided into two parts: 1. Polynomials and Chebyshev spaces; 2. Splines and weak Chebyshev spaces.

Fundamentals of Mathematical Statistics. By H. T. Nguyen and G. S. Rogers. Springer-Verlag, New York, 1989. Vol. I: *Probability for Statistics.* vii+432 pp., \$39.80. Vol. II: *Statistical Inference.* xi+422 pp., \$39.80.

These are volumes in the series Springer Texts in Statistics. They make up a text for a two semester course in mathematical statistics at the senior/graduate level. There are three parts in volume I: Elementary probability and statistics, 2. Probability and expectation, 3. Limiting distribution; and four parts in volume II: 4. Sampling and distribution, 5. Statistical estimation, 6. Testing hypotheses, 7. Special topics. Each part is divided into a number of 50 minute lessons. Most exercises are integrated into the discussions. Part 2 is an introduction to measure theoretic aspects which the authors believe today's students of mathematical statistics should learn.

Oscillatory Evolution Processes: Quantitative Analyses Arising from Applied Sciences. By I. Gumowski. Manchester University Press, New York, 1989. vi+329 pp., \$95.00.

This monograph is concerned with some global properties of nonlinear evolution systems described by ordinary differential equations of low order, and by one partial differential equation, also of low order, both evolution equations denoted formally by $Lx = O$, where x is a scalar or vector variable characterizing the "state" of the system at time t , and L is an operator characterizing the "internal mechanism" of the evolution process responsible for the time dependance of x . The 22 chapters are divided into two parts: part I, Second-order $Lx = O$'s with explicit periodic dependence (chapters 2-16) and part II, Higher order $Lx = O$'s, and some adequacy problems (chapters 17-22).

Continued from page 624

Shape from Shading. Edited by K. P. Berthold and Michael J. Brooks. MIT Press, Cambridge, 1989. viii+577 pp., \$49.95.

This book deals with an important problem in machine vision: how the shape of a three-dimensional object may be recovered from shading in a two-dimensional image of the object. It hinges together all the seminal papers on the subject, shows how recent work relates to more traditional approaches, and provides a comprehensive annotated bibliography. There are 17 research papers by various authors in this volume.

Computational Geometry: Curve and Surface Modelling. By Su Bu-qing and Liu Ding-Yuan. Academic Press, New York, 1989. x+295 pp., \$39.95.

This is a translation of a Chinese version finished in 1979; it has been brought up to date by the addition of 170 new references. Chapter headings: 1. Introduction. 2. Spline functions. 3. Parametric cubic spline curves. 4. Bézier curves and *B*-spline curves. 5. Spline surfaces. 6. Nonlinear splines. 7. Curve and net fairing. 8. The intrinsic affine invariants of parametric curves in affine hyperspace.

Data Analysis for Research Designs: Analysis of Variance and Multiple Regression/Correlation Approaches. By Geoffrey Keppel and Sheldon Zedeck. W. H. Freeman and Company, New York, 1989. xxiv+594 pp., \$42.95.

This is a textbook expressly designed for students of the behavioral and social sciences. Chapter headings: 1. Introduction. 2. Principles of research design. 3. Overview of design and analysis. 4. Basic concepts in statistical analysis. 5. Basic statistical concepts in correlation and regression. 6. Basic statistical concepts in ANOVA. 7. The correlational analysis of experimental data. 8. Significance and hypothesis testing. 9. General coding of experiments for the MRC design. 10. Overall analysis of the single-factor design. 11. Detailed analysis of the single-factor design. 12. Correction for multiple comparisons. 13. Introduction to the two-factor design. 14. The analysis of main effects and simple effects. 15. The analysis of interactions comparisons: The interaction contrast. 16. The within-subjects single-factor design. 17. The mixed two-factor design. 18. Detailed analysis of the mixed factorial design. 19. Higher-order factorial designs. 20. Nonexperimental research. 21. Other applications of MRC to nonexperimental research. 22. Analysis of covariance. 23. Analysis of trend. 24. Unequal sample size. 25. Epilogue.

Lectures on Minimal Surfaces, Volume 1: Introduction, Fundamentals, Geometry and Basic Boundary Value Problems. By Johannes C. C. Nitsche. Cambridge University Press, New York, 1989. xxv+563 pp., \$135.00.

This volume, the first of the proposed two, deals with parametric minimal surfaces in Euclidean spaces. The author presents a broad survey which extends from the classical beginnings to the current situation whilst highlighting many of the subject's main features and interspersing the mathematical development with pertinent historical remarks. The presentation is complete and is complemented by a bibliography of nearly 1600 references. The work is a revised and updated translation of the initial five chapters of *Vorlesungen über Minimalflächen*, augmented by eight relevant appendices and a collection of open problems. It provides a thorough, self-contained introduction to minimal surfaces. Chapter headings: 1. Introduction. 2. Curves and surfaces. 3. Conformal mapping of minimal surfaces. 4. Results from analysis. 5. Plateau's problem.

Continued on page 740

Continued from page 644

Numerical Methods for Initial Value Problems in Ordinary Differential Equations. By Simeon Ola Fatunla. Academic Press, New York, 1988. xi+295 pp., \$44.50.

This is a volume in the series Computer Science and Scientific Computing. Emphasis in this text is placed on the numerical treatment of special differential equations: stiff, stiff oscillatory, singular, and discontinuous initial value problems, which are often characterized by large Lipschitz constants and which have received considerable attention in the last two decades. Existing robust codes for these categories of problems are highlighted. Chapter headings: 1. Preliminaries. 2. Numerical integration algorithms. 3. Theory of one-step method. 4. Runge-Kutta processes. 5. Linear multistep methods. 6. Numerical treatment on singular/discontinuous initial value problems. 7. Extrapolation processes and singularities. 8. Stiff initial value problems. 9. Stiff algorithms. 10. Second order differential equations. 11. Recent developments in o.d.e. solvers.

Survey Errors and Survey Costs. By Robert M. Groves. John Wiley & Sons, New York, 1989. xxi+590 pp., \$59.95.

This is a volume in the Wiley Series in Probability and Mathematical Statistics. In it, the author aims to synthesize the statistical and social science perspectives to produce a complete treatment of survey errors and costs of alternative survey designs. He starts with the premise that all sample surveys are subject to various types of errors: 1. Coverage error, from the failure to give any chance of sample selection to some persons in the population. 2. Nonresponse error, from the failure to collect data on all persons in the sample. 3. Sample error, from heterogeneity on the survey measures among persons in the population. 4. Measurement error, from inaccuracies in responses recorded on the survey instruments. These arise from: a. effects of interviews on the respondents' answers to survey questions; b. error due to respondents, from inability to answer questions, lack of requisite effort to obtain the correct answer, or other psychological factors; c. error due to the weakness in the wording of survey questionnaires; and d. error due to the effects of the mode of data collection, the use of face to face or telephone communication. The author's goals in writing this book were: 1. to consolidate the social science and statistical literatures on survey errors, drawing on the statistical sciences for insights into measuring the errors and the social sciences for explaining why they exist; 2. to explore evidence of relationships among the several types of survey errors, presenting examples of increases in one error as an unintended result of decreasing another; and 3. to present cost models that correspond to efforts to reduce various errors, making explicit the consequences of data quality maximization on research budgets. The book is divided into four chapters: 1. An introduction to survey errors. 2. An introduction to survey costs. 3. Costs and errors of covering the population. 4. Nonresponse in sample surveys.

Asymptotic Approximations of Integrals. By R. Wong. Academic Press, New York, 1989. xiii+543 pp., \$69.95.

This is a volume in the series Computer Science and Scientific Computing. There are two main areas of asymptotic analysis: the differential equation side, and the asymptotic approximation of integrals. The book provides an up-to-date introduction to the latter (as F. W. J. Olver's book does to the former). Many of the results appear for the first time in book form. These include logarithmic singularities, Mellin transform technique for multiple integrals, summability method, distributional approach, uniform asymptotic expansions via a rational transformation, and double integrals with a curve of stationary points. For completeness, classical methods are also discussed in detail. There are nine chapters: 1. Fundamental concepts of asymptotics. 2. Classical procedures. 3. Mellin transform techniques. 4. The summability method. 5. Elementary theory of distributions. 6. The distributional approach. 7. Uniform asymptotic expansions. 8. Double integrals. 9. Higher dimensional integrals.

Continued on page 754

Continued from page 740

Applied Partial Differential Equations. By Paul DuChateau and David Zachmann. Harper & Row, New York, 1989. xiv+620 pp.

In this text, the authors have tried to emphasize the development of only a few mathematical tools, but concentrate on learning to use them very well. In this way, with only a modest mathematical background they are able to consider a number of interesting physical applications including flow in a porous medium, dispersive and nondispersive wave propagation, advection with a random coefficient, traffic flow, and waves in a ripple tank. This book differs from other elementary books on partial differential equations in that approximately one half of the book is devoted to numerical methods for solving partial differential equations. Chapter headings: 1. Mathematical modelling and partial differential equations. 2. Fourier series and eigenvalue expansions. 3. Boundary-value problems and initial-boundary-value problems on spatially bounded domains. 4. Integral transforms. 5. Boundary-value problems and initial-boundary-value problems on unbounded domains. 6. Uniqueness and continuous dependence on data. 7. First-order equations. 8. Finite-difference methods for parabolic equations. 9. Numerical solutions of hyperbolic equations. 10. Finite-difference methods for elliptic equations.

Methods in Neuronal Modeling: From Synapses to Networks. Edited by Christof Koch and Idan Segev. MIT Press, Cambridge, 1989. xii+524 pp., \$45.00.

This book evolved in parallel with an annual four-week-long summer course at the Marine Biological Laboratory in Woods Hole, held for the first time during August, 1988. The papers collected in this book were used in lieu of course notes. It is thus suitable as a textbook for a one-term advanced undergraduate or graduate course in computational neuroscience, biological information processing, or neural networks, as well as a source book for experimentalists and modelers. A basic knowledge of biophysics and neurophysiology, as well as some familiarity with differential equations, is assumed. There are thirteen chapters by various authors.

Mathematical Psychology in Progress. Edited by Edward E. Roskam., Springer-Verlag, New York, 1989. viii+385 pp., \$53.00.

This is the third volume of papers originating from the European Mathematical Psychology Group. The present collection of papers is partitioned into three groups: 1. Theory, metatheory, and measurement. 2. Choice, perception, cognition, and performance. 3. Psychometrics and theory of data.

The Analysis of Directional Time Series: Applications to Wind Speed Direction. By Jens Breckling. Springer-Verlag, New York, 1989. viii+238 pp., \$23.80.

This is volume 61 of Lecture Notes in Statistics. It is based on a Ph.D. thesis written at the University of Western Australia, Perth. It is divided into two parts: part I (chapters 1–5) has the objective to find regularities in the record of wind speed and direction, to detect general weather patterns, and to describe their seasonal characteristics and interdependencies. Part II (chapters 6–9) is motivated by the actual data analysis and focuses on two autoregressive models for directional time series. Chapter headings: 1. Introduction. 2. The initial decomposition. 3. The geostrophic component. 4. The land and sea breeze cycle. 5. Short-term events. 6. Time series models for directional data. 7. Measures for angular association. 8. Comparison of different measures of association. 9. Inference from the wrapped autoregressive process.

Continued on page 766

Continued from page 754

Theory of Optimal Design. By Kirti R. Shah and Bikas K. Sinha. Springer-Verlag, New York, 1989. viii+171 pp., \$19.95.

This is volume 54 of Lecture Notes in Statistics. There are eight chapters: 1. Optimality criteria in design of experiments. 2. Block designs: general optimality. 3. Block designs: specific optimality. 4. Row-column designs. 5. Mixed effects models. 6. Repeated measurements designs. 7. Optimal designs for some special cases. 8. Weighing designs.

From Data to Model. Edited by Jan C. Willems. Springer-Verlag, New York, 1989. i+246 pp., \$59.00.

This volume consists of a survey paper on Linear System Identification and four papers on deterministic and statistical aspects of model selection. It is an outgrowth of work done at the International Institute of Applied Systems Analysis in Laxenburg, Austria.

Practical Numerical Algorithms for Chaotic Systems. By T. S. Parker and L. O. Chua. Springer-Verlag, New York, 1989. xiv+348 pp.

The purpose of this book is to present robust, reliable algorithms for simulating nonlinear dynamics, with an emphasis on chaotic behavior, including the theoretical underpinnings of the algorithms. Mathematics is used throughout the book to describe the solutions and properties of dynamical systems, but the authors rarely state theorems and even less often prove them. The few proofs that are included in the book are relegated to the appendices. No prior knowledge of nonlinear systems is assumed. Much of the language of dynamical systems theory is couched in the terms of differential topology, so the authors included an appendix that reviews the concepts of diffeomorphisms, manifolds, and transversality. Chapter headings: 1. Steady-state solutions. 2. Poincaré maps. 3. Stability. 4. Integration. 5. Locating limit sets. 6. Manifolds. 7. Dimensions. 8. Bifurcation diagrams. 9. Programming. 10. Phase portraits.

Three Decades of Mathematical System Theory. Edited by H. Nijmeijer and J. M. Schumacher. Springer-Verlag, New York, 1989. vi+562 pp., \$69.00.

This, volume 135 of Lecture Notes in Control and Information Sciences, is a collection of twenty-one survey articles collected at the occasion of the 50th birthday of Jan. C. Willems, all related in some way to Willem's work.

Estimation and Analysis of Insect Populations. Edited by L. McDonald, B. Manly, J. Lockwood, and J. Logan. Springer-Verlag, New York, 1989. xiv+492 pp., \$54.00.

This volume 55 of Lecture Notes in Statistics. It is the Proceedings of a Conference held in Laramie, Wyoming, January 25-29, 1988. The papers are divided into four sections: 1. Analysis of stage-frequency data. 2. Modeling of population data. 3. Analysis of spatial data. 4. General sampling and estimation methods.

Continued on page 781

Continued from page 766

Advanced Topics in the Theory of Dynamical Systems. Edited by G. Fusco, M. Iannelli, and L. Salvadori. Academic Press, 1989. ix+266 pp., \$29.95.

This is volume 6 in the series Notes and Reports in Mathematics in Science and Engineering. It consists of the proceedings of an international conference held at Villa Madruzzo, Trento, Italy, June 1-6, 1987. There are papers devoted to finite dimensional systems with special emphasis on analysis of the existence of periodic solutions to Hamiltonian systems. Other contributions deal with infinite dimensional systems; they are concerned with recent developments of general methods of proving existence and with the qualitative theory, both in general and in particular application areas. There are 20 papers.

An Introduction to Mathematical Physiology and Biology. By J. Mazumdar, Cambridge University Press, 1989. 208 pp., \$49.50 cloth, \$16.95 paper.

This is volume 4 in the Australian Mathematical Society Lecture Series. It is addressed to mathematically sophisticated students who have not previously encountered applications of mathematics to physiology and biology, and uses mathematical rigor to elucidate physiological and biological phenomena. Much of the necessary mathematics is explained in the text. Chapter headings: 1. Dimensional analysis in mathematical physiology; 2. The mathematics of diffusion; 3. Population biology; 4. Biogeography: mathematical analysis of wildlife reserves; 5. Pharmacokinetics: drug distribution in pharmacology; 6. Biological fluid dynamics; 7. Analysis and applications of arterial flow dynamics; 8. Analysis and applications of left ventricular mechanics; 9. Analysis and applications of heart valve vibration; 10. Medical devices.

Sparse Distributed Memory. By Pentti Kanerva. A Bradford Book-The MIT Press, 1989. ix+155 pp., \$24.95.

In this monograph, the author presents a mathematical theory of human long-term memory. It begins with background material from mathematics, computers, and neurophysiology; this is followed by a step-by-step development of the memory model. The concluding chapter describes an autonomous system that builds from experience an internal model of the world and bases its operation on that model. Close attention is paid to the engineering of the memory, including comparisons with ordinary computer memories. The monograph aims to provide an overall perspective on neural systems and the model described in it is designed to be able to aid in understanding human memory and learning. The memory model is expected to be applicable to the creation of adaptive systems for signal processing, speech, vision, and motor control, and to robots in general. The realization of the memory with neural like components resembles the cortex of the cerebellum. Chapter headings: 0. Introduction; 1. Mathematical foundations; 2. Background material from computers; 3. Background material from idealized neurons; 4. Neurons as address decoders; 5. Search of memory for the best match; 6. Sparse memory; 7. Distributed storage; 8. Storage and retrieval of sequences; 9. Constructing distributed memory; 10. The organization of an autonomous learning system.

Statistical Modelling. Edited by A. Decarli, B. J. Francis, R. Gilchrist, and G. U. H. Seeber. Springer-Verlag, New York, 1989. ix+343 pp., \$37.80.

This is volume 57 of Lecture Notes in Statistics. It is the Proceedings of GLIM 89 and the 4th International Workshop on Statistical Modelling held in Trento, Italy, July 17-21, 1989.

Theory of Discrete and Continuous Fourier Analysis. By H. Joseph Weaver. John Wiley and Sons, 1989. xii+307 pp., \$39.95.

One of the main purposes of this book is to offer a consolidated presentation of the three topics: Fourier series, the Fourier transform, and the discrete Fourier transform. To make the text self-contained, chapters on mathematical analysis, integration theory, and introductory theory of distributions are included. There are nine chapters: 1. Introduction; 2. Basic mathematical background; 3. Integration theory; 4. Distribution theory; 5. The Fourier series; 6. The Fourier transform; 7. Fourier transform of a distribution (permitting the calculation of the transform of a much larger class of functions); 8. Discrete Fourier transform (exploring the striking similarities between the continuous and the discrete transform via several property theorems); 9. Sampling theory (including a proof of the celebrated Whittaker-Shannon sampling theorem).

Cell Kinetic Modelling and the Chemotherapy of Cancer. By Helmut Knolle. Springer Verlag, 1988. viii+157 pp., \$18.90.

This is volume 75 of Lecture Notes in Biomathematics. It has three chapters. Chapter I (Mathematical models of cell populations) presents the basic facts of cell proliferation and some mathematical model of population growth; in Chapter II (Determination of cell kinetic parameters) the mathematical evaluation of some cell kinetic experiments without drug effects is treated in a systematic fashion; in Chapter III (Cell kinetics and cancer therapy) various effects of cytotoxic agents are described in mathematical terms, experiments for the measurement of action parameters are discussed and their evaluation analysed. Computer simulations of the action of cytotoxic drugs on cell populations are also presented.

Adaptive Markov Control Processes. By O. Hernández-Lerma. Springer Verlag, 1989. viii+148 pp., \$39.80.

This is volume 79 in the series Applied Mathematical Sciences. It is concerned with a class of discrete-time stochastic control processes known as *controlled Markov processes* (CMP's), also known as Markov decision processes or Markov dynamic programs. The purpose of this monograph is to present some rather recent developments in the theory of *adaptive* CMP's, i.e., CMP's that depend on *unknown* parameters; these must be estimated at each decision time and the control actions adapted to the estimated values. Chapter headings: 1. Controlled Markov processes; 2. Discounted reward criterion; 3. Average reward criterion; 4. Partially observable control models; 5. Parameter estimation in MCM's; 6. Discretization procedures.

Percolation. By Geoffrey Grimmett. Springer Verlag, 1989. xi+296 pp., \$49.80.

This book is about the mathematics of percolation theory, with the emphasis upon presenting the shortest rigorous proofs of the main facts. The author restricts himself to the special case of bond percolation on the cubic lattice Z^d . Chapter headings: 1. What is Percolation? 2. Some basic techniques; 3. The uniqueness of the critical point; 4. The number of open clusters per vertex; 5. The subcritical phase; 6. The supercritical phase; 7. Near the critical point: rigorous results; 9. Bond percolation in two dimensions; 10. A miscellany of random processes.

Shape Theory: Categorical Methods of Approximation. By J.-M. Cordier and T. Porter. John Wiley and Sons, 1989. 207 pp., \$59.95.

This is a volume in the Ellis Horwood Series in Mathematics and its Applications. It is an account of geometric shape theory as developed by K. Borsuk and others. This theory exemplifies the process of using known information on the topology of polyhedra to obtain analogous information on arbitrary compact (metric) spaces. The monograph clarifies the different treatments of shape theory, treating the categorical form in depth for the first time. It treats shape theory as a case study to illustrate and motivate general ideas relevant to any situation in which certain archetypical models are used as a basis for systems of approximations to more general objects, a situation occurring in many areas of mathematics. The authors unify and consolidate much research from category theory, shape theory, and the study of topological algebras. Chapter headings: 1. Borsuk's shape theory for compact metric spaces; 2. Categorical shape theory; 3. Shape theory for topological spaces; 4. Distributors and shape theory; 5. Functors between shape theories; 6. Stability and movability. There is an appendix entitled: Categorical shape theory and Pattern Recognition, a possible link.

Statistical Design and Analysis of Experiments, with Applications to Engineering and Science. By Robert L. Mason, Richard F. Gunst, and James L. Hess. John Wiley and Sons, 1989. xvi+692 pp., \$59.95.

This is a volume in the Wiley Series in Probability and Mathematical Statistics. It is a practical guide, stressing the strategy of experimentation, data analysis, and the interpretation of experimental results and presenting statistics as an integral component of experimentation from the planning stage to the presentation of the conclusions. The authors have selected techniques that are widely recognized as fundamental to the statistical design and analysis of experiments or as valuable alternatives to standard ones, and new procedures for which proper application doesn't require extensive training in statistical theory. The book is divided into five sections, including an introduction (chapters 1 and 2) that presents an overview of many conceptual foundations of modern statistical practice. Part I (chapters 3 to 5) presents basic descriptive statistics and graphical displays. Part II (chapters 6 to 11) is the experimental design portion of the book. Part III (chapters 12 to 20) emphasizes the analysis of data from designed experiments and presents analysis of data from each of the designs discussed in Part II. Part IV (chapters 21 to 28) is devoted to regression modeling, including diagnostic techniques and identification of influential observations.

The Sequential Statistical Analysis of Hypothesis Testing, Point and Interval Estimation, and Decision Theory. By Z. Govindarajulu. American Sciences Press, 1987. ix+680 pp., \$48.50.

This is a corrected edition of volume 5 in the American Series in Mathematical and Management Sciences, first published in 1981. It is an up-to-date and comprehensive treatment of the field, with the mathematical and statistical level kept such as to make it suitable as a text for students, in addition to constituting a reference work for research workers and users of sequential procedures. Chapter headings: 1. Preliminaries; 2. The sequential probability ratio test; 3. Sequential tests for composite hypotheses; 4. Sequential estimation; 5. Specific problems in sequential estimation; 6. Optimal stopping problem: the secretary problem. There are eight appendices, on background material such as the solution of Wald's equation, large sample properties of maximum likelihood estimates, the normal diffusion process, etc.

An Introduction to Hilbert Space. By Nicholas Young. Cambridge University Press, 1988. x+239 pp., \$59.50 cloth, \$21.95 paper.

Chapters 1–8 present the basic notions of Hilbert Space in a way accessible to undergraduate students. It includes historical and background material. The second half of the book describes two substantial applications: (i) the Sturm-Liouville theory of eigenfunction expansions and its role in the solution of the partial differential equations of mathematical physics by the method of separation of variables (chapters 9–11), and (ii) chapters 12–16 (see below). Chapter headings: 1. Inner product spaces; 2. Normed spaces; 3. Hilbert and Banach spaces; 4. Orthogonal expansions; 5. Classical Fourier series; 6. Dual spaces; 7. Linear operators; 8. Compact operators; 9. Sturm-Liouville systems; 10. Green's functions; 11. Eigenfunction expansions; 12. Positive operators and contractions; 13. Hardy spaces; 14. Interlude: complex analysis and operators in engineering; 15. Approximation by analytic functions; 16. Approximation by meromorphic functions.

The Fourier Integral and Certain of Its Applications. By Norbert Wiener, Cambridge University Press, 1989. xiii+201 pp., \$16.95.

This is a reissue, with a new foreword by Jean-Pierre Kahane, of Wiener's famous treatise of 1933.

Physical Fluid Dynamics. By D. J. Tritton. Oxford University Press, 1988. xvii+519 pp., \$75.00 cloth, \$35.00 paper.

This is the second edition of a text first published by Van Nostrand Reinhold in 1977. There are several changes and additions, introducing topics that have assumed greater importance since the first edition was prepared. Its distinctive approach to the study of fluid mechanics is retained.

Relations, Bounds and Approximations for Order Statistics. By Barry C. Arnold and N. Balakrishnan. Springer Verlag, 1989. viii+173 pp., \$20.60.

This is volume 53 of Lecture Notes in Statistics. It is a compendium of results on the subject of bounds on order statistics, going back to Sir Francis Galton's work. Chapter headings: 1. The distribution of order statistics; 2. Recurrence relations and identities for order statistics; 3. Bounds on expectations of order statistics; 4. Approximations to moments of order statistics; 5. Order statistics from a sample containing a single outlier; 6. Record values.

Sparse Matrices. By U. Schendel. Halsted Press: a division of John Wiley and Sons., 1989. vii+115 pp., \$39.95.

This is a volume in the Ellis Horwood Series in Mathematics and Its Applications. It is a translation from the original German edition first published in 1977 by R. Oldenbourg, Munich. It developed from lectures held at the Free University and the Technical University of Berlin. The emphasis is on classical procedures which have proved their efficiency in practical applications. Chapter headings: 1. Introduction; 2. Storage techniques; 3. Systems of linear equations; 4. Computation of the inverse; 5. Block matrices; 6. Iterative algorithms; 7. Graphs and matrices; 8. Eigenvalues and eigenvectors; 9. Parallel numerical algorithms.