Mathematics of Computation

Volume 21, Number 100 October, 1967

Published by the American Mathematical Society PROVIDENCE, RHODE ISLAND

Editorial Committee

- EUGENE ISAACSON, Chairman, New York University, Courant Institute of Mathematical Sciences, 251 Mercer Street, New York, New York 10012 Assistant to the Chairman: CHARLOTTE W. JOHN
- Avron Douglis, Department of Mathematics, University of Maryland, College Park, Maryland 20740
- WALTER GAUTSCHI, Computer Sciences Department, Purdue University, Lafayette, Indiana 47907
- GENE H. GOLUB, Computer Science Department, Stanford University, Stanford, California 94305

A. S. HOUSEHOLDER, Oak Ridge National Laboratory, Oak Ridge, Tennessee

- HEINZ O. KREISS, Computer Science Department, University of Uppsala, Uppsala, Sturegatan 4, Sweden
- PETER D. LAX, New York University, Courant Institute of Mathematical Sciences, 251 Mercer Street, New York, New York 10012
- Y. L. LUKE, Midwest Research Institute, Kansas City, Missouri 64110
- JAMES M. ORTEGA, Computer Science Center, University of Maryland, College Park, Maryland 20740
- HARRY POLACHEK, Research Division, U. S. Atomic Energy Commission, Washington, D. C. 20545
- DANIEL SHANKS, Naval Ship Research and Development Center, Washington, D. C. 20007
- R. S. VARGA, Case Institute of Technology, Cleveland, Ohio 44106
- J. W. WRENCH, JR., Naval Ship Research and Development Center, Washington, D. C. 20007

Information for Subscribers

The journal is published quarterly in one volume per year, with issues numbered serially since Volume 1, Number 1. The subscription price is \$16.00. All back volumes are available. For Volumes 1–21 (1943–1967), prices are \$20.00 per volume and \$6.00 per issue.

Unpublished Mathematical Tables

The editorial office of the journal maintains a repository of Unpublished Mathematical Tables (UMT). When a table is deposited in the UMT repository a brief summary of its contents is published in the section *Reviews and Descriptions of Tables and Books*. Upon request, the chairman of the editorial committee will supply copies of any table for a nominal cost.

Subscriptions, address changes, business communications and payments should be sent to:

AMERICAN MATHEMATICAL SOCIETY P. O. Box 6248 Providence, Rhode Island 02904

Mathematics of Computation

TABLE OF CONTENTS

October 1967

A Procedure for Conformal Mapping of Triply-Connected Domains	
STEFAN BERGMAN & BRUCE CHALMERS	527
A Numerical Method for Locating the Zeros of an Analytic Function	
L. M. Delves & J. N. Lyness	543
On Numerical Contour Integration Round a Closed Contour	
J. N. Lyness & L. M. Delves	561
A Construction of Nonnegative Approximate Quadratures PHILIP J. DAVIS	578
Numerical Analysis of Boundary-Layer Problems in Ordinary Differential	
Equations	583
A Class of Single-Step Methods for Systems of Nonlinear Differential Equa-	
tions	597
Some Remarks on the Lax-Wendroff Finite-Difference Scheme for Nonsym-	
metric Hyperbolic Systems MASAYA YAMAGUTI	611
Numerical Solution for Flux Components in Potential Flow	
DALE U. VON ROSENBERG	620
Error Analysis of Recurrence Equations	629
The Asymptotic Representation of a Class of G-Functions for Large Parameter	
Jet Wimp	639
Error Estimates in Simple Quadrature with Voigt Functions ALEX REICHEL	647
The Efficient Calculation of the Incomplete Beta-Function Ratio for Half-	
Integer Values of the Parameters a, b	
A. R. DIDONATO & M. P. JARNAGIN	652
Computation of Tangent, Euler, and Bernoulli Numbers	
Donald E. Knuth & Thomas J. Buckholtz	663
Generalized Euler and Class Numbers DANIEL SHANKS	689
On Sequences of Integers with No 4, or No 5 Numbers in Arithmetical Pro-	
gression S. S.	695
The Number of Prime Divisors of Certain Mersenne Numbers	
John R. Ehrman	700
The second	
LeVa Constant and Commission	70-
Lars Constant and Generalizations	700
Generating resulto-Random Numbers by Snuming a Fibonacci Sequence	700
FRIEDRICH GEBHARDT	708
Note on Random Permutations	/10
Points I I Base & S. P. Seruperer	719
An Efficient Algorithm for Inverting a Block Symmetric Matrix	112
S CHARMONMAN	715
A Note on the Effect of Conditionally Stable Correctors	110
FRED T. KROGH	717

Midpoint Quadrature Formulas SEYMOUR HABER Zeros of $J_r(\lambda) Y_r(\eta \lambda) - J_r(\eta \lambda) Y_r(\lambda)$	719
JOYCE WEIL, TADEPALLI S. MURTY & DESIRAJU B. RAO More on the Calculation of the Integral	722
$I_n(b) = (2/\pi) \int_0^\infty ((\sin x)/x)^n \cos bx dx$ Henry E. Fettis	727
REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS	731
Table Errata	747
CORRIGENDUM	P7 ~ 1
BRILLHART & SELFRIDGE	751
Notes	
New Journals	752
Indices to Volume XXI	
Index of Papers and Technical Notes by Authors	753
Index of Reviews by Author of Work Reviewed	756
Index of Reviews by Subject of Work Reviewed	759
Index of Table Errata	767
Index of Corrigenda	767
Index of Notes	768

Mathematicians and Information-Processing Scientists FOUR NEW SIGNIFICANT TITLES FROM THOMPSON!



FUNCTIONAL ANALYSIS Edited by Bernard L. Gelbaum Dept. of Mathematics U. of Calif., Irvine

1

Papers in this volume have been grouped into three sections: Linear Spaces; Operations; Banach Algebras; covering the significant work being pursued in functional analysis. Contents include: Topological Groups and von Neumann Algebras; Algebras of Kernels; Dirichlet Theories in Functional Analysis; Ideal Theory of Certain Algebras Defined by Smoothness Conditions; Unitary Representations of Semi-Simple Lie Groups; On Spaces of Holomorphic Functions of a Given Type; Application of Scattering Theory to a Problem in Ergodic Theory. 272 pages, \$15.00



LOGIC, COMPUTABILITY AND AUTOMATA Edited by

4

2

F. B. Cannonito

Probably the best way to stress the importance of this book is simply by listing some of its contents: The Effectivity of Existential Statements in Axiomatic Set Theory; On Provable Recursive Functions and Ordinal Recursive Functions; The Word Problem for Commutative Semi-Groups; Automata-Based Computational Complexity; The State Space in Systems Theory; Preservation of Languages by Transducers; The Loop Complexity of Regular Events; Intelligence and Non-Computability; Random Access Storage Organization and Finite Automata. 512 pages, \$22.50



3 NUMERICAL ANALYSIS — AN INTRODUCTION Edited by J. Walsh, Dept. of Mathematics,

the University, Manchester, England

The account is sufficiently detailed for readers who want to go further to study the more advanced works listed in the references. Subjects include linear algebra and the eigenvalue problem, ordinary and partial differential equations, methods of approximation and function minimization, and some applications of modern techniques to industrial problems. Contents include: Applications of Computers to Pure Mathematics; Techniques of Operational Research; Computation in School and University Teaching. Two complete indexes, by subject and author. **240** pages, **\$12.00**



ALGEBRAIC NUMBER THEORY Edited by J. W. S. Cassels and A. Frohlich

The opening chapters give a broad introduction, followed by the elementary and utilitarian tools needed for class field theory. The emphasis is on intelligibility; the reader who has mastered what is done here can approach the rest of the literature with confidence. The concluding chapter is Tate's thesis, which was never before published. Contents include: Cohomology of Groups; Zeta-functions and Lfunctions; Semi-simple Algebraic Groups; Applications of Computers to Class Field Theory; Fourier Analysis in Number Fields.

350 pages, \$16.00

ORDER YOURS TODAY! (Please order by number.) THOMPSON	#1 #2 #3 #4	copies copies copies copies copies	s at \$15.00 s at \$22.50 s at \$12.00 s at \$12.00 s at \$16.00	\$
BOOK Company	│ │ □ Check	□ Cash	Money Order	Total \$
National Press Building Washington, D.C. 20004	Address		State	Zip



FROM CAMBRIDGE

A Short Introduction to Numerical Analysis M. V. WILKES

Professor Wilkes sets out the principles of the methods commonly employed in obtaining numerical solutions to mathematical equations and shows how they are applied in solving particular types of equations.

This concise book covers the needs of many users of digital computers. It will also serve as a sound introduction for those who need to consult more detailed works. Cloth \$4.75 Paper \$1.95

The Analytic S-Matrix

R. J. EDEN, P. V. LANDSHOFF, D. I. OLIVE, J. C. POLKINGHORNE

Four authors, who together are responsible for many developments in the field, present a theory of the **S-Matrix** starting from physically plausible assumptions and investigate the mathematical consequences.

"This type of 'experimental physics' is a highly developed mathematical art and is very clearly presented. Should be very useful to serious mathematical physicists."—<u>Science</u> \$14.00

Royal Society Mathematical Tables

6.	Tables of the Riemann Zeta Function C. B. HASELGROVE and J. C. P. MILLER	\$9.50
7.	Bessel Functions: Part III. Zeros and Associated Values F. W. J. OLVER, Editor	\$12.50
8.	Tables of Natural and Common Logarithms to 110 Decimals W. E. MANSELL. Edited by A. J. THOMPSON	\$8.00
10.	Bessel Functions: Part IV. Kelvin Functions ANDREW YOUNG and ALAN KIRK	\$12.50
11.	Coulomb Wave Functions A. R. CURTIS	\$15.00

CAMBRIDGE UNIVERSITY PRESS

32 EAST 57TH STREET, NEW YORK, N.Y. 10022

On-Line Computation and Simulation: The OPS-3 System by Martin Greenberger, Malcolm M. Jones, James H. Morris, Jr., and David N. Ness OPS-3 — an on-line system that is multipurpose, modular, and openended — described in fully readable fashion. Flexible in design, it invites the user to make his own extensions and enables him to assimilate previously written programs. \$4.95

LISP 1.5 Programmer's Manual

by John McCarthy, Paul W. Abrahams, Daniel J. Edwards, Timothy P. Hart, and Michael I. Levin The LISP language: designed primarily for symbolic data processing used for symbolic calculations in differential and integral calculus, electrical circuit theory, mathematical logic, game playing, and other fields of artificial intelligence. The manual describes LISP as a formal mathematical language. \$3.00

The Programming Language LISP:

Its Operation and Applications by Information International, Inc. The LISP language, elementary and advanced. The elementary section covers the syntax and semantics, programming and debugging techniques, and 240 exercises with solutions. The advanced section includes applications of LISP for discovering interrelations in data, drawing inductive inferences on sequences, checking mathematical proofs, and programming an incremental computer. **\$5.00**

ICES Systems Design

2nd edition, revised by Daniel Roos ICES (Integrated Civil Engineering System): a computer system designed for use by engineers, consisting of subsystems corresponding to the various engineering discipline areas. Each system features a series of problem-oriented language commands. **\$10.00**

An Analysis of Time-Shared Computer Systems

by Allan L. Scherr Introduction by Herbert M. Teager Applying analytic methods to real data, the author evaluates the interaction of a time-shared computer system and its users. The technique: to specify and measure various characteristics of such computer systems, to specify and measure relevant human characteristics, and, on the basis of these quantitative parameters, to predict the overall performance of both as they "discuss" their problem in sequences of command and response, \$5.00

SNOBOL3 Primer: An Introduction to the Computer Programming

Language by Allen Forte The ABC of SNOBOL3: an elementary computer programming language easily learned by novices and intended particularly for those in the humanities and social sciences who could make use of a computer in their research. Especially well suited to the processing of nonnumeric data. SNOBOL3 provides a powerful means for searching through arbitrary character strings in order to find patterns, to rearrange the strings, and to form new strings. Its other advantages: uncomplicated statement format. string-oriented input-output, editing aids, dynamic storage. Available late September 1967. Estimated price \$5.00

THENEW LINGUAFRANCAS THENERAL CASE INTERNATIONAL INTERNATI

NEW JOURNALS

JOURNAL OF COMPUTER AND SYSTEM SCIENCES

edited by A. V. BALAKRISHNAN, E. K. BLUM (Managing Editor), R. W. HAM-MING, P. D. LAX, L. A. ZADEH

Devoted to the newly emerging interdisciplinary area of computer theory and system sciences, this journal will feature papers on computers and computer-like information processing systems, the general theory of systems, and optimization theory of such systems with emphasis on computational methods and algorithms. Volume 2, 1968 (quarterly) \$20.00 Personal Subscription, \$12.00* Plus \$1.10 postage outside U.S.A.

JOURNAL OF FUNCTIONAL ANALYSIS

edited by PAUL MALLIAVIN, RALPH S. PHILLIPS and IRVING SEGAL This new publication, dedicated to ad-vancing the horizons of functional analysis, publishes original research papers in all branches of science in which func-

tional analysis plays an essential role. Volume 2, 1968 (Quarterly) \$16.00 Personal Subscription, \$10.00* Plus \$1.20 postage outside U.S.A.

JOURNAL OF COMPUTATIONAL PHYSICS

edited by BERNI J. ALDER, SIDNEY FERN-BACH and MANUEL ROTENBERG

A new journal devoted to the computational aspects of physical problems. It will emphasize the techniques involved in the numerical solution of mathematical equations and in automated data reduction. Volume 2, 1967-1968 (4 issues) \$25.00 Personal Subscription, \$10.00* Plus \$1.50 postage outside U.S.A.

JOURNAL OF **COMBINATORIAL THEORY**

edited by Andrew M. Gleason, Marshall Hall, Mark Kac, Claude Shannon, A. W. Tucker, W. T. Tutte, G. E. UHLENBECK, S. M. ULAM

This journal is devoted to the publication of original mathematical articles dealing with theoretical and physical aspects of the study of finite and discrete structures in all branches of science. It fully explores the field of combinatorial analysis and includes the efforts of scientists, working in many independent disciplines, who have found a common link through combinatorics.

Volumes 4 & 5, 1968 (8 issues) \$32.00 Personal Subscription, \$20.00* Plus \$2.40 postage outside U.S.A.

*Valid only on orders placed directly with the publishers certifying that the subscription is paid for by the subscriber for his personal use.



THE THEORY OF SPLINES AND THEIR APPLICATIONS

by J. H. AHLBERG, E. N. NILSON and J. L. WALSH Volume 38 of Mathematics in Science and Engineering A Series of Monographs and Textbooks

A comprehensive treatment of spline theory, including orthogonality, best approximation and other extremal properties, and convergence. The theory is developed systematically, based primarily on cer-tain fundamental integral relations. Applications to curve and surface fittings, as well as the use of splines in the solution of integral equations and ordinary differential equations, are presented. 1967, 285 pp., \$13.50

RECURSIVE FUNCTIONS

by Rozsa Peter

This clear, understandable discussion of recursive functions covers elementary number theory, analysis, set theory and the theory of transfinite ordinals. This new, revised edition includes the author's investigation on recursions of Hilbert's higher degrees as well as on recursions involving a variable number of earlier function values. 1967, 300 pp., \$13.50

ADVANCES IN CONTROL SYSTEMS

THEORY AND APPLICATIONS edited by C. T. LEONDES

"Those directly active in developing control theory, as well as those who use techniques of automatic control as an effective tool, will find this series invaluable as a comprehensive and readily accessible compilation of information. The teacher will find it a timely and convenient source to which to refer his students." VOLUME 5: 1967, 426 pp., \$18.50 -Current Science

new revised second edition SOLUTION OF EQUATIONS AND SYSTEMS OF EQUATIONS

by Alexander M. Ostrowski

Volume 9 of Pure and Applied Mathematics A Series of Monographs and Textbooks

"This is certainly a remarkable book which will be welcome, to everybody who wants suggestions for original work or for the preparation of lectures in numerical analysis with stress on mathematical -Mathematical Reviews rigour."

1966, 338 pp., \$11.95

THEORETICAL NUMERICAL ANALYSIS

by BURTON WENDROFF

"This book is a welcome addition to any library." -Mathematical Reviews

Presenting numerical analysis as a legitimate branch of mathematics in its own right, the book treats in depth five important fields: interpolation, approximation, numerical solution of ordinary and partial differential equations, and numerical solution of sys-tems of equations. Suggested problems to be worked on a computer, as well as computational exercises are provided at the end of each chapter. 1966, 241 pp., \$10.95

ACADEMIC PRESS 111 FIFTH AVENUE, NEW YORK, N.Y. 10003

CURRENT AND FORTHCOMING COMPUTER TEXTS-FROM PRENTICE-HALL

IBM 360: PROGRAMMING AND COMPUTING

By JAMES T. GOLDEN and RICHARD M. LEICHUS, both of the IBM Corporation

Provides a thorough and up-to-date introduction to programming and operating system fundamentals, utilizing as an example the IBM System/360 rather than a hypothetical computer. In addition to explanations of how the computer's instruction set operates, the text includes illustrations of such programming techniques as sorting, binary search, round-off, multiple precision arithmetic, scaling, JV overlapping, 1/0 device operation overlapped with computing, interrupt handling, programming with macros, and use of subroutines and teleprocessing.

August 1967 352 pp. paperbound \$5.50

PROGRAMMING LANGUAGE ONE

By FRANK BATES, Network Technical Services Department, Union Carbide Corporation, and MARY L. DOUGLAS, The Johns Hopkins University

This new book will prove valuable to programmers and system analysts for selfstudy applications and ideal for introductory courses in digital computing, computer methods, or electronic data processing in departments of computer science, engineering, and business. A knowledge of elementary algebra on the part of the reader is helpful though not essential.

March 1967 384 pp. \$5.95

for approval copies, write: Box 903

COMPUTER SOLUTION OF LINEAR ALGEBRAIC SYSTEMS

By GEORGE E. FORSYTHE, Head of the Computer Science Department, Stanford University, and CLEVE B. MOLER, University of Michigan

This text introduces the analytical and computational tools necessary to understanding matrix problems, presents a computer algorithm to solve linear equation systems, and investigates the fundamental concepts of error involved. Numerous exercises, including interpretation and application of results, details of proofs, computer projects, and research problems, are provided to help the reader.

June 1967 148 pp. \$6.75

INTERVAL ANALYSIS

By RAMON E. MOORE, Computer Sciences Department, University of Wisconsin

Interval Analysis presents a unified approach to the machine determination of the total computational error—round off, truncation, and propagation of initial error—in digital computation. The book presents a set of new techniques by which a computer can be programmed to provide solutions of guaranteed accuracy to a variety of types of mathematical problems, with all the necessary analysis carried out by the computer itself for each specific application of the resulting programs.

1966 128 pp. \$9.00

PRENTICE-HALL Englewood Cliffs, N.J. 07632 • Teaches algorithms and computer programming in the context of mathematics



- Uses the computer to further mathematical understanding
- Gives the reader a command of mathematics sufficient to program and solve meaningful problems on a computer
- these are just a few of many unique features in

MATHEMATICS AND COMPUTING: with FORTRAN Programming

By WILLIAM S. DORN, International Business Machines; and HERBERT J. GREENBERG, University of Denver. Covers essential topics in linear systems of equations and inequalities with optimization, calculus, probability and logic. The book is full of problems based on realistic applications. The use of the computer in the context of mathematics allows the reader to solve problems, develop insights and make discoveries in mathematics which otherwise would not be possible. Flow charts and computer programming are integrated with the mathematics. The programming is simple FORTRAN and will run on any computer with a FORTRAN compiler.

1967. 595 pages. \$8.95.

INTRODUCTION TO NUMERICAL METHODS AND FORTRAN PROGRAMMING

By THOMAS RICHARD McCALLA, Naval Research Laboratory.

1967. 359 pages. \$7.95.

SEQUENTIAL MACHINES AND AUTOMATA THEORY

By TAYLOR L. BOOTH, University of Connecticut. 1967. In press.

NONLINEAR PROGRAMMING

Edited by J. ABADIE, Electricité de France and l'Université de Paris.

1967. 316 pages. \$13.00.

JOHN WILEY & SONS, Inc.

605 Third Avenue • New York, N. Y. 10016

LECTURES

APPLIED MATHEMATICS

Volume 8

Relativity Theory and Astrophysics I. Relativity and Cosmology List Price \$9.40 Member Price \$7.05 Approximately 300 pages

Volume 9

Relativity Theory and Astrophysics II. Galactic Structure List Price \$8.10 Member Price \$6.08 Approximately 228 pages

Volume 10

Relativity Theory and Astrophysics III. Stellar Structure List Price \$6.70 Member Price \$5.03 Approximately 140 pages

These three volumes, edited by Jürgen Ehlers, contain the proceedings of the 1965 Summer Seminar in Applied Mathematics sponsored by the American Mathematical Society. The lectures contained in these volumes concern the state of knowledge and current problems in relativity and astrophysics.

Essentially five groups of problems are treated in the three volumes: empirical tests of general relativity in the laboratory and in the solar system; theoretical developments in general relativity; cosmology; galactic structure; and stellar structure. While the lectures deal with very different topics and methods of approach, they are all concerned with gravitation. The contributions are arranged to indicate the systematic relationships between the topics. Both basic information and new and advanced material are presented.

Please send orders to: AMERICAN MATHEMATICAL SOCIETY P. O. Box 6248 Providence, R. I. 02904 Oxford University Press

Algol: Introduction to Algol Programming

By TORGIL EKMAN and CARL-ERIK FRÖBERG

Algol holds a special place among programming languages because of its international status, and still more because of its strict and logical structure. This book has been written primarily to give students a modern textbook in Algol, but people in commercial, industrial, and administrative positions will find it valuable both as a text and handbook. It will prove useful for applications with a background of mathematics and natural science, and for applications within the field of administrative data processing. Solutions and answers to exercises, bibliography, index.

1966

123 рр.

\$5.00

\$5.00

\$7.50

V.

Numerical Solution of Partial Differential Equations

By G. D. SMITH, Brunel College of Advanced Technology, London

Designed as a textbook for students with no previous knowledge of numerical methods, this volume is also intended as a bridge to the increasing number of advanced treatises on the numerical solution of partial differential equations. The work assumes no prior training in finite-difference calculus and develops the subject clearly and in detail. Exercises and worked solutions are included.

190 pp.

1965

An Introduction to Numerical Linear Algebra With Exercises

By L. FOX, Oxford University

"An excellent text for those with minimal background in linear algebra who require matrix methods in their problem solving. The additional notes at the end of each chapter are very helpful"—KLAUS E. ELDRIDGE, Ohio University 1965 344 pp. \$8.50

Introduction to the Theory of Queues

By LAJOS TAKÁCS, Columbia University 1962 278 pp.

Random Processes

By MURRAY ROSENBLATT,	University of California, San Diego	
1961	218 pp.	\$6.00

🕍 OXFORD 🕍 UNIVERSITY 🕍 PRESS

200 Madison Avenue, New York, N.Y. 10016

CLASSIFICATION OF REVIEWS

- A. Arithmetical Tables, Mathematical Constants
- **B.** Powers
- C. Logarithms
- **D.** Circular Functions
- E. Hyperbolic and Exponential Functions
- F. Theory of Numbers
- G. Higher Algebra
- H. Numerical Solution of Equations
- I. Finite Differences, Interpolation
- J. Summation of Series
- K. Statistics
- L. Higher Mathematical Functions
- M. Integrals
- N. Interest and Investment

- **O.** Actuarial Science
- P. Engineering
- Q. Astronomy
- R. Geodesy
- S. Physics, Geophysics, Crystallography
- T. Chemistry
- U. Navigation
- V. Aerodynamics, Hydrodynamics, Ballistics
- W. Economics and Social Sciences
- X. Numerical Analysis and Applied Mathematics
- Y. Biological Science
- Z. Calculating Machines and Mechanical Computation

Information for Contributors

Manuscripts should be typewritten double-spaced in the format used by the journal. For journal abbreviations, see Mathematical Reviews, v. 28, Index. An author should submit the original and one copy of the manuscript and retain one copy. The author may suggest an appropriate editor for his paper. It is recommended that the author acquaint himself with the pertinent material contained in "Information for Contributors to Mathematics of Computation" and "Manual for Authors," both of which are available upon request from the American Mathematical Society. All contributions intended for publication and all books for review should be addressed to Eugene Isaacson, Chairman, Editorial Committee, Mathematics of Computation, New York University, Courant Institute of Mathematical Sciences, 251 Mercer Street, New York, New York 10012. Institutions sponsoring research reported in the journal are assessed page charges.

Table of Contents-Continued from back cover Reviews and Descriptions of Tables and Books 731 LAL 84, KNUTH & BUCKHOLTZ 85, OSTROWSKI 86, FICKEN 87, KOR-GANOFF & PAVEL-PARVU 88, NOBLE 89, WACHSPRESS 90, FETTIS & CASLIN 91, CHANG & YEH 92, LOVE 93, HESTENES 94, LEONDES 95, RUBINSTEIN 96, JARNAGIN 97, SHUBIK 98, HANDSCOMB 99, WILKES 100, Hull 101, von Neumann 102, Singh 103 747 TABLE ERRATA . ABRAMOWITZ & STEGUN 415, JOLLEY 416, MANGULIS 417 CORRIGENDUM 751 Notes New Journals 752 INDICES TO VOLUME XXI 753 756 Index of Reviews by Author of Work Reviewed Index of Reviews by Subject of Work Reviewed 759 767 767 768

Mathematics of Computation TABLE OF CONTENTS

OCTOBER 1967 A Procedure for Conformal Mapping of Triply-Connected Domains STEFAN BERGMAN & BRUCE CHALMERS 527 A Numerical Method for Locating the Zeros of an Analytic Function L. M. DELVES & J. N. LYNESS 543 On Numerical Contour Integration Round a Closed Contour J. N. LYNESS & L. M. DELVES 561 A Construction of Nonnegative Approximate Quadratures PHILIP J. DAVIS 578 Numerical Analysis of Boundary-Layer Problems in Ordinary Differential Equations W. D. MURPHY 583 A Class of Single-Step Methods for Systems of Nonlinear Differential Equa-597 Some Remarks on the Lax-Wendroff Finite-Difference Scheme for Nonsymmetric Hyperbolic Systems MASAYA YAMAGUTI 611 Numerical Solution for Flux Components in Potential Flow DALE U. VON ROSENBERG 620 Error Analysis of Recurrence Equations R. TAIT 629 The Asymptotic Representation of a Class of G-Functions for Large Parameter JET WIMP 639 Error Estimates in Simple Quadrature with Voigt Functions ALEX REICHEL 647 The Efficient Calculation of the Incomplete Beta-Function Ratio for Half-Integer Values of the Parameters a, bA. R. DIDONATO & M. P. JARNAGIN 652 Computation of Tangent, Euler, and Bernoulli Numbers DONALD E. KNUTH & THOMAS J. BUCKHOLTZ 663 Generalized Euler and Class Numbers DANIEL SHANKS 689 On Sequences of Integers with No 4, or No 5 Numbers in Arithmetical Pro-695 The Number of Prime Divisors of Certain Mersenne Numbers JOHN R. EHRMAN 700 TECHNICAL NOTES AND SHORT PAPERS Lal's Constant and Generalizations DANIEL SHANKS 705 Generating Pseudo-Random Numbers by Shuffling a Fibonacci Sequence FRIEDRICH GEBHARDT 708 710 On Finding the Disc of Minimum Radius Containing a Given Set of Points L. J. BASS & S. R. SCHUBERT 712 An Efficient Algorithm for Inverting a Block-Symmetric Matrix S. CHARMONMAN 715 A Note on the Effect of Conditionally Stable Correctors FRED T. KROGH 717 Midpoint Quadrature Formulas SEYMOUR HABER 719 Zeros of $J_n(\lambda) Y_n(\eta \lambda) - J_n(\eta \lambda) Y_n(\lambda)$ JOYCE WEIL, TADEPALLI S. MURTY & DESIRAJU B. RAO 722 More on the Calculation of the Integral $I_n(b) = (2/\pi) \int_0^\infty ((\sin x)/x)^n \cos bx \, dx$. . . Henry E. Fettis 727