## Information for Contributors

Authors are encouraged to prepare articles electronically with the AMS-TeX software package in the AMS pre-print style and to provide the article in this electronic form for typesetting. While this procedure may not reduce the interval between submission and publication of an article, generally much more accurate copy will be returned for proofreading. Production time for manuscripts prepared with other systems, even TeX itself without AMS-TeX, currently prevents cost-effective use of the existing electronic form. Before sending an AMS-TeX manuscript for typesetting, contact the AMS Composition Department for details.

Manuscripts prepared by some means other than AMS-TeX should be double-spaced and produced in the format used by the journal. For journal abbreviations, see the latest Mathematical Reviews volume index. An author should submit the original and two copies 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 "A Manual for Authors of Mathematical Papers," which is available from the American Mathematical Society. All contributions intended for publication and all books for review should be addressed to Walter Gautschi, Chairman, Editorial Committee, Mathematics of Computation, Department of Computer Sciences, Purdue University, West Lafayette, Indiana 47907. The date received, which is published with the final version of an accepted paper, is the date received in the office of the Chairman of the Editorial Committee, and it is the responsibility of the author to submit manuscripts directly to this office. Institutions sponsoring research reported in the journal are assessed page and microfiche charges.

Each article submitted for publication must be accompanied by a brief and reasonably self-contained abstract, and by 1980 Mathemattcs Subject Classification (1985 Revision) numbers. If a list of key words and phrases is included, it will be printed as a footnote on the first page. A list of the classification numbers may be found in the 1984 Subject Index to Mathematical Reviews.

The research journals of the American Mathematical Society carry a page charge of $\$ 50.00$ per page to help defray the cost of publication. This amount is charged to the institution or to a contract supporting the research reported in the published paper. The publication charge policy of the United States Federal Council for Science and Technology (FCST) is reported on page 112 of the February, 1975 issue of the NOTICES of the American Mathematical Society. In no case is the author personally responsible for paying the page charge, nor is acceptance of the author's paper for publication dependent upon payment of the page charge.

## Copying and Reprinting

Individual readers of this publication, and nonprofit libraries acting for them, are permitted to make fair use of the material, such as to copy an article for use in teaching or research. Permission is granted to quote brief passages from this publication in reviews provided the customary acknowledgement of the source is given.

Republication, systematic copying, or multiple reproduction of any material in this publication (including abstracts) is permitted only under license from the American Mathematical Society. Requests for such permission should be addressed to the Executive Director, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940.

The appearance of the code on the first page of an article in this journal indicates the copyright owner's consent for copying beyond that permitted by Sections 107 or 108 of the U. S. Copyright Law, provided that the fee of $\$ 1.00$ plus $\$ .25$ per page for each copy be paid directly to Copyright Clearance Center, Inc., 21 Congress Street, Salem, Massachusetts 01970 . This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotion purposes, for creating new collective works, or for resale.

# <div class="inline-tabular"><table id="tabular" data-type="subtable">
<tbody>
<tr style="border-top: none !important; border-bottom: none !important;">
<td style="text-align: left; border-left: none !important; border-bottom: none !important; border-top: none !important; width: auto; vertical-align: middle; ">Tho</td>
</tr>
<tr style="border-top: none !important; border-bottom: none !important;">
<td style="text-align: left; border-left: none !important; border-bottom: none !important; border-top: none !important; width: auto; vertical-align: middle; ">TEO</td>
</tr>
<tr style="border-top: none !important; border-bottom: none !important;">
<td style="text-align: left; border-left: none !important; border-bottom-style: solid !important; border-bottom-width: 1px !important; border-top: none !important; width: auto; vertical-align: middle; ">TEX</td>
</tr>
</tbody>
</table>
<table-markdown style="display: none">| Tho |
| :--- |
| TEO |
| TEX |</table-markdown></div>  <br> A Gourmet Guide to Typesetting with the $\AA_{M S} S-T_{E} X$ macro package <br> \author{ M. D. SPIVAK 

}

The Joy of $T_{E} X$ is the user-friendly user's guide for $\mathcal{A M S}-\mathrm{TEX}_{\mathrm{E}}$, an extension of $\mathrm{T}_{\mathrm{E}} \mathrm{X}$, Donald Knuth's revolutionary program for typesetting technical material. $A_{M} S-T_{E} X$ was designed to simplify the input of mathematical material in particular, and to format the output according to any of various preset style specifications.

There are two primary features of the $\mathrm{T}_{\mathrm{E}} \mathrm{X}$ system: it is a computer system for typesetting technical text, especially text containing a great deal of mathematics; and it is a system for producing beautiful text, comparable to the work of the finest printers.

Most importantly, TEX's capabilities are not available only to TEXperts. While mathematicians and experienced technical typists will find that TEX allows them to specify mathematical formulas with great
accuracy and still have control over the finished product, even novice technical typists will find the manual easy to use in helping them produce beautiful technical $\mathrm{T}_{\mathrm{E}} \mathrm{Xt}$.

This book is designed as a user's guide to the $\mathcal{A} M S-T_{E} \mathrm{X}$ macro package and details many features of this extremely useful text processing package. Parts 1 and 2, entitled "Starters" and "Main Courses," teach the reader how to typeset most normally encountered text and mathematics. "Sauces and Pickles," the third section, treats more exotic problems and includes a 60 -page dictionary of special $\mathrm{T}_{\mathrm{E}} \mathrm{X}$ niques.

Exercises sprinkled generously through each chapter encourage the reader to sit down at a terminal and learn through experimentation. Appendixes list summaries of frequently used and more esoteric symbols as well as answers to the exercises.

PREPAYMENT REQUIRED. Order from American Mathematical Society
PO Box 1571
Annex Station
Providence, RI 02901-9930
or call 800-556-7774 to use VISA or MasterCard.
Prices subject to change.


## WHEN MATH $\backslash$ SCI IS ONLINE MATHEMATICS IS ON THE SCREEN <br> 800,000 Entries in Seconds

Math $\backslash$ Sci is the online database that finds, in a matter of seconds, any information published in Mathematical Reviews (MR), Current Mathematical Publications (CMP), Current Index to Statistics (CIS), and the Index to Statistics and Probability by John Tukey and lan Ross. These combined sources give you over 800,000 entries in all areas of the mathematical sciences.

## Monthly Updates

Math $\backslash$ Sci is updated monthly, with over 3,700 new entries from MR and 4,000 from CMP; also quarterly updates of 750 new entries from CIS.

## Easy Fingertip Access

When can you use Math $\backslash$ Sci? Anytime... 24 hours a day. Now you can search for all the information from MR, CMP, CIS and the Tukey Index when you want it and need it. From your office. From your home. Anywhere you can connect a modem to a microcomputer (or terminal) and dial a local number.

## Where to Get Online with Math $\backslash \mathbf{S c i}$

Math $\backslash$ Sci is produced by the American Mathematical Society, a source of mathematical materials for nearly 100 years. Math $\backslash$ Sci can be accessed on BRS, DIALOG, CompuServe, EasyNet, and the European Space Agency (ESA). To learn more about Math $\backslash$ Sci, contact Taissa Kusma at the AMS by calling 800-556-7774 in the continental United States.

American Mathematical Society
P.O. Box 6248

Providence, RI 02940
401-272-9500
Telex: 797192

## PROBABILITY THEORY' SUBJECT INDEXES FROM MATHEMATICAL REVIEWS 1980-84, 1973-79, 1959-72, 1940-58

Many mathematicians have expressed a desire to have a compilation of articles, books and conference proceedings that have been reviewed in Mathematical Reviews available by subject area. Together with the companion index on statistics listed below, this volume is the first such compilation.

This volume gives a listing of author names and review numbers of all the items having primary or secondary classifications in probability theory for the entire 45-year span of Mathematical Reviews from 1940 through 1984, conveniently collected in one volume. The titles are also given for items beginning in 1959. Full bibliographic information is not provided here, but can readily be obtained using the information given here by consulting either the appropriate author indexes, the issues of $M R$, or Math $\backslash \mathrm{Sci}$ (for items beginning in 1959). The classification schemes used during these years are also included at the end of the index.

This convenient index should be of great value to researchers working in the area of probability, or persons who need to consult the literature in this active field.

ISBN 0-8218-0108-2, LC 86-26462
450 pages, March 1987
List \$67, Inst. mem. \$54, Indiv. mem. \$40, Reviewer \$34
To order, please specify PROBIN/40/84 MC

## STATISTICS SUBJECT INDEXES FROM MATHEMATICAL REVIEWS 1980-84, 1973-79, 1959-72, 1940-58

This volume is a companion to the volume of Probability Theory Subject Indexes mentioned above. It gives a listing of author names and review numbers of all the items having primary or secondary classifications in statistics for the entire 45-year span of Mathematical Reviews from 1940 through 1984, conveniently collected in one volume The titles are also given for items beginning in 1959. Full bibliographic information is not provided here, but can readily be obtained using the information given here by consulting either the appropriate author indexes, the issues of $M R$, or Math $\backslash$ Sci (for items beginning in 1959). The classification schemes used during these years are also included at the end of the index.

This convenient index should be of great value to researchers working in the area of statistics, or persons who need to consult the literature in this important field.

ISB.N 0-8218-0107-4, LC 86-26460
500 pages, March 1987
List \$67, Inst. mem. \$54, Indiv. mem. \$40, Reviewer \$34
To order. please specify STATIN/40/84 MC

## SPECIAL OFFER

Combination offer of the two indexes above:
Probability Theory Subject Indexes from Mathematical Reviews, 1940-84 Statistics Subject Indexes from Mathematical Reviews, 1940-84
Two volume set price:
List: $\$ 115$, Inst. mem. $\$ 92$, Indiv. mem. $\$ 69$, Reviewer $\$ 58$
To order, please specify STAPIN/40/84 MC

PREPAYMENT REQL:IRED. Add shipping
and handling: $\$ 2$ first book. $\$ 1$ each
add' 1 , max. $\$ 25$; by air $\$ 5$ first book.
$\$ 3$ each add'l, max. $\$ 100$

## Order from:

American Mathematical Society
Annex Station
P.(). Box 1571

Providence, RI 02901-9930
Call 401-272-9500 or 800-556-7774
to uise VISA or Master(ard

## DANIEL SHANKS, DEDICATION Special Issue Mathematics of Computation

This special issue of Mathematics of Computation (Volume 48, Number 177, January 1987) is dedicated to Daniel Shanks on the occasion of his 70th birthday. Since 1959, when Shanks joined the Editorial Committee for this journal, he has been a guiding force in shaping the computational number theory component of the journal, and has had an immense influence in the field. This volume contains papers by some of the top researchers in the field and covers such topics as elliptic curves, primality testing, congruences, class groups, and cyclotomic fields. Although a numbered issue of the Mathematics of Computation journal, it will serve as a stand alone reference work for computational number theory.

## Contents

William W. Adams, Characterizing Pseudoprimes for third-order linear recurrences
Leonard M. Adelman, Dennis R. Estes, and Kevin S. McCurley, Solving bivariate quadratic congruences in random polynomial time Richard Blecksmith, John Brillhart, and Irving Gerst, Parity results for certain partition functions and identities similar to theta function identities Johannes Buchmann, The computation of the fundamental unit of totally complex quartic orders Johannes Buchmann and H. C. Williams, On principal ideal testing in totally complex quartic fields and the determination of certain cyclotomic constants
Nicholas Buck, Lones Smith, Blair K. Spearman, and Kenneth S. Williams, The cyclotomic numbers of order fifteen
Duncan A. Buell, Class groups of quadratic fields II
David G. Cantor, Computing in the Jacobian of a hyperelliptic curve
H. Cohen and A. K. Lenstra, Implementation of a new primality test
H. Cohen and J. Martinet, Class groups of number fields: numerical heuristics
Harvey Cohn and Jesse Deutsch, Application of symbolic manipulation to Hecke transformations of modular forms in two variables
T. W. Cusick and Lowell Schoenfeld, A table of fundamental pairs of units in totally real cubic fields

Daniel Gordon, Douglas Grenier, and Audrey Terras. Hecke operators and the fundamental domain for (SL(3, Z ))
Marie-Nicole Gras, Special units in real cyclic sextic fields
R. K. Guy, C. B. Lacampagne, and J. L. Selfridge, Primes at a glance
Neal Koblitz, Elliptic curve cryptosystems
D. H. Lehmer and Emma Lehmer, Cyclotomic resultants
H. W. Lenstra, Jr. and R. J. Schoof, Primitive normal bases for finite fields
R. A. Mollin, Class numbers of quadratic fields determined by solvability of diophantine equations Peter L. Montgomery, Speeding the Pollard and elliptic curve methods of factorization
Morris Newman and Robert C. Thompson,
Numerical values of Goldberg's coefficients in the series for $\log \left(e^{x} e^{y}\right)$
A. M. Odlyzko, On the distribution of spacings' between zeros of the zeta function
M. Pohst, On computing isomorphisms of equation orders
Carl Pomerance, Very short primality proofs
Herman J. J. te Riele, On the sign of the difference $\pi(x)$ - li(x)
Robert D. Silverman, The multiple polynomial quadratic sieve
Jonathan W. Tanner and Samuel S. Wagstaff, Jr., New congruences for the Bernoulli numbers Heinz M. Tschöpe and Horst G. Zimmer, Computation of the Néron-Tate height on elliptic curves
Lawrence C. Washington, Class numbers of the simplest cubic fields
H. C. Williams, Effective primality tests for some integers of the forms $A 5^{n}-1$ and $A 7^{n}-1$
H. C. Williams and M. C. Wunderlich, On the parallel generation of the residues for the continued fraction factoring algorithm
Don Zagier, Large integral points on elliptic curves

> 1980 Mathematics Subject Classification 11
> ISSN 0025-5718
> 448 pages (softcover), January 1987
> Individual member $\$ 29$, List price $\$ 48$,
> Institutional member $\$ 38$
> To order, please specify SHANKS /MC

Shipping/Handling 1 st book $\$ 2$, each add'I $\$ 1$, \$25 max By air, 1st book \$5, each add'I \$3, \$100 max
Prepayment required Order from AMS, P O Box 1571, Annex Station, Providence, RI 02901-9930, or call 800-556-7774 to use VISA or MasterCard



Editors
Michael Artin
H. Blaine Lawson, Jr.

Richard Melrose
Wilfried Schmid
Robert E. Tarjan


The new Journal of the American Mathematical Society will be published quarterly beginning in January 1988. It will contain research articles of the highest quality in all areas of pure and applied mathematics. Selected articles scheduled to appear in Volume 1 include: Homology of the zero set of a unipotent vector field on a flag manifold by C. De Concici, G. Lusztig, and C. Procesi; Reduced Hausdorff dimension and the concentration-cancellation law for 2-dimensional incompressible flows by Ronald J. DiPerna and Andrew Majda; Extremals for the Sobolev inequality on the Heisenberg group and the CR Yamabe problem by David Jerison and John M. Lee; $p$-adic Hodge theory by G. Faltings; Flip theorem and the existence of minimal models for 3-folds by Shigefumi Mori; Zero-one laws for sparse random matrices by Saharon Shelah and Joel Spencer; and Arithmeticity of holonomy groups of Lie foliations by Robert J. Zimmer.

ISSN 0894-0347
Quarterly, Volume 1, 1988

1988 subscription price:
List \$100*
Institutional Member \$80*
Individual Member $\$ 60^{*}$
Order code: $88 \mathrm{JAMS} / \mathrm{MC}$

* Add for postage: Surface delivery to destinations outside the U.S. and India - \$8; to India - $\$ 18$; Expedited delivery to destinations in North America - $\$ 12$; elsewhere - $\$ 15$.
Note: Subscriptions to AMS journals are sold only on a calendar year basis (January-December). Split year and multiple years subscription orders are not accepted. Subscription cancellations from nonmembers will not be accepted after March 1 of the subscription year. Cancellation refunds are computed by deducting an $\$ 8$ cancellation fee, and the price of each issue already shipped, from the price paid.

TO ORDER: Prepayment required in U.S. funds.
Mail to: American Mathematical Society, Annex Station, P.(). Box 1571, Providence, Rhode Island, 02901-9930 USA or call 800-556-7774 in the continental U.S. to use VISA or MasterCard.
Kenneth Hardy, R. H. Hudson, D. Richman, Kenneth S. Williams, and
N. M. Holtz, Calculation of the Class Numbers of Imaginary Cyclic Quartic Fields ..... 615
Daniel M. Gordon, Perfect Multiple Error-Correcting Arithmetic Codes ..... 621
Duncan A. Buell, Integer Squares with Constant Second Difference ..... 635
Reviews and Descriptions of Tables and Books ..... 645
Gruber and Rappaz 30, Delves and Mohamed 31, Bellman and Roth 32
Table Errata ..... 651
Moon and Spencer 609
Indexes to Volumes 48 and 49 ..... 655
Supplement to "An A Posteriori Parameter Choice for Ordinary and Iterated Tikhonov Regularization of Ill-Posed Problems Leading to Optimal Con- vergence Rates" by Helmut Gfrerer ..... S5
Supplement to "A Table of Elliptic Integrals of the Second Kind" by B. C. Carlson ..... S13

# MATHEMATICS OF COMPUTATION TABLE OF CONTENTS 

## October 1987

James H. Bramble and Joseph E. Pasciak, New Convergence Estimates for Multigrid Algorithms ..... 311
Claes Johnson, Stig Larsson, Vidar Thomée, and Lars B. Wahlbin, Error Estimates for Spatially Discrete Approximations of Semilinear Parabolic Equations with Nonsmooth Initial Data ..... 331
Michel Crouzeix and Vidar Thomée, On the Discretization in Time of Semi- linear Parabolic Equations with Nonsmooth Initial Data ..... 359
Georges H. Guirguis, A Third-Order Boundary Condition for the Exterior Stokes Problem in Three Dimensions ..... 379
Zhong-ci Shi, The F-E-M-Test for Convergence of Nonconforming Finite Elements ..... 391
G. H. Cottet, Convergence of a Vortex In Cell Method for the Two-Dimensional Euler Equations ..... 407
Claes Johnson and Anders Szepessy, On the Convergence of a Finite Element Method for a Nonlinear Hyperbolic Conservation Law ..... 427
Daniel Michelson, Convergence Theorem for Difference Approximations of Hyperbolic Quasi-Linear Initial-Boundary Value Problems ..... 445
Martin Costabel and Ernst P. Stephan, On the Convergence of Collocation Methods for Boundary Integral Equations on Polygons ..... 461
Goong Chen and Ying-Liang Tsai, The Boundary Element Numerical Method for Two-Dimensional Linear Quadratic Elliptic Problems: (I) Neumann Control ..... 479
C. W. Groetsch and C. R. Vogel, Asymptotic Theory of Filtering for Linear Operator Equations with Discrete Noisy Data ..... 499
Helmut Gfrerer, An A Posteriori Parameter Choice for Ordinary and Iterated Tikhonov Regularization of Ill-Posed Problems Leading to Optimal Con- vergence Rates ..... 507
Chien-Cheng Chang, Numerical Solution of Stochastic Differential Equations with Constant Diffusion Coefficients ..... 523
A. Iserles and S. P. Nørsett, Two-Step Methods and Bi-Orthogonality ..... 543
U. Ananthakrishnaiah, $P$-Stable Obrechkoff Methods with Minimal Phase- Lag for Periodic Initial Value Problems ..... 553
Nabil R. Nassif, Eigenvalue Finite Difference Approximations for Regular and Singular Sturm-Liouville Problems ..... 561
J. Stoer and R. A. Tapia, On the Characterization of $q$-Superlinear Convergence of Quasi-Newton Methods for Constrained Optimization ..... 581
R. M. Dudley, Some Inequalities for Continued Fractions ..... 585
B. C. Carlson, A Table of Elliptic Integrals of the Second Kind ..... 595
Philip W. Kuchel, Brian T. Bulliman, and Edward D. Fackerell, Bi-Cyclide and Flat-Ring Cyclide Coordinate Surfaces: Correction of Two Expres- sions ..... 607

