Editorial Information

As of January 31, 1996, the backlog for this journal was approximately 1 issue. This estimate is the result of dividing the number of manuscripts for this journal in the Providence office that have not yet gone to the printer on the above date by the average number of articles per issue over the previous twelve months, reduced by the number of issues published in six months (the time necessary for editing and composing a typical issue).

A Copyright Transfer Agreement is required before a paper will be published in this journal. By submitting a paper to this journal, authors certify that the manuscript has not been submitted to nor is it under consideration for publication by another journal, conference proceedings, or similar publication.

Information for Authors and Editors

The first page must consist of a *descriptive title*, followed by an *abstract* that summarizes the article in language suitable for workers in the general field (algebra, analysis, etc.). The *descriptive title* should be short, but informative; useless or vague phrases such as "some remarks about" or "concerning" should be avoided. The *abstract* must be brief and reasonably self-contained. Included with the footnotes to the paper, there should be the 1991 *Mathematics Subject Classification* representing the primary and secondary subjects of the article. This may be followed by a list of *key words and phrases* describing the subject matter of the article and taken from it. A list of classifications may be found in the annual index of *Mathematical Reviews*, published with the December issue starting in 1990. Journal abbreviations used in bibliographies are also listed in the latest *Mathematical Reviews* annual index. The classifications and the journal abbreviations are accessible from e-MATH via the World Wide Web at the URL `http://www.ams.org/` or via telnet: `telnet e-math.ams.org` (login and password are `e-math`). The classifications are available as a browsable list and the journal abbreviations are available through a search tool. When the manuscript is submitted, authors should supply the editor with electronic addresses if available. These will be printed after the postal address at the end of each article.

TEX files available upon request. Authors may request a copy of the TEX files of their papers by sending e-mail to `file-request@ams.org` or by contacting the Editorial Department, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248. The request should include the title of the paper, the name(s) of the author(s), the name of the publication in which the paper has or will appear, and the volume and issue numbers if known. The TEX file will be sent to the author making the request after the article goes to the printer. If the requestor can receive Internet e-mail, please include the e-mail address to which the file should be sent. Otherwise please indicate a diskette format and postal address to which a disk should be mailed. **Note:** Because TEX production at the AMS sometimes requires extra fonts and macros that are not yet publicly available, TEX files cannot be guaranteed to run through the author's version of TEX without errors. The AMS regrets that it cannot provide support to eliminate such errors in the author's TEX environment.

Electronically Prepared Manuscripts. The AMS encourages submission of electronically prepared manuscripts in $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX or $\mathcal{A}\mathcal{M}\mathcal{S}$-LATEX because properly prepared electronic manuscripts save the author proofreading time and move more quickly through the production process. To this end, the Society has prepared author packages for each AMS publication. Author packages include instructions for preparing electronic manuscripts, the *AMS Author Handbook*, samples, and a style file that generates the particular design specifications of that publication series for both $\mathcal{A}\mathcal{M}\mathcal{S}$-TeX and $\mathcal{A}\mathcal{M}\mathcal{S}$-LATEX.

Those authors who make use of these style files from the beginning of the writing process will further reduce their own efforts. Electronically submitted manuscripts prepared in plain TEX or LATEX are normally not acceptable due to the high amount of technical time required to insure that the file will run properly through the AMS in-house production system. Users of plain TEX should have little difficulty learning $\mathcal{A}\mathcal{M}\mathcal{S}$-TEX, and LATEX

users will find that $\mathcal{AMS}$-LaTeX is the same as LaTeX with additional commands to simplify the typesetting of mathematics.

Authors may retrieve an author package from e-MATH via the World Wide Web at the URL `http://www.ams.org/tex/` or via telnet: `telnet e-math.ams.org` (login and password are `e-math`). The author package can also be obtained free of charge by sending e-mail to `pub@ams.org` (Internet) or from the Publication Division, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248. When requesting an author package, please specify $\mathcal{AMS}$-TeX or $\mathcal{AMS}$-LaTeX, Macintosh or IBM (3.5) format, and the publication in which your paper will appear. Please be sure to include your complete mailing address.

At the time of submission, authors should indicate if the paper has been prepared using $\mathcal{AMS}$-TeX or $\mathcal{AMS}$-LaTeX and provide the Managing Editor with a paper manuscript that matches the electronic manuscript. The final version of the electronic manuscript should be sent to the Providence office immediately after the paper has been accepted for publication. The author should also send the final version of the paper manuscript to the Managing Editor, who will forward a copy to the Providence office. Editors will require authors to send their electronically prepared manuscripts to the Providence office in a timely fashion. Electronically prepared manuscripts can be sent via e-mail to `pub-submit@ams.org` (Internet) or on diskette to the Editorial Department, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248. When submitting an electronic manuscript, please be sure to include a message indicating in which publication the paper has been accepted. No corrections will be accepted electronically. Authors must mark their changes on their proof copies and return them to the Providence office. Complete instructions on how to submit files are included in the author package.

Electronic graphics. Figures may be submitted to the AMS in an electronic format. The AMS recommends that graphics created electronically be saved in Encapsulated PostScript (EPS) format. This includes graphics originated via a graphics application as well as scanned photographs or other computer-generated images.

If the graphics package used does not support EPS output, the graphics file should be saved in one of the standard graphics formats—such as TIFF, PICT, GIF, etc.—rather than in an application-dependent format. Graphics files submitted in an application-dependent format are not likely to be used. No matter what method was used to produce the graphic, it is necessary to provide a paper copy to the AMS.

Authors using graphics packages for the creation of electronic art should also avoid the use of any lines thinner than 0.5 points in width. Many graphics packages allow the user to specify a "hairline" for a very thin line. Hairlines often look acceptable when proofed on a typical laser printer. However, when produced on a high-resolution laser imagesetter, hairlines become nearly invisible and will be lost entirely in the final printing process.

Screens should be set to values between 15% and 85%. Screens which fall outside of this range are too light or too dark to print correctly.

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. All contributions intended for publication and all books for review should be addressed to Lars B. Wahlbin, Managing Editor, Mathematics of Computation, Center for Applied Mathematics, 657 Frank H. T. Rhodes Hall, Cornell University, Ithaca, NY 14853-3801. The date received, which is published with the final version of an accepted paper, is the date received in the office of the Managing Editor, and it is the responsibility of the author to submit manuscripts directly to this office.

Any inquiries concerning a paper that has been accepted for publication should be sent directly to the Editorial Department, American Mathematical Society, P.O. Box 6248, Providence, RI 02940-6248.

Editorial Committee

ANDREW M. ODLYZKO, AT&T Bell Laboratories, 600 Mountain Avenue, Murray Hill, NJ 07974; *E-mail*: amo@research.att.com

STANLEY OSHER, Department of Mathematics, University of California, Los Angeles, CA 90024; *E-mail*: sjo@math.ucla.edu

G. W. STEWART, Department of Computer Science, University of Maryland, College Park, MD 20742; *E-mail*: stewart@thales.cs.umd.edu

LARS B. WAHLBIN, Chairman. Center for Applied Mathematics, 657 Frank H. T. Rhodes Hall, Cornell University, Ithaca, NY 14853-3801; *E-mail*: awahlbin@cam.cornell.edu

Board of Associate Editors

JAMES H. BRAMBLE, Department of Mathematics, Texas A & M University, College Station, TX 77843-3368; *E-mail*: bramble@math.tamu.edu

SUSANNE C. BRENNER, Department of Mathematics, University of South Carolina, Columbia, SC 29208; *E-mail*: brenner@math.sc.edu

HOWARD ELMAN, Department of Computer Science, University of Maryland, College Park, MD 20742; *E-mail*: elman@cs.umd.edu

RICHARD S. FALK, Department of Mathematics, Rutgers University, New Brunswick, NJ 08903-2101; *E-mail*: falk@math.rutgers.edu

WALTER GAUTSCHI, Department of Computer Sciences, Purdue University, West Lafayette, IN 47907; *E-mail*: wxg@cs.purdue.edu

DANIEL W. LOZIER, Applied and Computational Mathematics Division, National Institute of Standards and Technology, Gaithersburg, MD 20899-0001; *E-mail*: dlozier@nist.gov

JAMES N. LYNESS, Mathematics and Computer Science Division, Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL 60439; *E-mail*: lyness@mcs.anl.gov

HARALD NIEDERREITER, Institute for Information Processing, Austrian Academy of Sciences, Sonnenfelsgasse 19, A-1010 Vienna, Austria; *E-mail*: nied@qiinfo.oeaw.ac.at

SYVERT P. NØRSETT, Division of Numerical Mathematics, The University of Trondheim and The Norwegian Institute of Technology, Alfred Getz vei 1, N-7034 Trondheim-NTH, Norway; *E-mail*: norsett@imf.unit.no

JOHN E. OSBORN, Department of Mathematics, University of Maryland, College Park, MD 20742; *E-mail*: jeo@julia.umd.edu

CARL POMERANCE, Department of Mathematics, The University of Georgia, Athens, GA 30602; *E-mail*: carl@math.uga.edu

RENÉ SCHOOF, Dipartimento di Matematica, 2ª Università di Roma "Tor Vergata", I-00133 Roma, Italy; *E-mail*: schoof@volterra.science.unitn.it; and schoof@fwi.uva.nl

L. RIDGWAY SCOTT, Department of Mathematics, University of Houston, Houston, TX 77204-3476; *E-mail*: scott@casc.math.uh.edu

DANIEL SHANKS, Department of Mathematics, University of Maryland, College Park, MD 20742; *E-mail*: dns@gaby.umd.edu

CHI-WANG SHU, Applied Mathematics Division, Brown University, Providence, RI 02912-0001; *E-mail*: shu@cfm.brown.edu

FRANK STENGER, Department of Computer Science, University of Utah, Salt Lake City, UT 84112; *E-mail*: stenger@cs.utah.edu

HANS J. STETTER, Institut für Numerische Mathematik, Technische Universität Wien, Wiedner Hauptstrasse 6-10, A-1040, Wien, Austria; *E-mail*: stetter@uranus.tuwien.ac.at

NICO M. TEMME, Stichting Mathematisch Centrum, Centrum voor Wiskunde en Informatica, Kruislaan 413, 1098 SJ Amsterdam, The Netherlands; *E-mail*: nicot@cwi.nl

VIDAR THOMÉE, Mathematics Department, Chalmers University of Technology, S-412 96 Göteborg, Sweden; *E-mail*: thomee@math.chalmers.se

JOSEPH D. WARD, Department of Mathematics, Texas A & M University, College Station, TX 77843-3368; *E-mail*: jward@math.tamu.edu

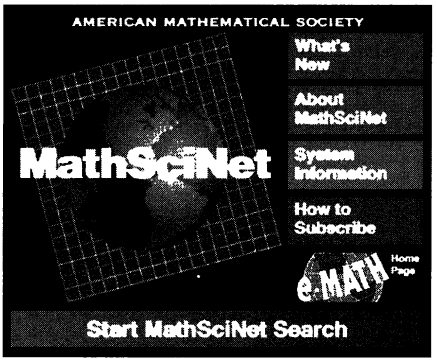
HUGH C. WILLIAMS, Department of Computer Science, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2; *E-mail*: Hugh_Williams@csmail.cs.umanitoba.ca

JOHN W. WRENCH, JR., 102 Mt. Olivet Boulevard, Frederick, MD 21701

STEPHEN J. WRIGHT, Mathematics and Computer Science Division, Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL 60439; *E-mail*: wright@mcs.anl.gov

New!

from the
AMERICAN
MATHEMATICAL
SOCIETY



Visit the MathSciNet Home Page on the Web:
URL: http://www.ams.org/mathscinet/

Starting in January 1996, librarians, researchers, faculty, and students can use the World Wide Web to access one of the most extensive mathematical databases in the world.

MathSciNet®

—available by subscription on the Internet from the American Mathematical Society— delivers instant access to more than 50 years of *Mathematical Reviews* (MR) and *Current Mathematical Publications* (CMP) data.

MathSciNet combines unparalleled search power with the point-and-click ease of the World Wide Web, making inquiries to the MR database easier, faster, and more productive than ever before.

For subscription details, or for further information on this powerful research tool, contact:

AMS Customer Services Department
(cust-serv@ams.org)
800-321-4AMS (4267) or
(401) 455-4000 (worldwide)

Instant access to the *Mathematical Reviews* database — at your fingertips

A single search from the office, library, classroom, or home *at any time of day* will yield a wealth of information unmatched by any other source, including:

works by a given author

full journal information

tables of contents

reviews referenced in an on-screen review

reviews that cite the on-screen review

institution codes and addresses

serial names and abbreviations

mathematics subject classification

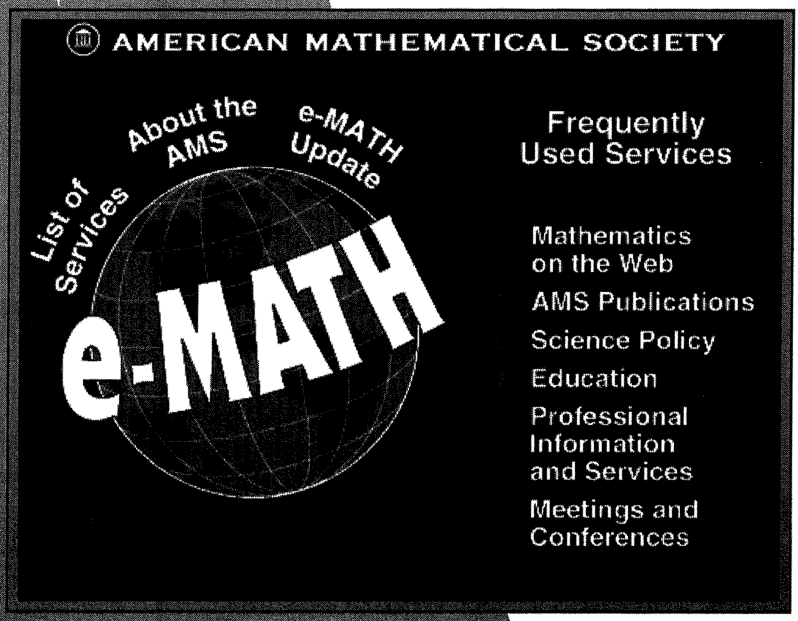
daily updates of CMP data

and more...

MathSciNet

AMERICAN MATHEMATICAL SOCIETY
Communicating Mathematics

Electronic Delivery of AMS Products and Services *on the* World Wide Web



URL:

`http://www.ams.org/`

For Telnet access:

`telnet e-math.ams.org`

Login and password both

`e-math` (lowercase)

AMERICAN MATHEMATICAL SOCIETY

Communicating Research in the Mathematical Sciences

NEW RELEASES IN ALGEBRA & COMBINATORICS

AMERICAN MATHEMATICAL SOCIETY

Seminar on Fermat's Last Theorem

V. Kumar Murty, *University of Toronto, ON, Canada,* ***Editor***

Based on a seminar held during 1993–1994 at the Fields Institute for Research in Mathematical Sciences, this book contains articles on elliptic curves, modular forms and modular curves, Serre's conjectures, Ribet's theorem, deformations of Galois representations, Euler systems, and annihilators of Selmer groups.

Members of the Canadian Mathematical Society may order at the AMS member price.

Conference Proceedings, Canadian Mathematical Society; Volume 17, 1995; 265 pages; ISBN 0-8218-0313-1; Softcover; Individual member $39; List $49; Order code CMSAMS/17MC

Lectures on Quantum Groups

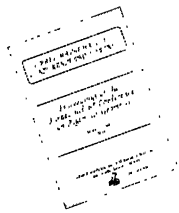
excellent textbook

Jens Carsten Jantzen, *Aarhus Universitet, Denmark*

This book is an introduction to the theory of quantum groups. The main topic is the quantized enveloping algebras introduced independently by Drinfeld and Jimbo.

Graduate Studies in Mathematics; Volume 6, 1995; 266 pages; ISBN 0-8218-0478-2; Hardcover; All AMS members $35; List $44; Order code GSM/6MC

Proceedings of the Hirzebruch 65 Conference on Algebraic Geometry



Mina Teicher, *Bar-Ilan University, Ramat Gan, Israel,* ***Editor***

Attended by 60 participants from Israel and abroad, the conference in May of 1993 focused on four topics: topology of algebraic varieties, classification of surfaces, vector bundles, and 3-folds.

Israel Mathematical Conference Proceedings is published by Bar-Ilan University of Israel and distributed worldwide by the AMS.

Israel Mathematical Conference Proceedings, Volume 9, 1995; 462 pages; Softcover; Individual member $39, List $65; Order code IMCP/9MC

Algebraic Number Fields

Second Edition

excellent textbook

Gerald J. Janusz, *University of Illinois, Urbana*

In this volume, the important theorems regarding the units of the ring of integers and the class group are proved and illustrated. Many examples are given in detail.

Graduate Studies in Mathematics; Volume 7, 1995; 271 pages; ISBN 0-8218-0429-4; Hardcover; All AMS members $35; List $44; Order code GSM/7MC

All prices subject to change. Charges for delivery are $3.00 per order, or for air delivery outside of the continental U.S., please include $6.50 per item. *Prepayment required.* Order from **American Mathematical Society**, P.O. Box 5904, Boston, MA 02206-5904. Or for credit card orders, fax (401) 331-3842 or call toll free 800-321-4AMS (4267) in the U.S. and Canada. Residents of Canada, please include 7% GST.

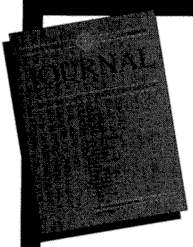
American Mathematical Society

ELECTRONIC JOURNALS FROM THE AMS

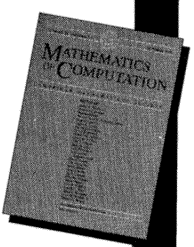
Four AMS core journals—popular for years in paper format—are now also available electronically.

New for 1996, the American Mathematical Society's peer-reviewed journals are available electronically on the World Wide Web. Choose the format that best fits your needs. Save money by ordering the electronic version, or, for only 15% more than the paper alone, subscribe to both. You'll get *both* versions—electronic and paper—for only 15% more than the cost of a single paper subscription!

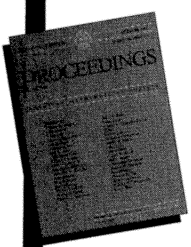
Subscribe now so you can access the latest, high-quality peer-reviewed advances in mathematics. The timeliness and ease of the World Wide Web will enable you to search for, browse, and print articles specifically in your discipline.



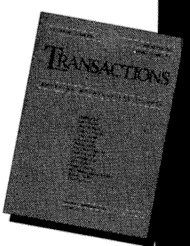
Journal of the American Mathematical Society
(ISSN 0894-0347)



Mathematics of Computation
(ISSN 0025-5718)



Proceedings of the American Mathematical Society
(ISSN 0002-9939)



Transactions of the American Mathematical Society
(ISSN 0002-9947)

With AMS Electronic Journals, your access to information is enhanced with...

- ***early availability***
  Information is available online 2–6 weeks sooner than the printed format.
- ***search capability***
  Retrieve journal articles by searching for authors, titles, keywords, Mathematics Subject Classification, and more.
- ***hypertext links***
  View articles online with hypertext links to bibliography entries, figures, tables, etc.
- ***access to back issues***
  Subscribers will have access to all issues available in electronic format.
- ***downloadable text***
  Entire articles can be downloaded and printed on your own printer.
- ***access site-wide***
  Your subscription entitles you to access the electronic journal from your home, office, or library.

Questions or pro forma requests?
AMS Membership and Customer Services,
P. O. Box 6248, Providence, RI 02940-6248;
(800) 321-4267 (401-455-4000 worldwide);
Fax (401) 331-3842; **cust-serv@ams.org**

American Mathematical Society

?

Do you need a definitive source of information on support for graduate study?

?

Could you use data from a broad range of academic institutions?

!

Then you need this valuable resource on mathematical sciences departments and faculty!

Assistantships and Graduate Fellowships in the Mathematical Sciences, 1995–1996

The *Assistantships and Graduate Fellowships, 1995–1996* brings together a wealth of information about resources available for graduate study in mathematical sciences departments in the U.S. and Canada.

"A centralized and comprehensive resource!"

You'll find...

- information on the number of faculty, graduate students, and degrees awarded by departments
- stipend amounts and the number of awards available
- information on foreign language requirements

and you'll locate...

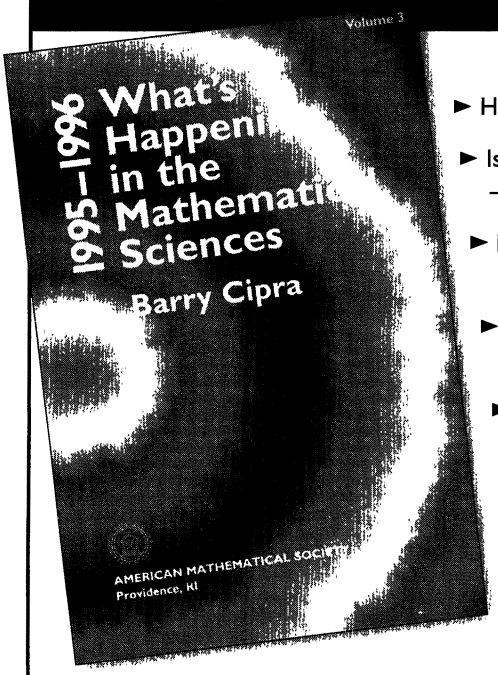
- sources of support for graduate study and travel, summer internships, and graduate study in the U.S. for foreign students
- a list of reference publications for fellowships information

September 1995; 127 pp.; ISBN 0-8218-0188-0; List $19: Individual member $11; Order code ASST/95MC

All prices subject to change. Charges for delivery are $3.00 per order, or for air delivery outside of the continental U.S., please include $6.50 per item. *Prepayment required.* Order from: **American Mathematical Society**, P. O. Box 5904, Boston, MA 02206-5904. Or for credit card orders, fax (401) 331-3842 or call toll free 800-321-4AMS (4267) in the U.S. and Canada. Residents of Canada, please include 7% GST.

AMERICAN MATHEMATICAL SOCIETY

Communicating Mathematics



► Has Fermat's Theorem really been proved?

► Is your PC always right when it computes something —even when you've input everything correctly?

► How well is turbulence understood, including the type that makes you uncomfortable on an airplane?

► Does modern mathematics have anything to teach the wizards of Wall Street?

► What is happening to one of the most renowned and complicated mathematical proofs in history, i.e., the classification of finite simple (!) groups?

Answers to these questions and other fascinating articles can be found in this book.

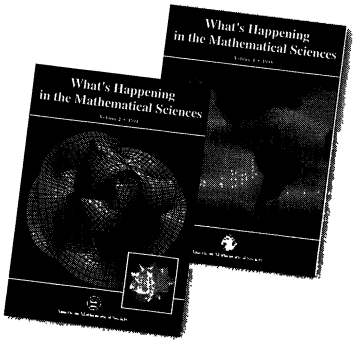
These articles describe many cutting-edge areas of modern pure and applied mathematical research, yet they are written at a level that can be understood and appreciated by anyone with a high-school mathematical background. The author, Barry Cipra, is a well-known scientific journalist and mathematical expositor who is a contributing correspondent for *Science* magazine and writes for *SIAM News* and *American Mathematical Monthly.* In reading these articles, you will also get a feeling for the beauty and the universality of mathematics.

What's Happening in the Mathematical Sciences, 1995–1996, vol. 3,
1995; 111 pp.; Softcover; ISBN 0-8218-0355-7; List $12; Order code HAPPENING/3MC

Also available from the AMS...

What's Happening in the Mathematical Sciences, vol. 2,
1994; 51 pp.; Softcover; ISBN 0-8218-8998-2; List $8;
Order code HAPPENING/2MC

What's Happening in the Mathematical Sciences, vol. 1,
1993; 47 pp.; Softcover; ISBN 0-8218-8999-0; List $7;
Order code HAPPENING/1MC



All prices subject to change. Charges for delivery are $3.00 per order, or for air delivery outside of the continental U.S., please include $6.50 per item. *Prepayment required.* Order from: **American Mathematical Society,** P. O. Box 5904, Boston, MA 02206-5904. Or for credit card orders, fax (401) 331-3842 or call toll free 800-321-4AMS (4267) in the U.S. and Canada. Residents of Canada, please include 7% GST.

(*Continued from back cover*)

Günter Löh and Wolfgang Niebuhr, A new algorithm for constructing large Carmichael numbers 823
P. Erdős and Mordechai Lewin, d-complete sequences of integers 837
David W. Boyd, On beta expansions for Pisot numbers 841
David W. Boyd, On the beta expansion for Salem numbers of degree 6 .. 861
Reviews and Descriptions of Tables and Books 877
Brenner and Scott **14**, Friedman and Littman **15**, Dongarra and Tourancheau, Editors **16**, Gander and Hřebíček **17**, Abell and Braselton **18**, Mangasarian **19**, Nesterov and Nemirovski **20**, Axelsson **21**, Bini and Pan **22**, Micchelli **23**, Chui, Montefusco, and Puccio, Editors **24**, Farin **25**, Sapidis, Editor **26**, Krishna, Krishna, Lin, and Sun **27**, Sloane and Ploufee **28**
Supplement to "On the beta expansion for Salem numbers of degree 6" by **David W. Boyd** S29

No microfiche supplement in this issue

MATHEMATICS OF COMPUTATION

CONTENTS

Vol. 65, No. 214 **April 1996**

Torgeir Rusten, Panayot S. Vassilevski, and Ragnar Winther, Interior penalty preconditioners for mixed finite element approximations of elliptic problems 447

Zhangxin Chen, Richard E. Ewing, and Raytcho Lazarov, Domain decomposition algorithms for mixed methods for second-order elliptic problems 467

Donald A. French and Todd E. Peterson, A continuous space-time finite element method for the wave equation 491

Laurence Halpern, Spectral methods in polar coordinates for the Stokes problem. Application to computation in unbounded domains 507

Bernardo Cockburn and Pierre-Alain Gremaud, A priori error estimates for numerical methods for scalar conservation laws. Part I: The general approach 533

Haim Nessyahu, Convergence rate of approximate solutions to weakly coupled nonlinear systems 575

Yuesheng Xu and Yunhe Zhao, An extrapolation method for a class of boundary integral equations 587

Evangelos A. Coutsias, Thomas Hagstrom, and David Torres, An efficient spectral method for ordinary differential equations with rational function coefficients 611

Rajendra Bhatia and Ren-Cang Li, On perturbations of matrix pencils with real spectra. II 637

R. C. Gayle and J. M. Wolfe, Unicity in piecewise polynomial L^1-approximation via an algorithm 647

Peter Borwein and Tamás Erdélyi, The integer Chebyshev problem .. 661

Ewald Quak, Trigonometric wavelets for Hermite interpolation 683

W. Lawton, S. L. Lee and Zuowei Shen, An algorithm for matrix extension and wavelet construction 723

Dirk P. Laurie, Anti-Gaussian quadrature formulas 739

Frank Emmerich, Pseudorandom vector generation by the compound inversive method 749

Takashi Kato, Li-Ming Wu, and Niro Yanagihara, The serial test for a nonlinear pseudorandom number generator 761

Charles H. Jepsen, Dissections of $p : q$ rectangles 771

Hisao Taya, Computation of $\mathbb{Z}_3$-invariants of real quadratic fields 779

Christian Wagner, Class number 5, 6 and 7 785

István Gaál, Computing all power integral bases in orders of totally real cyclic sextic number fields 801

(*Continued on inside back cover*)

0025-5718(199604)65:214;1-C