JOURNALS PUBLISHED BY
THE AMERICAN MATHEMATICAL SOCIETY

TRANSLATION JOURNALS

Soviet Mathematics-Doklady is a bimonthly translation journal containing the entire pure mathematics section of the DOKLADY AKADEMII NAUK SSSR, the Reports of the Academy of Sciences in the USSR. DOKLADY publishes 500 articles a year, each about four pages long.

Mathematics of the USSR-Izvestiya, a bimonthly journal, is a cover-to-cover translation of IZVESTIYA AKADEMII NAUK SSSR SERIYA MATEMATICHESKAYA, published by the Academy of Sciences of the USSR. This is a journal of current research in all fields of pure mathematics.

Mathematics of the USSR-Sbornik is a bimonthly journal and is a cover-to-cover translation of MATEMATICHESKIĬ SBORNIK (NOVAYA SERIYA), published by the Moscow Mathematical Society and the Academy of Sciences of the USSR. This is a journal of current research in all fields of pure mathematics.

Theory of Probability and Mathematical Statistics is the cover-to-cover translation into English of the TEORIYA VEROYATNOSTEI I MATEMATICHESKAYA STATISTIKA published by Kiev University, beginning with the 1970 Soviet publication.

Transactions of the Moscow Mathematical Society is a translation into English of TRUDY MOSKOVSKOGO MATEMATICHESKOGO OBSHCHESTA which contains the results of original research in pure mathematics.

Proceedings of the Steklov Institute of Mathematics is a translation of the AKADEMIYA NAUK SSSR TRUDY ORDENA LENINA MATEMATICHESKOGO INSTITUTA IMENI V. A. STEKLOVA. Issues contain book-length articles or collections of articles pertaining to the same topic.

CONTENT AND SUBMISSION INFORMATION FOR RESEARCH JOURNALS


Journal of the American Mathematical Society is devoted to research articles of the highest quality in all areas of pure and applied mathematics.

Mathematics of Computation is a quarterly journal devoted to original papers in numerical analysis, the application of numerical methods and high-speed calculator devices, the computation of mathematical tables, the theory of high-speed calculating devices, and other aids to computation. In addition, reviews and notes in these and related fields are published. Prospective publications should be sent to the Editor, WALTER GAUTSCHI, Computer Sciences Department, Purdue University, West Lafayette, Indiana 47907.

Memoirs of the American Mathematical Society is a bimonthly journal constituting a series of paperbound research tracts which are of the same general character as the papers published in the TRANSACTIONS. An issue of the MEMOIRS is made up of one or more numbers; a number contains either a single monograph or a group of cognate papers. Copy is supplied by the author; information on preparation of camera copy may be obtained by writing to the Editorial Department of the American Mathematical Society. Papers should be sent to the appropriate editor of TRANSACTIONS.
Proceedings of the American Mathematical Society is a monthly journal devoted entirely to research in pure and applied mathematics, principally to the publication of original papers of moderate length. A department called Shorter Notes was established for the purpose of publishing very short papers of an unusually elegant and polished character for which there is normally no other outlet. Send papers directly to one of the editors listed under the subject field of the paper. The numbers in parentheses are the first two digits of major classifications from the 1980 Mathematics Subject Classification (1985 Revision) and describe the fields being handled by the editor.

Logic and foundations (03 04) to Thomas J. Jech, Pennsylvania State University, University Park, PA 16802

Combinatorics and discrete mathematics (05 15) to Thomas H. Brylawski, University of North Carolina, Chapel Hill, NC 27514

Combinatorics, computer science, and information theory (05 68 94) to Andrew Odlyzko, Room 2C-370, Bell Laboratories, Murray Hill, NJ 07974

Commutative algebra (06 12 13 14 15 18) to Louis J. Ratliff, JR., Department of Mathematics, University of California, Riverside, CA 92502

General algebra (16 17 18 08) to Donald Passman, University of Wisconsin, Madison, WI 53706

Group theory (20) to Warren J. Wong, University of Notre Dame, Notre Dame, IN 46556

Algebraic and differential topology (55 57 58) to Frederick R. Cohen, University of Kentucky, Lexington, KY 40506

Real variables (26 28 40) to R. Daniel Mauldin, Department of Mathematics, North Texas State University, Denton, TX 76203

Complex variables (30 31 32) to Irwin Kra, State University of New York at Stony Brook, Stony Brook, NY 11794

Number theory (11) to William Adams, 11520 Lockhart Place, Silver Spring, MD 20902

Ordinary differential equations and dynamical systems (33 34 39 49 58) to Kenneth R. Meyer, Department of Mathematical Sciences, University of Cincinnati, Cincinnati, OH 45221-0025

Partial differential equations (35 49) to Barbara L. Keyfitz, University of Houston–University Park, Houston, TX 77004

General analysis (41 42 43 44 45) to J. Marshall Ash, DePaul University, Chicago, IL 60614

Functional analysis and operator theory (46 47) to John B. Conway, Department of Mathematics, Indiana University, Bloomington, IN 47405

Functional analysis and convexity (46 52) to William J. Davis, Ohio State University, Columbus, OH 43210

Complex variables, functional analysis, and operator theory (30 46 47) to Paul S. Muhly, University of Iowa, Iowa City, IA 52242

Lie groups and geometry (22 51 53) to Jonathan M. Rosenberg, University of Maryland, College Park, MD 20742

General topology (54) to Dennis Burke, Miami University of Ohio, Oxford, OH 45056, or James E. West, Cornell University, Ithaca, NY 14853

Probability and certain other fields (60–99 inclusive) to William D. Sudderth, Department of Statistics, University of Minnesota, Minneapolis, MN 55455, or George C. Papanicolaou, Applied Mathematics Division, New York University–Courant Institute, 251 Mercer Street, New York, NY 10012

All other communications should be addressed to the Managing Editor, William J. Davis, at the above address.
Transactions of the American Mathematical Society is a monthly journal devoted entirely to research in pure and applied mathematics and, in general, includes longer papers than those in the PROCEEDINGS. Two copies of the manuscript should be submitted to one of the following editors.

Ordinary differential equations, partial differential equations and applied mathematics to ROGER D. NUSSBAUM, Department of Mathematics, Rutgers University, New Brunswick, NJ 08903

Complex and harmonic analysis to ROBERT J. ZIMMER, Department of Mathematics, University of Chicago, Chicago, IL 60637

Abstract analysis to MASAMICHI TAKESAKI, Department of Mathematics, University of California, Los Angeles, CA 90024

Classical analysis to EUGENE FABES, Department of Mathematics, University of Minnesota, Minneapolis, MN 55455

Algebra, algebraic geometry and number theory to DAVID J. SALTMAN, Department of Mathematics, University of Texas at Austin, Austin, TX 78713

Geometric topology and general topology to JAMES W. CANNON, Department of Mathematics, Brigham Young University, Provo, UT 84602

Algebraic topology and differential topology to RALPH COHEN, Department of Mathematics, Stanford University, Stanford, CA 94305

Global analysis and differential geometry to JERRY L. KAZDAN, Department of Mathematics, University of Pennsylvania, Philadelphia, PA 19104-6395

Probability and statistics to RONALD K. GETOOR, Department of Mathematics, University of California at San Diego, La Jolla, CA 92039.

Combinatorics and number theory to CARL POMERANCE, Department of Mathematics, University of Georgia, Athens, GA 30602

Logic, set theory and general topology to JAMES E. BAUMGARTNER, Department of Mathematics, Dartmouth College, Hanover, NH 03755

Automorphic and modular forms and forms, geometry of numbers, multiplicative theory of numbers, zeta and L-functions of number fields and algebras to AUDREY TERRAS, Department of Mathematics, University of California at San Diego, La Jolla, CA 92093

All other communications to the editors should be addressed to the Managing Editor, RONALD L. GRAHAM, Mathematical Sciences Research Center, AT&T Bell Laboratories, 600 Mountain Avenue, Murray Hill, NJ 07974.

OTHER JOURNALS

Abstracts of Papers Presented to the American Mathematical Society contains abstracts of invited hour addresses, of papers presented in special sessions or in sessions for contributed papers, and of papers presented to the Society "by title".

Current Mathematical Publications, issued triweekly, contains a subject-classified index of papers and books being published currently in mathematics.

Mathematical Reviews is a monthly journal devoted to abstracts and reviews of the current mathematical literature of the world. Abstracts and reviews are grouped according to the 1980 Mathematics Subject Classification scheme (1985 Revision). The subscription includes an annual author and subject index.

Notices of the American Mathematical Society, published ten times a year, contains programs and reports of the meetings of the Society, reports on Society business, communications to the membership, and news items and information of interest to the mathematical community.
BULLETIN (New Series) of the American Mathematical Society

EDITORS

EDITORIAL BOARD FOR RESEARCH-EXPOSITORY ARTICLES

Lenore Blum
Morris W. Hirsch
Chairman
Victor Kac

Barry Mazur
David Vogan
Alan Weinstein
Guido L. Weiss

EDITORIAL BOARD FOR RESEARCH ANNOUNCEMENTS

William B. Arveson
Spencer Bloch
Percy Alec Deift
Michael D. Fried
Ronald L. Graham

Victor W. Guillemin
Roger Howe
Frank S. Quinn, III
Peter B. Shalen
Nolan R. Wallach

BOOK REVIEWS EDITOR: Edgar Lee Stout
MANAGING EDITOR: Morris W. Hirsch

MANUSCRIPT, PROOF, AND COPYING INFORMATION

MANUSCRIPT

Articles submitted for publication should be typewritten and double-spaced. The Manual for Authors, available from the Society, should be consulted for symbols and style conventions. Authors should take the greatest possible care in preparing the original manuscript. Hand-drawn symbols are satisfactory if clearly done; special instructions for the typesetter, when necessary, should be included on a separate sheet.

For Research-Expository Articles and Research Announcements, the first footnote should include subject classification numbers representing the primary and secondary subjects of the article. The 1980 Mathematics Subject Classification (1985 Revision) can be found in the annual subject index volumes of Mathematical Reviews.

To encourage the submission of manuscripts in electronic form using TeX and the \texttt{AMS-\TeX} macro package, the Executive Committee of the Council has adopted a policy that allows for accelerating the publication date of such manuscripts by as much as 20 weeks, which is approximately equal to the time normally needed by the Society for copyediting, typesetting, and proofreading an average manuscript.

GALLEY PROOF

When a paper with more than one author has been accepted for publication, only one set of galley proof will be sent. Joint authors should, therefore, indicate which of them should receive galley proof in the event that the manuscript is accepted for publication.

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 acknowledgment 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.

OFFPRINTS AND ADDRESS CHANGES

Any inquiries concerning a paper which has been accepted for publication, including information regarding reprints or changes of address for mailing proof, should be sent directly to the Editorial Department, American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940.

COPYRIGHT TRANSFER AGREEMENT

The signing of a Copyright Transfer Agreement is a requirement of publication in the BULLETIN. A copy of the agreement is sent to the author upon receipt of a manuscript in the Providence Office of the Society; in case of joint authors, a copy is sent to each author. Authors are urged to return the form immediately to prevent delays in processing and publishing the manuscript. The 1984 edition of the Manual for Authors has a description of Society policy concerning copyright and a copy of the agreement.

PUBLICATION CHARGES

There are no page charges assessed on papers published in the BULLETIN.

REMARKS ON RESEARCH ANNOUNCEMENTS

The BULLETIN of the American Mathematical Society is the only research mathematical journal received as a privilege of membership in the Society. Its circulation is larger, by an order of magnitude, than that of most journals, in particular specialized journals. Thus, a BULLETIN Research Announcement should contain results of sufficient depth and import to be of interest to a wide mathematical audience. And, consequently, beyond basic mathematical standards, Research Announcements should meet high standards for style.

Beyond general exhortations to write clearly and precisely, the following more specific suggestions are offered.

1. Keep in mind that you are writing for as wide an audience as possible. Avoid the shorthand and jargon of your area as much as you can. Carefully introduce the terminology needed to understand the main results. If space considerations prevent a full development of the concepts, delineate clearly what you are not explaining and provide references to it in the literature. Consider an Announcement an opportunity to explain your area of research to the world at large.

2. Do not confuse a graceful style with a sloppy style. Although a light touch or a colorful phrase can relieve the tedium of definitions, excessive breeziness and imprecision confuse readers who have only a casual knowledge of the subject. We say this not to encourage pedantic writing but to discourage obscure writing. Your results should be stated precisely with all important concepts and notations made clear.

3. Ask a colleague to review your manuscript before you submit it. Even better, ask two colleagues, one whose work is very close to yours, one whose work is farther away. (If you can’t get two people you know to read your work before it is published, how many will want to read it after?) Ask for suggestions on how to improve the readability.

ABCDEFHGIJ — 898
EDITORS
Morris W. Hirsch, Research Expository Articles
Edgar Lee Stout, Book Reviews
Roger E. Howe, Research Announcements

ASSOCIATE EDITORS
William B. Arveson
Spencer Bloch
Lenore Blum
Gregory Cherlin
Percy Alec Deift
Michael D. Fried
Ronald L. Graham
Victor W. Guillemin

Victor Kac
Barry Mazur
Frank S. Quinn, III
Peter B. Shalen
David Vogan
Nolan R. Wallach
Alan Weinstein
Guido L. Weiss

PROVIDENCE, RHODE ISLAND USA
ISSN 0273-0979
INDEX TO VOLUME 18
January–April 1988

RESEARCH-EXPOSITORY PAPERS

Durrett, Richard. Crabgrass, measles, and gypsy moths: An introduction to modern probability, 117
Friedman, Robert and Morgan, John W. Algebraic surfaces and 4-manifolds: Some conjectures and speculations, 1
Morgan, John W. See Friedman, Robert

RESEARCH ANNOUNCEMENTS

Andrews, George E. and Garvan, F. G. Dyson's crank of a partition, 167
Bank, Steven B. A note on the location of complex zeros of solutions of linear differential equations, 35
Barceló, Juan Antonio and Córdoba, Antonio Juan. Band-limited functions: $L^p$-convergence, 163
Burger, Marc. Asymptotics of small eigenvalues of Riemann surfaces, 39
Córdoba, Antonio Juan. See Barceló, Juan Antonio
Dabrowski, Romuald. On Fourier coefficients of a continuous periodic function of bounded entropy norm, 49
Garvan, F. G. See Andrews, George E.
Goldman, William M. and Millson, John J. The deformation theory of representations of fundamental groups of compact Kähler manifolds, 153
Gregory, John. Numerical methods for extremal problems in the calculus of variations and optimal control theory, 31
Hochster, Melvin and Huneke, Craig. Tightly closed ideals, 45
Huneke, Craig. See Hochster, Melvin
Kawski, Matthias. Control variations with an increasing number of switchings, 149
Li, T. Y., Sauer, Tim and Yorke, James A. Numerically determining solutions of systems of polynomial equations, 173
McCullough, Darryl. Virtual cohomological dimension of mapping class groups of 3-manifolds, 27
de Melo, W. and van Strien, S. One-dimensional dynamics: the Schwarzian derivative and beyond, 159
Millson, John J. See Goldman, William M.
Olver, Peter J. Classical invariant theory and the equivalence problem for particle Lagrangians, 21
Quinn, Frank. Topological transversality holds in all dimensions, 145
Rosay, Jean-Pierre. See Nagel, Alexander
Sauer, Tim. See Li, T. Y.
Stein, Elias M. See Nagel, Alexander
van Strien, S. See de Melo, W.
Ullrich, David C. An extension of the Kahane-Khintchine inequality, 52
Wainger, Stephen. See Nagel, Alexander
White, Donald L. On the 2-decomposition numbers of $\text{Sp}(4, q)$, 41
Wojtkowski, Maciej P. Bounded geodesics for the Atiyah-Hitchin metric, 179
Yorke, James A. See Li, T. Y.
INDEX TO VOLUME 18

BOOK REVIEWS

Andrianov, Anatolij N. *Quadratic forms and Hecke operators*, reviewed by Eichler, Martin, 224

Beardon, Alan F. *The geometry of discrete groups*, reviewed by Earle, Clifford J., 78

Béard, Pierre H. *Spectral geometry: Direct and inverse problems*, reviewed by Randol, Burton S., 191

Blackadar, Bruce. *K-theory for operator algebras*, reviewed by Lance, Christopher, 67

Camacho, César and Neto, Alcides Lins. *Geometric theory of foliations*, reviewed by Plante, Joseph F., 92

Daffer, Peter Z. *See Taylor, Robert L.*


Elliott, P. D. T. A. *Arithmetic functions and integer products*, reviewed by DeKoninck, Jean-Marie, 230

Fomenko, A. T. *See Dubrovin, B. A.*

Goldstein, Jerome A. *Semigroups of linear operators and applications*, reviewed by Bratteli, Ola, 100

Gromov, Mikhael. *Partial differential relations*, reviewed by McDuff, Dusa, 214

Guillemin, Victor and Sternberg, Shlomo. *Symplectic techniques in physics*, reviewed by Duistermaat, J. J., 97

Karpilovsky, Gregory. *Projective representations of finite groups*, reviewed by Reynolds, William F., 83


Katok, Anatole and Strelcyn, Jean-Marie. *Invariant manifolds, entropy and billiards; smooth maps with singularities*, reviewed by Brin, Michael, 256

Kawai, Takahiro. *See Kashiwara, Masaki*

Kimura, Tatsuo. *See Kashiwara, Masaki*

Ladde, G. S., Lakshmikantham, V. and Vatsala, A. S. *Monotone iterative techniques for nonlinear differential equations*, reviewed by Pao, C. V., 65

Lakshmikantham, V. *See Ladde, G. S.*

Lang, Serge. *Introduction to complex hyperbolic spaces*, reviewed by Green, Mark, 188

Mauclaire, Jean-Loup. *Intégration et théorie des nombres*, reviewed by Elliott, P. D. T. A., 193

Maz’ja, Vladimir G. *Sobolev spaces*, reviewed by Hedberg, Lars Inge, 87

McCarthy, Paul J. *Introduction to arithmetical functions*, reviewed by DeKoninck, Jean-Marie, 230


Neto, Alcides Lins. *See Camacho, César*

Novikov, S. P. *See Dubrovin, B. A.*

Olver, Peter J. *Applications of Lie groups to differential equations*, reviewed by Bluman, George W., 73

Patterson, Ronald F. *See Taylor, Robert L.*

Rao, B. L. S. Prakasa. *Asymptotic theory of statistical inference*, reviewed by Greenwood, Priscilla, 254

Ravenel, Douglas C. *Complex cobordism and stable homotopy groups of spheres*, reviewed by Landweber, Peter S., 88
INDEX TO VOLUME 18

Riesel, Hans. *Prime numbers and computer methods for factorization*, reviewed by Pomerance, Carl, 61

Shub, Michael. *Global stability of dynamical systems*, reviewed by Robbin, Joel, 248

Soare, Robert I. *Recursively enumerable sets and degrees: A study of computable functions and computably generated sets*, reviewed by Pour-El, Marian Boykan, 108

Sternberg, Shlomo. *See* Guillemin, Victor

Strelcyn, Jean-Marie. *See* Katok, Anatole

Stückrad, Jürgen and Vogel, Wolfgang. *Buchsbaum rings and applications: An interaction between algebra, geometry, and topology*, reviewed by Evans, E. Graham, Jr., 251

Taylor, Robert L., Daffer, Peter Z. and Patterson, Ronald F. *Limit theorems for sums of exchangeable random variables*, reviewed by Teicher, Henry, 80

Tikhomirov, Vladimir M. *Fundamental principles of the theory of extremal problems*, reviewed by Troutman, John L., 220

Vatsala, A. S. *See* Ladde, G. S.

Vogel, Wolfgang. *See* Stückrad, Jürgen

Zariski, Oscar. *Le problème des modules pour les branches planes*, reviewed by Washburn, Sherwood, 209
Global stability of dynamical systems by Michael Shub—Reviewed by Joel Robbin ................................................................. 248

Buchsbaum rings and applications: An interaction between algebra, geometry, and topology by Jürgen Stückrad and Wolfgang Vogel—Reviewed by E. Graham Evans, Jr. ................................. 251

Asymptotic theory of statistical inference by B. L. S. Prakasa Rao—Reviewed by Priscilla Greenwood ............................................... 254

Invariant manifolds, entropy and billiards; smooth maps with singularities by Anatole Katok and Jean-Marie Strelcyn—Reviewed by Michael Brin ................................................................. 256
CONTENTS

April 1988

Research-Expository Papers

Crabgrass, measles, and gypsy moths: An introduction to modern probability by Richard Durrett ........................................ 117

Research Announcements

Topological transversality holds in all dimensions by Frank Quinn ...... 145
Control variations with an increasing number of switchings by Matthias Kawski .......................................................... 149
The deformation theory of representations of fundamental groups of compact Kähler manifolds by William M. Goldman and John J. Millson 153
One-dimensional dynamics: the Schwarzian derivative and beyond by W. de Melo and S. van Strien .................................................. 159
Band-limited functions: $L^p$-convergence by Juan Antonio Barceló and Antonio Juan Córdoba ................................................. 163
Dyson's crank of a partition by George E. Andrews and F. G. Garvan .. 167
Numerically determining solutions of systems of polynomial equations by T. Y. Li, Tim Sauer, and James A. Yorke ................................. 173
Bounded geodesics for the Atiyah-Hitchin metric by Maciej P. Wojtkowski 179

Book Reviews

Malcev-admissible algebras by Hyo Chul Myung—Reviewed by J. Marshall Osborn ................................................................. 185
Introduction to complex hyperbolic spaces by Serge Lang—Reviewed by Mark Green ................................................................. 188
Spectral geometry: Direct and inverse problems by Pierre H. Bérard—Reviewed by Burton S. Randol ................................................. 191
Intégration et théorie des nombres by Jean-Loup Mauclaire—Reviewed by P. D. T. A. Elliott ......................................................... 193
Le problème des modules pour les branches planes by Oscar Zariski—Reviewed by Sherwood Washburn ........................................ 209
Partial differential relations by Mikhael Gromov—Reviewed by Dusa McDuff .............................................................. 214
Fundamental principles of the theory of extremal problems by Vladimir M. Tikhomirov—Reviewed by John L. Troutman ..................... 220
Quadratic forms and Hecke operators by Anatolij N. Andrianov—Reviewed by Martín Eichler .................................................. 224
Arithmetic functions and integer products by P. D. T. A. Elliott; Introduction to arithmetical functions by Paul J. McCarthy—Reviewed by Jean-Marie DeKoninck ......................................................... 230

(Continued on inside back cover)