

PROCEEDINGS  
OF THE  
AMERICAN MATHEMATICAL SOCIETY

EDITED BY

FRED G. BRAUER	RICHARD R. GOLDBERG
GLEN E. BREDON	JACOB FELDMAN
W. WISTAR COMFORT	JOSEPH J. ROTMAN
GEORGE B. SELIGMAN	

WITH THE COOPERATION OF

THOMAS A. CHAPMAN	JAMES D. KUELBS
JAY R. GOLDMAN	ALLEN L. SHIELDS
ROBERT I. SOARE	

Coden: PAMYAR  
VOLUME 38  
NUMBER 1

PAGES 1—220  
MARCH 1973  
WHOLE NO. 165

*Published by the*  
AMERICAN MATHEMATICAL SOCIETY  
PROVIDENCE, RHODE ISLAND



## Proceedings of the American Mathematical Society

THIS JOURNAL is devoted entirely to research in pure and applied mathematics, and the publication of original papers of moderate length. The maximum length of an acceptable paper is about 8 printed pages. Since a page of the PROCEEDINGS contains about 400 words, a rule of thumb is that under 10 typed pages is probably within the limit, but that over 12 typed pages is probably too long.

**SHORTER NOTES.** Very short notes not to exceed 1 printed page of an unusual nature are also accepted, and appear under the heading **SHORTER NOTES**. Items deemed suitable include an elegant new proof of an important and well-known theorem, an illuminating example or counterexample, or a new viewpoint on familiar results. New results, if of a brief and striking character, might also be acceptable, though in general a paper which is merely very short will not be suitable for the **SHORTER NOTES** department.

**PREPARATION OF THE MANUSCRIPT.** Articles for insertion should be typewritten and double spaced. Ditto is not generally satisfactory, although other modes of multiple reproduction may be. 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; directions to the printer should be included where necessary on a separate sheet, not in the accompanying letter. Authors must keep a complete copy of their manuscript, and editors will acknowledge receipt; manuscripts can therefore be sent by ordinary mail and any other kind (registered, certified) is entirely unnecessary. Submission of two copies of the manuscript is desirable.

**FORM OF MANUSCRIPT.** The first page should consist of a *descriptive title*, followed by an *abstract* which 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. Also avoid proper names unless mathematical usage associates them with the work. The *abstract* should be at least one complete sentence, and at most 150 words. Included with the footnotes to your paper, but placed before the first footnote, there should be first the AMS (MOS) *subject classification numbers* 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. The AMS (MOS) Subject Classification Scheme (1970) with instructions for its use can be found as an appendix to Mathematical Reviews, Index to Volume 39 (June 1970). See the June 1970 Notices for more details, as well as illustrative examples.

**SUBMISSION OF MANUSCRIPTS, REPRINTS AND ADDRESS CHANGES.** See the last page of this issue.

**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.

**BACKLOG: NONE.** Two-thirds of the papers currently being received by the editors will be published in 8-10 months.

**SUBSCRIPTION INFORMATION.** Five volumes are planned for 1973; the subscription price is \$100. Back number prices are as follows: Volumes 1-16, \$14 per volume; Volumes 17-19, \$18 per volume; Volumes 20-26, \$30 per volume; Volumes 27-30, \$27 per volume; Volumes 31-38, \$30 per volume.

THE PROCEEDINGS OF THE AMERICAN MATHEMATICAL SOCIETY is published monthly. Subscriptions, orders for back numbers and inquiries in regard to nondelivery of current numbers should be addressed to the American Mathematical Society, P.O. Box 6248, Providence, R.I. 02904.  
Second-class postage paid at Providence, Rhode Island, and additional mailing offices.

Copyright © American Mathematical Society 1973  
Printed in the United States of America

PROCEEDINGS  
OF THE  
AMERICAN MATHEMATICAL SOCIETY

EDITED BY

FRED G. BRAUER	JACOB FELDMAN
GLEN E. BREDON	RICHARD R. GOLDBERG
W. WISTAR COMFORT	JOSEPH J. ROTMAN
GEORGE B. SELIGMAN	

WITH THE COOPERATION OF

THOMAS A. CHAPMAN	JAMES D. KUELBS
JAY R. GOLDMAN	ALLEN L. SHIELDS
ROBERT I. SOARE	

VOLUME 38  
MARCH—MAY 1973

*Published by the*  
AMERICAN MATHEMATICAL SOCIETY  
PROVIDENCE, RHODE ISLAND

**Printed in the United States of America**



# RESEARCH AND REVIEW JOURNALS PUBLISHED BY THE AMERICAN MATHEMATICAL SOCIETY

## **Bulletin of the American Mathematical Society**

This journal is the official organ of the Society. It reports official acts of the Society and the details of its meetings. It contains some of the officially invited addresses presented before the Society, reviews of advanced mathematical books, and a department of research announcements.

The current issue of the journal lists editors to whom prospective publications should be addressed. Publication is bimonthly.

## **Transactions of the American Mathematical Society**

This monthly journal is devoted entirely to research in pure and applied mathematics, and includes in general longer papers than those in the PROCEEDINGS.

The current issue of the journal lists editors to whom prospective publications should be addressed.

## **Mathematics of Computation**

A 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 it publishes reviews and notes in these and related fields.

Prospective publications should be addressed to the Editor, Professor Eugene Isaacson, Courant Institute of Mathematical Sciences, New York University, 251 Mercer Street, New York, New York 10012. The author may suggest the name of an editor for review of his paper.

## **Mathematical Reviews**

This journal is devoted to abstracts and reviews of the current mathematical literature of the world. Currently publication is monthly; two volumes are published each year, each volume consisting of 6 regular issues plus an index issue. In each regular issue the abstracts and reviews are grouped under subject headings. Publication began in 1940.

## **Soviet Mathematics—Doklady**

This bimonthly is a translation journal containing the entire pure mathematics section of the DOKLADY AKADEMII NAUK SSSR, the Reports of the Academy of Sciences of the USSR. The DOKLADY for a year contains about 500 articles, each about 4 pages long.

## **Mathematics of the USSR—Izvestija**

This journal is a cover-to-cover translation of IZVESTIJA AKADEMII NAUK SSSR SERIJA MATEMATIČESKAJA, published bimonthly by the Academy of Sciences of the USSR. It is a journal of current research in all fields of pure mathematics. The translation is published bimonthly starting with Volume 1, Number 1, January–February 1967.

## **Mathematics of the USSR—Sbornik**

This journal is a cover-to-cover translation of MATEMATIČESKII SBORNIK (New Series), published monthly by the Moscow Mathematical Society and the Academy of Sciences of the USSR. It is a journal of current research in all fields of pure mathematics. The translation is published monthly starting with Volume 1, Number 1, January 1967.

## Submission of Manuscript

Send papers directly to one of the editors listed under the subject field of the paper.

*Algebra and algebraic number theory.*

JOSEPH J. ROTMAN, Department of Mathematics, University of Illinois, Urbana, Illinois 61801

GEORGE B. SELIGMAN, Department of Mathematics, Yale University, New Haven, Connecticut 06520

*Modern or classical analysis and analytic number theory.*

JACOB FELDMAN, Department of Mathematics, University of California, Berkeley, California 94720

RICHARD R. GOLDBERG, Department of Mathematics, University of Iowa, Iowa City, Iowa 52240

ALLEN L. SHIELDS, Department of Mathematics, University of Michigan, Ann Arbor, Michigan 48104

*Algebraic geometry.*

GEORGE B. SELIGMAN, Department of Mathematics, Yale University, New Haven, Connecticut 06520

*Set-theoretic and general topology.*

THOMAS A. CHAPMAN, Department of Mathematics, University of Kentucky, Lexington, Kentucky, 40506

W. WISTAR COMFORT, Department of Mathematics, Wesleyan University, Middletown, Connecticut 06457

*Algebraic topology and all other types of geometry.*

GLEN E. BREDON, Department of Mathematics, Rutgers University, New Brunswick, New Jersey 08903

*Applied mathematics, differential equations, and related areas of analysis.*

FRED G. BRAUER, Department of Mathematics, University of Wisconsin, Madison, Wisconsin 53706

*Probability, statistics, and related fields.*

JAMES D. KUELBS, Department of Mathematics, 213 Van Vleck Hall, University of Wisconsin, Madison, Wisconsin 53706

*Logic, set theory, and related areas.*

ROBERT I. SOARE, Department of Mathematics, University of Illinois at Chicago Circle, Chicago, Illinois 60680

*Combinatorics and related areas of discrete mathematics.*

JAY R. GOLDMAN, School of Mathematics, University of Minnesota, Minneapolis, Minnesota 55455

All other communications should be addressed to the Managing Editor, JOSEPH J. ROTMAN, at the above address.

## Reprints 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 02904.



# CONTENTS—Continued from back cover

## D. GEOMETRY

- The Gauss map in spaces of constant curvature. By JOEL L. WEINER ..... 157  
 A global invariant of conformal mappings in space. By JAMES H. WHITE ..... 162

## F. STATISTICS AND PROBABILITY

- The Erdős-Rényi new law of large numbers for weighted sums. By STEPHEN A. BOOK ..... 165

## G. TOPOLOGY

- The homotopy groups of spaces whose cohomology is a  $Z_p$  truncated polynomial algebra. By ALBERT SHAR ..... 172  
 Transitive actions on highly connected spaces. By VICTOR SCHNEIDER ..... 179  
 Realcompactifications of products of ordered spaces. By WILLIAM G. MCARTHUR ..... 186  
 Sets of points of discontinuity. By RICHARD BOLSTEIN ..... 193  
 The product of totally nonmeagre spaces. By J. M. AARTS and D. J. LUTZER ... 198  
 Imbedding classes and  $n$ -minimal complexes. By BRIAN R. UMMEL ..... 201  
 On weakly flat 1-spheres. By ROBERT J. DAVERMAN..... 207  
 A study of monotonically normal spaces. By CARLOS R. BORGES ..... 211

## SHORTER NOTES

- A short proof of the martingale convergence theorem. By CHARLES W. LAMB ... 215  
 Differentiability of the metric projection in finite-dimensional Euclidean space. By EDGAR ÅSPLUND..... 218  
 Corrigendum to "Cyclic vectors of induced representations". By A. HULANICKI and T. PYTLIK ..... 220



# CONTENTS\*

Vol. 38, No. 1

MARCH 1973

Whole No. 165

	Page
A. ALGEBRA AND NUMBER THEORY	
Free inverse semigroups. By H. E. SCHEIBLICH .....	1
Global dimension of triangular orders of a discrete valuation ring. By VASANTI A. JATEGAONKAR .....	8
A property of a class of nonlinear difference equations. By F. T. HOWARD .....	15
On the structure of semiprime rings. By AUGUSTO H. ORTIZ .....	22
Vector bundles over finite CW-complexes are algebraic. By KNUD LØNSTED .....	27
Normal subgroups of Fuchsian groups with fixed parabolic class number. By MARC BERGER .....	32
A note on intersections of valuation ideals. By CHARLES H. BRASE .....	37
Realizability of representations in cyclotomic fields. By BURTON FEIN .....	40
A new simple Lie algebra of characteristic three. By MARGUERITE FRANK .....	43
Radicals and bimodules. By D. M. FOSTER .....	47
On free abelian $\ell$ -groups. By PAUL HILL .....	53
Quasi-unmixed local rings and quasi-subspaces. By PETER G. SAWTELLE .....	59
Some examples from infinite matrix rings. By ROBERT W. MILLER and DARRELL R. TURNIDGE .....	65
B. ANALYSIS	
Axiomatic cohomology for Banach modules. By I. G. CRAW .....	68
Bianalytic functions with exceptional values. By P. KRAJKIEWICZ .....	75
Oscillatory solutions for a generalized sublinear second order differential equation. By J. W. HEIDEL and I. T. KIGURADZE .....	80
A hyponormal operator whose spectrum is not a spectral set. By BHUSHAN L. WADHWA .....	83
Duality in $B^*$ -algebras. By SHEILA A. MCKILLIGAN .....	86
Demicontinuity and hemicontinuity in Fréchet space. By HUGO D. JUNGHEHN ..	89
Restrictions of Fourier transforms of continuous measures. By BENJAMIN B. WELLS .....	92
The critical points of a typically-real function. By A. W. GOODMAN .....	95
On the estimation of the $L_2$ -norm of a function over a bounded subset of $\mathbb{R}^n$ . By HOMER F. WALKER .....	103
Fixed point theorems in reflexive Banach spaces. By R. KANNAN .....	111
Bergman operators for parabolic equations in two space variables. By DAVID COLTON .....	119
Lower bounds for solutions of hyperbolic inequalities in unbounded regions. By AMY C. MURRAY .....	127
On normal derivations. By JOEL ANDERSON .....	135
General Wiener-Hopf operators and the numerical range of an operator. By VICTOR J. PELLEGRINI .....	141
The norm of a derivation in a $W^*$ -algebra. By LÁSZLÓ ZSIDÓ .....	147
Trèves' identity. By P. C. ROSENBLOOM .....	151
On fixed points of nonexpansive mappings in nonconvex sets. By W. G. DOTSON, JR. ....	155

\* The volume indexes contain a mapping showing the correspondence between sections A-G and the AMS (MOS) subject classification numbers.