

PROCEEDINGS
OF THE
AMERICAN MATHEMATICAL SOCIETY

EDITED BY
FRED G. BRAUER
W. H. J. FUCHS
IRVING GLICKSBERG
ERNEST A. MICHAEL
JOSEPH J. ROTMAN
GEORGE B. SELIGMAN
EMERY THOMAS

WITH THE COOPERATION OF
Joshua Chover
Allen L. Shields
Robert I. Soare

VOLUME 30, NUMBER 1
SEPTEMBER, 1971

CODEN: PAMYAR

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 helpful, but by no means necessary.

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.

SUBSCRIPTION INFORMATION. Four volumes are planned for 1971. The subscription price is \$72. Back issues of Volumes 1-16 are available at a price of \$14 each. Volumes 17-19 at a price of \$18 each, and Volumes 20-29 at a price of \$30 each.

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, 1971
Printed in the United States of America

PROCEEDINGS
OF THE
AMERICAN MATHEMATICAL SOCIETY

EDITED BY
FRED G. BRAUER ERNEST A. MICHAEL
W. H. J. FUCHS JOSEPH J. ROTMAN
IRVING GLICKSBERG GEORGE B. SELIGMAN
EMERY THOMAS

WITH THE COOPERATION OF
JOSHUA CHOVER ALLEN L. SHIELDS
ROBERT I. SOARE

VOLUME 30
SEPTEMBER–DECEMBER 1971

PUBLISHED BY THE AMERICAN MATHEMATICAL SOCIETY
PROVIDENCE, RHODE ISLAND

GEORGE BANTA COMPANY, INC., MENASHA, WISCONSIN

RESEARCH AND REVIEW JOURNALS PUBLISHED BY THE AMERICAN MATHEMATICAL SOCIETY

Bulletin of the American Mathematical Society

The 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 *MATEMATIČESKIIĖ 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 number theory.

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

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

Modern or classical analysis.

IRVING GLICKSBERG, Mathematics Department, University of Washington, Seattle, Washington 98105

W. H. J. FUCHS, Department of Mathematics, White Hall, Cornell University, Ithaca, New York 14850

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.

ERNEST MICHAEL, Mathematics Department, University of Washington, Seattle, Washington 98105

Algebraic topology and all other types of geometry.

EMERY THOMAS, Mathematics Department, University of California, Berkeley, California 94720

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

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

Probability, statistics, and related fields.

JOSHUA CHOVER, Mathematics Department, University of Wisconsin, Madison, Wisconsin 53706

Logic, set theory, and related areas.

Robert I. Soare, Mathematics Department, University of Illinois at Chicago Circle, Chicago, Illinois 60680

All other communications should be addressed to the Managing Editor, W. H. J. FUCHS, 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

The Hardy class of a Bazilevič function and its derivative. By SANFORD S. MILLER.....	125
On a theorem of Fell. By ROBERT C. BUSBY.....	133
Continuity of systems of derivations on F -algebras. By R. L. CARPENTER.....	141
Approximations of the identity operator by semigroups of linear operators. By A. PAZY.....	147

E. LOGIC AND FOUNDATIONS

The failure in computable analysis of a classical existence theorem for differential equations. By OLIVER ABERTH.....	151
---	-----

G. TOPOLOGY

Concerning upper semicontinuous decompositions of irreducible continua. By W. R. R. TRANSUE, J. W. HINRICHSSEN and B. FITZPATRICK, JR.....	157
A class of arcwise connected continua. By CHARLES L. HAGOPIAN.....	164
Tame polyhedra in wild cells and spheres. By R. B. SHER.....	169
Conditions for continuity of certain open monotone functions. By MELVIN R. HAGAN.....	175
Mappings of indecomposable continua. By DAVID P. BELLAMY.....	179
On the immersion of an n -dimensional manifold in $n+1$ -dimensional Euclidean space. By BENJAMIN HALPERN.....	181
Can a 2-coherent Peano continuum separate E^3 ? By W. C. CHEWNING.....	185
Realcompactness and partitions of unity. By G. DE MARCO and R. G. WILSON.....	189
On the centralizer of a subgroup of a Lie group. By DONG HOON LEE...	195
Countable paracompactness in product spaces. By PHILLIP ZENOR....	199

SHORTER NOTES

A note on the Blum-Hanson theorem. By LEE JONES and VELIMIR KUFTINEC.....	202
A short proof of the F. and M. Riesz Theorem. By BERNT K. ØKSENDAL.....	204

CONTENTS*

Vol. 30, No. 1 SEPTEMBER, 1971 Whole No. 147

	Page
A. ALGEBRA AND NUMBER THEORY	
Right LCM domains. By RAYMOND A. BEAUREGARD.....	1
Sheltered modules and rings. By SETH WARNER.....	8
Geometrical realization of combinatorial geometries. By J. H. MASON.....	15
The word and conjugacy problems for the knot group of any tame, prime, alternating knot. By C. M. WEINBAUM.....	22
Bounds for the determinant of the sum of hermitian matrices. By MIROSLAV FIEDLER.....	27
Spectrum of X satisfying $0 \leq X^p \leq X$. By RALPH GELLAR.....	32
Embedding the dual of Π_m in the lattice of equational classes of commutative semigroups. By STANLEY BURRIS and EVELYN NELSON.....	37
Some radical properties of s -rings. By MICHAEL RICH.....	40
Principal elements of lattices of ideals. By P. J. MCCARTHY.....	43
Products of normal supersolvable subgroups. By D. K. FRIESEN.....	46
On a theorem of Malcev. By GERARD LALLEMENT.....	49
A free rank 4 Hopf algebra with antipode of order 4. By DAVID E. RADFORD.....	55
Rings generated by the inner-automorphisms of nonabelian groups. By A. JOHN CHANDY.....	59
Note on the Kloosterman sum. By KENNETH S. WILLIAMS.....	61
On rings with a higher derivation. By SHIZUKA SATO.....	63
Some applications of the Turán-Kubilius inequality. By R. L. DUNCAN.....	69
The conjugation representation and fusionless extensions. By EDWARD FORMANEK.....	73
Endomorphisms of finitely presented modules. By GABRIEL SABBAGH..	75
B. ANALYSIS	
On the Arens product and annihilator algebras. By PAK-KEN WONG... .	79
Generalisation of the Muirhead-Rado inequality. By D. E. DAYKIN .	84
Property L and direct integral decompositions of W^* algebras. By PAUL WILLIG.....	87
Nonoscillation properties of a nonlinear differential equation. By MICHAEL E. HAMMETT.....	92
Oscillation of nonlinear systems of matrix differential equations. By A. G. KARTSATOS.....	97
Unitary groups and differential operators. By ROBERT M. KAUFFMAN .	102
Quasilinear systems with several periodic solutions. By JANE CRONIN..	107
A criterion for disfocality. By PUI-KEI WONG.....	112
Topological algebras and Mackey topologies. By ALLAN C. COCHRAN..	115
A convergence question in H^p . By STEPHEN SCHEINBERG.....	120

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

Continued on inside back cover