

**Pacific
Journal of
Mathematics**

VOLUME XXXV

1970

PACIFIC JOURNAL OF MATHEMATICS

EDITORS

H. SAMELSON
Stanford University
Stanford, California 94305

J. DUGUNDJI
Department of Mathematics
University of Southern California
Los Angeles, California 90007

RICHARD PIERCE
University of Washington
Seattle, Washington 98105

RICHARD ARENS
University of California
Los Angeles, California 90024

ASSOCIATE EDITORS

E. F. BECKENBACH

B. H. NEUMANN

F. WOLF

K. YOSHIDA

SUPPORTING INSTITUTIONS

UNIVERSITY OF BRITISH COLUMBIA
CALIFORNIA INSTITUTE OF TECHNOLOGY
UNIVERSITY OF CALIFORNIA
MONTANA STATE UNIVERSITY
UNIVERSITY OF NEVADA
NEW MEXICO STATE UNIVERSITY
OREGON STATE UNIVERSITY
UNIVERSITY OF OREGON
OSAKA UNIVERSITY
UNIVERSITY OF SOUTHERN CALIFORNIA

STANFORD UNIVERSITY
UNIVERSITY OF TOKYO
UNIVERSITY OF UTAH
WASHINGTON STATE UNIVERSITY
UNIVERSITY OF WASHINGTON
* * *
AMERICAN MATHEMATICAL SOCIETY
CHEVRON RESEARCH CORPORATION
TRW SYSTEMS
NAVAL WEAPONS CENTER

Printed in Japan by International Academic Printing Co., Ltd., Tokyo, Japan

CONTENTS

N. L. Alling, <i>Analytic and harmonic obstruction on nonorientable Klein surfaces</i>	533
S. A. Amitsur, <i>Embeddings in matrix rings</i>	553
B. D. Arendt and C. J. Stuth, <i>On the structure of commutative periodic semigroups</i>	1
B. D. Arendt and C. J. Stuth, <i>On partial homomorphisms of semigroups</i>	7
J. D. Arrison and M. Rich, <i>On nearly commutative degree one algebras</i>	533
Leonard Asimow, <i>Extensions of continuous affine functions</i>	11
B. A. Barnes, <i>Algebras with minimal left ideals which are Hilbert spaces</i>	537
V. D. Belousov and P. L. Kannappan, <i>Generalized Bol functional equation</i>	259
S. M. Berman, <i>Excursions above high levels for stationary Gaussian processes</i>	579
C. M. Biles, <i>Gelfand and Wallman-type compactifications</i>	267
C. E. Billigheimer, <i>Regular boundary problems for a five-term recurrence relation</i>	23
L. H. Blake, <i>A generalization of Martingales and two consequent convergence theorems</i>	279
R. F. Brown, <i>An elementary proof of the uniqueness of the fixed point index</i>	549
E. Buchman and F. A. Valentine, <i>A characterization of the parallelepiped in E^n</i>	53
D. K. Burke, <i>On p-spaces and $w\Delta$-spaces</i>	285
J. B. Butler, Jr., <i>Almost smooth perturbations of self-adjoint operators</i>	297
M. Cambern, <i>Isomorphisms of $C_0(Y)$ onto $C(X)$</i>	307
Victor Camillo, <i>A note on commutative injective rings</i>	59
R. L. Carpenter, <i>Principal ideals in F-algebras</i>	559
C. C. Chang and Y. N. Moschovakis, <i>The Suslin-Kleene theorem for V_κ with cofinality $(\kappa) = \omega$</i>	565
T. S. Chihara, <i>The derived set of the spectrum of a distribution function</i>	571
T. Cho, <i>On the Choquet boundary for a nonclosed subspace of $C(S)$</i>	575
D. E. Cook, <i>A conditionally compact point set with noncompact closure</i>	313
T. E. Cramer, <i>Countable Boolean algebras as subalgebras and homomorphs</i>	321
L. J. Cummings, <i>Decomposable symmetric tensors</i>	65

R. B. Darst, <i>The Lebesgue decomposition, Radon-Nikodym derivative, conditional expectation, and Martingale convergence for lattices of sets</i>	581
J. R. Edwards and S. G. Wayment, <i>A v-integral representation for linear operators on spaces of continuous functions with values in topological vector spaces</i>	327
D. Eisenbud and P. Griffith, <i>The structure of serial rings</i>	633
J. E. H. Elliott, <i>On matrices with a restricted number of diagonal values</i>	79
M. R. Embry, <i>Similarities involving normal operators on Hilbert space</i>	331
Lynn Erbe, <i>Oscillation theorems for second order linear differential equations</i>	337
D. E. Fields, <i>Dimension theory in power series rings</i>	601
W. J. Firey, <i>Local behaviour of area functions of convex bodies</i> .	345
J. W. Fisher, <i>The primary decomposition theory for modules</i> .	359
M. L. Fredman, <i>Congruence formulas obtained by counting irreducibles</i>	613
G. Garfinkel, <i>Generic splitting algebras for Pic</i>	369
G. I. Gaudry, <i>Bad behavior and inclusion results for multipliers of type (p, q)</i>	83
J. E. Gilbert, <i>On the ideal structure of some algebras of analytic functions</i>	625
G. Goss and G. Viglino, <i>Some topological properties weaker than compactness</i>	635
G. Grätzer and J. Sichler, <i>On the endomorphism semigroup (and category) of bounded lattices</i>	639
P. Griffith, See D. Eisenbud and P. Griffith	
Frances F. Gulick, <i>Derivations and actions</i>	95
J. D. Hansard, <i>Function space topologies</i>	381
K. A. Hardie, <i>Quasifibration and adjunction</i>	389
L. F. Harris, <i>On subgroups of prime power index</i>	117
Jutta Hausen, <i>The hypo residuum of the automorphism group of an abelian p-group</i>	127
G. Hochschild, <i>Coverings of pro-affine algebraic groups</i>	399
R. Hrycay, <i>Noncontinuous multifunctions</i>	141
G. L. Itzkowitz, <i>On nets of contractive maps in uniform spaces</i> .	417
P. L. Kannappan, See V. D. Belousov and P. L. Kannappan	
M. Krom and M. Krom, <i>Groups with free nonabelian subgroups</i> .	425
M. Krom, See M. Krom and M. Krom	
T. R. Kuttler, <i>Upper and lower bounds for eigenvalues by finite differences</i>	429
R. C. Lacher, <i>Cell-like mappings, II</i>	649
Jeanne LaDuke, <i>On a certain generalization of ℓ_p spaces</i>	155

S. N. Lal, <i>On a theorem of M. Izumi and S. Izumi</i>	661
H. B. Lambert, <i>Differential mappings on a vector space</i>	669
D. Leviatan, <i>A new approach to representation theory for convolution transforms</i>	441
R. G. Levin and T. Tamura, <i>Notes on commutative power joined semigroups</i>	673
R. E. Lewand and K. McCrimmon, <i>MacDonald's theorem for quadratic Jordan algebras</i>	681
M. J. S. Lim, <i>Rank preservers of skew-symmetric matrices</i>	169
J. H. Lindsey, II, <i>On a six dimensional projective representation of the Hall-Janko group</i>	175
Brenda MacGibbon, <i>A necessary and sufficient condition for the embedding of a Lindelof space in a Hausdorff K_σ space</i> . .	459
R. Mansfield, <i>Perfect subsets of definable sets of real numbers</i> . .	451
J. A. Marti, <i>On some types of completeness in topological vector spaces</i>	707
R. C. McCann, <i>Transversally perturbed planar dynamical systems</i> .	187
K. McCrimmon, See R. E. Lewand and K. McCrimmon	
B. D. McLemore, See D. G. Mead and B. D. McLemore	
D. G. Mead and B. D. McLemore, <i>Ritt's question on the Wronskian</i> .	467
W. J. Meyer, <i>Characterization of the Steiner point</i>	717
E. Y. Mikami, <i>Focal points in a control problem</i>	473
P. G. Miller, <i>Characterizing the distribution of three independent n-dimensional random variables X_1, X_2, X_3, having analytic characteristic functions by the joint distribution of $(X_1 + X_3, X_2 + X_3)$</i>	487
S. Mohamed, <i>Rings whose homomorphic images are q-rings</i>	727
Y. N. Moschovakis, See C. C. Chang and Y. N. Moschovakis	
L. Narens, <i>A nonstandard proof of the Jordan curve theorem</i> . .	747
T. O'Brien and W. Reddy, <i>Each compact orientable surface of positive genus admits an expansive homeomorphism</i>	737
T. W. Palmer, <i>Real C^*-algebras</i>	195
R. J. Plemmons and M. T. West, <i>On the semigroup of binary relations</i>	743
Don Porter, <i>Symplectic bordism, Stiefel-Whitney numbers and a Novikov resolution</i>	205
T. R. Prabhakar, <i>On a set of polynomials suggested by Laguerre polynomials</i>	213
B. L. S. Prakasa Rao, <i>Infinitely divisible characteristic functionals on locally convex topological vector spaces</i>	221
C. R. Putnam, <i>Unbounded inverses of hyponormal operators</i> . . .	755
J. R. Reay, <i>Caratheodory theorems in convex product structures</i> .	227
W. Reddy, See T. O'Brien and W. Reddy	
W. T. Reid, <i>Some remarks on special disconjugacy criteria for differential systems</i>	763

M. Rich, See J. D. Arrison and M. Rich	
C. A. Rogers, <i>The convex generation of convex Borel sets in Euclidean space</i>	773
P. Rosenthal, <i>On the Bergman integral operator for an elliptic partial differential equation with a singular coefficient</i> . .	493
S. Saran, <i>A general theorem for bilinear generating functions</i> . .	783
J. Sichler, See G. Grätzer and J. Sichler	
A. M. Sinclair, <i>Eigenvalues in the boundary of the numerical range</i>	231
D. B. Smith, <i>On the number of finitely generated O-groups</i> . . .	499
S. W. Smith, <i>Cone relationships of biorthogonal systems</i>	787
J. W. Spellmann, <i>Concerning the domains of generators of linear semigroups</i>	503
D. R. Stone, <i>Torsion-free and divisible modules over matrix rings</i> .	235
Arne Stray, <i>An approximation theorem for subalgebras of H^∞</i> . .	511
C. J. Stuth, See B. D. Arendt and C. J. Stuth	
C. J. Stuth, See B. D. Arendt and C. J. Stuth	
T. Tamura, See R. G. Levin and T. Tamura	
F. A. Valentine, See E. Buchman and F. A. Valentine	
W. V. Vasconcelos, <i>On commutative endomorphism rings</i>	795
G. Viglino, See Goss and G. Viglino	
A. L. Villone, <i>Self-adjoint differential operators</i>	517
S. G. Wayment, See J. R. Edwards and S. G. Wayment	
M. T. West, See R. J. Plemmons and M. T. West	
W. J. Wickless, <i>A characterization of the nil radical of ring</i> . .	255
Vernon Zander, <i>Products of finitely additive set functions from Orlicz spaces</i>	799

Pacific Journal of Mathematics

B. D. Arendt and C. J. Stuth, <i>On the structure of commutative periodic semigroups</i>	1
B. D. Arendt and C. J. Stuth, <i>On partial homomorphisms of semigroups</i>	7
Leonard Asimow, <i>Extensions of continuous affine functions</i>	11
C. E. Billigheimer, <i>Regular boundary problems for a five-term recurrence relation</i>	23
E. Buchman and F. A. Valentine, <i>A characterization of the parallelepiped in E^n</i>	53
Victor Camillo, <i>A note on commutative injective rings</i>	59
L. J. Cummings, <i>Decomposable symmetric tensors</i>	65
J. E. H. Elliott, <i>On matrices with a restricted number of diagonal values</i>	79
G. I. Gaudry, <i>Bad behavior and inclusion results for multipliers of type (p, q)</i>	83
Frances F. Gulick, <i>Derivations and actions</i>	95
L. F. Harris, <i>On subgroups of prime power index</i>	117
Jutta Hausen, <i>The hypo residuum of the automorphism group of an abelian p-group</i>	127
R. Hrycay, <i>Noncontinuous multifunctions</i>	141
Jeanne LaDuke, <i>On a certain generalization of ℓ_p spaces</i>	155
M. J. S. Lim, <i>Rank preservers of skew-symmetric matrices</i>	169
J. H. Lindsey, II, <i>On a six dimensional projective representation of the Hall-Janko group</i>	175
R. C. McCann, <i>Transversally perturbed planar dynamical systems</i>	187
T. W. Palmer, <i>Real C^*-algebras</i>	195
Don Porter, <i>Symplectic bordism, Stiefel-Whitney numbers, and a Novikov resolution</i>	205
T. R. Prabhakar, <i>On a set of polynomials suggested by Laguerre polynomials</i>	213
B. L. S. Prakasa Rao, <i>Infinitely divisible characteristic functionals on locally convex topological vector spaces</i>	221
J. R. Reay, <i>Caratheodory theorems in convex product structures</i>	227
A. M. Sinclair, <i>Eigenvalues in the boundary of the numerical range</i>	231
D. R. Stone, <i>Torsion-free and divisible modules over matrix rings</i>	235
W. J. Wickless, <i>A characterization of the nil radical of ring</i>	255

PACIFIC JOURNAL OF MATHEMATICS

EDITORS

H. SAMELSON
Stanford University
Stanford, California 94305

J. DUGUNDJI
Department of Mathematics
University of Southern California
Los Angeles, California 90007

RICHARD PIERCE
University of Washington
Seattle, Washington 98105

RICHARD ARENS
University of California
Los Angeles, California 90024

ASSOCIATE EDITORS

E. F. BECKENBACH

B. H. NEUMANN

F. WOLE

K. YOSHIDA

SUPPORTING INSTITUTIONS

UNIVERSITY OF BRITISH COLUMBIA
CALIFORNIA INSTITUTE OF TECHNOLOGY
UNIVERSITY OF CALIFORNIA
MONTANA STATE UNIVERSITY
UNIVERSITY OF NEVADA
NEW MEXICO STATE UNIVERSITY
OREGON STATE UNIVERSITY
UNIVERSITY OF OREGON
OSAKA UNIVERSITY
UNIVERSITY OF SOUTHERN CALIFORNIA

STANFORD UNIVERSITY
UNIVERSITY OF TOKYO
UNIVERSITY OF UTAH
WASHINGTON STATE UNIVERSITY
UNIVERSITY OF WASHINGTON
* * *
AMERICAN MATHEMATICAL SOCIETY
CHEVRON RESEARCH CORPORATION
TRW SYSTEMS
NAVAL WEAPONS CENTER

The Supporting Institutions listed above contribute to the cost of publication of this Journal, but they are not owners or publishers and have no responsibility for its content or policies.

Mathematical papers intended for publication in the *Pacific Journal of Mathematics* should be in typed form or offset-reproduced, (not dittoed), double spaced with large margins. Underline Greek letters in red, German in green, and script in blue. The first paragraph or two must be capable of being used separately as a synopsis of the entire paper. The editorial "we" must not be used in the synopsis, and items of the bibliography should not be cited there unless absolutely necessary, in which case they must be identified by author and Journal, rather than by item number. Manuscripts, in duplicate if possible, may be sent to any one of the four editors. Please classify according to the scheme of Math. Rev. Index to Vol. 39. All other communications to the editors should be addressed to the managing editor, Richard Arens, University of California, Los Angeles, California, 90024.

50 reprints are provided free for each article; additional copies may be obtained at cost in multiples of 50.

The *Pacific Journal of Mathematics* is published monthly. Effective with Volume 16 the price per volume (3 numbers) is \$8.00; single issues, \$3.00. Special price for current issues to individual faculty members of supporting institutions and to individual members of the American Mathematical Society: \$4.00 per volume; single issues \$1.50. Back numbers are available.

Subscriptions, orders for back numbers, and changes of address should be sent to Pacific Journal of Mathematics, 103 Highland Boulevard, Berkeley, California, 94708.

PUBLISHED BY PACIFIC JOURNAL OF MATHEMATICS, A NON-PROFIT CORPORATION

Printed at Kokusai Bunken Insatsusha (International Academic Printing Co., Ltd.), 7-17, Fujimi 2-chome, Chiyoda-ku, Tokyo, Japan.