

Notices

OF THE
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MATHEMATICAL
SOCIETY



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Notices
OF THE
AMERICAN MATHEMATICAL SOCIETY

Edited by Everett Pitcher and Gordon L. Walker

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MEETINGS

Calendar of Meetings

NOTE: This Calendar lists all of the meetings which have been approved by the Council up to the date at which this issue of the *Notices* was sent to press. The summer and annual meetings are joint meetings of the Mathematical Association of America and the American Mathematical Society. The meeting dates which fall rather far in the future are subject to change. This is particularly true of the meetings to which no numbers have yet been assigned.

Meeting No.	Date	Place	Deadline for Abstracts*
679	November 20-21, 1970	Athens, Georgia	Oct. 6, 1970
680	November 21, 1970	Pasadena, California	Oct. 6, 1970
681	November 28, 1970	Urbana, Illinois	Oct. 6, 1970
682	January 21-25, 1971 (77th Annual Meeting)	Atlantic City, New Jersey	Nov. 5, 1970
683	March 26-27, 1971	Chicago, Illinois	
684	April 7-10, 1971	New York, New York	
685	April 24, 1971	Monterey, California	
	August 30-September 3, 1971 (76th Summer Meeting)	University Park, Pennsylvania	
	January 17-21, 1972 (78th Annual Meeting)	Las Vegas, Nevada	

*The abstracts of papers to be presented in person at the meetings must be received in the Headquarters Offices of the Society in Providence, Rhode Island, on or before these deadlines. The deadlines also apply to news items. The next two deadlines for by-title abstracts will be September 29, 1970, and October 29, 1970.

OTHER EVENTS

December 27, 1970	Symposium on Some Mathematical Questions in Biology	Chicago, Illinois
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Six Hundred Seventy-Eighth Meeting
George Washington University
Washington, D. C.
October 31, 1970

The six hundred seventy-eighth meeting of the American Mathematical Society will be held at the George Washington University in Washington, D.C., on Saturday, October 31, 1970. All sessions will take place in Building C, 2201 G Street, N. W.

By invitation of the Committee to Select Hour Speakers for Eastern Sectional Meetings, there will be two invited addresses. Professor James B. Ax of the State University of New York at Stony Brook will speak on "On the algebraic relations among differentially-algebraic analytic functions" at 11:00 a.m. Dr. Alan Baker of Cambridge University and The Institute for Advanced Study will speak on "On the class number of imaginary quadratic fields" at 2:00 p.m.

There will be sessions for ten-minute contributed papers Saturday morning and afternoon. There will be no provision for late papers.

REGISTRATION

The registration desk will be located on the first floor of Building C. It will be open at 9:00 a.m.

PROGRAM OF THE SESSIONS

The time limit for each contributed paper is 10 minutes. The contributed papers are scheduled at 15-minute intervals. To maintain this schedule, the time limit will be strictly enforced.

SATURDAY, 9:00 A.M.

Session on Analysis, Room 200, Building C

9:00-9:10

- (1) P-sets in \mathbb{R}^N - \mathbb{N} and regular matrices. Preliminary report
Professor Robert E. Atalla, Ohio University (678-B4)

9:15-9:25

- (2) A Cantor-Lebesgue theorem for two dimensions. Preliminary report
Professor Roger L. Cooke, University of Vermont (678-B12)

*For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting.

MEALS AND ACCOMMODATIONS

A list of nearby restaurants will be available.

Washington, D. C. has, of course, a sufficient number of suitable hotels and motels. People should make their own reservations.

TRAVEL

The George Washington University is located in downtown Washington, five blocks from the White House, Building C, where all sessions will be held, is at 2201 G Street, N. W. It can be reached by taxi in fifteen minutes from National Airport, the Airport Bus Terminal (serving Dulles and Friendship Airports), or Union Station.

Parking space will be available at the lot located at 22nd and G Streets. Show your copy of these Notices to gain admittance. In case of overflow you will be directed to another lot.

9:30-9:40

- (3) Pointwise estimates of eigenfunctions for Schrödinger operators
Dr. Norman W. Bazley* and Dr. Hans R. Fankhauser, Batelle Institute,
Geneva, Switzerland (678-B9)

9:45-9:55

- (4) A few relations connecting real and imaginary parts of a Bessel function of the first kind
Mr. Prahlad Ram Gupta, Aggarwal Company, Punjab, India (678-B6)

10:00-10:10

- (5) A theorem on the existence of periodic solutions to Hamiltonian systems with convex potential
Dr. William B. Gordon, U. S. Naval Research Laboratory, Washington, D. C. (678-B8)

10:15-10:25

- (6) Sturm theorems for a class of fourth order differential equations
Professor Joaquin B. Diaz*, Rensselaer Polytechnic Institute, and Professor Dennis R. Dunninger, Michigan State University (678-B2)

10:30-10:40

- (7) The bifurcation of periodic solutions in Banach spaces
Professor William S. Hall, University of Pittsburgh (678-B1)

SATURDAY, 9:00 A.M.

General Session, Room 202, Building C

9:00-9:10

- (8) The tensor interpretation of Grassmann's Ausdehnungslehre. I
Dr. Vivian Eberle Spencer, Bureau of Mines, Washington, D.C., and Professor Domina Eberle Spencer*, University of Connecticut (678-C2)

9:15-9:25

- (9) A new treatment of surface wave problems under uniform magnetic and current fields
Professor Lokenath Debnath, East Carolina University (678-C1)

9:30-9:40

- (10) Representation of mesons and baryons in terms of linked quantized flux loops
Dr. Herbert Jehle, George Washington University (678-C3)

9:45-9:55

- (11) Rates of convergence for some functionals in probability
Professor Stanley A. Sawyer, Belfer Graduate School, Yeshiva University (678-F1)

10:00-10:10

- (12) Distributing quantifiers and the theory of set expansions
Professor T. W. Shook, University of Detroit (678-E2)

10:15-10:25

- (13) Comparing notions of effectiveness in abstract first-order structures
Professor William M. Lambert, Jr., University of Detroit (678-E1)

10:30-10:40

- (14) A characterization of the Hausdorff perfect preimages of metric spaces
Professor Howard H. Wicke*, Ohio University, and Dr. John M. Worrell, Jr., Sandia Laboratories, Albuquerque, New Mexico (678-G1)

SATURDAY, 11:00 A.M.

Invited Address, Room 100, Building C

- On the algebraic relations among differentially-algebraic analytic functions
Professor James B. Ax, State University of New York at Stony Brook

SATURDAY, 2:00 P.M.

Invited Address, Room 100, Building C

On the class number of imaginary quadratic fields

Dr. Alan Baker, Cambridge University and Institute for Advanced Study

SATURDAY, 3:15 P.M.

Session on Functional Analysis, Room 200, Building C

3:15-3:25

(15) Some nice functions on Lie groups. Preliminary report

Professor Matthew M. Hackman, University of Washington (678-B15)

3:30-3:40

(16) A characterization of Hilbert module. Preliminary report

Professor Parfeny P. Saworotnow, Catholic University of America
(678-B3)

3:45-3:55

(17) Continuity and linearity of centralizers on a complemented algebra

Professor Parfeny P. Saworotnow, Catholic University of America, and
Professor George R. Giellis*, U.S. Naval Academy (678-B7)

4:00-4:10

(18) For p between 1 and 2, ℓ_p obeys a weak parallelogram law

Professor William Lee Bynum, College of William & Mary (678-B5)

4:15-4:25

(19) Spectral resolution of differential operators associated with symmetric hyperbolic systems

Professor Geraldo S. S. Avila, Georgetown University (678-B14)

4:30-4:40

(20) The Jacobi theorem on transformation of Wiener integrals

Dr. Hui-Hsiung Kuo, Courant Institute, New York University (678-B13)

4:45-4:55

(21) Orthogonality and nonlinear functionals on L_p -spaces

Professor Kondagunta Sundaresan, Carnegie-Mellon University (678-B10)

5:00-5:10

(22) Norm-order bounded maps. I

Professor Joseph Diestel, University of Florida (678-B11)

SATURDAY, 3:15 P.M.

Session on Algebra and Geometry, Room 202, Building C

3:15-3:25

(23) Isomorphism-induced line isomorphisms on pseudographs

Professor Robert L. Hemminger, Vanderbilt University (678-A1)

3:30-3:40

(24) Some extremal properties concerning transitivity in graphs

Professor Roger C. Entringer*, University of New Mexico, Professor
Paul Erdős, Hungarian Academy of Science, Budapest, Hungary, and
Dr. Charles C. Harner, Sandia Corporation, Albuquerque, New Mexico
(678-A2)

3:45-3:55

(25) On the genera of graphs of group presentations. II

Professor Henry W. Levinson, Rutgers University (678-A5)

4:00-4:10

(26) More on generalized inverses

Professor F. A. Ficken, New York University, University Heights Campus
(678-A3)

4:15-4:25

- (27) Radical constructions in the presence of two universal classes
Professor Anthony E. Hoffman, State University of New York, College at
Geneseo (678-A6)

4:30-4:40

- (28) Fields and projective planes: A category equivalence
Professor Lynn E. Garner, Brigham Young University (678-D1)
(Introduced by Professor Hal G. Moore)

4:45-4:55

- (29) A characterization of modular semilattices by their retracts
Professor Joe B. Rhodes, Virginia Polytechnic Institute and State Uni-
versity (678-A4)

Austin, Texas

Leonard Gillman
Associate Secretary



NEWS ITEM

BENJAMIN PEIRCE LECTURESHIPS IN MATHEMATICS

The Department of Mathematics of Harvard University is accepting applications for the Benjamin Peirce Lectureships which carry the rank of Assistant Professor. The appointments are for three years with a starting salary of \$10,000 (for the nine month academic year) and annual increments of \$500. The teaching commitment is six hours per week, including a one-term graduate course on a subject of

the lecturer's choice, if desired. An application form and two letters of recommendation must be received by January 20, 1971, to guarantee consideration. First announcements of awards will be made by February 15. Application blanks may be obtained by writing to the Chairman, Department of Mathematics, Harvard University, 2 Divinity Avenue, Cambridge, Massachusetts 02138.

PRELIMINARY ANNOUNCEMENTS OF MEETINGS

Six Hundred Seventy-Ninth Meeting University of Georgia Athens, Georgia November 20-21, 1970

The six hundred seventy-ninth meeting of the American Mathematical Society will be held at the University of Georgia at Athens, Georgia, on Friday and Saturday, November 20-21, 1970.

By invitation of the Committee to Select Hour Speakers for the Southeastern Meetings, there will be three one-hour addresses. Professor Erik Hemmingsen of Vanderbilt University will give an address entitled "Light open maps on n -manifolds." An address entitled "Representations of algebras by continuous sections" will be given by Professor Karl Hofmann of Tulane University, and Professor Ernest E. Shult of the University of Florida will give an address entitled "Recent results on doubly transitive groups."

There will be sessions for contributed papers both morning and afternoon. Abstracts for contributed papers should be sent to the American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02904, so as to arrive prior to the deadline of October 6, 1970.

Sessions for contributed papers will be held in the designated rooms in the Center for Continuing Education on the University of Georgia campus.

The registration desk will be located at Second Floor Registration Desk on the second floor of the Center. Registration hours will be from 1:00 a.m. to 5:00 p.m. on Friday, November 20, and 9:00 a.m. to 11:00 a.m. on Saturday, November 21. There will be a registration fee of \$2.50 (\$1.50 for students).

Athens is located on U. S. 29, U. S. 78 and U. S. 441, approximately 65 miles east of Atlanta. It is served by Southern, Air South, and Cherokee Airways airlines and

by Greyhound and Trailways bus companies. From the Atlanta Airport to the University of Georgia campus is a drive of less than an hour and one-half by way of Interstate 20 and Georgia 138 at Conyers.

Meals and snacks will be available at the Center, at campus cafeterias and off-campus establishments. Coffee will be served outside the Center Auditorium from 2:00 p.m. to 2:30 p.m. on Friday and from 10:00 a.m. to 10:30 a.m. on Saturday. A beer party is planned for Friday evening at the Catholic Student Center which is within walking distance of the Center. Tickets for this may be purchased at the time of registration.

The Center can accommodate up to 150 guests in rooms with private baths. Requests for reservations must be received by November 7, 1970, and should be addressed to The American Mathematical Society Meeting, Georgia Center for Continuing Education, Athens, Georgia 30601.

Rates are as follows:

Single	\$ 8.00
Double	\$12.00

Additional accommodations, with approximate driving times to the Center are given below.

DOWNTOWNER (10 minutes walking time)
198 S. Milledge Avenue

Single	\$10.00-\$11.50
Double	\$16.00 (two beds-- two persons)

HOLIDAY INN (five minutes driving time)
White Avenue

Single	\$10.50
Double	\$17.00 (two beds-- two persons)

KEY TO AMERICA (7 minutes driving time)
230 N. Finley

Single \$11.00-\$12.00
Double \$13.00-\$15.00

Single \$12.00
Double \$16.00-\$17.00

O. G. Harrold
Associate Secretary

HOWARD JOHNSON'S (10 minutes driving
2465 W. Broad time)

Tallahassee, Florida



Six Hundred Eightieth Meeting California Institute of Technology Pasadena, California November 21, 1970

The six hundred eightieth meeting of the American Mathematical Society will be held at the California Institute of Technology in Pasadena, California, on Saturday, November 21, 1970.

By invitation of the Committee to Select Hour Speakers for Far Western Sectional Meetings, there will be two invited hour addresses at this meeting. Professor Tosio Kato of the University of California, Berkeley, will lecture at 11:00 a.m. on Saturday. The title of his talk is "On the functional equation $y'(x) = ay(\lambda x) + by(x)$." Professor D. S. Ornstein of Stanford University will speak at 2:00 p.m. on Saturday. His lecture is entitled "The isomorphism problem in ergodic theory." Both of these addresses will be given in Room 201 of East Bridge. There will be sessions for contributed papers on Saturday morning and afternoon. The deadline for abstracts of contributed papers to be published in the program of the meeting is October 6, 1970. However, late papers will be accepted for presentation until a few days before the meeting. All sessions of contributed papers will be held in the Sloan Laboratory of Mathematics and Physics.

The registration desk for the meeting will be set up in the hallway of Sloan adjacent to Room 151. Registration will begin at 8:30 a.m. on Saturday.

There are numerous hotels and mo-

tels in Pasadena, including the following:

IMPERIAL 400
1203 E. Colorado Blvd.
Rates from \$11.00 up

SAGA MOTOR HOTEL
1633 E. Colorado Blvd.
Rates from \$10.00 up

HUNTINGTON-SHERATON HOTEL
1401 S. Oak Knoll Avenue
Rates from \$15.00 up

ARROYO MOTOR INN
400 S. Oak Knoll Avenue
Rates from \$12.00 up

The first two of these motels are within walking distance from Caltech. The airport bus stops at the Huntington-Sheraton and the Arroyo Motor Inn.

Luncheon will be available at the Athenaeum on the Caltech campus. Luncheon tickets can be purchased at the registration desk.

The California Institute of Technology is located on California Boulevard between Hill Avenue and Wilson Avenue. Free parking is available on California Boulevard and in a parking lot on California Boulevard opposite the Sloan Laboratory.

R. S. Pierce
Associate Secretary

Seattle, Washington

Six Hundred Eighty-First Meeting

University of Illinois

Urbana, Illinois

November 28, 1970

The six hundred eighty-first meeting of the American Mathematical Society will be held at the University of Illinois, Urbana, Illinois, on Saturday, November 28, 1970. All sessions of the meeting will be held in classrooms of the University.

By invitation of the Committee to Select Hour Speakers for Western Sectional Meetings, there will be two one-hour addresses. Professor Richard S. Varga of Kent State University will address the Society at 11:00 a.m. His subject will be "How functional analysis and approximation theory mix today with numerical analysis." Professor O. Timothy O'Meara of the University of Notre Dame will speak at 1:45 p.m. on the topic, "Automorphisms of linear groups." Both hour addresses will be in 314 Altgeld Hall.

By invitation of the same committee there will be three special sessions of selected twenty-minute papers. Professor Roger C. Lyndon of the University of Michigan is arranging one such session on the subject of Combinatorial Group Theory; the list of speakers will include Louis Auslander, Gilbert Baumslag, William W. Boone, Jacques Lewin, Michael F. Newman, Donald Solitar, Heiner Zieschang, and possibly two or three others.

Another special session is being arranged by Professor Walter V. Philipp of the University of Illinois on the subject of Probabilistic Number Theory; tentatively the list of speakers will include Hubert Delange, John D. Dixon, Paul Erdős, Robert P. Kaufman, Johan H. B. Kemperman, William J. LeVeque, Walter V. Philipp, Peter Szűsz, and possibly one or two others. The third special session is being arranged by Professor J. J. Uhl of the University of Illinois on the subject of Vector Measures; the list of speakers will appear in the November issue of these *Notices*.

There will be sessions for the presentation of contributed ten-minute papers

both morning and afternoon. Those having time preferences for the presentation of their papers should so indicate on their abstracts. Abstracts should be submitted to the American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02904, so as to arrive prior to the deadline of October 6, 1970. There will be a session for late papers if one is needed.

REGISTRATION

The registration desk will be located inside the north entrance of Altgeld Hall, which is located on the southeast corner of Wright and Green Streets in Urbana. The desk will be open from 9:00 a.m. to 4:00 p.m. on Friday, November 27, and from 8:30 a.m. to 3:30 p.m. on Saturday, November 28.

ACCOMMODATIONS

Approximately 100 guest rooms are available in the Illini Union, which is located just east of Altgeld Hall. The rates are \$11.55 for single occupancy and \$16.80 for double occupancy. All rooms are suitable for double occupancy. Requests for reservations should be addressed to Guest Room Reservations, 125 Illini Union, Urbana, Illinois 61801, and should refer to the meeting of the American Mathematical Society. The Illini Union provides free parking for registered guests.

FOOD SERVICE

Food will be available in the cafeteria and in the snack bar in the basement of the Illini Union. On Thanksgiving Day, the cafeteria and snack bar will close at 2:00 p.m., but a vending machine room on the first floor will remain open and will be freshly stocked with sandwiches, doughnuts, fruit, soup, and drinks. A list of other suggested local restaurants will be available at the registration desk.

Champaign-Urbana is served by the Illinois Central Railroad, the Norfolk and Western Railway, and Ozark Air Lines. The Illinois Central has direct service from Chicago, New Orleans, and Miami. The Norfolk and Western provides direct connections with Detroit and St. Louis. Ozark Air Lines has direct service from Chicago, Indianapolis, New York, St. Louis, and Washington.

On Friday, November 27, 1970, the day before the meeting itself, the University of Illinois will sponsor a symposium on the Theory of Probability. More details will be given in the November issue of these *Notices* .

Paul T. Bateman
Associate Secretary

Urbana, Illinois


The Seventy-Seventh Annual Meeting
Chalfonte-Haddon Hall
Atlantic City, New Jersey
January 21-25, 1971

The seventy-seventh annual meeting of the American Mathematical Society will be held at the Chalfonte-Haddon Hall in Atlantic City, New Jersey. The meeting is being held in conjunction with the annual meeting of the Association for Symbolic Logic (January 21-22), the annual meeting of the Mathematical Association of America (January 23-25), and a meeting of the National Council of Teachers of Mathematics (January 23-25). There will be at least four invited hour addresses. Professor Leopoldo Nachbin of the University of Rochester and Instituto de Matemática Pura e Aplicada, Rio de Janeiro, Brazil, will speak on "Recent developments in infinite dimensional holomorphy." Professor Dennis P. Sullivan of Massachusetts Institute of Technology will speak on "Symmetry in manifold theory." Other addresses will be given by Professor Harry Kesten of Cornell University and Professor Daniel G. Quillen of Massachusetts Institute of Technology; their titles, and information about additional addresses, will be announced later. The Josiah Willard Gibbs Lecture will be given by Professor Eberhard Hopf of Indiana University; his title is "Ergodic theory and the geodesics on surfaces of negative curvature."

There will be no limit on the number of ten-minute papers accepted for presentation in the regular sessions for contributed papers at the annual meeting. However, only the first 720 abstracts received will be assigned to day sessions. Abstracts received after the first 720 will

be assigned to general evening sessions. The deadline for abstracts to be received in the Providence office is November 5, 1970. Because of the short period of time that is available to prepare the program for the annual meeting, the Providence office will not be able to accept changes in abstracts. Authors are requested to notify the Providence office of papers to be withdrawn.

The registration desk for this meeting will be in the Haddon Hall Hotel. The desk will be open from 2:00 p.m. to 8:00 p.m. on Wednesday, January 20; from 8:00 a.m. to 5:00 p.m. on Thursday, January 21; from 9:00 a.m. to 5:00 p.m. on Friday through Sunday, January 22-24; and from 9:00 a.m. to 3:00 p.m. on Monday, January 26.

The Council of the Society will meet at 2:00 p.m. on Wednesday, January 20, in the West Room. The Business Meeting of the Society will be held on Saturday, January 23, at 1:15 p.m. in the Pennsylvania Room. Both rooms are located in Haddon Hall.

The Mathematical Sciences Employment Register will be maintained from 9:00 a.m. to 5:00 p.m. on Friday, Saturday, and Sunday in the Carolina Room of the Chalfonte Hotel.

Further information and a reservation form will be incorporated into the November issue of these *Notices* .

Leonard Gillman
Associate Secretary
Austin, Texas

Some Mathematical Questions in Biology

Chicago, Illinois

December 27, 1970

The fifth annual symposium on Some Mathematical Questions in Biology will be held on December 27, 1970, in Parlor A of the Conrad Hilton Hotel, Chicago, Illinois. This symposium is cosponsored by the American Mathematical Society and the Society for Industrial and Applied Mathematics, and is being held in cooperation with Section A (Mathematics) of the American Association for the Advancement of Science. The symposium will be supported by a grant from the National Science Foundation. Registration and hotel arrangements will be announced in SCIENCE.

This is the fifth in a series of annual symposia whose purpose is to stimulate direct contact between biologists with some mathematical background and math-

ematicians. Three topics will be discussed: morphogenesis and development, the statistical mechanics of complex biological associations, and neurobiology. The main theme of the symposium will be the study of large-scale biological organization, and the way in which mathematics, computers, and experimental investigations can complement each other in such studies.

The program, consisting of six lectures, was arranged by the AMS-SIAM Joint Committee on Mathematics in the Life Sciences. The members of this committee are Murray Gerstenhaber (chairman), Hans J. Bremermann, Alston S. Householder, Robert MacArthur, and R. C. Lewontin.

PROGRAM

- 9:00 a.m. Chairman: Morrel H. Cohen, Director, James Franck Institute; Professor of Physics, Committee on Mathematical Biology, University of Chicago
- Slime molds and theories of the control of development
 Anthony D. J. Robertson, Assistant Professor, Committee on Mathematical Biology, University of Chicago
- On collective motions of chemotactic cells
 Lee A. Segel, Associate Professor of Mathematics, Rensselaer Polytechnic Institute
- Biological complex and Gibbs-ensemble simplex
 Edward H. Kerner, Professor of Physics, University of Delaware
- 2:00 p.m. Chairman: Jack D. Cowan, chairman, Committee on Mathematical Biology, University of Chicago
- Statistical mechanics of competition between species
 Elliott W. Montroll, Professor of Physics and Astronomy, University of Rochester
- Stochastic properties of neuronal spike-trains and their significance
 Richard B. Stein, Associate Professor of Physiology, University of Alberta
- Cooperative phenomena in vision
 Bela Julesz, Head, Sensory and Perceptual Process Department, Bell Telephone Laboratories

Philadelphia, Pennsylvania

Murray Gerstenhaber
Chairman

LETTERS TO THE EDITOR

Editor, the *Notices*)

Regarding resolution B, recommended to the members of the Society by the Council on April 4, 1969 (The *Notices*), June 1969), which reads in part, "... resolved that the Society shall not attempt to speak with one voice for the membership on political and social issues not of direct professional concern ...", we, the undersigned mathematics faculty and students of San Jose State College, alarmed at the widening United States involvement in Southeast Asia and at the official acts of repression and violence directed against those who protest the war, do hereby suggest that these issues are indeed of the greatest "professional concern" to the mathematical community, and that a resolution condemning these acts of violence and repression, both in Southeast Asia and at home, be presented to the membership of the Society for a referendum by mail.

William A. Michael
and sixteen others

The Editors received a copy of a petition with typed "signatures" of twenty-five persons and indications of forty-nine more. The covering letter was signed by three of the signers of the petition, namely Murray Protter, A. H. Taub, and Robert Vaught. The text of the petition follows:

We, faculty of the Department of Mathematics of the University of California at Berkeley, call for the immediate withdrawal of United States armed forces from Indochina. We urge the AMS to take this position as a national stand.

Editor, the *Notices*)

I have received a circular letter from Professors Protter, Taub, and Vaught of Berkeley asking mathematicians and other scientists to join in a resolution calling for "the immediate withdrawal of United States armed forces from Indochina" and to urge the AMS and other societies to adopt this

stand. I continue to deplore this injection of political issues, notwithstanding their grave importance, into AMS affairs, and I urge the Council to take no action of the type these petitioners request.

It appears that some of the signers who have joined the above three professors in this position feel so deeply about their position on the issue in question that their feelings have overcome the normal reluctance, among some of them at least, to involve their professional societies in political matters. However, the principal reason for keeping politics out of the AMS, for example, is to enable mathematicians of all political persuasions to feel comfortable in joining one another in this organization and to facilitate free mathematical exchange among them. It is precisely when the issues are very urgent and very emotional that the greatest danger to the Society is present from political involvement.

The futility of an AMS position on this issue is underscored when one considers the weight of its political effect. If the entire 14,000 members of the AMS were united as one voice, which assuredly they are not, the political effect of an AMS position as such would be that of a pressure group, and would, therefore, be gauged in terms of numbers (our political weakness) and not by reason or by force of argument, which is our greatest strength in dealing with the rest of the world.

This is not to say that mathematicians as individuals should refrain from politics. We most certainly should take an interest in political affairs and conscientiously exercise our precious franchise at the very least. Hopefully some, maybe many of us, will engage actively in the work of political organizations. Building on whatever stature we have acquired in our own communities, in part as a result of professional accomplishments, we can in many ways be highly effective, and we can influence the course of political actions, sometimes in rather important ways. Caution: To be very effective this is very demanding of time, and thus tends to conflict with a mathematician's productivity. It is a para-

doxical truth that politically we are stronger as a collection of individuals than as an organized society.

In my opinion, the AMS stands clearly at the top, among several professional societies I have known fairly well, including three or four nonmathematical societies, in terms of production of journals of the highest quality, progressive modernization of its services to its profession, and the orderly conduct of its affairs. These are precious values which none of us wants to lose, but I sincerely feel that the AMS would jeopardize its integrity if it should take positions on political issues unrelated to mathematics as such.

Daniel H. Wagner

Editor, the *Notices*

Only one year has passed since the membership of our Society has voted, in a referendum, 10 to 1 in favor of resolution B, which reads in part "... that the Society shall not attempt to speak with one voice for the membership on political and social issues not of direct professional concern ...", and already groups of mathematicians, in complete disregard of this expressed wish of the overwhelming majority of the membership, are addressing petitions to the officers of the Society, calling for "the immediate withdrawal of United States armed forces from Indochina" and urging "the AMS to take this position as a national stand." In a letter which accompanies one of these petitions (namely the one by a Berkeley group), signed by three of the petitioners (identified as co-chairmen, Mathematics Department Coordinating Committee for Antiwar Activity) and addressed to the President-Elect rather than to the President of the Society, the following justification is given for this cavalier treatment of the outcome of the recent referendum:

"Many of the signers of these petitions have in the past taken the position that scientific organizations whose purpose was to deal with the furtherance of research and teaching in particular disciplines would not take positions on certain issues they deemed to be political. They now feel that the present national

emergency is so grave that their former position should be reversed."

Copies of that letter were sent out to "other officers of the AMS and members of the Council." Your president has prepared these comments, which he has also submitted to the (*Notices*), so that they could reach the wider forum of the entire membership of the Society.

To the Members of the Council and the Board of Trustees of the American Mathematical Society

July 27, 1970

1) The fact that some signers of the Berkeley petition feel that their former position should be reversed is irrelevant. Before the Council takes any action it would have to be ascertained that the membership as a whole has also reversed its position. So what do we do next? Another referendum (as requested, for instance, by some faculty members and students of San Jose State College in a letter to the Editor of the *Notices*)?

2) The three signers of the cited Berkeley letter speak of "the present national emergency" which they term "grave." I do not believe that there is general agreement among the members of the Society on the question of whether we have now in this country a national emergency. I know from personal experience (having been in Russia during the years of the revolution until 1921, and in Italy during the advent of fascism in 1922) what a "national emergency" is like, and I, for one, do not recognize in the present agitation in this country the characteristics of a real national emergency. May I add that I hope, for their sake, that the signers of the Berkeley petition never have to live through a national emergency, but if they do, they will really know, beyond any doubt, sometimes even at their own expense, what this means.

3) One could go on indefinitely arguing pro or contra the points indicated by me in 1) and 2), as well as raise a host of other questions, such as: (a) what is the exact meaning of the word "immediate" as applied to "withdrawal of United States armed forces from Indochina"; or (b) what could be the long-range effects, both international and domestic, of such a with-

drawal, etc. I am sure that on all such questions the positions of the members of the Society cover a wide spectrum of opinions. We could argue all that, and I would still say that we are missing the main and only issue at hand. The main issue to me lies in the plain indisputable fact that the only thing the members of the Society have in common is that they are mathematicians. They do not share in common any political beliefs; they do not agree in their estimates of the "correct" way of solving the national problems that face their country or of settling the current political issues. What is even more important is the fact that no member of the Society has ever expected, when joining the Society, that he is joining an organization which will claim the right to speak in his name on domestic political matters or on matters of national foreign policy. No matter how important these matters are, they are not matters of "professional concern," as some other petitions claim. Since everything that happens in this country on a national scale affects every citizen, one could equally well claim that everything that happens in this country on a national scale is of "professional concern" to the AMS:

4) Nothing illustrates better the confusion of minds that reigns among some sections of our membership than the appeals of the petitioners to disregard the expressed wishes of the membership of the Society, and their unwillingness or inability to grasp the limitations which are inherent to professional organizations in the matter of forming a consensus on political issues. For, I say, even were a majority of the membership to vote in favor of taking a definite stand on a political issue, I would still object to the Society taking that stand. As a member of the Society, I have given no license to the Society to speak in my name on political

issues. I herewith serve notice, as a plain member of the Society, that if the Society at any time votes to take a definite stand on a political issue, I will resign forthwith from the Society, and I will do so regardless of whether I agree or do not agree with the political content of that stand. In fact, in case of agreement I would feel especially a moral responsibility to resign, in order to make abundantly clear that I want to have no part in this imposition of my personal political opinions on other dissenting members of the Society.

Oscar Zariski, President

Editor, the *Notices*)

Here is an idea for "limit" notation. Why wouldn't it be expedient to write:

$\lim (x, c): f(x) = f(c)$ (Vertical line
or could be used in
place of colon.)

$\lim (x \rightarrow c): f(x) = f(c)$

instead of

$\lim_{x \rightarrow c} f(x) = f(c)?$

It seems to me that it would be easier to type and to typeset.

William B. Klein
[The writer is mathematics editor for Barnes and Noble, Inc.].

Editor, the *Notices*)

In reply to A. Sard's open letter (*Notices*) 17(1970), 734) one uses "automata theory" instead of "automaton theory" for much the same reason one uses "mathematics" instead of "mathematic".

Albert A. Mullin

PERSONAL ITEMS

Professor KARL A. BERES of Syracuse University has been appointed to an assistant professorship at Ripon College.

Professor ALLAN U. BRENDER of the Illinois Institute of Technology has been appointed to an assistant professorship at the University of Arizona.

Dr. COLIN W. CLARK of the University of British Columbia has been appointed to a visiting research professorship at New Mexico State University.

Professor W. EDWIN CLARK of the University of Florida has been appointed to a professorship at the University of South Florida.

Professor CRAIG COMSTOCK of the University of Michigan has been appointed to an associate professorship at the Naval Postgraduate School, Monterey, California.

Professor PAUL F. CONRAD of Tulane University has been appointed to a professorship at the University of Kansas.

Professor G. M. DUNKEL of the National Biomedical Research Foundation, Silver Spring, Maryland, has been appointed to an assistant professorship at Howard University.

Professor NEIL A. EKLUND of the University of Minnesota has been appointed to an assistant professorship at Vanderbilt University.

Mr. CARLTON LEE EVANS of New Mexico State University has been appointed to an assistant professorship at Adams State College, Alamosa, Colorado.

Dr. RONALD C. FREIWALD of the University of Rochester has been appointed to an assistant professorship at Washington University, St. Louis, Missouri.

Professor MATTHEW P. GAFFNEY of Franklin and Marshall College has been appointed to a professorship at the University of Massachusetts at Boston.

Dr. EDWARD D. GAUGHAN of New Mexico State University will be on sabbatical leave during the spring semester of 1971. He will be in residence at Las Cruces, New Mexico.

Mr. ELLIOT C. GOOTMAN of the Massachusetts Institute of Technology has

been appointed to an assistant professorship at the University of Georgia.

Dr. CHARLES HALL of the Bettis Atomic Power Laboratory, West Mifflin, Pennsylvania, has been appointed to an associate professorship at the University of Pittsburgh.

Dr. THOMAS J. HEAD of the University of Alaska has been appointed to a visiting research professorship at New Mexico State University.

Professor RALPH HENSTOCK of the University of Lancaster, Lancaster, England, has been appointed to a professorship at the New University of Ulster, Coleraine, Northern Ireland.

Professor B. F. HOBBS of Olivet Nazarene College has been appointed to a professorship and to the chairmanship of the Department of Mathematics at Pasadena College.

Dr. GARY R. JENSEN, an ONR Postdoctoral Research Associate at Washington University, has been appointed to an assistant professorship at Washington University, St. Louis, Missouri.

Professor R. ARTHUR KNOEBEL has returned to his assistant professorship at New Mexico State University after a one year leave of absence.

Professor MARTIN M. LIPSCHUTZ of the University of Bridgeport has been appointed chairman of the Department of Mathematics at Paterson State College, Wayne, New Jersey.

Professor JOAQUIN LOUSTAUNAU has returned to his assistant professorship at New Mexico State University after a two year leave of absence which he spent at the University of New Mexico.

Dr. PETER H. MASERICK of Pennsylvania State University has been appointed to a visiting research professorship at New Mexico State University for the academic year 1970-1971.

Professor JOERG W. P. MAYER of George Mason College of the University of Virginia has been named chairman of the Department of Mathematics at Lebanon Valley College, Annville, Pennsylvania.

Professor PAUL S. MOSTERT of Tulane University has been appointed to a professorship at the University of Kansas and to the chairmanship of the Department of Mathematics.

Professor BENJAMIN MUCKENHOUPHT of Rutgers University has been appointed to a visiting professorship at the State University of New York at Albany.

Dr. DAVID L. MYERS of Massachusetts Institute of Technology has been appointed to an assistant professorship at Wellesley College.

Professor WALTER J. NEATH of Northern Illinois University has been appointed to an associate professorship at Chico State College, Chico, California.

Professor EDWARD NEWBERGER of the University of Kentucky has been appointed to an assistant professorship at the State University of New York, College at Buffalo.

Dr. DeWAYNE S. NYMANN of the University of Texas has been appointed to an associate professorship at the University of Tennessee at Chattanooga.

Professor HARRY POLLARD of Purdue University has been appointed to a visiting professorship at Harvard University for the academic year 1970-1971.

Mr. LAWRENCE J. POZSGAY of St. Louis University has been appointed to an instructorship at the State Community College, East St. Louis, Illinois.

Dr. WILLIAM C. QUEEN of the Electric Boat Division of General Dynamics, Groton, Connecticut, has been appointed to an assistant professorship at the University of South Carolina.

Dr. PAUL H. RANDOLPH of New Mexico State University has been appointed to the AID Program at the Middle East Technical University, Ankara, Turkey, for the academic year 1970-1971.

Dr. DANIEL J. RANDTKE of the University of California, Santa Barbara, has been appointed to an assistant professorship at the University of Georgia.

Professor PETER L. RENZ of Reed College has been appointed to an assistant professorship at Wellesley College.

Professor FRANK RHODES of Wesleyan University has been appointed to a professorship at the University of Southampton, Southampton, England.

Professor FRED RICHMAN has returned to his associate professorship at New Mexico State University after a one year sabbatical leave which he spent at Florida Atlantic University.

Dr. RICHARD H. ROCHBERG of the Institute for the Future, Middletown, Connecticut, has been appointed to an assistant professorship at Washington University, St. Louis, Missouri.

Mr. FRED W. ROUSH of Princeton University has been appointed to an assistant professorship at the University of Georgia.

Mr. RICHARD SEE of the National Library of Medicine has been appointed Head of the Data Processing Department, U. S. Naval Medical Research Unit No. 2, Taipei, Taiwan.

Professor HELMUT H. SCHAEFER of the University of Tübingen has been elected a corresponding member of the Academy of Sciences at Zaragoza, Spain.

Dr. RUTH SILVERMAN of the University of Washington, Seattle, Washington, has been appointed to an assistant professorship at Washington University, St. Louis, Missouri.

Dr. JACK SONN of City College of the City University of New York has been appointed to an assistant professorship at Adelphi University.

Dr. RYSZARD SYSKI of the University of Maryland is on sabbatical leave for one year. From September 1970 to January 1971 he will be at the Technion, Haifa, Israel; from February to August 1971 he will be with the Department of Mathematical Sciences, New Mexico State University.

Dr. JOHN D. THOMAS of New Mexico State University will be on sabbatical leave during the fall semester of 1970. He will spend his leave at Los Alamos Scientific Laboratory, New Mexico.

Professor JAMES R. THOMPSON of Indiana University has been appointed to an associate professorship at Rice University.

Professor NEIL S. TRUDINGER of Macquarie University, North Ryde, Australia, has been appointed to a readership at the University of Queensland, Queensland, Australia.

Dr. CAROL L. WALKER of New

Mexico State University will be on sabbatical leave during the academic year 1970-1971. She will spend her leave at Rice University.

Dr. ELBERT A. WALKER of New Mexico State University will be on sabbatical leave during the academic year 1970-1971. He will spend his leave at Rice University.

Mr. W. D. WALLIS of La Trobe University, Bundoora, Australia, has been appointed a lecturer at the University of Newcastle, Newcastle, Australia.

Professor HOWARD J. WILCOX of Amherst College has been appointed to an assistant professorship at Wellesley College.

Professor LELAND H. WILLIAMS of Auburn University has been appointed president and director of the Triangle Universities Computation Center. He has also been appointed adjunct associate professor of mathematics at Duke University, of computer and information science at the University of North Carolina at Chapel Hill, and of computer science at North Carolina State University at Raleigh.

Dr. JOSEPH D. ZUND of Virginia Polytechnic Institute has been appointed to an associate professorship at New Mexico State University.

PROMOTIONS

To Professor. City College of the City University of New York: H. J. COHEN; University of Georgia: J. C. CANTRELL; New Mexico State University: D. G. JOHNSON, J. D. THOMAS; Wayne State University: LEON BROWN.

To Associate Professor. Clarkson College of Technology: A. J. JERRI; University of Georgia: W. R. ALFORD, C. B. SCHAUFLELE; New Mexico State University: W. H. JULIAN, W. J. LIEBERT, MARK MANDELKER, C. W. SWARTZ; Washington University, St. Louis: R. R. COIFMAN; Wayne State University: SUN TZE-CHIEN.

To Professor and Head. St. Xavier's College in Madurai University, Postgraduate Department of Mathematics, Tirunelveli, India: K. CHANDRASEKHARA RAO.

To Department Head. Bell Telephone Laboratories, Mathematical Analysis Department: W. M. BOYCE; New Mexico State University, Department of Mathematics: R. J. WISNER.

To Director. University of Texas at Austin, Center for Numerical Analysis: D. M. YOUNG; University of Texas at Austin, Computation Center: C. H. WARLICK.

INSTRUCTORSHIPS

Brown University: R. J. ELLISON; Cornell University: M. A. GRAJEK; Queens College of the City University of New York: R. D. HOROWITZ.

DEATHS

Professor GIULIO ANDREOLI of the University of Pisa, Pisa, Italy, died on December 7, 1969, at the age of 76. He was a member of the Society for 9 years.

Dr. HERBERT K. BROWN of Somerville, Massachusetts, died on August 9, 1970, at the age of 55. He was a member of the Society for 30 years.

The Reverend FRANCIS J. GERST of Loyola University died on September 30, 1968, at the age of 86. He was a member of the Society for 39 years.

Mr. J. V. McKELVEY of Washington, D. C., died on November 28, 1969, at the age of 89. He was a member of the Society for 60 years.

Dr. LIONEL RINTEL of the College of William and Mary in Virginia died on June 19, 1970, at the age of 43. He was a member of the Society for 1 year.

Professor ZEVI W. SALSBURG of Rice University died on June 20, 1970, at the age of 42. He was a member of the Society for 14 years.

NEW AMS PUBLICATIONS

PROCEEDINGS OF THE STEKLOV INSTITUTE

Number 102

BOUNDARY VALUE PROBLEMS OF
MATHEMATICAL PHYSICS, PART V.
Edited by O. A. Ladyženskaja, et al.

192 pages; List Price \$16.10; Member
Price \$12.10.

This volume of the translations of the Proceedings of the Steklov Institute of Mathematics in the Academy of Sciences of the USSR contains the following papers: "A generalization of Marcinkiewicz's interpolation theorem" by K. K. Golovkin; "New equations modeling the motion of a viscous fluid, and their unique solvability" by K. K. Golovkin; "Harnack's inequality for generalized solutions of quasi-linear parabolic equations of second order" by A. V. Ivanov; "New equations for the description of motion of viscous incompressible fluids and solvability in the large of boundary value problems for them" by O. A. Ladyženskaja; "A priori estimates of first derivatives of solutions of the Dirichlet problem for nonuniformly elliptic quasi-linear equations" by A. P. Oskolkov; "Solvability of the Dirichlet problem for quasi-linear elliptic equations in an unbounded domain" by A. P. Oskolkov; "Estimates in L_p of solutions of elliptic and parabolic systems" by V. A. Solonnikov.

TRANSLATIONS—SERIES II

Volume 92

SEVENTEEN PAPERS ON TOPOLOGY
AND DIFFERENTIAL GEOMETRY

288 pages; List Price \$14.40; Member
Price \$10.80

This volume in the Translations series contains the following papers: "On a class of spaces containing all metric spaces and all locally bicomact spaces" by A. V. Arhangel'skiĭ; "On extension of mappings of topological spaces" by N.

Veličko; "On Pontryagin classes. I, II, and IV" by Wu Wen-tsün; "Some remarks on limiting spaces of Postnikov systems" by E. G. Skljarenko; "On simple systems of paths on complete pretzels" by H. Čišang; "Parallel and normal correspondence of two-dimensional surfaces in the four-dimensional euclidean space E_4 " by L. N. Krivonosov; "On Demoulin transforms of projective minimal surfaces. I and III" by Su Bu-chin; "A method for determining a quaternary differential quadratic form with prescribed characteristics" by P. I. Petrov; "A characterization of Riemannian manifolds" by P. I. Petrov; "An invariant tensor criterion for conformally reducible Riemannian spaces" by A. M. Ančikov; "Conformally euclidean generalized Riemannian spaces" by S. M. Bahrah; "Completely reducible connections" by V. I. Vedernikov; "Connections in homogeneous bundles" by Ju. G. Lumiste; "The theory of the curvature of X_2 in E_4 " by K. S. Ramzanova.

Volume 93

NINE PAPERS ON FUNCTIONAL ANALYSIS

260 pages; List Price \$13.00; Member
Price \$9.75.

This volume in the Translations series contains the following papers: "Positive-definite functionals on nuclear spaces" by A. G. Kostjučenko and B. S. Mitjagin; "Nuclearity and other properties of spaces of type S" by B. S. Mitjagin; "On regular bases in nuclear spaces" by M. M. Dragilev; "Bessel and Hilbert systems in Banach spaces and questions of stability" by B. E. Veĭc; "Introduction to the geometry of indefinite J-spaces and to the theory of operators in those spaces" by M. G. Kreĭn; "On some new Banach algebras and Wiener-Lévy type theorems for Fourier series and integrals" by M. G. Kreĭn; "Exponential law for spaces of continuous linear mappings" by D. A. Raĭkov; "On an eigenfunction expansion for self-adjoint operators" by Ju. M. Berezanskiĭ;

"Theorems on positive solutions of equations of the second kind with nonlinear operators" by V. Ja. Stecenko and A. R. Esajan.

Volume 94

SIXTEEN PAPERS ON LOGIC AND ALGEBRA

280 pages; List Price \$14.00; Member Price \$10.50

This volume in the Translations series contains the following papers: "Some questions in the theory of algorithms" by È. S. Orlovskii; "A new algorithm for derivability in the constructive propositional calculus" by N. N. Vorob'ev; "An associative calculus with an unsolvable problem of equivalence" by G. S. Ceitin; "On the semantics of the theory of types," "Generalized quasi-universal classes of models," and "Some remarks on ultraproducts" by S. R. Kogalovskii; "On Horn formulas" by A. D. Taïmanov; "Conditions of decomposability of relations into direct products" by M. A. Spivak; "Partial universal algebras with prescribed lattices of subalgebras and correspondences" by A. A. Iskander; "On a class of mixed abelian groups with primary periodic part" by V. I. Myškin; "Completeness of holomorphs of abelian groups with automorphism 2" by I. H. Bekker; "An abstract characterization of the classes of semigroups of endomorphisms of systems of general type" by E. S. Ljapin, "Strong bands of semigroups" and "On lattice isomorphisms of commutative holoïd semigroups" by L. N. Ševrin; "Lattice isomorphisms of semigroups decomposable into free products" by L. N. Ševrin and V. A. Baranskiĭ; and "On potential invertibility of elements of semigroups" by È. G. Šutov.

MEMOIRS OF THE AMERICAN MATHEMATICAL SOCIETY

Number 101

DECAY OF SOLUTIONS OF SYSTEMS OF NONLINEAR HYPERBOLIC CONSERVATION LAWS

By James Glimm and Peter D. Lax

130 pages; List Price \$2.10; Member Price \$1.54

This Memoir deals with a system of two partial differential equations of the

form $u_t + f_x = 0, v_t + g_x = 0$, where f and g are functions of u and v subject to the conditions that the system be hyperbolic and genuinely nonlinear in a sense previously introduced by Lax, and that the interaction of two shocks of the same family always produces a shock of the same family plus a rarefaction wave of the opposite family. The initial data need not have bounded total variation. The main results are: (1) If the oscillation of the initial data are sufficiently small, the initial value problem exists for all positive time; and (2) If the initial data are periodic, the solution decays as $1/t$. The proofs of these results are based on methods introduced previously by Glimm, supplemented by further inequalities which take into account the interaction of shock waves and rarefaction waves of the same family. The new estimates prove that such interactions must occur and that when they do occur they lead to decay in the solution. The inequalities presented in this paper can also be used to prove that if the initial data are constant outside of a compact interval, the solution decays as $1/(t)^{1/2}$.

Number 102

VOLTERRA INTEGRAL EQUATIONS AND TOPOLOGICAL DYNAMICS

By R. K. Miller and G. R. Sell

72 pages; List Price \$1.80; Member Price \$1.35

The purpose of this Memoir is to show how Volterra integral equations may be studied within the framework of the theory of topological dynamics. Part I contains the basic theory. Local dynamical systems are discussed together with some of their elementary properties. The notation of compatible pairs of function spaces is introduced. Local dynamical systems are constructed, in general, for any class of Volterra equations whose coefficients are in a compatible pair of function spaces. This theory is used to study bounded solutions of Volterra equations and to characterize their ω -limit sets. Part II contains examples of compatible pairs. These spaces are studied in some detail to determine compactness criterion for orbits and characterizations of the hull of a point. Part III contains some applications of the first two parts. One application deals with invariance

properties of the ω -limit sets of bounded solutions of differential equations. Other results concern the asymptotic behavior of solutions of Volterra equations.

Number 103

UNORIENTED BORDISM AND ACTIONS OF FINITE GROUPS

By R. E. Stong

80 pages; List Price \$1.80; Member Price \$1.35

This paper analyzes the equivariant homology theories arising from equivariant unoriented bordism. It is shown that the Conner and Floyd fixed-point methods are applicable to actions of an arbitrary finite group. Emphasis is placed upon computing the bordism groups as explicitly as possible in terms of the structure of the finite group.

MATHEMATICAL SURVEYS

Volume 5

THE KERNEL FUNCTION AND CONFORMAL MAPPING

By Stefan Bergman

268 pages; List Price \$20.00; Member Price \$15.00

The Kernel Function and Conformal Mapping by Stefan Bergman is a revised edition of The Kernel Function. The author has made extensive changes in the original volume. The present book will be of interest not only to mathematicians, but also to engineers, physicists, and computer scientists. The applications of orthogonal functions in solving boundary value problems and conformal mappings onto canonical domains are discussed; and publications are indicated where programs for carrying out numerical work using high-speed computers can be found.

The unification of methods in the theory of functions of one and several complex variables is one of the purposes of introducing the kernel function and the domains with a distinguished boundary. This approach has been extensively developed during the last two decades. This second edition of Professor Bergman's book reviews this branch of the theory including recent developments not dealt with in the first edition. The presentation of the

topics is simple and presupposes only knowledge of an elementary course in the theory of analytic functions of one variable.

PROCEEDINGS OF SYMPOSIA IN PURE MATHEMATICS

Volume 18, Part 1

NONLINEAR FUNCTIONAL ANALYSIS

Edited by Felix E. Browder

304 pages; List Price \$12.00; Member Price \$9.00

Volume 18, Part 1 of the Proceedings of Symposia in Pure Mathematics contains a major portion of the proceedings of the Symposium on Nonlinear Functional Analysis held at a Chicago meeting of the American Mathematical Society in April of 1968. Represented in this work are all but two of the twenty-six distinguished mathematicians whose papers were presented there. One of the two not included is Felix E. Browder, editor of these Proceedings, whose comprehensive article will appear as Part 2.

LECTURES ON MATHEMATICS IN THE LIFE SCIENCES

Volume 2

SOME MATHEMATICAL QUESTIONS IN BIOLOGY

Edited by Murray Gerstenhaber

160 pages; List Price \$5.50; Member Price \$4.15

This volume of Lectures on Mathematics in the Life Sciences contains four papers presented at the Second and Third Symposia on Mathematical Biology. These Symposia are jointly sponsored by the American Mathematical Society and the Society for Industrial and Applied Mathematics and held annually in conjunction with the American Association for the Advancement of Science. The first two papers, "A statistical mechanics of nervous activity" by Jack D. Cowan and "Graphical analysis of ecological systems" by Robert Mac Arthur, were presented at the Second Symposium in New York on December 27, 1967; "Extinction" by Richard Levins and "The temporal morphology of a biological clock" by Arthur T. Winfree were presented at the Third Symposium in Dallas on December 28, 1968.

MEMORANDA TO MEMBERS

RETIRED MATHEMATICIANS

The List of Retired Mathematicians Available for Employment will once again be published in January 1971 and will be distributed to subscribers to the Employment Register lists when the January issue is mailed. Besides being available to subscribers, the list is available on request from the Employment Register office. Copies will also be available at the annual meeting in Atlantic City, New Jersey, January 21-25, 1971. Retired mathematicians who are interested in being included in the

list may either request a form from the Employment Register office or send the following information: name, date of birth, highest degree earned and where it was obtained, most recent employment, present address, date available, references, preference for academic or industrial employment, and geographic location preferred. The deadline for receipt of either the completed form or the above information is December 8, 1970.

NEW PROCEDURES FOR MATHEMATICAL SCIENCES EMPLOYMENT REGISTER

The Carolina Room in the Chalfonte Hotel in Atlantic City, New Jersey, will be the location of the Mathematical Sciences Employment Register during the annual meeting. The Employment Register will be open for three days, January 22 through January 24, 1971, from 9:00 a.m. to 5:00 p.m. Registration for the Employment Register is separate and apart from meeting registration, and it is, therefore, most important that both applicants and employers sign in at the Employment Register desk as early as they can on Friday morning, January 22.

A new system of operation will be in effect for the open register in Atlantic City. The most significant change is that the registration for the open register is no longer associated with the January published lists. Applicants and employers will have to secure an instruction sheet to acquaint themselves with the new rules and the operating regulations. These instructions will be available on request in the Carolina Room registration area at 9:00 a.m. on Friday. There will be no interviews scheduled for the first day. Please keep in mind that the registration for the open register is separate and apart from both meeting registration and the published listings, and it is imperative that both applicants and employers who wish to participate in the open register sign in at the

Employment Register desk as early as they can on Friday morning. Appointments will be scheduled only for those people who have actually signed in at the Register and obtained a code number. Requests for appointments can be submitted on Friday and Saturday only and these interviews will be scheduled on Saturday and Sunday respectively.

The January published lists will be mailed on approximately December 28. Applicants and employers who wish to be listed in the published list should write to the Mathematical Sciences Employment Register, Post Office Box 6248, Providence, Rhode Island 02904, for applicant qualification forms or position description forms. These forms must be completed and returned to the Employment Register not later than December 8, 1970, in order to be included in the January lists. There is no charge for listing in the published lists except when the late listing charge of \$5 is applicable. Provision will be made for anonymity of applicants upon payment of \$5 to defray the cost involved in handling such a listing.

A subscription to the lists, which includes three issues (January, May, and August) of both the applicants list and the positions list, is available for \$30 a year; the individual issues of both lists may be

purchased in January, May, or August for \$15. A subscription to the applicants list alone or single copies of that list is not available. Copies of the positions list only may be purchased for \$5. A subscription to the list of positions, which also includes three issues (January, May, and August), is available for \$12 a year. Employers who wish to display literature pertinent to available positions may do so. The charge for this service is \$15. Checks should be made payable to the American Mathematical Society and sent to the address given above.

It should be carefully noted that lists are mailed "Book Rate" (which means average delivery time from Providence to most locations is approximately 14 to 21 days) unless the purchaser either indicates a willingness in advance to pay the "First

Class" or "Air Mail" charges or includes the fee for this service when prepayment is made. The applicable postage charges, determined by the location of the purchaser, will be furnished on request to those persons who would like to take advantage of this service. A limited number of the published lists will also be available at the meeting on a first-come-first-served basis.

The Employment Register is sponsored by the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics for the purpose of establishing communication between mathematical scientists available for employment and employers with positions to fill.

COLLOQUIUM LECTURES

A limited number of lecture notes of the series of Colloquium Lectures presented at the summer meeting in Laramie, Wyoming, in August 1970 are still available from the American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02904. These lectures were "Topo-

logy of 3-manifolds" by R. H. Bing of the University of Wisconsin, Madison, Wisconsin. Requests for the lecture notes should be accompanied by a check for \$1 each to cover the cost of handling, made payable to the American Mathematical Society.

DELIVERY OF THE *Notices*

The *Notices* are shipped to members via Fourth Class Mail--Book Rate, and therefore readers do not always receive the final announcement of a meeting in time to make plans to attend. Subscribers

can arrange to have the *Notices* sent to them by Air Mail by writing to the American Mathematical Society, P.O.Box 6248, Providence, Rhode Island 02904.

ANNUAL SALARY SURVEY

This fall an additional questionnaire was sent to departments of the mathematical sciences and the 1970 salary survey has been expanded to include Projected Faculty Growth and Graduate Student Support as well as Faculty Salaries and Starting Salaries for Ph.D.'s which have been included in recent years. In all except the Starting Salary Survey institutions are divided into groups according to the highest degree offered in the mathematical sciences as follows:

Ph.D. Granting Institutions.

Group I and Group II include the universities with leading mathematics departments according to the findings of a survey made by the American Council of Education in 1964* in which departments were rated according to the quality of their graduate facility. Group I is composed of institutions that were considered "Distinguished" and "Strong"; Group II

are those considered "Good" and "Adequate Plus".

Group III includes those universities that have granted three or more doctorates during the last three years, according to the list of doctorates which is published in these *Notices*.

Group IV consists of institutions that have granted two or less doctorates during the past three years.

All Canadian universities maintaining Ph.D. granting programs are included in Groups III and IV.

Master's Degree Granting Institutions.

Bachelor's Degree Granting Institutions.

Nondegree Granting Institutions. These include junior colleges and other institutions offering courses but not degrees in mathematics.

Faculty Salaries

This survey is the fourteenth in an annual series begun in 1957 by the Society's Committee on the Economic Status of Teachers.

The 1970 survey is based on returns from 727 departments in mathematics, a substantially higher number than the 478 returns recorded last year. These departments included 10,726 academic positions held in 1969-1970 and 11,062 positions in 1970-1971.

Each institution submitted a minimum, median, and maximum salary figure for each of four academic ranks, both for staff members with master's degrees and for those with doctorates, creating 48 categories of salary figures.

In some instances relatively few universities or colleges reported, and in as much as there were no significant figures available, salaries could not be listed.

In the following two pages the data in the parentheses give the range of the middle 50% of salaries reported. The figures outside the parentheses represent the minimum and maximum salary listed by any reporting institution. Salaries are given in "hundreds of dollars."

All salaries refer to an academic year of 9 or 10 months. Grants and contracts are included but sabbatical payments and other part-time salaries are not.

*The findings were published in a book by Allan Cartter entitled "An Assessment of Quality in Graduate Education." The information on mathematics was reprinted by the Society and can be found on pages 978-980 of the December 1966 issue of these *Notices*.

PH. D. GRANTING INSTITUTIONS. Group I

Number of Usable Returns: 35

	Total Number of Staff Members		1969-1970			1970-1971		
	1969-1970	1970-1971	Minimum	Median	Maximum	Minimum	Median	Maximum
<u>DOCTORAL DEGREE</u>								
Instructor	96	82	65(87-98)	(92-100)	(95-100)105	73(97-104)	(104-105)	(105-110)112
Asst. Professor	432	392	60(100-110)	(109-120)	(120-136)155	95(104-115)	(114-128)	(125-143)160
Assoc. Professor	298	327	112(120-135)	(133-155)	(155-170)200	118(128-137)	(140-155)	(164-178)225
Professor	563	581	140(158-187)	(210-234)	(255-305)345	140(161-190)	(220-250)	(270-320)360
	<u>1389</u>	<u>1382</u>						

PH. D. GRANTING INSTITUTIONS. Group II

Number of Usable Returns: 34

	59	42	60(75-86)	(75-101)	(87-110)122	65(79-92)	(85-101)	(92-115)130
<u>MASTER'S DEGREE</u>								
Instructor								
<u>DOCTORAL DEGREE</u>								
Instructor	11	17	-----	-----	-----	-----	-----	-----
Asst. Professor	406	399	90(104-110)	(114-123)	(124-133)160	95(106-115)	(116-127)	(130-142)170
Assoc. Professor	244	275	100(120-140)	(138-155)	(160-175)190	109(130-145)	(147-158)	(167-188)205
Professor	302	313	120(157-184)	(200-215)	(243-286)350	130(167-200)	(207-226)	(250-302)370
	<u>963</u>	<u>1004</u>						

PH. D. GRANTING INSTITUTIONS. Group III

Number of Usable Returns: 89

	281	252	32(67-83)	(75-90)	(86-105)150	50(73-90)	(81-98)	(90-107)158
<u>MASTER'S DEGREE</u>								
Instructor	106	96	80(90-106)	(90-114)	(108-117)165	86(95-109)	(98-119)	(110-125)166
Asst. Professor	68	70	94(105-121)	(120-145)	(131-152)210	94(110-124)	(126-152)	(135-148)234
Assoc. Professor	19	19	-----	-----	-----	-----	-----	-----
Professor	474	437						
<u>DOCTORAL DEGREE</u>								
Instructor	14	15	-----	-----	-----	-----	-----	-----
Asst. Professor	899	936	81(100-110)	(112-120)	(122-140)170	81(105-114)	(116-127)	(129-143)170
Assoc. Professor	535	629	89(120-136)	(136-155)	(150-180)214	89(126-145)	(141-164)	(154-185)234
Professor	569	611	100(153-180)	(180-203)	(210-267)365	100(155-182)	(191-220)	(228-283)383
	<u>2017</u>	<u>2191</u>						

PH. D. GRANTING INSTITUTIONS. Group IV

Number of Usable Returns: 32

	95	78	62(74-81)	(79-85)	(86-93)102	66(80-90)	(82-92)	(82-101)115
<u>MASTER'S DEGREE</u>								
Instructor	59	53	73(92-100)	(97-113)	(98-115)137	85(93-113)	(98-116)	(105-130)151
Asst. Professor	26	27	93(108-125)	(129-145)	(131-145)166	97(127-143)	(143-151)	(149-171)182
Assoc. Professor	13	13	-----	-----	-----	-----	-----	-----
Professor	193	171						

<u>DOCTORAL DEGREE</u>									
Instructor	2	0							
Asst. Professor	232	248							
Assoc. Professor	145	176							
Professor	146	155							
	525	579							

MASTER'S DEGREE GRANTING INSTITUTIONS

<u>MASTER'S DEGREE</u>									
Instructor	427	373	60(74-85)	(80-91)	(85-98)118	(89-98)118	(90-105)125		
Asst. Professor	593	605	75(88-100)	(97-112)	(105-120)154	(105-120)154	(110-128)165		
Assoc. Professor	251	275	80(107-122)	(114-134)	(122-143)170	(122-143)170	(136-151)187		
Professor	85	111	101(137-154)	(133-174)	(160-193)249	(160-193)249	(172-203)249		
	1356	1364							

Number of Usable Returns: 146

<u>DOCTORAL DEGREE</u>									
Instructor	2	9							
Asst. Professor	511	652	80(101-110)	(108-120)	(118-130)184	(118-130)184	(120-137)198		
Assoc. Professor	414	460	102(120-132)	(126-142)	(138-155)226	(138-155)226	(145-158)242		
Professor	388	416	100(143-161)	(152-180)	(169-193)280	(169-193)280	(180-207)298		
	1315	1537							

BACHELOR'S DEGREE GRANTING INSTITUTIONS

<u>MASTER'S DEGREE</u>									
Instructor	365	275	60(70-84)	(77-87)	(82-93)105	(82-93)105	(85-100)136		
Asst. Professor	603	500	59(82-94)	(90-103)	(96-111)151	(96-111)151	(100-114)155		
Assoc. Professor	262	229	70(94-113)	(103-124)	(110-139)182	(110-139)182	(111-137)197		
Professor	82	72	90(110-142)	(119-151)	(140-162)207	(140-162)207	(145-169)230		
	1312	1076							

Number of Usable Returns: 278

<u>DOCTORAL DEGREE</u>									
Instructor	2	5							
Asst. Professor	186	275	75(94-105)	(100-110)	(105-119)140	(105-119)140	(110-124)151		
Assoc. Professor	177	199	80(110-130)	(114-131)	(127-140)164	(127-140)164	(127-151)179		
Professor	231	230	100(126-160)	(140-171)	(150-183)230	(150-183)230	(157-192)251		
	596	709							

Number of Usable Returns: 113

NONDEGREE GRANTING INSTITUTIONS

<u>MASTER'S DEGREE</u>									
Instructor	231	256	58(75-87)	(82-100)	(91-115)163	(91-115)163	(85-106)		
Asst. Professor	166	170	64(85-103)	(90-108)	(98-124)172	(98-124)172	(92-113)		
Assoc. Professor	83	94	78(90-120)	(102-130)	(102-146)202	(102-146)202	(107-152)223		
Professor	47	50	69(100-135)	(110-148)	(120-164)238	(120-164)238	(120-153)		
	527	570							

Number of Usable Returns: 113

Projected Faculty Growth

In the 1970 questionnaire chairmen of departments were asked to predict the size of their staffs for each of the five academic years 1970-1971, ..., 1974-1975. The figures given below for 1969-1970 were drawn from two sources: The MAA Guidebook (1970) and the Annual Salary Survey. Both of these surveys were based on the same mailing list which contains 1,367 departments of mathematical sciences in four year colleges and universities of the United States; a total of 1,234 departments responded to one or both of these questionnaires. The response rates are indicated for each of the categories I, II, III, IV, Master's and Bachelor's in the column headed 1969-1970 of Table I below; the remaining columns indicate the percentage responses for predictions covering the years 1970-1971, ..., 1974-1975.

The figures in Table II are extrapolations, based on the predictions made

by those chairmen who were willing to make predictions; they were obtained by dividing the total number of positions predicted for each year by the ratio of the number of departments reporting to the total number of departments in that category. Within each category, the figures were weighted by a factor proportional to the size of the departments reporting. These results are rough at best. As indicated in Table I, the percentage of chairmen willing to predict even one year ahead varied between 21% and 61%, and those willing to predict as many as five years ahead varied between 19% and 52%.

The entries in the last column of Table II give the average annual growth rate predicted for each category: This varies from 3% for group I to over 7% for IV, Master's and Bachelor's. The entries in the last row give the annual increment predicted for each of these five years.

L. K. Durst

TABLE I. PERCENTAGE OF DEPARTMENTS RESPONDING

	Total No. of Depts.	Percentage Response:					
		<u>1969-1970</u>	<u>1970-1971</u>	<u>1971-1972</u>	<u>1972-1973</u>	<u>1973-1974</u>	<u>1974-1975</u>
I	62	79	50	37	35	34	34
II	44	89	61	57	55	52	52
III	151	99	50	48	48	47	47
IV	64	66	45	45	45	44	44
Mast.	233	99	54	52	51	50	50
Bach.	813	89	21	20	19	19	19

TABLE II. PROJECTED NUMBER OF FACULTY MEMBERS

	<u>1969-1970</u>	<u>1970-1971</u>	<u>1971-1972</u>	<u>1972-1973</u>	<u>1973-1974</u>	<u>1974-1975</u>	<u>Growth Rate</u>
I	2270	2260	2360	2510	2590	2650	3.2%
II	1220	1290	1340	1450	1560	1640	6.1%
III	5380	5650	6130	6510	6990	7370	6.5%
IV	1380	1470	1600	1720	1840	1980	7.5%
Mast.	4200	4460	4880	5250	5550	6010	7.4%
Bach.	2850	2960	3190	3420	3670	4020	7.1%
TOTALS	17300	18450	19880	21270	22640	24150	6.9%
Annual Increment -		1150	1430	1390	1370	1510	-

Graduate Student Support

291 departments out of a possible 554 responded to the questionnaire concerning the number of graduate students enrolled in 1969-1970 and the number expected in 1970-1971. These figures have been converted into percentages according to type of support.

The number in parentheses after each group title below indicates the number of usable responses involved. The possible numbers would have been 62 in Group I, 44 in Group II, 151 in Group III, 64 in Group IV, and 233 in Master's degree granting institutions.

	<i>Students primarily supported by teaching assistantships</i>	<i>Students primarily supported by research project funds</i>	<i>Students primarily supported by fellowship or traineeship support</i>	<i>Students not primarily supported by any of above</i>	<i>Total number of students in sample</i>
Ph. D. GRANTING INSTITUTIONS					
Group I (33)					
1969-1970					
All Students	31%	9%	21%	39%	4175
New Students	29%	3%	25%	43%	1355
1970-1971					
All Students	32%	10%	21%	37%	3988
New Students	28%	3%	27%	42%	1267
Ph. D. GRANTING INSTITUTIONS					
Group II (30)					
1969-1970					
All Students	38%	6%	12%	44%	2815
New Students	42%	4%	15%	39%	869
1970-1971					
All Students	38%	6%	11%	45%	2720
New Students	35%	6%	13%	46%	962
Ph. D. GRANTING INSTITUTIONS					
Group III (82)					
1969-1970					
All Students	34%	9%	18%	36%	4811
New Students	38%	8%	19%	35%	1659
1970-1971					
All Students	36%	8%	16%	40%	5144
New Students	40%	11%	18%	31%	1714
Ph. D. GRANTING INSTITUTIONS					
Group IV (29)					
1969-1970					
All Students	34%	2%	11%	53%	942
New Students	45%	2%	9%	44%	385
1970-1971					
All Students	34%	4%	9%	53%	892
New Students	33%	6%	12%	49%	363
MASTER'S DEGREE GRANTING INSTITUTIONS (117)					
1969-1970					
All Students	17%	1%	5%	77%	3663
New Students	33%	1%	7%	59%	1144
1970-1971					
All Students	20%	1%	6%	73%	3526
New Students	33%	1%	7%	59%	1345

Starting Salary for Mathematicians with a Ph. D.

This 1970 Survey was compiled from questionnaires sent to 1,322 individuals who received a Ph.D. in the Mathematical Sciences during the academic year 1969-1970. There were 611 usable returns.

Of those reporting 84% accepted positions in academic life, 10% went into industry, 2% were connected with research institutions and 4% went into government. The number in parentheses after each category represents the number of usable returns for that category. Geographically, 34% accepted jobs in the northeast, 22% in the southeast, 21% in the midwest, 5% in the mountain states, 13% in the far west and 5% in Canada.

57% of the new Ph.D.'s had more than a year of experience in their field prior to receiving their doctorate, 13% had between one-half year and one year of experience, and 28% had less than one-half year of experience.

It should be noted that the first category listed below (teaching, 9-month salary) represents 60% of all positions reported in the Survey. Of those accepting academic positions, 73% were in master's or Ph.D. granting institutions, 26% in bachelor's degree granting institutions, and less than 1% in junior colleges.

Salaries are listed in hundreds of dollars. Dashes indicate that not enough returns were received to warrant including the Survey figures.

TEACHING (362) (Nine-Month Salary)				TEACHING (56) (Twelve-Month Salary)				TEACHING AND RESEARCH (20) (Nine-Month Salary)			
<u>Year</u>	<u>Min.</u>	<u>Median</u>	<u>Max.</u>	<u>Year</u>	<u>Min.</u>	<u>Median</u>	<u>Max.</u>	<u>Year</u>	<u>Min.</u>	<u>Median</u>	<u>Max.</u>
*1967	70	93	120	*1967	85	112	150	*1967	75	90	105
**1967	65	96	140	**1967	83	122	200	**1967	--	--	---
1968	72	102	170	1968	95	120	180	1968	78	100	130
1969	80	105	165	1969	75	128	168	1969	95	110	138
1970	85	110	195	1970	95	128	200	1970	90	106	120
RESEARCH (33) (Nine-Month Salary)				RESEARCH (27) (Twelve-Month Salary)				FELLOWSHIP (18) (Yearly Stipend)			
<u>Year</u>	<u>Min.</u>	<u>Median</u>	<u>Max.</u>	<u>Year</u>	<u>Min.</u>	<u>Median</u>	<u>Max.</u>	<u>Year</u>	<u>Min.</u>	<u>Median</u>	<u>Max.</u>
*1967	78	93	108	*1967	80	101	130	*1967	40	80	120
**1967	70	93	103	**1967	80	105	132	**1967	60	85	100
1968	78	100	115	1968	80	100	134	1968	--	--	---
1969	63	105	125	1969	78	149	180	1969	--	--	---
1970	78	105	160	1970	90	120	205	1970	60	86	120
RESEARCH INSTITUTES (15) (Twelve-Month Salary)				INDUSTRY (58) (Twelve-Month Salary)				GOVERNMENT (22) (Twelve-Month Salary)			
<u>Year</u>	<u>Min.</u>	<u>Median</u>	<u>Max.</u>	<u>Year</u>	<u>Min.</u>	<u>Median</u>	<u>Max.</u>	<u>Year</u>	<u>Min.</u>	<u>Median</u>	<u>Max.</u>
*1967	60	120	150	*1967	125	145	200	*1967	84	111	161
**1967	60	135	215	**1967	97	151	204	**1967	--	---	---
1968	120	157	192	1968	110	156	248	1968	85	134	170
1969	75	156	235	1969	125	168	250	1969	82	138	192
1970	70	170	200	1970	96	170	235	1970	100	150	223

*These figures represent the survey compiled from returns sent in by individuals who received their doctorates in 1966.

**These figures represent the survey compiled from returns sent in by individuals who received their doctorates during the first six months of 1967.

VISITING MATHEMATICIANS Supplementary List

The following is a supplement to the lists of visiting mathematicians printed in the August issue of these *Notices*. There are two lists: the first contains the names of American mathematicians visiting abroad during 1970-1971, and the second list contains the names of foreign mathematicians visiting in the United States and Canada.

American Mathematicians Visiting Abroad

<u>Name and Home Country</u>	<u>Host Institution</u>	<u>Field of Special Interest</u>	<u>Period of Visit</u>
Baggett, Lawrence (U.S.A.)	University of Oslo, Norway	Topological Groups and Re- presentations	9/70-6/71
Baily, Walter L., Jr. (U.S.A.)	University of Tokyo, Japan	Complex Manifolds	7/70-6/71
Boothby, William M. (U.S.A.)	University of Strasbourg, France	Differential Geometry	2/71-6/71
Coifman, Ronald R. (U.S.A.)	University of Paris at Orsay, France	Harmonic Analysis	9/70-6/71
DeBaggis, Henry F. (U.S.A.)	Middle East Technical Uni- versity, Ankara, Turkey	Analysis	9/70-8/71
Della Riccia, Giacomo (U.S.A.)	Hebrew University of Jeru- salem, Israel		9/69-
Gautschi, Walter (U.S.A.)	Mathematical Institute of the Technische Hoch- schule, Munich, F.R. of Germany		9/70-8/71
Korevaar, Jacob (U.S.A.)	Imperial College, England	Classical Analysis, Dis- tributions	9/70-7/71
Magill, Kenneth D. (U.S.A.)	Australian National Uni- versity Institute for Ad- vanced Study	Topology, Topological Algebra, Semigroups of Functions	9/70-1/71
Smith, Roy (U.S.A.)	University of Copenhagen, Denmark	Ergodic Theory	9/70-6/71
Tamari, Dov (U.S.A.)	Hebrew University of Jeru- salem, Israel Technion, Haifa, Israel	Algebra, Logic, Com- binatorial Analysis, Word Problems	9/70-6/71
Weiss, Guido L. (U.S.A.)	University of Paris at Orsay, France	Harmonic Analysis	9/70-6/71
Thron, Wolfgang (U.S.A.)	Erlangen, Schlossplatz, F. R. of Germany	Analysis, Topology	9/70-8/71
Wyman, Bostwick F. (U.S.A.)	University of Oslo, Nor- way		8/70-7/71

Foreign Mathematicians Visiting in the United States and Canada

Balslev, Erik (Denmark)	SUNY at Buffalo		9/70-6/71
Day, Brian (Australia)	University of Chicago	Category Theory	10/70-9/71
DeJongh, Richard (Amster- dam)	SUNY at Buffalo	Logic	9/70-6/71
Dinghas, Alexander (Germany)	Fordham University	Complex Analysis	9/70-8/71

<u>Name and Home Country</u>	<u>Host Institution</u>	<u>Field and Special Interest</u>	<u>Period of Visit</u>
Dorofeev, Igor F. (Russia)	University of Michigan	Optimal Control	9/70-6/71
Furuta, Yoshiomi (Japan)	University of Maryland	Algebraic Number Theory	9/70-5/71
Gerritzen, Lothar (Germany)	University of Maryland	p-adic Analysis	9/70-5/71
Hess, Peter (Switzerland)	University of Chicago	Analysis	10/69-6/71
Hsiang Fu-cheng (Taiwan)	SUNY at Buffalo	Analysis, Fourier Series	1/71-6/71
Kelly, Gregory M. (Australia)	University of Chicago	Category Theory	10/70-6/71
Koizumi, Shoji (Japan)	SUNY at Buffalo		9/70-6/71
Kurata, Yoshiki (Japan)	University of Chicago		10/70-6/71
Kwee Bun-kong (Malaysia)	University of Chicago	Analysis	8/70-3/71
Madsen, Ib H. (Denmark)	University of Chicago	Algebraic Topology	10/70-9/71
Merriman, John R. (England)	University of Michigan	Algebraic Geometry	9/70-5/71
Näkki, Raimo T. (Finland)	University of Michigan	Analysis	9/70-6/71
Ostrowski, Alexander M. (Switzerland)	SUNY at Buffalo	Algebra, Number Theory	10/70-12/70
Parry, William (England)	University of Maryland	Ergodic Theory	9/70-1/71
Sidki, Said (Venezuela)	University of Chicago	Group Theory	10/70-6/71
Stekette, J. A. (Netherlands)	University of Michigan		9/70-6/71
Suszko, Roman (Poland)	Stevens Institute of Technology	Logic	9/70-6/71
Trudinger, Neil S. (Australia)	University of Minnesota Stanford University	Partial Differential Equations	9/70-1/71 2/71-8/71

NEWS ITEMS AND ANNOUNCEMENTS

FELLOWSHIP AWARDS AT CALIFORNIA INSTITUTE OF TECHNOLOGY

Four mathematics students at the California Institute of Technology have been awarded \$1,200 each from an anonymous donor. These students are all undergraduates, and they were chosen from among 19 competitors by a panel of mathematicians on the faculty of the California Institute of Technology. The winners are Leonard Berman who is working in group theory with Dr. David Wales; Andrew Odlyzko who is doing research in number theory with Dr. Tom Apostol; Leonidas Guibas who is working with Dr. Herbert J. Ryser, using computer techniques created by Professor Fred Thompson; and Bruce Litow who is working in group theory with Dr. John McKay. The students were judged on the sophistication, inventiveness, and novelty of the problems they presented, as well as the significance of the problems to mathematics as a whole.

SUMMER RESEARCH INSTITUTE IN AUSTRALIA

The Australian Mathematical Society will hold the Eleventh Summer Research Institute at the University of Sydney, January 11-February 20, 1971. Two speakers have been invited to give the main lecture courses, each course to consist of two or three lectures per week for the duration of the conference. Professor Jonathan L. Alperin, University of Chicago, will present a series of lectures entitled "Block theory for the layman," and Professor Karl Gruenberg, University of London, has tentatively agreed to speak. In addition, Professor Morris Marden of the University of Wisconsin, Milwaukee, will give three lectures during the first week on "Integral operators and harmonic polynomials in 3-space." Seminars on other topics will be arranged according to the needs of those taking part. Several seminar topics have already been suggested, and the organizers are P. W. Donovan and J. Gray, University of New South Wales

(global analysis); D. W. Barnes, University of Sydney (Lie algebras); G. K. Eagleson, University of Sydney (martingales and their applications); O. H. Lancaster, University of Sydney (orthogonal functions in statistics); P. R. Wilson, University of Sydney (general astrophysics); J. Cannon, University of Sydney (computing in algebra); P. B. Kirkpatrick (finite projective planes); Alan McIntosh, Macquarie University (functional analysis). Those interested in the aforementioned topics should write directly to the organizer. Accommodations will be available on the college campus. For further information, please write to The Australian Mathematical Society, Secondary Teachers' College, Swanston Street, Parkville, Victoria 3052, Australia.

FINAL REPORT ON THE 1970 SUMMER INSTITUTE ON ALGEBRAIC TOPOLOGY

The Society held its seventeenth summer research institute at the University of Wisconsin from June 29 to July 17, 1970. The topic for the institute was selected by the Committee on Summer Institutes, which at the time was composed of Jim Douglas, Jr., L. H. Loomis, Israel N. Herstein (chairman), Gilbert A. Hunt, Louis Nirenberg, and Edwin H. Spanier. The Organizing Committee consisted of William Browder, Edward R. Fadell, Edwin E. Floyd, Peter J. Hilton, Richard K. Lashof, Arunas L. Liulevicius (chairman), Mark E. Mahowald, R. James Milgram, Franklin P. Peterson, James D. Stasheff, and P. Emery Thomas. The program for the institute was divided into four parts: (1) survey talks on recent developments in the field of algebraic topology; (2) invited one-hour talks on important recent work (these tended to be more technical than the survey talks); (3) sessions on problems; and (4) seminars organized by the participants in the institute. A total of 204 mathematicians attended the institute, this number including 13 participants from foreign countries. The National Science Foundation provided financial support to the institute.

FINAL REPORT ON THE SUMMER
SEMINAR ON MATHEMATICAL
PROBLEMS IN THE GEOPHYSICAL
SCIENCES

The American Mathematical Society held its sixth summer seminar on applied mathematics from July 6 to July 31, 1970, at Rensselaer Polytechnic Institute. The seminar program of the Society is largely instructional in purpose, and the plan of the Organizing Committee of the Seminar on Mathematical Problems in the Geophysical Sciences was to have graduate students and recent recipients of the Ph.D. attend, learn about the problems involved, and be stimulated to do research in these subjects. The program consisted of series of lectures given by 16 principal speakers in the following (and related) fields: geophysical fluid dynamics, wave propagation, tidal theory, mechanisms for geomagnetism, and inverse problems in geophysics. In addition, three special lecturers presented talks. Ample opportunity was provided for informal discussion between the participants and the lecturers. Of the 91 persons in attendance at the seminar, 19 were foreign nationals (not including Canadians). The Organizing Committee consisted of Hirsh Cohen, Richard C. DiPrima, Dave Fultz, C. C. Lin, and William H. Reid (chairman). Financial support was provided by the National Science Foundation, the Office of Naval Research, and The New York State Science and Technology Foundation.

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ASSOCIATE MEMBERS

The Society acknowledges with gratitude the support rendered by the following corporations who held either Corporate Membership or Institutional Associateships in the Society as of June 1, 1970.

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Princeton University Press
Prindle, Weber & Schmidt, Incorporated
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SPECIAL YEAR IN PARTIAL
DIFFERENTIAL EQUATIONS AND
THEIR APPLICATIONS

The Departments of Mathematics of the Universities of Dundee, Edinburgh, Glasgow, Newcastle, and Strathclyde plan to hold a Special Year in Partial Differential Equations and their Applications during the 1971-72 session with support from the Science Research Council. Visitors expert in the field of partial differential equations will be in residence in each of the five universities during some or all of the year, and there will be a program of lectures and seminars through the year. The opening meeting will be a symposium at the University of Strathclyde on September 20-24, 1971. The program will be announced later. Further information may be obtained by writing to Professor W. D. Collins, Department of Mathematics, The University of Strathclyde, Glasgow, C.1., Scotland.

PANEL OF VOLUNTEERS
FOR CAREER INFORMATION

The American Mathematical Society and the many students who ask for career information from the Society are indebted to the volunteers listed below, who have, with impressive care and thoughtfulness, encouraged students in mathematics by answering their letters. An average of ap-

proximately seventy requests for career information are received every month. Most of them are routine in nature and are answered with a form letter and pamphlets available for free distribution by the Society. Some of the letters, however, show a real interest in mathematics; it is these that are sent to the panel of volunteers to be answered. During the past year, sixty-three letters were turned over to these volunteers. The present volunteers are Richard A. Alo (Carnegie-Mellon University), Richard V. Andree (University of Oklahoma), William F. Atchison (University of Maryland), Prem N. Bajaj (Wichita State University), Barnard H. Bissinger (Lebanon Valley College), Wray G. Brady (Slippery Rock State College), R. C. Carson (University of Akron), Daniel Clock (Northern Michigan College), Romae J. Cormier (Northern Illinois University), Charles H. Cunkle (Slippery Rock State College), John M. Danskin (Clark University), Richard C. DiPrima (Rensselaer Polytechnic Institute), Underwood Dudley (DePauw University), Joseph H. Engel (The Franklin Institute), Harry A. Gehman (State University of New York, Buffalo), Herbert A. Gindler (San Diego, California), Deborah T. Haimo (University of Missouri), Franklin Haimo (Washington University), R. G. Helsel (Ohio University), Hubert L. Hunzeker (Michigan Technological University), Ladis D. Kovach (Naval Postgraduate School), David M. Krabill (Bowling Green State University), George R. Kuhn (Northwestern Michigan College), John B. Lane (Virginia Polytechnic Institute), William J. LeVeque (University of California, Los Angeles), William F. Lucas (Ithaca, New York), Eugene Lukacs (The Catholic University of America), Kenneth O. May (University of Toronto), Bernard McGovern (RCA), Robert A. Melter (University of South Carolina), Paul D. Minton (Southern Methodist University), Richard C. Morgan (St. John's University), Abraham Nemeth (Detroit, Michigan), Sam Newman (Federal Aviation Agency), Malcolm W. Oliphant (Hawaii Loa College), Otway Pardee (Syracuse University), George Piranian (University of Michigan), Lyle E. Pursell (University of Missouri at Rolla), Gordon Raisbeck (Arthur D. Little, Inc.), Stewart M. Robinson (Cleveland Heights, Ohio), Ervin Y. Rodin (Washington University), Alex

Rosenberg (Cornell University), Paul Rotter (The Mutual Benefit Life Insurance Company), Jules P. Russell (Polytechnic Institute of Brooklyn), Albert J. V. Sade (Pertuis, France), I. Richard Savage (Florida State University), Thomas H. Southard (California State College at Hayward), Raymond A. Spong (General Dynamics), Nancy Tapper (Ithaca, New York), Charles J. Thorne (U. S. Naval Missile Center), Daniel H. Wagner (Daniel H. Wagner Associates), Myron E. White (Teaneck, New Jersey), John W. Young, Jr. (The National Cash Register Company), S. Charmonman (University of Missouri at Columbia), C. Ionescu Tulcea (University of Illinois).

Anyone who would be willing to be a part of this service is invited to send his name, address, and field of interest to Career Information, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02904.

CANADIAN MATHEMATICAL BULLETIN

With volume 13, number 1, the Canadian Mathematical Bulletin has changed its format to a typeset edition. In the past, the Bulletin was reproduced photographically from typed copy. The Bulletin, which is published by the Canadian Mathematical Congress, began on a trial basis as a Newsletter 16 years ago with Professor Peter Scherk as editor. Four years later the Newsletter became the Canadian Mathematical Bulletin, and the policy has been to encourage mathematical research and publication in Canada, particularly by beginners in research. While it has not been a truly international journal like the Canadian Journal of Mathematics, the editors have interpreted the policy generously, and many articles by non-Canadians have been published. Professor W. O. J. Moser has been the editor-in-chief for the past eight years.

DEGREE PROGRAM IN COMPUTER SCIENCE AT THE AMERICAN UNIVERSITY

The College of Arts and Sciences of The American University is instituting a program of courses leading to degrees in computer science. Course work and directed research are available at both the undergraduate and graduate levels. A limi-

ted number of student assistantships are available. Administration of the computer science program has been placed in the Department of Mathematics and Statistics, which is chaired by Professor Walter W. Jacobs. For further details, either telephone the department secretary at (202) 686-2394 or write to Department of Mathematics and Statistics, The American University, Washington, D. C. 20016.

CONFERENCE ON TEACHING OF MATHEMATICS

The Third CSMP (Comprehensive School Mathematics Program) International Conference on the Teaching of Mathematics at the pre-college level will be held in Carbondale, Illinois, November 21-27, 1970. The conference is being co-sponsored by the Central Midwestern Regional Education Laboratory and Southern Illinois University. The topic of this conference is algebra, and a number of eminent mathematicians are being invited to participate, including Thomas Bartee, Hyman Bass, Paul W. Cohn, C. W. Curtis, Johannes De Groot, Z. P. Dienes, Paul Erdős, Nathan Fine, Bernard Fischer, Andrew Gleason, Karl Gruenberg, Heini Halberstam, Marshall Hall, Paul Halmos, Israel N. Herstein, Heinz Jacobinski, William Johntz, Irving I. Kaplansky, Aleksandr Kurosh, D. J. Lewis, Saunders Mac Lane, Calvin Moore, Frederique Papy, Georges Papy, Gunter Pickert, Pierre Samuel, John Tate, Stanislaw Ulam, B. L. Van Der Waerden, and Hans Zassenhaus. Since space for observer participants will be limited, the organizers of the conference are interested in knowing as soon as possible how many observers may wish to attend. For further information, write to Burt Kaufman, Director of CSMP, 103 South Washington Street, Carbondale, Illinois 62901.

CONFERENCE ON ANALYTIC NUMBER THEORY AND RELATED TOPICS

A three-day conference on analytic number theory and related topics will be held on the Carbondale campus of Southern Illinois University, October 22-24, 1970. Southern Illinois University is observing its centennial for the years 1969-1974, and limited support for this conference is provided by the Office for the Centennial

Period. There will be a number of invited speakers and opportunity for a small number of twenty-minute talks. Anyone interested in attending is kindly asked to write to Professor Lawrence Kuipers or to Professor Harald Niederreiter, Department of Mathematics, Southern Illinois University, Carbondale, Illinois 62901.

INTERNATIONAL CONFERENCE ON APPROXIMATION THEORY

An International Conference on Approximation Theory in honor of Professor J. L. Walsh on the occasion of his seventy-fifth birthday will be held at the University of Maryland, College Park, Maryland, on October 26-30, 1970. Among the scheduled speakers are: G. Birkhoff, R. P. Boas, R. C. Buck, G. Choquet, P. Davis, J. B. Diaz, W. H. J. Fuchs, A. M. Gleason, S. Karlin, M. Marden, T. S. Motzkin, L. Nachbin, D. J. Newman, I. J. Schoenberg, and J. Wermer. There will be a banquet honoring Professor Walsh on Tuesday evening, October 27th. Further information may be obtained by writing to Professor M. Zedek, Department of Mathematics, University of Maryland, College Park, Maryland 20742.

NSF GUIDE TO PROGRAMS

A guide to all the programs of the National Science Foundation, reflecting major program changes and additions in the last year, has just been published by the NSF.

Four new research project support programs are listed in the new publication which replaces the Guide to Programs issued in June 1969. The new research project support programs are: Interdisciplinary Research Relevant to Problems of our Society, International Decade of Ocean Exploration, Arctic Research Program, and Earthquake Engineering. Addition of these program descriptions reflects both assignments by the Executive Branch of the Government to NSF, and new NSF initiatives in research support.

A program description of the National Arecibo Observatory has been added to the section on National Research Centers. The NSF has assumed the funding and sponsorship of the Observatory.

A new program in education support is that of Student-Originated Studies. This program, announced during the past year, supports student-originated research in environmental problems.

Among the institutional science programs, the National Science Foundation Guide now lists Science Development Program, which replaces the three separate programs formerly known as University Science Development, Departmental Science Development, and Graduate Science Facilities.

The Cooperative Science Programs with Australia, China, France, and Romania are now listed and described separately in the section on International Science Activities. Formerly they were grouped in a single listing.

The new volume includes an updated National Science Foundation organization chart.

Single copies of the Guide to Programs are available on request to the National Science Foundation, Washington, D. C. 20550. Additional copies may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, at a price of seventy-five cents.

THIRD ANNUAL SYMPOSIUM ON THEORY OF COMPUTING

The Special Interest Group for Automata and Computability Theory (SIGACT) of the Association for Computing Machinery (ACM) plans to hold its Third Annual ACM Symposium on Theory of Computing on May 3-5, 1971. The symposium will be held at Stouffer's Somerset Inn, Shaker Heights, Ohio. The format will be similar to that of the previous symposium, held last May, at which twenty-nine papers were presented in the areas of computational complexity, program schemata, automata and language theory, theory of parsing and semantics, and applications of logic and algebra to computing. It is anticipated that papers for the coming conference will be along similar lines, although the submission of theoretical papers in any area of computation is welcome. Those wishing to present a paper should submit six copies of a detailed abstract (about five pages) to the program chairman: Dr. Philip M.

Lewis II, GE Advanced Research and Development Center, Schenectady, New York 12308 by December 1, 1970.

The conference chairman is M. A. Harrison, local arrangements are being handled by R. B. Banerji and W. C. Rounds, and J. D. Ullman is publicity chairman. The program committee, in addition to Dr. Lewis, consists of M. J. Fischer, J. E. Hopcroft, A. L. Rosenberg, J. W. Thatcher, and P. R. Young.

Papers presented at the conference will be published in a proceedings available at the conference.

CALL FOR PAPERS-- INTERNATIONAL SYMPOSIUM ON THE THEORY OF MACHINES AND COMPUTATIONS

An International Symposium on the Theory of Machines and Computations will be held at the Technion, Israel Institute of Technology, in Haifa, Israel, on August 16-19, 1971, immediately preceding the IFIP congress in Ljubljana, Yugoslavia. The symposium is sponsored by the Technion, department of Computer Science and Electrical Engineering, in cooperation with the IEEE Technical Committee on Switching and Automata Theory and the ACM Special Interest Group for Automata and Computability Theory (SIGACT). The organizing committee consists of Z. Kohavi, Technion; A. Paz, Technion; and M. O. Rabin, Hebrew University. Papers written in English describing original research in the general areas of switching theory, automata theory, formal languages, and computability theory are being sought.

Authors are requested to send six copies of an extended abstract (about five pages) by December 31, 1970, to one of the following addresses, according to subject of paper. Switching theory: Dr. Z. Kohavi, Department of Electrical Engineering, Technion--Israel Institute of Technology, Haifa, Israel. Automata theory: Dr. M. A. Harrison, Department of Computer Science, University of California, Berkeley, California 94720. Formal languages: Dr. J. D. Ullman, Department of Electrical Engineering, Princeton University, Princeton, New Jersey 08540. Computability theory: Dr. R. E. Miller, IBM Research Center, P. O. Box 218, Yorktown

Heights, New York 10598.

Authors will be notified of acceptance or rejection by February 26, 1971. A copy of each accepted paper will be due by May 5, 1971, for inclusion in the symposium proceedings.

Charter flights to Israel at considerably reduced rates will be arranged for participants. Through its branches in various countries, GOL Tours & Travel (Global of London, Ltd.), as the official travel agency for the symposium, offers assistance with air travel, hotel accommodations, and transportation. An attempt is being made to offer combined trips to Haifa and the IFIP congress.

For further information, write to the Department of Computer Science, Technion, Haifa, Israel.

BATTELLE RENCONTRES

In 1967 the Battelle Memorial Institute inaugurated a series of rencontres between physicists and mathematicians. Three have been held at the newly established Battelle Seattle Research Center-- in 1967, 1968, and 1969. In view of their success, the Battelle Memorial Institute is again planning to hold rencontres in Seattle, Washington, in 1971 and 1973, and to contribute a fellowship fund and/or a publication fund to other established schools or symposia which might be interested in furthering this dialogue in 1970, 1972, and 1974. To implement these plans, Battelle is also sponsoring a committee which consists of F. J. Dyson, Chairman; V. Bargmann; R. Bott; T. Regge; I. M. Singer; E. Henley, representative of the University of Washington (Seattle); and F. J. Milford and L. Jansen, representatives of the Battelle Memorial Institute. C. DeWitt is Secretary.

The theme of the 1971 Rencontres, which will be held at the Battelle Seattle Research Center from July 26 to September 3, will be Statistical Mechanics and Associated Mathematical Problems. The format will be similar to the ones of Battelle Seattle Rencontres of previous years: three or four lecture series on major topics, and seminars organized informally on special topics of interest to participants, participation being limited to approximately twenty-five persons. In charge of planning

for the scientific program is Andrew Lenard of Indiana University at Bloomington.

For further information write to Mr. Louis Bonnefond, Conferences Coordination, Battelle Seattle Research Center, 4000 NE 41st St., Seattle, Washington 98105.

COMBINATORIAL THEORY ADVANCED SCIENCE SEMINAR

A Combinatorial Theory Advanced Science Seminar for graduate and post-graduate students of mathematics will be held at Bowdoin College, Brunswick, Maine, from June 22 to August 12, 1971. The program will consist of a course entitled Combinatorial Theory and Applications given by Gian-Carlo Rota, assisted by Curtis Greene; seminars at various levels on appropriate topics; and a Research Colloquium in Combinatorial Mathematics. Tentative lecturers and topics include: H. H. Crapo, "Constructions in combinatorial geometry"; D. R. Fulkerson; M. Hall, Jr., "Construction of combinatorial designs"; F. Harary; T. S. Motzkin, "Matrices in combinatorics"; A. W. Tucker, "Pivotal algebra"; W. T. Tutte, "The enumerative theory of chromatic polynomials"; and H. S. Wilf.

For further information on this seminar, write to Professor Dan E. Christie, Department of Mathematics, Bowdoin College, Brunswick, Maine 04011. All inquiries concerning facilities and accommodations should be addressed after December 1, 1970, to Coordinator of Summer Programs, Bowdoin College, Brunswick, Maine 04011.

SYMPOSIUM ON SWITCHING AND AUTOMATA THEORY

The Eleventh Annual Symposium on Switching and Automata Theory will be held on October 28-30, 1970, at the Miramar Hotel, Santa Monica, California. One of the sessions and a social hour will be held on the UCLA campus. For further information write to Professor J.W. Carlyle, Department of System Science, School of Engineering and Applied Science, University of California, Los Angeles, California 90024.

POINT SET TOPOLOGY CONFERENCE

The University of Houston will host a Point Set Topology Conference on March 22-24, 1971. The conference will follow the pattern of the previously held conferences at Arizona State University (1967), the University of Houston (1968), Auburn University (1969), and Emory University (1970). Announcements concerning the program will be made in December or January. For additional, or earlier, information write to D. R. Traylor, Department of Mathematics, University of Houston, Houston, Texas 77004.

INSTITUTE FOR ADVANCED STUDY MEMBERSHIPS

The School of Mathematics of the Institute for Advanced Study will grant a limited number of memberships, some with financial support, for research in mathematics at the Institute during the academic year 1971-1972. Candidates must have given evidence of ability in research comparable at least with that expected for the Ph. D. degree. Application blanks may be obtained from the Secretary of the School of Mathematics, Institute for Advanced Study, Princeton, New Jersey 08540, and should be returned (whether or not funds are expected from some other source) by January 15, 1971, or as soon thereafter as possible.

MEETING OF THEORETICAL PHYSICISTS AND MATHEMATICIANS

The Eleventh Meeting of Theoretical Physicists and Mathematicians will be held November 12-14, 1970, at the Research Institute for Advanced Mathematics in Strasbourg, France. For further information write to: Secrétariat de la R.C.P. No. 25, Institut de Recherche Mathématique Avancée, 7, rue René Descartes, 67-Strasbourg, France.

CONFERENCE ON LINGUISTICS

A conference on linguistics was held at the University of Iowa on October 19-21, 1970. Attendance was open to all persons with an active interest in linguistics, computer science, or mathematics. Some of the invited speakers were: Dr. Daniel

Barbrow, "Parsing algorithms"; Professor Seymour Ginsberg, "Automata and formal language theory, 1970--AFL theory"; Professor Harry Josselson, "The matrix for the concept of structuring the lexicon"; Professor Marvin Minsky, "Analysing narrative and explanatory text"; and Professor Barbara Hall Partee, "The question of speaker-hearer symmetry and generative grammar." In addition, there were a number of contributed papers. More detailed information can be obtained by writing to: Conference on Linguistics, Conference Center, University of Iowa, Iowa City, Iowa 52240.

CALL FOR PAPERS--CONFERENCE ON INFORMATION SCIENCES AND SYSTEMS

The Fifth Annual Princeton Conference on Information Sciences and Systems will be held on March 25-26, 1971. Authors are invited to submit papers describing new advances, applications and ideas in the areas of computer science, communication theory, system and circuit theory. Two kinds of papers are solicited. The first will be standard papers requiring approximately 30 minutes for presentation; these will be reproduced in full in the conference Proceedings. The second will be short papers suitable for presentation in 10-15 minutes; 250 word summaries will be published in the Proceedings.

For regular papers, a title, 50-word abstract and summary are to be submitted before January 4, 1971. Summaries should be of sufficient detail and length to permit careful reviewing. For short papers, a title and summary should be received by January 18, 1971. Authors will be notified of acceptance by February 1, 1971. All manuscripts are to be submitted to Professor K. Steiglitz or Professor P. J. Denning, Engineering Quadrangle, Princeton University, Princeton, New Jersey 08540.

NSF REGIONAL RESEARCH CONFERENCES IN THE MATHEMATICAL SCIENCES

It is anticipated that again this fall the National Science Foundation will invite proposals for five-day regional conferences on subjects of current research interest in the mathematical sciences to be

held during the summer or fall of 1971. The objective of the regional conference project has been to stimulate and broaden mathematical research activity, particularly in regions of the country where such activity needs further development. As in the past two years, the organization of the conferences, evaluation of proposals, and arrangements for publication of conference-related expository papers are expected to be carried out by the Conference Board of the Mathematical Sciences, Washington, D. C., under contract with the National Science Foundation.

Usually around a dozen conferences per year are provided for, each to take place at a host institution during a summer week, or possibly within a recess of the succeeding fall term. Topics for conferences may be concerned with one or more of the various disciplines of the mathematical sciences, including, in addition to pure mathematics, fields such as applied mathematics, statistics, computer science, operations research, and management science.

Each conference should plan for a single principal guest lecturer and about twenty-five other participants, the latter to be active research mathematicians from the broad geographic region around the host institution. It is expected that the lecturer would give two lectures per day during the five days of the conference, with the remainder of the time available for study, informal discussion and exchange of ideas.

All participants in a conference receive allowances for travel and subsistence. The principal lecturer receives, in addition, a fee for delivering his lectures and for organizing these into a substantial expository paper. The Conference Board arranges for the editing and publication of these expository papers.

Preliminary inquiries regarding details of these regional conferences may be addressed to the Conference Board of the Mathematical Sciences, 834 Joseph Henry Building, 2100 Pennsylvania Avenue, N.W., Washington, D. C. 20037. Proposals by prospective host institutions should be sent to the Mathematical Sciences Section, National Science Foundation, 1800 G Street, N.W., Washington, D. C. 20550. It is anticipated that proposals will be evaluated by a

panel of the Conference Board and that awards of conference grants will be made by the National Science Foundation with the advice of the panel.

CANCAM 71

The Third Canadian Congress of Applied Mechanics, CANCAM CALGARY, will be held May 17-21, 1971, at the University of Calgary, Alberta, Canada. The scope of the congress covers the fields of solid mechanics, fluid mechanics, heat transfer, thermodynamics, applied mechanics, and applied mathematics. There will also be a session on unsolved problems in engineering and related fields.

Paper selection will be based on the review of a 500-800 word abstract. The abstracts of papers accepted for presentation will appear in the Congress Proceedings, together with the full length lectures of keynote speakers invited from throughout the world. The deadline for submission of abstracts is January 8, 1971. For further information write to the Host Committee, CANCAM CALGARY, The University of Calgary, Calgary 44, Alberta, Canada.

CONFERENCE ON MAPPING TECHNIQUES AND PROBLEMS

A Conference on Mapping Techniques and Problems will be held at the University of Houston, Houston, Texas, November 6-7, 1970. Those wishing to participate should contact any member of the committee: A. Charnes, University of Texas, Austin, Texas 78712; M. L. Curtis, Rice University, Houston, Texas 77001; J. L. Doob, University of Illinois, Urbana, Illinois 61801; R. J. Duffin, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213; R. M. Thrall, Rice University, Houston, Texas 77001; and J. N. Younglove, University of Houston, Houston, Texas 77004. The following additional persons intend to participate: Reinhold Baer, Robert Baer, Paul Bateman, Salomon Bochner, Raoul Bott, David G. Bourgin, Leonard Gillman, John Isbell, L. A. Karlovitz, Kenneth O. Kartanek, G. R. Livesay, G. G. Lorentz, Juan Schaffer, and H. Weinberger.

DOCTORATES CONFERRED IN 1969-1970

The following are among those who received doctorates in the mathematical sciences and related subjects from universities in the United States and Canada during 1969-1970. The numbers appearing in parentheses after each university indicate the following: the first number is the total number of degrees listed for that institution; the next six numbers are the numbers of degrees in the categories of 1. Pure Mathematics, 2. Applied Mathematics, 3. Computer Science, 4. Statistics, 5. Mathematics Education, 6. Other. Each entry includes the dissertation title. 134 universities are listed with a total of 1,322 individual names.

ALABAMA

AUBURN UNIVERSITY (5;5,0,0,0,0,0)

French, James Austin
Inductive dimensions in metric spaces and covering dimension in collectionwise normal spaces

Hill, Joseph Benton, Jr.
A collection of sequence spaces

Ott, James William
Subsets of separable spaces

Powell, David Edward
Regular functionals and L-reflexivity

Williams, Jerry Frank
On 2-ramification points of a dendroid

UNIVERSITY OF ALABAMA (14;12,2,0,0,0,0)

Brackin, Eddie Joe
Semirings and the Hilbert basis theorem

Campbell, William Holmes
Some mapping theorems for unicoherent continua and cohesive lattices

Case, Bettye Anne Busbee
On non-analytic functions related to a system of partial differential equations

Chambers, Barbara Fromm
Theory and applications of Hadamard's convolution integral

Finch, George Lawson
Borel structures in group representations

Hill, Robert Joe
Bounds for the greatest characteristic roots of nonnegative matrices

Morris, Joseph Richard
Deleted product spaces and the fixed point property

Oliver, Carl Edward
Representation theory on homogeneous spaces via the method of horospheres

Pukatzki, Dieter Herbert
Cohesive lattices

Roberson, Fred Alan
Some theorems on equicontinuity of transformation groups

Schleusner, John William
An investigation of biorthogonal polynomials in several variables

Vaughan, Loy Ottis
On the almost fixed point property

Weaver, Patricia Lucille

On some properties of R-spaces and the compactification of closure structures

Windham, Rodney William

Operator semigroups with applications to semirings

ARIZONA

ARIZONA STATE UNIVERSITY (5;5,0,0,0,0,0)

Berg, Gordon

Convex metrics in locally compact spaces

Berney, Ernest S., III

Strongly compact spaces

Bragg, David B.

Theory and application of the carrier in reduced algebraic function fields

Fitzgerald, Robert W.

Generalized finite graphs

Gehrmann, James Edward

Asymptotic behavior of nonoscillatory solutions of Nth order linear differential equations

UNIVERSITY OF ARIZONA (4;3,0,0,1,0,0)

Cohen, Stephen Burton

Measures of convexity

Narvarte, John Anthony

Lens spaces with special complex coordinates

Samanta, Mrityunjay

Universally efficient nonparametric inference

Sims, Stillman Eugene

Convergence properties of spline functions

ARKANSAS

UNIVERSITY OF ARKANSAS (1;1,0,0,0,0,0)

McGehee, Earl Edward, Jr.

Connectedness in syntopogenous spaces

CALIFORNIA

CALIFORNIA INSTITUTE OF TECHNOLOGY
(6;3,3,0,0,0,0)

Chow Kwang-nan

Representing measures on the Royden boundary for solutions of $\Delta u = Pu$ on a Riemannian manifold

Day, Peter William
Rearrangements of measurable functions
Luecke, Glenn Richard
Paranormal operators on a Hilbert space

Department of Applied Mathematics

Casten, Richard Guy
Methods for deriving conservation laws
Goodman, Seymour E.
The hydro-kinetic theory of liquid helium II
Wiscombe, Warren J.
Non-linear dispersive waves with a small dissipation

STANFORD UNIVERSITY (36;15,1,4,9,0,7)

Armacost, David L.
Topics in the character theory of locally compact Abelian groups
Brodsky, Stuart Lee
Asymptotic distributions and some integral equations
Chestnut, Paul Cotter
Oseen flow past a finite flat plate at large Reynolds number
De Temple, Duane William
Generalizations of the Grunsky-Nehari inequalities
Glett, Alan Stuart
Topics in simplex space theory
Helton, Frances Joanne McWhirter
Algebra automata, stack automata and operator semigroups
Huckleberry, Alan Trinler
Holomorphic mappings and algebras of holomorphic functions of several complex variables
Kellner, Richard George
Some eigenvalue problems connected with potential theory
Larson, Alan Holder
A case study of predicative mathematics: Uniform spaces, completions and algebraic number theory
Mansfield, Richard Beech
The theory of Σ^1_2 sets
Nebres, Bienvenido Florendo
Preservation theorems and Herbrand theorems for infinitary languages
Ogden, William Frederick
Intercalation theorems for pushdown store and stack languages
Portnoy, Esther Ruth Glotzhober
Toward a generalized Gauss-Bonnet formula for complete, open manifolds
Rose, Keith Alden
On a class of extremal elliptic operators
Smythe, Robert Thomas
Local time at boundary atoms of a Markov chain
Tucker, Alan Curtiss
Two characterizations of proper circular-arc graphs
Wigner, David Wheeler
Algebraic cohomology of topological groups

Department of Computer Science

Abrams, Philip S.
An APL machine
Becker, Sheldon I.
TAXL--a simple hierarchical data structure manipulation system
Hoffman, Lance J.
The formulary model for access control and privacy in computer systems

Department of Operations Research

Bigelow, James Harold
The chemical equilibrium problem: A special case of nonlinear programming
Lansdowne, Zachary Fenton
The theory and applications of generalized linear control processes
McGill, James Terry
Optimal control of queueing systems with variable number of exponential servers
North, Daniel Warner
An invariance approach to the probabilistic encoding of information
Riverola, Jose
Step size problems
Rogers, John Scott
A dynamic model for planning capacity expansion: An application to plant reliability in electric power systems
Sarkar, Tapas Kumar
Some lower bounds of reliability

Department of Statistics

Gelfand, Alan Enoch
Seriation of multivariate observations through similarities
Gluckman, Perry Morton
Applications of diffusion approximations to the collective theory of risk
Kromer, Ralph Eugene
Asymptotic properties of the autoregressive spectral estimator
Lamborn, Kathleen Rundle
Problems from biostatistics
Lehoczky, John Paul
Stochastic models in traffic flow theory: Intersection control
Mariano, Roberto Sanchez
On distributions and moments of single-equation estimators in a set of simultaneous linear stochastic equations
Shorrock, Richard William
Caravans in traffic flow
Ware, James Hutchinson
Regression when both variables are subject to error and the ranks of their means are known
Weldon, Kenneth Laurence
Stochastic storage processes with multiple slope linear inputs and outputs

UNIVERSITY OF CALIFORNIA, BERKELEY
(60; 31,9,0,20,0,0)

Amer, Mohamad A.
Boolean algebras of sentences of ω -order logic

- Arnold, Robert F.
Plus and times
- Blair, Jerome
Approximate solutions of elliptic and parabolic boundary value problems
- Bowen, Robert
Topological entropy and Axiom A
- Bunch, James Ralph
On direct methods for solving symmetric systems of linear equations
- Byers, William Paul
Anosov flows
- Demaree, Daniel B.
Studies in algebraic logic
- Ebenstein, Samuel
Harmonic analysis on compact Abelian groups
- Eckel, Charles Richard
Smooth functions on locally compact groups
- Eisenman, Donald Alfred
Intrinsic measures on complex manifolds and holomorphic mappings
- Goodwin, Jerrold Ralph
The structure of finite right transformation semigroups
- Guckenheimer, John
Endomorphisms of the Riemann sphere
- Howe, Roger
On representations of nilpotent groups
- Kiernan, Peter
Quasiconformal mappings and Schwarz's lemma
- King, James
Families of intermediate Jacobians
- Knight, William John
Functions into Banach spaces, with applications to random differential equations
- Kostinsky, Alan Loeb
Some problems for rings and lattices within the domain of general algebra
- Lipner, Leonard
Some aspects of generalized quantifiers
- Moore, John Douglas
Some geometric applications of exteriorly orthogonal quadratic forms
- Murray, Amy C.
Asymptotic behavior and unique continuation for hyperbolic operators
- Pigozzi, Don L.
Amalgamation and interpolation properties of cylindric algebras
- Robinson, Rex Clark
Generic properties of conservative systems
- Savitch, Walter John
Nondeterministic tape bounded Turing machines
- Schmid, Edwardine Michele
Some theorems on value distributions of meromorphic functions
- Shahshahani, Siavash Mirshams
Global theory of second order ordinary differential equations on manifolds
- Stauduhar, Richard P.
The automatic determination of Galois groups
- Stauffer, Howard Boyer
Completions of categories, satellites, and derived functors
- Stiffler, Price
Extension of the fundamental theorem of finite semigroups
- Tang, Alfred S.
Studies in quasi-ordinary singularities of embedded surfaces
- Taylor, Michael E.
Hypoelliptic differential equations
- Tirao, Juan A.
Square integrable representations of semi-simple Lie groups
- Wagner, Diane Marie
Homology of piecewise linear chain complexes of a polyhedron
- Weinberger, Peter Jay
Proof of a conjecture of Gauss on class number two
- Department of Industrial Engineering and Operations Research
Arunkumar, Shri Subramani
Estimation of the change point of the generalized failure rate function
- Brumelle, Shelby Lee
Some inequalities for multi-server queues
- Butterworth, Richard Wesley
A branch and bound method for optimal fault finding
- Haji, Rasoul
Study of multiple channel queue
- Nigam, Avadhesh Kumar
Optimal strategies in capacity expansion
- Perrakis, Stylianos
Interregional wage structure and wage determination in Mexican manufacturing
- Rageh, Nabil Saad El-Din Ibrahim
General class of stochastic transportation problems
- Ravindran, Arunachalam
An inventory model with contiguous demand distribution
- Reynolds, Gary Hill
An M/M/c queue for the distance priority machine interference system
- Van Den Heever, Rudolf Johannes
Computer time-sharing priority systems
- Department of Statistics
Aiyar, Radhakrishnan Jemboonath
On some tests for trend and autocorrelation
- Boza, Luis Bernabé
Asymptotically optimal tests for finite Markov chains
- Clifford, Peter
A stochastic model of survival where accumulated damage may be repaired
- De Acosta, Alejandro Daniel
Existence and convergence of probability measures in Banach sequences
- De Hoyos, Arnolde Guevara
Continuity of some Gaussian processes parameterized by the compact convex sets in \mathbb{R}^S
- Fernandez, Pedro Jesús
On the weak convergence of random sums of

- independent random elements
- Gilat, David
 I. On the convergence of random series
 II. Exponential bounds for semi-martingales with subnormal conditional increments
- Jaeckel, Louis Alan
 Robust estimates of location
- Laghrari, Abdelaziz
 Estimation with crude measurements
- Meilijson, Isaac
 A bargaining problem
- Oyelese, John Oyedokun
 A stochastic model of epidemics involving an intermediate host (vector)
- Samuels, Myra Jordan
 Distribution of the population among generations in an age-dependent branching process
- Singh, Jokhan
 A sometimes pool test procedure for the analysis of variance model II
- Stefansky, Wilhelmine von Türk
 On the rejection of outliers by maximum normed residual
- Yarbrough, Charles Joseph
 Sequential discrimination with likelihood ratios
- Yohai, Victor Jaime
 Optimal strategies of a buyer when price information is costly
- Group in Logic and the Methodology of Science
- Laver, Richard Joseph
 Order types and well-quasi orderings
- UNIVERSITY OF CALIFORNIA, DAVIS
 (4;3,0,0,1,0,0)
- Dickinson, Robert Peter, Jr.
 Right zero union of semigroups
- Dubois, Paul Fred
 Pure-injective problems in Abelian groups
- Durham, Stephen Daniel
 Limit theorems for a general critical branching process
- Etterbeek, Wallace Allen
 Semigroups whose lattice of congruences form a chain
- UNIVERSITY OF CALIFORNIA, IRVINE
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- Gatterdam, Ronald
 Embeddings of primitive recursive computable groups
- Gilfeather, Frank Larkin
 The structure of non unitary operators and their asymptotical behavior
- Harvey, Bernard Neil
 Representation of certain linear operators in Hilbert space
- Haslam, Harold B.
 G-spaces and H-spaces
- Hudson, William N.
 An investigation into Brownian motion processes with multidimensional time parameters
- Kerlin, John E., Jr.
 Tensor products over Banach algebras with applications to harmonic analysis
- Vasudeva, Harkrishan L.
 Monotone matrix functions
- Walter, Martin E.
 W^* -algebras and non-abelian harmonic analysis
- Wulfsohn, Aubrey
 Tensor products of Hilbert spaces and of C^* -algebras
- UNIVERSITY OF CALIFORNIA, LOS ANGELES
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- Antoniak, Charles Edward
 Mixtures of Dirichlet processes with application to Bayesian non-parametric problems
- Behrens, Michael Frederick
 The maximal ideal space of algebras of bounded analytic functions of infinitely connected domains
- Berman, Sorrell
 Spectral theory for a first-order symmetric system of ordinary differential operators
- Duncan, Arthur Gibson
 Visibility and L-sets
- Eberlein, Patrick Barry
 Geodesic flow in manifolds of negative curvature
- Fan Hsin-ya
 On elastic load diffusion from a strip to sheets
- Farrenkopf, Robert Leo
 The generation and local behavior of optimal trajectory families
- Gold, Jerrold Marvin
 Definable cardinals
- Gregory, John
 An approximation theory for elliptic quadratic forms on Hilbert spaces
- Krieger, Michael Marvin
 Coverings and packings in combinatorics and related extremal graphs
- Leech, Jonathan Edmund
 An extension of group extensions to the theory of monoids
- Ludwig, Robert Loyd
 Approximation of harmonic functions
- Morizumi, Shigenori James
 An investigation of infrared radiation by vibration-rotation bands of molecular gases
- Nathanson, Weston Irwin
 A control theory Polza problem with intermediate constraints
- Read, Dwight Webster
 On (J,M,m) extensions of Boolean algebra
- Rupp, Russell Daniel
 Unified sufficiency theory in the calculus of variations
- Sabella, Ralph Robert
 On convergence properties of neighboring sequences
- Slaninger, Jeanne Carolyn
 Subconvex sets

- Smith, Perry Buckman
Some contributions to Montague's abstract recursion theory
- Tafel, Richard Edward
Further results in the theory of meromorphic minimal surfaces
- Thompson, James Martin
A computational approach to the generalized solution of a first-ordered conservation law
- Weiss, Neil Alan
Limit theorems for infinite particle systems
- Zeitlin, Joel Loeb
Correspondence between the Lie algebra invariant subspaces and Lie group invariant subspaces of representations of Lie groups

UNIVERSITY OF CALIFORNIA, RIVERSIDE
(5;5,0,0,0,0)

- Burk, Francis E.
Finite difference methods for a singular Cauchy problem
- Diederich, James Raymond
Removable sets for pointwise solutions of elliptic partial differential equations
- Lippman, Gary Edwin
Spherical summability of conjugate multiple Fourier series & integrals at the critical index; a convergence problem for a certain class of multiple Fourier series
- Shirley, Edward D.
Extensions & compactifications of topological spaces
- Wolfe, Stephen James
On the unimodality and continuity properties of L functions

UNIVERSITY OF CALIFORNIA, SAN DIEGO
(7;6,0,1,0,0,0)

- Crocker, Thomas Hayes
A priori integral inequalities and L_p estimates for positive linear operators and elliptic partial differential equations
- Duncan, Richard D.
The representation of excessive functions of a Markov process
- Goldberg, Merrill B.
Convergence results as a consequence of convexity properties of certain spaces
- Nuber, John A.
A constructive ergodic theorem and an improvement on Doob's upcrossing inequality for submartingale sequences
- Page, Rector L.
An extremal problem on a class of positive-definite functions on the circle
- Preston, Christopher
A theory of capacities and its application to some convergence results
- Smith, Robert R.
Extrapolation applied to the numerical solution of hyperbolic partial differential equations

UNIVERSITY OF CALIFORNIA, SANTA BARBARA
(8;8,0,0,0,0)

- Hartig, Donald
Characterization of the functor of the space of continuous functions
- Kranzler, Stanley K.
Existence theorems for certain convolution equations
- Ma Paul Tsoy-wo
Topological degrees of set-value compact fields in locally convex spaces
- Nicholson, W. Keith
On the structure of certain classes of rings
- Randtke, Daniel J.
Nuclear spaces and their associated seminorms
- Samuelson, D. James
Some properties of conversion & independence in universal algebra
- Ware, Roger P.
Endomorphism rings projective modules
- Watkins, William E.
Inequalities for derivation operators on a tensor space

UNIVERSITY OF SOUTHERN CALIFORNIA
(7;6,1,0,0,0,0)

- Casti, John L.
Invariant imbedding and the solution of Fredholm integral equations with displacement kernels
- Dayton, Barry H.
Topological K-theory in algebraic homotopy categories
- Logan, Buford A., Jr.
Stationary random measures
- Oba, Marilyn
A natural iteration measure
- Phadke, Bhalchandra B.
Equidistant loci
- Velman, John R.
Likelihood ratios determined by differentiable families of isometries
- Wenska, Thomas M.
Imbedding of non-linear integral equations

COLORADO

COLORADO STATE UNIVERSITY (6;1,0,0,5,0,0)

Department of Mathematics and Statistics

- Broffitt, James Drake
Estimating the probability of misclassification based on discriminant function techniques
- Brown, Marian Ruth Safford
Generalizations of inverse semigroups
- Eicker, Patrick Joseph
A matrix occupancy problem
- Kingman, Albert
Distribution of pseudolinear and pseudo-quadratic forms with characterizations of the normal distribution

McDonald, Lyman Lynn
Investigations on generalized multiresponse
linear models
Milliken, George Albert
Extension of the general linear model

UNIVERSITY OF COLORADO (13;11,2,0,0,0)

Brase, Charles H.
Some results on Bezout rings and Prüfer rings
Chung Kyong-soo
Decomposition of an isometry in a symplectic
or orthogonal space
Donovan, George Stetson
Arithmetic series
Finkelstein, Harold S.
A study of perfect groups
Hartman, William Joseph
The method of steepest descent for several
parameters
Hartzman, Carl Steven
Differential equations on 2-dimensional mani-
folds of genus 2
Ingram, Steven K.
Continuous dependence, differential inequalities
and maximal solutions for nonlinear ordinary
differential equations
Lathrop, James F.
Applications of spline functions to the numeri-
cal solution of ordinary and partial differential
equations
Nielsen, Howard
Generalized integral formulas for the sawtooth
and related functions
Oliver, James M.
Asymptotic behavior of solutions of certain
boundary value problems
Shader, Leslie Elwin
Arithmetical functions associated with unitary
divisors in $GF[q : x]$
Stone, Michael G.
On endomorphism semigroup structure in uni-
versal algebras
Swarztrauber, Paul N.
A study of the time dependent free boundary of
an ideal fluid

UNIVERSITY OF DENVER (1;0,1,0,0,0)

Snyder, Charles William
The asymptotic expansion for the fundamental
solution of the diffusion equation

CONNECTICUT

UNIVERSITY OF CONNECTICUT (6;1,0,0,5,0,0)

Metzger, Jerry M.
Quasi-uniform and quasi-proximity spaces

Department of Statistics

Badhe, Sahadeo Kautik
On the exact and the approximate forms of the
distribution of the Behrens-Fisher-Welch V
statistic

Fulton, David LeRoy
Semigroups on oriented mobs
Goldstein, Matthew
Nonparametric discriminant analysis
Gulati, Bodh Raj
On packing problem and its applications
Sogliero, Gene Sandra
Sequential procedures for estimating linear
combinations of means of several normally
distributed random variables when the vari-
ances are unknown

WESLEYAN UNIVERSITY (3;3,0,0,0,0)

Cohen, Marion Deutsch
Pseudo order type maps
Tzeng Zong-hwe
Extended-real-valued functions and the pro-
jective resolution of a compact Hausdorff
space
Ulmer, Milton
Functions on product spaces and C-embedded
 Σ -spaces

YALE UNIVERSITY (12;11,0,0,1,0,0)

Allison, Bruce Normansell
Rational data for isomorphisms of Lie algebras
Andre, Peter Paul
K-regular elements in semi-simple algebraic
groups
Arthur, James Greig
Harmonic analyses of tempered distributions
on semi-simple Lie groups
Benard, Mark
On the Schur indices of characters of the ex-
ceptional Weyl groups
Fendel, Daniel Matthew
A characterization of a group of Conway
Henle, Michael Gilman
Galois theory of von Neumann algebras
Jones, Lowell E.
A converse to a theorem of P. A. Smith
Richardson, Leonard Frederick
Decompositions of the L_2 space of a general
compact nilmanifold
Ryan, James Patrick
Shift commuting continuous maps
Sharpe, Richard Walter
The obstruction group to the surgery problem
Terras, Audrey Bowdoin
Generalization of the Epstein zeta function

Department of Statistics

Cleveland, William Swain, II
Time series projections, theory and practice

DELAWARE

UNIVERSITY OF DELAWARE (3;2,1,0,0,0,0)

Jones, H. Louise Hinrichsen
Integral equation methods for non-linear eigen-
value problems
Munshower, Donald Craig
Quasi spirallike functions

Ziegler, Michael Robert
A class of regular functions related to the theory
of univalent functions

DISTRICT OF COLUMBIA

CATHOLIC UNIVERSITY OF AMERICA
(8;3,1,0,4,0,0)

Fitzgerald, Kenneth
Error estimates for the solution of linear
systems
Gallo, Daniel
Centralizers on an H^* -algebra of Ambrose
and right H^* -algebra of Smiley
Giellis, George R.
The study of topological modules over an
 H^* algebra
Sullivan, Richard
The theory of Banach-space-valued functions
generated by finite-additive measures and the
theory of a Bochner-Stieltjes-Pettis type in-
tegral

Statistical Laboratory

Devlin, Thomas F.
Sample properties of general linear processes
Gupta, Devendra
On circular distributions
McDonagh, Francis B.
Renewal theorems for Cesáro sums of inde-
pendent random variables
Swinsky, Gregor W.
Nonparametric concordance for small sample
time series

GEORGE WASHINGTON UNIVERSITY(3;0,0,0,3,0,0)

Department of Statistics

Chu, Herbert Hsien
Some results in tests of hypotheses of separate
families of distributions by the minimum dis-
crimination information statistic
MacLean, Charles Jacob
Statistical inference within the nonstationary
Poisson process
Molk, Yehuda
On estimation of probabilities in contingency
tables with restrictions on marginals

FLORIDA

FLORIDA STATE UNIVERSITY (10;6,0,0,4,0,0)

Davis, Richard L.
A Galois theory for a class of purely insepar-
able field extensions
Hofler, John T.
Positive operators, plasterable cones, and con-
tinuous lattice operations in locally convex
spaces
Morrell, Joseph Salvador
Absolutely summing operators in Banach
spaces

Prins, Charles Alan
Banach spaces with the projection property
Shinohara, Yaichi
On the signature of knots and links
Thwing, Henry W.
The field of constants of an integral derivation
on a p-adic field

Department of Statistics

Conroy, John Elliott
Bounds and comparisons of distributions of
partial maxima of independent, identically
distributed random variables
Petrasovits, Andres
Approximations to Bayes procedures for quantal
assays with simple exponential tolerance dis-
tributions
Pirie, Walter Ronald
Distribution-free tests for ordered alternatives
in the randomized block model
Rao, A. Vijaya
The log-zero Poisson distribution

UNIVERSITY OF FLORIDA (2;0,0,0,2,0,0)

Department of Statistics

Beaver, Robert John
On ties in triple comparisons
Bradley, Edwin Luther
Queues with balking and their application to an
inventory problem

UNIVERSITY OF MIAMI (6;6,0,0,0,0,0)

Guettler, Edward P.
P-nilpotency and criteria for the solvability
of finite groups
Haynsworth, William Hugh
Finite to one open mappings on manifolds
Marrero, Osvaldo
Modular Hadamard matrices and related com-
binatorial designs
Musser, Gary Loren
Two classes of radicals determined by integral
polynomials
Rudd, David
On isomorphisms between ideals in rings of
continuous functions
Smith, Jack Warren
Reflexive open mappings

GEORGIA

EMORY UNIVERSITY (1;1,0,0,0,0,0)

Irwin, Caulton L.
Green's functions and inverting operators for
singular boundary value problems

GEORGIA INSTITUTE OF TECHNOLOGY
(4;4,0,0,0,0,0)

Brown, David L.
Convergences and topologies for families of
functions

Lucas, Thomas R.

A theory of generalized splines with applications to nonlinear boundary value problems

Martin, Robert H.

Existence and bounds of solutions to ordinary differential equations in a Banach space

Wertheimer, Stanley J.

Semicontinuous, quasi-compact and related multifunctions

UNIVERSITY OF GEORGIA (7;3,1,0,2,0,1)

Connor, Andrew C.

Splittable knots

Ivansic, Ivan

Bounded piecewise linear manifolds in Euclidean spaces

Knowles, Frank LeRoy

Semigroups that are the union of a maximal group on E^3

Walker, Philip William

Asymptotica of the solutions to $[(ry)'] - py'] + qy = oy''$

Walker, Winston W., Jr.

Stationarity theorems for stochastic differential equations

Department of Statistics

Graney, Richard Wesley

Tests of concentration and identification of mixed samples

Patel, Harjiphal Ishuardas

Structure and distance of logic patterns

IDAHO

UNIVERSITY OF IDAHO (3;2,0,0,1,0,0)

Spraktes, Floyd William

Fitting segmented non-linear regression functions

Stone, Wesley Curtis

Representations of a two-manifold

Takeda, Yoza

On the structure of Jordan algebras of characteristic two

ILLINOIS

ILLINOIS INSTITUTE OF TECHNOLOGY

(8;4,4,0,0,0,0)

Buntinas, Martin

Convergent and bounded Cesaro sections in sequence spaces

Detry, Ronald J.

An extended collision model in the kinetic theory of gases

Gorton, Robert B.

Trigonometry in the finite affine plane

Mayne, Joseph

Flexible algebras of degree two

Miller, Naza

Multipliers of some sequence spaces

Department of Mechanics

Schmerr, Lester William, Jr.

Elastic wave propagation and scattering

Sidhu, Harbans Singh

Elastic/plastic torsion of doubly connected cylinder

Thigpen, Lewis

Stability of shear flows in porous wall channels

NORTHWESTERN UNIVERSITY (18;15,2,0,1,0,0)

Chen Kuang-ho

Liouville type problem and symmetrization of distributions

Chiu Sou-yung

On the homology of local rings: Betti series and algebra resolution

Fauntleroy, Amassa

Commutator subgroups of solvable linear algebraic groups

Geman, Don

Horizontal window conditioning for stationary processes

Gibbons, Joel

One-dimensional attracting sets in the three-sphere

Lau, Brian

The linearized equations of water waves

Mount, Bertha

The geometric dimension of complex bundles

Nussbaum, Frank

Obstruction theory of possibly nonorientable fibrations

Paciorek, Joseph W.

Resolutions of ideals defined by matrices and Chern classes

Raffety, Don

Random environment branching processes

Schuss, Zeev

Asymptotic expansions for parabolic systems

Silverman, Gerald B.

Rearrangement invariant Köthe spaces

Simon, Carl

Non-genericity of rational zeta functions and instability in $\text{Diff}^r(T^3)$

Tang Min-ming

Singular perturbation of some quasilinear

Dirichlet problems given in divergence form

Torelli, Paul A.

The theory of higher order M-adic differentials

Vesely, William

Asymptotic solution of a linear Volterra integral equation

Committee on Applied Mathematics

Unger, Philip Steven

The dual of the dual in nonlinear programming

Zlobec, Sanjo

Contributions to mathematical programming and generalized inverses

SOUTHERN ILLINOIS UNIVERSITY (2;2,0,0,0,0,0)

Hare, George

On doubly transitive projective groups

Hu, T. K.
On universal algebras with infinitary operations

the weak convergence of stochastic processes
with several parameters

UNIVERSITY OF CHICAGO (25;20,1,0,2,0,2)

Department of Mathematical Biology

Calvert, Bruce Donald
Nonlinear equations of evolution and fixed points
Chalabi, Ahmad A. H.
On the Jacobson radical of a group algebra
Cohn, Leslie
The dimensions of spaces of automorphic forms
on a certain two dimensional complex domain
Currano, John James
Conjugate p-subgroups with maximal intersection
Donaldson, Thomas K.
Embedding theorems for Orlicz-Sobolev spaces
and applications
Dubuc, Eduardo J.
V-completions by V-monads through the use
of Kan extensions
Eisenbud, David
Torsion modules over Dedekind prime rings
Evans, Edward G., Jr.
Studies on commutative rings
Golber, David
Torus actions on a product of two spheres
Herrero, Domingo A.
Inner function-operators
Kohn, Marvin J.
Riemann summability of multiple trigonometric
series
Lanski, Charles P.
The group of units of a simple ring
McAdam, Stephen Joseph
The going down theorem
Meyer, Harold David
Analytic continuation in C^d : A representation
theorem and variational techniques in non-
linear parabolic problems
Montgomery, M. Susan
Lie structure for characteristic 2
Nussbaum, Roger D.
The fixed point index and fixed point theorems
for K-set contractions
Sandling, Robert
The modular group rings of p-groups
Schochet, Claude L.
Unstable two-stage Posnikov systems
Sullivan, Richard Ward
Differentiable actions of classical groups on
spheres with positive dimensional principal
isotropy subgroup
Walsh, Thomas
Singular integrals of L^1 functions
Weiss, Stanley Allen
Nonlinear eigenvalue problems

Cull, Paul
Linear analysis of switching nets
Rothberg, Joseph M.
Thermal dependence of the electrical charact-
eristics of the giant muscle fibre of "Bal-
anus Nubilus" Darwin

UNIVERSITY OF ILLINOIS (32;24,3,4,1,0,0)

Abu-Salih, Muhammad S.
On termination with probability one and bounds
on sample size distribution of sequential prob-
ability ratio tests where the underlying model
is an exponential family
Africk, Henry Louis
A proof theoretic proof of Scott's general inter-
polation theorem
Blanton, John David
Spaces of isotopic triangulations of a 2-cell
Brady, Michael Melvin
Meromorphic solutions of a system of func-
tional equations involving the modular group
Eiseman, Peter Robert
Derivations of function algebras
Fairchild, Lonnie Jane
Extreme invariant means and minimal sets in
the Stone-Ćech compactification of a semi-
group
Fleury, Patrick John
Aspects of Harrison's homology theory
Heath, David Clay
Probabilistic analysis of hyperbolic systems
of partial differential equations
Johnson, Harold Randall
Infinite strings over finite machines
Johnson, Jerry Alan
Spaces of Lipschitz functions and vector-
valued Lipschitz functions
Kieffer, John Cronan
A generalization of the Shannon-McMillan
theorem and its applications to information
theory
Lewis, John Lawson
Some theorems on the $\cos \pi \lambda$ inequality
Long, Robert L.
Steinitz classes of relative Galois extensions
McCullough, Dean Paul
Model connectives and intuitionistic model
logic with respect to the Kripke model
Mech, William Paul
On the monotone extensions property
Orzech, Grace Geist
Obstruction theory in algebraic categories
Papas, Theodore Thomas
Acyclic models and fibrations
Rajput, Balram Singh
Determinable sets in Banach spaces
Schneider, Ross Nelson
A decomposition of the automorphism group
of an autonomous linear sequential machine

Department of Statistics

Marshall, Jack
On Yates's approximation for the missing
value problem in model I analysis of variance
Straf, Miron Lowel
A general Skorohod space and its application to

Shepard, Clarence Day
 Languages in general algebras
 Strutt, Joseph Raymond Arnold
 Projective homotopy classes
 Takiff, Steven Joel
 On the ring of invariant polynomials for representations of Lie groups
 Terras, Riho
 Almost automorphic functions on topological groups
 Thompson, Mary Elinore Beattie
 Some aspects of optimal stopping theory
 Wagner, Neal Richard
 Global properties of the space of retractions of the two-sphere and the annulus
 Woan-Wen-Jin
 A characterization of linear groups
 Wong Chi-song
 Fixed point theorems for non-singular mappings
 Zemanek, Janice Rose
 On the semisimplicity of integral representation rings

Department of Computer Science

Atkins, Daniel Ewell, III
 A study of methods for selection of quotient digits during digital division
 Baugh, Charles Richmond
 Pseudo-logic: A generalization of threshold logic
 Chen Tuan-lin (Frank)
 An algorithm for the minimization of two-level multiple-output networks
 Ellis, Clarence Arthur
 Probabilistic languages and automata

INDIANA

INDIANA UNIVERSITY (7;7,0,0,0,0)

Crawford, Robert R.
 Homomorphism species, triples, and operators
 Deddens, James A.
 Co-isometric extensions of semigroups of operators
 Kulkarni, Ramesh M.
 Subnormal operators and weighted shifts
 Newberger, Edward
 Asymptotic Gevrey classes and the Cauchy problem
 Ramankutty, P.
 On a class of partial differential equations with singular coefficients
 Wogen, Warren R.
 On generators for von Neumann algebras
 Wong Tin-kin
 On real normal operators

PURDUE UNIVERSITY (34;14,5,5,10,0,0)

Agrawal, Jagdish Chandra
 A study in non-linear stability theory
 Arifin, Achmad
 Finitistic dimensions of left perfect rings

Brand, Michael
 The essential set and interpolating sets in function algebras
 Duchateau, Paul Christian
 The non-linear Cauchy-Kovalevska theorem with applications to Cauchy problems with coefficients and data in a Gevrey class
 Eckberg, Carl F., Jr.
 Recursive metric spaces
 Ellison, Robert John
 A characterization of $PSU(3,5^2)$
 Hack, Thomas George
 Sufficient conditions in optimal control theory and differential games
 Helm, John Paul
 Two topics in recursion theory: I. Effective operators and II. Effective enumeration of sets
 Hintz, Gerald
 Mixed problems for linear transport equations in slab geometry
 Jones, William Charles, Jr.
 Finite groups with conditions on the subgroup lattice
 Lang, George Edward
 Evaluation subgroups and related topics
 Melka, Richard
 The method of characteristics in perturbation solutions of hyperbolic partial differential equations
 Nelson, William
 Stability of a non-linear system of integro-differential equations from the field of radiative transfer
 Rao, Ramachan Drachar Vittal
 Spectral analysis of integral operators with difference kernels on finite intervals
 Schonefeld, Steven
 A study of products and sums of Schauder bases in Banach spaces
 Shirey, James Eugene
 Subseries convergence of Schauder basis expansions
 Shultz, Harris Samuel
 Algebraic approaches to distributions and operational calculus
 Williams, Robert Douglas
 Intersections of primary ideals in rings of functions
 Yoon Byung-ho
 The plateau problem as a one-dimensional variational problem

Department of Computer Sciences

Dershem, Herbert Lewis
 Approximation of Bessel's differential operator of fractional order by finite-difference operators
 Oldehoeft, Arthur Earl
 A computer system to teach computational mathematics
 Phillips, James Lincoln
 Collocation as a projection method for solving integral and other operator equations

- Pruess, Steven Arthur
 Estimating the eigenvalues of Sturm-Liouville problems by approximating the differential equation
- Smith, Douglas K.
 A dynamic component suppression algorithm for the acceleration of vector sequences

Department of Statistics

- Basu, Adhir Kumar
 On some problems in the theory of optimal stopping rules and the log-log law
- Chen Shun-zer
 Contribution to the theory of queues with semi-Markovian features
- Deverman, Jerone N.
 A general selection procedure relative to the best populations
- Li Hung-chiang
 Asymptotic expansion for distributions of the characteristic roots of two matrices from classical and complex Gaussian populations
- Murty, Vedula Narayana
 Optimal designs of individual regression coefficients with a Tchebycheffian spline regression function (TSF)
- Nair, Sreekantan S.
 On certain priority queues
- Panchapakesan, S.
 Some contributions to multiple decision (selection and ranking) procedures
- Paranjape, Suresh R.
 On some estimation and distribution problems
- Resnick, Sidney I.
 Maximum of a sequence of random variables defined on a Markov chain
- Tomkins, Robert J.
 On the law of the iterated logarithm

UNIVERSITY OF NOTRE DAME (15:14,1,0,0,0,0)

- Berry, John William
 Almost recursively enumerable sets
- Boner, Robert P.
 Maximal affine subschemes
- Chabot, Paul Leo
 Sylow 2-groups with cyclic commutator groups
- Countryman, James Joseph
 On commutation semigroups of pq groups
- Gaudreau, Romeo René
 Pure subgroups of completely decomposable groups
- Hall, Joseph Wilburn
 Applications of commutator calculus to the theory of unipotent groups
- Hickman, David James
 The Tschebyscheff polynomials for regular polygons inscribed in the unit circle of the complex plane
- Ling Hsu-shih
 Extending families of pseudoconcave complex spaces
- Nakar, Rudolph Michael
 Fundamental exact sequences in relative cohomology

- Ochiai, Takushiro
 Geometry associated with semi-simple flat homogeneous spaces
- Pan Yi-chuan
 Analytic sets of finite order in the space of several complex variables
- Senft, James R.
 On weak automorphisms of universal algebras
- Solazzi, Robert E.
 The automorphisms of certain subgroups of $PGL_n(V)$
- Yagi, Katsumi
 On compact homogeneous affine manifolds
- Yuan Tah-zen
 On the solvability of the freest group of exponent 4

IOWA

IOWA STATE UNIVERSITY (18;7,0,5,6,0,0)

- Brink, James Edwin
 Inequalities involving $\|f\|_p$ and $\|f^{(n)}\|_q$ for f with n zero
- Eke, Boniface Ichemeotuonye
 Structure of inseparable composites
- Johnson, William Buhmann
 Operator and dual operator bases in linear topological spaces
- Klasi, Melvin Leroy
 Applications and extensions of the weighted integral
- Shive, Robert Allen, Jr.
 Existence theorems for the ψ integral
- Sommer, Clive Alexander
 The method of synergistic models
- Strawn, George Owen
 Results in polyadic group theory

Department of Computer Science

- Branstad, Dennis Keith
 A computer aided instructional system for teaching formal languages
- Hedrick, George Ellwood, III
 User error analysis and automatic correction for compiling
- Marks, Martha Ann
 A student directed, computer assisted, programming environment
- Thomas, Rex Allen
 Computerized simulation for teaching experimental design
- Wright, Charles Thomas, Jr.
 A method for the complete definition of programming languages

Department of Statistics

- Carrillo, Alfonso
 Estimation of variance after preliminary tests of significance
- Kennedy, William J., Jr.
 Model building for prediction in regression analysis based on repeated significance tests
- Mexas, Abel G.
 Some computational aspects of linear classifi-

- cation models
 Mount, Kenneth S.
 Minimax properties of likelihood ratio tests related to goodness of fit
 Papaioannou, P. C.
 On statistical information theory and related measure of information
 Sposito, Vincent
 Aspects of duality in linear programming

UNIVERSITY OF IOWA (16;11,0,2,3,0,0)

- Arrison, John Duncan
 On a class of power-associative algebras of degree less than three
 Avelsgaard, Roger Allen
 The cohomology of a certain class of Jordan algebras as the derived functor of Hom
 Czerwinski, Ralph Albert
 Bounded quadratic division algebras
 Detlefsen, Michael Ernest
 Independence and closure in noether lattices
 Johnson, Marjory Jane
 Ideal and submodule structure transformation near-rings
 Jordan, Mary Joel
 On some classes of H-semigroups
 Neuzil, John Paul
 Spheroidal decompositions of E^4
 Pohl, Victoria
 Collineation groups and Baer subplanes
 Rine, David Craig
 A theory of general machines and functor projectivity
 Stinebrickner, Ralph Peter
 Maximal Goldie subrings
 Summerhill, Ralph Richard
 The topological unknotting of cones

Department of Computer Science

- Gyllstrom, Hans Christer
 A syntax-directed translating system
 Walljasper, Stanley James
 On non-deterministic automata and effective languages

Department of Statistics

- Kuenzi, Norbert James
 An investigation of some problems concerning the additivity of conditional expectation with respect to a sigma-lattice
 Miller, Michael Franklin
 Some different approaches to goodness-of-fit tests
 Wolfe, Douglas Alan
 A new approach to statistical inference about certain probabilities

KANSAS

KANSAS STATE UNIVERSITY (6;3,0,0,3,0,0)

- Hart, Garry D.
 Vanishing algebras of Fourier-Stieltjes transforms

- Schelp, Richard H.
 Partial Baer *-semigroups and partial Baer semigroups
 Spears, Janina L.
 Simultaneous binary compositions involving a pair of relatively ℓ -free integers and a pair of integers, one of which is K-free and the other h-free

Department of Statistics and Computer Science

- Beckman, Richard Joseph
 Randomized spring balance weighing design
 Knowles, Walter Eaton
 Optimal equally-spaced designs for polynomial models
 Worthley, Reginald Gerald
 On the use of finite algebras in the construction of confounding plans for mixed factorial experiments

UNIVERSITY OF KANSAS (2;2,0,0,0,0,0)

- Prince, Deborah E.
 X-hypercentral groups
 Wright, Michael J.
 Henselizations and Henselian valuation rings

KENTUCKY

UNIVERSITY OF KENTUCKY (9;9,0,0,0,0,0)

- Bennett, Donald Earl
 Aposyndetic continua and some characterizations of dendrites
 Bowe, Ann Fowler
 Some aspects of small modules
 Bowe, James Jay
 Neat homomorphisms
 Brewster, Benjamin
 Formations of π closed groups
 Chelgren, Allen Kirby
 Defect groups and the radical of a group algebra
 Ekblaw, Keith A.
 The functions of bounded index as a subspace of a space of entire functions
 King, Amy C. Patterson
 A class of entire functions of bounded index and radii of univalence of some functions of zero order
 Nelson, James Donald
 Algebras of analytic functions with smooth boundary values
 Shaw, John Kenneth
 Zeros of partial sums and remainders of power series

LOUISIANA

TULANE UNIVERSITY (11;11,0,0,0,0,0)

- Bowman, Thomas T.
 On the automorphism groups of certain types of compact semigroups

- Cutrer, Milton Wayne
Analytic structure in homomorphism spaces of bounded holomorphic functions on polydiscs
- Kahn, Harold David
The governing theory of compact semigroups (notably cylindrical semigroups)
- Martin, John R.
Determining oriented knot type from the diagram of a knot
- Martinez, Jorge
Order extensions of pseudo lattice groups
- Nummela, Eric C.
Classifying spaces of compact semigroups and the algebraic cohomology of semigroups
- Olsen, Catherine L.
A structure theorem for polynomially compact operators and related lifting theorems
- Pederson, Katherine Lipps
A characterization of 2-polytopes
- Robinson, William B.
Extensions of basic sequences in Fréchet spaces
- Tung Hsu-lin
Quasi conformal mappings and pseudo quasi conformal mappings in R^3
- Zame, William Robin
Stable algebras of holomorphic germs
- Cellina, Arrigo
Multi-valued mappings and multi-valued flows
- Cohen, Joel S.
Absolutely P-summing, P-nuclear operators and their conjugates
- Connett, John
Block bundles and embeddings
- Franklin, Lawrence
Compact Abelian transformation groups
- Freiman, Richard
Regular minimal sets over the circle and the Ellis minimal set
- Gard, James
Homomorphisms of topological group
- Gauntt, Robert
The Axiom of Choice for collecting of finite sets
- Gregory, John
On a finiteness condition for infinitary languages
- Grossman, Steven
Stability and asymptotic behavior of differential-delay equations
- Hilbert, Stephen
Numerical methods for elliptic boundary problems
- Horak, Martin
 L_p solutions of nonlinear hyperbolic differential equations
- Kneece, Royce
Approximating strictly singular operators
- Kuntz, Richard
Primary decomposition in commutative rings
- Lusk, Ewing
Homotopy groups of spaces of embeddings
- Poreda, Stanley
Best approximation to some rational functions
- Reed, James
Extending homeomorphisms on the circle of pseudo-arcs
- Rosenzweig, Michael
On weak solutions of a mildly nonlinear Dirichlet problem and a finite difference approximation scheme
- Rosier, Ronald
Generalized sequence spaces
- Saperstone, Stephen
Controllability of linear oscillatory systems using positive controls
- Snively, James
Bounds on the complexity of grammars
- Stephens, Arthur
Convergence of the residual for Ritz-Galerkin approximations
- Styer, David
Multivalent meromorphic weakly-starlike functions
- Voigt, Robert
Rates of convergence for iterative methods for nonlinear systems of equations
- Yu Chin-shih
On upper bounds of asymptotic power and Pitman efficiencies of Kolmogorov and Smirnov tests

MARYLAND

JOHNS HOPKINS UNIVERSITY (6;4,0,0,2,0,0)

- Calica, Arnold
Reversible homeomorphisms of the real line
- Crisalli, Anthony
Observations on a reduction theory other than Minkowski's
- Haris, Stephen
Some irreducible representations of exceptional algebraic groups
- Simpson, J. Robley
Fourier coefficients of an adelic zeta function

Department of Biostatistics

- Marcus, Helen M.
A stochastic model of the population dynamics of malaria parasites in the mammalian host
- Rosenberg, Saul H.
Topics in variance component estimation

UNIVERSITY OF MARYLAND (29;21,5,0,3,0,0)

- Bernfeld, Steve
On the extendability of solutions of ordinary differential equations
- Blake, Louis
The preservation of regularity of conditional probabilities
- Brooks, Lowell
Linear programs for the solutions of discrete dynamic programming and Markov renewal programming problems
- Cavanagh, Raymond
Difference equations and iterative processes

Yu Chung-ling

Reflection principle for solutions of elliptic equations with analytic coefficients

MASSACHUSETTS

BOSTON UNIVERSITY (3;1,2,0,0,0)

DeLorenzo, Joseph D.

Electromagnetic transient studies in space-time

Spuria, Anthony J.

Parametric approximation of curves given by parametric equations

Wright, Rozelle May

The average of a function on a measurable group

BRANDEIS UNIVERSITY (7;7,0,0,0,0)

Ault, Robin

Embedding fixed-point-free homeomorphisms of the plane in continuous flows

Gover, Eugene

Generalized local complete intersections

Landolfi, John

Rigidity and geometry on Grassmanians

Leighton, Ralph

Gorenstein and semiuniserical noncommutative rings

Menzin, Margaret

Indecomposable modules over Artin local rings

Turner, Stuart

Zeta-functions of central simple algebras over global fields

Winslow, Richard

Relative homological dimension

CLARK UNIVERSITY (1;1,0,0,0,0)

Chase, Warren Edgar

The influence of the second coefficient on close-to-convex and close-to-star functions in the unit disc

HARVARD UNIVERSITY (30;8,17,0,5,0,0)

Blass, Andreas R.

Orderings of ultrafilters

Brown, Julia M. N.

Homologies and relations of finite projective planes

Fay, John D.

Special moduli and theta relations

Hales, R. Stanton

Numerical invariants and gamma products of graphs

MacPherson, Robert

Singularities of maps and characteristic classes

Poythress, Vern S.

Partial algebras

Rochberg, Richard

Properties of isometries and almost isometries of some function algebras

Spencer, Joel

Probabilistic methods in combinatorics

Division of Engineering and Applied Physics

Agrawala, Ashok Kumar

Learning with a probabilistic teacher

Budelis, Joseph J.

Optimal growth problems with explicit consideration of human capital development: Optimal paths for some differential-difference equations

Cohen, Joel Ephriam

Casual groups of monkeys and men: Stochastic models of elemental social systems

Gadgil, Sullochana M.

Time dependent topographic meandering and structure of jets in rotating systems

Goodenough, John B.

The description of programming languages-- A linguistic approach

Greenes, Robert A.

A computer-based system for medical record-keeping by physicians

Hammond, Allen Lee

On the energy supply of hurricanes: A model of the boundary layer

Lipson, John D.

Flowgraphs and their generating functions

MacLaughlin, Dean S.

Constructed server systems

Philander, Samuel G. M.

Equatorial dynamics of a homogeneous ocean

Rose, Donald J.

Symmetric elimination on sparse positive definite systems and the potential flow network problem

Slatkin, Montgomery

Dispersal and selection in natural populations

Thorpe, Rodney W.

A mathematical model for the spreading of urban renewal projects

Wakoff, Gary I.

Piecewise polynomial spaces and their use with the Rayleigh Ritz-Galerkin method

Watanabe, Daniel S.

Numerical methods for the time-dependent Krook equation

Weathersby, George B.

The allocation of public resources-- A decision and control theory analysis

Wegbreit, Eliot L.

Studies in extensible programming languages

Department of Statistics

Ellenberg, Jonas Harold

Detection of outliers in multivariate linear regression

Sung Bing

Decision rules for optimal personnel selection

Weisberg, Herbert Ira

Upper and lower probability inferences from ordered multinomial data

Wittes, Janet Turk

Estimation of population size: The Bernoulli census

Zahn, Douglas Alfred

An empirical study of the half-normal plot

- Abreu Leon, Jose Luis
Smoothing, filtering and prediction of generalized stochastic processes
- Akiba, Tadatoshi
On piecewise linear bundles
- Blumsack, Steven Lloyd
Mechanically and thermally driven motions of a rotating stratified fluid on the beta plane
- Chan Shu-kwan
Upper bound on turbulent heat convection for infinite Prandtl number
- Davis, Jon Haskell
Stability of linear feedback systems
- Doles, John Henry, III
Numerical solution of the Navier-Stokes equation
- Fabrey, James Douglas
Exponential representations of the canonical commutation relations
- Friedlander, Eric Mark
Fibrations in Etale homotopy theory
- Flaschka, Hermann
Asymptotic expansions and hyperbolic equations with multiple characteristics
- Griffith, Arnold Koons
Computer recognition of prismatic solids
- Ho Chung-wu
On a space of piecewise linear homeomorphisms of a 2-simplex
- Kelly, Edmund Francis Aloysius
Immersion of symmetric spaces
- Kilmoyer, Robert William
On some irreducible representations of a finite group with BN pair
- Machtey, Michael Axel
Intrinsic consistency and lattices of recursively enumerable sets in abstract recursion theory
- Nobile, Augusto
On approximation of embedded analytic singularities
- Perkins, David Norman, Jr.
Computer stereo vision: A combinatorial theory with implementation
- Poulsen, Niels Skovhus
Regularity aspects of the theory of infinite-dimensional representations of Lie groups
- Robbins, David Peter
Jordan elements in a free associative algebra
- Recht, Lazaro
Banach categories with conjugation
- Roskes, Gerald Jacob
Wave envelopes and nonlinear waves
- Schonbek, Tomas Pedro
On inverse scattering for the Klein-Gordon equation
- Stillwell, John Colin
Reducibility in generalized recursion theory
- Winters, Gayn Burns
Regular deformations of curves

Department of Mathematics and Statistics

- Curtis, Wendell Dan
Some results on S' -actions on homotopy spheres
- DeVun, Edmond Ernest
Semigroups on the disk with threads on the boundary
- Erickson, Theodore S.
Lie and Jordan systems in rings with involution
- Johnson, Carlos S.
Rap congruences on Baer semigroups
- Piziak, Robert
An algebraic generalization of Hilbert space geometry
- Schneider, Victor P.
Transitive actions on products of spheres

MICHIGAN

- Adeniran, Michael Tinouye
Monotone/uniform properties in topological spaces
- Bash, David Winfield
Normalcy of sums and products of normal functions and real and complex harmonic normal functions
- Conner, William T.
The capacity and unambiguity of a transducer
- Evans, Michael Jon
Properties of L_p derivatives
- Gibbs, Richard A.
Self-complementary graphs: Their structural properties and adjacency matrices
- Gillam, John D.
Formulations and relative F -normalizers
- Hayden, John L.
A characterization of the simple groups $Sp_6(2^n)$
- Matti, Joseph T.
Tangential boundary behavior in the unit disk and the exceptional sets of functions and their fractional integrals
- Meyer, Robert Louis
Bounds on the discretization error for the numerical solution of the Dirichlet problem
- Murphy, James L.
2-manifolds in euclidean 4-space
- Myung, Hyo-chul
Flexible Lie-admissible algebras
- Parry, Charles John
On a problem of Schinzel concerning principal divisors in arithmetic progressions
- Van Deventer, James E.
Some theorems about the automorphism of certain p -groups
- Villanueva, Antonio Santiago
Erdős's conjecture on the distribution of the sums $\sum_{i=1}^n \epsilon_i a_i$ of n vectors in d -dimensional space
- Zettel, Larry Joseph
Radicals in standard rings

Department of Statistics and Probability

- Guthery, Scott
 - An inversion algorithm for one-dimensional F-expansion
- Huang Jin-sheng
 - Equivariance in compound decision problems and a stability of symmetrifications of product measures
- Oaten, Allan
 - Approximation to Bayes risk in compound decision problems

UNIVERSITY OF MICHIGAN (30;20,0,5,5,0,0)

- Angell, Thomas Strong
 - Existence theorems for a class of optimal control problems with delay
- Breckenridge, John Clark
 - Geöcze k-area and measure theoretical methods in surface area theory
- Conn, Arthur Gerald
 - Continuous model theory and set theory
- Edwards, Robert Duncan
 - Homeomorphisms and isotopies of topological manifolds
- Hoover, Thomas Benton
 - Quasi-similarity and hyperinvariant subspaces
- Keller, Edward Lee
 - Quadratic optimization and linear complementarity
- King, Nancy Evelyn
 - Real length functions in groups
- Kramer, Earl Sidney
 - On λ -designs
- Lambert, Alan Leslie
 - Strictly cyclic operator algebras
- Manvel, Bennet
 - On reconstruction of graphs
- Meike, Gerald Edward
 - A decision procedure for the prefix class $\forall \dots \forall \exists \exists \dots \forall$
- Metzger, James Jerome
 - Weighted spaces of entire function
- Muhly, Paul Scott
 - Commutants containing a compact operator
- Norton, Victor Thane, Jr.
 - On polynomial and differential transvections of the plane
- Schneeberger, Charles Michael
 - Commutators on a separable L_p -space
- Schryer, Norman Loren
 - Symbolic computer solution of elliptic boundary value problems
- Schuur, Susan Jane Evelyn
 - Systems of quadratic forms over local fields
- Shuchat, Alan Howard
 - Integral representation theorem in topological vector spaces
- Spain, Harry Eugene
 - Linear perturbations of connexions
- Strube, Richard Ferdinand Ernst
 - Stable bundles and stable manifolds
- Suryanarayana, Manda Butchi
 - Optimization problems with hyperbolic partial differential equations

Tharakan, C. Thomas

- Some contributions to sampling from finite population

Department of Biostatistics

- Henderson, William Gray
 - Application of some statistical methods including factor analysis to a battery of clinical quantitative neurological tests for evaluating disability in multiple sclerosis
- Ullman, Betty Michelson
 - On Bayesian estimation of a binomial parameter
- Ullman, Nelly Szabo
 - Models for statistical analysis of experiments using repeated drug treatments: Chemotherapy of L1210 leukemia in mice

Department of Computer and Communication Sciences

- Brender, Ronald Franklin
 - A programming system for the simulation of cellular spaces
- Jefferson, David Kenoss
 - A heuristic programming system
- Sauvain, Richard Warren
 - Structural communication in a personal information storage and retrieval system
- Weinberg, Roger
 - Computer simulation of a living cell

Department of Statistics

- Halpern, Elkan Frank
 - Bayesian polynomial regression analysis

WAYNE STATE UNIVERSITY (5;4,0,0,1,0,0)

- Beckwith, John
 - Estimation of prior distributions
- Choike, James
 - On transcendental singularities and spiral functions
- Garipey, Ronald
 - Current valued measures and Geöcze area
- Ip Bing-fun
 - Banach space-valued martingale
- Kannan, Dhandapani
 - On probability theory in separable Banach spaces

WESTERN MICHIGAN UNIVERSITY (2;2,0,0,0,0,0)

- Mitchem, John
 - On extremal partitions of graphs
- Pothoven, Kenneth
 - Characterizations of some functors in categories of Banach spaces

MINNESOTA

UNIVERSITY OF MINNESOTA (7;0,0,1,6,0,0)

Department of Biometry

- James, Kenneth E.
 - A system for convenient description and analysis for linear classification models utilizing an orthogonal projection operator

Ko Ung-ring

The effect of mortality changes for specified causes of death on population structure

Lee, John G.

Some mathematical models for the intravenous glucose tolerance test

Nelson, Norma A.

Treatment estimation in randomized clinical trials with strate heterogeneity

Ochi, Shigeru

Laboratory automation for improved speed quality control, and diagnosis

Yeh Chiao

Stochastic models of "follow-up" in the clinical trial: Life tables and competing risk analysis

Department of Computer, Information and Control Sciences

Zimmerman, Carl Duane

Extended Fortran algebraic manipulator with application to linear problems of physics

MISSISSIPPI

UNIVERSITY OF MISSISSIPPI (1;1,0,0,0,0)

Nanney, Jimmy Ray

The geometric Hahn-Banach theorem for near topological vector spaces

MISSOURI

SAINT LOUIS UNIVERSITY (6;6,0,0,0,0)

Beuckman, John Albert

Exponentially convex functions and real characters

Bourgeois, Mary Denis

Further properties of a Lambert type series

Faust, Deborah Doyle

The existence of polar nondegenerate functions on differential manifolds

Frey, George Thomas

Almost periodic functions on groups

Gleeson, Owen Michael

Existence of Chebyshev quadrature for the weight function X^n

Skloss, Elmur Robert

2-segments in 2-metric spaces

UNIVERSITY OF MISSOURI-COLUMBIA (6;3,0,0,3,0,0)

Chaffer, Robert Allan

On a Wedderburn principal theorem for the flexible algebras

Miles, Thomas James

A Wedderburn decomposition for nearly (1,1) algebras

Morley, Lanny Charles

On Veblen-Wedderburn systems and spread sets

Department of Statistics

Mann, Charles Roy

Bayesian estimation of probability densities

Morgan, Ronnie Lee

A class of conjugate prior distributions and optimal allocation

Pledger, Gordon Wayne

Consistency of restricted least squares estimators

UNIVERSITY OF MISSOURI-KANSAS CITY (1;1,0,0,0,0)

Appelbaum, Elizabeth

Tensor products of polynomial identity algebras

UNIVERSITY OF MISSOURI-ROLLA (8;2,0,3,3,0,0)

Dunonceaux, Robert Henry

Statistical inferences for location and scale parameter distributions

Edwards, Harry Kerry

A heuristic algorithm for determining a constructive suboptimal solution to the combinatorial problem of facility allocation

Haas, Gerald Nicholas

Statistical inferences for the Cauchy distribution based on maximum likelihood estimators

Hager, Harold Walter

Statistical inferences for the generalized gamma distribution

Jamison, James Edward

Extensions of some theorems of complex functional analysis to linear spaces over the quaternions and Cayley numbers

Rothmann, Derald David

Characterizing topologies by continuous self-maps

Thoman, Darrel Ray

Inferences on the parameters of the Weibull distribution

Department of Computer Science

Prater, John Bruce

Search algorithms for the simple plant location problem

WASHINGTON UNIVERSITY (4;4,0,0,0,0)

Heideman, Nikalaas

Duality and fractional integration in the spaces $\Lambda(B, X)$ of A.P. Calderón

Hughes, Daniel

Eigenvalues of convolution operators

Karp, Samuel

Topics in central simple algebras

Ogden, Robert

Group representations of pseudo orthogonal groups

MONTANA

MONTANA STATE UNIVERSITY (1;1,0,0,0,0,0)

Feichtinger, Oskar

Lower semi-continuous multifunctions and properties of the λ and χ topology

NEBRASKA

UNIVERSITY OF NEBRASKA (4;4,0,0,0,0)

- Bosch, William
Polyanalytic functions
- Bruning, Linda Mae Frank
The classification of rings by the characteristic free module admitted
- Leech, Robert B.
Characterization of $\mathcal{N}(B)$ spaces
- Woodward, Walter Randolph
Semigroups of operators and invariant functionals

NEW HAMPSHIRE

DARTMOUTH COLLEGE (8;8,0,0,0,0)

- Berg, Michael Jay
Slowly returning Markov chains
- Brylawski, Thomas Henry
The Tutte-Grothendieck ring
- Cochran, David Samuel
Links with zero Alexander polynomial
- Cramton, Thomas James
Inverse eigenvalue problems
- Gisselquist, Richard Irving
Interactions of stochastic processes
- Harrod, Scott Boynton
The root character of the Weyl group of a (B, N) group
- Miletta, Peter David
Harmonic functions on semisimple Lie groups and regular matrix summability
- Ryan, Peter Michael
Frame theory

NEW JERSEY

PRINCETON UNIVERSITY (13;12,0,0,1,0,0)

- Campbell, Loughlin Andrew
Regularity and dimension of the analytic Hilbert scheme
- Cappell, Sylvain Edward
Super-spinning and knot complements
- Gelbart, Stephen Samuel
Fourier analysis on matrix space
- Goldberg, Charles Harvey
On the genera of links
- Gonzalez Acuna, Francisco Javier
On homology spheres
- O'Nan, Michael Edward
A characterization of the three-dimensional projective unitary group over a finite field
- Ordman, Edward Thorne
Amalgamated free products of groupoids
- Pasternack, Joel S.
Topological obstructions to integrability and the Riemannian geometry of smooth foliations
- Pittie, Harsh V.
Group actions and algebraic K-theory
- Quinn, Frank Stringfellow, III
A geometric formulation of surgery

- Stone, David A.
Block bundle sheaves
- Yoseloff, Mark Laurence
A combinatorial approach to the diagonal N -representability problem

Department of Statistics

- Lewis, Charles
The countback method for analyzing sensitivity data

RUTGERS UNIVERSITY (13;8,0,0,5,0,0)

- Addis, David Fletcher
Generalizations of completely regular mappings and lifting spaces of maps through a light mapping
- Camillo, Victor Peter
Balanced rings and a problem of Thrall
- Cozzens, John Henry
Homological properties of the ring of differential polynomials
- Evanovich, Peter Jon
Galois groups of difference fields
- Levine, Jeffrey Michael
The injective hull of semisimple modules
- McCarthy, Douglas Robert
The topological degree and ordinary non-linear differential equations
- Pitasky, Roger Herman
 LP -theory of distributive lattices
- Zipse, Philip Wayne
Multiplicative σ -extensions of measures

Department of Statistics

- Dickinson, Peter C.
Properties of some non-parametric two-sample tests based on exceedances
- Dykstra, Otto, Jr.
The augmentation of experimental data in more than one independent variable
- Gutjahr, Allen Leo
Sequential hypothesis tests for semi-Markov processes
- Lasater, H. Alan
On the robustness of a class of continuous sampling plans under certain types of process models
- Trout, J. Richard
Uniform confidence bands and inverse estimation in certain regression models

STEVENS INSTITUTE OF TECHNOLOGY
(5;5,0,0,0,0,0)

- Astor, Peter
The fixed time, fixed endpoint control problem with quadratic cost
- Brown, Jeffrey M.
On the structure of twisted wreath products of groups
- Brown, Jerome Donald
Abstract logics
- Feldman, Eliot Dee
A closure property for an extension of the hyperprojective hierarchy

Kagan, Joel David
Self-dual algebras and a language of kind-W

NEW MEXICO

NEW MEXICO STATE UNIVERSITY(4;4,0,0,0,0)

Bahauddin, Mohammed
Some algebraic topology in the category of uniform spaces
Greer, Curtis Lavell
Rings of quotients
Leestma, Sanford Clay
Naturally pseudometrizable semigroups
McKnight, Conrad K.
A class of Banach sequences spaces

UNIVERSITY OF NEW MEXICO (10;9,0,0,1,0,0)

Burgmeier, James
On the reduction of classes of Fredholm integral equations to equivalent matrix problems
Dabboucy, Abdulla
A new characterization of Besicovitch almost periodic functions
Dahlgren Dirk
Adaptive nonlinear prediction and convergence rates
Hardy, Christopher
Right Baer semigroups
Harner, Charles
Transitive subgraphs of undirected and directed graphs
Holley, Frieda
The ideal and new interval topologies on lattice ordered groups
Newton, Mervin
Some principal differential ideals
Schoene, Andrew
Semi-groups and a class of singular perturbation problems
Simmons, Gustavus J.
A combinatorial analysis of finite minimal uniform covers
Walter, Charles
Conic Archimedean primes and Galois groups; density and non-archimedean ordered fields

NEW YORK

ALDEPHI UNIVERSITY (1;0,1,0,0,0,0)

Stevenson, John C.
On the annihilation of solar magnetic fields:
A numerical study

COLUMBIA UNIVERSITY (25;16,0,0,7,2,0)

Bak, Anthony E.
The stable structure of quadratic modules
Cassidy, Phyllis Joan
Differential algebraic subgroups of the general linear group
Cook, Dexter S.
Actions of finite groups on spheres

Goldfeld, Morris
Some methods of averaging in the analytic theory of numbers
Haboush, William J.
A theory of codimension one phenomena with an application to the theory of purely inseparable descent
Hsieh, David K.
The σ -compactification and topological properties associated with Banach algebras of functions
Johnsen, John
Some estimates in number theory
Kleinstein, Arnold D.
The Hamilton in a class of models for a quantum field theory
Liukkonen, John R.
Compactness conditions and duals of topological groups
Miller, John C.
The Hilbert irreducibility property and the inverse problem in the Galois theory of differential fields
Mosak, Richard D.
The L^1 - and C^* -algebras of $[FIA]_{\mathbb{B}}^{-}$ groups and their representations
Servedio, Frank J.
Prehomogeneous vector spaces
Small, Charles
The Brauer-Wall group of a commutative ring
Staples, Edmund B., III
An effective procedure for factoring a 3-manifold into primes
Stein, Michael R.
Central extensions of Chevalley groups over commutative rings
Wong Chak-kuen
A continuity theorem for Fuchsian groups

Department of Mathematical Education

Carroll, Constance Anne
Four logical inference forms: An analysis of difficulties and of the effect of small group instruction
Hoban, Michael J.
Transformation geometry in the junior high school

Department of Mathematical Statistics

Hertz, Ellen S.
On convergence rates in the central limit theorem
McCabe, George P., Jr.
Some problems in sequential discrimination
O'Reilly, Neville E.
On applications of the invariance principle on finite and semi-infinite time intervals
Rutledge, Robert A.
The survival of epistatic gene complexes in subdivided populations
Stanley, Richard M.
Boundary crossing probabilities for the Kolmogorov-Smirnov statistics

- Strauss, Stephen J.
Random fragmentation of a rod
- Wind, Serge L.
An empirical Bayes approach to the multiple linear regression problem
- CORNELL UNIVERSITY (31;16,0,5,8,0,2)
- Alton, Donald Alvin
Uniformities in recursively enumerable sets
- Brownawell, Woodrow Dale
Some transcendence results for the exponential function
- Cutler, William Henry
Negligibility and deficiency in Fréchet manifolds
- Geoghegan, Ross
Topological and simplicial properties of function-spaces, and a stability theorem for spaces of homeomorphisms and embeddings
- Goodman, Victor Wayne
Regularity properties of harmonic functions on Hilbert space
- Halperin, John Stephen
Real cohomology and smooth transformation groups
- Harris, Lawrence Albert
Schwarz's lemma and the maximum principle in infinite-dimensional spaces
- Jeroslow, Robert Gerard
Uses of self-reference in arithmetic
- Kainen, Paul Chester
Universal coefficient theorems and weak adjoint functors
- Krikorian, Nishan Kay
Manifolds of maps
- Kuo Hui-hsiung
Integration theory on infinite-dimensional manifolds
- Morris, Robert Alan
The reciprocity isomorphisms of class field theory for separable field extensions
- Newman, Kenneth Wilfred
Topics in the theory of irreducible Hopf algebras
- O'Byrne, Brian Kenneth
On Finsler geometry and applications to Teichmüller spaces
- Ollmann, Loyal Taylor
Operators on models
- Speiser, Robert David
Cohomological dimension and abelian varieties
- Department of Biometry
Hedayat, Abdossamad
On the theory of the existence, non-existence, and the construction of mutually orthogonal F-squares and Latin squares
- Department of Computer Science
Boggs, Paul Thomas
The solution of nonlinear operator equations by A-stable integration techniques
- Borodin, Allan Bertram
Computational complexity and the existence of complexity gaps
- Elder, Howard Anthony
On the feasibility of voice input to an on-line computer processing system
- Kerr, Leslie Robert
The effect of algebraic structure on the computational complexity of matrix multiplication
- Lewis, Forbes Downer
Unsolvability considerations in computational complexity
- Department of Economic and Social Statistics, New York State School of Industrial and Labor Relations
Chapman, David
Cluster sampling and approximate distribution-free confidence intervals for a median
- Department of Operations Research
Baker, Kenneth Robert
Control policies for an integrated production and inventory system
- Bawa, Vijay Singh
Asymptotically optimal ranking and selection procedures
- Eisner, Mark J.
On duality in infinite-player games and sequential chance-constrained programming
- Hooke, John A.
Some limit theorems for priority queues
- Jaquette, David Leaf
Mathematical models for the optimal control of epidemics and pest populations
- Katumanu, Prasadarao V.
Continuous time Markov decision models with applications to optimization models
- McCaughran, Donald A.
A method for constructing joint confidence limits on an ordered set of parameters
- Nocturne, Dominique
Asymptotic efficiency of the maximum likelihood estimates with the parameters of certain stochastic processes
- NEW YORK UNIVERSITY (33;14,15,0,4,0,0)
- Berenstein, Carlos Alberto
Convolution operators and related quasianalytic classes
- Brigham, Robert
Non-isomorphic metabelian just-infinite groups with isomorphic finite epimorphic images
- Cain, Richard N.
The Leray spectral sequence for generalized cohomology
- Deem, Gary S.
A nearly-normal theory for decaying, zero-mean turbulence
- Denes, John
Definable automorphisms in model theory

- Folguera, Hugo Carlos
Some problems in the nonlinear theory of plates
- Glass, Michael
Perturbation of a first order equation by a small diffusion
- Goldstein, Ronald A.
Stability of the boundary value problem for harmonic mappings
- Gottlieb, Ellen R.
A variational principle for periodic waves of infinite depth
- Hochberg, Murray
Meshalkin systems and the reliability theory of multicomponent structures
- Horowitz, Robert
Two dimensional special linear characters of free groups
- Kaminetzky, Lee
The determination of some diffraction coefficients
- Kerzman, Norberto L. M.
Holder and L^p estimates for solutions of $\bar{\partial} u = F$ in strongly pseudoconvex domains
- Kim, Hong W.
On commutative nilpotent transformations
- Klein, Morris M.
Shape and stress of a supported balloon
- Korn, David G.
Computation of shock-free transonic flows for airfoil design
- Leibowitz, Martin
Promise date policies in inventory theory
- McHugh, James
New results in turning point theory
- Papanicolaou, George
On stochastic differential equations and applications
- Poss, Samuel
Residual properties of free groups
- Proshan, Joshua Harris
On the changes of sign of a certain class of error functions
- Rechtschaffen, Rudolph
Weak convergence of the empiric process for independent random vectors and the joint asymptotic normality of linear combinations of component order statistics
- Rorres, Chris
Multiple channel potential scattering and simple scattering by an inhomogeneous medium or by a potential
- Rosen, Lon Michael
A quantum field theory without cutoffs for self-interacting bosons
- Steinberg, Howard
Buckling of a heavy circular plate resting on an elastic foundation
- Sussmann, Hector J.
A differential operator with nonintegrable potential
- Turkel, Eli
Frontal motion in the atmosphere
- Vogel, John W.
Theoretical and numerical studies of the deflection of thin elastic sheets
- Watson, Mary Anderson
The Plancherel measure for the hyperbolic groups $SO(1,p)$
- Wenzel, Alan
Propagation of acoustic waves in a turbulent medium
- Quantitative Analysis Area
- Letendre, Emile, J. Jr.
Economics of scale in the operating costs of N. Y. State savings banks
- Shih, Wei
An analysis of shortage penalties in a dynamic inventory model
- Simkowitz, Michael A.
Quadratic portfolio selection with theoretically predicted inputs
- POLYTECHNIC INSTITUTE OF BROOKLYN
(4;3,0,0,1,0,0)
- Badalamenti, Anthony Francis
The structure of the Fourier coefficients of the kernel of $L^2(G)$
- Lieb, Murray Ira
A Monte Carlo method for certain types of Hammerstein integral equations
- Ratner, Phillip
Ramification groups of infinite Galois extensions
- Staum, Richard
Non-archimedean structures
- RENSSELAER POLYTECHNIC INSTITUTE
(13;0,9,1,0,0,3)
- Boudjelkha, Mohammed T.
Half space and quarter space Dirichlet problems for $\Delta u - \lambda^2 u = 0$
- Day, William B.
Stochastic boundary value problems
- Drew, Donald A.
Development and application of averaged equations for multiple phase media
- McCammon, Stephen R.
On complementary pivoting
- Minch, Roland A.
On generalizations of differentiability and convexity
- Palmer, Lloyd G.
Paramountcy of impedance and admittance matrices
- Price, Arthur L.
Complementary problems for strongly copositive operators
- Thomas, Larry E.
Some problems in self-excited stochastic differential equations
- Wollkind, Robert A.
A linear stability analysis of a two-dimensional fluid flow in a constantly rotating system

Department of Computer Science

Bishko, Donald

Planning for common mineral resources in the urban-suburban environment: A computer simulation approach

Department of Operations Research and Statistics

Abranovic, Wynn A.

A computer simulation approach for planning in hospital auxillary services

Mohoney, Frank J.

The design of experiments for regression analysis by computer search procedures

Salkin, Harvey M.

Enumerative algorithms for integer and mixed integer programming

ROCKEFELLER UNIVERSITY (1;1,0,0,0,0,0)

Donaghey, Robert

Algebraic complexes arising in the study of chemical systems

STATE UNIVERSITY OF NEW YORK AT BUFFALO (3;0,0,0,3,0,0)

Department of Statistics

Bircher, John Jacob

An age-dependent branching process with arbitrary state space

Nair, K. Aiyappan

Some topics in the multi-dimensional age-dependent branching processes

Schotz, William E.

Theoretical values for the labelling and mitotic indices associated with pulse, continuous and double label experiments

STATE UNIVERSITY OF NEW YORK AT STONY BROOK (5;0,5,0,0,0,0)

Department of Applied Analysis

Balakrishnan, V. K.

An application to the causality of convolution operators

Buanouckas, Francis R.

Distributional semi-groups, semi-groups, and passive Hilbert-ports

Lee Doo-sung

Fourier methods in elastostatic mixed boundary value problems

Meidan, Reuven

The mathematical foundation of translation varying operators

Sevian, Walter Andrew

One dimensional transient flow through porous media

SYRACUSE UNIVERSITY (3;0,0,3,0,0,0)

Department of Systems and Information Science

Bray, David William

Formal languages considered as abstract structures

Seemann, M. Dale

A combinatorial investigation of linear block codes

Wengert, Robert

On a certain conjecture concerning mechanical proof procedure in first order logic with equality

UNIVERSITY OF ROCHESTER (5;5,0,0,0,0,0)

Chae Soo-bong

Holomorphic germs on Banach spaces

Freiwald, Ronald Charles

Images of Borel sets and k-analytic sets

Lal, Nand

Isometries of H^p spaces derived from logmodular algebras

O'Reilly, Sean B.

Adequate, completely adequate and standardized neighborhood systems

Orfinger, Ellen

Fibre products of algebraic curves

YESHIVA UNIVERSITY (4;4,0,0,0,0,0)

Beller, Elliot

Polynomial extremal problems in L^p and l_q

Teitz, Elazar Mayer

Pseudo-Fredholm operators

Walker, Sue Ann

Tableau systems for first order number theory and certain higher order theories

Webber, Carroll Aubrey, Jr.

Subrecursive hierachies and classification algorithm

NORTH CAROLINA

DUKE UNIVERSITY (11;10,0,0,1,0,0)

Anderson, David H.

Study of certain subspaces of a measure algebra

Bookhout, Glenn Allen

Relations among certain dimension functions

Dunning, William C.

On the solution of cubic equations in a finite field

Grimson, Roger

Enumeration of rectangular arrays

Lobb, Barry Lee

A study of uniformity-dependent dimension functions

Milton, Emmette Ohmer, III

Asymptotic behavior of transforms of distributions

Nash, Humphrey H.

Single variable Bell polynomials

Nichols, Joseph Caldwell

Equivalent metrics giving different values to metric-dependent dimension functions

Piech, Jeffrey Lawrence

The distribution of the number of lines in the random intersection of two graphs

Wagner, Carl George
Interpolation polynomials for $GF(q,x)$
Weber, James King, Jr.
Complementation in the locally convex spaces
 L_p^+ and L_p^-

NORTH CAROLINA STATE UNIVERSITY
(15;0,5,0,8,0,2)

Bolen, David Winton
A random walk with a drift arising from a learning model
Brown, Stephen Hunt
On rationally complete modules
Harbertson, Noal Cope
Integral manifolds for perturbed nonlinear differential equations
Krider, Daniel Wood
Localization of non-commutative rings
Williamson, Norman Francis
Some topics in system theory

Department of Statistics

Davis, Clarence Edwards
Some measures of skewness
Goldsmith, Charles Harry
Three-stage nested designs for estimating variance components
Gregory, Walton Carlyle
Design procedures and use of prior information in the estimation of parameters of the non-linear model
Helms, Ronald William
A procedure for the selection of terms and estimation of coefficients in a response surface model with integration-orthogonal terms
Johnson, Mark Allyn
On the Kiefer-Wolfowitz process and some of its modifications
Lee Eun-sul
Aspects of institutional mobility patterns of chemists in higher education
McBride, Leon Curtis
A study of the distribution pattern of the incorporation of radioiron into rat liver ferritin
Michaels, Scott Edward
Optimization of testing and estimation procedures for a quadratic regression model
Sehult, Allan Henry
On unbiased estimation of density functions
Weber, Donald Chester
A stochastic model for automobile accident experience

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL (16;4,0,0,12,0,0)

Blanchard, Andrew Allan
A categorical study of mathematical structures
Greim, Barbara Ann
The algebraic structure of semigroup rings
Radford, David Eugene
Rationality and the theory of coalgebras

Winton, Charles Newton
Derived quotient modules and orders in quasi-Fröbenius rings

Department of Biostatistics

Fergany, Nader A.
On the macro-dynamic stochastic treatment of the size and age structure of a human population
Gaines, Rose E.
Some multivariate methods in human genetics with special consideration of the problems of separation into genetically distinct groups and twin discrimination
Haseman, Joseph Kyd
The genetic analysis of quantitative traits using twin and sib data
Hogan, Michael Dennis
Comparison of duodenal ulcer surgical procedures
Talwar, Prem Prasad
Age patterns of fertility

Department of Statistics

Cole, James W.
Multivariate analysis of variance using patterned covariance matrices
Ghosh, Malay
Asymptotically optimal nonparametric tests for miscellaneous problems of linear regression
Kleinbaum, David G.
Estimation and testing hypotheses for generalized multivariate linear models
Kupper, Lawrence L.
Optimal response surface techniques using Fourier series and spherical harmonics
Read, Campbell B.
On minimizing the risk in certain sequential tests, for known or unknown cost
Sproule, Raymond N.
A sequential fixed-width confidence interval for the mean of a U-statistic
Weissner, Edward W.
Multitype branching processes on random environment

OHIO

CASE WESTERN RESERVE UNIVERSITY
(8;5,0,0,1,0,2)

Department of Mathematics and Statistics

Altinger, Joseph
Normalizers of permutation groups
Carlson, David Helmer
Extensions of dynamical systems via prolongations
Chan Pui-ying (Paula)
Approximation theory with emphasis on spline functions
Dailey, James William
Approximation by spline-type functions and related problems

Simanaitis, Dennis Joseph
Limit sets in dynamical systems
Warner, James Ernie
Asymptotic properties of multivariate permutation tests

Department of Operations Research

Balinsky, Warren L.
Some manpower models based on educational attainment
Izzet, Sahin
Some stochastic systems with secondary inputs

OHIO STATE UNIVERSITY (16;14,0,0,2,0,0)

Brown, Dean Raymond
B-convexity in Banach spaces
Dudgeon, Charles Robert
On the exact power functions of some rank tests
Fong Sek-ching (Humphrey)
Contributions to the ergodic theory of semi-Markovian operators
Hale, Douglas Fleming
Studies involving single hydrogen-bridge boranes
Hern, Thomas Albert
Error estimates for the weak convergence of certain infinitely divisible probability distributions
Hogan, Guy Theodore
Variations on the H_p problem for finite p-groups
Kimble, Kenneth Richard
On the algebraic closure of the field of Mikusinski operators
Klein, Albert Jonathan
Semi-uniform spaces and hyperspace construction
Krier, Nicholas K.
On infinite ovals and Möbius planes
Kunes, Laurence Edward
Error estimates for the normal approximation to normed sums of random variables of a Markov chain
Mathis, Robert Fletcher
Error bounds in discrete potential theory
Meeks, Joseph
Measure in proximity structures
Price, Bertram Phillip
Distribution free estimation
Scott, Frank Lee
A new hyper-uniformity with applications to multi-valued mappings
Wee Leben-li
Integral of real-set-valued set functions with respect to Banach-set-valued measures
Wilson, Richard Michael
An existence theory for pairwise balanced designs

UNIVERSITY OF CINCINNATI (1;1,0,0,0,0,0)

Huebener, Mary Jeannette
Complimentation in the lattice of regular topologies

UNIVERSITY OF TOLEDO (2;1,1,0,0,0,0)

Robinson, Richard A.
Some theorems related to pattern recognition
Schwartz, Howard J.
Composition operators on H^p

OKLAHOMA

OKLAHOMA STATE UNIVERSITY (12;5,0,0,2,5,0)

Department of Mathematics and Statistics

Butler, Ronald G.
Metrization of Moore spaces
Dowdy, James Edward
Hochschild, Shukla and cotriple cohomologies of Lie algebras
Flowers, Joe Dale
Facial cones, local similarity and indecomposability of polytopes
Hajek, Francis B.
A study of a learning set hierarchy encountered in learning the concept of the limit of a function
Ikard, Thomas E.
Summability methods, sequence spaces and applications
Krehbiel, Jesse D.
An introduction to the theory of partitions
Littell, Ramon C.
Properties of Bahadur efficiency
MacKinnon, Ronald J.
Elementary approaches to Waring's problem
Magalit, Henry F.
Detecting a change in the mean of a normal distribution at an unknown time
Mosley, Edward N.
A study of valuations of general rank
Rakestraw, Roy Martin
Convex cones on n-monotone functions
Snook, Verbal M.
A study of P-adic number fields

UNIVERSITY OF OKLAHOMA (9;5,0,0,4,0,0)

Freivald, Joseph Allen
General algebras and their manipulative syntaxes
Growney, Jo Anne Simpson
Finitely generated free groupoids
Growney, Wallace James
Edge conjugation and coloration in cubic maps
Knickmeyer, Joe Wilbur
Generalizations of connexions on manifolds and submanifolds
Womble, Eugene Wilson
Convexity structures and the theorems of Carathéodory, Radon, and Helly

Department of Biostatistics and Epidemiology

Dorr, Albert Ernest
An empirical investigation of the multivariate multiple sample location problem
Duncan, Karen Marie Atkins
On robustness of the F-test for correlated observations

- Folk, Earl Donald
An analysis and simulation of R-R intervals
- Parker, Earl Donald
The analysis of biological data collected systematically and pseudo-systematically over time

OREGON

OREGON STATE UNIVERSITY (13;8,1,1,3,0,0)

- Alameddine, Ahmad Faouzi
Auxiliary conditions for the convergence of sequences of measurable functions
- Al-Ayat, Rokaya Abdel-Ghani
Initial and boundary value problem for a third order differential equation of parabolic type
- Elwin, John David
Homology theories on the mapping category
- Gabrielsen, Ralph Edwin
Numerical aspects of the inverse Sturm-Liouville problem
- James, Ralph Leland
Convergence of positive operators
- Main, Robert Vaughn
A critique of the incidence and order axioms of geometry
- Nelson, Thomas Clayton
Universal computing systems: (1) Simulation of any normal algorithm by Turing machine; (2) A universal Turing machine to translate any Turing machine to a normal algorithm
- Short, Donald Ray, Jr.
On the theorems of Sard and de Rham
- Southam, James Lewis
The generating function for three-line partitions
- Zelver, Jack Solomon
The integro-geometric tangent measures of euclidean n-space

Department of Statistics

- Hirunraks, Anek
Nonparametric C-sample tests for arbitrarily censored data
- Reinmuth, James E.
Empirical studies on the estimation of variances in linear regression models
- Youssef, Mary N.
Optimization techniques for time-shared computer systems

UNIVERSITY OF OREGON (15;15,0,0,0,0,0)

- Burrowes, Theodore Cooley
Numerical differentiation using complex arithmetic
- Comisky, Clifford Victor
Multipliers of Banach modules
- Cunningham, Joel Luther
The quotient sheaf of a valuation ring and some results on primes
- Cunningham, Robert Steven
Strongly separable pairings of rings

- Dressler, Robert Eugene
On an extension of natural and asymptotic density
- Gage, Howard Raymond
Fourier analysis on convolution Orlicz algebras
- Gislason, Gary Allen
On the characterization and construction of best non-linear Tchebycheff approximations with interpolation
- Hawley, Douglas Neil
Fourier analysis on a-adic solenoids
- Hubbart, Wayland Michael
Blocks of representations of finite groups over local fields
- Jones, Ben Jeral
Flat covers of modules over local rings
- LaDuke, Alice Jeanne
 Σ^P
- Parker, Willard Albert
Central Sidon sets and central Λ_p sets
- Perrie, Andrew Leslie
Uniform rational approximation with osculatory interpolation
- Schmidt, Harvey John, Jr.
The \mathcal{L} -crucial depth of an \mathcal{L} -covering subgroup
- Tucker, Lloyd David
Compact continuously quasi-ordered spaces and order connectedness

PENNSYLVANIA

CARNEGIE-MELLON UNIVERSITY (14;5,1,6,2,0,0)

- Bandyopadhyay, Utpal Kumar
Integral representations of nonlinear transformations
- Chi Yu-hua (George)
Non-linear prediction and multiplicity theory of generalized random processes
- Fisher, Edward Russell, Jr.
Toward integration without fear
- Gifford, Theodore Joseph
Boundary value problems for a class of odd-order partial differential operators
- Haytock, Benjamin David
Numerical methods in linear analysis
- McDermot, Richard Frederick
A computer method for the factorization of polynomials over the integers
- Trapp, George Elmer, Jr.
Operator algebra related to network theory
- Weir, Maurice Dean
A treatise on realcompactness

Department of Computer Science

- Berglass, Gilbert R.
A generalization of macro processing
- Fisher, David A.
Control structures for programming languages
- Freeman, Peter A.
Sourcebook for OSD--An operating system designer

King, James C.
A program verifier
Shoup, Richard G.
Programmable cellular logic arrays

Department of Statistics

Waugh, Kenneth Richard
Statistical information based on uncertainty functions

LEHIGH UNIVERSITY (7;6,1,0,0,0)

Guyker, James
Reducing subspaces of contractions with no isometric part
Herz, James Rudolph, Jr.
Almost conservative and almost regular matrices
Laverell, William David, Jr.
Spaces of continuous functions
Levko, John James, III
Curvature and homology of compact Riemannian manifolds
Narayan, Yogishwar
Uniform splitting of Nth order linear differential equations containing a small parameter
Stern, Louis William
Conformality and isometry of Riemannian manifolds to spheres

Department of Mechanical Engineering and

Mechanics

Kiral, Erhan
On the constitutive relations for anisotropic materials

PENNSYLVANIA STATE UNIVERSITY

(23;15,0,2,2,4,0)

Ault, Janet
Extensions of primitive inverse semigroups
Chimenti, Frank A.
A study of convergence in the power set
Crotty, David W.
Algebraic structure theory: Its impact on probability and mathematical statistics
DeVries, David John
Lattices of equivalence relations and generalized primes
Fennemore, Charles Frederick
All varieties of bands
Hall, Robert Eugene
The structure of certain commutative separative and commutative cancellative semigroups
Jain, Darshan Lal
Solutions of various boundary-value problems by integral equation techniques
Judd, William Boyd
A proposed sophomore-level experimental course in geometric algebra based primarily on the work of Emil Artin
Keleman, Charles Ferenc
Topological semigroup actions
Kim Taeboo
Investigation of a differential-boundary opera-

tor of the second order with an integral boundary condition on a semi-axis

Kost, Franklin Calvin
On compactifications of Wallman-type
Lavelle, John
Fermat's Last Theorem in fields of algebraic functions
Marty, Roger Henry
Mazur theorem and m-adic spaces
Parberry, Edward Allen
On a partition function related to a theorem of Schur
Platt, Craig R.
Iterated limits of universal algebras
Smith, Robert Sefton
On the distributivity of filter and ideal lattices
Thanigasalam, Kandiah
Some results in the additive theory of numbers
Vancko, Robert M.
Local independence in finite universal algebras
Wasileski, John
Compactifications

Department of Computer Science

Campbell, Graham Murray
On the numerical solution of Volterra integral equations
Fornaro, Robert Joseph
Numerical integration around a simple closed contour

Department of Statistics

Godambe, Ashok Vasant
Some problems related to the study of random matrices
Janardan, Konanur G.
On a class of multivariate hypergeometric models

UNIVERSITY OF PENNSYLVANIA (6;0,0,6,0,0,0)

Moore School of Electrical Engineering

Bernstein, Noel
An interactive general purpose computer animated two-dimensional movie system with real-time viewing capabilities implemented on a small machine
Kapps, Charles
SPRINT: A programming language with general structure
Levy, Leon
Generalized local adjunction and replacement in adjunct languages
Lomet, David B.
The construction of efficient deterministic language processors
O'Neil, John
An interactive language design system
Selkow, Stanley
Pattern recognition in neurophysiology

UNIVERSITY OF PITTSBURG (8;6,1,0,1,0,0)

Bordon, Robert S.
The approximation property for Banach spaces

Chi Han-hua (Donald)
 Linear multistep methods based on G-splines
 McKean, Joel Mercer
 Term-relation | n numbers and Weierstrass' final theorem of arithmetic
 Reynolds, Richard Francis
 Differentiable manifolds with singularities
 Sacks, Hershel
 On the summability of the Cauchy product of Cesáro summable series
 Schweinsberg, Allen Ross
 L^p spaces of vector-valued functions

Michener, James Cope
 A flowchart programming system
 Orth, William Albert
 Linearized secondary flow between concentric cylinders with a narrow annulus
 Richardson, Thomas George
 The sound propagation problem in kinetic theory
 Stahl, Neil
 Theory of continuum flush probes
 Vitale, Richard Albert
 Regression in time series and convolutions on a group

Department of Industrial Engineering

Barnoon, Shlomo
 A sequential decision model for the selection of treatment procedures
 Turksen, I. B.
 Micro level resource allocation and forecasting models with an information system for universities

RHODE ISLAND

BROWN UNIVERSITY (18;6,12,0,0,0,0)

Abe, Kinetsu
 Relative curvature and applications to submanifolds in space forms
 Derrig, Richard A.
 C^* -algebras of multipliers and operators induced by measure preserving transformations
 Erbacher, Joseph A.
 Isometric immersions of Riemannian manifolds into space forms
 Ernst, Lawrence R.
 A proof that C^2 and T^2 are distinct measures and a characterization of certain Cartesian product measures by invariance
 Tillman, Stephen J.
 On quadratic forms over a certain class of function fields
 Weiss, Michael D.
 Restricted topological entropy and its application to problems in ergodic theory

Division of Applied Mathematics

Anton, John Joseph
 Convolution systems with large input
 Baker, Robert Leslie
 Linear instability of finite amplitude waves on shallow water
 Ganz, Anthony Adams
 The suction flow problem in kinetic theory
 Halabisky, Lorne Stanley
 On the structure of dissipative waves in 2 and 3 dimensions
 Haussmann, Wolf-Ulrich G.
 Harmonic analysis of Banach space
 Johnson, Gregert Darrow
 Time symmetry and acausality in classical electrodynamics
 McClure, Donald Ernest
 Feature selection for the analysis of line patterns

SOUTH CAROLINA

CLEMSON UNIVERSITY (3;2,1,0,0,0,0)

Haw, Larry Stoddard
 Factorization of certain convolution algebras and related properties
 Perkins, John Cleveland
 Symmetric involutory matrices over fields of characteristic two
 Suber, Harry Hammond
 Integral manifolds for perturbed systems

UNIVERSITY OF SOUTH CAROLINA (3;3,0,0,0,0,0)

Bland, Paul Edwin
 On rational and quasi-rational extensions of modules
 Conduff, Green Childress, Jr.
 Quotients of Hom and torsionness
 Faires, John Douglas
 Comparison of the states of a pair of closed linear transformations acting between two Banach spaces

TENNESSEE

GEORGE PEABODY COLLEGE FOR TEACHERS (1;0,0,0,0,1,0)

Grunwald, George B.
 The relative effectiveness of three types of help sessions when teaching a large section of mathematics to prospective elementary teachers

UNIVERSITY OF TENNESSEE (7;6,1,0,0,0,0)

Chadick, Stanley R.
 Topology of cluster sets for bounded analytic functions
 Feliciano, Manuel, Jr.
 Geometric properties of solutions of the differential system $X' = Ax$
 Funderlic, Robert Edward
 Norms and semi-inverses
 Lawson, Laura Miller
 The multiplicative semigroup of a ring
 Kurtz, Lawrence Alfred
 Condensation on fluted surfaces
 Mislove, Michael William
 Four problems about compact semigroups

Wall, Charles Robert
Topics related to the sum of unitary divisors
of an integer

VANDERBILT UNIVERSITY (3;3,0,0,0,0)

Bang Chang-mo
Modules over complete discrete valuation rings
Hong Dang-xuan
Covering relations among lattice varieties
Kilgore, Mary Spruill
Retracts, deformations, and Borsuk's notion
of shape

TEXAS

RICE UNIVERSITY (12;12,0,0,0,0)

Carmignani, Robert
Envelopes of holomorphy and holomorphic con-
vexity
Dennis, Roger Keith
Presentations for the elementary group, and
the functor K_2
Formanek, Edward W.
Matrix techniques in polycyclic groups
Heil, Wolfgang H.
On irreducible 3-manifolds which do not con-
tain projective planes
Huang Wu-hsiung Ushi
(I) Integral formulae in spheres; (II) Minimal
submanifolds in CP_n
Hunt, Louis R.
On the envelope of holomorphy of a two sphere
Kemper, John T.
Kernel functions and parabolic limits for the
heat equation
Pickel, Paul Frederick
On the isomorphism problem for finitely
generated torsion free nilpotent groups
Roeling, Lloyd Glaser
Reducing the genus of a Heegaard splitting
Vanderschel, David Jon
A theory of approximate inverses for the solu-
tion of matrix equations by iteration
Wilkerson, Clarence Wendell, Jr.
K-theory techniques in H-spaces
Windham, Michael Parks
Deformation spaces of period matrix domains
of compact Kähler surfaces

SOUTHERN METHODIST UNIVERSITY
(9;0,0,0,9,0,0)

Department of Statistics

Bratcher, Thomas Lester
A Bayesian treatment of a multiple comparison
problem for binomial probabilities
Durling, Frederick C.
Bivariate probit, logit and burrit analysis
Dyer, Danny Dee
Parametric estimation in a doubly truncated
bivariate normal distribution
George, Stephen L.
Partial prior information: Some empirical

Bayes and G-minimax decision functions
Matlock, Gibb Blanks
Statistical theory for the detection of signals
under linear scale transformations
Pope, Paul Terrell
On the stepwise construction of a prediction
equation
Schucany, William Roger
The reduction of bias in parametric estimation
Seibert, Guy Burton, Jr.
Estimation and confidence intervals for quantal
response of sensitivity data
Wysocki, Robert K.
Some useful generalizations in Markov renewal
processes

TEXAS A & M UNIVERSITY (16;1,6,2,7,0,0)

Crawley, Alton R.
Optimum Runge-Kutta formulas of fourth and
fifth-orders

Department of Industrial Engineering

Bateman, Barry L.
Generation of representative geologic strata
suitable for simulation of fluid flow
Bleuel, William H.
Optimum packaging design and component
sharing policies for repairable complex sys-
tems
Brown, Sidney P.
The effects of cannibalization on the optimal
transition of multi-unit,-component systems
under end transients
Gensler, Philip J.
A model to simulate a monitoring device for
investigating the locomotion pattern of fish
Jones, Hubert
Network planning based on the gamma distri-
bution
Trimble, Clifford J.
Development of an analysis logic for electronic
warfare effectiveness evaluation
Sharif, Mohammad N.
Stochastic planning procedure for water re-
source system design
Sims, Robert L.
Flow system evaluation and optimization

Institute of Statistics

Ghangurde, Prabhakal D.
Contributions to Bayesian optimization in samp-
ling and sampling in time
Hartmann, Norbert A., Jr.
An extension of the maximum F ratio with
unequal degrees of freedom
Johnston, Walter E.
Estimation and classification problems in the
fixed model analysis of variance
Katiyar, Anand Singh
Contributions to the stability of variance esti-
mators and the regression estimator
La Motte, Lynn Roy
Selection of regression variables and contri-

butions to the estimation of variance components

Matis, James Henry

Stochastic compartment analysis: Model and least squares estimation

Oxspring, Harry Hollis

Optimal estimation of multivariate parameters from fragmentary data

TEXAS CHRISTIAN UNIVERSITY (8;8,0,0,0,0)

Guthrie, Joe Alston

On some generalizations of metric spaces

Henry, David Michael

On the images of a stratifiable space under certain open and pseud-open mappings

Higgins, Stanley Bruce

Some generalizations of paracompactness

Martin, Jack Cornelius

Categorical bases in Banach spaces

Mastin, Charles Wayne

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Wilson, Robert Lee, Jr.

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Graphs and ultrapowers

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- Feng Yan-kwang
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On the regularity of the locally integrable and continuous solutions of the functional equations

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Department of Applied Mathematics

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ABSTRACTS OF CONTRIBUTED PAPERS

The October Meeting in Washington, D. C.

October 31, 1970

Algebra & Theory of Numbers

678-A1. ROBERT L. HEMMINGER, Vanderbilt University, Nashville, Tennessee 37203. Isomorphism-induced line isomorphisms on pseudographs.

Whitney ["Congruent graphs and the connectivity of graphs," Amer. J. Math. 54(1932), 150-168] has shown that, with four exceptions, line isomorphisms between finite graphs are induced by isomorphisms. Jung ["Zu einem isomorphiesatz von Whitney für graphen," Math. Ann. 164(1966), 270-271] has since shown that the assumption of finiteness can be dropped. In this paper we characterize the line isomorphisms between pseudographs (loops and multiple lines are allowed) that are not induced by isomorphisms. This generalization of the graph case is obtained by a method similar to that used by Jung. (Received June 22, 1970.)

678-A2. ROGER C. ENTRINGER, University of New Mexico, Albuquerque, New Mexico 87106, PAUL ERDÖS, Mathematical Institute, Hungarian Academy of Science, Reáltanoda Utca 11-13, Budapest 9, Hungary and CHARLES C. HARNER, Sandia Corporation, Albuquerque, New Mexico 87115. Some extremal properties concerning transitivity in graphs.

A directed graph D is transitive iff arc ac is in D whenever arcs ab and bc are in D . We show that for all tournaments T_n on n points, with $o(2^{\binom{n}{2}})$ exceptions, the largest transitive subgraph of T_n contains fewer than $(1/4)\binom{n}{2} + cn^{3/2}$ arcs for a suitable constant c . Results concerning the size of bipartite subgraphs of tournaments and transitive graphs are also obtained. (Received September 4, 1970.)

678-A3. F. A. FICKEN, New York University, Bronx, New York 10453. More on generalized inverses.

Let $L = \begin{bmatrix} A & B \\ C & D \end{bmatrix}$ be a given $m \times n$ block matrix of complex constants with rank $L = r = A$; hence $D = CA^{-1}B$. Let an asterisk denote conjugate transpose. We construct block matrices $M = \begin{bmatrix} P & Q \\ S & T \end{bmatrix}$, with blocks of appropriate sizes, to meet certain familiar conditions involving L . (1) As shown also by N. S. Urquhart (SIAM Rev. 11(1969), 268-271), $LML = L$ if and only if $P = A^{-1} - QCA^{-1} - A^{-1}BS - A^{-1}BTCA^{-1}$, with $Q, S,$ and T arbitrary; we designate this P , henceforth fixed, as P_1 . (2) Define $G = (AA^* + BB^*)^{-1}$ ($= G^*$). Then $LML = L$ and $(ML)^* = ML$ if and only if $P = P_1$ and $S = B^*G - TCA^{-1}$, with Q and T arbitrary. (3) Define $H = (A^*A + C^*C)^{-1}$ ($= H^*$). Then LML and $LM = (LM)^*$ if and only if $P = P_1$ and $Q = HC^* - A^{-1}BT$, with S and T arbitrary. (4) Finally, if we wish $LML = L$, $(ML)^* = ML$, $LM = (LM)^*$, and $MLM = M$, the result is known to be unique. We must choose $T = B^*GAHC^*$, with $P = P_1$ and S as in (2) and Q as in (3). If we define $J = GAH$, then $M = \begin{bmatrix} A^*JA^*A^*JC^* \\ B^*JA^*B^*JC^* \end{bmatrix}$. (Received August 11, 1970.)

678-A4. JOE B. RHODES, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061. A characterization of modular semilattices by their retracts.

A (meet) semilattice is modular iff $w \geq a \wedge b$ implies that there exist $x \geq a, y \geq b$ such that $x \wedge y = x \wedge w$ (Joe B. Rhodes, Abstract 672-659, these *Notices* 17(1970), 272). A retract of a semilattice S is a subsemilattice of S that is an epimorph of S . Theorem. A semilattice S is modular iff each pair of elements of S has an upper bound in S and there is no retract of S isomorphic to the non-modular five lattice. Examples are given to show that the theorem is false if "retract" is replaced by "sublattice" or "subsemilattice". A summary is made of recent results in modular semilattices and the distributive analog of the above theorem is discussed. (Received August 19, 1970.)

678-A5. HENRY W. LEVINSON, Rutgers University, New Brunswick, New Jersey 08903. On the genera of graphs of group presentations. II.

It is shown that for a certain class of group presentations, if the graph of one of them is non-planar, then it must contain a subgraph homeomorphic to the Kuratowski graph K_6 . All less-than-one-sixth groups, in the sense of Martin Greenlinger ("Dehn's algorithm for the word problem," Comm. Pure Appl. Math. 13 (1960), 67-83) are contained in this class. A certain subclass of the above class has nonplanar graphs iff it contains a subgraph homeomorphic to one of a given set of graphs. This class of group presentations contains all less-than-one-24th groups whose defining relators are all of equal length. Examples are given of nonplanar less-than-one-24th families of groups, and it is shown that an algorithm exists to decide the genus of the graph of a less-than-one-24th group with a finite number of defining relators of equal lengths. (Received September 4, 1970.)

678-A6. ANTHONY E. HOFFMAN, State University of New York, Geneseo, New York 14454. Radical constructions in the presence of two universal classes.

For notation and terminology see Leavitt, Proc. Amer. Math. Soc. 24 (1970), 680-687. Let \mathcal{X} and \mathcal{Y} be universal classes of rings with $\mathcal{X} \subseteq \mathcal{Y}$. A subscript of \mathcal{X} or \mathcal{Y} on a letter denoting a class construction indicates in which universal class the construction is performed. A generalization of a result of Kurosh (Mat. Sb. 33 (1953), 13-26) is provided by Theorem 1. Let \mathcal{M} be an arbitrary subclass of \mathcal{X} . Then $\mathcal{L}_{\mathcal{X}}(\mathcal{M}) = \mathcal{X} \cap \mathcal{L}_{\mathcal{Y}}(\mathcal{M})$. Similar results are obtained for the upper radical construction and the semisimple class construction. Leavitt's smallest radical construction and smallest semisimple construction are respectively treated by Theorem 2. If F is an admissible function and \mathcal{M} is an arbitrary subclass of \mathcal{X} , then $\overline{\mathcal{M}}_{\mathcal{X}} \subseteq \mathcal{X} \cap \overline{\mathcal{M}}_{\mathcal{Y}}$. Theorem 3. If F is an s -admissible function and \mathcal{M} is an arbitrary subclass of \mathcal{X} , then $\overline{\mathcal{M}}_{\mathcal{X}} = \mathcal{X} \cap \overline{\mathcal{M}}_{\mathcal{Y}}$. For each of the last two theorems mild conditions are imposed on the triples $(\mathcal{X}, \mathcal{Y}, F)$. (Received September 8, 1970.)

Analysis

678-B1. WILLIAM S. HALL, University of Pittsburgh, Pittsburgh, Pennsylvania 15213. The bifurcation of periodic solutions in Banach spaces.

Let D be the smooth, 2π -periodic functions of $x \in \mathbb{R}_n$ and let X be its completion under $\|\cdot\|_X$. Suppose $L: D \rightarrow D$ is a symmetric partial differential operator and f is a Lipschitz continuous map of X to its conjugate X^* . When will the equation $Lu = f(x,u)$ have 2π -periodic solutions when there are non-zero members of X satisfying $Lu = 0$? If X is reflexive and M is the (generalized) null space of L we can prove: (1) Lemma. If $g \in M^0 \subset X^*$, and $\|L\varphi\|_{X^*} \cong k\|\varphi + M\|_{X/M}$ for each $\varphi \in D$, then there is a unique $u + M$ in X/M such that $Lu = g$ (weakly). (2) Theorem. Suppose L is as above, and assume for each $u \in X$ there exists $y(u) \in M$ such that $f(x, y(u) + u)$ annihilates M . If y is Lipschitzian in u then $Lu = f(x,u)$ has weak solutions in X provided f is "small". The proof of (1) involves an application to reflexive Banach spaces of P. Lax's "negative norm" method, while (2) is proved using a theorem of L. Graves on the perturbation of epimorphisms. (Received May 27, 1970.)

678-B2. JOAQUIN B. DIAZ, Rensselaer Polytechnic Institute, Troy, New York 12181 and DENNIS R. DUNNINGER, Michigan State University, East Lansing, Michigan 48823. Sturm theorems for a class of fourth order differential equations.

Separation and comparison theorems for differential equations of order greater than two appear to be relatively rare. We are concerned here with such theorems for a special class of fourth order ordinary and partial differential equations. For example, a typical theorem is as follows: Suppose $0 > c \cong C$, $c \not\cong C$, in a regular domain R . If there exists a positive solution u of the system $\Delta^2 u + cu = 0$ in R , $u = \Delta u = 0$ on ∂R , then every solution v of the system $\Delta^2 v + Cv = 0$ in R , $\Delta v = 0$ on ∂R , has a zero in R . (Received July 3, 1970.)

678-B3. PARFENY P. SAWOROTNOW, Catholic University of America, Washington, D. C. 20017. A characterization of Hilbert module. Preliminary report.

Let A be a proper H^* -algebra such that the norm of any two minimal projections in A are equal and let H be a right module over A . Assume further that H has a structure of a Hilbert space which is connected to the module structure of H by the identity $(\lambda f)a = f(\lambda a) = \lambda(fa)$, $f \in H$, $a \in A$, λ complex. If (1) the mapping $\langle f, a \rangle \rightarrow fa$ of $H \times A$ into H is continuous, (2) orthogonal complement M^\perp of any submodule M of H is also a submodule and (3) $fa = 0$ for all $a \in A$ implies $f = 0$, then H is a Hilbert module (Duke Math. J. 35(1968), 191-197). (Received July 10, 1970.)

678-B4. ROBERT E. ATALLA, Ohio University, Athens, Ohio 45701. P-sets in $\beta\mathbb{N} - \mathbb{N}$ and regular matrices. Preliminary report.

Let T be a nonnegative regular matrix, F be the filter of sets A such that $T\text{-lim } \chi_A = 1$, and K_F the corresponding closed set in $\beta\mathbb{N} - \mathbb{N}$. Henriksen and Isbell (Abstract 608-116, these *Notices* 11(1964), 90-91) showed that K_F is perfect and a "P-set", i.e., is interior to any G_δ set which contains it. Assuming the continuum hypothesis, we prove the following. Theorem 1. There exists a family of 2^c pairwise disjoint perfect nowhere dense P-sets contained in K_F . Corollary. There exist perfect

nowhere dense P-sets in $\beta N - N$ which do not correspond to any matrix. Theorem 2. Let G be a filter such that K_G is a P-set in $\beta N - N$, and such that $F \subset G$. The following are equivalent: (a) There is a sequence $\{m(k)\}$ and $t > 0$ such that for each $A \in G$, $\liminf_{k \rightarrow \infty} \sum \{t_{m(k),j} : j \in A\} \geq t$. (b) There is a submatrix S of T , $A \in G$ and $t > 0$ such that $S\text{-lim } \chi_A \chi_B = t$ for each $B \in G$. (Received August 31, 1970.)

678-B5. WILLIAM LEE BYNUM, College of William & Mary, Williamsburg, Virginia 23185. For p between 1 and 2, \mathcal{L}_p obeys a weak parallelogram law.

Theorem. If $1 < p \leq 2$ and x and y are in \mathcal{L}_p , then $\|x + y\|^2 + (p - 1) \|x - y\|^2 \leq 2 \|x\|^2 + 2 \|y\|^2$. (Received August 3, 1970.)

678-B6. PRAHLAD RAM GUPTA, Aggarwal Company, Kurali (Punjab), India. A few relations connecting real and imaginary parts of a Bessel function of the first kind.

Bessel functions of the first kind, $J_\nu(z)$, are considered for a complex argument $z = x \exp(iy)$. A few relations of generalized nature are derived to deal with its real and imaginary parts and their derivatives with respect to w , of which x and y are the real functions. Modified Bessel functions of the first kind, $I_\nu(z)$ and Ber_ν and Bei_ν functions follow corresponding to $y = \pi/2$ and $y = 3\pi/4$ respectively. (Received August 13, 1970.)

678-B7. PARFENY P. SAWOROTNOW, Catholic University of America, Washington, D. C. 20017 and GEORGE R. GIELLIS, U. S. Naval Academy, Annapolis, Maryland 21402. Continuity and linearity of centralizers on a complemented algebra.

Let A be a semisimple complemented algebra and let T be a mapping of A into itself such that either $T(xy) = xTy$ or $T(xy) = (Tx)y$ holds for all $x, y \in A$. If T is defined everywhere on A then T is a bounded linear operator. (Received August 17, 1970.)

678-B8. WILLIAM B. GORDON, Mathematics Research Center, U. S. Naval Research Laboratory, Code 7840, Washington, D. C. 20390. A theorem on the existence of periodic solutions to Hamiltonian systems with convex potential.

Theorem. Let V be a C^2 function on R^n which is strictly convex in a deleted neighborhood of a critical point (i.e., we suppose $\nabla V(0) = 0$ and that there exists a neighborhood N of 0 such that for all x in N , except possibly at $x = 0$, the eigenvalues of the matrix $(\partial^2 V(x) / \partial x_i \partial x_j)$ are all positive). Then there exist an infinite number of (nontrivial) periodic solutions to the dynamical equation $d^2x/dt^2 + \nabla V(x) = 0$ which lie in arbitrarily small neighborhoods of the critical point. The method of proof consists of exhibiting the solutions as critical points of a certain functional on an appropriate function space which are located by the method of steepest descent. Example. Suppose $V(x) = x \cdot Ax +$ higher order terms, where A is a symmetric matrix with positive eigenvalues $\lambda_1^2, \dots, \lambda_n^2$. Then V satisfies the conditions of the theorem. Hence our result extends the classical theorem of Lyapounov which asserts the existence of periodic solutions to the dynamical equation provided that none of the ratios λ_i/λ_j , $i \neq j$, is integral. (Received August 13, 1970.)

678-B9. NORMAN W. BAZLEY and HANS R. FANKHAUSER, Battelle Institute, CH-1227, Carouge-Geneva, Switzerland. Pointwise estimates of eigenfunctions for Schrödinger operators.

Let \mathfrak{H} be the Hilbert space $L^2(\mathbb{R}^3)$ and consider the eigenvalue problem $Au = -\Delta u + V(\vec{r})u = \lambda u$, where λ is an isolated eigenvalue and u is a corresponding normalized eigenfunction. A bound is obtained for the quantity $|u(\vec{r}) - v(\vec{r})|$, where v is a known normalized trial wave function. The estimate makes essential use of a Sobolev inequality, together with the assumption that V can be written as the sum of L^2 and L^∞ potentials. The error bound is expressed in terms of upper and lower bounds to certain of the eigenvalues of A and reduces to zero when they are exact and v is the true eigenvector. (Received August 24, 1970.)

678-B10. KONDAGUNTA SUNDARESAN, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213. Orthogonality and nonlinear functionals on L_p -spaces.

Let (X, Σ, μ) be a totally σ -finite nonatomic positive measure space. A real valued function on $L_p(\mu)$ ($1 \leq p \leq \infty$) is said to be orthogonally additive if it satisfies the following three conditions: (1) If $p = \infty$, then F is uniformly continuous relative to L_∞ norm on each bounded subset of L_∞ , and if $1 \leq p < \infty$, then F has the same property provided M is supported by a set of finite measure. (2) F is continuous on the Banach space $L_p(\mu)$ if $p < \infty$ and is continuous with respect to bounded a.e. convergence if $p = \infty$. (3) If $x, y \in L_p(\mu)$ and $x \perp y$, i.e. $\|x + \lambda y\| \cong \|x\|$ for all real λ , then $F(x + y) = F(x) + F(y)$. Theorem. If $1 \leq p \leq \infty$ and $p \neq 2$, a functional F is orthogonally additive on $L_p(\mu)$ if and only if F is a continuous linear functional on $L_p(\mu)$. F is orthogonally additive on $L_2(\mu)$ if and only if there exists a real number c and a function $\beta \in L_2(\mu)$ such that, for all $x \in L_2(\mu)$, $F(x) = \int (cx^2(t) + \beta(t)x(t))d\mu(t)$. (Received August 27, 1970.)

678-B11. JOSEPH DIESTEL, University of Florida, Gainesville, Florida 32601. Norm-order bounded maps. I.

Let X be any (real) Banach space, let Y be any vector lattice; denote by $B(X; Y)$ the linear space of all linear maps of X into Y which take norm bounded sets of X into order bounded sets in Y . If T is any member of $B(X; Y)$ then there exists a nonnegative y in Y such that $|Tx| \leq \|x\|y$ holds for all x in X ; in case Y is order complete then we endow T with the "norm" $\|T\| = \inf\{y \in Y : |Tx| \leq \|x\|y \text{ for all } x \in X\}$. Proposition. If Y is T -interval-compact (order intervals in Y are relatively compact in the topology T), then each member of $B(X; Y)$ is T -compact. Theorem 1. For any measure space (Ω, Σ, μ) the class $B(L^2(\mu); L^2(\mu))$ coincides with the Hilbert-Schmidt class. Theorem 2. Let (Ω, Σ, μ) be a finite, nonatomic measure space and ρ be an absolutely continuous, saturated function norm satisfying the Fatou property. Then $L^\infty(\mu)$ is contained in $L^\rho(\mu)$, the identity injection being continuous (it is in fact, a meager F_σ -subset of $L^\rho(\mu)$), and if H is any linear subspace of $L^\infty(\mu)$ which is closed in $L^\rho(\mu)$ then H is finite dimensional; in particular, if Φ is a (continuous) Young's function satisfying the Δ_2 -condition, closed linear subspaces of $L^\Phi(\mu)$ consisting entirely of members of $L^\infty(\mu)$ are finite dimensional. (Received September 4, 1970.)

678-B12. ROGER L. COOKE, University of Vermont, Burlington, Vermont 05401. A Cantor-Lebesgue theorem for two dimensions. Preliminary report.

Let x be a point of Euclidean 2-space, and m a lattice point of Euclidean 2-space. The trigono-

metric series $\sum c_m \exp [i(m,x)]$ is written $\sum_{n=0}^{\infty} A_n(x)$ where $A_n(x)$ is the sum over lattice points m whose Euclidean absolute value is \sqrt{n} . It is shown that if $A_n(x)$ tends to zero in measure, then $\sum |c_m|^2$ tends to zero, where again the summation is over lattice points of norm \sqrt{n} . As an application it is shown that if $\sum_{n=0}^{\infty} A_n(x)$ converges to 0 for $x \neq 2\pi m$, then $c_m = 0$ for all m . (Received September 8, 1970.)

678-B13. HUI-HSIUNG KUO, Courant Institute of Mathematical Sciences, New York University, New York, New York 10012. The Jacobi theorem on transformation of Wiener integrals.

Suppose (i, H, B) is an abstract Wiener space with the H -norm denoted by $|\cdot|$, the B -norm by $\|\cdot\|$ and the Wiener measures by p_t , $t > 0$. A transformation T from an open subset U of B onto another open subset V of B is said to be admissible if it is a homeomorphism of class C^1 and satisfies the following conditions: (a) for all $x \in U$, $Tx - x \in H$ and T_x is nonsingular from B into itself with $(T_x - I)(B) \subset B^*$ and $T_x - I$ is a trace class operator when it is restricted to H ; (b) the mapping $x \rightarrow T_x - I$ is continuous from U into $\mathcal{B}(B, B^*)$ (the Banach space of the continuous linear operators from B into B^* with the uniform topology) and (c) the mapping $x \rightarrow T_x - I|_H$ is continuous from U into $\mathcal{B}_1(H, H)$ (the Banach space of the trace class operators of H with the trace class norm topology). Assuming that the function $\|\cdot\|$ is of class C^1 off the origin, we prove the Theorem. If T is an admissible transformation from U onto V , then $p_t \circ T$ and p_t , as measures on U , are equivalent. Moreover the Radon-Nikodym derivative of $p_t \circ T$ with respect to p_t is given by $(dp_t \circ T / dp_t)(x) = \exp\{-\frac{1}{2}(Tx - x, x) - |Tx - x|^2 / 2t\} \det |T_x|$, $x \in U$, where (\cdot, \cdot) is the natural pairing of B^* and B . (Received September 8, 1970.)

678-B14. GERALDO S. S. AVILA, Georgetown University, Washington, D. C. 20007. Spectral resolution of differential operators associated with symmetric hyperbolic systems.

This paper is concerned with the derivation of the spectral family $\{E(\lambda)\}$ of the operator $A = -i \sum_{j=1}^n A_j \partial / \partial_j$. Here the A_j 's are constant, real symmetric, $k \times k$ matrices. Aside from this, no further assumption is made. An expression for $E(\lambda)$ is given in terms of the Fourier transform and the spectral resolution of the matrix $A(p) = \sum_{j=1}^n p_j A_j$. The spectrum of A is proved to be absolutely continuous, unless the equation $\det(\tau I - A(p)) = 0$ possesses roots $\tau = \tau(p)$ which vanish for all p . In this case $\lambda = 0$ is an eigenvalue of A , but still the spectral measure $E(S)$ is absolutely continuous when restricted to the Borel sets S which do not contain the point $\lambda = 0$. (Received August 11, 1970.)

678-B15. MATTHEW M. HACKMAN, University of Washington, Seattle, Washington 98105. Some nice functions on Lie groups. Preliminary report.

Let G be a connected Lie group. With B a basis of left-invariant vector fields on G , $t(g)$ the distance from g to the identity calculated relative to a left-invariant Riemannian metric on G , and $L^2(G)$ taken relative to a left-invariant Haar measure on G , the following partial generalization of theorems of Gårding, and Gelfand and Šilov holds: Theorem. For $s \geq 2$, let $r = (2s)/(3s - 4)$. Then there exists a dense subspace A_s of $L^2(G)$ consisting of functions f which have, for suitable choice of $E > 0$, $\exp(Et^r)f$ in $L^2(G)$ and the set of numbers $\{\|\exp(Et^r)X_1 \dots X_m f\|_2^{1/m} / (m^{1/s}) : X_j \in B, m \geq 1\}$ bounded. (Received September 10, 1970.)

Applied Mathematics

678-C1. LOKENATH DEBNATH, East Carolina University, Greenville, North Carolina 27834.

A new treatment of surface wave problems under uniform magnetic and current fields.

An investigation is made into two-dimensional and axisymmetric, anisotropic wave motions in an inviscid, incompressible, homogeneous and electrically conducting fluid in the presence of the impressed, uniform magnetic and current fields. With the aid of generalized function treatment solutions of physical interest to both wave problems in a fluid of finite depth due to a harmonic disturbance are obtained in more general situations. Solutions of the corresponding problem in infinitely deep and very shallow fluids are recovered as special limiting cases. Effects of the imposed magnetic and current fields including the surface tension on the wave motions are examined in some detail. It is shown that the wave motions become dispersive as well as anisotropic in the presence of the MHD body force, and their characteristics, such as the phase and group velocities are qualitatively and quantitatively modified. Additionally, it is shown that the present method of solution provides an interesting example of the applicability of the generalized functions in problems of this type. (Received August 17, 1970.)

678-C2. VIVIAN EBERLE SPENCER, Bureau of Mines, Department of the Interior, Washington, D.C. and DOMINA EBERLE SPENCER, University of Connecticut, Storrs, Connecticut 06268.

The tensor interpretation of Grassmann's Ausdehnungslehre. I.

It is traditional to describe the Ausdehnungslehre which was published by Hermann Grassmann, first in 1844 and in a revised edition in 1861, as both one of the most important and least understood books on vectors and tensors. The paper begins the task of presenting Grassmann's ideas in tensor notation. If the words holor and mcrate which have recently been used in the general presentation of vectors (Moon and Spencer, "Vectors," Van Nostrand, Princeton, N. J., 1965) are introduced, the first chapters of die Ausdehnungslehre become a quite excellent introduction to holor algebra. This paper analyzes the algebraic foundation and studies the general method of forming products. (Received September 9, 1970.)

678-C3. HERBERT JEHLE, George Washington University, Washington, D.C. 20006.

Representation of mesons and baryons in terms of linked quantized flux loops.

Representations of quarks in terms of SU(3) and SU(6) provided a deep insight into particle physics. Although that group theoretical definition of quarks led to immense successes, attempts have been made to move from these formal descriptions of quarks to more specific models. In one such effort (which is considerably more conservative and advantageous than magnetic monopole theories), it is shown that a quark may be considered as a closed quantized flux loop, but only if it is interlinked with other such quark loops, thus representing a meson or a baryon. As an unlinked loop behaves as a muon, there is no meaning to the concept of free quarks in this model. Due to its topology this model has traits related to properties (especially strangeness) of mesons and baryons; also the conservation laws of charge and of lepton and baryon number may be interpreted in terms of the loop picture. (Received September 10, 1970).

Geometry

678-D1. LYNN E. GARNER, Brigham Young University, Provo, Utah 84601. Fields and projective planes: A category equivalence.

A lineation between projective planes is defined to be a collinearity-preserving point transformation. A Pappian plane together with a distinguished quadrangle is called a based plane, and a lineation between based planes is called basic if the bases are preserved. A lineation is called proper if some quadrangle is transformed onto a quadrangle. This paper proves that the category of based planes and basic lineations is equivalent to the category of fields and places. It is further demonstrated that to each proper lineation between Pappian planes is associated a place between the coordinatizing fields, and that the lineation is a collineation if and only if the corresponding place is an isomorphism. (Received September 8, 1970.)

Logic and Foundations

678-E1. WILLIAM M. LAMBERT, JR., University of Detroit, Detroit, Michigan 48221. Comparing notions of effectiveness in abstract first-order structures.

Given a structure $\langle A, F_0, \dots, R_0, \dots \rangle$ in the sense of [1] W. Lambert, "A notion of effectiveness in arbitrary structures," J. Symbolic Logic 33(1968), 577-602, with only finitely many distinguished relations, we associate to each function f which is search computable (sc) in the F_i, R_i in the sense of [2] Y. Moschovakis, "Abstract first-order computability. I", Trans. Amer. Math. Soc. 138(1969), 427-464, a partial relation R_f which is schematically definable (sd) in the sense of [1]. We first associate to each member z of A^* (built up from $A \cup \{0\}$ by iterated ordered pairing as in [2]) a family of codes $\langle n, a \rangle: n \in \omega, a \in A^\omega$ reflecting the structure of z in a natural way. Then if the (multiple-valued) function f is k -ary, R_f will be of type $\langle k+1, 0, k+1 \rangle$ and is such that (a) if $f(z_1, \dots, z_k) \rightarrow w$ then $R_f(n_0, \dots, n_k, a_0, \dots, a_k)$ for at least one code $\langle n_0, a_0 \rangle$ for w whenever $\langle n_i, a_i \rangle$ code $z_i: i = 1, \dots, k$; (2) whenever $R_f(n_0, \dots, a_k)$ then n_0, \dots, a_k correspond to some z_1, \dots, z_k, w as in (a). Since [1] requires that R_0 be the identity relation, this can not be interpreted as saying that sc is "stricter than" sd; indeed, we strongly conjecture that sd is no stronger than sc. (Received July 31, 1970.)

678-E2. T. W. SHOOK, University of Detroit, Detroit, Michigan 48221. Distributing quantifiers and the theory of set expansions.

Adjoining a distributing quantifier to the first order language whose individuals are members of a set S , we characterize an expansion S^* of S . An expansion is essentially equivalent to an ultra-power. (Received September 10, 1970.)

Statistics and Probability

678-F1. STANLEY A. SAWYER, Belfer Graduate School, Yeshiva University, New York, New York 10033. Rates of convergence for some functionals in probability.

Let $\{x_1, x_2, \dots\}$ be a sequence of identically distributed independent random variables with mean zero, variance one, and (1) $P(|x_k| \geq \lambda) \leq C \exp(-\alpha \lambda^\epsilon)$ for some $\alpha, \epsilon > 0$. Let $s_k = x_1 + \dots + x_k$, let $\{w(t): 0 \leq t \leq 1\}$ be Brownian motion, and let $f(t, x) \in C^1(\mathbb{R}^2)$ be (with its first partial derivatives) of slow growth in x . Then Theorem 1. $\sup_\lambda |p[(1/n) \sum_1^n f(k/n, s_k/\sqrt{n}) \leq \lambda] - P(\int_0^1 f(t, w(t)) dt \leq \lambda)| = O((\log n)^B / \sqrt{n})$ provided the latter distribution has a bounded density. If (1) is replaced by (1)' $E(|x_k|^p) < \infty$, some $p \geq 4$, then, we obtain $O((\log n)^B / n^{p/(2p+8)})$ instead. The method of proof is via the Skorokhod representation. Indeed, let T_1, T_2, \dots, T_n be the Skorokhod representation times for x_k/\sqrt{n} ; thus $x_n(k/n) = w(\sum_1^k T_i) \cong s_k/\sqrt{n}$. Then Theorem 2. Given (1)', $\lim_{n \rightarrow \infty} P(x_n(1) - w(1) \leq \lambda c/n^{1/4}) = G(\lambda)$ for some (determined) distribution $G(\lambda)$. Corollary. If $x_n(t) = x_n([nt]/n)$, then $P(\max_{0 \leq t \leq 1} |x_n(t) - w(t)| \geq A/n^{1/4} \log n) \rightarrow 1$ for every A . Thus it appears that the Skorokhod representation can give a rate of convergence better than $O(1/n^{1/4})$ only in special cases. Theorem 2 can also be viewed as a companion of a theorem of iterated logarithm type due to V. Strassen. (Received September 10, 1970.)

Topology

678-G1. HOWARD H. WICKE, Ohio University, Athens, Ohio 45701, and JOHN M. WORRELL, JR., Division 1721, Sandia Laboratories, Albuquerque, New Mexico 87115. A characterization of the Hausdorff perfect preimages of metric spaces.

For Condition Y_c , see the authors' by title abstract (Abstract 70T-G182, these *Notices*), this issue). For regularly refinable space see [Portugal. Math. 26 (1967), 405-420]. Theorem. A T_1 space (S, τ) is a Hausdorff perfect preimage of a metric space if and only if (1) S is regularly refinable, (2) every subcollection of τ covering S is refined by a point-countable subcovering of τ , and (3) S satisfies Condition Y_c . Remarks. (1) Compare Theorem 2 of Arhangel'skiĭ's article [Uspehi Mat. Nauk 18 (1963), No. 5, 139-145]. (2) Arhangel'skiĭ characterized these preimages as Hausdorff paracompact p -spaces. (3) In context, (3) is equivalent to S being a set pointwise uniformly of interior condensation in a regular T_0 locally countably compact space E . (Terminology is taken in a sense extending set of interior condensation as defined in the authors' article ["On the open continuous images of paracompact Čech complete spaces," to appear in Pacific. J. Math.].) Consideration of the case where, additionally, the condensation is light and E locally connected relates to one of the theoretic connections between first-countable and non-first-countable topological uniformization in base of countable order theory. This work was supported by the United States Atomic Energy Commission. (Received September 8, 1970.)

ABSTRACTS PRESENTED TO THE SOCIETY

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Algebra & Theory of Numbers

70T-A176. STEPHEN W. SMOLIAR, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139. Linear maps of transversal pregeometries. Preliminary report.

A pregeometry is said to be algebraic if it can be coordinatized over a transcendental extension of the rationals. Transversal pregeometries are algebraic, and a rank n pregeometry on a set of m elements can be represented by an $m \times n$ matrix, X . A linear map of the transversal pregeometry consists of matrix multiplication of X on the right, i.e. a linear transformation. A pregeometry is algebraic if and only if it is the image under a linear map of a transversal pregeometry. (Received April 30, 1970.)

70T-A177. ALBERT A. MULLIN, USATACOM, Warren, Michigan 48090. Generalizations of relatively prime sequences.

Recall that the sequence of Fermat numbers $F_n = 2^{2^n} + 1$ and the sequence of Mersenne numbers $M_n = 2^{p(n)} - 1$, where $p(n)$ is the n th prime in ascending order, are relatively prime sequences (RPS's). I.e., for $m \neq n$, $(M_m, M_n) = 1$ and $(F_m, F_n) = 1$. This note exploits recursion-theoretic ideas to generalize and unify the notion of RPS and to study properties of M_m and F_m in a more general context. Definitions. A sequence $\{a_k\}$ of natural numbers is said to be weakly relatively prime (WRP) provided: (1) $a_m \neq 0$ except for at most one m and (2) if $(r, s) = 1$, then $(a_r, a_s) = 1$. A sequence $\{b_k\}$ of natural numbers is said to be generalized relatively prime (GRP) provided: (1) $b_m \neq 0$ except for at most one m and (2) if the mosaics of r and s have no prime in common, then $(b_r, b_s) = 1$. E.g., Lemma. The class of GRPS's properly contains the class of WRPS's which properly contains the class of (standard) RPS's which properly contains the class totally prime sequences. Conjectures. If the mosaics of r and s have no prime in common, then the mosaics of M_r and M_s have no prime in common and the mosaics of F_r and F_s have no prime in common. (Received May 6, 1970.)

70T-A178. KHEE-MENG KOH, University of Manitoba, Winnipeg 19, Manitoba, Canada. Semilattices with additional symmetric operations.

For definitions and notations, see Abstract 69T-A54, these *Notices* 16(1969), 565. Theorem 1. Suppose that the sequence $\langle 0, 0, \overline{1, \dots, 1}, n, m \rangle$ is representable. Then any one of the following conditions implies $n = 1$: (1) $k > 1$ and $m \leq n + \max. \{n, k + 3\}$; (2) $k = 1$ and $m \leq 4$; (3) $k = 0$, $n > 0$ and $0 < m \leq 2$. Theorem 2. Let k be a nonnegative integer and n a positive integer. The sequence $\langle 0, 0, \overline{1, \dots, 1}, n, m \rangle$ is representable for every positive integer m if, and only if $n = 1$. Theorem 3. For

each pair of positive integers $\langle n, k \rangle$, let $F(n, k)$ be the smallest integer such that the sequence $\langle 0, 0, \overbrace{1, \dots, 1}^k, n, F(n, k) \rangle$ is representable in $\mathcal{K}(k)$ where $\mathcal{K}(k)$ is the class of all idempotent algebras with a semilattice operation such that all the $(k + 2)$ -ary essential polynomials are symmetric. Then $F(n, k) = 1 + (1/2)(n - 1) \cdot (k + 3) \cdot (k + 4)$. (Received August 17, 1970.) (Author introduced by George A. Grätzer.)

70T-A179. JAYME M. CARDOSO, University of Campinas, Caixa Postal 1170, Campinas, Brazil. Generalization of Stone's theorem. Preliminary report.

Let B be a Boolean ring with identity 1. It is shown that B is a Boolean algebra relative to the greatest lower bound defined by $x \wedge y = xy + x \cdot y + (x + y)\underline{a}$ and the least upper bound defined by $x \vee y = x \cdot y + x + y + (x + y)\underline{a}$, where \underline{a} is a fixed element of B . $1 + \underline{a}$ is the all element and \underline{a} is the zero element of the Boolean algebra. If $x \in B$, $1 + x$ is the complement of x . In particular if $\underline{a} = 0$ we have the Stone's theorem (Proc. Nat. Acad. Sci. U.S.A. 21 (1935), 103-105). (Received June 15, 1970.)

70T-A180. JOEL KARNOFSKY, University of California, Berkeley, California 94720. Varieties generated by finite simple semigroups. Preliminary report.

It follows from the Green-Rees theorem that a finite semigroup is simple (having no nontrivial homomorphisms) if and only if it is isomorphic to one of the following: type one, a finite simple group; type two, a two element semigroup; type three, a combinatorial Rees matrix semigroup with at least five elements whose structure matrix has no identical rows and no identical columns. It is well known that no two nonisomorphic type one semigroups generate the same variety, and this property easily extends to type two. However, (to answer a question of S. Burris) all type three semigroups whose structure matrices have exactly one nonzero entry in each row and column generate the same variety, and all other type three semigroups generate one other variety, which is larger than the first. Essential in proving these statements is that any type three semigroup of the second kind contains a subsemigroup isomorphic to a five element type three semigroup whose structure matrix has three nonzero entries. Thus there are two countable collections of finite, simple, non-isomorphic semigroups all of which generate the same variety, and the two nonisomorphic five element type three semigroups may be taken as representatives of these classes. (Received June 22, 1970.) (Author introduced by Professor Leon A. Henkin.)

70T-A181. STUART A. STEINBERG, University of Illinois, Urbana, Illinois 61801. Finitely-valued f -modules. Preliminary report.

Let R be a directed po-ring, and let M be a right R -module. M is an f -module if M is a 1-group and is 1-isomorphic to a subdirect product of totally ordered R -modules. Theorem 1. There is a natural one-to-one correspondence between the R -values of g in M and the values of g . This basic fact enables one to get all of the local structure theory for f -modules that Conrad has obtained for 1-groups [Czechoslovak Math. J. 15 (1965)]. There is, in addition, the interaction between the two structures. It is shown, for example, that a special element g has the same value in $C_R(g)$, the convex 1-submodule of M generated by g , that it has in $C_Z(g)$. The trunk of a rooted po-set is the intersection of its roots. Let Γ_R be the rooted po-set of R -values of M , and let $M_0(R)$ be the intersection of the elements in the trunk of Γ_R . Theorem 2. $M_0(R)$ is independent of R . (Received June 29, 1970.)

70T-A182. K. M. RANGASWAMY and N. VANAJA, Madurai University, Madurai-2, Tamil Nadu, India. A note on modules over regular rings.

A unitary right module M over a ring R with identity is called a torsion module if $\text{Hom}_R(S, R) = 0$, for every submodule S of M . M is called torsion-free if it has no nonzero torsion submodules. It is shown that a (von Neumann) regular ring R is right self-injective if and only if every finitely generated torsion-free right R -module is projective. This answers a question of R. S. Pierce [Mem. Amer. Math. Soc. No. 70(1967)]. In passing, it is shown that if R is self-injective regular and contains no nonzero nilpotent elements, then a maximal right ideal of R is projective if and only if it is a summand of R . A consequence is that a countable self-injective strongly regular ring is Artin semisimple. Finally, the above characterisation of right self-injective rings holds good if 'torsion-free' is replaced by 'torsion-less'. (Received June 29, 1970.) (Author introduced by Professor M. Rajagopalan.)

70T-A183. GABRIEL SABBAGH, 1 square Francois Couperin, Antony 92, France and Centre National de la Recherche Scientifique, Paris, France. A theorem on left perfect right coherent rings. Preliminary report.

All algebraic terms are defined in (Chase, "Direct products of modules," Trans. Amer. Math. Soc. 97(1960), 457-473), all logical terms are defined in (Eklof and Sabbagh, "Definability problems for modules and rings," submitted to J. Symbolic Logic). Theorem. A left perfect right coherent ring is semiprimary. Corollary 1. A left perfect right coherent ring is right perfect. Corollary 2. The class of left perfect right coherent rings is definable in $L_{\omega_1 \omega}$. (Received June 29, 1970.)

70T-A184. GARY H. MEISTERS, University of Colorado, Boulder, Colorado 80302. A formally real ring of distributions. Preliminary report.

Let D denote the set of all Schwartz distributions T in $\mathcal{D}'(\mathbb{R})$ such that (i) $T(\phi)$ is real for all real-valued ϕ in $\mathcal{D}(\mathbb{R})$ and (ii) the support of T is bounded below. Then D is a (commutative) convolution ring with no proper zero divisors (Titchmarsh's Theorem) and hence has a quotient field F (which is isomorphic to Mikusiński's field of real operators) containing \mathbb{R} as a proper subfield. Theorem. The field F and hence the convolution ring D are orderable, but not uniquely. Nevertheless, in every ordering the Heaviside function ($h(t) = 0$ for $t < 0$ and $h(t) = 1$ for $t \geq 0$) is a positive infinitesimal. Corollary. The ring D is formally real. That is, if T_1, \dots, T_n are distributions in D with $T_1 * T_1 + \dots + T_n * T_n = 0$, then all $T_j = 0$. In contrast to this, the convolution ring of all real-valued L_1 functions on \mathbb{R} is not formally real (and also contains zero divisors). (Received June 29, 1970.)

70T-A185. MARK HEDRICK, University of Houston, Houston, Texas 77004. Nonnegative matrices each of whose positive diagonals has the same sum.

The author shows that if A is a fully indecomposable nonnegative matrix each of whose positive diagonals has sum M and when $a_{ij} = 0$, the sum of each positive diagonal in the submatrix of A obtained by deleting the i th row and j th column is less than M , then there is a unique positive matrix B such that its rank is at most two, each of its diagonals has sum M , and $a_{ij} = b_{ij}$ when $a_{ij} > 0$. The author then compares his results to those obtained by Sinkhorn and Knopp who carried out a similar analysis for positive diagonal products. (Received June 25, 1970.) (Author introduced by Professor Richard D. Sinkhorn.)

70T-A186. CHARLES H. BRASE, University of Hawaii, Honolulu, Hawaii 96822. The extended valuation of Fuchs applied to a Bezout domain.

Let A be a Bezout domain with quotient field K . Let v be the valuation map of Fuchs (L. Fuchs, "The generalization of the valuation theory," Duke Math. J. 18(1951), 19-26). Let I be a proper nonzero ideal of A and let $K(I) = \{a/b \in K \mid a, b \text{ are in } A, (a, b) = A \text{ and } a \in I\}$. A segment of the partially ordered group K/v is any subset of the form $K/v - v(K(I) \cup K(I)^{-1})$. There is a 1-1 order reversing correspondence between proper nonzero ideals I of A and segments of K/v . A segment is an isolated subgroup of K/v iff I is a prime ideal of A . Let K^* denote the multiplicative group of K . The following are equivalent: (1) K^*/v is naturally isomorphic to a subdirect sum of integers. (2) For all M in Λ , MA_M is a principal ideal of A_M and $\bigcap_1^\infty (MA_M)^n = (0)$. (3) For all M in Λ , A_M is Noetherian and MA_M is a principal ideal of A_M . Furthermore K^*/v is naturally isomorphic to a weak direct sum of integers iff A is Noetherian. If the sum of condition (1) contains exactly one summand, the theorem reduces to a well-known result of Bourbaki for Krull valuation domains. Λ is the set of all maximal ideals of A . (Received September 3, 1970.)

70T-A187. J. M. GANDHI, Western Illinois University, Macomb, Illinois 61455. Estimates for the binomial coefficients $\binom{2n}{n}$.

We know [K. Chandrasekharan, "Introduction to number theory," 1968, p. 71, Equation (19)] that (1) $2^{2n}/2\sqrt{n} < \binom{2n}{n} < 2^{2n}/\sqrt{2n}$, $n \geq 2$. Improving upon this inequality we prove that (2) $2^{2n+1}\sqrt{n}/(2n+1)\sqrt{\pi} < \binom{2n}{n} < 2^{2n}/\sqrt{\pi n}$, for all n . We show that inequality (2) is the best possible for all range of values of n except for $n = 2$ and $n = 3$ when the left-hand side of inequality (1) is better than the corresponding inequality (2). (Received August 17, 1970.)

70T-A188. DARALD J. HARTFIEL, Texas A & M University, College Station, Texas 77843. Counterexamples to a conjecture of G. N. De Oliveira.

This paper gives counterexamples to the following conjecture of G. N. De Oliveira. Conjecture. Let A be an $n \times n$ irreducible doubly stochastic matrix and I the $n \times n$ identity matrix. If n is even, then $f(z) = \text{perm.}(Iz - A)$ has no real roots; if n is odd, then $f(z) = \text{perm.}(Iz - A)$ has one and only one real root. (Received July 7, 1970.)

70T-A189. VASANTI N. BHAT, University of Bombay, Bombay, India and S. F. KAPOOR, Western Michigan University, Kalamazoo, Michigan 49001. The powers of a connected graph are highly hamiltonian.

Let G be a connected graph and $n \geq 1$. The graph G^n has as its points those of G , and two points u and v are adjacent in G^n if the distance between u and v in G is at most n . Theorem. If G is a connected graph on p points and m satisfies $1 \leq m \leq p - 3$, then the deletion of any k points from G^{m+2} yields a hamiltonian graph for $0 \leq k \leq m$. (Received July 10, 1970.)

70T-A190. MARK E. WATKINS, Syracuse University, Syracuse, New York 13210 and LEWIS A. NOWITZ, Computer Applications Inc., 2880 Broadway, New York, New York 10025. On graphical regular representation of abstract groups. Preliminary report.

A finite simple graph X with vertex set $V(X)$ and automorphism group $A(X)$ is a graphical regular representation (GRR) of a group G if: (1) $G \cong A(X)$; and (2) $A(X)$ acts on $V(X)$ as a regular permutation

group; i.e., given $u, v \in V(X)$, there exists a unique $\alpha \in A(X)$ for which $\alpha(u) = v$. The question of whether or not a given abstract group has a GRR has been resolved for only a few classes of groups. (See, for example, M. H. McAndrew, these *Notices* 12(1965), 575, and M. E. Watkins, these *Notices* 16(1969), 817.) Theorem. If the nonabelian group G has a GRR and if G_1 is any cyclic extension of G such that G has index $[G_1:G] \cong 4$, then G_1 also has a GRR. (Received July 13, 1970.)

70T-A191. MICHAEL RICH, Temple University, Philadelphia, Pennsylvania 19122. Associo-symmetric algebras. Preliminary report.

Let A be an algebra over a field F satisfying $(x, x, x) = 0$. Assume also that there exists $g: A \times A \times A \rightarrow F$ such that for all $x, y, z \in A$, $(xy)z = g(x, y, z)x(yz)$. Then A is called an associo-symmetric algebra if $g(x, y, z) = g(x\pi, y\pi, z\pi)$ for all $\pi \in S_3$ and for all $x, y, z \in A$. The following theorems regarding associo-symmetric algebras over fields of characteristic $\neq 2, 3$ are proved. Theorem 1. If A contains an idempotent e then $A = A_{11}(e) + A_{10}(e) + A_{01}(e) + A_{00}(e)$. Theorem 2. If $e \neq 1$ then A_{ii} is associative ($i = 0, 1$). Theorem 3. If A is finite dimensional, semisimple then A has identity 1 and is a direct sum of simple algebras. Theorem 4. If A is simple and of degree > 2 then A is associative. Theorem 5. There do not exist any associo-symmetric nodal algebras. (Received July 16, 1970.)

70T-A192. GEORGE T. GEORGANTAS, State University of New York, Buffalo, New York 14226. A description of $\mathcal{C}(S, R)$ for purely inseparable exponent one ring extensions. Preliminary report.

Consider a commutative ring R with 1 such that R is of prime characteristic. Let S be a purely inseparable ring extension of R . Quite naturally, S is assumed to be a finitely-generated projective R -module and $\text{Hom}_R(S, S) = S[\partial]$, where ∂ is an R -derivation on S . S. Yuan ["On logarithmic derivatives," Bull. Soc. Math. France 96(1968), 41-52] describes the complex: $(1) \rightarrow R^* \rightarrow S^* \xrightarrow{\delta_0} S^+ \xrightarrow{\delta_1} R^+ \rightarrow (0)$. S. Chase and A. Rosenberg ["Amitsur cohomology and the Brauer group," Mem. Amer. Math. Soc. No. 52(1965), 34-79] define the group $\mathcal{C}(S, R)$, which in the classical case is just the Brauer group $\mathcal{B}(S/R)$. We show that $R/Z \cong \mathcal{C}(S, R)$, where $Z = \text{Im } \delta_1$. Hence, [Ref. S. Yuan: "Inseparable exponent one Galois cohomology," (to appear)] we have $R/Z \cong \mathcal{C}(S, R) \cong H^2(S/R) \cong \mathcal{B}(\partial, S)$. In the special case of fields, this gives the classical results $R/Z \cong \mathcal{B}(S/R) \cong H^2(S/R) \cong \mathcal{B}(\partial, S)$. (Received July 17, 1970.)

70T-A193. ROBERT ELTON MAAS, P. O. Box 371, Mountain View, California 94040. Principal differential ideals with finite exponents greater than two.

Let A_n be the determinant of the n by n matrix (α_{ij}) where $\alpha_{ij} = (i+1-j)! y_{n-(i+1-j)} / i!$ if $i > j-1$, $\alpha_{ij} = 1$ if $i = j-1$ and $\alpha_{ij} = 0$ if $i < j-1$ (A_n is a differential polynomial of order $n-1$, y_i is the i th derivative of y). Then in the ring $F[y, y_1, y_2, \dots]$ (F is any field of characteristic zero) the differential ideal generated by A_n has exponent n . (Received July 14, 1970.) (Author introduced by Professor Gerald L. Alexanderson.)

70T-A194. ALEIT MITSCHKE, Universität Bonn, 53 Bonn, Federal Republic of Germany. Implication algebras are 3-permutable and 3-distributive. Preliminary report.

In his paper "Two Mal'cev type theorems in universal algebra" (J. Combinatorial Theory 8(1970)) G. Grätzer asks for an example of an equational class, in which some Malcev-type conditions P_n of the form of his, Jonsson's (Math. Scand. 21(1967)) or Day's (Canad. Math. Bull. 12(1969)) theorems are not

equivalent for all n . An example for some of these conditions is the class K of implication algebras (see J. C. Abbott, *Mat. Vesnik* 4(19) (1967)). K is not permutable, but 3-permutable, that is for every pair of congruences Θ, Φ is $\Phi \circ \Theta \circ \Phi = \Theta \circ \Phi \circ \Theta$. As K is not permutable, K is not 2-modular (Day). K is 3-modular, because it is 3-permutable. K is not 2-distributive, but 3-distributive. This shows that the estimate in Day's paper, that every n -distributive equational class is $(2n - 1)$ -modular, is not minimal. (Received July 27, 1970.) (Author introduced by Dr. Rudolf Wille.)

70T-A195. JOHN K. PERRYMAN and CLARENCE E. BAYER, University of Texas, Arlington, Texas 76010. Factorization of correspondence with special emphasis on element identifiers.

We extend the work of M. W. Weaver, "The applications of cosets and correspondences in the theory of semigroups," reviewed by R. J. Levit, published in *J. Math. Anal. Appl.* 15 (1966), 165-169. A study of the factorization of correspondences is made and a necessary and sufficient condition for a correspondence to be a right or left identifier for any other correspondence is given. A new concept of a shell identifier is developed and similar theorems are developed for it. (Received July 16, 1970.)

70T-A196. STANLEY N. BURRIS, University of Waterloo, Waterloo, Ontario, Canada and EVELYN M. NELSON, McMaster University, Hamilton, Ontario, Canada. Embedding the dual of Π_{∞} in the lattice of equational classes of semigroups.

The lattice of equational classes of semigroups satisfying $x^2 = x^3$ contains a subinterval which is dually isomorphic to the lattice of partitions of a countable set. [For related results in the theory of commutative semigroups, see Abstract 70T-A126, these *Notices* 17(1970), 651.] (Received July 28, 1970.)

70T-A197. BRUNO J. MÜLLER, McMaster University, Hamilton, Ontario, Canada. All duality theories for linearly topologized modules come from Morita dualities.

Previously (these *Notices* 17(1970), 643) we have constructed, from any Morita duality for a pair of rings S and R , a duality between the categories ${}_S\overline{M}$ and \overline{M}_R whose objects are the equivalence classes of linearly topologized Hausdorff modules over the discrete rings (where such modules are called equivalent if they have identical underlying abstract modules and the same submodules closed) and whose morphisms are the continuous homomorphisms. Here we prove that every abstract duality (= additive contravariant category equivalence) between such categories is obtained in this way. (Received July 8, 1970.)

70T-A198. VÁCLAV CHVÁTAL, University of Waterloo, Waterloo, Ontario, Canada and JÁNOS KOMLÓS, Mathematical Institute of the Hungarian Academy of Sciences, Budapest, Hungary. Some combinatorial theorems on monotonicity.

The Main Theorem. Let D be an acyclic digraph and let f be a mapping from the set of edges of D into an ordered set. If the chromatic number of D exceeds $\binom{P+q-2}{p-1}$ then either there is a path with edges $\overrightarrow{x_0x_1}, \overrightarrow{x_1x_2}, \dots, \overrightarrow{x_{p-1}x_p}$ such that $f(\overrightarrow{x_0x_1}) \leq f(\overrightarrow{x_1x_2}) \leq \dots \leq f(\overrightarrow{x_{p-1}x_p})$ or there is a path with edges $\overrightarrow{x_0x_1}, \overrightarrow{x_1x_2}, \dots, \overrightarrow{x_{q-1}x_q}$ such that $f(\overrightarrow{x_0x_1}) > f(\overrightarrow{x_1x_2}) > \dots > f(\overrightarrow{x_{q-1}x_q})$. Some other related problems are also discussed. The main theorem implies the theorem of Erdős and Szekeres (*Composito Math.* 2 (1935), 463-470): Among more than $\binom{2n-4}{n-2}$ points in the plane (no three collinear) there are always n of them spanning a convex n -gon. (Received July 22, 1970.)

70T-A199. ALDO DE LUCA and SETTIMO TERMINI, Laboratorio di Cibernetica del CNR, 80072 Arco Felice, Naples, Italy. Some algebraic properties of fuzzy sets.

Let $\mathcal{L}(I)$ be the class of all maps from a set I to a poset L ; any element of $\mathcal{L}(I)$ is called an L -fuzzy set (Goguen, J. Math. Anal. Appl. 18(1967), 145). If L is a lattice, it is possible to induce a lattice structure to $\mathcal{L}(I)$ by the binary operations \vee and \wedge that associate to any pair of elements f and g of $\mathcal{L}(I)$ the functions $f \vee g$ and $f \wedge g$ of $\mathcal{L}(I)$ defined point by point as: $(f \vee g)(x) = \text{l.u.b. } \{f(x), g(x)\}$; $(f \wedge g)(x) = \text{g.l.b. } \{f(x), g(x)\}$. It holds the noteworthy Proposition. If L is a Brouwerian lattice then $\mathcal{L}(I)$ will be one too. In fact one can show that for any pair of elements f and g of $\mathcal{L}(I)$, the set of the elements ψ of $\mathcal{L}(I)$ such that $f \wedge \psi \leq g$ contains a greatest element f^g called the relative pseudo-complement of f in g . If L is the interval $[0, 1]$ of the real line (Zadeh, Information and Control 8 (1965), 338), f^g is the function defined as $f^g(x) = 1$ if $f(x) \leq g(x)$, $f^g(x) = g(x)$ if $f(x) > g(x)$. In this case $\mathcal{L}(I)$ will be a noncomplemented lattice; the only elements having complements form a sublattice of $\mathcal{L}(I)$, the one of the classical characteristic functions of set theory. We note, finally, that if L is a complete Brouwerian lattice, then $\mathcal{L}(I)$ will be a complete Brouwerian lattice having the complete distributivity of meet on joins. (Received August 3, 1970.) (Author introduced by Professor Rudolf E. Kalman.)

70T-A200. DENIS A. HIGGS, University of Waterloo, Waterloo, Ontario, Canada. Lattices isomorphic to their ideal lattices.

Let L be a lattice, $I(L)$ the lattice of nonempty ideals of L . Theorem. L is isomorphic to $I(L)$ if and only if every nonempty ideal of L is principal. This answers a question of Grätzer. (Received August 4, 1970.)

70T-A201. JAMES J. WOEPPEL, University of Illinois, Urbana, Illinois 61801. Join-irreducible cross product varieties. Preliminary report.

Let \underline{A}_m be the variety of all abelian groups with exponent dividing m , \underline{U} be a metabelian nilpotent variety of small class with exponent relatively prime to m , and let $\underline{M}_{c,p}^\delta$ be the join-irreducible metabelian nilpotent variety of small class c and exponent $p^\delta, p \nmid m$. A nilpotent variety of class c and exponent n is said to have "small" class if $c < p$ for all primes p dividing n . Theorem 1. The product variety $\underline{U}\underline{A}_m$ is join-irreducible if and only if the variety \underline{U} is join-irreducible. Theorem 2. Let C be a critical group of $\underline{M}_{c,p}^\delta \underline{A}_m$. The critical group C generates the product variety $\underline{M}_{c,p}^\delta \underline{A}_m$ if and only if (i) $|C/\text{Fit}(C)| \cong m^c$ and (ii) $\exp((\text{Fit}(C))_{(c)}) = \exp(\text{Fit}(C)) = p^\delta$. Here $\text{Fit}(C)$ is the Fitting subgroup of C and $(\text{Fit}(C))_{(c)}$ is the c th term of the lower central series of $\text{Fit}(C)$. Using Theorems 1 and 2, a characterization of finite groups generating the product variety $\underline{U}\underline{A}_m$ is given. For terminology see Hanna, Neumann, "Varieties of groups," Springer-Verlag, New York, 1967. (Received August 6, 1970.)

70T-A202. THOMAS L. JAGER, University of Chicago, Chicago, Illinois 60637. On whether the Steinberg character of a group is a Gallagher character. Preliminary report.

Let G be a finite group. An irreducible character of G is said to be a Gallagher character of G if for every Sylow subgroup P of G , its restriction to P contains the principal character of P . Theorem 1. The Steinberg character of $G_2(q)$ is a Gallagher character if and only if $q \neq 2$. The Steinberg character of $B_2(q)$ is a Gallagher character if and only if $q \neq 2, 3$. Theorem 2. The Steinberg

character of $GL(n,q)$ is a Gallagher character for any n , except in certain cases when $q + 1$ is a prime power. Examination of further cases is in progress. (Received August 5, 1970.)

70T-A203. KWANGIL KOH, North Carolina State University, Raleigh, North Carolina 27607. Noncommutative ring without nilpotent elements.

Let R be a ring with 1 and let $L(R)$ be the lattice of ideals. Let $X(R)$ be the set of prime ideals of R and let $\tau = \{\text{supp}(A) | A \in L(R)\}$ where $\text{supp}(A) = \{P \in X(R) | A \not\subseteq P\}$. Then $(X(R), \tau)$ is a topological space which is compact. Theorem. If R is a ring with 1 without nilpotent elements then R is isomorphic to the global sections of a sheaf of rings $\bigcup_{P \in X(R)} R/O_P$ over the space $X(R)$ where the ideal $O_P = \{r \in R | ra = 0 \ \exists a \notin P\}$, R/O_P is a ring without nilpotent elements and R/O_P is an integral domain if and only if P is a minimal prime ideal. (Received July 27, 1970.)

70T-A204. MARY RAYAR, Indiana University, Bloomington, Indiana 47401. M-injective hull.

Definition. Let M be a left R -module. A left R -module Q is called M -injective, if for any R -module N , any mono. $\varphi: R^N \rightarrow R^M$ and any homo. $g: R^N \rightarrow R^Q$, there exists a homo. $f: R^M \rightarrow R^Q$ such that $f \circ \varphi = g$. Theorem. Let \hat{Q} be the injective hull of the left R -module Q . Then (1) $\bar{Q} = Q + \sum_{h: M \rightarrow \hat{Q}} h(M)$ is M -injective. (2) \bar{Q} can be embedded in every M -injective extension of Q . Definition. \bar{Q} is called the M -injective hull of Q . Corollary. A left R -module M is quasi injective iff $h(M) \subseteq M$ for all $h \in \text{End}(\hat{M})$ (Johnson and Wong). (Received August 11, 1970.) (Author introduced by Professor Goro Azumaya.)

70T-A205. HARRY LAKSER, R. PADMANABHAN and CRAIG R. PLATT, University of Manitoba, Winnipeg 19, Manitoba, Canada. Algebras defined by regular identities.

An identity ' $f = g$ ' is called regular if the set of variables occurring in the polynomial f is the same as that in g . For an equational class K , let K_r denote the equational class defined by all regular identities of K . An element $a \in A$ is a zero of the algebra $\mathfrak{A} = \langle A; F \rangle$ if, for all $f \in F$, $f(x_1, \dots, x_n) = a$ whenever $a \in \{x_1, \dots, x_n\}$. For $\mathfrak{A} \in K$, we define $\bar{\mathfrak{A}} = \langle \bar{A}; F \rangle$ where $\bar{A} = A \cup \{0\}$ with 0 being a zero of the algebra $\bar{\mathfrak{A}}$ and \mathfrak{A} a subalgebra of $\bar{\mathfrak{A}}$. Let the equational class K have no nullary fundamental operations and assume that no member of K has a zero. Theorem 1. An algebra $\mathfrak{A} \in K_r$ is subdirectly irreducible iff $\mathfrak{A} \in K$ and is subdirectly irreducible or $\mathfrak{A} \cong \bar{\mathfrak{B}}$ for some subdirectly irreducible $\mathfrak{B} \in K$. Theorem 2. The lattice of equational subclasses of K_r is isomorphic to the direct product of the lattice of equational subclasses of K and the two-element chain. Corollary. The equational class defined by all the regular identities of K together with any nonregular identity is an equational subclass of K . Theorem 2 and the above corollary were obtained for the special case of lattices by R. Padmanabhan (Abstract 69T-A166, these *Notices* 16(1969), 959) and for rings by S. M. Lee. An example is given to show that Theorem 2 need not hold if K has algebras with zero even if $K \neq K_r$. (Received August 11, 1970.)

70T-A206. RONALD HIRSHON, Polytechnic Institute, Brooklyn, New York 11201. The direct product of a hopfian group with an infinite cyclic group.

The author conjectures that the direct product of a hopfian group with an infinite cyclic group need not always be hopfian. However, we show the following Theorem. Let H be a hopfian group whose center is finitely generated modulo its torsion subgroup. Also suppose H is finitely generated

modulo its commutator subgroup. Then the direct product of H with an infinite cyclic group is hopfian. (Received August 13, 1970.)

70T-A207. JOHN DAUNS, Tulane University, New Orleans, Louisiana 70118. Embeddings in division rings.

Integral domains A that do not satisfy the Ore condition are constructed with a generalized valuation into a noncommutative semigroup. The multiplicative semigroup $A \setminus \{0\}$ can be embedded in a group G. The main difficulty is to introduce addition on $G \cup \{0\}$, thus embedding $A \subset G \cup \{0\}$ in a division ring. This generalizes a construction of P. M. Cohn (Proc. London Math. Soc. 3(1961), 511-530), where only integer valued valuations are considered. One of the main objectives of the present newer method is to completely replace Cohn's topological proofs entirely by inverse limit arguments. (Received August 18, 1970.)

70T-A208. JOSEPH A. WEHLEN, Michigan State University, East Lansing, Michigan 48823. Algebras of finite cohomological dimension.

Let A be an associative algebra, finitely generated over a commutative ring R. We say that $R\text{-dim } A = 1, \text{hd}_A(A)$ where $A^e = A \otimes_R A^{op}$. We extend a result of Endo and Watanabe [Osaka Math. J. 4 (1967), 233-242]. Theorem 1. Let A be a projective R-algebra, $n < \infty$. The following are equivalent: (a) $R\text{-dim } A = n$; (b) $R_m\text{-dim } A_m \leq n$ for all maximal ideals m of R with equality at some; (c) $R/m\text{-dim } A/mA \leq n$ for all maximal ideals of R with equality at some m. This theorem yields Proposition 2. Any projective, commutative R-algebra A has $R\text{-dim } A = 0$ or $R\text{-dim } A = \infty$. Proposition 3. If A is a projective, central S-algebra and S is a projective, fin. gen., faithful R-algebra, $R\text{-dim } A = n$ iff $R\text{-dim } S = 0$ and $S\text{-dim } A = n$. Using the definitions of M. Harada [Nagoya Math. J. 27 (1966), 263-484], we show Theorem 4. If A is an algebra over a local hensel ring (R, \mathfrak{m}) with $R\text{-dim } A \leq 1$, then A is isomorphic to a generalized triangular matrix algebra. (Received August 21, 1970.)

70T-A209. KWANGIL KOH and JIANG LUH, North Carolina State University, Raleigh, North Carolina 27607. On prime ring with a uniform right ideal.

Let M be a uniform right ideal of a prime ring R with zero singular ideal. Let \hat{U} be the injective hull of U and let $\mathbb{D} = \text{Hom}_R(\hat{U}, \hat{U})$. Theorem 1. If $\{u_1, u_2, \dots, u_n\}$ is a \mathbb{D} -linearly independent subset of U, then $\text{Hom}_R(R/\bigcap_{i=1}^n (u_i)^r, R/\bigcap_{i=1}^n (u_i)^r)$ is a right order in \mathbb{D} , the $n \times n$ matrix ring of \mathbb{D} , where $(u_i)^r = \{r \in R \mid u_i r = 0\}$. Theorem 2. Let R be a right primitive ring, M be a faithful right R-module and let $\mathbb{D} = \text{Hom}_R(M, M)$. Let $\dim_{\mathbb{D}} M = \aleph_0$ and let $\{m_1, m_2, \dots\}$ be a basis for ${}_{\mathbb{D}} M$. Let $(m_i)^r = \{r \in R \mid m_i r = 0\}$ and let $G_n = \bigcap_{i=1}^n (m_i)^r$. Then $\text{proj lim}_n R/G_n \cong \text{Hom}_{\mathbb{D}}(M, M)$. (Received August 24, 1970.)

70T-A210. EUGENE W. JOHNSON and JOHN P. LEDIAEV, University of Iowa, Iowa City, Iowa 52240. Structure of Noether lattices with join-principal maximal elements.

The local direct sum of local Noether lattices (\mathcal{L}_i, M_i) ($1 \leq i \leq n$) is the sum-multiplicative-lattice of $\mathcal{L}_1 \oplus \dots \oplus \mathcal{L}_n$ defined by $\mathcal{L} = (M_1/O \oplus \dots \oplus M_n/O) \cup \{(I, \dots, I)\}$. Theorem 1. If (\mathcal{L}, M) is a

local Noether lattice in which M is a join-principal element and M is not a prime of O , then \mathcal{L} is distributive. Theorem 2. Let (\mathcal{L}, M) be a distributive local Noether lattice. Then M is join-principal if and only if \mathcal{L} is the (finite) local direct sum of local Noether lattices with principal maximal elements. Corollary. If (\mathcal{L}, M) is a distributive local Noether lattice in which M is join-principal, then \mathcal{L} is Noether-lattice-embeddable in the lattice of ideals of a homomorphic image of a regular local ring. Theorem 3. Let \mathcal{L} be a distributive Noether lattice such that, for every maximal element M , \mathcal{L}_M satisfies the union condition on primes. If O has no embedded primes and if every maximal element is join-principal, then \mathcal{L} is Noether-lattice-embeddable in the lattice of ideals of a Noetherian ring. Theorem 4. Let \mathcal{L} be a Noether lattice. Then \mathcal{L} is distributive and representable as the lattice of ideals of a Noetherian ring if and only if for each maximal element M of \mathcal{L} , M is join-principal and O_M is meet-irreducible. (Received August 24, 1970.)

70T-A211. PAUL L. MANLEY, University of Windsor, Windsor, Ontario, Canada. Exact sequences of finitely generated modules.

We prove a certain inequality relation between the rank and the number of torsion coefficients in an exact sequence of modules. Theorem. If $M_1 \xrightarrow{f} M_2 \xrightarrow{g} M_3$ is an exact sequence of finitely generated modules M_i , $i = 1, 2, 3$, over a principal ideal domain, then $t(M_2) \leq t(M_1) + t(M_3) + r(\ker f)$, where r denotes the rank of the module and t the number of torsion coefficients. (Received August 26, 1970.)

70T-A212. ROBERT GILMER, Florida State University, Tallahassee, Florida 32306. On solvability by radicals of field extensions. Preliminary report.

Suppose that F is a subfield of the field K and that \bar{K} is an algebraic closure of K . To say that K is solvable by radicals over F means that there exists a finite sequence $F = \Delta_0 \subset \Delta_1 \subset \dots \subset \Delta_r$ of subfields of \bar{K} such that (1) $\Delta_i = \Delta_{i-1}(\theta_i)$ for $1 \leq i \leq r$, $\theta_i^{p_i} \in \Delta_{i-1}$, p_i is prime and is distinct from the characteristic of F , and $X^{p_i} - \theta_i^{p_i}$ is irreducible in $\Delta_{i-1}[X]$, and (2) $K \subseteq \Delta_r$ and Δ_r is normal over F . For any positive integer n , define $\Pi(F, n)$ to be $\Pi_0(F, n) \cup \Pi_1(F, n) \cup \dots$, where $\Pi_0(F, n)$ is the set of prime divisors of n , $\Pi_1(F, n)$ is the set of prime divisors of $[F(\zeta_q):F]$ for some q in $\Pi_0(F, n)$, etc. (ζ_q denotes a primitive q th root of unity.) This paper gives many equivalent forms of the statement: K is solvable by radicals over F , where F has characteristic $p \neq 0$ and K is a Galois extension of F . Probably the most important of these equivalent forms is the following: $E(\zeta_h)$ is solvable by radicals over $E(\zeta_h) \cap F$, where E is the prime field of F , and $h = p_1 p_2 \dots p_n$, where $\Pi(F, [K:F]) = \{p_i\}_{i=1}^n$. Note that the fields $E(\zeta_h)$ and $E(\zeta_h) \cap F$ are finite. (Received August 26, 1970.)

70T-A213. STEPHEN M. GERSTEN, Rice University, Houston, Texas 77001. Stable K-theory of discrete rings.

A stable K -theory $\{\hat{K}^i, i \in \mathbb{Z}\}$ is developed on the category of rings, where \hat{K}^i is a homotopy functor for all i . The theory is axiomatized as a special case of "stable homology theories". One has $\hat{K}^i(R) = K^i(R)$ if R is a K -regular ring. The theory is applied to free products of supplemented R -algebras A and B , where R is a commutative ring. We prove split exact sequences $0 \rightarrow \hat{K}^i(R) \rightarrow \hat{K}^i(A) \oplus \hat{K}^i(B) \rightarrow \hat{K}^i(A \otimes_R B) \rightarrow 0$, and $0 \rightarrow K^{-n}(R) \rightarrow K^{-n}(A) \oplus K^{-n}(B) \rightarrow K^{-n}(A \otimes_R B) \rightarrow 0 (n > 0)$.

If R has a unit and G and H are groups, we deduce the split exact sequence $0 \rightarrow K^{-n}(R) \rightarrow K^{-n}(RG) \oplus K^{-n}(RH) \rightarrow K^{-n}(R[G*H]) \rightarrow 0$. (Received August 27, 1970.)

70T-A214. ANASTASIA CZERNIAKIEWICZ, Courant Institute of Mathematical Sciences, New York University, New York, New York 10012. Endomorphisms of a free associative algebra of rank two.

Let $\mathbb{R}_2 = \mathbb{R}[[x,y]]$ be the free associative algebra of rank 2, on the free generators x and y , over the commutative domain \mathbb{R} . If ϕ is an automorphism of \mathbb{R}_2 that keeps $(xy - yx)$ fixed (up to multiplication by an element of \mathbb{R}), then ϕ is an elementary automorphism of \mathbb{R}_2 . The proof is obtained by showing that if P and Q are two elements of \mathbb{R}_2 such that (1) they do not contain terms which are pure in "y", (2) both P and Q are free of terms of degree zero and one, and (3) $[P,y] + [x,Q] + [P,Q] = 0$, then $P = 0$ and $Q = f(x)$. The statement follows by applying Jung's theorem ("Über ganze birationale Transformationen der Ebene," J. Reine Angew. Math. 184 (1942)) that says that every automorphism of the free abelian algebra of rank 2 is a product of elementary automorphisms. (Received August 27, 1970.) (Author introduced by Professor Wilhelm Magnus.)

70T-A215. ALAN E. ROSENBERG, Wesleyan University, Middletown, Connecticut 06457. On the primitivity of the group algebra. Preliminary report.

Let G be a group and F a field of characteristic zero, and $F[G]$ the group algebra of G over F . Theorem 1. If $F[G]$ is primitive, then $F[G]$ has no zero divisors. Corollary. If $F[G]$ is primitive, then G has no torsion. Theorem 2. If $F[H]$ is primitive and $[G:H] < \infty$ and $F[G]$ has no zero divisors, then $F[G]$ is primitive. If $R = F[G]$ is primitive and ρ is a maximal right ideal of R which contain no nontrivial two sided ideals, let $K = \{\sigma \in G | \sigma \rho \subseteq \rho\}$. Theorem 3. K is a subgroup of G and $[G:K] = \infty$. Conjecture. $F[G]$ is never primitive. (Received August 28, 1970.)

70T-A216. E. M. WRIGHT, University of Aberdeen, Aberdeen, Scotland. The number of strong digraphs.

There are $2^{n(n-1)}$ digraphs on n labelled nodes and s_n of these are strongly connected, i.e. every node can be reached by a directed path from every other node. V. A. Liskovec (Dokl. Akad. Nauk SSSR 184 (1969), 1284-1287 = Soviet Math. Dokl. 10 (1969), 242-246) has found three relations by which s_n can be calculated; this requires the calculation of a double sequence and two single sequences. From his result I deduce the two relations $s_n = \eta_n + \sum_{t=1}^{n-1} C(n-1, t-1) s_t \eta_{n-t}$ and $\eta_n + \sum_{t=1}^{n-1} C(n,t) 2^{(n-1)(n-t)} \eta_t = 2^{n(n-1)}$, which enable us to find s_n by calculating the two single sequences $\{\eta_n\}$ and $\{s_n\}$. We can, in the same way, simplify Liskovec's result for $s(n,N)$, the number of strong digraphs on n labelled nodes with just N edges. Using Wright (Proc. London Math. Soc. (3) 20 (1970), 558-572), we can find the general coefficient in the asymptotic expansion of s_n for large n and, using Wright (Proc. Roy. Soc. Edinburgh Sect. A 68 (1970), 298-308), a similar expansion for $s(n,N)$. Extensions to the case of unlabelled nodes are also possible. (Received August 31, 1970.)

Generalization of a theorem on distributive pseudo-complemented lattices.

In any distributive pseudo-complemented lattice, the following equations are equivalent: (1) $a^* \vee a^{**} = 1$, (2) $(a \wedge b)^* = a^* \vee b^*$, (3) $(a \vee b)^{**} = a^{**} \vee b^{**}$ (O. Frink, Duke Math. J. 29 (1962), 505-514).

On the other hand K. B. Lee has shown (Canad. J. Math., to appear) that when (1) is generalized to $E_n(\bigwedge_{i=1}^n x_i)^* \vee \bigvee_{i=1}^n (x_i \wedge \dots \wedge x_i^* \wedge \dots \wedge x_n)^* = 1$, these E_n characterize the whole lattice of equational classes of distributive pseudo-complemented lattices. The following generalizes Frink's result to cover all of Lee's equations, E_n . Theorem. In any distributive pseudo-complemented lattice the following are equivalent: (1) $(\bigwedge_{i=1}^n x_i)^* \vee \bigvee_{i=1}^n (x_i \wedge \dots \wedge x_i^* \wedge \dots \wedge x_n)^* = 1$, (2) $(\bigwedge_{i=1}^{n+1} x_i)^* = \bigvee_{i=1}^{n+1} (x_i \wedge \dots \wedge x_{i-1} \wedge x_{i+1} \wedge \dots \wedge x_n)^*$, (3) $(\bigvee_{i=1}^{n+1} x_i)^{**} = \bigvee_{i=1}^{n+1} (x_i \vee \dots \vee x_{i-1} \vee x_{i+1} \vee \dots \vee x_n)^{**}$. (Received August 31, 1970.)

Zeros of the derivative of the Riemann zeta function.

It is shown that the Riemann hypothesis implies that the derivative of the Riemann zeta function has no zeros in the open left half of the critical strip. It is also shown, with no hypothesis, that, with the exception of a bounded region where the zeros can be calculated, the closed left half plane contains only real zeros of the derivative. (Received August 31, 1970.)

It is proved in this paper that a skew Hadamard matrix of order $2(q+1)$ exists if $q = p^t$ is a prime power such that $p \equiv 5 \pmod{8}$ and $t \equiv 2 \pmod{4}$. For $p^t = 5^2$ the corresponding skew matrix of order 52 was obtained by Blatt and Szerkeres (Canad. J. Math. 22 (1970), 1319-1322). (Received September 2, 1970.)

Let $\mathcal{A} = (A; F)$ be a finitary algebra such that F contains a nondegenerate surjective operation and a k -fold transitive group of permutations. We say that a set P of permutations on the set A is k -fold transitive iff, for every subset $B \subseteq A$ of cardinality $\leq k$, every one-to-one function $f: B \rightarrow A$ can be extended to a permutation in P . \mathcal{A} is called primal-in-the-small (primal/sm.) iff for every $f: A^n \rightarrow A$ and every finite $B \subseteq A$ there is a $g: A^n \rightarrow A$ in the functional closure of F such that $f|_B = g|_B$. We give nsc for the primality/sm. of \mathcal{A} by stating the exceptional cases. \mathcal{A} is self-dual iff $|A| = 2$ and the automorphism group of \mathcal{A} is nontrivial. \mathcal{A} is affine with respect to an Abelian group $\mathcal{B} = (A; +)$ iff every $f \in F$ of n arguments can be written $f(x_1, \dots, x_n) = e_1(x_1) + \dots + e_n(x_n) + e$ for some endomorphisms e_i of \mathcal{B} and some $e \in A$. A function $f: A^n \rightarrow A$ is metamonic iff $f(x) = f(y)$ implies $x_i = y_i$ for some $i = 1, \dots, n$. Theorem 1. If $k \geq 4$, then \mathcal{A} is not primal/sm. iff (i) \mathcal{A} is self-dual, or (ii) \mathcal{A} is affine w.r.t. some isomorph of $\mathbb{Z}_2, \mathbb{Z}_3$ or $(\mathbb{Z}_2)^2$, or (iii) every $f \in F$ is metamonic. Theorem 2. If $k = 3$, then \mathcal{A} is not primal/sm. iff (i), (ii) or (iii) of Theorem 1 holds, or (iv) \mathcal{A} is affine w.r.t. some elementary Abelian 2-group. (Received September 3, 1970.)

All rings considered here are commutative containing at least two elements, but may not be containing unity. As defined in a previous paper [these *Notices*], 17 (1970), 562] a ring R is said to have the (K)-property if, for each nonzero ideal A of R , there exists an ideal A' of R such that AA' is a principal nonzero ideal. The concepts of (KH) and K (KPH) properties were also introduced in the paper referred to above. Here a ring R is said to have the restricted (KPH)-property if for each ideal A , whose radical is a nonzero proper prime ideal, the ring R/A has the (K)-property. A ring R is said to have the (KPrH)-property if for each prime ideal $A (\neq R)$, whose radical is nonzero, the ring R/A has the (K)-property. The following main results are proved: (I) A ring R has the restricted (KPH)-property iff for each ideal A , whose radical is a nonzero proper prime ideal, either R/A is a primary domain in which ideal is principal or R/A is a multiplication ring. (II) A ring R has the (KPrH)-property if for each primary ideal $A (\neq R)$ with $\sqrt{A} (\neq 10)$, the ring R/A is a multiplication ring. A domain D with unity $e \neq 0$ is said to be a (KE)-domain if each of its proper ideals A (as a ring) has the (K)-property. (Received September 3, 1970.) (Author introduced by Professor Robert E. Atalla.)

Analysis

70T-B194. JAMES T. BURNHAM, University of Iowa, Iowa City, Iowa 52240. Multipliers of $L^1(G) \cap L^p(G)$.

The algebras $A(p,G) = L^1(G) \cap L^p(G)$ have been extensively studied by Leonard Yap, "Ideals in subalgebras of the group algebra," *Studia Math.* 35(1970), to appear. The reader is referred to Yap's paper for the basic properties of the algebras $A(p,G)$. Theorem. The space of multipliers (bounded linear operators on $A(p,G)$ onto $L^1(G)$ commuting with translations) of $A(p,G)$ is isometrically isomorphic to the space of Fourier-Stieltjes transforms of the "usual" measure algebra. Professor Yap (unpublished) has communicated the same result to the author but Yap's proof is considerably different than the one presented in this note. (Received March 6, 1970.)

70T-B195. DAVID K. COHOON, University of Wisconsin, Madison, Wisconsin 53706. Nonexistence of a continuous right inverse for surjective linear partial differential operators on special spaces of infinitely differentiable functions. III. Preliminary report.

The author considers linear partial differential operators $P(D)$ with constant coefficients acting on $\gamma^{(\delta)}(\Omega)$ (see these *Notices* 17(1970), Parts I and II), where Ω is a $P(D)$ -convex open set and $\delta > 1$. Let N be a nonhyperbolic, noncharacteristic direction of $P(D)$. Let Ω be an open subset of \mathbb{R}^n , where $n \geq 2$ and n is the number of independent variables of $P(D)$. Suppose that there is an $x^{(0)}$ in the boundary of Ω such that there is a right circular cone W whose tip touches $x^{(0)}$, whose base is truncated by a hyperplane $\langle x, N \rangle = c$, and $\bar{W} - \{x^{(0)}\} \subset \Omega$. Assume also that every characteristic hyperplane which passes through the point $x^{(0)}$ passes through the base of W . Let $X(\xi')$ be a zero of $Q(\xi', X(\xi'))$, where ξ' and Q are defined in the abstract for Part II of the above paper in these *Notices*. Suppose that there are positive M and C and real B such that $\text{Im } X(\xi') < -C \|\xi'\|^M + B$ for all ξ' belonging to some unbounded subset \mathcal{A} of \mathbb{R}^{n-1} , where $\|\xi'\| = (\xi_1^2 + \dots + \xi_{n-1}^2)^{1/2}$. Then $P(D)$ has no continuous right inverse in $\gamma^{(\delta)}(\Omega)$ for any $\delta > 1/M$. (Received June 8, 1970.)

70T-B196. DONALD A. EISENMAN, University of North Carolina, Chapel Hill, North Carolina 27514. Holomorphic self-mappings of hyperbolic analytic spaces. Preliminary report.

Let X be a hyperbolic analytic space (in the sense of Kobayashi) and U be an open, relatively compact subset of X which intersects each irreducible component of X . If $f: X \rightarrow X$ is a holomorphic mapping and $U \subset f(U)$, then (i) $f(U) = U$, and (ii) f is an automorphism of X . The case where X is a complex manifold was treated by the author in "Intrinsic measures on complex manifolds and holomorphic mappings," Mem. Amer. Math. Soc. No. 96 (1970). (Received April 30, 1970.) (Author introduced by Professor Fred B. Wright.)

70T-B197. MICHAEL G. HENLE, Yale University, New Haven, Connecticut 06520. Spatial representation of groups of automorphisms of von Neumann algebras with properly infinite commutant.

Theorem. Let G be a topological group represented by $*$ -automorphisms of a von Neumann algebra \mathbf{R} which in turn acts on a separable Hilbert space \underline{H} . Assume that (a) G is locally compact and separable, (b) \mathbf{R}' is properly infinite, and (c) for $T \in \mathbf{R}$, and $x, y \in \underline{H}$, the function $g \rightarrow \langle g(T)x, y \rangle_{\underline{H}}$ is measurable on G . Then there exists a strongly continuous representation of G on \underline{H} , $g \rightarrow U_g$, such that for $g \in G$, $T \in \mathbf{R}$, $g(T) = U_g T U_g^*$. The proof involves a generalization of the cross product construction. (Received May 1, 1970.)

70T-B198. EDMOND D. CASHWELL and C. J. EVERETT, University of California, Los Alamos Scientific Laboratory, Los Alamos, New Mexico 87544. Extension of the Riesz representation theorem and solution of the Maxwell-Boltzmann functional equation.

The central problem arising from the Boltzmann H-theorem of kinetic theory is the determination of all functions $N(X)$ of the velocity vector X which satisfy the "Maxwell-Boltzmann" functional equation $N(Z)N(X + Y - Z) = N(X)N(Y)$ whenever the velocities X, Y, Z are in the collision relation $Z^2 + (X + Y - Z)^2 = X^2 + Y^2$. It is well known that a differentiable solution must be a Maxwell distribution of the form $N(X) = N(0)\exp(aX^2 + BX)$, and a trivial proof of this is given for vectors in a real space of finite dimension ≥ 2 . Much more generally, it is shown that the only continuous solutions of the problem, in a real Hilbert space H ($n \geq 2$), are of Maxwell form. This follows a known extension of the F. Riesz representation theorem (for which a simple proof is included) stating that a functional $L(X)$, continuous on H , and additive on orthogonal vectors, is of the form $aX^2 + BX$. (Received July 3, 1970.)

70T-B199. D. WILLETT, University of Utah, Salt Lake City, Utah 84112. Principal systems of solutions of disconjugate linear equations.

P. Hartman (Amer. J. Math. 91(1969)) showed that every disconjugate linear differential equation $Lu = 0$ has a principal system of solutions. We prove this result with essentially elementary considerations. In addition, we show that the Cauchy function $g(t,s)$ for $Lu = 0$ has the form $g(t,s) = u_1(t)v_1(s) - u_2(t)v_2(s) + \dots + (-1)^{n-1}u_n(t)v_n(s)$ with (u_1, \dots, u_n) a principal system for $Lu = 0$ and (v_1, \dots, v_n) a principal system for the formal adjoint equation $L^*v = 0$. These are called the fundamental principal solutions. It follows that $L^*v = 0$ is disconjugate on an interval $[a,b]$, if $Lv = 0$ is disconjugate on $[a,b]$ ($-\infty < a < b \leq \infty$). (Received July 8, 1970.) (Author introduced by Professor Jack W. Macki.)

70T-B200. ANTHONY TO-MING LAU, University of Alberta, Edmonton 7, Alberta, Canada.

Invariant means on almost periodic functions and fixed point properties.

Let S be a topological semigroup and $AP(S)$ be the space of strongly almost periodic functions on S . Theorem 1. The following conditions are equivalent: (a) $AP(S)$ has a left invariant mean (LIM). (b) For any separately continuous, equicontinuous and affine action of S on a compact convex subset K of a separated locally convex space ($\mathcal{L}.c.s.$), K has a common fixed point for S . (c) For any separately continuous and nonexpansive action of S on a compact convex subset K of a $\mathcal{L}.c.s.$ K has a common fixed point for S . Theorem 2. $AP(S)$ has a multiplicative LIM iff whenever S is a separately continuous and equicontinuous action on a compact Hausdorff space X , X has a common fixed point for S . Theorem 1 (a) \Leftrightarrow (b) generalises Kakutani fixed-point theorem [Dunford and Schwartz, "Linear operators. I," p.457]; (a) \Leftrightarrow (c) generalises fixed-point theorems of DeMarr [Pacific J. Math 13(1963), 1139], Takahashi [Kōdai Math. Sem. Rep. 21(1969), 384], Mitchell ["Fixed points of reversible semigroups of nonexpansive mappings," to appear], Holmes and the author [Corollary 1 in "Nonexpansive action of topological semigroup and fixed points," to appear]. (Received July 13, 1970.)

70T-B201. PETER J. KALMAN, State University of New York, Stony Brook, New York 11790.

A note on the integrability condition in demand theory.

In this paper we extend the literature on existence of solutions to systems of partial differential equations to cover the present case. Let the demand function σ be a mapping from $n + 1$ space to the reals. That is $\sigma: \Pi \rightarrow \mathbb{R}$ where $\Pi = \{(p, m) | p_i > 0, m \geq 0, i = 1, \dots, n\}$. Our main theorem is: Theorem (Integrability). Let $\sigma(p, m)$ satisfy the following: (1) $\sigma(p, m)$ is single valued and $\sigma(p, m) \geq 0$; (2) $\sigma(p, m)$ possesses a differential on Π ; (3) σ satisfies a Lipschitz condition; (4) σ satisfies a symmetry condition. Then the system $\partial m / \partial p_i = \sigma(p, m)$, $i = 1, \dots, n$, is uniquely integrable; i.e., for any $(\hat{p}, \hat{m}) \in \Pi$, there uniquely exists a function $\mu(\hat{p}, \hat{m}) \ni \mu(\hat{p}, \hat{m}) = \sigma(p, \mu(\hat{p}, \hat{m}))$ and $\mu(\hat{p}, \hat{m})$ is continuous with respect to (\hat{p}, \hat{m}) . (Received July 14, 1970.) (Author introduced by Dr. Lawrence E. Schwartz.)

70T-B202. DENNIS R. DUNNINGER, Michigan State University, East Lansing, Michigan 48823

and RICHARD J. WEINACHT, University of Delaware, Newark, Delaware 19711. Sturmian theory for a class of singular elliptic operators.

Separation and comparison theorems of Sturm's type are given for differential inequalities involving singular elliptic operators of the form $(a^{ij}(x, y)u_{,i})_{,j} + (k/y)u_y + c(x, y)u$ and a related class of degenerate elliptic operators. The region considered is an open connected subset of the half-space $y > 0$ in E_{n+1} with an open subset of the hyperplane $y = 0$ as part of the boundary. A notable feature is that data need not be prescribed on $y = 0$ in contrast to the regular case where data are prescribed on the entire boundary. (Received July 17, 1970.)

70T-B203. MORRIS MARDEN, University of Wisconsin, Milwaukee, Wisconsin 53201. Value

distribution of axisymmetric harmonic polynomials in several real variables.

Using Bergman's integral operator method and the analytic theory of polynomials, the author studies axisymmetric harmonic polynomials in \mathbb{R}^3 , $H(x, \rho) = \sum_{k=0}^n a_k r^k P_k(x/r)$, where (x, ρ) are cylindrical coordinates, $r^2 = x^2 + \rho^2$ and $P_k(u)$ is the Legendre polynomial of degree k . The results

pertain to value distributions of H ; critical circles of H ; derivatives and gradient of bounded H for $r \leq 1$; and coincidence theorems. For example, if in \mathbb{C} polynomial $h(\zeta) = \sum_{k=0}^n a_k \zeta^k$ omits a real value ν outside a bounded region ω symmetric in the real axis, then $H(x, \rho)$ omits the same value ν in certain cones determined by ω , ν and n . The results are generalized to certain nonaxisymmetric harmonic polynomials in R^3 , axisymmetric harmonic polynomials $H(x, \rho)$ in R^N with $x = x_1, \rho^2 = x_2^2 + x_3^2 + \dots + x_N^2$ and axisymmetric harmonic vectors $H(x, \rho) = P(x, \rho)i_x - \rho^{-1}S(x, \rho)i_\rho$, where polynomial $P(x, \rho)$ is an axisymmetric flow potential and $S(x, \rho)$ the corresponding Stoke's stream function. (Received July 20, 1970.)

70T-B204. WILLIAM D. L. APPLING, North Texas State University, Denton, Texas 76203.

A note on differential equivalence. Preliminary report.

Suppose h is a function from \mathbb{R} into the nonnegative numbers. The following three statements are equivalent: (1) If F is a field of subsets of a set U and B is a function from F into \mathbb{R} such that the integral (see previous abstracts) $\int_U B(I)$ exists, then $\int_U h[B(I) - \int_I B(J)] = 0$; (2) if F is a field of subsets of a set U and B is a function from F into \mathbb{R} such that $\int_{I_1} |B(I)| = 0$, then $\int_U h(B(I)) = 0$; (3) if $0 < c$, then there is a $d > 0$ such that if $\{x_i\}_{i=1}^n$ is a finite number sequence and $\sum_{i=1}^n |x_i| < d$, then $\sum_{i=1}^n h(x_i) < c$. (Received July 22, 1970.)

70T-B205. HWAI-CHIUAN WANG, University of Iowa, Iowa City, Iowa 52240. Nonfactorization in Segal algebras. Preliminary report.

Let G be a nondiscrete l.c.a. group with dual G . The following results are proved: Theorem 1. If S is a proper Segal algebra on G then S possesses no bounded approximate identity. Theorem 2. Let S be a proper Segal algebra on G such that $\|xf\|_S = \|f\|_S$ for all characters x and all $f \in S$. Suppose \hat{S} (the set of Fourier transforms of $f \in S$) is contained in $L^p(\hat{G})$ for some p ($0 < p < \infty$). Then S does not have the factorization property (that is, $S^2 \neq S$). Used in the proof of Theorem 2 is the following Lemma. If A is a subalgebra of $L^1(G)$ such that $A^2 = A$, and if $A \subset L^p(G)$ for some p ($0 < p < \infty$), then $A \subset L^p(G)$ for all p ($0 < p \leq \infty$). The Segal algebra of all $f \in L^1 \cap L^p$ with $\|f\| = \|f\|_1 + \|f\|_p$ and the algebra of all $f \in L^1$ such that $\hat{f} \in L^p$ with $\|f\| = \|f\|_1 + \|\hat{f}\|_p$ have been previously shown by Yap [Studia Math. 35 (1970)] and by Martin and Yap [Proc. Amer. Math. Soc. 24 (1970), 217-219], respectively not to possess the factorization property. Their results are corollaries to Theorem 2. (Received July 27, 1970.) (Author introduced by Professor Richard R. Goldberg.)

70T-B206. RONALD A. DEVORE, Oakland University, Rochester, Michigan 48063. On the direct theorem of saturation.

Let $F_n(t) = (2\pi n)^{-1} (\sin(nt/2)/\sin(t/2))^2$ be the Fejer Kernels and let $\Lambda_n(t) = (F_n(t - n^{-5/8}) + F_n(t + n^{-5/8}))/2$. Theorem. The operators $L_n(f) = f * \Lambda_n$ are saturated with order $(1/n)$ and $\lim_{n \rightarrow \infty} n(1 - 2\hat{\Lambda}_n(k)) = k$. However, there exists a function f such that $\sum_{-\infty}^{\infty} k\hat{f}(k)e^{ikx} \in L_\infty$ and $\|f - L_n(f)\| \neq O(1/n)$. This theorem supplies a counterexample to the direct theorem of saturation announced by Tureckii (Izv. Akad. Nauk. SSSR Ser. Mat. 25(1961), 411-442) for the case of positive operators. It complements the counterexamples of Sunouchi (Acta Sci. Math.(Szeged) 20(1969), 409-420) which were not positive operators. A general procedure for constructing counterexamples is given. (Received July 16, 1970.)

70T-B207. CHING CHOU, State University of New York at Buffalo, Amherst, New York 14226.
The multipliers of the space of almost convergent sequences.

Let N be the set of positive integers and $m(N)$ the space of bounded real-valued functions on N . $f \in m(N)$ is almost convergent if $\varphi(f)$ equals a fixed constant as φ runs through the set of Banach limits. Denote the set of almost convergent sequences by F . Theorem. Let $f \in m(N)$. Then f is a multiplier of F , i.e., $fF \subset F$, if and only if f converges to a constant a in the following weak sense: given $\epsilon > 0$ there is a set $A \subset N$ such that $\varphi(\chi_A) = 0$ for each Banach limit φ and $|f(n) - a| < \epsilon$ if $n \in N \setminus A$. It follows directly from the above theorem that if f is a nonconstant almost periodic function on N then $fF \not\subset F$. (Received July 30, 1970.)

70T-B208. STUART P. HASTINGS, State University of New York, Buffalo, New York 14226.
On the uniqueness of a similarity solution for a compressible boundary layer.

The equations considered are (1) $f''' + ff' + \lambda(h - f'^2) = 0$, (2) $h'' + fh' = 0$, (3) $f(0) = f'(0) = 0$, $h(0) = a$; $f'(\infty) = h(\infty) = 1$. This boundary value problem is sometimes called Stewartson's problem. For $\lambda > 0$ and $0 < a < 1$ the existence of a solution satisfying the further condition $f'' > 0$ was first proved by Ho and Wilson (Archive Rational Mech. Anal. 27(1967), 165-174). In this paper we prove that under the same conditions there is only one such solution. (Received July 30, 1970.)

70T-B209. LESLIE K. ARNOLD, Station Square One, Paoli, Pennsylvania 19301. Completely unbounded transformations in ergodic theory.

Let T be a 1-1, bi-measurable, nonsingular transformation of a finite measure space (X, Σ, m) onto itself. All sets mentioned are assumed or constructed to be measurable subsets of X . Two sets, A and B , are equivalent by countable decomposition (EBCD) if there are partitions $\{A_i\}$ and $\{B_i\}$ of A and B , respectively, and integers $n(i)$ for $i = 1, 2, \dots$ such that $T^{n(i)}(A_i) = B_i$. Suppose T is completely unbounded, i.e., if A is any set of positive measure, there is a subset B of A such that A and B are EBCD and $m(A - B) > 0$. Then the following statements hold modulo sets of measure 0 (which means two sets are regarded as equal if their symmetric difference has measure 0): (1) If A is any set, there is an infinite partition $\{A_i: i = 1, 2, \dots\}$ of A such that A and A_i are EBCD for each i . Also, if for each n , B_n is the union of the A_i such that $i > n$, then A and B_n are EBCD. (2) If A is any set, and A^* is the smallest set containing A such that $T(A^*) = A^*$, then A and A^* are EBCD. (3) If A and B are sets of positive measure which are not EBCD, then there is a set E such that $T(E) = E$ which contains A but not (all of) B , or vice versa. (4) If T is ergodic (i.e., $T(A) = A$ only if $m(A) = 0$ or $m(X - A) = 0$), then every pair of sets of positive measure are EBCD. (Received August 3, 1970.)

70T-B210. ARVIND B. BUCHE, Centre for Advanced Study in Mathematics, Panjab University, Chandigarh-14, India. Perturbation theory for the generalized semigroup.

Let $B(X)$ denote the family of bounded linear operators on a Banach space X . Let $F(s, t): \mathbb{R}^+ \times \mathbb{R}^+ \rightarrow B(X)$ and $S(t): \mathbb{R}^+ \rightarrow B(X)$ be families of operators strongly continuous in s, t and in t respectively such that $S(0) = I$, $S(s + t) - S(s)S(t) = F(s, t)$, $F(s, t) = F(t, s)$ for all $s, t \geq 0$. Given $F(s, t)$ the solution of the above equation for the generalized semigroup $S(t)$ in the uniform operator topology was studied by Buche and Bharucha-Reid (Proc. Nat. Acad. Sci. U.S.A. 60(4) (1968), 1170-1174). Let $A = \text{strong } \lim_{t \rightarrow 0} (S(t) - I)/t$, and assume that the Hille-Yosida-Phillips conditions are satisfied so that

$\{T(t), t \geq 0\}: T(t): R^+ \rightarrow B(X)$ is the semigroup of operators having the strong infinitesimal generator A , such that $\|F(s,t)x\| \leq K \|(T(s) - I)(T(t) - I)x\|$, for some constant $K > 0$, and for all $x \in X$. Define $A_h = (T(h) - I)/h, h > 0$, and $U(t): R^+ \rightarrow B(X), U(t) = \text{strong } \lim_{h \rightarrow 0} (1/h) \int_0^t \exp\{(t - \tau)A_h\} F(h,\tau) d\tau$. Then $S(t)$ admits in the strong operator topology the representation $S(t) = T(t) + U(t)$, if and only if $U(s+t) - U(s)U(t) - T(s)U(t) - U(s)T(t) = F(s,t)$ for all $s,t \in R^+$. Furthermore $\|(S(t) - T(t))x\| \leq Kt \sup_{0 \leq \tau \leq t} [\|T(t - \tau)\| \|A(T(\tau) - I)x\|]$, for all x in domain of A . (Received August 4, 1970.)

70T-B211. JOE W. JENKINS, State University of New York, Albany, New York 12203. Non-symmetric group algebras.

A locally compact group G with left Haar measure μ satisfies (F) if for some $a, b \in G$, and some neighborhood V of $e, \mu(ba^n 1_V \dots ba^n p_V \cap ba^m 1_V \dots ba^m p_V) \neq 0$ and $n_i, m_i \geq 0$ for $1 \leq i \leq p$ imply that $n_i = m_i$ for $1 \leq i \leq p$. Theorem 1. If G satisfies (F) then $L^1(G)$ is not symmetric. Theorem 2. For $n > 1, GL(n, R)$ and $SL(n, R)$ satisfy (F). (Received August 5, 1970.)

70T-B212. K. R. KELLUM, University of Alabama, University, Alabama 35486. Almost continuous functions of Baire class 1. Preliminary report.

All functions considered are real functions with domain $[0,1]$ and range a subset of $[0,1]$. A function is said to be almost continuous if and only if each open set which contains it also contains a continuous function with the same domain. Theorem. Suppose f is an almost continuous function. In order that f be of Baire class 1 it is necessary and sufficient that f be the intersection of a sequence D_1, D_2, D_3, \dots of open sets such that, for each positive integer $n, D_n \supset D_{n+1}$ and such that, if D is an open set containing f , there is a positive integer n such that $D_n \subset D$. (Received August 6, 1970.) (Author introduced by Professor Bert Dee Garrett.)

70T-B213. BERT DEE GARRETT and D. NELMS, University of Alabama, University, Alabama 35486. Connected real functions.

All functions considered are real functions with domain the real line R . A function is said to be connected whenever it is a connected subset of the plane E . If M is a subset of E , then $(M)_X$ is the X -projection of M , and l_z is the vertical line through the point $(z,0)$. Definition. The function f is connected at the point z of its domain if and only if (1) $(z, f(z))$ is a limit point of f from both the left and the right, and (2) if (z,a) and (z,b) are two limit points of f from the left (right), then the continuum M intersects f whenever $(M)_X$ has nondegenerate X -projection with right (left) end z , and $M \cap l_z$ lies between (z,a) and (z,b) . Theorem. The function f is connected if and only if it is connected at each point of its domain. Definition. If f is a function, $f(+)$ is the subset of E such that (x,y) is in $f(+)$ if and only if $y > f(x)$. The set $f(-)$ is defined similarly. Theorem. The function f is connected if and only if f intersects each continuum which intersects both $f(+)$ and $f(-)$. (Received August 6, 1970.)

70T-B214. CHARLES F. DUNKL and DONALD E. RAMIREZ, University of Virginia, Charlottesville, Virginia 22901. L^p multipliers on compact groups.

For G an infinite compact group and $1 \leq p \leq 2$, let M_p be the space of bounded operators on $L^p(G)$ which commute with right translation. The results of Bachelis and Gilbert [to appear] together with the results of Figà-Talamanca [Duke Math. J. 32(1965), 495-502] yield that M_p is the

second dual of a Banach space for $1 < p \leq 2$. Thus for $1 < p \leq 2$, $M_p \neq M(G) = M_1$; for if not, then $C(G)$ would be a dual space and thus G would be extremally disconnected and hence finite [Rajagopalan, Acta Sci. Math.(Szeged)25(1964), 86-89]. This is one way to answer quickly a question of Hewitt and Ross ["Abstract harmonic analysis. II," Springer-Verlag, New York, 1970, p. 410]. (Received August 12, 1970.)

70T-B215. J. P. SINGHAL, University of Victoria, Victoria, British Columbia, Canada. Certain extensions of the Mehler formula.

For the Hermite polynomial $H_n(z)$ defined by $\sum_{n=0}^{\infty} (t^n/n!) H_n(z) = \exp(2zt - t^2)$, Carlitz has, recently, obtained a number of interesting bilinear and multilinear generating functions which provide extensions of the well-known Mehler formula. The object of this note is to show how rapidly the results of Carlitz follow when we make use of the Rodrigues formula for the Hermite polynomial together with some elementary results involving the Laguerre polynomials. (Received August 13, 1970.)

70T-B216. HARI M. SRIVASTAVA, University of Victoria, Victoria, British Columbia, Canada. A pair of dual series equations involving generalized Bateman k-functions.

By using a multiplying factor technique as well as by considering separately the equations when (i) $g(x) \equiv 0$, (ii) $f(x) \equiv 0$, and reducing the problem in each case to that of solving an Abel integral equation, an exact solution is obtained for the dual series equations (*) $\sum_{n=0}^{\infty} \{A_n/\Gamma(\alpha + n + 1)\} k_{2n}^{2\alpha}(x) = f(x)$, $0 \leq x < y$, (**) $\sum_{n=0}^{\infty} \{A_n/\Gamma(\beta + n + 1)\} k_{2n}^{2\alpha}(x) = g(x)$, $y < x < \infty$, where $\beta + 1 > \alpha > \beta > -1$, $k_{\nu}^{\alpha}(x)$ is the generalized Bateman function defined by $k_{\nu}^{\alpha}(x) = (2/\pi) \int_0^{\pi/2} (2 \cos \theta)^{\alpha} \cos(x \tan \theta \nu \theta) d\theta$, $\alpha > -1$, and $f(x)$ and $g(x)$ are prescribed functions. It is also shown how the method by reduction to Abel integral equations would enable one to obtain, without any additional effort, values of series in (*) and (**) where they are not already specified. (Received August 13, 1970.)

70T-B217. JAMES K. BROOKS and ROBERT S. JEWETT, University of Florida, Gainesville, Florida 32601. On finitely additive vector measures.

In this paper we extend the Vitali-Hahn-Saks and Nikodým theorems for measures to finitely additive vector-valued set functions. The main tool is a vector form of a result due to Phillips ("On linear transformations," Trans. Amer. Math. Soc. 48(1940), 516-541). (To appear in Proc. Nat. Acad. Sci. U.S.A.) (Received August 13, 1970.)

70T-B218. STEPHEN VÁGI, DePaul University, Chicago, Illinois 60614. On the boundary values of holomorphic functions.

Let V_1, V_2 be finite dimensional complex euclidean spaces, $\text{Re } V_1$ a distinguished real form of V_1 , Ω a regular open convex cone in $\text{Re } V_1$, and $\Phi: V_2 \times V_2 \rightarrow V_1$ an Ω -positive hermitian bilinear map. Let D be the Siegel domain of type II determined by the above, B its Bergman-Šilov boundary. $H^2(B)$ denotes the closed subspace of $L^2(B)$ which consists of boundary functions of elements of the Hardy space $H^2(D)$. Theorem. $f \in L^2(B)$ belongs to $H^2(B)$ iff the following two conditions are satisfied: (a) for almost every $\zeta \in V_2$ the Fourier transform of $f(\cdot, \zeta)$ vanishes almost everywhere outside the dual cone of Ω ; (b) f satisfies in the sense of distributions the tangential Cauchy-Riemann equations on B .

Corollary. If D is also a hermitian symmetric space, then the following two facts are equivalent: (i) D has no irreducible factor of tube type; (ii) $f \in L^2(B)$ is in $H^2(B)$ iff it satisfies condition (β) . (Received August 14, 1970.) (Author introduced by Professor Jerry Goldman.)

70T-B219. DOV AHARONOV and JOSEPH L. WALSH, University of Maryland, College Park, Maryland 20742. On the convergence of rational functions of best approximation to a meromorphic function. Preliminary report.

If a sequence of rational functions $r_n(z)$ of respective degrees n converges in a closed bounded region so that for the Tchebycheff norm $\|r_n(z)\|^{1/n} \rightarrow 0$, then that relation holds in any closed bounded region containing no limit point of the poles of the $r_n(z)$. Consequently if the $R_n(z)$ are the rational functions of best Tchebycheff approximations of respective degrees n to a meromorphic (at every finite point of the plane) function $f(z)$ in a closed bounded region C containing no pole of $f(z)$, then $\|f(z) - R_n(z)\|^{1/n} \rightarrow 0$ in C and in any closed bounded region containing no limit point of poles of the $R_n(z)$. (Received August 17, 1970.)

70T-B220. SHAIR AHMAD, Oklahoma State University, Stillwater, Oklahoma 74074 and ALAN C. LAZER, Case Western Reserve University, Cleveland, Ohio 44106. A uniqueness theorem for periodic solutions of a class of second order nonlinear systems.

Let $A(t)$ be a real continuous 2π -periodic, symmetric $n \times n$ matrix function such that there exist an integer N and numbers a and a' with $N^2 < a \leq a' \leq (N+1)^2$ and $aI \leq A(t) \leq a'I$ for all t where I is the identity. Theorem. The second order system $w'' + A(t)w = 0$ has no 2π -periodic solution other than the trivial one. As an application of this result we obtain Theorem. Let $G \in C^2(\mathbb{R}^n, \mathbb{R})$, $p \in C(\mathbb{R}, \mathbb{R}^n)$ with $p(t + 2\pi) = p(t)$. If a, a' and N are as above and $aI \leq (\partial^2 G(x) / \partial x_i \partial x_j) \leq a'I$ for all $x \in \mathbb{R}^n$ then the differential equation $x'' + \text{grad } G(x) = p(t)$ has at most one 2π -periodic solution. For $n = 1$ an elementary proof was given by D. E. Leach (J. Differential Equations 7(1970), 34-53). The second theorem settles a question left open by A. C. Lazer and D. A. Sanchez (Michigan Math. J. 16(1969), 193-200). (Received July 30, 1970.)

70T-B221. MAX SHIFFMAN, 318 Warren Avenue, San Leandro, California 94577. Some interesting nonmeasurable sets.

Let X be an arbitrary set on the real number line or in Euclidean n -space, with positive exterior Lebesgue measure, $m_e(X) > 0$. (The limitation to Euclidean space is unessential.) A subset N of X will be called an N -set in X if $m_i(N) = 0$, $m_e(N) = m_e(X)$ and $m_i(N^c) = 0$, $m_e(N^c) = m_e(X)$, where $m_i(\cdot)$ is interior Lebesgue measure and $N^c = X - N$ is the complement of N . The possibility $m_e(X) = \infty$ is included. Let α be an index symbol varying over a collection with a cardinal number $\leq 2^{\aleph_0}$ and > 1 , where 2^{\aleph_0} is the cardinal number of the continuum; the axiom of choice and the continuum hypothesis will be made use of. Notice that any positive integer > 1 , \aleph_0 , and 2^{\aleph_0} are the possible cardinal numbers over which α may vary. The following theorems are here proved: (1) X contains an N -set; (2) X contains two disjoint N -sets whose union is an N -set; (3) X contains mutually disjoint N -sets N_α , and whose union is an N -set; (4) X contains mutually disjoint N -sets N_α for which $X = \bigcup_\alpha N_\alpha$. As cases of particular importance, these theorems apply to a set $X = Z$ where $m_i(Z) = 0$, $m_e(Z) > 0$; and to an interval or any measurable set X , in which case the continuum hypothesis is not used when the number of α 's is $\leq \aleph_0$. (Received August 11, 1970.)

70T-B222. PETER HESS, University of Chicago, Chicago, Illinois 60637. A variational approach to nonlinear eigenvalue problems.

Let f be a real-valued differentiable function defined on the real reflexive Banach space X . The derivative $f': X \rightarrow X^*$ is said to satisfy the monotonicity condition (P) if for each sequence $\{u_n\}$ in X converging weakly to some $u \in X$, $\limsup (f'u_n, u_n - u) \geq 0$. Theorem 1. Let C be a weakly closed subset of X . If $\lim_{\|u\| \rightarrow \infty, u \in C} f(u) = +\infty$, and if f' is continuous and satisfies condition (P), the function f assumes a minimal value on C . A consequence of Theorem 1 and of Lusternik's principle is Theorem 2. Let f, g be continuously differentiable functions on X , with f' satisfying condition (P), and with g weakly continuous. Suppose that for a given constant c the level set $M_c(g) = \{u \in X: g(u) = c\}$ is nonempty, that $g'u \neq 0$ for $u \in M_c(g)$, and that $f(u) \rightarrow +\infty$ as $\|u\| \rightarrow \infty, u \in M_c(g)$. Then f assumes its minimum on the set $M_c(g)$ at a point u_0 which is a solution of the eigenvalue equation $f'u_0 = \lambda g'u_0$ for some real λ . Theorems 1 and 2 generalize recent results by F. E. Browder and by the writer and admit interesting applications to multiple integral functionals defined on an appropriate Sobolev space. (Received August 17, 1970.)

70T-B223. THOMAS L. KRIETE III, University of Virginia, Charlottesville, Virginia 22903 and DAVID TRUTT, Lehigh University, Bethlehem, Pennsylvania 18015. The Cesàro operator is not similar to a weighted shift. Preliminary report.

The Cesàro operator C_0 is defined on ℓ^2 by $C_0: \{a_n\} \rightarrow \{(a_0 + a_1 + \dots + a_n)/(n+1)\}$. The authors recently showed that C_0 is subnormal [Abstract 70T-B160, these *Notices* 17(1970), 818]. More recently, P. R. Halmos asked whether $I - C_0$ is similar to a weighted shift. We have shown that it is not. The proof depends on the methods used to show subnormality. (Received August 17, 1970.)

70T-B224. ANTOINE DERIGHETTI, Harvard University, Cambridge, Massachusetts 02138. On weak containment.

Let G be an arbitrary locally compact group. It is well known that G has property P_1 if and only if the regular representation of G weakly contains the one-dimensional identity representation i_G . This suggests, for an arbitrary continuous unitary representation π of G acting on a Hilbert space $\mathcal{H}(\pi)$, studying the minimum $d(\pi)$ of all nonnegative real numbers λ such that for every $\epsilon > 0$ and every compact subset K of G there exists $\xi \in \mathcal{H}(\pi)$ with $\|\xi\| = 1$ and $\sup\{ |(\pi(x)\xi, \xi) - 1| : x \in K \} < \lambda + \epsilon$. A slight modification of Theorem 1.5 [J. M. G. Fell, Trans. Amer. Math. Soc. 94(1960), 365-403] permits us to show that π weakly contains i_G if and only if $d(\pi) = 0$. For a large class of π (including those obtained by inducing the one-dimensional identity from arbitrary closed subgroups) a stronger result is obtained: $d(\pi) \geq 1$ if and only if π does not weakly contain i_G . These results are directly related to those of Abstract 70T-B174, these *Notices* 17(1970), 822. (Received August 19, 1970.)

70T-B225. JOSEPH M. TESSMER, JR., University of Virginia, Charlottesville, Virginia 22901. Measures on compact groups. Preliminary report.

Let G be a compact infinite group and \hat{G} its dual. For $\mu \in M(G)$, the measure of algebra of G , $\hat{\mu}$, the Fourier transform of μ , is a matrix-valued function defined on G . If the operator norm of $\hat{\mu}$ at α tends to zero as α tends to infinity in \hat{G} , one says that $\mu \in M_0(G)$. Say G satisfies (V) if there exists a nonzero singu-

lar measure in $M_0(G)$. If H is a closed normal subgroup of G and G/H satisfies (V), then so does G (by smearing the measure over cosets of H). If G/G' is infinite (G' the derived group of G) then the results of N. Varopoulos (Ann. Inst. Fourier (Grenoble) 16(1966), fasc. 2, 123-158) show that G satisfies (V). Example. The unitary group on C^n . One says that G satisfies (R) (D. Rider, Canad. J. Math. (to appear)) if $\lim_{\alpha \rightarrow \infty} \chi_{\alpha}(x)/n_{\alpha} = 0$ as $n_{\alpha} \rightarrow \infty$ for x not in the center of G (χ_{α} is the character of the class $\alpha \in \hat{G}$ of degree n_{α}) and there are only finitely many elements in G of any given degree. If G satisfies (R) and has a noncentral element whose conjugacy class is of Haar measure zero then G satisfies (V). Example. The special unitary group. (Received August 21, 1970.) (Author introduced by Professor Charles F. Dunkl.)

70T-B226. DONALD G. SAARI, Northwestern University, Evanston, Illinois 60201. Improbability of collisions in Newtonian gravitational systems.

Let n be finite and consider the n -body problem of Newtonian mechanics. Theorem. The set of initial conditions leading to collision in finite time has measure zero. Actually this theorem holds for the n -body problem in the inverse p force law where $1 < p < 15/7$. This answers one of the questions raised by J. E. Littlewood (J. E. Littlewood, "Some problems in real and complex analysis," Heath Math. Mono., Heath, Boston, 1968). (Received August 24, 1970.)

70T-B227. ULRICH KRENGEL, Ohio State University, Columbus, Ohio 43210. Weakly independent partitions and mixing properties.

Let T be an invertible measure preserving transformation of a probability space $(\Omega, \underline{F}, \mu)$. A partition $\xi = \{A_1, \dots, A_n\}$ is called weakly independent if there exists $k_1 < k_2 < \dots$ such that $\xi, T^{k_1}\xi, T^{k_2}\xi, \dots$ are mutually independent. T is called 2-sided weakly mixing if, for all $A, B, C \in \underline{F}$,
$$n^{-1} \sum_{k=0}^{n-1} |\mu(T^{-k}A \cap B \cap T^kC) - \mu(A)\mu(B)\mu(C)| \rightarrow 0.$$
 Theorem 1. Weak mixing is necessary and 2-sided weak mixing is sufficient for the possibility of modifying each finite partition on a set of arbitrarily small measure into a weakly independent partition. Theorem 2. T is weakly mixing if and only if, for all $A \in \underline{F}$, the sequence $(T^{-n}A)$ contains a remotely trivial subsequence. Theorem 3. If T is ergodic, then T has discrete spectrum if and only if there exists no $A \in \underline{F}$ with $0 < \mu(A) < 1$ such that $(T^{-n}A)$ contains a remotely trivial subsequence. (A sequence $(B_k) \in \underline{F}$ is called remotely trivial if the intersection of the σ -algebras \underline{G}_m generated by B_m, B_{m+1}, \dots contains only sets of measure zero or one. Theorems 2 and 3 therefore characterize weak mixing and discrete spectrum in terms of the null-sets of the measure space.) (Received August 28, 1970.) (Author introduced by Professor Mustafa A. Akcoglu.)

70T-B228. R. P. SINGAL, Thapar Institute of Engineering & Technology, Patiala, India. Transformation formulae for Kampe' de Fieret hypergeometric function.

MacRobert [Philos. Mag. 28(1939), 488-492, M.R. 1, 117] gave a result expressing ${}_4F_3(X)$ in a series involving ${}_2F_1(X)$. The author, using Gauss sum, Euler's first integral and a sum of the well-poised ${}_5F_4(1)$, obtained transformations for Kampe' de Fieret double hypergeometric function $F_{\rho, \nu}^{\lambda, \mu}(X, Y)$ [P. Appell

et J. Kampe' de Fariet, "Fonction hypergeometriques et hyperspheriques," Gauthier-Villars, Paris, 1926], one for $F_{1,2}^{1,3}$ and another for $F_{4,2}^{4,3}$. Then two results analogous to Bailey's results (Cambridge Tract No. 32, p. 87) are obtained from the first relation. In the end some sums of $F_{1,1}^{1,2}$ which can be called Dixon and Watson sums of double hypergeometric series are given. (Received August 28, 1970.) (Author introduced by Dr. Brij M. Nayar.)

70T-B229. S. M. SHAH, University of Kentucky, Lexington, Kentucky 40508. On entire functions of bounded index whose derivatives are of unbounded index.

In this paper some questions related to functions of bounded index are studied. (For definition and related problems see (i) W. J. Pugh and S. M. Shah, Pacific J. Math. 33(1970), 191-201, and (ii) W. J. Pugh, Proc. Amer. Math. Soc. 22(1969), 319-323.) Theorem 1. There exist strictly increasing sequences of positive integers $\{a_n\}_1^\infty$ and $\{k_n\}_1^\infty$ such that $f(z) = \prod_1^\infty (1 - z/a_n)^{k_n}$ is of unbounded index and $f(z)-c$, where c is any nonzero complex number, is of bounded index. One choice for $\{a_n\}$ and $\{k_n\}$ is $a_1 = k_1 = 10$, $k_{n+1} = k_n^2$ ($n \geq 1$), $a_{n+1} = k_{n+1} \exp\{k_n \log(3/2)\}$ ($n \geq 1$). Theorem 2. (i) If $f(z)$ is any entire function such that $f'(z)$ is of bounded index $N_{f'}$, then $f(z)$ is also of bounded index N_f and $N_f \leq N_{f'} + 1$. (ii) There exists an entire function $F(z)$ of bounded index such that $F'(z)$ is of unbounded index. The first part is easy to prove and the second part depends on Theorem 1. (Received August 31, 1970.)

70T-B230. THOMAS A. W. DWYER III, Northern Illinois University, De Kalb, Illinois 60115. Fischer spaces for the Hilbert-Schmidt holomorphy type. II

This is a continuation of Abstract 70T-B185, these *Notices* 17(1970), 825. With the same notation, let $p = \sum_n p_n$, where p_n is an n -H-S-polynomial on the Hilbert space E , and let f be an entire function on E , with Hilbert-Schmidt polynomial derivatives $\hat{d}^n f(x)$ at each x in E . The partial differential operator $p(d)$ is defined by $p(d)f(x) = \sum_n (\hat{d}^n f(x) | p_n)_H$. If f is in $F_r(E)$ then $p(d)f$ and pf are in $F_s(E)$ for $s < r$. Hence if f is in $\text{inv lim } F_r(E)$ (resp. $\text{dir lim } F_r(E)$) then so are $p(d)f$ and pf . Let $p' = \sum_{n=0}^m p'_n$, where p'_n is the n -H-S-polynomial on E' corresponding to p_n by duality, let f be in $F_r(E)$ (resp. $\text{inv lim } F_r(E)$) (resp. $\text{dir lim } F_r(E)$) and g' in $F_{r-1}(E')$ (resp. $\text{dir lim } F_r(E')$) (resp. $\text{inv lim } F_r(E')$): if $\langle \cdot, \cdot \rangle$ denotes the duality produced by the Fourier-Borel transformation, then $\langle p(d)f, g' \rangle = \langle f, p'g' \rangle$ for the corresponding dual pairs. Moreover, $\|p'g'\|_r \approx \|p'_m\|_r \|g'\|_r$, and transposition gives the following: if f is in $F_r(E)$ (resp. $\text{inv lim } F_r(E)$) (resp. $\text{dir lim } F_r(E)$) then there is a g in the same space such that $p(d)g = f$. This generalizes and extends the same result for $r = 1$ and E finite-dimensional of Newman, Shapiro and Trèves. (Received September 1, 1970.)

70T-B231. ROBERT W. CARROLL, University of Illinois, Urbana, Illinois 61801 and EMILE Y. STATE, University of Western Ontario, London, Ontario, Canada. Existence theorems for some weak variable domain hyperbolic problems.

Let H be a separable Hilbert space and $V(t) \subset H$ a family of Hilbert spaces dense in H with continuous

injections ($0 \leq t \leq T < \infty$). First let $a(t, \cdot, \cdot)$ be a family of continuous, coercive, selfadjoint, sesquilinear forms on $V(t) \times V(t)$ and put the scalar product $((x, y))_t = a(t, x, y)$ on $V(t)$. Let $S(t)$ be the selfadjoint positive standard operator with domain $V(t)$ such that $((x, y))_t = (S(t)x, S(t)y)$. One assumes $S^{-1}(\cdot)$ is weakly C^1 with $(S^{-1}(t)x, y)' = (S^{-1}(t)x, y)$ for $x, y \in H$ and sets $W = L^2(V(t)) = \{u \in L^2(H); Su \in L^2(H)\}$. Given $f \in L^2(H)$ the first problem is to find $u \in W$ with $u' \in L^2(H)$ such that $(*) - \int_0^T (u', v') dt + \int_0^T a(t, u, v) dt = \int_0^T (f, v) dt$ for all $v \in K = \{v \in W; v' \in L^2(H); v(T) = 0\}$. By a method of parabolic regularization for first order systems, existence is proved when $(**)$ $\operatorname{Re}(S^{-1}(t)S(t)x, x) \geq -\beta \|x\|^2$ for $x \in V(t)$. Another technique (involving a new space of test functions $\varphi(t) = S^{-1}(t) \int_0^T e^{2\gamma\lambda} S(\lambda)v(\lambda) d\lambda$ for $v \in K$ and the Lions projection theorem) is also developed and applied to $(*)$ with suitable terms $\int_0^T (B(\cdot)u', v) dt$ and $(u_1, v(0))$ added on the left and right sides respectively and with $a = p + r$ where $p(t, \cdot, \cdot)$ is coercive and selfadjoint and $|r(t, x, y)| \leq c \|x\|_t \|y\|_t$ with $\|x\|_t^2 = p(t, x, x)$ (also $u(0) = 0$ explicitly). Existence then follows from $(**)$ when $S^{-1}(\cdot)$ is weakly C^2 . The first method also applies to suitable extensions of $(*)$. (Received September 3, 1970.)

Applied Mathematics

70T-C34. I. A. BELOV, PADAM C. JAIN and K. SANKARA RAO, Indian Institute of Technology, Powai, Bombay-76, India. Heat flux from a jet impinging upon the flat plate.

The problem on the calculation of heat flux from an incompressible 'hot' jet impinging normally upon the flat plate within the length of the jet potential core has been considered. By the method of small disturbances, Reynolds' equations and the equation of energy have been linearized and solved approximately by Galerkin's method. The calculated results have shown that for high jet Reynolds numbers the curve of heat flux distribution along the flat plate has a minimum at the stagnation point; the latter is explained by the diffusion of mixing-induced jet turbulence to the shear layer of the flat plate. For low Reynolds numbers, the character of heat transfer is the same as in the case of a fully developed turbulent jet impingement upon the flat plate. Results of the calculation are compared with the experimental data. (Received March 17, 1970.)

70T-C35. VACLAV RAJLICH, Case Western Reserve University, Cleveland, Ohio 44106. Nonexpansive scattered context grammars.

A nonexpansive scattered context grammar is a 4-tuple $G = (N, T, s, P)$ such that $N \cap T = \emptyset$, P is a finite set of productions q of the form $(A_1, \dots, A_n) \rightarrow (w_1, \dots, w_n)$ where $A_i \in N$, $w_i \in (T \cup N)^*$. Then $x \Rightarrow_q y$ iff $x = x_1 A_1 \dots x_n A_n x_{n+1}$, $y = x_1 w_1 \dots x_n w_n x_{n+1}$ and $x_i \in T^*$. $x \Rightarrow_P y$ iff there exists $q \in P$ such that $x \Rightarrow_q y$. \Rightarrow_P^* is the transitive, reflexive closure of \Rightarrow_P . $w \in L(G)$ iff $s \Rightarrow_P^* w \in T^*$. Then $L(G)$ is a nonexpansive scattered context language (abbreviated nscl). Theorem. The family of nscl is equivalent to the family of languages generated by deterministic two-way finite-state transducers. Theorem. The family of nscl forms a full AFL. Theorem. The family of nscl is properly contained in the family of checking automata languages. Corollary. The emptiness problem for nscl is solvable. Theorem. The family of nscl properly contains the family of nonexpansive context-free languages. (Received June 29, 1970.) (Author introduced by Professor Otomar Hajek.)

70T-C36. NATHANIEL COBURN and MARTIN SOMMERFIELD, University of Michigan, Ann Arbor, Michigan 48104. The wave propagation in nonequilibrium magnetic compressible fluids. Preliminary report.

In a previous paper (to appear in the J. Math. Anal. Appl.), the authors showed that in the case of a particular speed of propagation (for nonequilibrium fluids where the density, ρ , velocity, v_j , entropy, s , and the relaxation variable, q , were of class (C^1, C^3)), the ordinary differential equation which governed the growth of the discontinuities, σ , in the second derivatives of the variables ρ, s, q, v_j satisfied an ordinary differential equation of the form $d\sigma/db + M\sigma = 0$. The scalar, M , was shown to depend on the internal energy and a new scalar, a . The variable, b , measured arc length along a bi-characteristic. The presence of a magnetic field (a hydromagnetic fluid) leads to the same basic ordinary differential equation for the propagation of discontinuities, except that M depends upon two scalars a, \bar{a} . These scalars satisfy a linked system of two ordinary differential equations. (Received July 16, 1970.)

70T-C37. OTOMAR HAJEK, Case Western Reserve University, Cleveland, Ohio 44106. Switching locus in control theory. Preliminary report.

This concerns the time-optimal problem for normal linear autonomous control systems in n -space, with 1-dimensional controls. For $\epsilon > 0$, and $k = 1, \dots, n - 1$, let M_k^+ consist of all $\sum_{i=1}^k (-1)^{i-1} \int_{t_{i-1}}^{t_i} e^{-As} b \, ds$ with $0 = t_0 < t_1 < \dots < t_k < \epsilon$; for small $\epsilon > 0$, M_k^+ is a $k - C^1$ - submanifold in n -space, and the union M of $M_k^+ \cup (-1)M_k^+$ coincides, for small $|x| > 0$, with (a) the switching locus, (b) the singular point set (where distinct optimal trajectories meet). It follows that there is an optimal feedback control, discontinuous only in M ; and outside the nowhere dense set M , the minimal-time function is differentiable. Similar inclusions hold for multidimensional controls. (Received August 20, 1970.)

70T-C38. LEONARD GROSS, Cornell University, Ithaca, New York 14850. Existence of maximum eigenvalues for certain operators of positive type. Preliminary report.

Theorem. Let A be a bounded Hermitian operator on $L^2(\Omega, \mu)$. Suppose that $\mu(\Omega) < \infty$, that A takes nonnegative functions to nonnegative functions and that for some $p > 2$ A is bounded from $L^2(\Omega, \mu)$ to $L^p(\Omega, \mu)$. Then $\|A\|_{L^2}$ is an eigenvalue of A of finite multiplicity. This theorem may be used to prove the existence of physical ground states in various models in quantum field theory. In particular one can prove the existence of physical one particle states at total momentum zero for a massive polaron (cf. E. Nelson, J. Math. Phys. 5(1964), 1190) for arbitrary real coupling constant when the interaction has a momentum cutoff and the kinetic energy function $E(\vec{p})$ of the nucleon satisfies the condition that $\exp(-tE(\vec{p}))$ is positive definite for all $t \geq 0$. The last condition is satisfied for $E(\vec{p}) = p^2/2m$ and for $E(\vec{p}) = (p^2 + m^2)^{1/2}$. The uniqueness of the physical one particle state follows from established irreducibility arguments (cf. I. E. Segal, Bull. Amer. Math. Soc. 75(1969), 1390). (Received September 3, 1970.)

Geometry

70T-D25. JOHN DECICCO, Illinois Institute of Technology, Chicago, Illinois 60616 and ROBERT V. ANDERSON, Université du Québec à Montréal, Montréal 110, Québec, Canada. On the system of scale curves of a cartogram T.

If two Riemannian spaces V_n and \bar{V}_n , $n \geq 2$, correspond by a cartogram T with $\rho = e^\omega = d\bar{s}/ds > 0$, and if $\kappa > 0$ is the scalar geodesic curvature of a scale curve C and if θ is the angle between $p_i = g_{ij}\dot{x}^i$ ($\dot{x}^i = dx^i/ds$), and \bar{x}^i , then $p\kappa \cos \theta + (1/2) g_{ij,k} \dot{x}^i \dot{x}^j \dot{x}^k = 0$. If a cartogram T is not locally conformal there exists at each point a curve C_0 in the direction of \bar{x}^i such that $p\kappa_0 + (1/2) g_{ij,k} \dot{x}^i \dot{x}^j \dot{x}^k = 0$. An analogue of Meusnier's Theorem is that if C is a scale curve tangent to the curve C_0 , then $\kappa \cos \theta = \kappa_0$. Let x be a fixed point of V_n and consider the set of all scale curves C of a cartogram T between V_n and \bar{V}_n , each of which has the scalar geodesic curvature $\kappa > 0$. Such a scale curve C obeys the differential condition $g_{ij,k} \dot{x}^i \dot{x}^j \dot{x}^k = 0$ if and only if its unit contravariant tangent vector \bar{x}^i is in exactly one of the characteristic Euclidean subspaces of T at the point x. The latter was developed in a previous article on some of the local conformal properties of a nonconformal cartogram T. (Received July 3, 1970.)

70T-D26. PETER W. AITCHISON, University of Manitoba, Winnipeg 19, Manitoba, Canada. Some results on ellipsoids.

The width of a convex body K in a direction v is the distance between the two support planes of K perpendicular to v. Define two n-dimensional convex bodies for $n \geq 3$ to be equivalent if the ratio of their widths in the direction v is constant as v varies. Theorem 1. If any two parallel sections of a convex body K are equivalent, then K is an ellipsoid. This generalizes a number of previous results. If the same properties are now considered "locally" instead of "globally" as in Theorem 2, rather surprisingly the body need not be an ellipsoid. Theorem 2. Suppose for any support plane of a convex body K, that any two sections of K sufficiently close and parallel to this support plane are equivalent. Then the boundary of K is composed of finitely many pieces of surfaces of second order. (Received July 3, 1970.)

70T-D27. JAMES L. HEITSCH, University of Chicago, Chicago, Illinois 60637. On the classifying space of Haefliger. Preliminary report.

In a recent paper [Topology 9(1970), 183-194] A. Haefliger has constructed a classifying space $B\Gamma_q$ for foliations of codimension q on open manifolds. He obtains a map $\nu: B\Gamma_q \rightarrow BO_q$ such that if M is an open manifold with a foliation F of codimension q and $f: M \rightarrow B\Gamma_q$ classifies the foliation, then $\nu \circ f$ classifies the normal bundle to the foliation. Theorem. $\nu^*: H^*(BO_q; Z_2) \rightarrow H^*(B\Gamma_q; Z_2)$ is injective. The proof employs the Whitney sum formula and the following Lemma. There is a map $\bar{f}: BO_1 \rightarrow B\Gamma_1$ such that $\nu \circ \bar{f} = 1_{BO_1}$, the identity map of BO_1 . (Received August 13, 1970.)

70T-D28. WITHDRAWN.

Logic and Foundations

70T-E69. STEPHEN G. SIMPSON, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139. Model-theoretic proof of a partition theorem.

Using the concept "relative saturation" one can give a short proof of the well-known partition theorem $B_r(k)^+ \rightarrow (k^+)_k^{r+1}$ of Erdős and Rado. (k denotes an infinite cardinal and B stands for beth.) Namely, given $F: [B_r(k)^+]^{r+1} \rightarrow k$ let M be a relatively $B_{r-1}(k)^+$ saturated proper elementary submodel of $(B_r(k)^+, F)$ such that k is contained in M . Fix an element c in $B_r(k)^+ - M$ and choose a sequence of elements $X = (x_i : i < B_{r-1}(k)^+)$ inside M such that always x_i realizes the same element type over $k \cup \{x_j : j < i\}$ as c does. Then using induction on r one easily refines X to a homogeneous set for F of power k^+ . Behind this proof lies the infinitary language $L_{m,m}$ where $m = B_{r-1}(k)^+$. One can give similar proofs for several other known theorems of combinatorial set theory including Theorems 3 and 6 of Erdős-Hajnal, Acta Math. Acad. Sci. Hungar. 9(1958), 111-131 and the Canonization Lemma of § 9, Erdős-Rado-Hajnal, ibid. 16(1965), 93-196. (Received April 29, 1970.) (Author introduced by Professor Gerald E. Sacks.)

70T-E70. JULIA F. KNIGHT, University of California, Berkeley, California 94720. An example involving Skolem functions and elementary embeddings. Preliminary report.

Theorem. There exist a language L , a pair of L -structures M and N , and an L -formula φ , with free variables u and v , such that $M \prec N$, but for any pair of Skolem functions f and g for $\exists v \varphi$, on M and N , respectively, it is not the case that $(M, f) \prec (N, g)$. Lemma. There exist sets U, A , and B such that (1) U is uncountable, (2) A is countable, (3) $A, B \subseteq P(U)$, (4) $A \subseteq B$, (5) for S_1 and S_2 disjoint finite, nonempty subsets of B , $\bigcap S_1 - \bigcup S_2$ is infinite, (6) for X_1 and X_2 disjoint finite subsets of U , there is some $\alpha \in A$ such that $X_1 \subseteq \alpha \subseteq U - X_2$, and (7) for any countable $X \subseteq U$, there is some $\beta \in B$ such that $\beta \subseteq U - X$. Taking U, A , and B from the lemma, it is possible to construct the example as follows: L has the single binary relation symbol R ; M and N are L -structures with $|M| = U \cup A$, $|N| = U \cup B$, $R^M = \epsilon \upharpoonright_{U \times A}$, and $R^N = \epsilon \upharpoonright_{U \times B}$, and the formula φ is Rvu . It is not known whether for M and N (and L) countable, if $M \prec N$, there must always exist Skolem functions f and g (for any formula of the form $\exists v \varphi$) such that $(M, f) \prec (N, g)$. (Received July 8, 1970.) (Author introduced by Professor William J. Knight.)

70T-E71. SHLOMO VINNER, The Hebrew University, Jerusalem, Israel. Completeness and model completeness in Fuhrken's language. II

For notation, see Abstract 70T-E18, these *Notices* 17(1970), 456. T denotes an ordinary first order theory. (1) Let T be a complete theory in the ordinary sense, $T \aleph_\alpha$ -model complete. Then $T(Q)$ is \aleph_α -complete ($\alpha \cong 0$). (2) Let T be denumerable. (i) If T is \aleph_α -complete (model-complete), then T is also \aleph_0 -complete (model-complete). (ii) If T is \aleph_1 -complete (model-complete), then T is complete (model-complete) in every regular cardinal. (iii) (G.C.H.) If T is \aleph_α -complete (model-complete) where \aleph_α is a successor of a regular cardinal, then T is complete (model-complete) in every regular cardinal. (Received July 3, 1970.) (Author introduced by Professor Azriel Levy.)

70T-E72. DIANA L. DUBROVSKY, McGill University, Montreal 110, Quebec, Canada. Computability and models of p-adically closed fields.

Let Q_p denote the p-adic completion of the rational numbers. Two definitions for a recursive p-adic number are given and proved equivalent. It is shown that the recursive p-adic numbers form a field $Q_p^{(R)}$ which satisfies Hensel's lemma and is therefore p-adically closed. (Cf. Kochen, "Number theory," Proc. Sympos. Pure Math., vol. 12, Amer. Math. Soc., Providence, R. I., 1969, pp.57-73.) Every computable valued subfield of Q_p is a proper subfield of $Q_p^{(R)}$. $Q_p^{(R)}$ is not even a computable field, however it is an arithmetically definable field and a fortiori an arithmetically definable valued field. Let T be the theory of p-adically closed fields with a new unary predicate $N(x)$ and as added axioms all truths of the natural numbers relativized to $N(x)$. As opposed to the case of algebraically closed fields (cf. A. Robinson, "Model theory and non-standard arithmetic," Proc. Sympos. Infinitistic Methods (Warsaw, 1959) Pergamon Press, Oxford; PWN, Warsaw, 1961, pp. 265-302), T is not a complete theory. (Q_H, N) is a model for T, where Q_H is the Henselization of Q and $N \subset Q_H$ stands for the natural numbers. If N^* is any strong nonstandard model of the natural numbers there exists a p-adically closed field $H \supset N^*$ such that $(Q_H, N) \supset (H, N^*)$. (Received July 15, 1970.) (Author introduced by Professor Philip Olin.)

70T-E73. DAVID F. PINCUS, University of Washington, Seattle, Washington 98105. Rigid models via iterated forcing. Preliminary report.

A model of ZF (without choice) is called rigid if it satisfies a well ordered support set theory where: (1) Every set has a canonical support. (2) Every support has a canonical well ordering. The ordering principle is one of several weak forms of choice which are often found to hold in rigid models. Starting with a rigid ground model, iterated forcing may be used to produce a new rigid model in which various failures of choice are eliminated. For example dependent choice can be introduced into a model by "killing" bad ω -trees. Typical Application. AC is independent of the conjunction of dependent choice and the ordering principle. (Received July 6, 1970.)

70T-E74. EUGENE M. KLEINBERG and R. A. SHORE, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139. On large cardinals and partition relations. Preliminary report.

Let κ denote an uncountable cardinal. For ordinals $\lambda, \gamma < \kappa$, and x a set, we let $[x]^\gamma$ denote the collection of subsets of x of order-type γ , and introduce $\kappa \rightarrow (\kappa)_\lambda^\gamma$ ($\kappa \rightarrow (\kappa)_\lambda^{<\gamma}$) as an abbreviation for the partition relation: for each function F from $[x]^\gamma$ ($\bigcup_{\alpha < \gamma} [x]^\alpha$) into λ there exists a subset C of x of cardinality κ such that (such that for each $\alpha < \gamma$) the range of F on $[C]^\gamma$ ($[C]^\alpha$) has cardinality 1. Now by the standard definition, a cardinal κ is a Ramsey cardinal if $\kappa \rightarrow (\kappa)_2^{<\omega}$. One can, however, characterize Ramsey cardinals in terms of a weakened version of $\kappa \rightarrow (\kappa)^\omega$ as follows: put a topology on $[x]^\omega$ by restricting the product topology on κ^ω , κ considered discrete. Let B_κ be the κ -field (closed under intersections of power $< \kappa$ and under complementation) generated by the open sets of this topology on $[x]^\omega$ and call a function F from $[x]^\omega$ into λ , $\lambda < \kappa$, κ -Borel if for each $\beta < \lambda$, $F^{-1}\{\beta\} \in B_\kappa$. Then if $\kappa \overset{*}{\rightarrow} (\kappa)_\lambda^\omega$ denotes the assertion of $\kappa \rightarrow (\kappa)_\lambda^\omega$ restricted to κ -Borel functions, we have Theorem. κ is a Ramsey cardinal iff for each $\lambda < \kappa$, $\kappa \overset{*}{\rightarrow} (\kappa)_\lambda^\omega$. A further restriction of $\kappa \rightarrow (\kappa)^\omega$ yields a characterization of weakly compact strongly inaccessible cardinals (i.e., those κ satisfying $\kappa \rightarrow (\kappa)^2$). (Received July 10, 1970.)

Universally complete universal theories. II, Preliminary report.

For notation see Abstract 70T-E48, these *Notices* 17(1970), 831. Let L be a first order language with finitely many predicates $\mathbb{R}_i, i \in I$, and let L' be obtained from L by adding one binary predicate \ll . Let $\Omega(\ll)$ be a set of sentences stating that \ll denotes a linear ordering. Theorem 3. If Σ is a universally complete universal L -theory then, for each $i \in I$, there exists a quantifier free formula ϕ_i with exactly the variables v_0, \dots, v_{t_i-1} and containing only the nonlogical constant \ll , such that Σ is the set of all universal L -sentences that are L' -consequences of $\Gamma = \Omega(\ll) \cup \{\forall v_0 \dots \forall v_{t_i-1} (\mathbb{R}_i v_0 \dots v_{t_i-1} \leftrightarrow \phi_i) \mid i \in I\}$. Corollary 4. There are only finitely many universally complete universal L -theories. Theorem 5. Let Σ be a universally complete universal L -theory, and let Γ be a set of L' -sentences as in Theorem 3. Then for any $\mathfrak{U}, \mathfrak{V} \in \text{Mod } \Sigma$ iff there exists $\ll \in |\mathfrak{U}|^2$ such that $(\mathfrak{U}, \ll) \in \text{Mod } \Gamma$. Corollary 6. If Σ is a universally complete universal theory, then the set of first order consequences of Σ is recursive. For the definition of chainable relational systems confer the work of R. Fraïssé. Theorem 7. \mathfrak{U} is chainable iff \mathfrak{U} is a model of a universally complete universal theory. Theorem 8. If Σ is a universally complete universal theory, then there exists a $\text{Mod } \Sigma$ -universal system of cardinality ω . (Received July 23, 1970.)

70T-E77. NEIL D. JONES, Computer Science Department, Pennsylvania State University, University Park, Pennsylvania 16802. Functions computable by space-bounded Turing machines. Preliminary report.

Let $L(n) \cong n$ be a function on the nonnegative integers. Define F_L to be the class of all unary functions computable by Turing machines which operate in space L , i.e., which use no more than $L(n)$ tape squares for any input of binary length n . Robert Ritchie has shown that $F_1 = \mathcal{B}^2$, where $l(n) = n$ and \mathcal{B}^2 is the third class of the Grzegorzcyk hierarchy. Hartmanis, Lewis and Stearns have studied the corresponding classes C_L of sets which are decidable in space L . Let $\mathcal{L}(x) = 2^{L(|x|)}$, where $|x|$ is the length of x in binary notation. Define L to be attainable if there is a Turing machine operating in space L which, for each n and some input of length n , uses exactly $L(n)$ tape squares. Theorem. If L is attainable then F_L consists of all functions of the form $g(\mathcal{L}(x))$, where $g \in \mathcal{B}^2$. Theorem. F_L consists of all functions of the form $g(\mu y(x, y) = 0)$, where $g, h \in \mathcal{B}^2$ and for some k and all $x, \mu y (h(x, y) = 0) \cong \mathcal{L}^k(x)$. (Received July 29, 1970.)

70T-E78. JAMES E. BAUMGARTNER, Dartmouth College, Hanover, New Hampshire 03755 and JEROME I. MALITZ and WILLIAM N. REINHARDT, University of Colorado, Boulder, Colorado 80302. Embedding trees in the rationals.

A partial order (T, \preceq) is tree-like if for all $t \in T$ $\{s \in T: s < t\}$ is linearly ordered by \preceq . A chain in (T, \preceq) is a linearly ordered subset of T . (T, \preceq) is a tree if for all $t \in T$ $\{s \in T: s < t\}$ is well-ordered by \preceq . If (T, \preceq) is a tree and $t \in T$ let $\mathcal{L}(t)$ be the order-type of $\{s \in T: s < t\}$. A tree (T, \preceq) is normal if $\forall t \in T \forall \alpha \in \omega_1 [\alpha \cong \mathcal{L}(t) \Rightarrow \exists s \in T (t \preceq s \text{ and } \mathcal{L}(s) = \alpha)]$; (T, \preceq) is Aronszajn if (T, \preceq) has no uncountable chains, (T, \preceq) is normal and $\forall \alpha \in \omega_1 \{t \in T: \mathcal{L}(t) = \alpha\}$ is countable. A partial order (T, \preceq) is embeddable in the rationals (or the reals) if there is a function f mapping T into the rationals (or

the reals) such that $s < t$ implies $f(s) < f(t)$. Theorem 1. Martin's axiom implies that if (T, \leq) is tree-like, $\bar{T} < 2^{\aleph_0}$ and (T, \leq) has no uncountable chains, then (T, \leq) is embeddable in the rationals.

Corollary 2. Martin's axiom + $2^{\aleph_0} > \aleph_1$ implies that every Aronszajn tree is embeddable in the rationals. It follows from results of Solovay and Tennenbaum that the conclusions of Theorem 1 and Corollary 2 are relatively consistent with ZFC. Moreover, the conclusion of Corollary 2 implies Souslin's hypothesis. (Received July 31, 1970.)

70T-E79. JAMES E. BAUMGARTNER, Dartmouth College, Hanover, New Hampshire 03755.
Decompositions and embeddings of trees. Preliminary report.

This abstract continues the notation of the Abstract 70T-E78 of Baumgartner, Malitz and Reinhardt in this issue of the *Notices*. A tree (T, \leq) is rooted if it has a unique minimal element. Theorem 1. Martin's axiom + $2^{\aleph_0} > \aleph_1$ implies that if (S, \leq_S) and (T, \leq_T) are normal rooted trees of power \aleph_1 then there exists a sequence $\langle S_n : n \in \omega \rangle$ of cofinal subtrees of S and a sequence $\langle T_n : n \in \omega \rangle$ of cofinal subtrees of T such that $\bigcup \{ S_n : n \in \omega \} = S$, $\bigcup \{ T_n : n \in \omega \} = T$ and, for all n , S_n is isomorphic to T_n . There are generalizations of Theorem 1 appropriate for trees of other cardinalities less than 2^{\aleph_0} . An Aronszajn tree (T, \leq) is non-Souslin if every uncountable subset of T contains an uncountable collection of pairwise incomparable elements. The following theorems are proved using a method developed by Jensen. Theorem 2. If $V = L[A]$ for some $A \subseteq \omega_1$ then there are non-Souslin trees (a) which are embeddable in the reals but not in the rationals and (b) which are not embeddable in the reals. Theorem 3. The conclusion of Theorem 2 is relatively consistent with $ZFC + 2^{\aleph_0} > \aleph_1$. (Received July 31, 1970.)

70T-E80. J. T. BALDWIN, Simon Fraser University, Burnaby 2, British Columbia, Canada.
 α_T is finite for \aleph_1 categorical T . Preliminary report.

Let T be a complete countable \aleph_1 categorical theory. Definition. If \mathcal{A} is a model of T and \underline{A} is a 1-ary formula in $L(\mathcal{A})$ then \underline{A} has rank 0 if $\underline{A}(\mathcal{A})$ is finite. $\underline{A}(\mathcal{A})$ has rank n degree m iff for every set of $m+1$ formulas $\underline{B}_1, \dots, \underline{B}_{m+1} \in S_1(L(\mathcal{A}))$ which partition $\underline{A}(\mathcal{A})$ some $\underline{B}_i(\mathcal{A})$ has rank $\leq n-1$. Theorem. If T is \aleph_1 categorical then for every \mathcal{A} a model of T and every $\underline{A} \in S_1(L(\mathcal{A}))$, $\underline{A}(\mathcal{A})$ has finite rank. Corollary. α_T is finite. The methods derive from Lemmas 9 and 11 in "On strongly minimal sets" by Baldwin and Lachlan. α_T is defined in "Categoricity in power" by Michael Morley (Trans. Amer. Math. Soc. 114(1965)). (Received August 6, 1970.) (Author introduced by Professor Alistair H. Lachlan.)

70T-E81. JOHN GREGORY, University of South Carolina, Columbia, South Carolina 29208.
Elementary extensions and uncountable models for infinitary finite-quantifier language fragments. Preliminary report.

Let A be a countable admissible set containing the set of natural numbers. Given a language $L_{\omega_1 \omega}$, the fragment L_A is the set of all $L_{\omega_1 \omega}$ formulas which are elements of A . Theorem. There is an $L_{\omega_1 \omega}$ and a set Ω of L_A sentences such that: Ω has a model which has a proper L_A -elementary extension (with exactly one L_A -undefinable element); but Ω has no uncountable model (and no proper L_A -elementary 3-chain of models of Ω). This answers a question mentioned in unpublished notes of Keisler. Such an Ω is not Σ_1^A because of the following: Let \mathcal{C} be the set of all sentences $\psi(\Phi)$ de-

fined in Makkai's Abstract 69T-E2, these *Notices* 16(1969), 322. Theorem. Suppose Ψ is a Σ_1^A set of L_A sentences. Then the following are equivalent: (a) Ψ has an uncountable model; (b) Ψ has a model with a proper L_A -elementary extension; (c) for every $C \in \mathcal{C} \cap A$, $\bigwedge \Psi \rightarrow C$ is not valid. By using Barwise's Σ_1 -compactness theorem, one can find other equivalent conditions. Theorem. Suppose $L_A\text{-Th}^+(\mathfrak{U})$ is a Σ_1^A set of sentences. Then \mathfrak{U} has an uncountable L_A -elementary extension if and only if \mathfrak{U} has a proper L_A -elementary extension. (Received August 11, 1970.) (Author introduced by Professor Carol Karp.)

70T-E82. SAHARON SHELAH, University of California, Los Angeles, California 90024.

Solution of Loś conjecture for uncountable languages.

Let T be a first order theory. Theorem 1. If T is categorical in one cardinality $> |T| + \aleph_0$, then T is categorical in every cardinality $> |T| + \aleph_0$, where Definition. T is categorical in λ if any two models of T of cardinality λ are isomorphic. Theorem 2. Suppose $\lambda > |T| + \aleph_0$; and every model of T of cardinality λ is homogeneous. Then every model of T of cardinality $> \min(\lambda, 2^{|T|})$ is homogeneous. (Received August 6, 1970.) (Author introduced by Professor Chen Chung Chang.)

70T-E83. ALEXANDER ABIAN, Iowa State University, Ames, Iowa 50010. Prime ideals of atomless

Boolean rings.

For every ordinal v let \mathfrak{U}_v denote the cardinal which is equal to $\sup_{u < v} 2^{\bar{u}}$. Also, for every Boolean ring B let $M(B)$ denote the set of all prime ideals of B . Theorem 1. For every infinite ordinal v there exists an atomless Boolean algebra B such that $\bar{B} = \mathfrak{U}_v$ and $\overline{M(B)} = \mathfrak{U}_{v+1}$. Theorem 2. For every infinite ordinal v there exists an atomless Boolean algebra A such that $\bar{A} = \bar{v}$ and $\overline{M(A)} = \mathfrak{U}_{v+1}$. Theorem 3. For every infinite ordinal v there exist nonisomorphic atomless Boolean algebras each of cardinality \mathfrak{U}_{v+1} .

Remark. The symbol \mathfrak{U} is the capitalized first letter of the Armentian alphabet and is read "ayb". (Received September 2, 1970.)

70T-E84. DAVID O. OAKLAND, Iowa State University, Ames, Iowa 50010. Prime ideals of Boolean

rings.

Using the notations of the preceding abstract (70T-E83) it is shown: Theorem 1. If B is a nonatomic Boolean ring then $\overline{M(B)} \geq \aleph$. Theorem 2. Let v be an infinite ordinal. If B is a complete and atomic Boolean ring with \mathfrak{U}_v atoms then $\overline{M(B)} \geq \mathfrak{U}_{v+1}$. (Received September 2, 1970.)

Statistics and Probability

70T-F20. IRENE M. TRAWINSKI and BENON J. TRAWINSKI, University of Alabama, Birmingham, Alabama 35233. Probability distribution for the size of a selected subset. Preliminary report.

In the literature a class of problems dealing with selection of the superior random variable X_s

of a set $A = \{X_1, X_2, \dots, X_k\}$, when a discriminant relation D operates on A , has been formulated so that the selection is made by way of a subset B of A . The essential elements of the theory are the probability of correct inclusion of X_s in B , and the expected value of the size C of B . These can be studied without direct reference to the probability distribution function F of C . More extensive study of this class of problems and the variables X_s and C can be made through the distribution F . Let $\theta = (\theta_1, \theta_2, \dots, \theta_k)$ be a parameter point in Θ associated with A , and let $v \in V$ be a value of a discriminant variable for which D is a function. This paper treats the derivation of the probability distribution F , and the study of its behavior on $\Theta \times V$. (Received June 30, 1970.)

70T-F21. HARI M. SRIVASTAVA and J. P. SINGHAL, University of Victoria, Victoria, British Columbia, Canada. On a class of generalized hypergeometric distributions. Preliminary report.

In the course of an attempt to unify the theory of the classical probability distributions, the authors introduce and study here a general family of statistical probability distributions involving the H-function of C. Fox [Trans. Amer. Math. Soc. 98(1961), 395-429]. In particular, the distribution function, the characteristic function, distributions of the largest order statistic and of the ratio of two independent stochastic variables having the probability functions in this family of statistical probability distributions, are investigated. Several interesting properties of this class of generalized hypergeometric distributions are also pointed out. (Received August 13, 1970.)

70T-F22. HABIB SALEHI, Michigan State University, East Lansing, Michigan 48823. On determination of the optimal factor of a nonnegative matrix-valued function.

Let $F = [f_{ij}]$, $1 < i, j \leq q$, be a measurable, nonnegative $q \times q$ matrix-valued function defined on the unit circle C . It is known that when F and $\log \det F$ are in $L_1(C)$, F admits a factorization of the form $F = \Phi \Phi^*$, where Φ is an optimal, full rank function in $L_2^{0+}(C)$. Under the additional assumption that $\{(\prod_{i=1}^q f_{ii}) / \det F\}$ is in $L_1(C)$, an iterative procedure which yields an infinite series for Φ in terms of F is given. The optimal function Φ plays a significant role in the multivariate prediction theory of stochastic processes. The present work generalizes the results of several authors concerning the determination of the optimal factor. (Received August 17, 1970.)

Topology

70T-G156. ARVIND K. MISRA, Indian Institute of Technology, Kanpur-16, India. On P-spaces.

A T_1 space is a P-space if the intersection of any countable number of open sets is itself an open set. A space X is para-Lindelöf if every open cover of X has a locally countable open refinement. Theorem 1. Let X be a T_1 space. Then X is a P-space if and only if the projection $\text{pr}_X: X \times Y \rightarrow Y$ is closed for every Lindelöf space Y . Theorem 2. A regular P-space is para-Lindelöf if and only if every open cover has an open refinement of the form $\bigcup_{\alpha < \omega_1} \mathcal{U}_\alpha$ where each \mathcal{U}_α is locally countable. Theorem 3. Para-compactness and the para-Lindelöf property are equivalent for regular P-spaces. The P-product of a family $\{X_\alpha\}$ of T_1 -spaces is the space (x, X_α, τ) where τ is the smallest P-topology finer than the Tychonoff product topology on $\times_{\alpha < \omega_1} X_\alpha$. Theorem 4. The product of two Lindelöf P-spaces is a Lindelöf P-space but the P-product of infinitely many Lindelöf P-spaces need not be Lindelöf. (Received March 2, 1970.) (Author introduced by Professor Richard A. Alo.)

70T-G157. T. THRIVIKRAMAN, Madurai University, Madurai-2, Tamil Nadu, India. Net theoretic approach to compactifications and other problems. Preliminary report.

Spaces considered are Tychonoff and compactifications Hausdorff. \mathcal{P} denotes a normal base for the space X , in the sense of Frink (Amer. J. Math. 86(1964)). Definition. A net S on X is said to be \mathcal{P} -universal if given any set $Z \in \mathcal{P}$ with nonempty interior, S is either eventually in Z or eventually in $X - Z$. Theorem 1. The Wallman-type compactification $w(X; \mathcal{P})$ of X in the sense of Frink is the space of all \mathcal{P} -universal nets modulo a natural equivalence. In particular, if \mathcal{P} is all zero-sets we get βX . Corollary (Steiner, E. F. and A. K.). $w(X; \mathcal{P}_1) \cong w(X; \mathcal{P}_2)$ in the usual sense if and only if \mathcal{P}_1 separates \mathcal{P}_2 (Duke Math. J. 35(1968)). Theorem 2. Let \mathcal{B} be a base of closed sets of a space X , which is also a ring. Then the space of \mathcal{B} -universal nets is a compactification of X if and only if \mathcal{B} is a normal base and thereby the compactification is Wallman-type. Theorem 3. A space X is \mathcal{P} -realcompact in the sense of Alo and Shapiro (J. Austral. Math. Soc. 10(1969)) if and only if every \mathcal{P} -universal net in it defined on some countably bounded directed set converges. The \mathcal{P} -realcompactification of a space X is the space of all \mathcal{P} -universal nets on countably bounded directed sets modulo a natural equivalence. If \mathcal{P} is all zero-sets, we get realcompactness and Hewitt realcompactification. (Received May 21, 1970.) (Author introduced by Professor M. Rajagopalan.)

70T-G158. OFELIA T. ALAS, Universidade de São Paulo, Caixa Postal 8105, São Paulo, Brazil. Density and continuous functions.

Let r, q and m be infinite cardinal numbers, with $m^q = m$, $((X_t, \sigma_t))_{t \in T}$ be a family of nonempty T_2 -spaces with density $\leq m$. In $X = \prod_{t \in T} X_t$ consider the topology generated by the set of the subsets $\prod_{t \in T} V_t$ of X such that $V_t \in \sigma_t, \forall t \in T$, and $|\{t \in T | V_t \neq X_t\}| \leq q$. Fix $(e_t)_{t \in T}$ of X and put $F = \{x \in X | |\{t \in T | x_t \neq e_t\}| < r\}$; F considered as a subspace of X . Theorem 1. Let Y be a T_2 -space such that the pseudo-weight (weight) of Y at any point does not exceed m . If $f: F \rightarrow Y$ is continuous (θ -continuous), there is a subset P of T , with $|P| \leq m$, such that if x, y belong to F and $x_t = y_t, \forall t \in P$, then $f(x) = f(y)$. Theorem 2. Let Y be a T_2 -space such that the pseudo-weight of Y at any point does not exceed 2^m . If $f: X \rightarrow Y$ is continuous, there is a subset Z of X , with $|Z| \leq m$, such that $f(Z)$ is dense in $f(X)$. (Received June 16, 1970.)

70T-G159. RONALD C. FREIWALD, University of Rochester, Rochester, New York 14627. Images of Borel sets and k -analytic sets.

All spaces given are metrizable. If $X \subset Y$, X is k -analytic in Y provided $X = \bigcup_{t \in B(k)} \bigcap_{n=1}^{\infty} F(t_1, \dots, t_n)$, where each $F(t_1, \dots, t_n)$ is a zero set of Y and where $B(k)$ is a product of countably many discrete sets of cardinal k . X is an absolute k -analytic (absolute Borel) set if X is k -analytic (Borel) in Y whenever $X \subset Y$. Typical results, extending theorems of Vainstein, Taimonov, and Čoban are as follows: Let P be the property "absolute k -analytic" or "absolute Borel" and let f map X onto Y . Then: (1) If $Y \in P$, then $X \in P$, provided f is locally perfect (Krolavec, Soviet Math. Dokl. 8(1967), 964). (2) If $Y \in P$, then $X \in P$, provided f is continuous, closed and each set $f^{-1}(y) \in P$. (3) If $X \in P$, then $Y \in P$, provided f is closed and Borel measurable of class α for some $\alpha < \omega_1$. (4) If $X \in P$, then $Y \in P$, provided f is open, Borel measurable of class α for some $\alpha < \omega_1$, and that for some metric on X , each set $f^{-1}(y)$ is complete. In the case $P =$ "absolute Borel", a bound is computed for the Borel class of the space in the conclusion; it depends only on the Borel class of the other space and of f . Various corollaries

to these results, and counterexamples to some of their generalizations are presented as well. (Received June 29, 1970.)

70T-G160. TSAU-YOUNG LIN, Purdue University, West Lafayette, Indiana 47906. Adequacy and inadequacy of ordinary homology theory. Preliminary report.

It is well known that a stable map can always be detected by some cohomology operations. (See Peterson's "Functional cohomology operations," Trans. Amer. Math. Soc. 86(1957), 197-211.) As Adams noted in his Seattle lecture, homology theory has its advantage over the cohomology. It is natural to ask..."does the analogous theorem hold true?" Unfortunately, we found some maps that can not be detected by any primary or higher order homology operation. This means homology theory is inadequate for the homotopy purpose. Fortunately however, when we restrict to complexes (or spectra) of finite skeleton, then the homology theory is as good as cohomology. (Received June 25, 1970.)

70T-G161. JAMES C. CANTRELL, University of Georgia, Athens, Georgia 30601, THOMAS M. PRICE, University of Iowa, Iowa City, Iowa 52240. and T. BENNY RUSHING, University of Utah, Salt Lake City, Utah 84112. A class of embeddings of S^{n-1} and B^n in R^n .

Theorem 1. Suppose that $\Sigma^{n-1} \subset S^n$ is an $(n-1)$ -sphere and that $D^{n-2} \subset \Sigma^{n-1}$ is an $(n-2)$ -cell. If $\Sigma^{n-1} - D^{n-2}$ and D^{n-2} are locally flat in S^n , and D^{n-2} is locally flat in Σ^{n-1} , then $S^n - \Sigma^{n-1}$ is 1-LC at each point of Σ^{n-1} . Theorem 1, together with recent results by Seebeck, ("Collaring an $(n-1)$ -manifold in an n -manifold," Trans. Amer. Math. Soc. 148(1970), 63-68) is used to prove the following. Theorem 2. If D is an n or $(n-1)$ -cell in R^n , $n > 4$, and E is an $(n-2)$ -cell in $Bd D$ with $D - E$ locally flat in R^n and E locally flat in each of $Bd D$ and R^n , then D is locally flat in R^n . (Received July 6, 1970.)

70T-G162. JAMES C. CANTRELL, University of Georgia, Athens, Georgia 30601. A criterion for detecting local flatness of codimension one submanifolds. Preliminary report.

We extend results of Cantrell and Lacher ("Some local flatness criteria for low codimensional submanifolds," Quart. J. Math., to appear) to establish the following. Theorem. Let M be a combinatorial $(n-1)$ -manifold topologically embedded in the interior of an n -manifold with $n \neq 4$. Assume that, for some combinatorial triangulation of M , each open $(n-1)$ -simplex is locally flat in N and that each closed $(n-2)$ -simplex is locally flat in N . Then M is locally flat in N . For $n = 4$ the best result thus far is that in Cantrell-Lacher in which one assumes that each closed simplex of M is locally flat and concludes that M is locally flat. (Received July 6, 1970.)

70T-G163. WILLIAM G. McARTHUR, Shippensburg State College, Shippensburg, Pennsylvania 17257. A characterization of zero-sets. Preliminary report.

For subsets A and B of a topological space, $A \Subset B$ means that $cl A$ is a subset of B . A partial order \leq on a set S is said to be dense if $x \leq y$ implies that there is an element z in S such that $x \leq z$ and $z \leq y$. Definition. A closed subset F of the topological space X is a strong G_δ -set iff F is the intersection of a countable family of open sets on which \Subset is a dense total order. Theorem. F is a zero-set if and only if F is a strong G_δ -set. (Received July 7, 1970.)

70T-G164. CHRIS B. SCHAUFLE and WILLIAM R. ALFORD, University of Georgia, Athens, Georgia 30601. Neuwirth knots with the same polynomial.

In her paper, "On the commutator subgroup of a knot group" (Annals, 1960), E. S. Rapaport asks for a given integer $n \geq 1$, how many finitely generated groups which have defect ≥ 1 and commutator quotient group infinite cyclic exist with commutator subgroup free of rank n . If n is even, the group of any Neuwirth knot of genus $n/2$ has all of the above properties, and the degree of its Alexander polynomial must be n . The authors have constructed examples of (i) infinitely many Neuwirth knots of genus 2 which have the same Alexander polynomial; and (ii) a Neuwirth knot of genus 2 with Alexander polynomial $\Delta(t)$ for any given polynomial $\Delta(t)$ of degree 4 which satisfies the properties of Alexander polynomials of Neuwirth knots. (Received July 14, 1970.)

70T-G165. W. JOHN WILBUR, Pacific Union College, Angwin, California 94508. Universal and permanence properties of locally convex spaces. II.

If \mathcal{G} is a class of spaces let $I(\mathcal{G})$ and $P(\mathcal{G})$ denote the I- and P-classes generated by \mathcal{G} . Denote the four basic operations of direct sum, product, quotient, and closed subspace by $\oplus, \times, /,$ and \subset , respectively. Theorem 1. Any one of the following sets of operations applied once to \mathcal{G} in the order listed will produce a class of spaces closed under the respective set of operations: (i) $\oplus, \times, /, \subset$; (ii) \oplus, \times, \subset ; (iii) $\times, \oplus, /$ if \mathcal{G} consists of Mackey spaces. Theorem 2. If M is Mackey $M \in I(\mathcal{G})$ if and only if for each discontinuous functional f on M there is an $E \in \mathcal{G}$ and a continuous map $g: E \rightarrow M$ with $g \cdot f$ discontinuous. A space A is in $P(\mathcal{G})$ if and only if for each divergent net (f, η) in A there is an $E \in \mathcal{G}$ and a continuous map $g: A \rightarrow E$ with $(g \cdot f, \eta)$ divergent. Theorem 3. If \mathcal{G} generates a Banach space B under the four basic operations then already $B \in I(\mathcal{G})$. Call a space E universal if under the four operations $\oplus, \times, /, \subset$, E generates all complete spaces. Theorem 4. A metric locally convex space E is universal if and only if for some Banach space B there is a continuous map $f: E \rightarrow B$ and $f(E)$ is infinite dimensional. Thus the base field is not universal. (Received July 17, 1970.)

70T-G166. PHILLIP L. ZENOR, Auburn University, Auburn, Alabama 36830. Spaces with subparacompact completions.

If X is a completely regular T_1 -space, then δX will denote the Dieudonné completion of X . A closed continuous function with compact fibers (countably compact fibers) is a perfect map (quasi-perfect map). Theorem. Suppose that f is a quasi-perfect map from the completely regular T_1 -space X onto the Dieudonné complete space Y . Then: (1) If Y is a semimetrizable space, then the extension of f over δX is a perfect map; and so, δX is subparacompact. (2) If Y is a Moore-space, then δX is a subparacompact p -space. (Received July 20, 1970.)

70T-G167. MARVIN W. GROSSMAN, Temple University, Philadelphia, Pennsylvania 19122. Multiplicative invariant means and fixed point properties on realcompact spaces. Preliminary report.

Let S be a semitopological semigroup and let \underline{X}_S denote the category of continuous (in the second variable) actions of S on T_2 spaces with action preserving continuous maps as morphisms. Theorem. If \underline{P} is a class of T_2 spaces that is stable with respect to forming product spaces and closed subspaces, then the full subcategory of \underline{X}_S consisting of all [separately; jointly] continuous actions of S on spaces in \underline{P} is epireflective in \underline{X}_S . Corollary. Let (S, X) be an object in \underline{X}_S and \underline{P} a class of realcom-

compact spaces that satisfies the conditions of the theorem. There exists an S -translation-invariant subalgebra $A_1[A_2; A_3]$ of $C(X)$ (all real-valued continuous functions on X) that contains the constants with the property that $A_1[A_2; A_3]$ has a multiplicative S -invariant mean iff whenever (S, Y) is a [separately; jointly] continuous action of S on a space Y in \underline{P} such that there exists a continuous map $\sigma: X \rightarrow Y$ with $\sigma(s \cdot x) = s \cdot \sigma(x)$ for all $s \in S, x \in X$, then Y has a common fixed point for S . The theorem and corollary generalize, in part, some recent results of Theodore Mitchell and of Anthony T. Lau. In addition to all compact T_2 spaces choices of \underline{P} in the corollary include: all compact totally disconnected spaces, all realcompact spaces, all zero-dimensional realcompact spaces, all totally disconnected realcompact spaces. (Received July 20, 1970.)

70T-G168. MICHAEL D. WEISS, Wayne State University, Detroit, Michigan 48202. Restricted topological entropy and realmappings.

Let "h" denote (topological) entropy. R. Adler and M. McAndrew [Trans. Amer. Math. Soc. 121(1966), 236-241] proved that $h(T_{\nu}) = \log \nu$, where T_{ν} is the ν th Chebyshev polynomial. We give a simpler proof based on a result of L. Goodwyn. Theorem. If a continuous mapping $f: [a, b] \rightarrow [a, b]$ is at most p -to-1, then $h(f) \leq \log p$. Let T be a continuous mapping of the compact metric space (X, d) into itself. Theorem. Suppose $d(T(x), T(y)) \leq Kd(x, y)$ for all $x, y \in X$. Then: if $K \leq 1$, $h(T) = 0$; while if $K > 1$ and (X, d) is a submetric space of \mathbb{R}^S , then $h(T) \leq s \log K$. Theorem. Let T be expansive or positively expansive and $\{E_i\}_{i=1}^{\infty}$ a sequence of (closed) T -invariant sets. If $\{E_i\}_{i=1}^{\infty}$ converges in the sense of the Hausdorff metric to a closed subset E of X , then $h(T|E) \geq \limsup h(T|E_i)$. If $E_1 \supset E_2 \supset \dots$, then $h(T| \bigcap_{i=1}^{\infty} E_i) = \inf_i h(T|E_i)$. Theorem (also proved independently by L. Goodwyn). $h(T) = h(T| \bigcap_{i=0}^{\infty} T^i X)$ (note $T| \bigcap_{i=0}^{\infty} T^i X$ is surjective). Define $\Omega_0 = X$ and $\Omega_i = \{y \in \Omega_{i-1} | y \text{ is a nonwandering point for } T| \Omega_{i-1}\}$ for $i \in \mathbb{N}$. Theorem. $h(T) = h(T| \bigcap_{i=0}^{\infty} \Omega_i)$. This answers a question of R. Bowen [Proc. Sympos. Pure Math., vol. 14, Amer. Math. Soc., Providence, R. I., 1970, 23 ff.]. (Received July 23, 1970.)

70T-G169. JOHN D. BLANTON, St. John Fisher College, Rochester, New York 14618. Spaces of isotopic triangulations of a 2-cell.

Let f be an imbedding in euclidean 2-space of a combinatorial 2-cell K with boundary \dot{K} . Let $I(f)$ be the space of triangulations of $|f(K)|$ that are isotopic to the triangulation (f, K) with the boundary fixed. If \dot{K} contains $\mathcal{L} \leq 5$ 0-simplexes and K contains k ($k \leq 10 - \mathcal{L}$) interior 0-simplexes, then $I(f)$ is homeomorphic to E^{2k} . More generally, for any combinatorial 2-cell K there is a subdivision K' of K such that $\dot{K} = \dot{K}'$, K' contains k interior 0-simplexes and $I(f')$ is homeomorphic to E^{2k} , where (f', K') is the triangulation induced by the subdivision. (Received August 7, 1970.)

70T-G170. JOHN P. HEMPEL, Rice University, Houston, Texas 77001 and WILLIAM H. JACO, University of Michigan, Ann Arbor, Michigan 48104. 3-manifolds which fiber over a surface.

Theorem. Let M be a compact 3-manifold (with or without boundary and possibly nonorientable). Suppose there is an exact sequence $1 \rightarrow N \rightarrow \pi_1(M) \rightarrow \pi_1(S) \rightarrow 1$ where N is nontrivial and finitely generated and S is a compact 2-manifold different from $B^2, S^2, P^2, S^1 \times I$, Mobius band. Then N is infinite-cyclic. Furthermore if \hat{M} is the 3-manifold obtained from M by capping off all 2-spheres in ∂M with 3-cells, then $\hat{M} = M_1 \# H$ where H is a homotopy 3-sphere and M_1 is the total space of a fiber bundle

with fiber S^1 , base space a compact 2-manifold S^* , and bundle projection $g: M_1 \rightarrow S^*$ satisfying $\ker g_* = N$. If $\partial S = \emptyset$ we may assume $S^* = S$. (Received July 29, 1970.)

70T-G171. BRUCE A. ANDERSON, Arizona State University, Tempe, Arizona 85281. Families of mutually complementary topologies.

If L is a nonempty complete lattice, define the complementary width of L , $w^*(L)$, to be the sup of the set of cardinals d such that L has a family of d mutually complementary elements. Suppose X is an infinite set and L is either the lattice of all topologies, the lattice of principal topologies, the lattice of T_1 topologies or the lattice (introduced by R. E. Larson) of \aleph_0 -topologies (Abstract 672-489, these *Notices*) 17(1970), 223) on X . Theorem. $|X| \leq w^*(L) \leq 2^{|X|}$. The upper bound of this inequality is very easily obtained, but the lower bound is shown by a fairly detailed construction. Theorem. If T is a Fréchet Hausdorff topology, a locally compact \aleph_0 -topology or a symmetrizable Hausdorff topology, then T has an \aleph_0 -complement. Theorem. Every set of cardinal c carries a $(T_1)(\aleph_0)$ topology T such that for any $(T_1)(\aleph_0)$ topology S on a set X of cardinal c , T has a $(T_1)(\aleph_0)$ complement with a subspace homeomorphic to (X, S) . (Received July 31, 1970.)

70T-G172. WEI-LUNG TING, State University College of New York, Plattsburgh, New York 12901. On odd order nondegenerate immersions of RP^n . I. Preliminary report.

For terminology see Feldman [Trans. Amer. Math. Soc. 120(1965), 185-224]. Theorem 1. Let RP^n be the real projective n -space and ξ , the canonical line bundle over RP^n . If RP^n can be p th order nondegenerately immersed in $RP^{\nu(n,p)+k}$, where $k \geq 0$ and p an odd integer, then the bundle $(\nu(n,p) + k + 1)\xi$ has $\nu(n,p) + 1$ independent nonzero sections. Theorem 2. Let $n = 2^r - 1$, where $r \geq 3$. If RP^n can be 3rd order nondegenerately immersed in $RP^{\nu(n,3)+k}$ then RP^n/RP^{k-1} and $RP^{\nu(n,3)+n+1}/RP^{\nu(n,3)+k}$ are mod 2 S -related. Theorem 3. If $n = 2^r - 1$, $r \geq 3$, then RP^n cannot be 3rd order nondegenerately immersed in $RP^{\nu(n,3)+n-q}$, where $q = 2r$ if $r \equiv 1, 2 \pmod{4}$, $q = 2r + 1$ if $r \equiv 0 \pmod{4}$, $q = 2r + 2$ if $r \equiv 3 \pmod{4}$. (Received August 11, 1970.)

70T-G173. JAMES G. WILLIAMS, Bowling Green State University, Bowling Green, Ohio 43402. Nested sequences of local uniform spaces.

A local uniform space is a pair (X, \mathfrak{B}) , with \mathfrak{B} a filter on $(X \times X)$ such that for each $U \in \mathfrak{B}$, U contains the diagonal in $X \times X$, $U^{-1} \in \mathfrak{B}$, and $\forall x \in X, \forall V \in \mathfrak{B}; (V \circ V)[x] \subseteq U[x]$. Each local uniform space has a regular relative topology in the same way that each uniform space has a completely regular topology. While each nested (countable) sequence of uniform spaces has a limit uniform space, the analogous theorem is not true for local uniform spaces. However, using a weak generalization of pseudometrics, one may give a necessary and sufficient condition for a nested sequence of local uniform spaces to have a limit. Nested sequences of local uniform spaces may be used to give a straightforward construction of spaces with a topology of the type discovered by E. Hewitt and J. Novak, on which every real-valued continuous function is constant. The construction may be used to show that every regular (separable) (first-countable) space (of cardinality $\aleph \geq \aleph_1$) is a closed subspace of a Hewitt-type space with the same properties. (Received August 11, 1970.)

70T-G174. IVAN L. REILLY, Mathematics Institute, University of Warwick, Coventry, England and University of Auckland, Auckland, New Zealand. Quasi-gauge spaces.

If φ is a family of quasi-pseudo-metrics on a set X , then the topology $\mathcal{T}(\varphi)$ on X which has the family $\mathcal{B}(\varphi) = \{B(x, p, \epsilon) : x \in X, p \in \varphi, \epsilon > 0\}$ of balls as a subbase is called the topology induced on X by the family φ . If φ is a family of quasi-pseudo-metrics on X , then the family $\mathcal{L} = \{q : q \text{ is the conjugate quasi-pseudo-metric of some } p \in \varphi\}$ is the family conjugate to φ . A topological space (X, \mathcal{T}) [bitopological space $(X, \mathcal{T}_1, \mathcal{T}_2)$] is called a quasi-gauge space if there is a family φ of quasi-pseudo-metrics on X such that $\mathcal{T} = \mathcal{T}(\varphi)$ [$\mathcal{T}_1 = \mathcal{T}(\varphi)$ and $\mathcal{T}_2 = \mathcal{T}(\mathcal{L})$]. Characterizations of the topological and bitopological spaces which are quasi-gauge spaces are given, and their relationship to quasi-uniform spaces is investigated. (Received August 17, 1970.)

70T-G175. RUSSELL GRANT WOODS, University of Manitoba, Winnipeg 19, Manitoba, Canada. Homeomorphic sets of remote points.

If X is a completely regular Hausdorff space, let βX denote its Stone-Ćech compactification and let δX denote the smallest cardinal number m with the property that X contains a dense subset of cardinality m . A point $p \in \beta X$ is called a remote point of βX if p is not in the βX -closure of any discrete subspace of X . Let X and Y be two locally compact, noncompact metric spaces without isolated points. In this paper it is proved that if $\delta X = \delta Y$ then the set of remote points of βX is homeomorphic to the set of remote points of βY . (Received August 18, 1970.)

70T-G176. KUO-TSAI CHEN, University of Illinois, Urbana, Illinois 61801. Differential forms and homotopy groups.

By a method of iterated path integration, we prove the next Theorem. If a connected differentiable manifold X has closed 1-forms w_1, \dots, w_m such that (a) $w_i \wedge w_j = 0$, $i, j = 1, \dots, m$; (b) the cohomology classes $[w_1], \dots, [w_m]$ are linearly independent, then $\pi_1(X)$ has a free subgroup F of rank m . If, moreover, there exists a closed q -form w , $q > 1$, satisfying the conditions (c) $w_i \wedge w = 0$, $1 \leq i \leq m$; (d) the integral of w does not vanish over some spherical q -cycle, and if u is an element of $\pi_q(X)$ corresponding to the spherical q -cycle, then the set $F \cdot u$ is a basis of a free abelian subgroup of $\pi_q(X)$. Corollary. Let X be a compact connected Kähler manifold and let $b^{r,s} = \dim H^{r,s}(X)$. If $b^{1,0} > b^{2,0} + 1$, then $\pi_1(X)$ has a free subgroup of rank 2. If $b^{1,0} > b^{2,0} + b^{q+1,0} + 1$, $q > 1$, and if there exists a closed holomorphic q -form w whose integral does not vanish over some spherical q -cycle, then $\pi_q(X)$ contains a free abelian subgroup of infinite rank. (Received August 11, 1970.)

70T-G177. BEVERLY L. BRECHNER, University of Florida, Gainesville, Florida 32601. One-dimensional locally setwise homogeneous continua.

Locally setwise homogeneous continua were first defined by the author in "On the dimensions of certain spaces of homeomorphisms", Trans. Amer. Math. Soc. 121 (1966), 516-548, and further studied in "Strongly locally setwise homogeneous continua and their homeomorphism groups" (to appear in Trans. Amer. Math. Soc.) In this paper, we obtain a classification (and characterization) of the one-dimensional locally setwise homogeneous continua "without boundary" (as "boundary" is defined in this paper). The only such continua are the simple closed curve, universal (Menger)

curve, universal plane (Sierpinski) curve, and "copies of the Sierpinski curve on the closed two-manifolds". (Received August 21, 1970.)

70T-G178. ROBERT D. EDWARDS, University of California, Los Angeles, California 90024. The equivalence of close piecewise-linear embeddings.

Let K^k be a compact polyhedron and Q^q a pl (= piecewise-linear) manifold. Theorem. Suppose $f: K \rightarrow \text{int } Q$ is a topological embedding, $k \leq q - 3$. Given $\epsilon > 0$, there is a $\delta > 0$ such that if $g, h: K \rightarrow \text{int } Q$ are two pl embeddings each within δ of f , then there is a pl ambient ϵ -isotopy of Q which takes g onto h . This theorem was proved for the case K a pl manifold by Miller ("Close isotopies on piecewise-linear manifolds", to appear in the Trans. Amer. Math. Soc.) and Bryant-Seebeck (Abstract 69T-G83, these *Notices* 16 (1969), 696) and for the case f a pl embedding by Connelly (Abstract 69T-G139, these *Notices* 16 (1969), 988). The above generalization follows from an application of Bryant-Seebeck radial engulfing and the following Proposition. Suppose K^k is a compact polyhedron. Given any $\epsilon > 0$, there is a $\delta > 0$ such that if N^n is any abstract regular neighborhood of K , with collapsing retraction $r: N \rightarrow K$ and $k \leq n - 3$, and if $g: K \rightarrow \text{int } N$ is any pl embedding such that the map rg is within δ of $i: K \hookrightarrow N$, then there is a pl ambient isotopy $H_t: N \rightarrow N$, $t \in [0, 1]$, of N such that $H_0 = \text{id}$, $H_t = \text{id}$ on ∂N , $H_1 g = i$ and for each t , the map $rH_t: N \rightarrow K$ is within ϵ of r . This proposition is proved using an improved version of Connelly's fringe cutting lemma, plus Lickorish's cone unknotting theorem. The usual generalizations of the theorem hold. (Received August 31, 1970.)

70T-G179. RALPH JONES, University of Wisconsin, Madison, Wisconsin 53706. Unions of two open 2-cells. Preliminary report.

Theorem. Any connected open proper subset of a compact 2-manifold (without boundary) is a union of two open 2-cells. Of course, the only compact 2-manifold which is the union of two open 2-cells is the 2-sphere. Question. Is every noncompact 2-manifold a union of two open 2-cells? (Received September 2, 1970.)

70T-G180. WARREN H. WHITE, Instituto de Matematica Pura e Aplicada, Rua Luiz de Camoes, 68, Rio de Janeiro, Brasil. Curvature and collapsibility of 2-dimensional polyhedra.

Analogues of Riemannian metric and sectional curvature are defined in the PL category which make the following theorem true. Theorem. Let P be a simply-connected polyhedron with a PL metric, such that sectional curvature is nowhere positive. Then any two points of P are joined by a unique minimal geodesic. Corollary. A simply-connected, 2-dimensional, finite polyhedron is collapsible if and only if it can be realized in E^n , for some n , as a geometric complex K with the following property: For every vertex $v \in K$ and every simple closed curve $J \subset |\text{link}(v, K)|$, the sum of the interior angles at v of the 2-simplexes of K in $v \cdot J$ is at least 2π . (Received September 2, 1970.)

70T-G181. JOHN M. WORRELL, JR., Division 1721, Sandia Laboratories, Albuquerque, New Mexico 87115. Lightness of mappings and the topological theory of metrization.

Properties of lightness provide motivating theoretic connections between topologically uniform first-countable structures, as given by the base of countable order condition, and non-first-countable extensions of the theory as reported on in [these *Notices* 14 (1967), 935]. The following central theorem has numerous variations and extensions: A locally connected regular T_0 space has a base of

countable order if and only if it has a light perfect mapping ϕ onto a space having a base of countable order. In particular, the stipulation that ϕ be perfect may be relaxed to the requirement that it be appropriately uniformly complete, thus, in a context of paracompactness of the domains, relating metrization of locally connected spaces to a general theory of completeness of mappings. Another variational extension, on which the article [Pacific J. Math. 30 (1969), 555-562] bears closely, illustrates one of the motivations for emphasizing sets of interior condensation: A Tychonoff space has a base of countable order if it is pointwise uniformly a set of light interior condensation in a locally connected T_2 bicomactification. This work was supported by a National Science Foundation Postdoctoral Fellowship and by the United States Atomic Energy Commission. (Received September 3, 1970.)

70T-G182. JOHN M. WORRELL, JR., Division 1721, Sandia Laboratories, Albuquerque, New Mexico 87115 and HOWARD H. WICKE, Ohio University, Athens, Ohio 45701. A base of countable order-like formulation.

A collection K of open sets is said to be monotonically contracting if for each P of any D in K belonging to a proper open subset D' of D , K contains such a D' . Such a K is said to satisfy Condition $Y_b(Y_c)$ if, additionally, it covers the space and, if M is the common part of the closures of the elements of a perfectly decreasing subcollection T of K , then M is bicomact (countably compact) and every open set in which it lies includes an element of T . Theorem. A regular T_0 space has a collection of open sets satisfying Condition $Y_b(Y_c)$ if and only if it is covered by the terms of a monotonically contracting sequence G_1, G_2, \dots of collections of open sets such that if g_1, g_2, \dots is a decreasingly monotonic sequence of sets such that g_n belongs to G_n and M is the common part of the closures of the sets g_n , then M is bicomact (countably compact) and g_1, g_2, \dots converges to M . Remarks. (1) This proposition is analogous to Theorem 2 of [Canad. J. Math. 17 (1965), 820-830]. (2) Regular T_0 spaces satisfying Condition $Y_b(Y_c)$ are precisely the regular T_0 (appropriately) uniformly complete open continuous images of Hausdorff paracompact p -spaces (regular T_0 M -spaces of Morita). This work was supported by the United States Atomic Energy Commission. (Received September 3, 1970.)

70T-G183. ANTONIO O. FARIAS, Eastern Michigan University, Ypsilanti, Michigan 48197. Orientation-preserving mappings, a semigroup of geometric transformations, and a class of integral operators. Preliminary report.

Let D denote the open unit disk in the plane R^2 , D^- its closure and S^1 its boundary. All mappings are smooth ($= C^\infty$). An $f: S^1 \rightarrow R^2$ is extendable if there is an $F: D^- \rightarrow R^2$ with nonnegative Jacobian whose restriction to S^1 is f ; f is normal if it is an immersion with no triple points and all double points are transversal. A Titus transformation is a linear operator on the space of smooth mappings from the circle into the plane given by $(Tf)(t) = f(t) + \alpha(t) \det[v, f'(t)]v$, where α is a non-negative function on S^1 , v is a fixed vector on the plane and $\det[\cdot, \cdot]$ denotes the usual determinant form on R^2 . A Titus mapping is the image under a finite composition of Titus transformations of a mapping $\alpha_0 v_0$, α_0 a function on S^1 and v_0 fixed in R^2 . Theorem. A normal mapping is extendable iff it is a Titus mapping. An application is made to a class of integral operators, $y(t) = \int_0^2 k(s)x(t-s)ds$, introduced by Loewner (Ann. of Math. (2) 49 (1948), 316-332). It is proved that, under certain conditions, such an operator is topologically equivalent to Hilbert's transform $y(t) = \int_0^2 \cot(s/2)x(t-s)ds$, which relates the real and imaginary parts of the boundary values of a function holomorphic on D . (Received August 19, 1970.)

ERRATA

Volume 17

GEORGE GLAUBERMAN. Prime-power factor groups of finite groups, Abstract 674-86, Page 546.

In Corollary 2, "prime q " should be replaced by "prime divisor q of $|G|$ " and " $N(Q)/C(Q)$ " should be replaced by " $N(Q)$ ".

JOHN L. LEONARD. On Bollobás' number $k_r(n)$. Preliminary report, Abstract 677-05-3, Page 759.

After first sentence add: "The corresponding number for edge-independent paths is denoted $\ell_r(n)$," For " $k_5(n) \leq 3n - 5$ " read " $\ell_5(n) \leq 3n - 5$."

SERGE MAUMARY. The open surgery obstruction in odd dimensions. Preliminary report, Abstract 70T-G152, Page 848.

Line 5: After the words "at each end", insert "for $* \neq m/2$ ".

M. RAJAGOPALAN and BERT M. SCHREIBER. Ergodic properties of automorphisms of a locally compact group II, Abstract 671-51, Page 85.

The last sentence should read, "It is proved in this paper that the verification of the conjecture above can be reduced to the study of totally disconnected groups and that it is in fact valid for a sizeable collection of such groups."

CHAMAN LAL SABHARWAL. Multiplication of singularity functions, Abstract 677-46-3, Page 783.

Line 5: Replace "and $(ntx;k)|x|^{-\alpha} \dots$ of $\delta(x)$ and to $\delta(x)$ for $\alpha = 0$ " by "and $nt(nx;k)|x|^{-\alpha} \dots$ of $\delta_{(x)}^{(p)}$ and to $\delta(x)$ for $\alpha = 0$, $[a] = p$ ".

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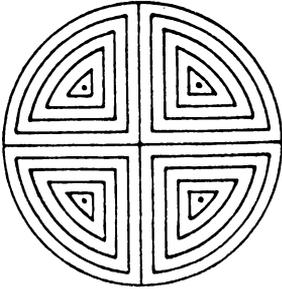
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