Calendar

This Calendar lists all of the meetings which have been approved by the Council up to the date 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 meetings to which no numbers have yet been assigned.

Abstracts should be submitted on special forms which are available in most departments of mathematics; forms can also be obtained by writing to the headquarters of the Society. Abstracts to be presented at the meeting *in person* must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline for the meeting.

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*Deadline for abstracts not presented at a meeting (by title). January 1975 issue: October 30
February 1975 issue: January 21

OTHER EVENTS

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The zip code of the Post Office Box of the Society has been changed from 02904 to 02940. Correspondents are requested to note this change in their records.

Please affix the peel-off label on these *Notices* to correspondence with the Society concerning fiscal matters, changes of address, promotions, or when placing orders for books and journals.

The *Notices* of the American Mathematical Society is published by the American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940, in January, February, April, June, August, October, November, and December. Subscription per annual volume is $10. Member subscription of $5 is included in annual dues. Price per copy $3. Special price for copies sold at registration desks of meetings of the Society, $1 per copy. Subscriptions, orders for back numbers (back issues of the last two years only are available), and inquiries should be addressed to the American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940. Second class postage paid at Providence, Rhode Island, and additional mailing offices.

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The seven hundred sixteenth meeting of the American Mathematical Society will be held at Wesleyan University, Middletown, Connecticut, on Saturday, October 26, 1974. All sessions will take place in the Science Tower of the Science Center.

By invitation of the Committee to Select Hour Speakers for Eastern Sectional Meetings, there will be two one-hour addresses. Professor Mark Kac of Rockefeller University will speak on "Some analytic problems suggested by statistical mechanics" at 11:00 a.m., and Professor Philip J. Davis of Brown University will speak on "Geometry, computer graphics, and theorems of visual type" at 2:00 p.m. Both lectures will be presented in Room 150.

Professor Ernest G. Manes of the University of Massachusetts, Amherst, has organized a special session on Category Theory Applied to Analysis and Topology for the afternoon, 3:15 p.m. to 6:15 p.m., in Room 58. Speakers will be Professors John Isbell, John Kennison, and Joan Wick Pellelter. Sessions for contributed papers will be scheduled in the morning. No provision will be made for late papers. Walls, chalkboards, but no overhead projectors, will be available at all sessions.

There will be a meeting of the Association for Women in Mathematics in the Private Dining Room of McConaughy Dining Hall from 12:00 noon to 1:00 p.m., and continuing in Room 137 (first floor), Science Tower, from 1:00 p.m. to 2:00 p.m.

The registration desk will be located in the first floor lobby of the Science Tower and will be open from 8:30 a.m. to 3:30 p.m. There will be no registration fee. The most convenient access to the Science Tower is from Church Street. Some unmetered parking spaces on nearby streets, such as Church Street and Pine Street, would likely be available. The nearest university parking areas open and free to the public are Area C on Church Street and Area V on Vine Street.

Free coffee and doughnuts will be served all day in the Mathematics Lounge (6th floor) to the registrants. A limited number of complimentary tickets for lunch at nearby McConaughy Dining Hall will be available at the registration desk to participants on a first-come first-served basis. A no-charge cocktail party for the registrants will take place in the Mathematics Lounge (6th floor) on Saturday from 6:00 p.m. to 7:00 p.m.

The following motels provide the accommodations nearest to the Wesleyan University campus, distance in miles being given next to the name:

**CRESTLINE MOTEL (1-1/2 mi)**
Meriden Road (Route 66)
Middletown, CT 06457
Phone: (203) 347-6955

- Single $10.60
- Double $12.75 (1 bed)
- Twin $14.56 (2 beds)
- Quadruple $19.10 (2 beds)
6% Connecticut sales tax included

**LORD CROMWELL MOTOR INN (3 mi)**
Berlin Road (Route 72)
Cromwell, CT 06416
Phone: (203) 347-7427

(Numbers in parentheses refer to number of persons.)

- Single $16 (1) $20 (2) (1 dble bed)
- Double $18 (1) $25 (2) (2 dble beds)
- King $18 (1) $25 (2) (1 king bed)
- Balcony Suite $35 (2-6) (2 dble beds & 1 sofa bed)
Each additional person $3.00. Cots, $3.00.
Plus 6% Connecticut sales tax.

**MIDDLETOWN MOTOR INN (1 mi)**
Washington Street Extension (Meriden Road, Route 66),
Middletown, CT 06457
Phone: (203) 346-9251

- Single $11-12
- Double $13-14 (1 bed)
- Twin $16-17 (2 beds)
Each additional person, $3.00.
Plus 6% Connecticut sales tax.

Reservations should be made directly with the motel, mention of this meeting being made in the correspondence or call. All prices quoted in this announcement are as of early September 1974.

Middletown, located in central Connecticut on the Connecticut River, is approximately 15 miles south of Hartford and 25 miles northeast of New Haven. Midway between New York City and Boston, it is about 2-1/4 hours of driving time from the center of each city. State Highways 9, 17, and 66 pass thru Middletown, and National Interstate Highway I-91 is 5 to 8 miles away. Middletown is served by Continental Trailways and Greyhound Bus Lines. Bradley International Airport, about 32 miles north of Middletown, is off I-91 in Windsor Locks, and Tweed-New Haven Airport is just outside of New Haven. Direct taxi fare between these airports and Middletown is around $20. The nearest Penn Central passenger train station (Amtrak) is located in Meriden, about 10 miles west of Middletown. The taxi fare between Meriden and Middletown is approx-
imately $9. Scheduled limousine service between Bradley International Airport and Lord Cromwell Motor Inn (see above) is available at $6.50 one way and $11.50 round trip; for information on
schedules and fares, contact Central Connecticut Limousine Service, Inc., 65 Quinnipiac Avenue, North Haven, CT 06473, telephone: (203) 562-3165.

PROGRAM OF THE SESSIONS

The time limit for each contributed paper in the general sessions is ten minutes and in the special session is fifty minutes. To maintain this schedule, the time limits will be strictly enforced.

SATURDAY, 9:30 A. M.

General Session, Room 139 (first floor), Science Tower
9:30- 9:40 (1) Conjugacy classes and Fuchsian subgroups of the Picard group. Professor BENJAMIN FINE, Fairfield University (716-A1)
9:45- 9:55 (2) Recurrence criteria for random walks on countable Abelian groups, II. Professor JOEL H. PIT, State University of New York, College at New Paltz (716-F1)
10:00-10:10 (3) Duality. Preliminary report. Professor V. SANKRITHI KRISHNAN, Temple University (716-A2)
10:15-10:25 (4) A categorical construction with applications to automorphisms. Preliminary report. Professor CHARLES WELLS, Case Western Reserve University (716-A3)

SATURDAY, 9:30 A. M.

Session on Topology, Room 141 (first floor), Science Tower
9:30- 9:40 (5) Octahedral knot covers. Mr. KENNETH A. PERKO, Jr., New York (716-G1)
9:45- 9:55 (6) A Seifert–van Kampen theorem for the second homotopy group. II. Preliminary report. Professor STEVEN C. ALTHOEN, Hofstra University (716-G4)
10:00-10:10 (7) On the action of free bordism on G–bordism. Preliminary report. Dr. R. PAUL BEEM, University of Pennsylvania (716-G3)
10:15-10:25 (8) A chain compact space which is not strongly scattered. Professor M. RAJAGOPALAN, Memphis State University (716-G2)
10:30-10:40 (9) Not every scattered space has a scattered compactification. Preliminary report. Professor PETER J. NYIKOS, University of Illinois (716-G5)

SATURDAY, 11:00 A. M.

Invited Address, Room 150 (Large Auditorium), Science Tower
(10) Some analytic problems suggested by statistical mechanics. Professor MARK KAC, Rockefeller University (716-C2)

SATURDAY, 2:00 P. M.

Invited Address, Room 150 (Large Auditorium), Science Tower
(11) Geometry, computer graphics, and theorems of visual type. Professor PHILIP J. DAVIS, Brown University (716-C1)

SATURDAY, 3:15 P. M.

Special Session on Category Theory Applied to Analysis and Topology, Room 58 (Small Auditorium), Science Tower
3:15- 4:05 (12) Dual functors and integral operators in Ban. Professor CARL HERZ, McGill University, and Professor JOAN WICK PELLETIER*, York University (716-B1)
4:15- 5:05 (13) Some concrete dualities. Professor JOHN ISBELL, State University of New York at Buffalo (716-A5)
5:15- 6:05 (14) Representing algebras by sections. Preliminary report. Professor JOHN KENNISON, Clark University (716-A4)

Walter H. Gottschalk
Associate Secretary

Middletown, Connecticut
The seven hundred seventeenth meeting of the American Mathematical Society will be held at Vanderbilt University in Nashville, Tennessee, on Friday and Saturday, November 8–9, 1974.

By invitation of the Committee to Select Hour Speakers for the Southeastern Sectional Meetings, there will be three one-hour addresses, the first being at 1:00 p.m. on Friday in the auditorium of the Sarratt Commons. All other sessions will be held in the Stevenson Center for the Natural Sciences. Professor Trevor Evans of Emory University will give an address entitled "Word problems". An address entitled "Geometry of sub-manifolds in Euclidean space" will be given by Professor Robert B. Gardner of the University of North Carolina, and Professor J. R. Retherford of Louisiana State University will present an address entitled "Banach ideals of operators".

There will be three special sessions in addition to the regular sessions. A special session entitled "Combinatorial theory," organized by Professor J. V. Brawley of Clemson University, will include as participants Professors Leonard Carlitz, Henry W. Gould, Bernard R. McDonald, David P. Roselle, Cecil C. Rousseau, and Richard Scoville. Participants included in a special session on "Number theory" to be organized by Professor Robert M. McConnel of the University of Tennessee will be Professors Bruce Berndt, Ezra Brown, Richard Hudson and Gordon Pall, Professor Richard S. Varga of Kent State University, Kent, Ohio, is organizing a special session on "Approximation theory". Included in this special session will be Professors Steven Demko, Thomas R. Lucas, G. W. Reddien, Jr., and Edward B. Saff.

There will be a concurrent meeting of the Association for Women in Mathematics.

The registration desk will be located in the lobby of the Mathematics Building in the Stevenson Center. Registration hours will be from 12:00 noon to 5:00 p.m. on Friday, November 8, and from 9:00 a.m. to 12:00 noon, on Saturday, November 9. There will be a beer party from 8:00 p.m. until 12:00 midnight on Friday at the University Club; details will be available at the registration desk.

Nashville is on Interstates 24, 40, and 65, is served by Amtrak, and the Greyhound and Trailways Bus Lines. Many airlines have service to Nashville; limousine service from the airport to the Vanderbilt area is $3.25. Cars may be rented at the airport through the Avis, Hertz, and National agencies.

Three cafeterias on campus will be open for all meals. Also, a list of local restaurants will be available at the registration desk.

Three motels near the campus are holding blocks of rooms with a reservation deadline of October 25. Reservations should be made directly with them, with mention of this meeting included in that correspondence. The zip code for each of the following is 37203.

**HOLIDAY INN-VANDERBILT**
(100 rooms reserved)
2613 West End Avenue
(five blocks from the Stevenson Center)
Phone: (615) 383-1147

- **Single**: $14.00 up
- **Double**: $18.50 up (one bed)
- **Twins**: $20.50 up (two beds)

**ALLEN MOTEL**
(15 rooms reserved)
2004 West End Avenue
(six blocks from the Stevenson Center)
Phone: (615) 327-1841

- **Single**: $12.00
- **Double**: $14.00

**ANCHOR MOTEL**
(40 rooms reserved)
1921 West End Avenue
(six blocks from the Stevenson Center)
Phone: (615) 327-4581

- **Single**: $13.00
- **Double**: $16.00 (one bed)
- **Twins**: $18.00 (two beds)

Accommodations are also available at:

**HOLIDAY INN–WEST END**
1800 West End Avenue
(eight blocks from the Stevenson Center)
Phone: (615) 329-3711

**SHERATON–NASHVILLE HOTEL**
920 Broadway
(one mile from the Stevenson Center)
Phone: (615) 244-0150

Emergency messages may be left for delivery at (615) 322-6672.

O. G. Harrold
Associate Secretary
Tallahassee, Florida
The Seven Hundred Eighteenth Meeting
University of Southern California
Los Angeles, California
November 23, 1974

The seven hundred eighteenth meeting of the American Mathematical Society will be held at the University of Southern California in Los Angeles, California, on Saturday, November 23, 1974.

By invitation of the Committee to Select Hour Speakers for Far Western Sectional Meetings, there will be two invited hour addresses. Professor C. Edmund Burgess of the University of Utah will lecture on "Embeddings of surfaces in Euclidean three-space" at 11:00 a.m.; Professor Paul R. Chernoff of the University of California, Berkeley, will lecture at 3:30 p.m. The title of his talk is "Quasi-analytic vectors and quasi-analytic functions." Both addresses will be given in the auditorium in Olin Hall of Engineering, Room 122.

There will be sessions for contributed papers on Saturday. All sessions will be held in Olin Hall of Engineering. Blackboard space and overhead projectors will both be available. Late papers will be accepted for presentation at the meeting, but they will not be listed in the printed program.

Professor William A. Harris, Jr. of the University of Southern California is organizing a special session of twenty-minute papers on Analytic Theory of Ordinary Differential Equations. These sessions will be held on Saturday morning and afternoon. The speakers will include Louis J. Grimm, William A. Harris, Jr., Frederick A. Howes, James S. Muldowney, Robert E. O'Malley, Jr., and Yasutaka Sibuya.

The registration desk will be located in the lounge of Olin Hall of Engineering. Registration hours will be from 8:30 a.m. to 12:00 noon and from 1:00 p.m. to 2:30 p.m.

The following hotels and motels are located in Los Angeles. The Vagabond Motor Hotel is the nearest to the campus; it is about a twenty-minute walk away. Reservations should be made directly with the hotel or motel. The rates listed are special USC discounts. To obtain them, state that you are attending a conference at USC and that you would like the USC rate.

**AMBASSADOR HOTEL**
3400 Wilshire Boulevard (90010)
Phone: (213) 387-7011

- Single $15.00
- Double $21.00

**HOLIDAY INN**
1020 South Figueroa Street (90007)
Phone: (213) 748-1291

- Single $16.00
- Double $20.00

**LOS ANGELES HILTON HOTEL**
930 Wilshire Boulevard (90017)
Phone: (213) 629-4321

- Single $15.00
- Double $20.00

**OLYMPIAN MOTOR HOTEL**
1903 West Olympic Boulevard (90006)
Phone: (213) 385-7141

- Single $13.00
- Double $17.00

**VAGABOND MOTOR HOTEL**
3101 South Figueroa Street (90007)
Phone: (213) 746-1531

- Single $14.00
- Double $19.00

The noon meal can be taken on campus at the Commons and Faculty Club. A restaurant near campus is Carl's and Julie's.

Kenneth A. Ross
Associate Secretary
Eugene, Oregon
The seven hundred nineteenth meeting of the American Mathematical Society will be held at the University of Houston, Houston, Texas, on Saturday, November 23, 1974. All sessions will be held in the Continuing Education Center of the university.

By invitation of the Committee to Select Hour Speakers for Western Sectional Meetings, there will be two one-hour addresses. Professor Seymour V. Parter of the University of Wisconsin will address the Society at 11:00 a.m.; his topic will be Differential Equations with "Turning Points" and Numerical Methods. Professor William A. Veech of Rice University will give an hour talk at 1:45 p.m. on the subject Topological Dynamics.

By invitation of the same committee there will be two special sessions of selected twenty-minute papers. Professor E. Ward Cheney of the University of Texas will organize a special session on Approximation Theory; the tentative list of speakers includes Bill D. Anderson, Hermann G. Burchard, Charles K. Chui, Frank R. Deutsch, Oved Shisha, Philip W. Smith, and Daniel E. Wulbert. Professor Richard D. Sinkhorn of the University of Houston will organize a special session on Matrix Theory; the tentative list of speakers includes Peter M. Gibson, Darald J. Hartfiel, Emilie V. Haynsworth, Mark Hedrick, Marvin Marcus, William L. Morris, and Robert J. Plemmons. There will also be sessions for contributed papers both morning and afternoon.

On Friday, November 22, 1974, the day before the meeting itself, the University of Houston will sponsor a Symposium on Pure and Applied Mathematics in Memory of Pasquale Porcelli, formerly Professor of Mathematics at Louisiana State University. This symposium will include an hour talk by J. S. MacNerney of the University of Houston, an hour talk by J. W. Neuberger of Emory University, and two sessions of twenty-minute papers.

REGISTRATION

The registration desk will be located in the lobby of the Continuing Education Center. It will be open from 9:00 a.m. to 4:00 p.m. on Friday and from 8:30 a.m. to 3:30 p.m. on Saturday. The registration fee for the meeting will be $2.

ACCOMMODATIONS

The Continuing Education Center is located on the University of Houston campus in the Conrad Hilton School of Hotel and Restaurant Management. The School maintains an 80 room hotel for guests. Persons wishing to stay at the School hotel should make their own reservations by writing:

University of Houston Hotel
Attention: Reservations Desk
4800 Calhoun
Houston, Texas 77004
Telephone: (713) 741-2447

The Ramada Inn at 3815 Gulf Freeway, (800) 228-2828 (toll free), has reserved a block of rooms for the meeting. It is located at the Cullen exit on the Gulf Freeway (IH45) and is about 6 blocks from the campus.

There are four classes of rates for guest rooms at the Continuing Education Center:

- Standard (60) $14 single, $18 double
- Executive (10) $20 single, $25 double
- Suites (5) $28 single, $32 double
- Presidential Suite $50

There is a $4 charge for each additional person in a double room. Food service is available in the Center's public dining room.

TRAVEL

Persons coming to Houston by air are advised that some lines (Braniff, Texas International, and Southwest, at this writing) have service to Hobby Airport, which is much closer to the campus than Houston International. The University of Houston is located off the Gulf Freeway (IH45) approximately 3 miles South of downtown Houston. The Continuing Education Center is easily found by entering the campus at entrance 1 on Calhoun Street. The Continuing Education Center has underground parking facilities for those attending the meeting.

Paul T. Bateman
Associate Secretary

Urbana, Illinois
SHORT COURSE ON MATHEMATICS IN OPERATIONS RESEARCH, January 21 and 22

On the recommendation of its Committee on Employment and Educational Policy, the American Mathematical Society will present a one and one-half day Short Course on Mathematics in Operations Research on Tuesday and Wednesday, January 21 and 22, in the Palladian Room of the Shoreham Hotel. The course is designed to identify opportunities for mathematicians in operations research, both in employment and in intellectual content; to give substantial introductions to several of the important areas of operations research; and to introduce some of the mathematically challenging aspects of the subject. This short course, which is open to all who wish to participate, will be similar in format to the short courses given at the 1973 summer meeting in Missoula and the annual meeting in San Francisco last January.

The program is under the direction of Dr. Alan J. Goldman, National Bureau of Standards. The members of the AMS Committee on Employment and Educational Policy are Richard D. Anderson (chairman), Michael Artin, Wendell H. Fleming, Calvin C. Moore, Richard S. Palais, and Martha Kathleen Smith.

The program will consist of lectures by the following six distinguished mathematical scientists: Dr. Ralph E. Gomory, Vice President and Director of Research, IBM Corporation, "Stock cutting and its ramifications: Mathematical operations research in industry"; Dr. Carl M. Harris, Program Director, RMC Research Corporation (Professor on leave from George Washington University), "Queueing theory and applications: Some mathematical frontiers"; Professor Frank Proschan, Florida State University, "Mathematical theory of reliability, with applications"; Dr. Gordon Raisbeck, Vice President (and Head of Physical Systems Research), Arthur D. Little, Inc., "Mathematicians in the practice of operations research"; Professor Arthur F. Veinott, Jr., Stanford University, "Lattice programming and inventory theory"; and Dr. Christoph Witzgall, Senior Mathematician, National Bureau of Standards, "Linear programming and flows of networks".

ANNUAL MEETING, January 23—26

The eighty-first annual meeting of the American Mathematical Society will be held at the Shoreham Hotel in Washington, D. C., from Thursday, January 23, through Sunday, January 26, 1975. The meeting will be held in conjunction with the annual meeting of the Association for Symbolic Logic (January 23–24) and the annual meeting of the Mathematical Association of America (January 25–27). The National Council of Teachers of Mathematics will meet jointly with MAA on Saturday and Sunday, January 25 and 26. The Association for Women in Mathematics will hold a session on Friday, January 24, at 10:00 a.m. The Conference Board of the Mathematical Sciences will present a panel discussion on "Aspects of the uses of statistics" at 2:00 p.m. on Saturday, January 25.

Professor Henry L. Alder will retire at the end of January 1975 as Secretary of the Association following fifteen years of service in this position. A luncheon will be held in his honor on Saturday, January 25, at 12:00 noon. Participants planning to attend the luncheon should check the appropriate space on the preregistration and reservation form. Tickets will be on sale in the registration area at the meeting; further details will be announced in a later issue of these Notices.

The AMS Committee on Employment and Educational Policy is planning a panel discussion on Friday evening, January 24, at 8:30 p.m. Professor Martha Kathleen Smith of the University of Texas, Austin, will serve as moderator; the topic to be discussed is "Seeking employment outside academia: Views from some who have recently succeeded." Names of the additional members of the panel will be announced later.

There will be a discussion of public science policy on Saturday, January 25, at 8:30 p.m. This subject and the speakers were selected by a Society committee appointed by the Executive Committee and Board of Trustees. The committee members are R. H. Bing (chairman), Paul Halmos, and A. H. Taub. H. Guyford Stever, Director of Research, IBM Corporation (Professor on leave from George Washington University), "Queueing theory and applications research in industry"; Dr. Carl M. Harris, Program Director, RMC Research Corporation (Professor on leave from George Washington University), "Queueing theory and applications: Some mathematical frontiers"; Professor Frank Proschan, Florida State University, "Mathematical theory of reliability, with applications"; Dr. Gordon Raisbeck, Vice President (and Head of Physical Systems Research), Arthur D. Little, Inc., "Mathematicians in the practice of operations research"; Professor Arthur F. Veinott, Jr., Stanford University, "Lattice programming and inventory theory"; and Dr. Christoph Witzgall, Senior Mathematician, National Bureau of Standards, "Linear programming and flows of networks".

There will be one set of Colloquium Lectures which will consist of four one-hour talks. Professor H. Jerome Keisler of the University of Wisconsin, Madison, will present these lectures; the title of these talks will be "New directions in model theory."

The Josiah Willard Gibbs Lecture will be presented by Professor Fritz John of the Courant Institute of Mathematical Sciences, New York University, on Thursday, January 23, 1975, at 8:30 p.m. in the Regency Ballroom. He will speak on "A priori bounds, geometrical effects and asymptotic behavior."

The Retiring Presidential Address will be given at 2:15 p.m. on Friday, January 24, by Professor Saunders Mac Lane of the University
of Chicago. The title of his lecture will be announced in a later issue of these Notices.

The Frank Nelson Cole Prize in Algebra and the 1974 Steele Prizes will be awarded at a session at 3:15 p.m. on Friday, January 24.

By invitation of the Committee to select Hour Speakers for Annual and Summer Meetings, there will be eight hour addresses. They will be given by Professor Donald W. Anderson, University of California, San Diego; Professor Donald L. Burkholder, University of Illinois, Urbana-Champaign; Professor Sigurdur Helgason, Massachusetts Institute of Technology; Professor Linda Keen, Graduate School and University Center, City University of New York; Professor Haskell P. Rosenthal, University of Illinois, Urbana-Champaign; Professor Rainer Sachs, University of California, Berkeley; Professor Wilfried Schmid, Columbia University; and Professor Nolan R. Wallach, Rutgers University. The titles and times of these lectures can be found in the Summary of Activities which follows this announcement.

There will be no limit on the number of contributed ten-minute papers. Abstracts should be submitted to the American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940, so as to arrive prior to the deadline of November 6, 1974. See page 179 of the June 1974 Notices for new format required for abstracts. No provision will be made for late papers.

SPECIAL SESSIONS

Many special sessions of selected papers of varying lengths will be held. The subjects of these special sessions and the names of the mathematicians arranging them are as follows: Operator Theory, Professor William B. Arveson, University of California, Berkeley; Topological Dynamics, Professors Joseph Auslander and Nelson G. Markley, University of Maryland; Probabilistic Analysis, Professor A. T. Bharucha-Reid, Wayne State University; Set-theoretic and Combinatorial Methods in Topology, Professor W. W. Comfort, Wesleyan University; Hyperbolic Conservation Laws, Professor Constantine M. Dafermos, Brown University; Commutative Algebra, Professor David Eisenbud, Brandeis University; Singular Cauchy Problems, Professor Bernard A. Fusaro, Salisbury State College; Interpolation of Operators and Applications, Professors John E. Gilbert and George G. Lorentz, University of Texas, Austin; Analytic Number Theory, Professor Emil Grosswald, Temple University; Graph Theory, Professor Frank Harary, University of Michigan; Interrelations between Computation and Number Theory, Dr. Morris Newman, National Bureau of Standards; Structure and Representations of Lie Algebras over General Fields, Professor George B. Seligman, Yale University; Fourier Integral Operators, Professor Francois Treves, Rutgers University; and Mathematics and Games, Professor Stanislaw M. Ulam, University of Colorado.

Most of the papers presented at these special sessions will be by invitation but some of the organizers will also consider unsolicited abstracts submitted to the Society. Anyone contributing an abstract for the meeting, who feels that his or her paper would be particularly appropriate for one of these special sessions, should indicate this conspicuously and unambiguously on the abstract and submit it so that it arrives at the Society offices in Providence by October 29, 1974. This earlier deadline is necessary in order to allow time for the additional handling. Papers not selected for special sessions will automatically be considered for the regular program.

COUNCIL AND BUSINESS MEETING

The Council will meet on Wednesday, January 22, at 2:00 p.m. in the Diplomat Room of the Shoreham Hotel. Most of the meeting is open to members of the Society as observers. The agenda will be posted. The Diplomat Room is located on the lower lobby level of the hotel.

The Business Meeting will be held on Friday, January 24, at 4:30 p.m. in the Regency Ballroom of the Shoreham Hotel which is located one level below the Diplomat Room. The Secretary notes the following resolution of the Council. Each person who attends a Business Meeting of the Society shall be willing and able to identify himself as a member of the Society. In further explanation, it is noted that "each person who is to vote at a meeting is thereby identifying himself as and claiming to be a member of the American Mathematical Society."

MEETING PREREGISTRATION AND REGISTRATION

Operations Research short course participants may register at the desk in the upper lobby level which is located directly adjacent to the main lobby of the Shoreham. The desk will be open from 11:00 a.m. to 3:00 p.m. on Tuesday, January 21, and from 8:30 a.m. to 1:00 p.m. on Wednesday, January 22.

The registration desk for the joint meeting will be in the same location. The desk will be open from 2:00 p.m. to 5:00 p.m. on Wednesday, January 22; from 8:00 a.m. to 5:00 p.m. on Thursday, January 23; from 8:00 a.m. to 4:00 p.m. on Friday through Sunday, January 24–26; and from 8:30 a.m. to 2:30 p.m. on Monday, January 27.

Participants who wish to preregister should complete the Meeting Preregistration Form found on the last page of these Notices. Those who preregister will pay a lower registration fee than those who register at the meetings, as indicated in the schedule below. Preregistrants will be able to pick up their badges and programs when they arrive at the meeting. Complete instructions on procedure for making hotel reservations are given in the section entitled ACCOMMODATIONS.

Checks for the preregistration fee should be mailed to arrive in Providence not later than December 20, 1974. It is necessary to complete the Meeting Preregistration Form on the last page of these Notices to take advantage of the lower meeting registration fee even though the services of the housing bureau are not required.
Please note that separate registration is required for the short course and the joint meetings. Registration fees for the meetings are as follows:

<table>
<thead>
<tr>
<th></th>
<th>Preregistration</th>
<th>At meeting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>All participants</td>
<td>$9</td>
<td>$12</td>
</tr>
<tr>
<td>Joint Mathematics Meetings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Member</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Student or unemployed member</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Nonmember</td>
<td>16</td>
<td>20</td>
</tr>
<tr>
<td>One-day fee (Monday, January 27 only)</td>
<td>$4</td>
<td></td>
</tr>
</tbody>
</table>

There will be no extra charge for members of the families of registered participants. The unemployed status refers to any member currently unemployed and actively seeking employment. It is not intended to include members who have voluntarily resigned or retired from their latest position.

Students are considered to be only those currently working toward a degree who do not receive an annual compensation totaling more than $7,000 from employment, fellowships, and scholarships.

A fifty percent refund of the preregistration fee will be reimbursed for all cancellations received prior to January 21. There will be no refunds granted for cancellations received after that date or to persons who do not attend the meetings.

**EMPLOYMENT REGISTER**

The Mathematical Sciences Employment Register will be maintained from 9:00 a.m. to 4:00 p.m. on Friday, January 24, with interviews scheduled from 9:00 a.m. to 5:40 p.m. on Saturday, Sunday, and Monday, January 25–27. The addition of a third day of interviews continues a previously adopted procedure recommended by the Joint Committee on Employment Opportunities in an attempt to expand the interview schedule and to eliminate the necessity for evening interviews. The Register will be located in the Empire Room of the Shoreham Hotel which is adjacent to the lower lobby reception area.

A short meeting of persons planning to participate in the Employment Register has been called by the committee for Thursday, January 23, at 4:30 p.m. in The Forum of the Shoreham Hotel. The purpose of this meeting is to explain Register procedures and the various printed forms which are used. Both applicants and employers are urged to attend the session in order to become familiar with the details in advance. An informal question and answer session will follow the meeting. This orientation session is designed to increase the efficiency of the Register and make it run more smoothly.

**EXHIBITS**

The book and educational media exhibits will be displayed in the Ambassador Room of the Shoreham from Thursday through Sunday, January 23–26. The exhibits will be displayed from noon to 5:00 p.m. on Thursday; from 9:00 a.m. to 5:00 p.m. on Friday, Saturday, and Sunday. All participants are encouraged to visit the exhibits during the meeting. The Ambassador Room is located adjacent to the Regency Ballroom.

**BOOK AND AUDIO TAPES SALE**

Books published by the Society and the Association and audio tapes of invited addresses will be sold for cash prices somewhat below the usual prices when these same books and tapes are sold by mail.

**ACCOMMODATIONS**

Forms for requesting accommodations will be found on the last two pages of these *Notice*. Please note that there are two separate and distinct preregistration forms—one for students and unemployed members who would like to reserve accommodations in a room with triple occupancy and a second form for regular preregistration and reservations.

The use of the housing services offered by the Washington Convention and Visitors Bureau requires preregistration for the meeting. Persons desiring accommodations should complete the appropriate form (or a reasonable facsimile) and send it to the Mathematics Meetings Housing Bureau, P. O. Box 6887, Providence, Rhode Island 02940. Reservations will be made in accordance with preferences indicated on the reservation form, insofar as this is possible, and all reservations will be confirmed. Deposit requirements vary from hotel to hotel, and participants will be informed of any such requirements at the time of confirmation. REQUESTS FOR RESERVATIONS SHOULD BE MAILED TO ARRIVE IN PROVIDENCE NO LATER THAN DECEMBER 20, 1974.

**BARBIZON TERRACE**

- Singles: $16
- Twins: 18
- Extra person in room: 4.50

**BRIGHTON HOTEL**

- Singles: $12
- Doubles or twins: 16
- Suites: 24
- Extra person in room: 4

**SHERATON-PARK**

- Singles: $22, 24, 26, 28, 30
- Doubles or twins: 26, 28, 30, 32, 34
- *Triples*: 27
- Suites: 75 and up
- Extra person in room: 9

*The triples are reserved for students and unemployed members; see special reservation form which may be found on penultimate page of these *Notice* for criteria governing eligibility for these rooms.*
WASHINGTON HILTON

Singles $23, 25, 27
Doubles or twins 28, 30, 32
*Triples 33

WASIDNGTON HILTON

Singles $20, 21, 22, 24, 26, 28
Doubles or twins 26, 27, 28, 30, 32
*Triples 27
Suites 60, 70, 80, 90
Extra person in room 6

YMCA

Singles or twins $ 5.25

N. B. Space is available to accommodate only 35 male and 15 female participants; reservations will be accepted on a first-come-first-served basis. Reservations must be accompanied by a separate check for $5, 25 (made payable to YMCA of Metropolitan Washington), which will cover the first night's lodging, and sent to the Housing Bureau in Providence along with the appropriate preregistration form and fee.

YWCA (Strong Residence)

1011 17th Street, N. W.
Washington, D. C. 20036

Strong Residence (for women only) has limited accommodations. YMCA will not quote rates for 1975 until the latter part of November. Singles are currently $8. Reservations will be taken by mail starting in December; write directly.

TEN TOURIST ATTRACTIONS

(1) The U. S. Capitol, Capitol Hill at east end of the Mall. Visitor hours 9:00 a. m. to 4:30 p. m.; guided tours leave from the upstairs rotunda daily every fifteen minutes from 9:00 a.m. to 3:45 p.m. The tour takes 45 minutes. The charge is 25¢ for adults; children are free.

(2) The White House, 1600 Pennsylvania Avenue, N. W. Visitor hours 10:00 a.m. to noon Tuesday through Saturday.

(3) Jefferson Memorial. South side of Tidal Basin. Visitor hours 8:00 a.m. to midnight.

(4) The Washington Monument. For 10¢ you can ride to the top in one minute. Visitor hours 9:00 a.m. to 5:00 p.m.

(5) The Lincoln Memorial. Open around the clock. Fifteen minute tours are conducted at random daily by National Park service guides.

(6) The John F. Kennedy Center for the Performing Arts. At Rock Creek Park and New Hampshire Avenue. The Center contains an Opera House, Concert Hall, Eisenhower Theater (for live drama), a Film Theater, an Exhibition Hall, and three restaurants. It is worth a sightseeing trip even if you do not attend one of the performances. The building is open for tours from 10:00 a.m. to 5:00 p.m. daily.

(7) National Archives. 7th and 9th Streets, N. W. Open 9:00 a.m. to 10:00 p.m., weekdays and holidays; 1:00 p.m. to 10:00 p.m. on Sundays.

(8) The National Gallery of Art. Offers general tours which convene in the rotunda at 11:00 a.m., 3:00 p.m., and 5:00 p.m. Monday through Saturday, and at 5:00 p.m. on Sunday. Special tours and concerts are also scheduled. The Gallery is open to visitors from 10:00 a.m. to 5:00 p.m. Monday through Saturday, and from 2:00 p.m. to 10:00 p.m. on Sunday.

(9) The Museum of History and Technology. The newest of the Smithsonian buildings, 14th and Constitution on the north side of the Mall, Visitor hours are 9:00 a.m. to 5:00 p.m. daily.

(10) Museum of Arts and Industries. Southside of Mall, Independence at 9th St., S.W. Visitor hours 9:00 a.m. to 5:30 p.m. daily. Apollo 11, Spirit of St. Louis, Wright Brothers plane on display.

Brochures on these and other attractions in the Washington, D.C. area will be available at the Information Desk. It is anticipated that several tours will be organized for registrants at the Mathematics Meetings.

TRAVEL AND LOCAL INFORMATION

The District of Columbia is served by two airports: Washington National (4 miles from city center) and Dulles International (26 miles from city center). Allegheny, American, Braniff, Delta, Eastern, National, Northwest, Piedmont, TWA and United Airlines provide service to Washington National. Several commuter airlines (i.e., Altair, Pennsylvania, etc.) also operate service into National. Transfers are available at variable rates and limousine service at $2. 50 is available from National Airport directly to the hotel.

Dulles International Airport is served by American, Braniff, Delta, Eastern, Northwest,
Ozark, Pan American, Piedmont, Southern, TWA, United, and Viasa Airlines, as well as Colgan Airway, a commuter line. Metered taxi service to the hotel will cost approximately $20, plus fifty cents for each additional passenger. Limousine-bus service for $3.75 is available from Dulles to the Washington Hilton, not quite a mile south of the Shoreham. City buses (Metrobus L2, L4, and L6) run on Connecticut Avenue past the Washington Hilton and the Shoreham.

Amtrak service is available from many points to Union Station. The high-speed Metroliner runs between New York, Philadelphia and Washington. Metrobus numbers 96 and 98 go from Union Station past the Shoreham. The fare anywhere within the city is 40¢ in exact change.

From Exit 20 on the Capitol Beltway (Interstate 495) south to Calvert Street is approximately 8-1/2 miles. The Shoreham is located at 2500 Calvert Street, N. W., near Connecticut Avenue. There is a parking garage within the hotel. The charge is $2.50 for each 24-hour period; there is no extra charge for in/out service. Parking is available in this garage for commuters as well as hotel residents.

WEATHER

Washington weather in January varies from brisk to balmy (10° to 60°) but rarely prevents travel. The average daily high is 44°; the average daily low is 29°; in January there are approximately eleven days with at least .01 inches of rain. Medium to heavy clothing is recommended.

MAIL AND MESSAGE CENTER

All mail and telegrams for persons attending the meetings should be addressed in care of Mathematics Meetings, The Shoreham Hotel & Motor Inn, Calvert Street and Connecticut Avenue, N. W., Washington, D. C. 20008. Mail and telegrams so addressed may be picked up at the Mail and Information Desk located at the registration area in the upper lobby of the hotel.

A message center will be located in the same area to receive incoming calls for all members in attendance. Messages may be left for registrants during the hours the registration desk is open, cf. the section entitled MEETING PREREGISTRATION AND REGISTRATION, above. Messages will be taken down, and the name of any member for whom a message has been received will be posted until the message is picked up at the Message Center. Members are advised to leave the following number with anyone who might want to reach them at the meeting (202) 797-8356.

LOCAL ARRANGEMENTS COMMITTEE

The AMS Committee to Monitor Problems in Communications has recommended that a Summary of Activities appear in the issue of the NOTICES which contains a reservation form for either an annual or a summer meeting. The purpose of this summary is to provide assistance to registrants in the selection of arrival and departure dates. The program, as outlined below, is based on information available at press time.

### American Mathematical Society

**Summary of Activities**

**TUESDAY, January 21**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:00 a.m.</td>
<td>Registration</td>
</tr>
<tr>
<td>1:45 p.m.</td>
<td>Introductory remarks</td>
</tr>
<tr>
<td></td>
<td>Alan J. Goldman</td>
</tr>
<tr>
<td>2:00 p.m.</td>
<td>Mathematicians in the practice of operations research</td>
</tr>
<tr>
<td></td>
<td>Gordon Raisbeck</td>
</tr>
<tr>
<td>3:45 p.m.</td>
<td>Linear programming and flows in networks</td>
</tr>
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<td></td>
<td>Christoph Witzgall</td>
</tr>
</tbody>
</table>

**WEDNESDAY, January 22**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30 a.m.</td>
<td>Registration</td>
</tr>
<tr>
<td>9:00 a.m.</td>
<td>Stock cutting and its ramifications: Mathematical</td>
</tr>
<tr>
<td></td>
<td>operations research in industry</td>
</tr>
<tr>
<td></td>
<td>Ralph E. Gomory</td>
</tr>
<tr>
<td>10:45 a.m.</td>
<td>Mathematical theory of reliability, with applications</td>
</tr>
<tr>
<td></td>
<td>Frank Proschan</td>
</tr>
<tr>
<td>2:00 p.m.</td>
<td>Lattice programming and inventory theory</td>
</tr>
<tr>
<td></td>
<td>Arthur F. Veinott, Jr.</td>
</tr>
<tr>
<td>3:45 p.m.</td>
<td>Queueing theory and applications: Some mathematical</td>
</tr>
<tr>
<td></td>
<td>frontiers</td>
</tr>
<tr>
<td></td>
<td>Carl M. Harris</td>
</tr>
</tbody>
</table>

### AMS - MAA Annual Meetings

<table>
<thead>
<tr>
<th>American Mathematical Society</th>
<th>Other Organizations</th>
</tr>
</thead>
</table>

**WEDNESDAY, January 22**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:00 p.m.</td>
<td>AMS Council Meeting</td>
</tr>
<tr>
<td>2:00 p.m.</td>
<td>Registration</td>
</tr>
<tr>
<td>8:00 a.m.</td>
<td>Registration</td>
</tr>
<tr>
<td>9:00 a.m.</td>
<td>INVITED ADDRESS (title tentative)</td>
</tr>
<tr>
<td></td>
<td>Sigurdur Helgason</td>
</tr>
<tr>
<td>9:00 a.m.</td>
<td>Sessions of Contributed Papers and Special Sessions</td>
</tr>
<tr>
<td>9:00 a.m.</td>
<td>Association for Symbolic Logic Sessions</td>
</tr>
<tr>
<td>10:15 a.m.</td>
<td>INVITED ADDRESS (title tentative)</td>
</tr>
<tr>
<td></td>
<td>Wilfried Schmid</td>
</tr>
<tr>
<td>12:00 noon</td>
<td>EXHIBITS</td>
</tr>
<tr>
<td>1:00 p.m.</td>
<td>COLLOQUIUM LECTURE I</td>
</tr>
<tr>
<td></td>
<td>New directions in model theory</td>
</tr>
<tr>
<td></td>
<td>H. Jerome Keisler</td>
</tr>
<tr>
<td>1:00 p.m.</td>
<td>Sessions of Contributed Papers and Special Sessions</td>
</tr>
<tr>
<td>1:30 p.m.</td>
<td>ASL Sessions</td>
</tr>
<tr>
<td>2:15 p.m.</td>
<td>INVITED ADDRESS</td>
</tr>
<tr>
<td></td>
<td>Riemann surfaces and the moduli problem</td>
</tr>
<tr>
<td></td>
<td>Linda Keen</td>
</tr>
<tr>
<td>2:45 p.m.</td>
<td>Mathematicians Action Group Business Meeting</td>
</tr>
<tr>
<td>3:30 p.m.</td>
<td>INVITED ADDRESS (title tentative)</td>
</tr>
<tr>
<td></td>
<td>Haskell P. Rosenthal</td>
</tr>
<tr>
<td>Time</td>
<td>Event</td>
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<td>--------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>THURSDAY, January 23</td>
<td></td>
</tr>
<tr>
<td>4:30 p.m.</td>
<td>Open Register orientation session</td>
</tr>
<tr>
<td>8:30 p.m.</td>
<td>JOSIAH WILLARD GIBBS LECTURE</td>
</tr>
<tr>
<td></td>
<td>A priori bounds, geometrical effects, and asymptotic behavior</td>
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<td></td>
<td>Fritz John</td>
</tr>
<tr>
<td>FRIDAY, January 24</td>
<td></td>
</tr>
<tr>
<td>8:00 a.m. - 4:00 p.m.</td>
<td>REGISTRATION</td>
</tr>
<tr>
<td>9:00 a.m. - 10:00 a.m.</td>
<td>INVITED ADDRESS</td>
</tr>
<tr>
<td></td>
<td>A survey of current non-quantum general</td>
</tr>
<tr>
<td></td>
<td>relativity (title tentative)</td>
</tr>
<tr>
<td></td>
<td>Rainer K. Sachs</td>
</tr>
<tr>
<td>9:00 a.m. - 11:30 a.m.</td>
<td>Sessions of Contributed Papers</td>
</tr>
<tr>
<td></td>
<td>and Special Sessions</td>
</tr>
<tr>
<td>9:00 a.m. - 12:00 noon</td>
<td>EMPLOYMENT REGISTER</td>
</tr>
<tr>
<td>9:00 a.m. - 4:00 p.m.</td>
<td>Mathematical Association of America</td>
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<tr>
<td></td>
<td>Board of Governors Meeting</td>
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<tr>
<td>10:15 a.m. - 11:15 a.m.</td>
<td>INVITED ADDRESS</td>
</tr>
<tr>
<td></td>
<td>A representation theoretic proof of a</td>
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<td></td>
<td>formula of Max Noether</td>
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<tr>
<td></td>
<td>Nolan R. Wallach</td>
</tr>
<tr>
<td>1:00 p.m. - 2:00 p.m.</td>
<td>COLLOQUIUM LECTURE II</td>
</tr>
<tr>
<td></td>
<td>New directions in model theory</td>
</tr>
<tr>
<td></td>
<td>H. Jerome Keisler</td>
</tr>
<tr>
<td>1:30 p.m. - 5:00 p.m.</td>
<td>Retiring Presidential Address</td>
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<td></td>
<td>Title to be announced</td>
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<tr>
<td></td>
<td>Saunders Mac Lane</td>
</tr>
<tr>
<td>3:15 p.m. - 4:30 p.m.</td>
<td>Cole Prize Session</td>
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<tr>
<td></td>
<td>Steele Prize Session</td>
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<tr>
<td>4:30 p.m.</td>
<td>AMS Business Meeting</td>
</tr>
<tr>
<td>7:30 p.m.</td>
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<tr>
<td>7:30 p.m. - 9:00 p.m.</td>
<td>MAA - Film Program</td>
</tr>
<tr>
<td></td>
<td>Panel discussion: Computer oriented supplements to the undergraduate</td>
</tr>
<tr>
<td></td>
<td>mathematics curriculum</td>
</tr>
<tr>
<td></td>
<td>(Report of an N. S. F. workshop group)</td>
</tr>
<tr>
<td></td>
<td>Richard Alo</td>
</tr>
<tr>
<td></td>
<td>Lyle Mauland</td>
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<tr>
<td></td>
<td>Neal Harbertson</td>
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<tr>
<td></td>
<td>Joseph Mayne</td>
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<tr>
<td></td>
<td>Carl Lelbach</td>
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<td></td>
<td>Harold Weinstock</td>
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<tr>
<td></td>
<td>J. C. Mathews</td>
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<tr>
<td>9:00 a.m.</td>
<td></td>
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<tr>
<td>9:00 a.m.</td>
<td>MAA Joint Sessions with National Council of Teachers of Mathematics</td>
</tr>
<tr>
<td></td>
<td>Personalized systems of instruction</td>
</tr>
<tr>
<td></td>
<td>B. A. Green, Jr.</td>
</tr>
<tr>
<td>10:15 a.m. - 10:45 a.m.</td>
<td>The first U. S. participation in the International Mathematical</td>
</tr>
<tr>
<td></td>
<td>Olympiad</td>
</tr>
<tr>
<td></td>
<td>S. L. Greitzer</td>
</tr>
<tr>
<td>11:00 a.m. - 11:50 a.m.</td>
<td>What is an automorphic form?</td>
</tr>
<tr>
<td></td>
<td>L. J. Goldstein</td>
</tr>
<tr>
<td>SATURDAY, January 25</td>
<td></td>
</tr>
<tr>
<td>8:00 a.m. - 4:00 p.m.</td>
<td>REGISTRATION</td>
</tr>
<tr>
<td>9:00 a.m. - 5:00 p.m.</td>
<td>EXHIBITS</td>
</tr>
<tr>
<td>9:00 a.m. - 5:40 p.m.</td>
<td>EMPLOYMENT REGISTER</td>
</tr>
<tr>
<td>9:00 a.m.</td>
<td></td>
</tr>
<tr>
<td>9:00 a.m. - 10:00 a.m.</td>
<td>MAA Joint Sessions with National Council of Teachers of Mathematics</td>
</tr>
<tr>
<td>10:15 a.m. - 10:45 a.m.</td>
<td>The first U. S. participation in the International Mathematical</td>
</tr>
<tr>
<td></td>
<td>Olympiad</td>
</tr>
<tr>
<td>11:00 a.m. - 11:50 a.m.</td>
<td>What is an automorphic form?</td>
</tr>
<tr>
<td></td>
<td>L. J. Goldstein</td>
</tr>
<tr>
<td>12:00 noon</td>
<td></td>
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<tr>
<td></td>
<td>LUNCHEON - Honoring Henry L. Alder</td>
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</tbody>
</table>

248
<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Speaker(s)</th>
</tr>
</thead>
</table>
| 1:00 - 2:00 p.m. | COLLOQUIUM LECTURE III  
New directions in model theory  
H. Jerome Keisler |                                                                     |
| 1:00 - 6:00 p.m. | Sessions of Contributed Papers and Special Sessions |                                                                     |
| 2:15 - 3:15 p.m. | INVITED ADDRESS  
Applications of homological algebra to topology  
Donald W. Anderson |                                                                     |
| 2:00 - 4:00 p.m. | Conference Board of the Mathematical Sciences  
Panel discussion: Aspects of the uses of statistics  
Joan R. Rosenblatt (moderator) |                                                                     |
| 5:00 - 6:30 p.m. | NO-HOST COCKTAIL PARTY |                                                                     |
| 8:30 p.m. | AMS Panel  
Public science policy  
H. Guyford Stever |                                                                     |
| 8:00 - 4:00 p.m. | REGISTRATION  
EXHIBITS  
EMPLOYMENT REGISTER |                                                                     |
| 9:00 - 5:40 a.m. | MAA-NCTM - Joint Session  
Panel discussion: Teaching mathematics to the beginning undergraduate  
C. A. Lathan  
M. H. Protter  
Andrew Sterrett, Jr.  
Benjamin Volker  
A. B. Wilcox (moderator) |                                                                     |
| 10:00 a.m. - 11:00 a.m. | MAA Business Meeting  
MAA-NCTM - Joint Session |                                                                     |
| 11:10 a.m. | The Open University in Great Britain - a progress report  
R. J. Wilson |                                                                     |
| 11:10 a.m. - 12:00 noon | |                                                                     |
| 1:00 - 2:00 p.m. | COLLOQUIUM LECTURE IV  
New directions in model theory  
H. Jerome Keisler |                                                                     |
| 1:00 - 6:00 p.m. | Sessions of Contributed Papers and Special Sessions |                                                                     |
| 1:30 p.m. | National Association of Mathematicians  
Panel discussion: Open admissions and the mathematics curriculum  
Theodore Sykes (moderator) |                                                                     |
| 2:00 - 6:00 p.m. | CBMS - Council Meeting |                                                                     |
| 2:15 - 3:15 p.m. | INVITED ADDRESS  
Martingale methods in analysis  
Donald L. Burkholder |                                                                     |
| 7:30 - 10:30 p.m. | CBMS - Council Meeting |                                                                     |
| 8:30 a.m. - 2:30 p.m. | REGISTRATION  
EMPLOYMENT REGISTER |                                                                     |
| 9:00 a.m. - 5:40 p.m. | Sessions of the MAA  
The challenges to a discipline in an era of interdisciplinary emphasis  
L. J. Paige |                                                                     |
| 9:00 a.m. - 9:50 a.m. | The National Institute of Education  
J. M. Mays |                                                                     |
| 10:00 a.m. - 10:50 a.m. | Ordering of fields and prime ideals of Witt rings  
Alex Rosenberg |                                                                     |
SUMMARY OF ACTIVITIES

American Mathematical Society | Other Organizations

MONDAY, January 27

1:30 p.m. | Sessions of the MAA
1:30 p.m. - 2:20 p.m. | On measuring things, Eudoxus revisited
                        | A. M. Gleason
2:30 p.m. - 3:20 p.m. | The early days of probability theory:
                        | reminiscences and reflections
                        | Mark Kac
3:30 p.m. - 4:20 p.m. | Intuitive geometry is alive and well
                        | Branko Grunbaum

Middletown, Connecticut

Walter H. Gottschalk
Associate Secretary

CHAIRMEN AND TOPICS OF SPECIAL SESSIONS

Abstracts of contributed papers to be considered for possible inclusion in special sessions should be submitted to Providence by the deadlines given below and should be clearly marked "For consideration for special session on (title of special session)." Those papers not selected for special sessions will automatically be considered for regular sessions unless the author gives specific instructions to the contrary.

Houston, Texas, November 1974 | September 3, 1974
E. Ward Cheney, Approximation Theory
Richard D. Sinkhorn, Matrix Theory

Los Angeles, California, November 1974 | September 10, 1974
William A. Harris, Jr., Analytic Theory of Ordinary Differential Equations

Nashville, Tennessee, November 1974 | September 10, 1974
J. V. Brawley, Combinatorial Theory
Robert M. McConnel, Number Theory
Richard S. Varga, Approximation Theory

Washington, D.C., January 1975 | October 29, 1974
William B. Arveson, Operator Theory
Joseph Auslander and Nelson G. Markley, Topological Dynamics
A. T. Bharucha-Reid, Probabilistic Analysis
W. Wistar Comfort, Set-theoretic and Combinatorial Methods in Topology
Constantine M. Dafermos, Hyperbolic Conservation Laws
David Eisenbud, Commutative Algebra
Bernard A. Fusaro, Singular Cauchy Problems
John E. Gilbert and George G. Lorentz, Interpolation of Operators and Applications
Emil Grosswald, Analytic Number Theory
Frank Harary, Graph Theory
Morris Newman, Interrelations between Computation and Number Theory
George B. Seligman, Structure and Representations of Lie Algebras over General Fields
Francois Treves, Fourier Integral Operators
Stanislaw M. Ulam, Mathematics and Games

250
Symposium on Some Mathematical Questions in Biology
New York, New York
January 29—30, 1975

The ninth annual symposium on Some Mathematical Questions in Biology will be held for one and one-half days on January 29-30, 1975, in the LaLoire Room 2 and 3 of the Americana Hotel in New York City. The symposium is being held in conjunction with the annual meeting of the American Association for the Advancement of Science. It will be cosponsored by the American Mathematical Society and the Society for Industrial and Applied Mathematics. The support of the National Science Foundation is anticipated. Registration and local arrangements will be announced in Science.

The program has been arranged by the AMS-SIAM Committee on Mathematics in the Life Sciences, whose members are Hans J. Bremermann, Jack D. Cowan, Murray Gerstenhaber, Alston S. Householder, Simon Levin (chairman), and Richard C. Lewontin.

The symposium will be divided into three half-day sessions; the main topics of the symposium will be ecology and evolutionary biology and neurobiology. There will be six forty-minute lectures presented in two sessions by the following: Horace B. Barlow, "Is neurobiology totally unmathematical?", Trinity College, Cambridge, England; Brian Charlesworth, "Natural selection in age-structured populations," University of Sussex, England; Hirsch G. Cohen, "Mathematical developments in Hodgkin-Huxley theory and its approximation," T. J. Watson Research Center, IBM; Simon A. Levin, "Spatial heterogeneity in ecological systems," Cornell University; George F. Oster, "Dynamics of age-structured populations," University of California, Berkeley; John Rinzel, "Simple model equations for active nerve conduction and passive neuronal integration," National Institute of Health.

The third session will be devoted to twenty-minute short papers selected and refereed in advance by the committee. Persons wishing to present a paper for consideration by the committee should submit an abstract, on a standard AMS abstract form, to the American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940. Abstracts should be mailed so as to arrive prior to the deadline of November 6, 1974. See page 179 of the June 1974 Notices for the new format required for abstracts. All abstracts should be clearly marked "For presentation at Symposium on Some Mathematical Questions in Biology." There will be no provision for late papers. A complete program of the sessions will be included in the January 1975 issue of these Notices.

Simon A. Levin, Chairman
Organizing Committee
Ninth Annual AMS-SIAM Symposium on Some Mathematical Questions in Biology

Symposium on Theory vs. Practice in the Finite Element Method
New York, New York
January 31, 1975

A symposium on Theory vs. Practice in the Finite Element Method will be held on the morning of January 31, 1975, at the Americana Hotel in New York City, in conjunction with the annual meeting of the American Association for the Advancement of Science. The symposium will be sponsored by the American Mathematical Society. The support of the Air Force Office of Scientific Research is anticipated. Registration and local arrangements will be announced in Science.

The program is being arranged by Professors Ridgway Scott and Gilbert Strang (co-chairmen). In addition to lectures by Professors Scott and Strang, the other speakers will be Todd Dupont (The University of Chicago); Robert Nickell (Sandia Corporation); and Robert Taylor (University of California, Berkeley). Professors Dupont, Scott, and Strang will discuss the mathematical aspects of the subject while Dr. Nickell and Professor Taylor will discuss the engineering aspects of the subject. The titles of their addresses will appear in a subsequent issue of these Notices.

Ridgway Scott and
Gilbert Strang
Chairmen, Organizing Committee

Ithaca, New York
The Society held its eighth summer seminar in Applied Mathematics on Inverse Problems at the University of California, Los Angeles, California, from August 5 to August 16, 1974. The topic for the seminar was selected by the AMS-SIAM Committee on Applied Mathematics which at the time was composed of Earl A. Coddington, Hirsh G. Cohen (chairman), Lester E. Dubins, Harold Grad, J. Barkley Rosser, and Richard S. Varga. The Organizing Committee for the seminar consisted of Victor Barcilon and Julian D. Cole (co-chairmen), Michael Crandall, Nathaniel Grossman, F. Gilbert, Leon Knopoff, R. G. Newton, and James Ralston. The program for the seminar consisted of twelve series of major lectures. The lectures and their subjects follow.

Victor Barcilon, Iterative solution of inverse eigenvalue problems and Analytic solution of inverse problem of radiative transfer.

Kenneth Case, Orthogonal polynomials from the viewpoint of scattering theory.

Moustafa Chahine, Inverse solution of the nonlinear radiative transfer equation.

Freeman Gilbert, Inverse normal modes problem in seismology.

Ole Hald, Computational methods for inverse eigenvalue problems for matrices: existence and uniqueness of solutions; Computational methods for the inverse eigenvalue problem for the vibrating string and the composite pendulum and Computational methods for the inverse Sturm-Liouville problem.

Harry Hochstadt, Inverse problems associated with second order difference equations; Inverse problems for Hill’s equation and Inverse problems for Sturm–Liouville operators.

Mark Kac, The shape of the drum revisited; The Gelfand-Levitan method from the probabilistic point of view; Be wise discretize and Some isospectral problems.

Lewis D. Kaplan, The information content of atmospheric emission spectra.

Roger Newton, The three-dimensional inverse scattering problem in quantum mechanics.

Robert Parker, Inverse problems of gravity in geophysics and Inverse theory with grossly inadequate data.

Pierre Sabatier, Construction of the elastic scattering amplitude from the cross-section; Construction of potentials from elastic scattering amplitudes and Construction of potential from cross-sections by approximate methods.

Kennan Smith, Interplay between mathematics and practice in the reconstruction of object from radio graph.


A total of sixty-five mathematicians and scientists attended the seminar; including five participants from foreign countries. The National Science Foundation and the Office of Naval Research provided financial support to the seminar. There will be no published proceedings of this seminar.
The twenty-first summer research institute on Algebraic Geometry, sponsored by the Society, was held from July 29 to August 16, 1974, on the campus of Humboldt State University, Arcata, California. The topic for the institute was proposed by members of the Committee on Summer Institutes which, at the time, consisted of Louis Auslander, Richard E. Bellman, William Browder (chairman), Louis Nirenberg, Walter Rudin, and John T. Tate. The Organizing Committee, with David Mumford as chairman, consisted of Michael Artin, Phillip A. Griffiths, Robin Hartshorne, Heisuke Hironaka, and Nicholas Katz.

The scientific program of the institute consisted of ten series of lectures. The speakers and the titles of their talks were: Egbert Brieskorn, "Special singularities—resolution, deformation, and monodromy"; Maurizio Cornalba and Phillip Griffiths, "Some transcendental aspects of algebraic geometry"; Pierre Deligne, "Inputs of étale cohomology"; David Eisenbud, "Serre problem and homological methods in commutative algebra"; Robin Hartshorne, "Equivalence relations on algebraic cycles, and subvarieties of small codimension"; Heisuke Hironaka, "Triangulation of algebraic sets"; Joseph Lipman, "Introduction to resolution of singularities"; Barry Mazur, "Eigenvalues of Frobenius acting on algebraic varieties over finite fields"; Jean-Pierre Serre, "Problems on 1-adic representations"; and C.S. Seshadri, "Theory of moduli".

In addition, there were 15 seminars. The topics of these seminars were proof of the Weil conjectures and the hard Lefschetz theorem, varieties of low codimension, classification questions and special varieties, topics in analytic algebraic geometry, toroidal embeddings, deRham and crystalline cohomology, singularities—equisingularity, recent work on compactification of moduli, arithmetic, K-theory, special examples of intermediate Jacobians, etc., algebraic groups, Weierstrass points, complex manifolds, and deformation of complex analytic spaces.

A total of two hundred seventy mathematicians registered for the institute, of which forty-nine were accompanied by their families; eighty-four participants were from foreign countries.

The National Science Foundation provided financial support to the institute. During the coming year the proceedings will be published by the Society as one of the series of Proceedings of Symposia in Pure Mathematics.

INVITED SPEAKERS AT AMS MEETINGS

This section of these Notices lists regularly the individuals who have agreed to address the Society at the times and places listed below. For some future meetings, the lists of speakers are incomplete.

Houston, Texas, November 1974
Seymour V. Parter
William A. Veech

Los Angeles, California, November 1974
C. Edmund Burgess
Paul R. Chernoff

Nashville, Tennessee, November 1974
Trevor Evans
R. B. Gardner
J. R. Retherford

Washington, D.C., January 1975
Donald W. Anderson
Donald L. Burkholder
Sigurdur Helgason
Fritz John (Gibbs Lecturer)
Linda Keen
H. Jerome Keisler (Colloquium Lecturer)
Haskell P. Rosenthal
Rainer K. Sachs
Wilfried Schmid
Nolan Wallach
DOCTORATES IN MATHEMATICS AND RELATED AREAS
JULY 1967 – JUNE 1973

The following table was prepared on behalf of the Committee on Employment and Educational Policy. It shows data from the last six annual Summary Reports, Doctorate Recipients from United States Universities, issued by the National Research Council.

The classification is by the doctorate recipients themselves from forms prepared at the time of their graduation. It is believed to be essentially complete, giving data in somewhat different form than that collected by the AMS from department chairmen. The 1973 report for doctorates earned from July 1, 1972, to June 30, 1973, was issued recently. A substantial, but not yet complete, list of the 1974 doctorates is given elsewhere in these Notices. Note the rather substantial recent drop in the number of pure mathematics degrees (classified here as items A, B, C, D, E, G, and K) and the steady overall growth in degrees in applied areas, particularly computing theory and practice.

Current AMS figures indicate a probable further drop of about sixty pure mathematics degrees for fiscal 1974 and a probable increase in degrees in applied areas. In light of the academic job market, such a drop in pure mathematics degrees should be welcomed. If the pattern of reduction continues for several more years, we may reach a point of relative balance of supply and demand. Information on 1974 employment phenomena will be published in the November Notices.

Finally, figures for numbers of degrees in areas closely related to the mathematical sciences are also given for 1967–1973. The oscillations in statistics and mathematical statistics degree totals may be due to variations in classification.

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Algebra</td>
<td>145</td>
<td>181</td>
<td>190</td>
<td>200</td>
<td>167</td>
<td>141</td>
</tr>
<tr>
<td>B. Analysis</td>
<td>246</td>
<td>266</td>
<td>244</td>
<td>262</td>
<td>241</td>
<td>244</td>
</tr>
<tr>
<td>C. Geometry</td>
<td>31</td>
<td>25</td>
<td>39</td>
<td>35</td>
<td>35</td>
<td>32</td>
</tr>
<tr>
<td>D. Logic</td>
<td>30</td>
<td>28</td>
<td>37</td>
<td>31</td>
<td>39</td>
<td>33</td>
</tr>
<tr>
<td>E. Number Theory</td>
<td>20</td>
<td>24</td>
<td>27</td>
<td>33</td>
<td>36</td>
<td>31</td>
</tr>
<tr>
<td>F. Probability, Mathematical Statistics</td>
<td>132</td>
<td>49</td>
<td>82</td>
<td>91</td>
<td>151</td>
<td>156</td>
</tr>
<tr>
<td>G. Topology</td>
<td>105</td>
<td>108</td>
<td>143</td>
<td>120</td>
<td>130</td>
<td>111</td>
</tr>
<tr>
<td>H. Computing Theory and Practice</td>
<td>51</td>
<td>79</td>
<td>118</td>
<td>139</td>
<td>163</td>
<td>221</td>
</tr>
<tr>
<td>I. Operations Research</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J. Applied Mathematics</td>
<td>131</td>
<td>127</td>
<td>147</td>
<td>122</td>
<td>119</td>
<td>119</td>
</tr>
<tr>
<td>K. Mathematics, General</td>
<td>51</td>
<td>86</td>
<td>94</td>
<td>108</td>
<td>112</td>
<td>90</td>
</tr>
<tr>
<td>L. Mathematics, Other</td>
<td>28</td>
<td>90</td>
<td>96</td>
<td>95</td>
<td>88</td>
<td>41</td>
</tr>
<tr>
<td>Total Pure (A, B, C, D, E, G, K)</td>
<td>628</td>
<td>718</td>
<td>774</td>
<td>789</td>
<td>760</td>
<td>682</td>
</tr>
<tr>
<td>Total Other (F, H, I, J, L, M)</td>
<td>342</td>
<td>345</td>
<td>444</td>
<td>447</td>
<td>521</td>
<td>540</td>
</tr>
</tbody>
</table>

| Education       |       |       |       |       |       |       |
| Mathematics Education | 95  | 111   | 128   | 131   | 152   | 134   |

| Engineering     |       |       |       |       |       |       |
| Engineering Mechanics | 227 | 238   | 235   | 215   | 209   | 176   |
| Operations Research | 62  |       |       |       |       |       |

| Life Sciences   |       |       |       |       |       |       |
| Biometrics and Biostatistics | 23  | 18    | 37    | 42    | 30    | 34    |

| Social Sciences |       |       |       |       |       |       |
| Econometrics    | 30    | 20    | 27    | 27    | 32    | 31    |
| Statistics      | 19    | 96    | 121   | 133   | 85    | 62    |
EIGHTEENTH ANNUAL AMS SURVEY

This Survey is the eighteenth in an annual series begun in 1957 by the Society's Committee on the Economic Status of Teachers. The present Survey is under the direction of the Committee on Employment and Educational Policy.

As has been the practice for several years, questionnaires were sent to departments in the mathematical sciences, asking for information on salaries. The two-year colleges were sent a form which allowed them to report salaries without regard to academic rank, because many of the junior colleges do not rank their teaching staffs. For the reports on salaries, the departments are divided into groups according to the highest degree offered in the mathematical sciences.

The Doctorate granting departments are in six groups as follows:

Group I and Group II include the leading departments of mathematics according to the findings of the American Council of Education in 1969* in which departments were ranked according to the quality of their graduate faculty. Group I is composed of the 27 departments ranked highest; Group II is made up of the other 38 leading departments listed in that report.

Group III contains all other U.S. departments of mathematics.

Group IV includes departments of statistics, biostatistics and biometrics.

Group V includes all other departments in the mathematics sciences.

Group VI consists of all departments in the mathematical sciences from Canadian universities.

The total number of departments in the mathematical sciences in the various groups are given below. Only doctorate granting Canadian departments are grouped separately, the two-year colleges and those granting bachelor and master degrees are included with U. S. departments.

<table>
<thead>
<tr>
<th>Type of Department</th>
<th>Number of Departments Responding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doctorate Granting</td>
<td></td>
</tr>
<tr>
<td>Group I</td>
<td>27</td>
</tr>
<tr>
<td>Group II</td>
<td>38</td>
</tr>
<tr>
<td>Group III</td>
<td>91</td>
</tr>
<tr>
<td>Group IV</td>
<td>65</td>
</tr>
<tr>
<td>Group V</td>
<td>106</td>
</tr>
<tr>
<td>Group VI</td>
<td>30</td>
</tr>
<tr>
<td>Total Doctorate Granting</td>
<td>357</td>
</tr>
<tr>
<td>Master Degree Granting</td>
<td>325</td>
</tr>
<tr>
<td>Bachelor Degree Granting</td>
<td>1014</td>
</tr>
<tr>
<td>Two-Year Colleges</td>
<td>855</td>
</tr>
<tr>
<td>Total, All Departments</td>
<td>2551</td>
</tr>
</tbody>
</table>

Faculty Salaries

Departments submitted a minimum, median, and maximum salary figure for each of four academic ranks, both for staff members with and without doctorates, creating forty-eight categories of salary figures. In some categories, relatively few departments reported and, inasmuch as there were no significant figures available, salaries are not listed.

The 1974 Survey is based on returns from 791 departments in the mathematical sciences. The number of faculty positions in these departments are reported in the following table. The numbers are slightly higher than would be found by adding positions from the following three pages because all faculty positions are included in the figures including categories which had too few returns to be used in the salary compilation, for example, two doctoral granting Group I departments which had instructors without a doctorate.

NUMBER OF FACULTY POSITIONS IN DEPARTMENTS SUBMITTING USABLE RETURNS 1973-1974 1974-1975

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Doctorate, Master and Bachelor</td>
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</tr>
<tr>
<td>Granting Departments</td>
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</tr>
<tr>
<td>Total Faculty</td>
<td>9,484</td>
<td>9,275</td>
</tr>
<tr>
<td>With Tenure</td>
<td>5,729</td>
<td>6,000</td>
</tr>
<tr>
<td>Women</td>
<td>867</td>
<td>838</td>
</tr>
<tr>
<td>With Tenure</td>
<td>452</td>
<td>452</td>
</tr>
<tr>
<td>Two-Year Colleges</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Faculty</td>
<td>1,418</td>
<td>1,439</td>
</tr>
<tr>
<td>With Tenure</td>
<td>880</td>
<td>920</td>
</tr>
<tr>
<td>Women</td>
<td>264</td>
<td>266</td>
</tr>
<tr>
<td>With Tenure</td>
<td>125</td>
<td>133</td>
</tr>
</tbody>
</table>

*The findings were published in "A Rating of Graduate Programs" by Kenneth D. Roose and Charles J. Anderson, American Council of Education, Washington, D. C., 1969, 115 pp. The information on mathematics was reprinted by the Society and can be found on pages 338-340 of the February 1971 issue of these Notices.
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<td>Total Tenure</td>
<td>Total Tenure</td>
<td>Total Tenure</td>
<td>Total Tenure</td>
</tr>
<tr>
<td><strong>DOCTORATE GRANTING DEPARTMENTS. Group I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WITH DOCTORATE</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td>66</td>
<td>0</td>
<td>61</td>
<td>0</td>
</tr>
<tr>
<td>Asst. Prof.</td>
<td>169</td>
<td>3</td>
<td>169</td>
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<tr>
<td>Asso. Prof.</td>
<td>195</td>
<td>177</td>
<td>182</td>
<td>168</td>
</tr>
<tr>
<td>Professor</td>
<td>406</td>
<td>406</td>
<td>413</td>
<td>413</td>
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<tr>
<td><strong>Total</strong></td>
<td>836</td>
<td>536</td>
<td>825</td>
<td>553</td>
</tr>
<tr>
<td><strong>DOCTORATE GRANTING DEPARTMENTS. Group II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WITHOUT DOCTORATE</td>
<td>31</td>
<td>7</td>
<td>25</td>
<td>7</td>
</tr>
<tr>
<td>WITH DOCTORATE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td>31</td>
<td>0</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Asst. Prof.</td>
<td>320</td>
<td>16</td>
<td>292</td>
<td>18</td>
</tr>
<tr>
<td>Asso. Prof.</td>
<td>303</td>
<td>262</td>
<td>308</td>
<td>293</td>
</tr>
<tr>
<td>Professor</td>
<td>345</td>
<td>342</td>
<td>357</td>
<td>355</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>999</td>
<td>620</td>
<td>987</td>
<td>666</td>
</tr>
<tr>
<td><strong>DOCTORATE GRANTING DEPARTMENTS. Group III</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WITHOUT DOCTORATE</td>
<td>58</td>
<td>22</td>
<td>65</td>
<td>15</td>
</tr>
<tr>
<td>WITH DOCTORATE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td>19</td>
<td>15</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Asst. Prof.</td>
<td>54</td>
<td>54</td>
<td>54</td>
<td>52</td>
</tr>
<tr>
<td>Asso. Prof.</td>
<td>19</td>
<td>19</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Professor</td>
<td>229</td>
<td>229</td>
<td>216</td>
<td>216</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>441</td>
<td>397</td>
<td>438</td>
<td>438</td>
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</tbody>
</table>

### SALARIES

(in hundreds of dollars)

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
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<tr>
<td>Instructor</td>
<td>40(84-115)</td>
<td>110(115-122)</td>
</tr>
<tr>
<td>Asst. Prof.</td>
<td>110(115-125)</td>
<td>110(115-125)</td>
</tr>
<tr>
<td>Asso. Prof.</td>
<td>132(137-155)</td>
<td>132(137-155)</td>
</tr>
<tr>
<td>Professor</td>
<td>160(179-207)</td>
<td>170(182-219)</td>
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<td>80(84-129)</td>
<td>90(92-140)</td>
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<tr>
<td>Instructor</td>
<td>70(84-125)</td>
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<tr>
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<td>98(113-120)</td>
<td>100(117-127)</td>
</tr>
<tr>
<td>Asso. Prof.</td>
<td>110(137-152)</td>
<td>110(144-156)</td>
</tr>
<tr>
<td>Professor</td>
<td>140(171-200)</td>
<td>140(177-209)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>398</td>
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</tr>
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<td>67(84-115)</td>
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<tr>
<td>WITH DOCTORATE</td>
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</tr>
<tr>
<td>Instructor</td>
<td>91(109-132)</td>
<td>93(109-137)</td>
</tr>
<tr>
<td>Asst. Prof.</td>
<td>122(135-161)</td>
<td>122(135-161)</td>
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<tr>
<td>Asso. Prof.</td>
<td>132(143-167)</td>
<td>132(143-167)</td>
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<tr>
<td>Professor</td>
<td>147(170-194)</td>
<td>147(170-194)</td>
</tr>
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<td><strong>Total</strong></td>
<td>412</td>
<td>413</td>
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</table>

Number of usable Returns:
- Group I: 17
- Group II: 26
- Group III: 58
DOCTORATE GRANTING DEPARTMENTS. Group IV

<table>
<thead>
<tr>
<th>Category</th>
<th>Without Doctorate</th>
<th>With Doctorate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructor</td>
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<tr>
<td>Asst. Prof.</td>
<td>106</td>
<td>35</td>
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<tr>
<td>Asso. Prof.</td>
<td>117</td>
<td>15</td>
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<tr>
<td>Professor</td>
<td>174</td>
<td>8</td>
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<tr>
<td>Total</td>
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</table>

Number of usable Returns: 32

DOCTORATE GRANTING DEPARTMENTS. Group V

<table>
<thead>
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<th>With Doctorate</th>
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</thead>
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<td>8</td>
</tr>
<tr>
<td>Asst. Prof.</td>
<td>78</td>
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</tr>
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<td>Asso. Prof.</td>
<td>75</td>
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<tr>
<td>Professor</td>
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</table>

Number of usable Returns: 30

DOCTORATE GRANTING DEPARTMENTS. Group VI

<table>
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<th>With Doctorate</th>
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<tr>
<td>Instructor</td>
<td>160</td>
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<tr>
<td>Asst. Prof.</td>
<td>206</td>
<td>4</td>
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<tr>
<td>Asso. Prof.</td>
<td>143</td>
<td>15</td>
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<td>Professor</td>
<td>581</td>
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<tr>
<td>Total</td>
<td>889</td>
<td>12</td>
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</table>

Number of usable Returns: 15

MASTER DEGREE GRANTING DEPARTMENTS

<table>
<thead>
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<th>Category</th>
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<th>With Doctorate</th>
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</thead>
<tbody>
<tr>
<td>Instructor</td>
<td>189</td>
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<tr>
<td>Asst. Prof.</td>
<td>628</td>
<td>15</td>
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<tr>
<td>Asso. Prof.</td>
<td>675</td>
<td>45</td>
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<tr>
<td>Professor</td>
<td>487</td>
<td>12</td>
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<tr>
<td>Total</td>
<td>889</td>
<td>11</td>
</tr>
</tbody>
</table>

Number of usable Returns: 127
### Size of Faculty

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Tenure</td>
<td>Total Tenure</td>
<td>Total Tenure</td>
</tr>
<tr>
<td>Facilities Without Doctorate</td>
<td>Instructors</td>
<td>137</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Asst. Prof.</td>
<td>370</td>
<td>178</td>
</tr>
<tr>
<td></td>
<td>Asso. Prof.</td>
<td>205</td>
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</tr>
<tr>
<td></td>
<td>Professor</td>
<td>59</td>
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</tr>
<tr>
<td>Total</td>
<td>771</td>
<td>422</td>
<td>166</td>
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</table>

### Salaries (in hundreds of dollars)

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Median</th>
<th>Maximum</th>
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<tbody>
<tr>
<td>Facilities Without Doctorate Instructors</td>
<td>30 (88-105)</td>
<td>(90-108)</td>
<td>(90-110)173</td>
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<tr>
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<td>70 (99-119)</td>
<td>(101-123)</td>
<td>(103-130)175</td>
</tr>
<tr>
<td></td>
<td>80 (110-140)</td>
<td>(116-141)</td>
<td>(122-147)243</td>
</tr>
<tr>
<td>Total</td>
<td>100(129-178)</td>
<td>(129-178)</td>
<td>(140-150)284</td>
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</tbody>
</table>

### Bachelor Degree Granting Departments

### WITH DOCTORATE

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Median</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructors</td>
<td>72 (92-113)</td>
<td>(95-115)</td>
<td>(95-116)188</td>
</tr>
<tr>
<td></td>
<td>77(102-125)</td>
<td>(107-129)</td>
<td>(108-135)179</td>
</tr>
<tr>
<td></td>
<td>84(118-146)</td>
<td>(120-150)</td>
<td>(121-155)243</td>
</tr>
<tr>
<td>Total</td>
<td>100(140-184)</td>
<td>(147-185)</td>
<td>(147-190)292</td>
</tr>
</tbody>
</table>

### WITH TWO-YEAR COLLEGES

### WITHOUT DOCTORATE

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Median</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructors</td>
<td>32 (92-120)</td>
<td>(104-145)</td>
<td>(112-167)270</td>
</tr>
<tr>
<td></td>
<td>67(100-130)</td>
<td>(110-151)</td>
<td>(120-176)300</td>
</tr>
<tr>
<td>Total</td>
<td>90(119-169)</td>
<td>(120-183)</td>
<td>(125-188)350</td>
</tr>
</tbody>
</table>

### WITH DOCTORATE

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Median</th>
<th>Maximum</th>
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</thead>
<tbody>
<tr>
<td>Instructors</td>
<td>32 (92-120)</td>
<td>(104-145)</td>
<td>(112-167)270</td>
</tr>
<tr>
<td></td>
<td>67(100-130)</td>
<td>(110-151)</td>
<td>(120-176)300</td>
</tr>
<tr>
<td>Total</td>
<td>90(119-169)</td>
<td>(120-183)</td>
<td>(125-188)350</td>
</tr>
</tbody>
</table>
The latest figures in this Survey were compiled from questionnaires sent to individuals who received a doctorate in the mathematical sciences during the 1973–1974 academic year from universities in the United States and Canada. This report includes summaries from previous years; more details for 1973 will be found on page 276 of the October 1973 issue of these C(Notes).

Of the 1,145 questionnaires distributed there were 456 returns of which 379 (340 men and 39 women) were used in the tables below, 102 were returned to Providence for bad addresses. Of the unused returns 21 did not have sufficient information for use in the compilation, 18 persons (16 men and 2 women) were unemployed, 3 persons (2 men and 1 woman) were not seeking employment, and 35 men have accepted positions in foreign countries, in most cases these were foreign nationals who returned to their homeland after completion of studies in the United States.

The Teaching and Teaching and Research categories were combined in the 1974 questionnaire into one group because it is difficult to determine how much time has to be devoted to research in order to be included in the second of the above mentioned categories. The result is that there are no comparable figures before 1974. For the convenience of the reader we have repeated information published last year for each of the categories and then followed it by the new combined category. It should be noted that in 1973 there were nearly four times as many individuals listed in the Teaching than in the Teaching and Research categories.

Eighty percent of the doctorates included in this report accepted academic positions, 16% accepted positions in business or industry and 4% in government. Of those reporting academic positions, 50% held positions in doctoral granting departments, 23% in departments granting master's as the highest degree, 23% in bachelor granting departments, 3% in junior colleges and 1% in high schools.

Of all those reporting, including those not used in the salary compilations, 82% accepted jobs in the United States, 6% in Canada and 8% in other countries; 4% were not employed at the time of reporting.

**KEY TO TABLE**

Salaries are listed in hundreds of dollars. Dashes indicate that not enough returns were received to warrant including the figures. *Years* listed refer to the academic year ending in the listed year. *M* and *F* are Male and Female respectively. One *year experience* means that the persons had experience limited to one year or less in the same or a similar position to the one reported; some persons receiving a doctorate had been employed in their present position for several years. *X* men and *Y* women in the sample. Quartile figures are given only in cases where the number of responses are large enough to make them meaningful.

### NINE-MONTH SALARIES

<table>
<thead>
<tr>
<th>Year</th>
<th>Min.</th>
<th>Q1</th>
<th>Median</th>
<th>Q3</th>
<th>Max.</th>
</tr>
</thead>
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</tr>
<tr>
<td>1971</td>
<td>70</td>
<td>105</td>
<td>110</td>
<td>120</td>
<td>178</td>
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<td>1972</td>
<td>61</td>
<td>105</td>
<td>115</td>
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<td>192</td>
</tr>
<tr>
<td>1973</td>
<td>60</td>
<td>107</td>
<td>116</td>
<td>127</td>
<td>178</td>
</tr>
<tr>
<td>1972M</td>
<td>61</td>
<td>105</td>
<td>115</td>
<td>125</td>
<td>192</td>
</tr>
<tr>
<td>1972F</td>
<td>94</td>
<td>105</td>
<td>110</td>
<td>115</td>
<td>192</td>
</tr>
<tr>
<td>1973M</td>
<td>60</td>
<td>108</td>
<td>116</td>
<td>128</td>
<td>178</td>
</tr>
<tr>
<td>1973F</td>
<td>60</td>
<td>105</td>
<td>115</td>
<td>124</td>
<td>150</td>
</tr>
</tbody>
</table>

| TEACHING AND RESEARCH* | | | | | |
| 1971 | 88  | 110 | 156 |
| 1972 | 95  | 115 | 160 |
| 1973 | 90  | 117 | 170 |
| 1972M | 100 | 116 | 166 |
| 1972F | 95  | 105 | 135 |
| 1973M | 90  | 117 | 170 |
| 1973F | 105 | 113 | 135 |

| TEACHING OR TEACHING AND RESEARCH* (215 + 25) | | | | |
| 1974 | 85  | 115 | 121 | 135 | 200 |
| 1974M | 85  | 115 | 124 | 137 | 200 |
| 1974F | 90  | 108 | 115 | 120 | 145 |

One year experience (171 + 19)

| 1974M | 85  | 113 | 120 | 130 | 156 |
| 1974F | 90  | 106 | 115 | 120 | 141 |

### RESEARCH (9 + 1)

<table>
<thead>
<tr>
<th>Year</th>
<th>Min.</th>
<th>Q1</th>
<th>Median</th>
<th>Q3</th>
<th>Max.</th>
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<td>1971</td>
<td>90</td>
<td>110</td>
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<tr>
<td>1972</td>
<td>60</td>
<td>111</td>
<td>155</td>
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<td></td>
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</tr>
<tr>
<td>1974</td>
<td>90</td>
<td>80</td>
<td>130</td>
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<td></td>
</tr>
<tr>
<td>1973M</td>
<td>30</td>
<td>110</td>
<td>120</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973F</td>
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<td>1974M</td>
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<tr>
<td>1974F</td>
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<td>70</td>
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<td></td>
</tr>
</tbody>
</table>

One year experience (8 + 1)

| 1974M | 50  | 80  | 130 |
| 1974F | ---- | 70  | ---- |

### TWELVE-MONTH SALARIES

<table>
<thead>
<tr>
<th>Year</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
<th>Year</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
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<tr>
<td>TEACHING*</td>
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</tr>
<tr>
<td>1971</td>
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<td>126</td>
<td>190</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>1972</td>
<td>92</td>
<td>124</td>
<td>210</td>
<td></td>
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</tr>
<tr>
<td>1973</td>
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<td>127</td>
<td>270</td>
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<tr>
<td>1972M</td>
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<td>125</td>
<td>210</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1972F</td>
<td>103</td>
<td>104</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973M</td>
<td>104</td>
<td>133</td>
<td>270</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1973F</td>
<td>105</td>
<td>116</td>
<td>127</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| TEACHING AND RESEARCH* | | | | |
| 1971 | 100 | 137 | 165 |
| 1972 | 100 | 125 | 205 |
| 1973 | 100 | 125 | 175 |
| 1972M | 100 | 127 | 185 |
| 1972F | 106 | --- | 205 |
| 1973M | 85  | 159 | 172 |
| 1973F | --- | --- | ---- |

| TEACHING OR TEACHING AND RESEARCH* (33 + 7) | | | | |
| 1974 | 90  | 138 | 185 |
| 1974M | 90  | 146 | 185 |
| 1974F | 106 | 126 | 145 |

One year experience (24 + 7)

| 1974M | 90  | 134 | 185 |
| 1974F | 106 | 126 | 145 |

| RESEARCH (11 + 2) | | | | |
| 1971 | 60  | 120 | 181 |
| 1972 | 50  | 125 | 180 |
| 1973 | 90  | 150 | 176 |
| 1974 | 72  | 95  | 265 |
| 1972M | 50  | 126 | 180 |
| 1972F | 100 | --- | 125 |
| 1973M | 90  | 150 | 176 |
| 1973F | 120 | --- | 172 |
| 1974M | 72  | 95  | 265 |
| 1974F | 90  | --- | 180 |

| RESEARCH (11 + 2) | | | | |
| 1971 | 60  | 120 | 181 |
| 1972 | 50  | 125 | 180 |
| 1973 | 90  | 150 | 176 |
| 1974 | 72  | 95  | 265 |

| 1972M | 50  | 126 | 180 |
| 1972F | 100 | --- | 125 |
| 1973M | 90  | 150 | 176 |
| 1973F | 120 | --- | 172 |
| 1974M | 72  | 95  | 265 |
| 1974F | 90  | --- | 180 |

*Figures in the Teaching and the Teaching and Research categories compiled in 1974 are not comparable to those for prior years; the two categories were combined in 1974.
Questions of the quality of graduate programs or graduate departments are of continuing concern and interest to the departments themselves, to their institutions, to the mathematics profession, to the academic world at large and to federal agencies which support research and education. The word "quality" in this context is, of course, a complex concept and clearly subjective. One may speak of quality with respect to each of numerous aspects of a department or program or of combinations of various aspects. Judgments of overall quality made by various people will generally be somewhat different because of varying assessments of particular aspects and varying weights assigned to these aspects.

The most widely used and generally accepted quality ratings of doctoral level departments of mathematics are included in the American Council of Education (ACE) ratings based on surveys conducted in 1964 and 1969, the first done by Allan Cartter and the second by Kenneth D. Roose and Charles J. Andersen. These reports rated doctoral programs in various disciplines by peer group judgments of (1) quality of graduate faculty and (2) effectiveness of the doctoral program. The care taken in the ACE studies reflects the difficult and controversial nature of the problem.

In mathematics, the two lists were generally in rather close agreement. Both were published in these News, February 1971, pp. 338-339. The 'quality of graduate faculty' list is the one most widely cited and is used by the AMS in its classification of departments with respect to salary and other data. However, because our study deals with Ph.D. graduates, we use the 'effectiveness of doctoral program' list as our primary reference. It is important to note that the methodology of the ACE study did not produce assessments of the qualities themselves, but rather produced results giving average or consensus judgment by the graduate and research mathematical community of the qualities concerned.

Many specific measures of quality itself are possible, but the authors are not aware of any recent broad studies of this sort in mathematics. For example, in judging departmental faculty quality, one could use numbers of refereed or reviewed publications, numbers of citations in other publications, numbers of invited AMS or International Congress talks, numbers or amounts of research grants, or numbers of departmental members in the National Academy. Such numbers could be given per department or per faculty member or per faculty member involved in the graduate program and could be given for recent years or over a longer period.

In assessing "effectiveness of graduate programs" one could use, for example, numbers of Ph.D.'s produced, numbers of Ph.D.'s produced publishing at least five papers, numbers of Ph.D. graduates giving invited addresses, or numbers of Ph.D. graduates on faculties of leading departments. Such numbers could be averaged for recent years or for longer periods and could, or should, be normalized for size of department or numbers of graduate students or for quality of graduate students.

Knowing the lists of all Ph.D.'s from various departments, the task of identifying current location and research performance for statistical purposes is not easy.

In this report, we analyze the numbers of Sloan Fellowships in mathematics awarded to graduates of various universities to give indicators of quality related to the effectiveness of the graduate program. Since 1955, Alfred P. Sloan Research Fellowships have been awarded to young people in various physical sciences and mathematics on the basis of their early research performance and potential. The Fellows are selected on the basis of nominations and recommendations by other scientists; the fellowships are not applied for. The list of past Fellows in mathematics includes many important mathematicians; relatively few of the earlier Sloan Fellows are not well-known and respected for their research accomplishments. All six post-1940 Fields Medalists who were trained in the U.S. had been awarded Sloan Fellowships from four to twelve years before receiving their Fields Medals. Incidentally, the six Fields Medalists were trained at Princeton, Michigan, Harvard, and Chicago with two each at the latter two schools.

There have been 223 Sloan Fellows in mathematics with initial awards in 1973 or earlier. (The new 1974 Sloan Fellows had not been announced at the time this report was organized.) Of the 223, 17 had foreign Ph.D. origins and one had no Ph.D. Also, 110 got degrees prior to 1961 and 112 in the period 1961-1970. A handful of the Sloan Fellows in mathematics are known to have gotten their Ph.D.'s in departments other than mathematics departments per se, e.g., statistics, physics, or applied mathematics. These are included in the figures cited below.

*This study is an outgrowth of discussions in meetings of the AMS Committee on Employment and Educational Policy, but is not a CEEP document or project. In general, the Committee felt that in these days of the need for modification and possible contraction of the national Ph.D. program, studies involving various criteria of quality are needed. The opinions expressed in this paper are those of the authors, and in no way represent official views of their employing institutions.
Any identification of (young) effective research mathematicians is subject to many subjective estimates and judgments. The Sloan selection process emphasizing early postdoctoral research would appear to be as sound as any for indication of potential high level research quality and performance. The median time gap between the Ph.D. degree and the beginning of the Sloan Fellowship has been five years. It is clearly understood, of course, that many extremely able and important research mathematicians have not been recipients of Sloan Fellowships. Since the preparation and cultivation of exceptional young researchers would appear to have been a primary goal of any doctoral program, an analysis of the effectiveness in turning out Ph.D.'s who became Sloan Fellows should lead to a valid measure of the quality of those programs for which the numbers of Sloans are large enough to be meaningful. Furthermore, because of the relatively short time lag involved, an analysis of recent Sloan Fellows should give a judgment of recent programs. For this reason, in the analysis to follow, we have concentrated on those 1961-1970 doctorates who became Sloan Fellows by 1973.

In Table I we list all the universities for which two or more of their Ph.D.'s from 1961-1970 had gotten Sloan Fellowships by 1973. In column (1) (on the left) we list the number of Ph.D.'s from 1960 and before who got Sloan Fellowships and in column (2) those with Ph.D.'s from 1961-1970.

The figures of columns (1) and (2) show a continuing very impressive role by Princeton in American mathematics and the more recent growth of Berkeley and MIT as major factors. In the late forties and fifties it was generally believed that Chicago, Harvard and Princeton (in some order) were the "big three" of mathematics. The distribution of Sloans trained in that period amply supports that belief. The data also supports the contention that American mathematics has, more recently, had a substantially broader base of high level graduate programs.

Column (3) of Table I gives the number of Ph.D.'s produced in mathematics in the period 1961-1970 as listed in the AMS Notices. The figures include all of those listed through 1964 and those from the Department of Mathematics alone since then, the available data having been organized in different ways in the early and late sixties. Column (4) gives the percentage ratio of the entries in columns (2) and (3). Thus, column (4) gives an index of excellence or high performance output to overall output. The percentages are less meaningful and are not computed for schools with small numbers of Sloans. Column (5) gives the total number of nationally competitively awarded NSF predoctoral fellowships in the mathematical sciences identified with the various universities in the period 1961-1970 (as announced in the March NSF press releases on NSF predoctoral fellows). Column (6) gives the percentage ratio of the entries in columns (2) and (5). Thus, column (6) gives an index of output performance to input talent. Again, only schools with four or more Sloans are used.

It is interesting to note that of the sixteen schools listed in the table, only Berkeley, Wisconsin, Michigan, LSU and Utah are public in-

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<td>6</td>
<td>4.2</td>
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<td>6</td>
<td>3.2</td>
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</table>
stitutions. However, the ratio of NSF predoctoral fellowships between the five public and the eleven private schools is about .35, less than the ratio of about .38 of the output of Sloans.

There are six departments not listed which produced two, three or four Sloans each (for a total of eighteen) from the pre-1961 period. These departments produced a total of only two Sloan Fellows from 1961-1970. At least three of these departments were known primarily for the distinction of a small number of their faculty.

The other fourteen U.S. universities that had any of their Ph. D.'s from 1961-1970 as Sloan Fellows, each having one, are: CUNY, Colorado, Cornell, Dartmouth, Georgia, Houston, Iowa, Rice, Rockefeller, Syracuse, Tennessee, Washington, Wayne State and Yeshiva.

In Table II, we give various rankings of departments related to effectiveness of the doctoral program. Column (1) gives the 1969 ACE "effectiveness" ranking for the sixteen departments in Table I. That ranking was by linear order in Groups I and II through twenty-five departments and then was an alphabetical listing of thirty-six departments in Group III. Column (2) gives the 1969 ACE "faculty quality" ranking which was by linear order in Groups I and II through twenty-five departments and then was an alphabetical listing of thirty-six departments in Group III. Column (3) gives the ranking of the sixteen departments of Table I by number of Sloans trained in 1961-1970. It is remarkable how closely the rank by number of Sloan Fellows trained in 1961-1970 follows the 1969 ACE effectiveness ranking for the first 10 schools of the latter list. However, as noted below, for those schools not in the "top ten", the ACE rankings appear almost unrelated to the number of Sloans.

Columns (4) and (5) give the rankings of the 10 schools with four or more Sloans by the indices of columns (4) and (6) of Table I. These rankings, particularly those of (5), differ markedly from the ACE rankings. Indeed, the various Sloan rankings suggest that opinion ratings such as the ACE are more concerned with total visibility (of excellence?) than with the relationship of excellence to total output or with output/input efficiency.

For the period 1961-1970, the fifteen universities ranked eleven through twenty-five by ACE on effectiveness had a combined total of eight Sloan Fellows among their graduates (ten having none and three having one each). The thirty-six universities in the ACE group on effectiveness had a total of seventeen Sloan Fellows among their graduates (twenty-six having none and six having one each). Departments unranked by the ACE on effectiveness had a total of five Sloan Fellows among their 1961-1970 Ph. D.'s. Since 8/15 ≈ 17/36 one is tempted to conjecture that the ACE rankings below the "top ten" have very little relationship to the effectiveness of training of the very best of the young research mathematicians. The distinction of LSU and Johns Hopkins having respectively had four and three Sloan Fellows trained in 1961-1970 while thirteen different universities in the ACE top twenty-five list had none or one should not go unnoticed.

Finally, it should be mentioned that with changing patterns of higher education in the seventies, including different emphasis on the roles of pure and the various forms of applied mathematics, the phenomena of the sixties may not be reliable indicators of the future.
THE ROLE OF THE PH.D.
IN TWO-YEAR COLLEGE TEACHING

John Jewett

This article is based on a panel discussion held at the Missoula meeting of the American Mathematical Society in August, 1973. This panel discussion was an outgrowth of concerns expressed by the AMS Committee on Employment and Educational Policy and was jointly sponsored by AMS and by the Mathematical Association of America. The panel members were William G. Chinn of San Francisco City College, Betty J. Hinman of South Texas Junior College, and Robert D. Larsson of Schenectady County Community College. The moderator was John Jewett, who is responsible for this summary.

At a time when employment prospects for mathematicians are deteriorating and when the long term outlook is for between 200 and 400 openings per year in four-year institutions, it is natural for the mathematical community to examine critically the availability and appropriateness of employment for mathematicians. The AMS Annual Survey was able to find fewer than twenty new Ph.D.'s who went to two-year colleges in 1973.

Opinions the moderator has heard expressed as to the appropriateness of Ph.D.'s as faculty members in two-year colleges have ranged all the way from the tacit assumption that almost all such openings will be filled by Ph.D.'s (now that they are available) to the statement by one junior college chairman that possession of a doctorate is a disqualification for two-year college teaching.

In looking for the truth between these two extremes one must realize that a two-year college has different students and different goals from four-year institutions. Dr. Hinman, who came to two-year college teaching after teaching at a selective private college and a large university, commented:

The student himself is probably the hardest thing the Ph.D. has to understand in the two-year college. The open door policy brings with it a cross section of students with widely varying backgrounds—not only educationally, but socially and economically as well. Many of the students are mathematically ignorant. Many of the basic concepts of mathematics, which were so much a part of my understanding, were just meaningless words and symbols to many to these students. They were not dumb and unteachable but merely lacked exposure to the subject.

A belief central to the philosophy of the community college is the reasonableness of expecting significant results from working with such apparently unpromising material. Chinn summed this up by saying: "We exist mainly for the welfare of the students—whether they are in a terminal program, in a semi-professional or technical program or in a university-parallel program." Hinman commented, "The rewards of teaching are not always immediate. This summer I taught a calculus class which was probably one of the best I have ever had. Scattered throughout this class were faces I had seen several semesters before, struggling with factoring and fractions."

Since community college students present such a wide spectrum of ability and preparation, and since aspirations for their eventual progress are so high, it should not be too surprising that there exists a certain suspicion as to the suitability of many or most Ph.D.'s for two-year college teaching. Chinn considers the question from the point of view of how he might view an applicant for a position and states:

I would have to weigh an applicant's Ph.D. against my estimate as to whether or not the candidate can teach well. There is usually a great deal in the Ph.D.'s favor. We can most likely assume that his command of subject matter is more than adequate... If the Ph.D. is of recent vintage, he is likely to be aware of the latest directions occurring in his own specialty at least. But we must also remember that this individual has in all likelihood been honed so keenly and has kept his sights so high in the last few years that it may be very difficult for him to appreciate the beginning student's struggles and to understand the difficulties a student may be encountering. This may be the Ph.D. who had aspired to more lofty levels of teaching, whether or not he is conscious of this aspiration.

In a similar vein, Hinman asserted, "The Ph.D. is mathematically over-educated for the two-year college. Clearly he does not receive his challenge in teaching from the content of the courses... The challenge comes in trying to find ways to present this elementary material (which is second nature to us) to these students."

Some resistance to hiring Ph.D.'s stems from the fear that a Ph.D. will regard a two-year college position as a stop-gap job to be abandoned quickly as soon as something better becomes available. The extent to which this assumption is valid is not actually known. Larsson suggested
that it would be of value to administrators of community colleges if a survey were conducted to determine what percentage of new Ph. D.'s have a genuine interest in a teaching career in a community college, not influenced by the job market, the results being widely disseminated among two-year colleges.

There were several advantages suggested by the panelists in having Ph. D.'s as members of a two-year college faculty. Hinman suggested that a Ph. D. might well be of value in creating new approaches to existing courses, in development of new courses and interdisciplinary studies, in leading seminars with colleagues, and in conducting independent study with able students. Chinn felt that the Ph. D.'s more extensive training might bring a useful perspective in curricular discussions. Larsson stressed the increasing number of upperclassmen in four-year institutions who are transfers from community colleges and concluded that Ph. D.'s would be valuable both in advising students who expect to transfer to four-year colleges and universities and in helping to shape transfer curricula in such a way as to expedite further study.

It occurs to the moderator that the reservations expressed by the panelists and others concerning Ph. D.'s as members of two-year college faculties apply to some Ph. D.'s rather than to all Ph. D.'s. Chinn remarked, "In summary, I don't think the Ph. D. should be an 'open sesame' for the holder, nor do I think it should be held against the individual." In discussing whether the Ph. D. can adapt to the needs of students who require remedial work or whose academic goals are modest, Larsson commented, "I suspect that this really depends upon the individual and I know of no reason to suspect that Ph. D.'s are, by their nature, not up to this challenge."

However, the arguments advanced above in favor of the Ph. D. as a two-year college faculty member do not tend toward filling every vacancy with a Ph. D., but point more toward a leavening of two-year college mathematics faculties by a certain number of people with more advanced training. In fact Larsson states specifically,

You will note that I have not asserted that all members of the faculty should hold the doctorate. The comprehensive community college has many programs in which the mathematical needs of the students do not require the background of a Ph. D. Perhaps it requires someone with a feel for applications in the business field or the technologies, perhaps an experience in the background necessary to teach at the elementary or high school level; perhaps one familiar with the computer.

What is needed is a balanced department reflecting the programs offered by that college and there is no doubt in my mind that many community colleges could profit by adding a Ph. D. to their mathematics faculty.

From the remarks of the panelists and from other information, the moderator concludes that a majority of vacancies in two-year college mathematics faculties will, quite properly, continue to be filled by persons not holding a doctorate. It is probable, however, that a substantial minority of vacancies could be filled to mutual advantage by members of the substantial minority of Ph. D.'s whose natural propensities lean more strongly toward teaching and extensive contact with students than towards scholarship and research. What is needed is perhaps some means of facilitating this self-recognition—especially among those two to five years past a Ph. D.—and some means of communicating to two-year colleges that a given candidate for employment is actually seeking the kinds of satisfaction that a two-year college position can provide.
The Mathematical Sciences Section of the National Science Foundation again announces that in order to insure full consideration, proposals requesting support beginning prior to September 1, 1975, should be in the hands of the cognizant program director six months prior to the desired starting date of such support, but not later than November 1, 1974.

The Section also wishes to encourage greater attention to the new NSF brochure "Grants for Scientific Research" (NSF 73-12) in the writing of proposals. Recent proposals have frequently been deficient in one or more of the following items necessary in the properly written proposal:

1. A full description of all other current research support or pending applications for such for all proposed investigators; in case there is no other support and no other application is pending or contemplated, the proposal must contain such a statement explicitly (for example: None of the listed investigators has any other research support and no other application is pending or contemplated);

2. In requests for renewed support, an estimate of the projected residual balance in the current award (NSF 73-12, pp. 16-17);

3. An abstract of the proposed research (in the entire proposal), about one-half page in length, written in the third person, with a minimal number of symbols not on standard typewriters, and suitable for inclusion in the Science Information Exchange and for transmittal to several Foundation offices for information;

4. Justification for any but the most usual items of support; in particular, this should be done in requests for partial support of sabbatical leaves;

5. Curricula vitae of the proposed investigators, including for each a list of publications relevant to the proposed research;

6. A bibliography of other pertinent publications (one's results are rarely based entirely on one's own work); and

7. It would be helpful if each proposal listed the telephone numbers of the mathematics department and the principal investigator(s).

OCCUPATIONAL OPPORTUNITIES AND SUMMER SEMINARS ABROAD

Grants to teach abroad or to attend a summer seminar abroad are available under the Fulbright-Hays Act for the 1975-1976 academic year. Elementary and secondary teachers, college instructors, and assistant professors are eligible to participate in the program. United States citizenship, a bachelor's degree, and at least three years of successful full-time teaching are required for teaching positions. A minimum of two years teaching experience is required for summer seminars. Seminars for teachers of art, German, the classics, Italian, European, and world/Asian history will be held in 1975. Application should be made before November 1, 1974. An information bulletin and application forms may be obtained in September by writing to: Teacher Exchange Section, Division of International Education, U.S. Office of Education, Washington, D.C., 20202.

RETIRED MATHEMATICIANS

The List of Retired Mathematicians Available for Employment will be published and distributed to subscribers as part of the December 1974 issue of EMPLOYMENT INFORMATION FOR MATHEMATICIANS. It is available to nonsubscribers who request it from the Mathematical Sciences Employment Register, P.O. Box 6248, Providence, R.I. 02940. Copies will also be available at the annual meeting in Washington, D.C., January 21-27, 1975.

Retired mathematicians interested in being included in the list should submit the following information: name, date of birth, highest degree earned and where obtained, most recent employment, present address, date available, references, preference for academic or industrial employment, and geographic location preferred. Preprinted forms available from the Providence office may be used for this purpose, although they are not required. The deadline for receipt of the required information is December 2, 1974.
ENERGY-RELATED POSTDOCTORAL PROGRAM

The National Science Foundation announced that it plans a new fellowship program entitled "Energy-Related Postdoctoral Program." Details of this program were scheduled to be announced in September 1974 following approval by the National Science Board. Approximately 100 postdoctoral scientists and engineers are expected to be involved in energy-related work and research. The recipients of these postdoctoral awards will be chosen individually on the basis of academic accomplishments and potential contribution to the research areas to be pursued. Details of the program, including instructions for submission of applications, will be announced in brochure E-75-37, Postdoctoral Energy-Related Program, which may be requested by individual postcard addressed to Forms and Publications Unit, National Science Foundation, Washington, D. C. 20550. Further information about this activity may be obtained by writing to the Office of the Assistant Director for Education, National Science Foundation, Washington, D. C. 20550.

NORTH ATLANTIC TREATY ORGANIZATION (NATO) SENIOR FELLOWSHIPS IN SCIENCE

The National Science Foundation (NSF) has opened competition for NATO Senior Fellowships in Science and has just published the 1974–1975 program announcement (E 75-14). NSF administers the program for U. S. citizens or nationals. These fellowships enable senior staff of U. S. colleges and universities and nonprofit scientific research institutions to study new scientific techniques and developments abroad under a program designed to foster interchange of information among NATO nations, or countries cooperating with NATO.

The closing dates for receipt of applications in the 1974–1975 program are November 20, 1974 and March 1, 1975; approximate award dates are February 15, 1975 and May 15, 1975.

NATO Senior Fellows receive a subsistence allowance and a travel allowance. The fellowships normally carry tenures of one to three months. Awards are made in all fields of science, mathematics, engineering, history and philosophy of science, and interdisciplinary science fields.

For a copy of the program announcement (E 75-14) and application materials contact: Fellowships and Traineeships Section, Division of Higher Education in Science, National Science Foundation, Washington, D. C. 20550. Telephone: (202) 282-7595.

AMS-SIAM COMMITTEE ON APPLIED MATHEMATICS

Over the past years this committee has made recommendations for symposia usually held in conjunction with the AMS spring meeting in the New York City area, and summer seminars held at different universities. The symposia are held annually and usually last two days. In April, 1974 the topic was "Mathematical Aspects of Chemical and Biochemical Problems and Quantum Chemistry"; for the spring of 1975 the topic is "Nonlinear Programming" with Richard Cottle as chairman. The summer seminars are held approximately every other summer, and are of two to four weeks duration. During the summer of 1974 a two-week seminar on "Inverse Problems" was held at the University of California at Los Angeles and a two-week seminar on "Modern Modeling of Continuum Phenomena" is planned for 1975 at Rensselaer Polytechnic Institute with Richard DiPrima as chairman. Proceedings of the symposia are now published as a SIAM-AMS Proceedings and lectures given at the summer seminars are published in the series Lectures in Applied Mathematics. A complete list of symposia and seminars is given in these Notices (Vol. 21, August 1974, p. 223).

The Committee would be very pleased to have suggestions for topics for future symposia and seminars. Suggestions can be sent to any member of the Committee or directly to the chairman; Richard C. DiPrima, Department of Mathematical Sciences, Rensselaer Polytechnic Institute, Troy, New York 12181. The members of the Committee, with the year that their term expires in parentheses, are as follows: E. Coddington (1975), L. B. Dubins (1974), R. C. DiPrima (1976), H. Grad (1974), J. B. Rosser (1975), and W. G. Strang (1976).

CAMBRIDGE PHILOSOPHICAL SOCIETY

CHANGES NAME OF PUBLICATION

Starting in January 1975 with volume 77, Proceedings of the Cambridge Philosophical Society, a journal of pure and applied mathematics, will be published as Mathematical Proceedings of the Cambridge Philosophical Society. Each volume will continue to consist of three parts published at two-monthly intervals, making two volumes in each year.

Mathematical Proceedings will be edited by J. C. Burkill, in consultation with a committee of Fellows of the Society. Communications should be addressed to the Editor of Proceedings, Cambridge Philosophical Society, Bene't Street, Cambridge, CB2 3PY, England.
TO NSF REVIEWERS

The Mathematical Sciences Section of the National Science Foundation wishes to thank publicly all those members of the international mathematical community who assisted in the evaluation of proposals submitted to the Section during the past year. Reviewing proposals is a difficult and time-consuming task. Without the gracious and conscientious assistance of our many reviewers, we in the Section would be unable to discharge our own responsibilities.

We thank you and look forward to your continuing cooperation in the future.

William H. Pell
William G. Rosen
R. Barnett Agins
Alvin T. Thaler
Ralph M. Krause
John C. Wells

EXCHANGE PROGRAMS WITH EASTERN EUROPE AND THE SOVIET UNION

The International Research and Exchange Board is now accepting applications for their exchange program between scholars in the United States and the countries of East-Central and Southeast Europe and the Soviet Union. The application deadline for the 1975-1976 academic year for most of the exchange programs is November 15, 1974. Additional information on eligibility and specific programs may be obtained from: International Research and Exchange Board, 110 East Fifty-Ninth Street, New York, New York 10022. Phone number (212) 826-0230.

CALL FOR INFORMATION AND SUGGESTIONS

In accordance with action taken at the Business Meeting in San Francisco, President Saunders Mac Lane has appointed a Committee on Teaching Loads and Class Size. The committee consists of Daniel Finkbeiner (Kenyon College), Mary W. Gray (American University), Meyer Jerison (Purdue), George Piranian, Chairman (Michigan), and Lance Small (University of California at San Diego).

The committee invites information about the extent and nature of the problem in a variety of institutions. Suggestions of appropriate action that the American Mathematical Society might undertake are especially welcome. Communications to the chairman will reach all members.

ACTA MATHEMATICARUM VIETNAMICARUM

Subscriptions for the foreign edition (mostly French) of the Vietnamese Math Journal, Acta Mathematicarum Vietnamicarum, are now available. There will be at least two and possibly four issues per year, which will be produced in the Democratic Republic of Vietnam, and mailed from France. As in the past, there will be a broad range of contributors.

To subscribe in the Americas: $12/year.
Mail to Professor Ed Dubinsky, Clarkson College of Technology, Potsdam, New York 13696.

To subscribe in Europe: 50 francs/year.
Mail to Societe Mathematique de France, c/o Yvette Amice, IHP, 11 rue Pierre et Marie Curie, 75231 Paris, France.

Individual and library advance subscriptions will help bring the journal back into full production.

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 1975-1976. 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, 1975.

FELLOWSHIP AND RESEARCH OPPORTUNITIES IN THE MATHEMATICAL SCIENCES

In its annual brochure on Fellowship and Research Opportunities in the Mathematical Sciences, the Division of Mathematical Sciences of the National Research Council calls attention to a number of fellowships and other kinds of support for research in the mathematical sciences at both the predoctoral and postdoctoral levels to be awarded during the year 1974-75. Copies of this brochure are available from the Division of Mathematical Sciences, National Research Council, 2101 Constitution Avenue, N.W., Washington, D. C. 20418.

BOOKS AND JOURNAL ORDERS FROM JAPAN

In Japan, all orders from nonmembers of the AMS for publications sold by the Society should be sent to our agent: Maruzen Co., Ltd., 3-10, Nihonbashi 2-chome, Chuo-ku, Tokyo, Japan 103.

ERRATA

John Backus, IBM Research Laboratory, San Jose, California should have been listed as a new member of the news item "NATIONAL ACADEMY OF SCIENCES ELECTS NEW MEMBERS," p. 198, of the August 1974 Notices.
MATHEMATICAL SCIENCES EMPLOYMENT REGISTER

The Empire Room of the Shoreham Hotel in Washington, D.C., will be the location of the Mathematical Sciences Employment Register OPEN REGISTER during the annual meeting. In order to make it possible for applicants and employers to participate in as many interviews as possible, interviews are scheduled by computer on the basis of preference. Employers are encouraged to send more than one interviewer, making it possible to increase the number of interviews that may be scheduled.

The OPEN REGISTER will operate for four days, Friday through Monday, January 24-27, 1975. Hours of operation will be from 9:00 a.m. to 4:00 p.m. on Friday for registration with interviews scheduled from 9:00 a.m. to 5:40 p.m. on Saturday, Sunday and Monday. The addition of a third day of interviews continues a previously adopted procedure recommended by the Joint Committee on Employment Opportunities in an attempt to expand the interview schedule and to eliminate the necessity for evening interviews.

The system of operation introduced in January 1971 will again be in effect in Washington, D.C. Applicants and employers MUST BE REGISTERED for the general Mathematics Meetings before registering for the OPEN REGISTER. There is no Register fee for applicants participating in interview schedules; employers pay a $10 fee. Location of the general meeting registration area, fees, and hours of operation for the registration of participants for the Mathematics Meetings are listed in the preliminary announcement of the annual meeting included in this issue of these Notice.

Applicants and employers should plan to attend a short meeting called by the committee for Thursday, January 23, at 4:30 p.m. in The Forum of the Shoreham Hotel. The purpose of this meeting is to explain Register procedures and the various printed forms which are used. It is hoped that both applicants and employers will attend the session in order to become familiar with the details in advance.

Instruction sheets will be available in the Empire Room registration area at 9:00 a.m. on Friday; applicants and employers should secure this information as soon as possible. There will be no interviews scheduled for the first day. 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, Saturday and Sunday only, and these interviews will be scheduled on Saturday, Sunday and Monday respectively.

The Mathematical Sciences Employment Register publishes a bi-monthly bulletin, Employment Information for Mathematicians. Information on this publication and other Register services can be obtained by writing the MSER, P.O. Box 6248, Providence, Rhode Island 02940.

The Mathematical Sciences Employment Register is sponsored by the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics.
STATEMENT BY THE CCMJ EDITORIAL COMMITTEE

A number of readers of the Contents of Contemporary Mathematical Journals (CCMJ) whose name will be changed to Current Mathematical Publications (CMP) in 1975, have commented on the change in the nature of this journal. The Editorial Committee has reviewed these letters and believes it worthwhile to make a number of remarks on this matter.

First, CCMJ does provide a timely and current listing of papers and books. Thus there is only an average of about 10 weeks between the time that a journal issue is received at Mathematical Reviews (MR) and the time that the papers in that issue are listed in CCMJ. (There is no question of waiting two years for an MR review to be on hand.) Further, the Editorial Committee has recommended that this 10 week period be reduced to 7 weeks. It is difficult to compare this time with the situation under the old format of CCMJ.

Second, the present coverage is much broader in scope than previously since in place of the 250-300 journals handled by CCMJ, the present coverage is identical with that of MR—approximately 1200 journals. One qualification may be stated here—some papers will not be listed in CCMJ because they are not judged to be of a kind that MR normally reviews; even though they appear in journals which MR examines; and which, formerly, CCMJ may have covered through its reproduction of the table of contents. By and large, this should not inconvenience the mathematical community although questions have been raised about the coverage in the applied mathematical fields. The question of whether the AMS publications are providing adequate services in the applied areas is now being considered by the CBMS Committee on the Abstracting and Indexing of Applied Mathematics.

Third, it was the view of the Committee on the Index of Mathematical Papers, the Committee to Monitor Problems in Communication, and the CCMJ Committee that a second major advantage of the new CCMJ is that the listing of papers according to the MOS classification scheme permits a reader to search his areas of interest in shorter time.

It may also be remarked that the Editorial Committee has recommended to the Trustees that semi-annual author indexes be published on a current basis in order to significantly increase access to the current literature. Whether this recommendation will be implemented is an open question at this time.

Apart from the fact that some readers prefer the distinctive formats of the individual tables of contents, a format which is inconsistent with a classified arrangement, two principal objections have been raised. The first has to do with what is considered to be poor readability and, more specifically, small type size. Some improvements in appearance have already been made, and a major improvement will be obvious in a few months after MR has acquired new equipment which will produce copy which has an appearance and legibility which is close to that of printing.

Probably the greatest inconvenience that readers have remarked on is the omission of the authors' address. This feature was dropped largely for financial reasons and because its utility to readers was difficult to judge. The author addresses were prepared by examining the original journal issue; where this lacked addresses, no attempt was made to consult the Combined Membership List, the International Directory of Mathematicians, the various Who's Who, or other reference sources. With the increased coverage, the number of authors for whom addresses cannot be found will probably increase. Apart from the possibility of restoring the author addresses, an alternative was considered and adopted on an experimental basis. Under this arrangement, MR offers as a free service to CCMJ subscribers, to supply authors' addresses on request or to forward a letter to an author. The following instructions issued by MR should be followed:

Subscribers are invited to send requests for addresses, or letters addressed to authors, to the editorial offices of Mathematical Reviews, 611 Church Street, Ann Arbor, Michigan 48104. The envelope should be clearly labelled CCMJ and the request should include the author's name, the bibliographic data for the article (journal title, volume number, year and page numbers) and the number of the page of CCMJ on which the article is listed.

Within a week of receipt the letter will be forwarded to the author and the subscriber will be sent a confirmatory postcard giving the address requested; a postcard with the address will be sent even if there is no letter to be forwarded to the author.

It is the hope of the CCMJ Editorial Committee that these remarks will serve to clarify the nature of the present journal and that the changes indicated will on balance provide CCMJ readers with better service.

July 25, 1974
Lowell Schoenfeld, Chairman
Editorial Committee for Current Mathematical Publications

P.S. To Editors of Journals: Papers in your journals will receive prompter listing in CCMJ if page proof is sent to MR as soon as it is available.

L.S.
Information on the backlog of papers for research journals is published in the February and October issues of these journals with the cooperation of the respective editorial boards. Since all columns in the table are not self-explanatory, we include further details on their meaning.

Column 3. This is an estimate of the number of printed pages which have been accepted but are not necessary to maintain copy editing and printing schedules.

Column 5. The first (Q1) and third (Q3) quartiles of the final revision and publication are presented to give a measure of normal dispersion. They do not include misleading extremes, the result of unusual circumstances arising in part from the refereeing system.

The observations are made from the latest issue of each journal received at the Headquarters Offices before the deadline for the appropriate issue of these journals. Waiting times are measured in months from receipt of manuscript to receipt of final publication at the Headquarters Offices. When a paper is revised, the waiting time between an editor's receipt of manuscript and final publication may be much shorter than the case otherwise, so these figures are low to that extent.

<table>
<thead>
<tr>
<th>JOURNAL</th>
<th>Number of issues per year</th>
<th>Approximate number of pages per year</th>
<th>BACKLOG 6/15/74</th>
<th>BACKLOG 12/31/73</th>
<th>Est. time for paper submitted currently to be published (in months)</th>
<th>Q1 Med. Q3 Observed waiting time in latest published issue (in months)</th>
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<td>8-9</td>
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</table>

*NR means that no response was received to a request for information.
**Six issues per year in 1975.
***Date of receipt of manuscript not indicated in this journal.
****The latest issue of this journal contained just one article.
PERSONAL ITEMS

DEANE ARGANBRIGHT of Iowa State University has been appointed a lecturer at the University of Papua New Guinea.

JAMES R. BUNCH of Cornell University has been appointed an associate professorship at the University of California, San Diego, at La Jolla.

KIM KI-HANG BUTLER of the Instituto De Fisica E Matematica, Lisbon, Portugal has been appointed to a professorship at Alabama State University.

GEORGE D. BYRNE of the University of Pittsburgh has been appointed a visiting scientist at the Applied Mathematics Division, Argonne National Laboratory.

RONALD L. CARISLE of Kennesaw Junior College has been appointed to an assistant professorship and to the chairmanship of the Division of Natural Sciences and Mathematics at Atlanta Junior College.

LOKENATH DEBNATH of East Carolina University was appointed to a visiting professorship at the Institute for Fluid Dynamics and Applied Mathematics, University of Maryland for the summer 1974.

RICHARD F. DeMAR of the University of Cincinnati has received a Mrs. A. B. (Dolly) Cohen Award for outstanding achievement in teaching.

ALBERT FEUER of Columbia University has been appointed a post doctoral teaching fellow at Miami University, Oxford, Ohio.

B. A. FUSARO of Queens College, North Carolina, has been appointed to a professorship and to the chairmanship, department of mathematics at Salisbury State College.

THOMAS GARD of the University of Tennessee has been appointed to an assistant professorship at the University of Georgia.

GEORGE R. GORDH, JR., of the University of Kentucky has been appointed to an assistant professorship at Guilford College.

SAMUEL GORENSTEIN of IBM T. J. Watson Research Center, Yorktown Heights has accepted a position with the Department of Economic Research, IBM Corporate Headquarters, Armonk.

JOHN GOSSELIN of Syracuse University has been appointed to an assistant professorship at the University of Georgia.

CHARLES W. GROETSCH of the University of Cincinnati has been appointed to a visiting assistant professorship at the University of Rhode Island.

GERALD JANUSZ of the University of Illinois has been appointed to a visiting associate professorship at Yale University.

WILLIAM A. LAMPE of the University of Hawaii has been appointed a visiting member at the Institute for Advanced Study for 1974–1975.

BENJAMIN LEPSON of the U. S. Naval Research Laboratory has been appointed to a visiting professorship at the University of Maryland, for the academic year 1974–1975.

DALE W. LICK of Russell Sage College has been appointed Dean, School of Sciences at Old Dominion University.

PETER LOEB of the University of Illinois has been appointed to a visiting associate professorship at Yale University for the first term.

EUGENE LUKACS of Bowling Green State University has been designated as a University Professor by the Board of Trustees of that institution.

OSVALDO MARREDO of Francis Marion College has been appointed to a visiting associate professorship at the College of Charleston.

JOHN MILLSON of the Institute for Advanced Study has been appointed to an assistant professorship at Yale University.

MICHAEL A. MINOVITCH of the Jet Propulsion Laboratory has been appointed president of Phaser Telepropulsion, Inc., Los Angeles, California.

MICHAEL MORLEY of Cornell University has been appointed to a visiting professorship at Yale University for the second term.

JUSTIN PETERS has been appointed to an assistant professorship at the Technical University of Munich.

WALTER A. POOR, JR., has been appointed a Wissenschaftlicher Mitarbeiter at the Mathematics Institute of the University of Bonn.

STEPHEN SMALE of the University of California at Berkeley has been appointed to a visiting professorship and member, Cowles Foundation, Yale University for the first term.

LOUIS SUCHESTON of Ohio State University has been appointed to a visiting professorship at the University of British Columbia, for the Canadian academic year 1974–1975.

THEODORE SULLIVAN of the University of South Carolina has been appointed to a systems engineering position with IBM, Miami, Florida.

ELLEN TORRANCE of Sterling College has been appointed to a visiting assistant professorship at Kansas State University.

JOEL L. WEINER of Michigan State University has been appointed to an assistant professorship at the University of Hawaii.

PROMOTIONS

To Deputy Assistant Director for Education, National Science Foundation: FRANCIS G. O'BRIEN.

To Director, Center for Applied Mathematics, Cornell University: JAMES H. BRAMBLE.
To Chairman and Associate Professor, Department of Mathematics, Saint Mary's College: PAUL A. FROESCHL.

To Professor, Miami University, Oxford, Ohio; STANLEY PAYNE; University of Rhode Island: RODNEY D. DRIVER; Yale University: ROBERT H. SZCZARBA.

To Associate Professor, Bowling Green State University: CHARLES H. APPLEBAUM, THOMAS A. HERN, FRED R. McMORRIS, RAYMOND F. SNIPES; Dartmouth College: STEPHEN J. GARLAND; Florida State University: CHIU YEUNG CHAN; Miami University, Oxford, Ohio: DENNIS BURKE, MILTON COX; University of Georgia: FRANK G. LETHER; University of Hawaii: WILLIAM A. LAMPE; University of Northern Iowa: HYO CHUL MYUNG.

To Research Associate, College of Business and Economics, University of Kentucky: EDWARD T. ORDMAN.

INSTRUCTORSHIPS
Yale University: JOSEPH SGRO.

DEATHS
Professor Emeritus ROSS H. BARDELL of the University of Wisconsin-Milwaukee died on May 20, 1974, at the age of 70. He was a member of the Society for 47 years.

Professor C. E. BURES of the California Institute of Technology died on April 30, 1974, at the age of 64. He was a member of the Society for 34 years.

Professor MARIAN E. DANIELLS of Iowa State University died on June 27, 1974, at the age of 88. She was a member of the Society for 49 years.

Dr. EDWIN O. ELLIOTT of Bell Telephone Laboratories died on May 24, 1974, at the age of 46. He was a member of the Society for 21 years.

Professor Emeritus GORDON H. GRAVES of Purdue University died on December 23, 1973, at the age of 89. He was a member of the Society for 51 years.

Professor KONRAD JÖRGENS of the University of Munich died on April 28, 1974, at the age of 47. He was a member of the Society for 10 years.

Professor RICHARD J. KOHLMEYER of Hartwick College died on April 1, 1974, at the age of 54. He was a member of the Society for 6 years.

Professor CORNELIUS LANCZOS of the Dublin Institute for Advanced Study died on June 26, 1974, at the age of 81. He was a member of the Society for 40 years.

Professor Emeritus GEORGE F. McEWEN of Scripps Institute of Oceanography died on March 1, 1972, at the age of 89. He was a member of the Society for 58 years.

Professor PIERRE G. ROBINSON of Iowa State University died on May 8, 1973, at the age of 83. He was a member of the Society for 47 years.

Professor FREDERICK L. WOOD of Hull, Massachusetts, died on December 2, 1971, at the age of 67. He was a member of the Society for 27 years.
NEW AMS PUBLICATIONS

PROCEEDINGS OF THE STEKLOV INSTITUTE

APPROXIMATION OF PERIODIC FUNCTIONS, edited by S. B. Steckin

Volume 109 (1971)
132 pages; list price $18.50; member price $13.88; ISBN 0-8218-3009-0
To order, please specify STEKLO/109

This collection consists of seven papers on the approximation of periodic functions, and related questions. In three of the papers the asymptotic behavior of the norms of trigonometric series and trigonometric polynomials is investigated relative to properties of the Fourier coefficients. In the remaining papers various problems of approximation of periodic and also analytic functions are considered, for example best approximation of periodic analytic functions by trigonometric polynomials on an interval smaller than the period, best approximation of a class of analytic functions by another class, best approximation of periodic functions by spline functions, and linear approximation of continuous periodic functions by trigonometric polynomials.

The titles of the papers and names of the authors follow: "Estimates for the Lebesgue constants" by P.V. Galkin, "Asymptotic behavior of an integral of a trigonometric series" by A.A. Zaharov, "On approximation of continuous periodic functions by Favard sums" by S.B. Steckin, "Approximation by spline functions and estimates of diameters" by Yu. N. Subbotin, "Analytic continuation of functions with error" by L.V. Taĭkov, "An estimate, useful in problems of approximation theory, of the norm of a function by means of its Fourier coefficients" by S.A. Teljakovskiǐ and "Approximation of analytic functions by trigonometric polynomials on a segment smaller than the period" by N.I. Černyh.

COLLECTION OF ARTICLES, II, edited by S.M. Nikol'skiǐ

Number 128 (1972)
306 pages; list price $33.00; member price $24.75; ISBN 0-8218-3028-7
To order, please specify STEKLO/128

This volume is the second collection of articles dedicated to Ivan Matveeviĉ Vinogradov in honor of his eightieth birthday. The collection contains articles by outstanding mathe-

The book also includes sixty-six index and an index.

LECTURES ON LINEAR GROUPS by O.T. O'Meara

Number 22
88 pages; list price $4.10; individual price $3.08; ISBN 0-8218-1672-1
To order, please specify CBMS/22

The notes in this volume evolved from the author's lectures at the California Institute of Technology during the spring of 1968, from ten survey lectures on classical and Chevalley groups at an NSF Regional Conference at Arizona State University in March 1973, and from lectures on linear groups at the University of Notre Dame in the fall of 1973.

The author's goal in these expository lectures is to explain the isomorphism theory of linear groups over integral domains as illustrated by the theorem

\[ \text{PSL}_2(\mathbb{Q}) \cong \text{PSL}_2(\mathbb{Q}_1), \]

for dimensions \( \geq 3 \). The theory that follows is typical of much of the research of the last decade on the isomorphisms of the classical groups over rings. The author starts from scratch, assuming only basic facts from a first course in algebra. The classical theorem on the simplicity of \( \text{PSL}_2(F) \) is proved, and whatever is needed from projective geometry is developed. Since the primary interest is in integral domains, the treatment is commutative throughout. In reorganizing the literature for these lectures the author extends the known theory from groups of linear transformations to groups of collinear transformations, and also improves the isomorphism theory from dimensions \( \leq 5 \) to dimensions \( \geq 3 \).

MEMOIRS OF THE AMERICAN MATHEMATICAL SOCIETY

A LAPLACE TRANSFORM CALCULUS FOR PARTIAL DIFFERENTIAL OPERATORS by Thomas Donaldson

Number 143
166 pages; list price $3.60; member price $2.70; ISBN 0-8218-1843-0
To order, please specify MEMO/143

This Memoir develops a general existence theory for a class of hypoelliptic linear partial differential problems of the form

\[ P(D_t, A)u = \sum A_j \frac{D^j}{t} u = f \]

with boundary conditions of the form

\[ Q_j(D_t, B)u = \sum m B_{kj} D^k_t u = g_j \]

where the coefficients \( \{A_j\} \) and \( \{B_{kj}\} \) are linear partial differential operators with variable coefficients. This theory contains the class of operators parabolic in the sense of Petrovskii as a special case.

The methods developed here require few conditions on the coefficients in (I) and (I'). In particular the orders of the coefficients in (I) and (I') may be essentially independent of one another and no homogeneity assumption on the symbols is required.

GENERIC HAMILTONIAN DYNAMICAL SYSTEMS ARE NEITHER INTEGRABLE NOR ERGODIC by L. Markus and K. R. Meyer

Number 144
52 pages; list price $2.80; member price $2.10; ISBN 0-8218-1844-9
To order, please specify MEMO/144

The general theory of Hamiltonian dynamical systems on global symplectic manifolds is reviewed and developed, as motivated by historical references and classical problems. In particular the modern results on stable equilibrium points and angle integrals are carefully presented and related to the studies originated by Lagrange, Liouville and others. Then a consideration of the Baire space \( K \) of all Hamiltonians on a given symplectic manifold \( M \) leads to an analysis of generic properties of Hamiltonian systems, with the main theorem as paraphrased in the title of this Memoir, "Generic Hamiltonian Dynamical Systems Are Neither Integrable nor Ergodic."

FOURIER ANALYSIS OF UNBOUNDED MEASURES ON LOCALLY COMPACT ABELIAN GROUPS by Loren Argabright and Jesus Gil de Lamadrid

Number 145
53 pages; list price $2.80; member price $2.10; ISBN 0-8218-1845-7
To order, please specify MEMO/145

Let \( G \) be a locally compact group with character group \( \Gamma \). A measure (bounded or unbounded) on \( G \) is said to be transformable if there exists a measure \( \mu \) on \( \Gamma \) such that, for every continuous function \( f \) with compact support, the function \( \gamma \mapsto f(\gamma^{-1}) \) belongs to \( L_2(\mu) \) and

\[ \int_{\Gamma} f(\gamma) d\mu(\gamma) = \int_{\Gamma} |f(\gamma^{-1})|^2 d\nu(\gamma). \]

If one systematically identifies locally integrable functions with absolutely continuous measures, the resulting transformation \( \mu \mapsto \tilde{\mu} \) simultaneously extends the Fourier–Stieltjes transform, and the classical \( L_2 \)-Fourier transform (1 \( \neq 2 \)). It also encompasses Bochner's theorem in the sense that it assigns to each positive definite measure on \( G \) a positive measure on \( \Gamma \). The present theory thus provides a unifying framework under which the
various classical notions of Fourier transforms can be simultaneously subsumed and, in addition, leads to generalizations of a variety of important results of harmonic analysis, including the Plancherel theorem and the Poisson summation formula.

The present theory contains many formal similarities to distribution theory. It is shown in fact that every transformable measure is a tempered distribution in the sense of L. Schwartz and F. Bruhat. However, the main results and techniques employed are measure-theoretic in nature and are necessarily developed quite independently of distribution theory.

DERIVATIONS AND ENDOMORPHISMS OF BANACH ALGEBRAS OF POWER SERIES by Sandy Grabiner

Number 146
124 pages; list price $3.30; member price $2.48; ISBN 0-8218-1846-5
To order, please specify MEMO/146

This Memoir is a study of the structure of certain radical Banach algebras \( B \) which are continuously embedded in the algebra of complex formal power series in the indeterminate \( z \). Under appropriate hypotheses on the sequence \( \{ \| z^n \| \} \), the derivations, endomorphisms, and automorphisms of \( B \) are described and the structure of the automorphism group of \( B \) as a topological group, is determined. The final third of the Memoir applies the structure theory of Banach algebras of power series to study weighted shifts on Banach spaces; spaces of analytic functions, such as \( H^p \) spaces, under the convolution product:

\[
F \ast G(x) = \int_0^x F(x - t)G(t) \, dt;
\]

and the formal power series operational calculus for quasi-nilpotent operators.

FINITE GROUPS WHOSE 2-SUBGROUPS ARE GENERATED BY AT MOST 4 ELEMENTS by Daniel Gorenstein and Koichiro Harada

Number 147
464 pages; list price $6.40; member price $4.20; ISBN 0-8218-1847-3
To order, please specify MEMO/147

In this Memoir the authors determine all finite simple groups each of whose 2-subgroups can be generated by at most 4 elements. As a corollary they obtain a classification of all simple groups whose Sylow 2-subgroups possess no elementary abelian normal subgroups of order 8. This Memoir will provide the reader with a broad knowledge of the basic group-theoretic techniques needed for the further study of simple groups of low 2-rank.

Recent Advances in the Representation Theory of Rings and \( C^* \)-algebras by Continuous Sections, edited by K.H. Hofmann and J. Liukkonen

Number 148
182 pages; list price $4.00; member price $3.00; ISBN 0-8218-1848-1
To order, please specify MEMO/148

This Memoir contains the proceedings of a seminar on Recent Progress Made in the General Theory of the Representation of Rings and Topological Algebras by Continuous Sections in Sheaves and Bundles held at Tulane University, March 28-April 5, 1973. This collection of articles represents the majority of the contributions presented by the participants of the seminar; it contains, in addition, three papers which were presented by title.

The seminar was divided into two main sections: One was concerned with sheaf representation, the other with bundle representation. While the first one was concerned with ringed spaces, applications to logic, universal algebra and lattice theory, the second was almost exclusively devoted to \( C^* \)-algebra and Hilbert space bundles or closely related material.

The algebraic aspect of the theory is represented by articles by Mulvey, Keimel and Werner, and by Wolf. Mulvey's contribution presents a systematic view of ringed spaces and their module theory. Somewhat in the spirit of nonstandard analysis, in a suitably circumscribed language and logic, certain ringed spaces over \( X \) are interpreted as rings, local rings, fields, as the ring of integers, the field of rationals, the field of reals, etc. (the last one being, by way of example, the sheaf \( C(\mathbb{R}) \) of germs of real valued functions on \( X \). A \( C(X)- \) module is thus interpreted as a real vector space. In this framework Kaplansky's theorem characterizing the projective modules over a local ring as free applies to yield a proof of Swan's theorem that the category of real vector bundles over a compact space \( X \) is equivalent to the category of finitely generated projective \( C(X)- \) modules. The other contributions in this portion of the Memoir are concerned with applications of sectional representation to universal algebra; the bibliography of the subject indicates that such applications have become rather frequent. Keimel and Werner find an application to prove a duality theory for a certain equational class of algebras which reduces in a very special case to the classical duality of Stone's between Boolean spaces and Boolean algebras. Wolf presents a sectional representation theorem for universal algebras which generalizes much of what is in the literature in this direction.

The second section of the seminar was much more analytical. It was principally concerned with representation and classification...
Theorems and with applications of C*-algebra bundles, J. Varela presented a new approach to a portion of the representation theory for C*-algebras described in generality by Dauns and Hofmann; he proved a duality theorem for C*-algebras with identity which generalizes the Gelfand-Naimark duality between compact spaces and commutative C*-algebras (with identity). Varela's duality was then used by Greene to expand a duality theorem due to Takahasi (who proved that the category of Hilbert modules over commutative C*-algebras with identity and the category of Hilbert space bundles are dual). Greene removed the restriction of commutativity with the aid of Varela's result. At the same time he developed, parallel to this theory, a generalized theory of Ambrose algebras whose ground ring, instead of being the integers, is taken to be an arbitrary C*-algebra. In all of these considerations the center, respectively centroid of a C*-algebra, plays an important role. The paper by Lazar and Taylor describes the centroid of Pedersen's ideal K of an arbitrary C*-algebra. (K is the non-commutative analog of the ideal of all functions with compact support in the C*-algebra of all continuous functions on a locally compact space which vanish at infinity.) The centroid of K is naturally isomorphic with the algebra of all continuous complex valued functions on the spectrum. In the case of the C*-algebra of a locally compact amenable [Sin] group, Liukkonen gives an explicit description of the centroid and its spectrum (the latter being equivalent to the space of nonzero extreme points in the space of all positive definite functions f with f(1) ≤ 1 which are, in addition, invariant under inner automorphisms). Techniques from the algebraic topology of fiber bundles were applied by Krauss and Lawson to describe explicitly all homogeneous C*-algebras with n-spheres as spectrum with n ≤ 5. Dupré's contribution discusses the classification of certain Hilbert space bundles with variable fibers in terms of homotopy; if (X, A) is a pair of spaces, he considers Hilbert space bundles over X whose fibers have a fixed finite dimension over A and are separable infinite dimensional over the other points. If X is finite dimensional there is a bijection between the isomorphism classes of such bundles and the space [A, G_m] of homotopy classes of maps from A into the Grassmann space G_m of m-dimensional projections of separable Hilbert space in the strong operator topology.

A quick orientation on the details of each contribution may be found in the collection of abstracts which appears at the beginning of the Memoir. For the convenience of the reader who is interested in the literature on the sectional representation of rings and topological algebras the Memoir includes a list of recent references to papers which appeared after the relatively extensive bibliography in Bull. Amer. Math. Soc., 78 (1972), 370-373 or, which, for some reason, did not get listed there and came to our attention recently. A list of errata for this survey article in the Bulletin (loc. cit.) complements this bibliographical appendix.


UNIFORM SIMPLIFICATION IN A FULL NEIGHBORHOOD OF A TRANSITION POINT by Yasataka Sibuya

Number 149
106 pages; list price $3.20; member price $2.40; ISBN 0-8218-1849-X
To order, please specify MEMO/149

This Memoir concerns a method of reducing the asymptotic study of a large class of second order linear differential equations with a transition (turning) point to the same problem for a differential equation of the form

\[ y'' - \lambda y = 2 \left[ x^m + \lambda \sum_{j=1}^{m} \frac{a_j x^{m-j}}{j} \right] y = 0, \]

where \( m \) is the order of the transition point. The method consists of three steps: (i) formal simplification, (ii) uniform asymptotic simplification in a sector with the vertex at the transition point, and (iii) uniform asymptotic simplification in a full neighborhood of the transition point. The main problem is in Step (iii). A uniform simplification in a full neighborhood is constructed by connecting simplifications in various sectors. The heart of the problem is to find a differential equation of form (E) which admits exactly the same Stokes' phenomenon as the given differential equation exhibits around the transition point. Therefore this analysis is based on properties of Stokes' multipliers of solutions of differential equation (E). Such properties are derived and fully utilized. The cases \( m = 1 \) and \( m = 2 \) are used as illustrations.

MATHEMATICAL SURVEYS

TOPICS IN OPERATOR THEORY, edited by C. Pearcy

Number 13
235 pages; list price $23.00; member price $17.25; ISBN 0-8218-1513-X
To order, please specify SURV/13

The five articles in this volume are expository in nature, and they all deal with various aspects of the theory of bounded linear operators on Hilbert space. The volume is very timely, because in the last year or two great progress
has been made on hard problems in this field, and thus operator theory today is a very exciting area of mathematical research. One particular problem on which considerable progress has been made recently is the invariant subspace problem. This is the question whether every bounded linear operator on a separable, infinite-dimensional, complex Hilbert space \( \mathcal{H} \) has a nontrivial invariant subspace. Even though this problem remains unresolved, there are some operators \( T \) on \( \mathcal{H} \) for which the structure of the lattice of all invariant subspaces of \( T \) is known, and the first article in this volume, "Invariant subspaces", by Donald Sarason, is devoted to a discussion of such operators. One of the interesting features of this lucid presentation is the interplay between operator theory and classical analysis.

The second article is entitled "Weighted shift operators and analytic function theory" and was written by Allen Shields. He has taken essentially all of the information presently known about weighted shift operators (with scalar weights) and incorporated it into this comprehensive article. A central theme of the exposition is the interaction between weighted shift operators and analytic function theory, and as an added bonus for the reader, the article contains a list of thirty-two interesting research problems.

The third article in the volume is a treatise entitled "A version of multiplicity theory" by Arlen Brown. The problem treated is how to decide when two normal operators are unitarily equivalent. (Unitary equivalence is the analog for operators of the concept of isomorphism for groups, rings, etc.) The unitary equivalence problem for arbitrary operators is exceedingly difficult, but the theory of spectral multiplicity, which can be approached in several different ways, furnishes a reasonable complete set of unitary invariants for normal operators. The author focuses attention on the concept of a spectral measure, and his clear presentation of this circle of ideas should lead to a better understanding of multiplicity theory by beginners and experts alike.

The fourth article in this volume, "Canonical models" by R.G. Douglas, is concerned with the theory of canonical models for operators on Hilbert space. The central underlying idea is that if \( T \) is any contraction operator on \( \mathcal{H} \) (i.e., if the norm of \( T \) is at most 1), then there is a canonical construction that associates with \( T \) an operator \( \mathcal{M}_T \) that is unitarily equivalent to \( T \), called its "canonical model". One can therefore study \( T \) by studying \( \mathcal{M}_T \) instead, and this theory has made significant progress in the past ten years. The author, who has contributed substantially to the geometrization of this theory, exposes in his article various important components of the theory, and thereby gives the reader much insight into its successes and failures.

The final article in this volume, "A survey of the Lomonosov technique in the theory of invariant subspaces" by Carl Pearcy and Allen Shields, is a survey of some new invariant-subspace theorems that resulted from the brilliant and elegant method of proof introduced by Victor Lomonosov early in 1973. Further study and refinement of this technique should lead to additional progress on the invariant subspace problem.
SPECIAL MEETINGS INFORMATION CENTER

The purpose of this center is to maintain a file on prospective symposia, colloquia, institutes, seminars, special years, meetings of other associations, and to notify the organizers if conflicts in subject matter, dates, or geographical area become apparent. An announcement will be published in these Notices if it contains a call for papers, place, date, subject (when applicable), and speakers; a second announcement will be published only if changes to the original announcement are necessary, or if it appears that additional information should be announced. In general, SMIC announcements of meetings held in the United States and Canada carry only date, title of meeting, place of meeting, speakers (or sometimes general statement on the program), deadline dates for abstracts or contributed papers, and name of person to write for further information. Meetings held outside the North American area may carry slightly more detailed information. Information on the pre-­preliminary planning will be stored in the files, and will be available to anyone desiring information on prospective conferences. All communications on special meetings should be sent to the Special Meetings Information Center of the American Mathematical Society. Deadlines for particular issues of the Notices are the same as the deadlines for abstracts which appear on the inside front cover of each issue.

October 13–16, 1974
FIFTEENTH ANNUAL SYMPOSIUM ON SWITCHING AND AUTOMATA THEORY
Delta Towers Hotel, New Orleans, Louisiana
Sponsors: The IEEE Computer Society Technical Committee on Switching and Automata Theory, with the cooperation of the ACM Special Interest Group for Automata and Computability Theory and the University of New Orleans
Information: Ronald Book, Program Chairman, Harvard University, Cambridge, Massachusetts 02138

October 15, 1974
SYMPOSIUM ON MANPOWER PLANNING
The Institute of Mathematics and its Applications, Essex, England
Program: The symposium will deal with the mathematical models and techniques involved with illustrations of their practical application. These applications include areas such as education and the health service which are of special interest at the national level and also problems arising in individual firms and organizations.
Information: Secretary and Registrar, The Institute of Mathematics and its Applications, Maitland House, Warrior Square, Southend-on-Sea, Essex SS1 2JY, England

October 16–18, 1974
FOURTY-SIXTH NATIONAL MEETING OF ORSA AND XXI INTERNATIONAL MEETING OF TIMS
Americana and El San Juan Hotels, San Juan, Puerto Rico
Program: Sessions on environmental, energy and urban problems, together with a full complement of methodology and application sessions. A wide variety of operations research and management science topics will be covered.
Information: (Abstracts, registration, and hotel cards) ORSA/TIMS Puerto Rico Meeting, 428 East Preston Street, Baltimore, Maryland 21202; (other inquiries) Armando Riesco, General Chairman, ORSA/TIMS Puerto Rico Meeting, P. O. Box 2342, Mayaguez, Puerto Rico 00708

October 24–26, 1974
SYMPOSIUM ON STATISTICS AND RELATED TOPICS
Carleton University, Ottawa, Canada

Information: A. K. Md. Ehsanes Saleh, Department of Mathematics, Carleton University, Ottawa, Canada K1S 5B6

November 2, 1974
SIXTH ILLINOIS NUMBER THEORY CONFERENCE
Illinois State University, Normal, Illinois
Abstracts: 15 to 20-minute talks. Two sentence abstracts. Deadline October 21, 1974
Information: L. E. Eggen, Mathematics Department, Illinois State University, Normal, Illinois 61761

November 4, 1974
SYMPOSIUM ON COMPUTER SCIENCE AND THE EDUCATION OF COMPUTER SCIENTISTS
Scientific Societies Lecture Theatre, Savile Row, London, England
Speakers: C. G. Broyden, Computing Centre, University of Essex; R. P. Churchhouse, Computing Centre, University College, Cardiff; J. H. Howlett, Atlas Computer Laboratory; V. E. Price, Department of Mathematics, The City University, London; J. E. Sellars, Department of Computer Science, Lanchester Polytechnic; J. Cranke, Brunel University
Information: Secretary and Registrar, The Institute of Mathematics and its Applications, Maitland House, Warrior Square, Southend-on-Sea, Essex SS1 2JY, England

November 23, 1974
CONFERENCE ON NON-COMMUTATIVE RINGS
Northern Illinois University, DeKalb, Illinois
Invited speakers: Goro Azumaya, Indiana University; Kent B. Fuller, University of Iowa
Contributed papers: Twenty-minute papers are solicited, for which an abstract should be received by October 25.
Information: John A. Beachy, Department of Mathematical Sciences, Northern Illinois University, DeKalb, Illinois 60115

January 7–9, 1975
CONFERENCE ON OPTIMIZATION IN ACTION
University of Bristol, Bristol, England
Program: The aim of the conference is to provide a forum at which people who have applied optimization techniques to practical problems can present their case studies.
Information: Secretary and Registrar, The Institute of Mathematics and its Applications, Maitland House, Warrior Square, Southend-on-Sea, Essex SS1 2JY, England

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February 10–13, 1975
CONFERENCES ON FINITE GROUPS
C'est Bon Hotel, Park City, Utah
Program: Invited speakers and contributed papers
Sponsor: University of Utah
Information: W.R. Scott, Department of Mathematics.
University of Utah, Salt Lake City, Utah 84112

April 3–6, 1975
SECOND INTERNATIONAL CONFERENCE ON COMPUTERS AND THE HUMANITIES
University of Southern California, Los Angeles, California
Invited papers: Papers and performances, spanning the arts and humanities, are invited. Papers may cover either the design of computer-related research or the results thereof. Performances may include computer-generated music, graphics, etc.
Deadline for abstracts: January 15, 1975
Sponsor: Association for Literary and Linguistic Computing
Information: Robert Dilligan or Rudolf Hirschmann

April 7–10, 1975
CONFERENCE ON THE MATHEMATICS OF FINITE ELEMENTS AND APPLICATIONS
Brunel University, Uxbridge, Middlesex, England
Program: The aim of the conference will be to bring together workers from different disciplines whose common interest if finite element methods. Sessions will include submitted papers on the mathematical theory of finite elements, engineering and scientific applications of finite elements, computational techniques, algorithms and programs for the implementation of finite element techniques.
Information: Secretary and Registrar, The Institute of Mathematics and its Applications, Maitland House, Warrior Square, Southend-on-Sea, Essex SS1 2JY, England

May 5–7, 1975
SEVENTH ANNUAL ACM SYMPOSIUM ON THEORY OF COMPUTING
Albuquerque, New Mexico
Contributed papers: Detailed abstracts by December 2, 1974
Sponsor: ACM Special Interest Group for Automata and Computability Theory
Information: J.W. Carlyle, Department of System Science, 4531 Boelter Hall, University of California, Los Angeles, California 90024

May 12–16, 1975
NINETEENTH ANNUAL MEETING OF THE AUSTRALIAN MATHEMATICAL SOCIETY
James Cook University of North Queensland, Australia
Information: B.B. Newman, Department of Mathematics, James Cook, University of North Queensland, POB 999, Townsville, Qld 4810, Australia

July 1–4, 1975
DUNDEE BIENNALE CONFERENCE ON NUMERICAL ANALYSIS
University of Dundee, Dundee, Scotland
Program: A limited number of submitted papers will be presented. The proceedings will be published in the Lecture Notes in Mathematics Series.
Information: J.L. Morris, Department of Mathematics, University of Dundee, Dundee DD1 4HN, Scotland

July 14–18, 1975
FIFTH BRITISH COMBINATORIAL CONFERENCE
University of Aberdeen, Aberdeen, Scotland
Program: Invited and contributed lectures
Deadline for abstracts: January 15, 1975
Information: (until December 31) C., St. J.A. Nash-Williams, Department of Mathematics, King's College, Aberdeen AB9 2UB, Scotland; (after January 1, 1975) C. St. J.A. Nash-Williams, Department of Mathematics, University of Reading, Whiteknights, Reading RG6 2AX, England

July 23–26, 1975
TWENTY-SECOND INTERNATIONAL MEETING OF THE INSTITUTE OF MANAGEMENT SCIENCES (TIMS)
International Conference Center and Kyoto University, Kyoto, Japan
Program: The program will feature presentations and active dialogue with other disciplines such as information systems, legal and policy sciences, behavioral and life sciences, and industrial engineering and other technologies, and will focus on the sources of the next generation of operations research/management sciences models.
The meeting is being held in cooperation with The International Federation of Operational Research Societies (IFORS).
Information: Julio Bucatinsky, IBM Corporation, 2651 Strang Boulevard, Yorktown Heights, New York 10598

September 2–12, 1975
DURHAM SYMPOSIUM ON L-FUNCTIONS AND GALOIS PROPERTIES OF NUMBER FIELDS
Durham University, Durham, England
Program: The fourth Working Research Symposium at Durham will bear the title, "Algebraic Number Theory: L-Functions and Galois Properties of Number Fields."
Support: (anticipated) Science Research Council and the Royal Society
Information: S.M.J. Wilson, Department of Mathematics, Science Laboratories, Durham DH1 3LE, England

August 30–September 4, 1976
FOURTEENTH INTERNATIONAL CONGRESS OF THEORETICAL AND APPLIED MECHANICS
Delft University of Technology, Delft, The Netherlands
Program: The Congress will encompass the entire field of science of analytical, solid and fluid mechanics, including applications.
Contributed papers: Approximately 200 contributed papers will be presented. Participants are asked to submit a summary of about 500 words by March 15, 1976, to the Congress Office in the Hague. The Office will forward the summaries to the Program Committee responsible for selection.

CHANGES OF DATES:
May 13–16, 1975 (formerly May 21–23, 1975)
1975 INTERNATIONAL SYMPOSIUM ON MULTIPLE-VALUED LOGIC
Indiana University, Bloomington, Indiana 47401

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The QUERIES column is published in each issue of these Notices. This column welcomes questions from AMS members regarding mathematical matters such as details of, or references to, vaguely remembered theorems, sources of exposition of folk theorems, or the state of current knowledge concerning various conjectures. When appropriate, replies from readers will be edited into a definitive composite answer and published in a subsequent column. All answers received to QUERIES will ultimately be forwarded to the questioner. Consequently, all items submitted for consideration for possible publication in this column should include the name and complete mailing address of the person who is to receive the replies. The queries themselves, and responses to such queries, should be typewritten if at all possible and sent to Professor Wendell H. Fleming, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940.

QUERIES

Edited by Wendell H. Fleming

The QUERIES column is published in each issue of these Notices. This column welcomes questions from AMS members regarding mathematical matters such as details of, or references to, vaguely remembered theorems, sources of exposition of folk theorems, or the state of current knowledge concerning various conjectures. When appropriate, replies from readers will be edited into a definitive composite answer and published in a subsequent column. All answers received to QUERIES will ultimately be forwarded to the questioner. Consequently, all items submitted for consideration for possible publication in this column should include the name and complete mailing address of the person who is to receive the replies. The queries themselves, and responses to such queries, should be typewritten if at all possible and sent to Professor Wendell H. Fleming, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940.

QUERIES

46. Richard Steinberg (Box 1096, Reed College, Portland, Oregon 97202). I am interested in obtaining knowledge of any recent results in the Three Color Problem—the problem in graph theory asking under what conditions a planar graph can be face-colored in three colors.

47. Stanley E. Hayes (Department of Mathematics, State University College, New Paltz, New York 12561). It is known that Tychonov's theorem is equivalent to the axioms of choice. Is it known whether the following special cases are weaker than the axiom of choice?

1. The product of finite topological spaces is compact.
2. A power of a finite space is compact.

48. Otmar H"{a}kik (Department of Mathematics and Statistics, Case Western Reserve University, Cleveland, Ohio 44106). I recall reading a description of the bread-and-butter (buttered toast?) experiment, in which a slice of bread was spun, and the frequency of "buttered side down" computed; the result was significantly over one-half, and provided a tongue-in-cheek measure of the extent to which Nature is antagonistic. Would anyone supply this or related references? (This might be a pre-1965 graduate level textbook, odd-numbered page and footnote.)

49. Alfred J. Lazar (Department of Mathematics, University of Massachusetts, Amherst, Massachusetts 01002). Let $H$ be an infinite dimensional (complex or real) Hilbert space and $n$ a natural number. Consider the set $S$ of all the $n$-dimensional subspaces of $H$ with the metric given by the Hausdorff distance between the closed unit balls. Is $S$ contractible? Are the closed balls of $S$ contractible?

50. R. K. Patnak (Department of Mathematics, SUNY at Stony Brook, Stony Brook, New York 11790). Suppose we have $n_1$ objects of the ith kind, $i = 1, 2, 3, \ldots, r$, and $k$ identical cells. Let $n = n_1 + n_2 + \cdots + n_r$. Does there exist an explicit formula for the number of ways these $n$ objects can be distributed among these $k$ identical cells, such that each cell has at least one object?

51. L. Heller and W. A. Beyer (Los Alamos Scientific Laboratory, University of California, Los Alamos, New Mexico 87544). Suppose $\sum_{n=0}^{\infty} a_n z^n$ has a radius of convergence $R$, and $r_n(z) = \left[ \sum_{k=0}^{n} a_k z^k \right]$. With $|z_1| < |z_2| < R$, is it possible that $r_n(z_1) > r_n(z_2)$ for all $z$ in some neighborhood of $z_2$.

(a) for infinitely many values of $N$?

(b) for all $N$ except a finite number?

Remarks. (i) P. Lax has shown (unpublished) that (b) is impossible if $R$ is finite, even for a single point $z = z_2$.
(ii) It is obvious that (a) is impossible, even for a single point, if $\lim_{n=\infty} a_n = a \neq 0$. (iii) The function $f(z) = \frac{1}{2} (1+2z) (1-z^2)^{-1}$ shows that (a) is possible at a single point, $z_2 = -\frac{1}{2}$. In this case the $a_n$ have two points of accumulation.

RESPONSES TO QUERIES

 Replies have been received to queries published in recent issues of these Notices, as follows:


Concerning the higher dual spaces of other classical nonreflexive Banach spaces, M. E. Munroe replied as follows:

"The common nonreflexive spaces are either $L$-type (norm given by sum or integral) or $M$-type (norm given by supremum). Logically there are other possibilities, but these seem to be the only practical devices for defining norms that are not uniformly convex. Duals for all the well-known separable spaces are described in S. Banach, Théorie des opérations linéaires, Monografie Mat., PWN, Warsaw, 1932; reprint, Chelsea, New York, 1955 (MR 17, 176). In On bounded linear functional operations, Trans. Amer. Math. Soc. 36 (1934), 865-873, T. H. Hildebrandt introduced a device for describing duals of nonseparable $M$-type spaces. This gives us one example of an explicitly described four-deck structure: $c_0^{(1)}, c_0^{(2)}, c_0^{(4)}, m$.

"Questions: Is there a five-deck structure with an explicit description? Is there a nonseparable $L$-type space whose dual has been explicitly described?"


The editor wishes to thank those who have responded.
VISITING MATHEMATICIANS

The list of visiting mathematicians includes both foreign mathematicians visiting in the United States and Canada, and Americans visiting abroad. Note that there are two separate lists.

American and Canadian Mathematicians Visiting Abroad

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<thead>
<tr>
<th>Name and Home Country</th>
<th>Host Institution</th>
<th>Field of Special Interest</th>
<th>Period of Visit</th>
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</thead>
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<tr>
<td>Arthur, James G. (U.S.A.)</td>
<td>Institut des Hautes Études Scientifiques, France</td>
<td>Lie and Algebraic Groups and Their Representations</td>
<td>1974 – 1975</td>
</tr>
<tr>
<td>Baouendi, Mohamed S. (U.S.A.)</td>
<td>Université de Paris, France</td>
<td>Partial Differential Equations</td>
<td>8/74 – 5/75</td>
</tr>
<tr>
<td>Becker, James C. (U.S.A.)</td>
<td>Oxford University, England</td>
<td>Algebraic Topology</td>
<td>1/75 – 5/75</td>
</tr>
<tr>
<td>Brunner, H. (Canada)</td>
<td>University of Dundee, Scotland</td>
<td>Numerical Analysis</td>
<td>8/74 – 6/75</td>
</tr>
<tr>
<td>Comer, Stephen D. (U.S.A.)</td>
<td>University of Manitoba, Canada</td>
<td>Universal Algebra</td>
<td>9/74 – 6/75</td>
</tr>
<tr>
<td>Craggs, Robert F. (U.S.A.)</td>
<td>University of Iceland, Iceland</td>
<td>Topology</td>
<td>9/74 – 6/75</td>
</tr>
<tr>
<td>DeMeyer, Frank R. (U.S.A.)</td>
<td>Eidgenössische Technische Hochschule, Switzerland</td>
<td>Algebra</td>
<td>9/74 – 7/75</td>
</tr>
<tr>
<td>Dlab, Vlastimil (Canada)</td>
<td>Université de Paris, France</td>
<td>Algebra</td>
<td>7/74 – 6/75</td>
</tr>
<tr>
<td>Ellis, Homer (U.S.A.)</td>
<td>International Centre for Theoretical Physics, Italy</td>
<td>Relativity Theory, Differential Geometry</td>
<td>6/74 – 6/75</td>
</tr>
<tr>
<td>Gaines, Robert E. (U.S.A.)</td>
<td>University of Louvain, Belgium</td>
<td>Ordinary Differential Equations</td>
<td>1/75 – 7/75</td>
</tr>
<tr>
<td>Gray, John W. (U.S.A.)</td>
<td>Eidgenössische Technische Hochschule, Switzerland</td>
<td>Category Theory</td>
<td>9/74 – 6/75</td>
</tr>
<tr>
<td>Hestenes, Marshall (U.S.A.)</td>
<td>Technical University, Eindhoven, Netherlands</td>
<td>Combinatorics, Group Theory</td>
<td>9/74 – 8/75</td>
</tr>
<tr>
<td>Levine, Harold (U.S.A.)</td>
<td>École Polytechnique, France</td>
<td>Differential Topology</td>
<td>9/74 – 2/75</td>
</tr>
<tr>
<td>Liu, Pan-Tai (U.S.A.)</td>
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<td>Optimal Controls and Differential Games</td>
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<td>Matsusaka, Teruhisa (U.S.A.)</td>
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<td>Sinha, Indranand (U.S.A.)</td>
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<td>Thron, Wolfgang (U.S.A.)</td>
<td>Panjab University, India</td>
<td>Analysis, Topology</td>
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**Foreign Mathematicians Visiting in the United States**

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<tr>
<td>Anderson, James M. (England)</td>
<td>University of Illinois, Urbana</td>
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<td>Andrianov, Anatolii N. (U.S.S.R.)</td>
<td>Institute for Advanced Study</td>
<td>Automorphic Forms</td>
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<td>Baas, Nils A. (Norway)</td>
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<td>Babu, G. Jogesh (India)</td>
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<td>Probabilistic Number Theory</td>
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DOCTORATES CONFERRED IN 1973-1974

The following are among those who received doctorates in the mathematical sciences and related subjects from universities in the United States and Canada during the interval July 1973–June 1974. 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 seven numbers are the number of degrees in the categories of 1. Pure Mathematics, 2. Statistics, 3. Operations Research, 4. Computer Science, 5. Applied Mathematics, 6. Mathematics Education, 7. Other. Each entry contains the dissertation title. 152 universities are listed with a total of 1,148 individual names; 232 departments granting doctorates.

ALABAMA

AUBURN UNIVERSITY (6;2,0,0,1,0,3)

Chuang, Teh–Huey
J–matrices and quasi–partial isometries

Hattaway, Walter Jerry
The Chipman inverse

Khleif, Subaii Basim
The deformation of an elastic perfectly plastic sphere

Moreman, Douglas
Convex topology

Steedley, Dwight M.
Separable quasigroups

Straley, William
Applications of set–valued functions to topological spaces

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

Miller, Maurice Hugh, Jr.
Some topological properties of discontinuous functions

Wright, Patricia Libscomb
Fixed points in dendrites and tree–like continua

ARIZONA

ARIZONA STATE UNIVERSITY (2;0,0,0,0,0,2)

Neves, Kenneth Wayne
Numerical solution of functional differential equations with state dependent lags

Utter, Donald Freeman, Jr.
Variational and convergence properties of splines used for curve design

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

Armsen, Gerhard Moritz
Geodesic fields in the calculus of variations for multiple integrals

DeFranco, Ronald James
Stability results for multiple Volterra integral equations

Kaigh, William Daniel
The weak convergence of recurrent random walk conditioned by a late return to zero

ARKANSAS

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

Ashmore, Billy Linn
Subgroups of P–groups via representations

Deo, Satya
Sheaf cohomology, a cohomology theory and the tautness property of cohomology theories

Hogan, Doyne Turner
On quasi–uniform spaces

Mukherjee, Tarun K.
Solutions to some open problems concerning the open mapping theorem

Norwood, Dwight Lemar
Cohomology with compact support

Tsai, Yen-shung
Commutative Archimedean semigroups

CALIFORNIA

CALIFORNIA INSTITUTE OF TECHNOLOGY (9;3,0,0,0,4,0,2)

Clapham, Paul C.
Steiner triple systems with block–transitive automorphism groups

Ford, Lawrence
Generalized multipliers on locally compact Abelian groups

Huffman, William Cary
Eigenvalue structure in primitive linear groups

Lam, Clement
Rational G–circulants satisfying the matrix equation $A^2 = df + \lambda J$

Morris, Howard
Two pigeon hole principles and unions of convexly disjoint sets

Department of Applied Mathematics

Boo, James A.
A model biochemical reaction

Brabston, Donald C., Jr.
Numerical solutions of boundary value problems

Mazaika, Paul K.
On the settling speed of dilute arrays of spheres

White, Andrew B., Jr.
Numerical solution of two–point boundary value problems

CLAREMONT GRADUATE SCHOOL (3;3,0,0,0,0,0,0)

Bellenot, Steven Francis
Completeness and reflexivity properties in topological vector spaces using standard and nonstandard methods

Cuzick, Jack M.
On the moments of the number of curve crossings by a stationary Gaussian process

Schultz, Henry Joseph
Banach and Fréchet algebras of power series

STANFORD UNIVERSITY (18;4,0,13,0,0,1)

Kockinos, Constantin Neophytos
Jets, derivations, and deformation of pseudogroup structures

Lind, Douglas Allen
Locally compact measure preserving flows

Majda, Andrew Joseph
Coercive inequalities for nonelliptic symmetric systems

Seabury, Chester Cornelius
Some extension theorems for regular maps of Stein manifolds

Simont, Warren Mann
On P–adic L–functions

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UNIVERSITY OF NOTRE DAME (10;10,0,0,0,0,0,0)
Bravaco, Ralph J.
Models and generalized extensions
Geot, Robert Miller III
Semicharacteristic detection of obstructions to rational homotopy equivalence
Lada, Thomas J.
Strong homotopy monads, iterated loop spaces, and transfer
O'Sullivan, John J.
Manifolds without conjugate points
Peltier, Charles Francis
Classifying spaces for sectioning multiples of a symplectic line bundle
Phillips, John Gilbert
Genera and modular decomposition numbers
Saenz, Jorge
Framed f-structures on principal toroidal bundles
Shrader-Frechette, Maurice A.
The equivalence of sesquilinear forms
Tung, Chi-Chi
The first main theorem on complex spaces
Wright, Edward T., Jr.
Killing vector fields and harmonic forms

IOWA

IOWA STATE UNIVERSITY (11;4,7,0,0,0,0,0,0)
Dotseth, Gregory Mark
Volterra integral equations: Admissibility results and the generic property of uniqueness of solutions

Harms, Dennis Walter
A direct method based on projections for solving systems of linear equations
Keller, Kirby Joe
Qualitative behavior of integrodifferential systems with applications in reactor dynamics
Lammers, Thomas Allen
Results on nonisotential value distribution of functions meromorphic in a disk

Department of Statistics
Batteese, George
Parametric models for response errors in survey sampling
El-Sabbagh, Mohamed
Aspects of the convergence of Bayes policies and posterior distribution for Markov decision processes
Goebel, John Jeffrey
Nonlinear regression in the presence of autocorrelated errors
Grimes, Joseph E.
Regression type estimators based on preliminary test of significance
Karpinski, Kazimierz F.
Conditional cum sigmas, factorial experiments, and expectation of mean squares
Salen, M. A.
Alternative multivariate normal admissibility criteria
Schmid, John Richard
Solution algorithms for Markov decision processes and sequential analysis

UNIVERSITY OF IOWA (12;6,3,0,0,0,0)
Grahek, Michael Arthur
Collapsing low dimensional polyhedra
Hubbard, Steven Andrew
On some classes of mappings on Banach spaces
McKim, James C., Jr.
On spaces whose boundaries are spheres, fake spheres, or Euclidean spaces
Seydel, Robert E.
Translation planes admitting affine homologies
Shimi, Tawfik N.
Fixed point theorems in functional analysis for nonlinear mappings which satisfy certain geometric conditions
Slater, Peter J.
Classifying a-connected graphs

Department of Computer Science
Ciglioglu, Dogan
On the computational properties of a class of cellular automata
Newton, Glen E.
A theory of correctness of concurrent processes
Workman, David A.
On the structural complexity of context-free grammars and languages

Department of Statistics
Jones, Arthur M.
Some location and scale invariant goodness of fit tests for normality
Sager, Thomas W.
Consistency in nonparametric estimation of the mode
Sawyer, Richard L.
Estimating regular functions

KANSAS

KANSAS STATE UNIVERSITY (8;1,7,0,0,0,0,0)
Hatzeshuber, James P.
On a class of Lie groups of equivariant diffeomorphisms

Department of Statistics
Asrabad, Radyullah Restami
Development of a bivariate double exponential and discrimination between bivariate probability models
Bell, Graydon Willis
Parameter estimation in the presence of functional relationships
Bird, Howard Alan
Estimable functions in the nonlinear model
Bowser, Robert Dwight
On the equality of means of two normal distributions with equal coefficients of variation

Heltshle, James Francis
A modified birth-death model for population growth and regulation

Higa, Isamu
Waiting times for the (S-1, S) inventory model

Hobbs, Gerald Robert, Jr.
Some results of the theory of rank tests for two or more samples from categorical population

Krauss, Fritz
Indicators of the growth of entire functions in several variables and in Banach spaces

Hsieh, Ming
A stable time independent queue model for studying the effect of overhead in computing systems

Kroonenberg, Nelly
A comparison of pseudo F-statistics with regard to the split-plot design

Muse, Henry David
Comparison of designs to estimate variance components in a two-way classification model

Burtner, Dale K., Jr.
A generalized Hieß-Schauder decomposition theorem

Costa, Douglas L.
Symmetric algebras and retracts

Prince, Richard G.
Sub-rings of Goldman's quotient ring of a commutative ring

Department of Computer Science
Sub, Charles M.
A stable time independent queue model for studying the effect of overhead in computing systems

KENTUCKY

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

Butcher, Ralph Steven
A generalized Hieß-Schauder decomposition theorem

Costa, Douglas L.
Symmetric algebras and retracts

Prince, Richard G.
Sub-rings of Goldman's quotient ring of a commutative ring

Department of Computer Science
Shub, Charles M.
A stable time independent queue model for studying the effect of overhead in computing systems

LOUISIANA

LOUISIANA STATE UNIVERSITY (4;4, 0, 0, 0, 0, 0, 0)

Hsieh, Ming S.
Quasi-normed ideals of operators on Banach spaces

Kroonenberg, Nelly
Pseudo-interiors of hyperspaces

Smith, Thomas J.
The geometric realization of a group presentation

Vekovius, W. A.
Projective and injective in a setting of axiomatic exactness

UNIVERSITY OF SOUTHWESTERN LOUISIANA (1;0, 1, 0, 0, 0, 0, 0)

Bhalla, Prem
A Bayes selection procedure with particular results for binomial probability parameters

TULANE UNIVERSITY (6;6, 0, 0, 0, 0, 0, 0)

Greene, William A.
Generalizations and functorial aspects of $H^*$-algebras

Helmer, Dietrich
Continuity of group actions

Krauss, Fritz
Structure theory of $C^*$-algebras

LaMartin, William Frederick
$k$-groups

Thomas, David Edward
Freeness and its generalizations in valued vector spaces

Sandefur, James Tandy
Higher order abstract Cauchy problems

MARYLAND

JOHNS HOPKINS UNIVERSITY (24;4, 7, 10, 0, 3, 0, 0)

Adeboye, Adeniran
On the eigenfunctions of the Laplacian on certain Riemannian coverings

Butz, Jeffrey
Properties of Hankel operators

Prevatt, Truman
Asymptotic integration and singular boundary value problems for ordinary differential equations

Snyder, Robert L.
Vector invariants for the classical groups

Department of Mathematical Sciences

Aniela, Yash Paul
On a class of set covering problems

Berkowitz, Allen
Operational decisions in outpatient clinics

Bisschop, Johannes Jacobus
Solution representations for nonlinear systems and the controllability problem

Brown, Kenneth G.
Estimation of heteroscedastic variances with linear structures

Drez-Camodo, Javier Marquez
A null-space approach to the linearly constrained non-linear programming problem

Fox, Kenneth R.
Production scheduling on parallel lines with dependencies

Holl, Stephen T.
Efficient solutions to a multicriteria linear program with application to an institute of higher education

Love, Robert R., Jr.
Multi-commodity production and distribution scheduling with capacity and changeover restrictions

Moore, Thomas G.
The central cutting plane algorithm

Plionis, Dimitri A.
A stochastic model for an investment portfolio revision model

Polyzos, Paul S.
Optimal partitioning of discrete point sets with applications in location theory and cluster analysis

Smith, Benjamin Thomas
Nash equilibria in a sealed bid auction

Woreham, Richard H.
Discrete pursuit-evasion games with no information: The circle game

Wu, Margaret Chien-jung
Asymptotic behavior of posterior distributions and Bayes' estimators for the independent not identically distributed case

Yilmaz, Mustafa R.
Sequential testing in automated health screening

Department of Biostatistics

Greenstreet, Richard
Multivariate aspects of finite population sampling under linear models

Hartz, Arthur
Finding prediction equations using least squares regression

Schaible, Wesley L.
Bias in the estimation of finite population parameters from incomplete sample data

Wang, Chao-Ling
Least squares with inequality constraints for binary data

Zuraik, Huda
Demand for contraception in Pakistan dialogue between data and theory

UNIVERSITY OF MARYLAND (20;11, 0, 0, 3, 6, 0, 0)

Bock, David N.
On the Navier-Stokes equations in noncylindrical domains

Bravy, Steve
Generalizing the Grothendieck prime spectrum
Briggs, Albert W., Jr.
A classification of the normal congruence subgroups of the simplectic modular group

Dillon, John
Elementary Hadamard difference sets

Foti, James
Asymptotic behavior of solutions of perturbed autonomous contingent equations

Francaviglia, Sebastiano
Singualr integrals on Lipschitz lines

Jaworski, Allan
Mathematical models and the control of infectious disease

Grainger, Hennessey

Francaviglia, Oberlin, Daniel M.

Leventhal, Martin, Robert Paul

Luebbe, Raymond

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Shoenfeld, Peter

Department of Computer Science

Cook, Craig
Grammatical inference by heuristic search

Fishman, Daniel
Experiments with a resolution-based deductive question-answering system and a proposed clause representation for parallel search

Milgram, David
Web automata

MASSACHUSETTS

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

Adams, William Briggs
Near integral domains and fixed-point-free automorphisms

Esch, Linda Sue
Commutator and distributor theory in nearrings

Yang, Shok
Condition of finite element matrices

BRANDEIS UNIVERSITY (6;6, 0, 0, 0, 0, 0, 0)

Ackerman, Michael R.
On the generating functions of certain Eisenstein series

Bandes, Dean
S-equivalence and modules of genus one knots

Flashman, Martin
The homology of the loop space of certain pushouts

Mesirov, Jill
Perturbation theory for the existence of critical points in the calculus of variations

Sheets, Ronald Paxton
A criterion for the rigidity of the union of rigid subschemes

Tan, Vo Van
On the classification of Q-convex complex spaces by their compact analytic subvarieties

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

Perry, Robert J.
Rational models as generators of triples through reflector and coreflector functors

HARVARD UNIVERSITY (38;8, 7, 0, 0, 23, 0, 0)

Buchner, Michael Anthony
Stability of cut loci

Candidotti, Alan
Iwasawa invariants in Z1 extensions of number fields

Carroll, Joseph Edgar
On the 2-primary part of K20 and on Z2-extensions for imaginary quadratic fields

Godfrey, Michael Colin
Ideals of orbits of nilpotent Lie algebras

Kramer, Kenneth B.
Two-descent for elliptic curves in characteristic two

Myers, Jerome Francis
p-adic Schottky groups

Pinkham, Henry Charles
Deformations of algebraic varieties with Gm action

Shapiro, George Sandor
Some aspects of balayage of Fourier transforms

Committee on Applied Mathematics

Goldman, Neil L.
Fully plastic crack problems

Narayanam, Savithri
Quasi geostopic waves in the open ocean

Department of Biostatistics

Hartz, Stuart Carl
An evaluation of bias in a logistic odds ratio function

Department of Statistics

Diaconis, Persi
Weak and strong averages in probability and the theory of numbers

Donner, Allan Phillip
The use of auxiliary information in the design of clinical trials when there are one or more categories of patients

Krueger, Abba Meyer
Bounds on moments and percentiles from group data

Mellor, Robert Walter
Subsample replication variance estimators

Sutherland, Michael Reed
Estimation in large sparse multinomials

Weisberg, Sanford
Contributions to order statistics

Division of Engineering and Applied Physics

Antal, Michael J., Jr.
The triple center approximation for charge exchange in atomic scattering theory

Baras, John S.
Intrinsic models for infinite dimensional linear systems

Brosgol, Benjamin M.
Deterministic translation grammars

Dobkin, David P.
on the complexity of a class of arithmetic computations

Downey, Peter J.
Formal languages and recursion schemes

Fagen, Robert M.
Theoretical bases for the evolution of play in animals

Hartman, William H.
Topics in team theory; Cost relevant nesting and random observation sets

Hirschorn, Ronald M.
Topological semigroups and controllability of bilinear systems

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Lind, Matthew M.
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Adaptive routing algorithms for distributed computer networks

Muradilharam, Ramalingam
Parameterized solution of a family of minimax problems

Oksman, Warren
Markov decision properties with utility independent objective functions

Pliskin, Joseph
The management of patients with end-stage renal failure: A decision theoretic approach

Spitzen, Jay Michael
Elastic-plastic analysis of combined mode crack problems

Videc, Bernard
Nonlinear random boundary value problems for ordinary differential equations

Williamson, Darrell
Approaches to automatic programming

Yang, Frank F.
Photochemistry and transport processes in the Earth and Venus atmosphere

Wiggins, Richard H., Jr.
Numerical solution of the Fokker-Planck equation with application to control theory

Williamson, Darrell
A geometric theory of oscillations in nonlinear feedback systems

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
(s2,20, 1, 1, 4, 5, 0, 2)

Abramson, Fred G.
Flipping properties and equiconsistency results for large cardinals

Barker, William H.
Positive definite distributions on semisimple Lie groups

Bell, David E.
Resolution of duality gaps in discrete optimization

Blau, Irwin
The value of information in nonzero-sum stochastic games

Bonneau, Richard J.
Fast polynomial operations using the fast Fourier transform

Collino, Alberto
The Chow ring of symmetric products of curves

Dwyer, William G.
Strong convergence of the Eilenberg-Moore spectral sequence

Erickson, Stanley A., Jr.
Vibrations and instabilities of a disk galaxy with modified gravity

Gechter, Jerry
Gaussian sums for Artin L-series

Goldhammer, Arthur L.
Some results on topological cobordism

Goldstein, Ira P.
Understanding fixed instruction turtle programs

Grossman, Jerrold W.
A homotopy theory of pro-spaces

Hager, William W.
Rates of convergence for discrete approximations to problems in control theory

Harrington, Leo A.
Contributions to recursion theory on higher types

Hendel, Russell J.
Improvements in estimates of linear forms of algebraic numbers and applications

Hendricks, Edward C.
Triangulation of stratified sets

Ho, Siu-Ming
On the isotropy group of a homogeneous polynomial

Hu, Men-chang
Determination of the conical distributions for the rank one symmetric spaces

Klein, Ruben
Topics on Gaussian sample functions

Lax, Robert F.
On the variety of special divisors and moduli

Lowenthal, Francis D.
The minimal pair problem for higher type objects

Metcalfe, Ralph W.
Spectral methods for boundary value problems in fluid mechanics

Rudolph, Lee N.
Morse theory of a surface in $\mathbb{CP}^3$

Shah, Jayant M.
Monodromy of semistable quartic surfaces and sextic double planes

Sussman, Gerald J.
A computational model of skill acquisition

Wang, Da-Lun
Recovering degree sequences by graphs with special properties

Yao, Foong Frances
On lower bounds for computing the 1-th largest element

Zaslavsky, Thomas K.
Facing up to arrangements: Or, how to count the faces of an arrangement of hyperplanes, and other matters

Zuker, Michael
Speeds of convergence of random probability measures

UNIVERSITY OF MASSACHUSETTS (5;4, 0, 0, 1, 0, 0, 0)

Ho, Yin
Harmonic analysis on symmetric pairs

Jacobs, Donald R.
Lie derivations on the skew elements of a simple Lie algebra with involution

Wakin, Shirley A.
The degree of symmetry of a product of three manifolds

White, Robert Ernest
Linear differential operators with interior regularity

Department of Computer and Information Science

Michigan State University (11;4, 1, 0, 4, 1, 0, 1)

Chantip, Suchat
Differential equations invariant under one-parameter transformation groups

Kim, Paik Kee
PL involutions on lens spaces and other 3-manifolds

Meng, Daniel H-C.
Matchings and coverings for graphs

Miamee, Abolghassem
Banach space valued stationary stochastic processes and the factorization of nonnegative operator valued functions on a Banach space

Natsheh, Muhammad A.
Piecewise linear involutions on $\mathbb{P}^2 \times \mathbb{S}^1$

Shaw, Donald
Involutions of 3-manifolds with a 2-dimensional fixed point set component

Department of Computer Science

Chang, Lung-Hsiung
Analysis of faulty logic networks

Gates, Geoffrey W.
A computer system load model based on cluster analysis
Hansen, John  
Structural properties of processes

Williams, Kenneth L.  
U-tree automata: Machines that can classify patterns

Department of Statistics and Probability

Singh, Radhey  
Estimation of derivations of average of densities and sequence-compound estimation in exponential families

UNIVERSITY OF MICHIGAN (19;14, 2, 0, 0, 0, 0, 3)

Anderson, Gerald A.  
Surgery with coefficients and invariant problems in surgery

Barrow, David L.  
Shock thickness in hyperbolic systems of conservation laws

Bedford, Eric D.  
Totally real submanifolds and the edge of the wedge theorem

Childress, Charles Lynn  
Weierstrass division in quasianalytic local rings

Chiswell, Ian Michael  
Construction of large quasiconvex subgroups of hyperbolic 3-groups

Day, Kenneth M.  
Codimension-one Morse theories

Fiakow, Lawrence A.  
Non-quasitriangular operations and metric properties of the q function

Johnson, Peter D., Jr.  
Approximation numbers of diagonal maps between normed sequence spaces

Kaiser, Paul Joseph  
Existence theorems in the calculus of variations

Liu, Tai-Ping  
Riemann problem for general 2 x 2 systems of conservation laws

Schneider, Dennis M.  
Sufficient sets for some spaces of entire functions

Stocking, Charles D.  
Nonlinear Dirichlet problem in a circle and related questions of Bessel functions

Van Loan, Charles F.  
Generalized singular values with algorithms and applications

Zelger, Michael  
Nonnegative expansions and extremal sets

Department of Biostatistics

Kalsbeek, William D.  
Method for obtaining local postcensal estimates for several types of variables

Noblis, MarijaDurante  
Symptom nonindependence in mathematical models for diagnosis

Department of Statistics

Petell, Howard A.  
Maximum likelihood estimation in censored samples in a non-regular case

Wen, Jen-Shan  
On the commutant of analytic Toeplitz operators

WESTERN MICHIGAN UNIVERSITY (5;3, 0, 0, 0, 0, 0, 2)

Carroll, Timothy B.  
Severance classes and multiplicative arithmetic functions

Hummel, Kenneth Gene  
The automorphism group of the wreath product of finite groups

Lesniak, Linda Marie  
On the theory of Hamiltonian graphs

Nadathur, Krishnamachari  
Linear operators between nonarchimedean Banach spaces

Williamson, James Edward  
On hamiltonian-connected graphs

MINNESOTA

UNIVERSITY OF MINNESOTA (11;2, 2, 0, 3, 0, 0, 4)

Rno, Jung Sik  
Clebsch-Gordan coefficients and special functions related to the Euclidean group in three-space

Sund, Terje  
Structure spaces for groups with compactness conditions

Department of Biometry

Berkat, John A.  
Quantitative assessment of aftercare in the treatment of the chemically dependent

Chern, Ming-fen Myra  
Inheritance of menstrual traits

Hsu, Ping-hwa  
Population regulation in ecosystems

Sandford, Roy L.  
On the accuracy and optimization of tracking systems

Department of Computer, Information, and Control Sciences

Arvind, Lucknow  
Models for the comparison of memory management algorithms

Heath, Richard D.  
Formal computer coordinate transformations of symbolic algebraic equations

Houle, Philip, Jr.  
A study of performance driven scheduling in a multiprocessing system

Department of Statistics

Florian, Dietmar Anton  
Group testing with uncertain test results; Dorfman-type procedures with continuous random variables

Rasmussen, Uttara  
Testing and estimation problems concerning noncentrality parameters

MISSISSIPPI

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

Shores, Richard James  
A subclass H(α) of analytic functions

MISSOURI

UNIVERSITY OF MISSOURI–COLUMBIA

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

Froeschl, Paul A. III  
Chained rings and maximal conductor rings

Getu, Sooyoum  
Generalizing alternative rings

McKinney, James  
On volumes of central sections of convex bodies

McKinney, Judith  
Kernels of measures on completely regular spaces

Thornburg, James Lewis  
Convergent subsequences from sequences of functions
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DAIRTMOHT COLLEGE (4;4, 0, 0, 0, 0, 0)
Hua, Yang
Harmonic analysis on the space of $2 \times 2$ Hermitian matrices and representations of $U(2, 2)$
Jekel, Solomon M.
K(G, 1)'s and real analytic foliations
Liepins, Gunar Eric
A Paley-Wiener theorem for locally compact Abelian groups
Schiffman, Stephan Jay
Ext P-completion in the homotopy category
UNIVERSITY OF NEW HAMPShIRE (1;1, 0, 0, 0, 0, 0)
Lee, Christopher
Dynamic probabilistic systems with continuous parameter Markov chains and semi-Markov processes

NEW JERSEY
PRINCETON UNIVERSITY (23;21, 1, 0, 0, 1, 0, 0)
Adolphson, Alan Carl
A $p$-adic theory of Hecke polynomials
Donkar, Eli N.
On sums of three integral squares in algebraic number fields
Koblitz, Neal Irving
$p$-adic variation of the zeta-function over families of varieties defined over finite fields
Krantz, Steven G.
Optimal Lipschitz and $L^p$ estimates for the equation $u = f$ on strongly pseudoconvex domains
Kraushar, Philip G.
The height and depth of modular lattices, modules, and rings
Lin James Peicheng
$H$-spaces with finitely generated cohomology algebras
Nakagawa, Yoko
Elementary disks and their equivalences
Ocken, Stanley
Parametrized knot theory
Oliver, Robert Alan
Smooth fixed-point free actions of compact Lie groups on disks
Papastavridis, Stavros
The Arf invariant of manifolds with few non-zero Stiefel-Whitney classes
Parks, Harold Raymond
Some new constructions and estimates in the problem of least area
Pitts, Jon T.
Every compact three dimensional manifold contains two dimensional minimal submanifolds
Rosen, Jay S.
Logarithmic Sobolev inequalities and supercontractivity for anharmonic oscillators
Scheffer, Vladimir
Regularity and irregularity of solutions to nonlinear second order elliptic systems of partial differential equations and inequalities
Stoltzfus, Neal W.
Equiavariant concordance of invariant knots
Trauber, Phillip
The continuous cohomology of the Lie algebra of vector fields on a smooth manifold
Washington, Lawrence C.
Class numbers and $Z_p$-extensions
Wong, Bum
Singularities and complex analytic structures on the space of flat bundles over complex manifolds (0)
Yang Ping  
Adjoint type representations of classical groups on cohomology spheres
Yoshida, Hiroyuki  
On the representations of the Galois groups obtained from Hilbert modular forms
Zucker, Steven Mark  
Generalized intermediate Jacobians and the theorem on normal functions

Department of Statistics
Binkowski, Edward S.  
Optimal estimates and robust estimation

RUTGERS UNIVERSITY (15;13, 2, 0, 0, 0, 0, 0, 0)
Boyno, Edward A.  
Group actions with three orbit types
Gentry, Roosevelt  
Compact interpolation between Banach spaces
Gilloli, Antonio  
A class of evolution equations with double characteristics
Goldman, Roy  
A necessary condition for local solvability
Greenberg, Brian V.  
Global dimension of cartesian squares
Guhl, Richard A.  
Two types of recursively enumerable vector spaces
Houme, Jorge  
Local solvability and Cauchy problem for a class of degenerate hyperbolic operators
Jones, Roger  
Inequalities for the ergodic maximal function
Kelterborn, Marian J.  
Abstract uniform structures and uniform spaces with the same completion
Kopcew, David P.  
Forms of certain generalized Witt algebras
Meyerohoff, Alan A.  
Pro proper equivariant maps of complex representation spaces of torus groups
Sharma, Saroj (Jain)  
Flat injective modules and FP-injectivity
Viola Prioli, Ana Maria  
Flat analytic extensions
Viola Prioli, Jorge E.  
On absolutely torsion-free rings and kernel functors

Department of Statistics
Maher, James Alfred  
Bayes equivariant estimators of variance components

NEw MEXICO

UNIVERSITY OF NEW MEXICO (6;5, 0, 0, 0, 0, 0, 0, 0)

Department of Mathematics and Statistics
Bolcourt, Grenfell P.  
A method of moments applied to an invariant imbedding solution of a certain class of Fredholm integral equations
Burris, Charles H., Jr.  
The numerical solution of the generalized eigenvalue problem for rectangular matrices
Crain, Chester Raymond, Jr.  
Independence, essential independence and zero correlation of two random variables conditioned on a third
Gassman, Larry D.  
1. Line critical point determining and point distinguishing graphs; 2. Geodetic orientations of complete k-partite graphs
Hill, Douglas W.  
Estimation of probability functions using splines

ADelphi UNIVeRSITY (1;1, 0, 0, 0, 0, 0, 0)
 Ratay, Gabriella  
The relationship between the commutator and the central factor groups

CITY UNIVERSITY OF NEW YORK (6;6, 0, 0, 0, 0, 0, 0)
Althoen, Steven C.  
A Seifert-van Kampen theorem for the second homotopy group
Braverman, Harvey  
Abelian groups of two and three dimensional simply transitive affine motions
Hoffman, Arlene M.  
Non-linear large deflection bending of a clamped square plate under uniform normal pressure
Kolb, Barry  
Torsion-layers and generalized Hermittan forms
Plakun, Geraldine Taliani  
Non-existence of solutions to the Cauchy problem for first order partial differential equations
Simenauer, Ronald  
A space of modular forms

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NEW YORK

ADelphi UNIVeRSITY (1;1, 0, 0, 0, 0, 0)
 Ratay, Gabriella  
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Non-existence of solutions to the Cauchy problem for first order partial differential equations
Simenauer, Ronald  
A space of modular forms

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Stanton, Robert Joseph
On mean convergence of Fourier series on compact Lie groups

Toomer, Graham Hilton
Lusternik Schnirelman category and the Moore spectral sequence

Biometrics Unit
Brownie, Cavell
Stochastic models allowing age-dependent survival rates for banding experiments on exploited bird populations
Hsuan,Tzat-may Alice
Some chi-square statistics for goodness-of-fit tests
Joiner, James R. R.
Similarity of designs in fractional factorial experiments
Pollock, Kenneth Hugh
The assumption of equal catchability of animals in tag-recapture experiments

Center for Applied Mathematics
Bezdek, James C.
Fuzzy mathematics in pattern classification
Donoghue, Edward S., Jr.
Stochastic models in the theory of chemical reaction rates
Hamilton, Eugene P.
The infinitely renormalized field in the scalar field model
Helfand, H. Mark
An application of the method of multiple scales to problems arising in supersonic aerodynamics and stratified fluid mechanics
Wang, Lilian Shiao-Yen
On dynamic theories for n-person games

Department of Computer Science
Baker, Theodore Paul
Computational complexity and nondeterminism in flowchart programs
Hunt, Harry Bowen III
On the time and tape complexity of languages
Meihorn, Kurt
Polynomial and abstract subrecursive classes
Sahni, Sartaj R.
On the knapsack and other computationally related problems
Williamson, Robert E.
Real-time document retrieval

Department of Operations Research
Fenech, Alan Paul
Asymptotically maximum probability estimators for parameters of symmetric stable distributions
Hsuan, Francis Chin-Yeh
Characterization of the minimal complete class in the statistical decision theory

FORDHAM UNIVERSITY (11;10,0,0,0,1,0,0)
Tsau, Chih-shen
Double multipliers of Banach *-algebras

NEW YORK UNIVERSITY (15;5,1,0,2,6,0,1)
Alpern, Steven
An approximating measure preserving homeomorphism
Betancourt, Octavio L.
Three dimensional computation of magnetohydrodynamic equilibrium of toroidal plasma without axial symmetry
Freilich, Esther
On Haras's modular group
Harten, Amiram
The method of artificial compression for shock and contact discontinuity calculations
Hess, Paul
The counting problem for Sperner families and generalizations thereof
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Jerome, Carl
Robust estimation of location by maximum likelihood
Mullin, Melvin
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Sastri, Chelluri
Long-range correlations in kinetic theory
Schlissel, Arthur
The development of asymptotic solutions of linear ordinary differential equations, 1819–1930
Voronka, Roman W.
Population genetics: Asymptotic analysis of diffusion models
Weinberg, Henry
A horizontal ray theory for ocean acoustics
Zeman, Marvin
Existence and uniqueness theorems for partial differential equations with multiple characteristics

Department of Computer Science
Harrow, Keith
Sub-elementary classes of functions and relations
Hobbs, Jerry R.
A metalanguage for expressing grammatical restrictions in nodal spans parsing of natural language

POLYTECHNIC INSTITUTE OF NEW YORK
(11;10,0,0,0,1,0,0)
Cheung, Shiu Ming
Inverse problems for differential and difference operators
Cohen, Ronald A.
Lattice measures and topologies
D'Ambrosa, Michael J.
Hausdorff compactifications by collections of 0-1 measures
Goldberg, Wallace
On the determination of a Hill's equation from its spectrum
Hery, William J.
Rings of continuous Banach algebra valued functions
Lee, Jing
Nonlinear multistep methods for solving initial value problems in ordinary differential equations
Loehr, Sister Raymond Augustine
Operator generated topologies on topological algebras
Lutfak, Ervin
Dual cross-measures
Sultan, Alan
Lattice compactifications and lattice real compactifications
Tropp, Carl
Circumscribed cubes
Woodruff, David S.
Complete function algebras over topological fields

RENSSELAER POLYTECHNIC INSTITUTE
(9;3,0,1,1,4,0,0)
Department of Mathematical Sciences
Donahue, Edward Colwell
Constraints on paramout matrices to be realized as impedance matrices
Franchi, Edward Richard
Environmental-acoustics models for a moving ocean with emphasis on geostrophic effects
Gillote, Michael Joseph, Jr.
On nonlinear uniform approximation
Hannay, David George
Finite-state automata with recursive-call state transitions
Lax, Melvin David
A method of moments solution to a class of random initial value problems and random boundary value problems
Lockhart, Deborah Frank
Dynamic buckling of imperfection-sensitive structures
Pratt, Thomas Kester
Multiple scaling techniques for studying the evolution of spatially periodic and aperiodic disturbances in nonlinear hydrodynamic stability
Somers, Kay Bergstresser
A generalization of strong unicity
Zorzi, Michael John
A primal method for geometric programming

STATE UNIVERSITY OF NEW YORK AT ALBANY
(6;0,0,0,0,0,0)

Aravamudhan, Renganathan
On symmetry of group algebras of connected
solvable Lie groups
Deeb, Waleed M.
Maximal ideals in $H^m(D)$ adherent to an infinitely
connected domain
Feng, Jinfu
Extreme points and integral mean estimates for
classes of analytic functions
Libera, John J., Jr.
Differentiable quasi-free-like circle actions on
homotopy seven spheres
Mynatt, Helga
Composition operators on spaces of analytic
functions
Stern, Charles
Function spaces and minimal intersections of
peak sets

STATE UNIVERSITY OF NEW YORK AT BINGHAMTON
(2;2,0,0,0,0,0,0)

Department of Mathematical Sciences

Boyd, Michael Wayne
Properties of ultraproduct spaces
Walsh, John J.
Monotone, monotone open, and light open
mappings on manifolds

STATE UNIVERSITY OF NEW YORK AT BUFFALO-
(10;7,0,0,3,0,0,0,0)

Hoefer, Edwin T.
Properties of solutions of linear partial differential
equations given by Bergman integral operators
Klun, Miroslav
Affinity and strength in groups and related structures
Lawn, Samuel D.
The asymptotic behavior of sums of multiplicative
functions
Osondu, Kevin E.
A unified theory of extensions of bins to semigroups
and groups
Painter, George W.
Differentiability and star-shaped sets
Tan, Hung Pheng
$\mathcal{N}$-compactness and strong zero-dimensionality
Yoh, Richard
Conjugate monic and conjugate epic algebraic functors

Department of Computer Science

Furugori, Teiji
A memory model and simulation of memory
processes for driving a car
Huang, Chung-Ping
Global convergence of the QR algorithm for normal
matrices with various shifts and a Jacobi-type
method for finding eigenvalues of an arbitrary matrix
Wang, Chung Chian
An algorithm for the chromatic number of a graph
with application to uniquely colorable graphs and
observations on pairs of orthogonal cliques with
application to the biocromatic coloring of random
graphs

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

Department of Computer Science

Chua, Yap Siong
Analysis and synthesis of feedback queueing models
for time sharing systems
Haq, Inum ul
Security in a statistical data base
Nassi, Issac R.
Control structure semantics for programming
languages

Schantz, Richard E.
Operating system design for a network computer
Yen, Shou-Chien
Representation and implementation of organic
chemical reactors in a heuristic program for the
discovery of organic synthesis routes

SYRACUSE UNIVERSITY (11;4,0,0,7,0,0,0)

Cohen, Elaine
On the degree of approximation of a function by the
partial sums of its Fourier series
Engels, David
Bounded variation and its generalizations
Shah, Gopalda
Differential extensions of $F$-algebras
Shindhelm, Arthur
Generalizations of the Banach-Saks property

Department of Systems and Information Science

Anderson, Henry D.
Optimal selection of secondary indexes in data base
management systems
Ducey, James B.
Analysis of the structure of generalized projective
geometry codes
Goti, Carlos J.
Optimal n-rectangular partitioning of large data
bases for multiple attribute retrieval
Riek, Justus R.
Decoding of some classes of binary cyclic codes
Shaver, Donald P.
Construction of configurations using a non-
enumerative search technique
Statz, Joyce
The development of computer programming concepts
and problem solving abilities among ten-year-olds
learning LOGO
Wang, Robert C.
Non-stationary dynamic programming with additive
and multiplicative rewards

UNIVERSITY OF ROCHESTER (6;2,2,1,0,0,0,0)

Bradley, W. James
Optimal strategies and transition surfaces in a
class of differential games
Gantz, Donald T.
Stochastic iterates of set-to-set transformations
with applications to dynamic systems in economics
Weiss, Laura
A generalization of the fundamental theorem of
algebra to $\Gamma$ structures

Department of Statistics

Chen, Hubert
Subset selection of normal populations with unknown
equal variances
Mietkowski, William Leonard
Some studies involving homogeneity of dispersion

YESHIVA UNIVERSITY (6;5,0,0,0,0,0,0)

Belfer Graduate School of Science

Gogol, Daniel F.
Models of formulas in various languages
Koller, Herbert
Schrödinger operators in the uniform norm
Nienstadt, Helmut
Rates of approximation for stochastic integrals in
Kolmogorov-Smirnov norm
Podlak, Esther
A new method in the study of nonlinear Fredholm
operator equations
Schwartz, Edward Norman
Existential definability in terms of some quadratic
functions
Slater, Morton
Waring's problem for the ring of polynomials and
the irregularity of binary digit distribution

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NORTH CAROLINA
DUKE UNIVERSITY (4:0, 0, 0, 0, 0, 0, 0)
Alexander, Elaine Elliston
Stirling and Eulerian operators
Cozart, David Lee
The nonstandard analysis of locally convex Riesz spaces
Nichols, Elizabeth Agnew
Locally bounded topologies on finite extension fields of the rationals
Weidner, Peter Risk
Fraissé recursiveness on the set of expressions on a finite alphabet

NORTH CAROLINA STATE UNIVERSITY (2:0, 2, 2)
Hall, Frank Jerry
The fundamental matrix of constrained minimization and applications
Wright, Hampton
Coefficient identities derived from symmetric function expansions

Department of Mathematics and Science Education
Clayton, McLouis
The differential effects of three types of structured reviews on the learning and retention of mathematics
Preston, Dorothy K.
Immediate post-learning memory exercises as aids to retention of learning in mathematics

Department of Statistics
Bayne, Charles Kenneth
Protecting main effect models against two-factor interaction bias in fractions of 2^r factorial designs
Castillo-Morales, Alberto
Drawing an optimal tree from a distance matrix
Chromy, James Raymond
Pairwise probabilities in probability non-replacement sampling
Curran, Thomas Cooke
Stochastic models of oxygen transport in respiring tissues

Koong, Ling Jung
A mathematical model for the joint metabolism of nitrogen and energy
Smeach, Stephen Charles
Comparison of stochastic and deterministic models for the kinetic behavior of certain structured enzyme systems
Spann, Robert Michael
The supply of natural resources: the case of oil and natural gas
Young, Sidney Stanley
Analysis of dialled, trialled and quadrangle crosses using a general genetic model

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL (1:0, 0, 0, 0, 0, 1)
Boyd, David M.
Composition operators on the Bergman space and analytic function spaces on the annulus
Lucas, Thomas Dean
Mappings in combinatorial geometry
McVoy, John Michael
Representation of H

Molnar, Richard K.
Smash coproducts and decompositions of Hopf algebras
Molnar, Suzanne Miller
Representing measures with values in locally convex Hausdorff spaces
Thompson, James Edward
The commutant of analytic Toeplitz operators

Department of Computer Science
Austin, Joseph Harold, Jr.
Formal models of binding processes in control programs

Cammon, Robert Laurence, Jr.
State grammar parsing
Mudge, Jonathan Craig
Human factors in the design of a computer-assisted instruction system
Nomura, Kunihiko
Stochastic models for systems of multiple integrated processors
Whitlock, James Smith, Jr.
Modeling computer systems with time-varying Markov chains

Department of Statistics
Davies, Hyton I.
On the sequential estimation of a probability density function
Gould, Jerren A. R.
Automata in environments
Lee, Alan James
Some results in the theory of stochastic processes
O’Fallon, Judith Rich
Discriminant analysis under truncation

OHIO
CASE WESTERN RESERVE UNIVERSITY (1:0, 0, 0, 0, 0, 0)
Fernandes, Lawrenciana V.
Permutations of finite cyclic groups
Gnapp, Steven
Dynamical systems on proximity spaces
Hsu, Berndadette Feng Hsi
On reachable sets
Vincenzi, Fabio Maximo
Limiting distributions of inventory processes induced by simple policies
van Vugt, Elizabeth Maria
Sojourn time problems in the theory of queues
Yeung, Daniel So
Synthesis of time-optimal control

Department of Operations Research
Aggarwal, Vijaykumar
Bimatrix Markovian decision processes and stochastic ratio games
Huckfeldt, Vaughn Eugene
A national planning model for higher education
Kondylis, Emmanuel
A multinational plant capacity expansion system
Micnenzi, Alfred R.
Analysis of feedback models of higher education degree production
Service, Allan A.
A social system measurement model

KENT STATE UNIVERSITY (1:0, 0, 0, 0, 0, 1)
Demko, Stephen G.
L_p error bounds for spline interpolation and linear spline interpolation

OHIO STATE UNIVERSITY (1:0, 0, 0, 0, 0, 0)
Bieberich, Richard Allen
Bounded functions with no spectral gaps
Hansen, Henry Walter, Jr.
The second gap of the Markoff spectrum of Q(l)
McLean, Jeffrey Thomas
Transivities in finite affine and projective planes
Mortens, Robert Lee
On the product of linear forms
Peterson, Roger David
A group ring invariant for finite groups and quadratic forms over semi-local rings
Winkler, William Erwin
Contributions to the theory of Markov chains
Wong, Kwok chi
Restricted representations of classical Lie algebras of prime characteristics
Department of Computer and Information Science

Chan, Paul Shiu-yuen
  An investigation of symmetric radix for computer arithmetic

Gillenson, Mark Lee
  The interactive generation of facial images on a CRT using a heuristic strategy

Hepler, Stephen Philip
  Use of probabilistic automata as models of human performance

Wang, Paul Ting Renn
  Bandwidth minimization, reducibility decomposition, and triangulation of sparse matrices

Department of Statistics

Lam, Chun Choon
  The conditional distribution of $\frac{1}{2} |X_1 - X_2|$ given $\frac{1}{2} |X_1 + X_2|$ and a test for normality

OHIO UNIVERSITY (1;1,0,0,0,0,0,0)

James, Thomas Ray
  The theory of completeness settings

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

Berkey, Dennis D.
  Diagonally dominant systems

Carola, Eugene
  On convex sets of univalent functions in certain linear spaces

Chang, Chiu Cheng
  The relation of Pólya property to uniqueness, expansion, and approximation of functions

Idowu, Elayne
  The p-Frattini subgroup of a finite group

Maslowski, Henryka Buyniski
  Non-associative arithmetic and applications as the logarithmic of non-associative algebras

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

Beehler, Jerry R.
  Categories and semigroups

taylor, Barbara June
  On Wallman rings and embeddings

OKLAHOMA

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

Department of Statistics

Murphy, John R.
  Procedures for grouping a set of observed means

Palmer, John M.
  On certain non-classical procedures applied to the inverse Gaussian

UNIVERSITY OF OKLAHOMA (7;4,0,0,0,0,3,0)

Bennett, John Bruce
  Volterra integral equations and Fréchet differentials

Caponecchi, Waldo Peter
  A comparative study of an advance organizer in mathematics to determine its effectiveness on knowledge acquisition and retention

Denny, William Francis II
  A linear Riemann–Stieltjes integral equation system

Herdman, Terry Lee
  Existence and continuation properties of solutions of a nonlinear Volterra integral equation

Kontogianes, John T.
  The effects on achievement, retention, and attitude of an individualized instructional program in mathematics for prospective elementary school teachers

Nunley, Irene MacGregor
  A study of the child's ability to understand the concept of function

Phillips, Thomas M.
  Completeness in topological spaces

OREGON

OREGON STATE UNIVERSITY (14;5,6,0,0,2,0,1)

Baker, Steven Michael
  Obstruction theory for simplicial bundles

Dastrange, Nasser
  On the reconstruction of band-limited signals from sampled values

Hartvigson, Zenas Russell
  The completeness axiom of the Lobachevskian geometry

Hook, Donald George
  Effects of conjunctivity on the inertia of complex matrices

Ng, Dina Ng
  An effective criterion for congruence of real symmetric matrix pairs

Solmon, Donald Clyde
  The X-ray transform

Toms, Ralph Marvin
  Globally optimal Runge–Kutta methods

Un, Elizabeth Lingfoong
  Matrices conjunctive with their adjoints

Department of Statistics

Armstrong, Gerald Andrew
  A characterization of strongly identifiable linear functionals of mixing distributions

Deaton, Leonard W.
  A Bayesian approach to regression

Dodge, Yadolah
  Estimability considerations of N-way classification experimental arrangements with missing observations

Fegan, George R.
  The pure birth process with time-independent, unequal transition parameters: Maximum likelihood estimation; exact and computational forms for the expectation and the variance of the process

Haff, Leonard R.
  Bayesian regression with autoregressive priors

Olsen, Dale E.
  Statistical prediction intervals

UNIVERSITY OF OREGON (3;3,0,0,0,0,0,0)

Bekes, Robert Andrew
  Reductive algebras

Penk, Anna Michaelides
  Two forms of choice for an elementary topos

Potluri, Venkata Rao
  Finite groups having a unique irreducible character of a given degree

PENNSYLVANIA

CARNEGIE–MELLON UNIVERSITY (21;4,1,0,14,1,0,1)

Hlavac, Paul P.
  Geometrical and analytical properties of the generalized Lo-spaces $N_1 (E)$

Kung, Hsiang-Tsung
  Topics in analytic computational complexity

Kuo, Tsung-hai
  On Grothendieck spaces and conjugate Banach spaces with Radon-Nikodym property

Naber, Gregory L.
  Problems from the theory of coverings, dimension theory and cardinal invariants

Purisch, Steven
  The orderability and suborderability of topological spaces

Department of Computer Science

Aygun, Birol
  Dynamic analysis of execution: Possibilities, techniques and problems

Barbacci, Mario Roberto
  Automated exploration of the design space for register transfer systems

Chanon, Robert Noyes
  On a measure of program structure
Chen, Robert Chia-Hua
Bus communications systems
Farley, Arthur
VIPS: A visual imagery and perception system; the result of a protocol analysis
Hansen, Gilbert J.
Adaptive systems for the dynamic run-time optimization of programs
Huen, Wing Hing
A unifying notation and analysis of modular, register transfer (RT) control
Jones, Anita Katherine
Protection in programmed systems
Lipton, Richard Jay
On synchronization primitive systems
Mann, William Carlton
Memory processes for information assimilation
Morgan, Thomas Patrick
The symbolic imagery hypothesis: An empirical investigation via a product system simulation of human behavior in a visualization task
Price, William Robert
A virtual memory mechanism for implementing protection in a family of operating systems
Reeker, Larry H.
A problem solving theory of syntactic acquisition
Wile, David Sheridan
A generative, nested sequential basis for general purpose programming languages
Department of Statistics
Barnett, William Arnold
Labor supply and the allocation of consumption expenditure
Talwar, Prem Parkash
Robust estimation of regression parameters
DREXEL UNIVERSITY (1;1, 0, 0, 0, 0, 0, 0)
Scott, Frederick John
Partial asymptotic stability properties for nonlinear ordinary differential equations
LEHIGH UNIVERSITY (8;7, 0, 0, 1, 0, 0, 0)
Al-Hashimi, Basil Atta
Some applications of higher homotopies
Brubaker, Marvin L.
A comparison of the Shukla cohomology with a cotriples cohomology
Franekic, Damir
Matrix, almost matrix and Tauberian operators on locally convex spaces
Gordon, Henry George
Complete degrees and complete automata
Guza, Marcia Ann
Orthogonal designs and projective planes of order congruent to two modulo four
Lo, Timothy Ping
Congruence theorems for compact hypersurfaces of a Riemannian manifold
Sachar, Howard Edward
Error-correcting codes associated with finite projective planes
Stangl, Walter David
Weak-star convergence of measures and matrix summability
PENNSYLVANIA STATE UNIVERSITY (16;5, 1, 8, 0, 2, 0, 0)
Jones, Richard M.
On generalized connectedness
Light, Barry W.
The structure of the Sylow p-subgroup of the class group in a cyclotomic field
Mullen, Gary L.
Equivalence classes of polynomials over finite fields
Pasha, Mohammed L.
Solutions of some boundary value problems in the theory of elasticity and of elastico viscous fluids
Singh, Sukjit
Three dimensional AR's which do not contain two dimensional AR's
Townsend, Robert P.
Decidability results in algebra and algebraic language theory
Wilson, James H.
The non-local Dirac electron
Department of Computer Science
Butler, Robert S.
The design and implementation of a chemical reaction analysis and modeling system
Couturnine, Terry A.
The development and evaluation of a teaching and coursework computer language (TACL)
Goldfine, Alan H.
The numerical solution of Volterra integral and integro-differential equations
Koch, Harvey S.
A common data definition language for FORTRAN and COBOL
Mashey, John R.
Semantic error detection in programming languages
Perry, James E.
The design and construction of numerical harmonics
Rose, Lawrence L.
A theory of dynamic file management
Snow, Walter A.
Numerical solution by quadrature methods of differential and integro-differential equations
Department of Statistics
Rademaker, Alfred
Choosing between two location and scale parameter models and related topics
TEMPLE UNIVERSITY (2;2, 0, 0, 0, 0, 0, 0)
Conway, John Patrick
Partially ordered and semi-uniform loops
Lord, Harriet M.
Hull operations on a category of spaces of continuous functions
UNIVERSITY OF PENNSYLVANIA (10;3, 1, 1, 4, 0, 0, 1)
Chung, Fan R.
Ramsey numbers and combinatorial designs
Schwartz, Robert E.
P.L. actions and equivariant general position
Skau, Christian P.
Commutative projections and Abelian subalgebras
Torriani, Hugo Horatio
On the cohomology of fiber varieties over a symmetric space
Department of Computer and Information Science
Cortin, Barnett C.
Designing optimal file system
Cunningham, Michael A.
A psychological theory and computer model of sensorimotor intelligence
Felsen, Jerry
Decision making under uncertainty
Kurafin, Barry Joel
The general component tolerance assignment problem in electrical networks
Department of Statistics and Operations Research
Plaston, Arthur
Airline fleet size and maintenance cost minimization
Whitfield, Ronald M.
The efficient allocation of resources by the state to systems of public libraries
UNIVERSITY OF PITTSBURGH (7;3, 1, 0, 1, 0, 2)
Gittings, Raymond Frank
A study of quasi-complete spaces and products of generalized metrizable spaces
Hill, David R.
The numerical solution of functional differential equations
Nobel, Deana J.
Coplansarity of alternative ternary rings
ODonnell, Mary Grace
A sheaf-theoretical characterization of projective spaces
Department of Biostatistics
Cruz, Bidelonso Tolentino
On a general form of the student probability density function and some of its applications
Mauchamp, Olivier Pierre
An experimental study in cranio facial genetics using inbred strains of mice
Potrzebowski, Patricia Wren
A family study of dermatoglyphics and oral facial clefts

RHODE ISLAND

BROWN UNIVERSITY (13;7, 3, 2, 1, 0, 0, 0)
Dippolito, Paul Randall
Quasibundles in codimension one foliations. I
Mitchell, Alan Robert
Meromorphic vector fields and Atiyah characteristic classes in topology
Perla-Menzala, Gustavo Alberto
On the inverse problem for three-dimensional potential scattering
Wang, James Li-ming
An approximate Taylor’s theorem for R(X)

Division of Applied Mathematics
Ang, Beng-Tung
Heuristic-adaptive search for regimes in a string of data
Berry, Daniel Martin
On the design and specification of the programming language Oregano
Bourke, Patrick D.
The design and improvement of heuristics for an insurance management game
Chen, Ching-hui
A study of patient scheduling
Gavin, Thomas Littlewood
Stochastic approximation type methods for unconstrained and constrained optimization problems
Lin, Wen-Te Kobe
A statistical study of CP/67 operating system
Ruiz Claeyssen, Julio Cesar
Effects of delays on perturbed functional differential equations
Thacker, John Charles
Time series models in pattern analysis
Tsai, Chun-ping
Perturbed stochastic dynamical systems

SOUTH CAROLINA

CLEMSON UNIVERSITY (7;6, 1, 0, 0, 0, 0, 0)
Department of Mathematical Sciences
Buckhister, Philip George
Symmetric bilinear forms and the matrix equation $XAX = C$ over a finite field of characteristic two
Guthrie, Gary Lee
On record and inter-record times for a sequence of random variables defined on a Markov chain
Latimer, Alexia Broughton
Nuclear FK-sequence and sum spaces
Russell, Donald Robert
Some goodness-of-fit tests
Taylor, Robert Richard, Jr.
Certain matrix equations over finite Boolean and incidence algebras
Turner, Danny William
A semi-Markov model for a particle in motion on the line
Williams, Hugh Martin
Projections and isomorphisms in Banach spaces

UNIVERSITY OF SOUTH CAROLINA (1;1, 0, 0, 0, 0, 0, 0)
Department of Mathematics and Computer Science
Crabtree, Leslie H.
On dual spaces of groups and transformation groups

TENNESSEE

GEORGE PEABODY COLLEGE FOR TEACHERS
(6;0, 0, 0, 0, 0, 0, 0)
Carleton, Cecil Robert
Effectiveness of topic sequencing in a college mathematics course for non-science majors
Edwards, William Patrick
An experiment in self-paced individualized instruction in a mathematics course for prospective elementary school teachers
Ling, Nancy Ting
A comparative study of effectiveness of spiral homework assignment and vertical homework assignment in college mathematics
Mitchell, William Montgomery
The design of mathematics curricula for the small college
Sherard, Wade Hampton III
The effect of arithmetical operations on the difficulty levels of verbal problems

UNIVERSITY OF TENNESSEE (7;7, 0, 0, 0, 0, 0, 0)
Anderson, Robert Lee
Singular symmetric differential operators on a Hilbert space of vector valued functions
Gard, Thomas Charles
Uniqueness criteria for solutions of initial value problems for ordinary differential equations and stochastic differential equations
Jones, Robert A.
Existence theorem for matrix Riccati equations
Lawkins, William F.
Permutation polynomials of finite fields
Owens, Calvin
On semigroups of binary relations
Sakhare, Vishwa M.
Asymptotic and oscillation theorems for a second order differential equation with delay
Yeager, Dorian Phillip
Some results on the structure of compact inverse semigroups

VANDERBILT UNIVERSITY (3;2, 0, 0, 0, 0, 1, 0, 0)
Bozeman, Robert Edward
Periodic solutions in the plane four-body problem of mixed circular-elliptic type
Greenwell, Donald Lee
Forbidden subgraphs
Linton, Ronald Charles
A-large subgroups of $\mathcal{C}_\lambda$-groups

TEXAS

RICE UNIVERSITY (7;4, 0, 0, 0, 3, 0, 0)
Boler, James S.
Embedding and conjugacy in metabelian groups
Drouilhet, Sidney James II
Ramification and unicity of equidimensional holomorphic maps
Kuperberg, Krystyna Maria
The shape theory analogues of some classical isomorphism theorems for homology and homotopy groups
Mayur, Neela
Reinhardt domains and meromorphic functions

Department of Mathematical Sciences
Bennett, John Overton
Estimation of multivariate probability density functions using B-splines
Guerra-Ortiz, Victor M.
Error detection and data smoothing based on local procedures
Ho, Tsu-Li
Continuum theory for composite materials
M. Minor
TEXAS A&M
Apte, Ravi
Department of Statistics
Institute of Statistics
SOUTHERN
Stracener, Jerrell T.
Lin, Tzy-Ping
Department of
Wilson, William Joe
TEXAS
Wang, Amy Huei-Mei
Huang, Li, Loretta
Seaver, William L.
Owen
Peters
Edwards, Donald Eugene
Liau, Ta-Lin

An investigation of the doubly folded bivariate normal distribution

TEXAS A&M UNIVERSITY (5;1, 4, 0, 0, 0, 0, 0)
Peters, Burnis Charles, Jr.
Fixed point theorems in linear topological spaces

Institute of Statistics
Pelveton, Alan H.
On selecting variables for regression and maximum likelihood classification by thresholding
Liu, Ta-Lin
Confidence regions for global optima in nonlinear programming
Seaver, William L.
A multivariate analysis of the financial structure of selected industries
Wilson, William Joe
A linear model involving order statistics

TEXAS CHRISTIAN UNIVERSITY (6;6, 0, 0, 0, 0, 0, 0)
Cochener, David J.
Projectivity and injectivity in semimodules
Edwards, Donald Eugene
Essential ideals in semirings
Gresham, John Hall
A class of infinite dimensional topological spaces with applications to the theory of retracts and selection theory
Owen, Aubrey Patillo
Density topologies
Tucker, Shirley Sue Smith
Groups of infinite exponent whose proper quotient groups are of finite exponent
Wang, Amy Huei-Mei
On the equation \( \varphi(x) = \int_{x}^{x+1} K(\xi) f(\varphi(\xi)) \, d\xi \)

TEXAS TECH UNIVERSITY (4;1, 2, 0, 0, 1, 0, 0)
Pore, Michael David
Factor analysis as a data compression technique
Rizzuto, Gaspare Thomas
Estimation in multivariate linear models
Walker, Billy Kenneth
Control and stability theory for differential equations
Whiteside, Mary Charles
A comparison of some non-parametric tests

UNIVERSITY OF TEXAS AT AUSTIN (6;3, 0, 0, 3, 0, 0, 0)
Copley, Patricia Ann
Structure and characterization of pLg-splines
Ewing, Richard Edward
The numerical approximation of certain parabolic equations backward in time via Sobolev equations
Nilsson, David Otto
On tensors and extensors having complex components

Department of Computer Sciences
Brice, Richard
A study of feedback coupled resource allocation policies in a multiprocessing computer environment

Friedman, Daniel P.
GROPE: A graph processing language and its formal definition
Marinov, Vesko
Maximal clause length resolution

UTAH
UNIVERSITY OF UTAH (6;2, 0, 0, 0, 0, 0, 1)
Knop, Larry E.
Factorizable groups
Liddell, Michael J.
Separable topological algebras
Pilcher, David T.
Smooth approximation of parametric curves and surfaces

VERMONT
UNIVERSITY OF VERMONT (1;1, 0, 0, 0, 0, 0, 0)
Swan, Douglas Arthur
Criteria for the absolute convergence of multiple Fourier series

VIRGINIA
UNIVERSITY OF VIRGINIA (7;0, 0, 0, 1, 0, 0, 0)
Department of Applied Mathematics and Computer Science
Baxter, Anthony Quentin
Input/output behavior of computer systems
Bowles, Roland Lee
Asymptotic methods for the Helmholtz equation
Dixon, Edward Thomas
Some combinatorial circuit problems in graph theory
Penalin, James Anthony
A class of singular integral equations
Shoosmith, John Norman
A study of monotone matrices with an application to the high-order finite difference solution of a linear, two point boundary-value problem
Underwood, Robert Gordon
A functional differential equation approach to solving infinite games
Ward, Robert Cleveland
A numerical solution to the generalized eigenvalue problem

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY (7;2, 4, 0, 0, 0, 0, 1)
Francis, Gerald
Properties of cocontinuous functions and cocompact spaces
Johnson, Robert
Graphical sequences
Lane, John B.
A new approach to Kneser's theorem on asymptotic density

Department of Statistics
Andrews, Richard Wayne
The expected mean squared error of an empirical Bayes estimator
Houck, Ernest Carl
Sequential first order response surface designs
Laboda, Steve Jackson
Optimal experimental designs for estimating the slope of a response surface
Woteki, Thomas H.
Equivariant estimators and a special group structure

WASHINGTON
UNIVERSITY OF WASHINGTON (17;12, 1, 0, 3, 0, 0, 1)
Brenton, Lawrence B.
Complex singularities: A Riemann-Roch theorem for singular surfaces, and extensions of holomorphic differential forms
Eaton, Timothy
Necessary conditions for non-smooth problems in optimal control and the calculus of variations

Enright, Thomas J.
Asymptotic behavior of spectra of compact quotients of symmetric spaces of rank one of the noncompact type

Fornaess, John Erik
Embedding strictly pseudoconvex domains in convex domains

Herb, Rebecca A.
Fourier inversion on semi-simple Lie groups of real rank two

Joss, Richard R.
On the surface area analogue of Winternitz' measure of symmetry in dimension two

Kitto, William G.
Korovkin sets

Luna, George W.
Support points, subdifferentials and monotone operators

Ni Chuiv, Nora
On the closure of modules on a compact set in a Stein manifold

Slagle, Johnnie
The theory and applications of localization in topology

Stewart, Michael
Contributions to Lie algebra homology: An extended exact homology sequence for Lie algebra homology

Biomathematics Group

Davis, Kathryn Ann Bullock
A Fourier integral estimate for probability density functions

Raphael, David
Analytical closed-form solutions for ray caustics and passive range estimation in the surface and so far acoustic channels

Computer Science Group

Andrews, Gregory R.
COPS - A protection mechanism for computer systems

Gales, Lawrence E.
Elaboration: A system for varying program and data structures and its application to the dimensional expansion of arrays

Glikbarg, William S.
High level language cooperative processing in a network environment

WISCONSIN

UNIVERSITY OF WISCONSIN—MADISON
(309, 8, 0, 12, 1, 0, 0)

Armstrong, Alan
The derived algebra of $L_p$ of a compact group and central Fourier-Similel transforms with 0 as an isolated value

Benson, Michael P.
Errors in numerical quadrature for certain singular integrands and the numerical solution of Abel integral equations

Crowson, Lawrence David
Flows on compact surfaces

Foresger, Thomas Huntad
Some problems in combinatorial theory

Garrison, Sidney Clarence III
On groups with a small number of character degrees

Heitmann, Raymond
Principal ideal domains with specified residue fields

Hilgers, John W.
Non-iterative methods for solving operator equations of the first kind

Pengra, Roy
Inner functions in various settings

Wright, David Grant
Cantor sets and homotopy connectedness of manifolds

You, Byung-Wok
On boundary behavior and invariant subspace of an annulus

Department of Computer Sciences

Abdali, S. Kamal
A combinatory logic model of programming languages

Ambler, Allen L.
Nested LR(k) parsing using grammars of the Van Wijngaarden type

Athavale, Manohar L.
Mesh point optimization and computational considerations in solving boundary value problems using a collocation-projection method

Hine, John H.
Generalizations of queueing network models for multiprogrammed computer systems

Huang, Tsong-Jen
Superlinearly convergent algorithms in nonlinear programming

Johnson, Robert
Proving assertions about the state structure of formally-defined, interacting, digital systems

Rubard, Cyrenus M.
Algorithms for polynomials over a real algebraic field

Steward, Donald V.
The analysis of the structure of systems

Wetterstrand, William H.
Error analysis for statistical computer procedures

White, Brian E.
Discrepancy formulas for N-ary quasirandom sequences in the plane

Williams, Harold A.
A net-structure learning system for pattern description

Wittle, Larry D.
A computer system to model the cerebellar cortex and other brain structures

Department of Statistics

DeAlba-Guerra, Enrique
An empirical Bayes approach to the detection of spurious observations to inferences about a covariance matrix

Kenamasu, Hiromitsu
Topics in model building

Kartha, Peethambaran
Some statistical and economic problems in quality control

Pack, David
The quality and quantity of information obtained from brand choice models

Peres, Clovis De Araujo
Asymptotic efficiency of the likelihood ratio conditional test for multinomial distribution

Shaw, Douglas Edward
The effects of nonlinearity in regression models

Wang, Min-Chiang
Smooth estimation of discrete distributions with applications to empirical Bayes approach

UNIVERSITY OF WISCONSIN—MILWAUKEE
(474, 8, 0, 0, 0, 0, 0)

Kasun, James K.
Representations, congruences and homomorphisms of class of regular bisimple semigroups

Maruszewski, Richard F.
Lower block triangular matrices and their associate radicals

O'Farrell, Richard J.
Irreducible matrix representations of orthodox semigroups

Walker, Robert G.
Analytic representations, values, and recoverability of distributions
WYOMING
UNIVERSITY OF WYOMING (1;1, 0, 0, 0, 0, 0, 0)
Su, Chung-hang Harold
Fixed point theorems in topological vector spaces

CANADA
CARLETON UNIVERSITY (3;2, 0, 0, 0, 1, 0, 0)
Barron, Ronald Michael
Unsteady Newtonian flow past oscillating bodies with applications to aerfoils supporting power-law shocks
Dubé, Lakshmi Shankar
Some Hankel transformations of generalized functions
Mulvihill, William Gerard
Split extension rings

DALHOUSIE UNIVERSITY (2;2, 0, 0, 0, 0, 0, 0, 0)
Cooper, Ellis Dexter
Groupoids and pre-orders
Diaconescu, Radu
Change of base for some toposes

McGILL UNIVERSITY (3;3, 0, 0, 0, 0, 0, 0, 0)
Klinecek, T. Gheza
Banach spaces of martingales in connection with H TRADEMARK-theory
McMater, Robert John
Cotorsion theories and torsion theories over perfect rings
Roberts, Paul Calvin
On complexes over local rings

McMASTER UNIVERSITY (3;3, 0, 0, 0, 0, 0, 0, 0, 0)
Chawla, Jag Mohan Singh
Entropies and the isomorphism problem for Bernoulli shifts
McDowell, Kenneth Paul
Commutative coherent rings
Mirabal, Ramon
Gauss structures and g-derivatives on differentiable manifolds

QUEEN’S UNIVERSITY (3;2, 0, 0, 0, 1, 0, 0)
Ciampi, Antonio
Classical linear systems
Rao, G. K. Radhakrishna
The numerical ranges of linear operators in L TRADEMARK-spaces
Subbarao, Dore B. R.
On the semi-simple rank of Artin-Schreier curves

SIMON FRASER UNIVERSITY (1;1, 0, 0, 0, 0, 0, 0, 0)
Gerson, Martin S.
A comparative study of modal propositional semantics

UNIVERSITÉ DE MONTRÉAL (9;9, 0, 0, 0, 0, 0, 0, 0)
Dutter, Rudolf
A discussion of the handling of outliers to detect spuriousness in the general univariate model, full and non-full rank cases
Fournier, Gilles
Indices de point fixe et théorème de Lefschetz
Hennequin, Daniel
Sur une classe de polynômes. Applications aux équations différentielles disconjugées
Leblanc, Raymond
Ensembles convexes et fonctionnelles affines extrêmes
Longtin, André
Structures uniformes catégoriques: Une étude du processus de compléction
Paradis, André
Sous-ensembles réguliers dans les produits semi-directs de monoides

Vo Ba Loc
Structures de relèvement
Wagneur, Edouard
Feuilletages à singularités génériques
Zaki, Muhammad
Almost automorphic solutions of certain abstract differential equations

UNIVERSITY OF ALBERTA (6;4, 0, 0, 2, 0, 0, 0, 0)
Anantharaman, Rajan
On the range of a vector measure
Botto-Mura, Roberta Teresa
Ordered groups and some related classes
Ismail, Mourad El Houssieny
A family of operational calculi
Warrack, Brian
Quotient resolvents of various classes of topological spaces
Department of Computing Science
Ng, Nam
General purpose interactive graphics systems
Sked, Robert
Automatic integration of pde’s

UNIVERSITY OF BRITISH COLUMBIA (3;3, 0, 0, 0, 0, 0, 0, 0)
Hoefsmid, Peter
Representations of Hecke algebras of finite groups with BN-pairs of classical type
Hung, Patrick Chia-Ling
Some problems on mountain climbing
Hutchings, John Edward
Bing’s dogbone space and Curtis’ conjecture

UNIVERSITY OF CALGARY (3;1, 1, 0, 0, 1, 0, 0)
Department of Mathematics, Statistics and Computer Science
Shanker, Mediboina
Dynamic coupled thermoelastic problems in micropolar theory
Watkins, David Scott
Blending functions and finite elements
Wignall, Thomas Kenneth
Probabilistic feedback queueing systems

UNIVERSITY OF MANITOBA (2;2, 0, 0, 0, 0, 0, 0, 0)
Edmunds, Charles Carter
Solution of certain equations in free groups
Rival, Ivan
Contributions to combinatorial lattice theory

UNIVERSITY OF NEW BRUNSWICK (1;1, 0, 0, 0, 0, 0, 0, 0)
Lin, Chia-Shiang
A family of generalized numerical ranges and boundaries of usual numerical ranges

UNIVERSITY OF OTTAWA (1;1, 0, 0, 0, 0, 0, 0, 0)
Wong, Cheuk Fai
A study of certain generalized hypergeometric functions

UNIVERSITY OF SASKATCHEWAN (1;1, 0, 0, 0, 0, 0, 0, 0)
Griffith, Gareth James
On the reality of the inflexions of real, plane, algebraic curves

UNIVERSITY OF TORONTO (21;12, 0, 0, 5, 3, 0, 1)
Callahan, Thomas Henry
The three-class groups of non-Galois cubic fields
Chang, W. C.
A history of the chi-square goodness-of-fit test
Evans, Geoffrey T.
Infiniteitisimal bundles and projective relativity
Günther, Georg
A geometric characterization of finite dimensional orthogonal groups for characteristic 2
Jhu, Ronald
Contributions to axiomatic recursion theory and related aspects of alpha-recursion theory
Johnson, David L.
The symmetric structure theorem for reductive Lie algebras

Kilgour, Donald Marc
Duels, truels and n-uels

Mahatabuddin, Md.
Semi-simplicial theory presented through a generalization of algebras and modules

Oakden, David John
Spreads in three-dimensional projective space

Ong, Hoong Kee-Seng
Linear transformations on matrices, the invariance of generalized permutation matrices

Ong, Kee-Seng
The limit point and limit circle theory of second order differential equations with an indefinite weight function

Soltenberg-Hansen, Hans Carl Viggo
On priority arguments in Feldberg theories

Sunday, Joseph George
Regular polytopes in affine spaces

Swett, Allen K.
Herbrand's theorem in infinitary logic

Wei, Albert Chia-Sheng
Linear transformations on matrices that preserve the real orthogonal group

Zemell, Sheldon Howard
Elastic wave propagation in a heterogeneous medium

Department of Computer Science

Gabura, Andrew James
An analog/hybrid instrument for electronic music synthesis

Geddes, Keith O.
Algorithms for analytic approximation

Moenck, Robert
Studies in fast algebraic algorithms

Sedwick, Arthur
An effective variable order, variable step multi step method

Tennent, Robert
Mathematical semantics and design of programming languages

UNIVERSITY OF WATERLOO (24;9, 1, 0, 8, 1, 0, 5)

Department of Applied Analysis and Computer Science

Arboa Durand, Julian Arturo
Polynedral neopolarities

Carvalho, Sergio Eduardo Rodrigues de
Design of interrelated lexical and syntactical analyzers

Houle, Jean-Louis
A formal language for the description, modelling and realization of digital systems

Lam, Cung-Chung-Lap
Implementation of the box scheme and modal analysis of diffusion-convection equations

Logrippo, Luigi
Renamings in parallel program schemas

Maguire, Robert Brian
Methods for producing visual displays of linear graphs

Probert, Robert Lorne
On the complexity of matrix multiplication

Rogers, Lawrence Douglas
Optimal paging strategies and stability considerations for solving large linear systems

Welch, James Williams
Towards the effective implementation of descriptive storage

Department of Applied Mathematics

May, Sherry Jan
On the applications of a minimum change principle to probability kinematics

Zung, Wei-Kwang
The comparison and index theorems on a Finsler manifold

Department of Combinatorics and Optimization

Colijn, Anton Willem
Lattice-Boolean programming

Cunningham, William Harry
A combinatorial decomposition theory

Hartnell, Bert Leonard
The characterization of those graphs whose spanning trees can be partitioned into two isomorphism classes

Richardson, William Roy Henderson
Connectivity, decomposition and complexity in matroids

Vanstone, Scott Alexander
The structure of regular pair-wise balanced designs

Department of Pure Mathematics

Chang, Pung-Liang
On the theory of quadratic forms

Kane, Richard Michael
Finite H-spaces and Steenrod modules

Lam, Ling Fai
On the existence of non-zero fixed points for positive operators

Sankappanavar, Hanamantagouda Pandappa
A study of congruence lattices of pseudocomplemental semilattices

Totten, James Edward
Classification of restricted linear spaces

Department of Statistics

Abass, Olayide
Studies in point and interval estimation for finite populations

Gentleman, Jane Forer
A statistical analysis of mortality data for smokers and non-smokers, and for males and females

Minder, Christoph Erwin
Some properties of marginal likelihood functions

UNIVERSITY OF WESTERN ONTARIO (5;2, 2, 0, 1, 0, 0)

Cheng, Si-Fang
Beta-expectation tolerance regions for structural models

Watson, Bruce Brigham
Flow problems in micropolar fluids

Keller, Gerald
On non-normality in the Bayesian approach to the analysis of variance and regression theory

Rahman, Matiur
Steady natural convection flow over a semi-infinite vertical plate induced by diffusion and chemical reaction

Wong, Man-Hok
Order properties of the space of continuous affine functions with values in an ordered Banach space

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DOCTORATES CONFERRED IN 1971-1972
Supplementary List

CANADA
UNIVERSITÉ DE MONTRÉAL (4;1, 3, 0, 0, 0, 0, 0)
Clément, Bernard
Estimation Bayésienne des composantes dans les modèles à effets aléatoires de classification hiérarchique et de classification double avec interaction

DOCTORATES CONFERRED IN 1972-1973
Supplementary List

COLORADO
UNIVERSITY OF COLORADO (1;0, 0, 0, 0, 0, 0, 1)
Coughlin, James P.
Self similar jets of ideal fluids

MICHIGAN
MICHIGAN STATE UNIVERSITY (7;5, 0, 0, 0, 0, 0, 2)
Anderson, L. B. Wade
Fitting sets in finite solvable groups
Babcock, Bruce S.
On properties of the approximate Peano
Butts, Thomas R.
On the genus field and its application to four problems in algebraic number theory
Goldberg, Kenneth P.
Quasiasymmetric functions and quasiconformal mappings
Mett, Coreen Louise
Some analogs of the Picone identity applied to fourth order differential equations
Shaw, Wei-Hwa
Boundary value problem and periodic solutions for contingent differential equations
Snover, Stephen L.
The uniqueness of the Nordstrom-Robinson and the Golay binary codes

NEW YORK
UNION COLLEGE (1;0, 1, 0, 0, 0, 0, 0)
Oksoy, Dolun
Truncated sequential life test for a three-way decision procedure, and new sequential methods for the comparison of two medical treatments

NORTH CAROLINA
UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL (1;0, 1, 0, 0, 0, 0, 0)
Department of Statistics
Bhattacharyya, Helen Tang
On some nonparametric estimates of scale and large sample distribution of sample median adjusted rank order statistics

OHIO
OHIO STATE UNIVERSITY (3;1, 0, 0, 0, 0, 0, 2)
Klippert, John Clayton
Necessary and sufficient conditions for the uniform convergence of interpolating polynomials to functions in $C_\omega(T)$
Ulrey, Michael Lawrence
Sequential coding for channels with feedback and a coding theorem for a channel with several senders and receivers
Vijayan, Kulakkatt
A nonexistence theory for association schemes and symmetric graphs

CANADA
UNIVERSITÉ DE MONTRÉAL (6;5, 1, 0, 0, 0, 0, 0)
Dion, Jean-Pierre
Estimation des probabilités initiales et de la moyenne d’un processus de Galton-Watson
Giroux, André
Sur les polynômes qui s’annulent en un point de cercle limité
Hell, Pavol
Retractions de graphes
Montador, Bruce
Sur des opérateurs de composition
Morales, Pedro
Un théorème général d’Ascoli pour K-espaces
Shen, Chang-Keng
Topology of some almost complex manifolds

SEX, RACE AND CITIZENSHIP OF NEW DOCTORATES, JULY 1973—JUNE 1974

At the same time that the Chairmen of doctorate granting departments were asked for the information given on the list of doctorates published above, they were requested to supply information on the sex, race and citizenship of the recipients. Entries in the table below represent the number reported in each category. The racial categories used are those by the U.S. Department of Labor. Usable information was provided for 968 of the 1,148 recipients of doctoral degrees reported above from universities in the United States. The rate of response from Canadian institutions was too low to justify publishing the results.

<table>
<thead>
<tr>
<th>RACIAL GROUP</th>
<th>MEN</th>
<th>WOMEN</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>U.S.</td>
<td>Canada</td>
<td>Other</td>
</tr>
<tr>
<td>Negro/Black</td>
<td>12</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Spanish Surname</td>
<td>2</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>American Indian</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Oriental</td>
<td>13</td>
<td>1</td>
<td>87</td>
</tr>
<tr>
<td>None of those above</td>
<td>558</td>
<td>13</td>
<td>106</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total Number</td>
<td>618</td>
<td>15</td>
<td>217</td>
</tr>
</tbody>
</table>

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LETTERS TO THE EDITOR

Editor, the Notices

The symposium on the role of the thesis in graduate education, reported in the June 1974 Notices, is as good an illustration as any of what I feel is wrong with mathematics. The participants seemed to start from the assumption that there was one Ideal Mathematician, and that any deviation was to be either deplored or tolerated by noblesse oblige. In every other scientific discipline, and of course in Computer Science and Statistics, which will increasingly be our main competitors for students, jobs, and intellectual substance, a certain spectrum of interests and talents is strongly encouraged. Until the leaders of the mathematics profession broaden their scientific outlook and educational philosophy, discussions like this one will inevitably seem unreal to those outside of a small closed circle.

Robert Hermann

Editor, the Notices

The Soviet Embassy in Washington refused to accept a petition composed by the International Defense Committee of Mathematicians for Shikhanovich and Plyushch and signed by over 650 American mathematicians. "The hostile and slanderous nature of those petitions compels us to reject them and return them to the sender" wrote Mr. V. I. Kuznetsov, Second Secretary of the Embassy on 8 July 1974. Mr. Kuznetsov failed, however, to point out a single inaccuracy in the statement of the Committee.

The Soviet mathematicians Yuri Shikhanovich and Leonid Plyushch were arrested (separately) in 1972 on charges of anti-Soviet propaganda, were held incommunicado for nearly a year, and were declared mentally incompetent at trials at which they were not present.

It is a pleasure to report that Shikhanovich has finally been released. On the other hand, Plyushch is still confined in a "special" psychiatric hospital in Dnepropetrovsk.

He is subject to harsh treatment and involuntary chemo-therapy. His body became bloated and he is unable to read or write. His wife and others feel that his condition is perilous. Plyushch was mentioned in the statement by Sakharov in connection with the latter's hunger strike during Nixon's visit. There is no doubt that the International Defense Committee of Mathematicians will continue its efforts on his behalf.

Lipman Bers

P. S. A partial list of members of the International Defense Committee of Mathematicians follows.


EDITORIAL ADDENDUM

The International Defense Committee has subsequently stated that a petition signed by more than 900 mathematicians, participants at the International Congress of Mathematicians in Vancouver, Canada, was sent to Soviet Premier Kosygin. The petitions requested that the Soviet mathematician Leonid Plyushch be released from the psychiatric prison ward and be given medical care chosen by his own family.

This petition was in response to a letter addressed to all participants of the Congress by the famous Soviet physicist Andrei Sakharov. The letter says in part, "Plyushch was arrested in January, 1972; after a year spent under investigation in jail, he has been confined for over a year and a half, under inhuman conditions, in the psychiatric prison hospital of the Ministry of Interior, USSR, Dnepropetrovsk."

"I ask the Congress to pass a motion in defense of Plyushch, and to do everything possible to save him."

The collection of signatures was initiated at the meeting of mathematicians, convened by five members of the International Defense Committee on 24 August. The conveners, who also signed the telegram to Kosygin were Professors Michael Atiyah (Cambridge, England—Fellow of the Royal Society, Fields Medalist), Lipman Bers (Columbia University, USA—Member, National Academy of Sciences), Henri Cartan (Paris, France—Member, Academy of Sciences of Paris, Foreign Associate, National Academy of Sciences, USA), Israel Halperin (Toronto, Canada—Fellow of the Royal Society of Canada), Shokichi Iyanaga (Tokyo, Japan—Member, Japanese Academy of Sciences).

The Committee counts among its members nine winners of the Fields Medal, numerous members of the National Academy of Sciences (USA) and of foreign academies, the past President of the International Mathematical Union and five past presidents and the president-elect of the American Mathematical Society. The two recipients of the Fields Medal awarded in Vancouver (Enrico Bombieri from Italy and David Mumford from the United States) signed the Vancouver petition.
In view of William Browder's comments in your June 1974 issue about the Soviet Union's offer of a royalty for reproducing U.S. scientific journals—apparently the same woefully inadequate offer was sent to all—perhaps your readers would be interested in the counteroffer that we are making to them for Operations Research.

We began with an equity principle (particularly important in view of the fact that the Soviets distributed the journals they reproduced to nearby countries, as well as to the Soviet Union): Any offer made to the Soviet publishing house approaching us should be available to a similar entrepreneur in any other country.

Pursuant to this principle, three options are available:

1. Individual subscriptions. Here the usual foreign subscription rates apply; however, the standard agent's discount also applies to a company acting as an agent.

2. Bulk shipment. Here the receiver of the bulk shipment handles distribution, billing, and collections on his own account, thus saving us the costs of these functions. Thus, the price per hundred copies for such an arrangement can be discounted from the usual subscription price to take account of these economies.

3. Photographic reproduction. Here the rate is a pro rata share of the cost of producing the material (setting in type, editorial costs, certain overhead items, and so on, but not including printing and distribution costs).

All of these arrangements are fair to the members of our Society and the other subscribers to our journal, and all will produce income commensurate with the services rendered and the benefits gained by the recipients.

We do not yet know what the Soviet response to these possibilities will be. However, we feel that equity demands that we present them on a take-it-or-leave-it basis.

Hugh J. Miser

ERRATA

Volume 20


The Main Lemma should begin with "Let B contain an origin-centered n-dimensional ball of radius \( r = 1/2 \)." Thus, the convex body B should contain (be "reinforced" by) another suitable origin-symmetrical stellar body containing no visible lattice point.

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Theorem 2, due to the following example, is not true and should be deleted. Let \( X = (c_0) \), \( K = \{x \in E : ||x|| \leq 1\} \) and \( T:K \rightarrow K \) be defined by \( T(x_1,x_2,...) = T(1,x_1,x_2,...) \). Then \( T \) satisfies the hypothesis of Theorem 2 but has no fixed point. The continuity assumption on \( f \) in Theorem 2 is redundant.


Theorem 1 has not been proved.


Delete both the Theorem and the Corollary. Theorem 1. If an NP \( \leq_T \)-degree \( \preceq \) is closed under complements, then there is a set \( A \) so that \( A \in \preceq \) and \( \overline{A} \not\leq_P A \). Theorem 2. NP is closed under complements iff there is a \( \leq_T \)-complete set \( A \) in NP such that \( \overline{A} \) in NP.
ABSTRACTS PRESENTED TO THE SOCIETY

Preprints are available from the author in cases where the abstract number is starred. Invited addresses are indicated by •

The papers printed below were accepted by the American Mathematical Society for presentation by title. The abstracts are grouped according to subjects chosen by the author from categories listed on the abstract form. The miscellaneous group includes all abstracts for which the authors did not indicate a category.

An individual may present only one abstract by title in any one issue of the Notices but joint authors are treated as a separate category. Thus, in addition to abstracts from two individual authors, one joint abstract by them may also be accepted for an issue.

Algebra & Theory of Numbers

*74T-A192 ALBERT A. WUL'IN, 9213 Kristin Lane, Fairfax, Virginia 22030,

A note on generalized multiplicative functions.

Let \( C \subseteq M \subseteq G \) be, respectively, the classes of all completely multiplicative, multiplicative, and generalized multiplicative arithmetic functions. Let \( f_s(n) = (2s)^{-1}r_s(n) \), where \( r_s(n) \) is the number of representations of \( n \) as a sum of \( s \) integral squares. Let \( \Phi_s(n) \) be defined as in these Notices 20 (1973), A-60. Lemma 1. \( s \in \{1,2,4,8\} \) only if \( f_s \in G \) only if \( s \in \{1,2,4,8\} \). Problem 1. Although \( f_{613} \in M \), is \( f_{613} \in G \) only if \( f_{613} \not\in M \)? Corollary 1. There does not exist an integer \( t \) such that \( f_t \not\in M \). Lemma 2. \( s \in \{0,1,2,\ldots,8\} \) only if \( \Phi_s \in G \) only if \( \Phi_s \not\in M \) only if \( s \in \{0,1,2,\ldots,8\} \). Problem 2. Although \( \Phi_{1933} \not\in M \), is \( \Phi_{1933} \in G \)? Corollary 2. There does not exist a complex \( t \) such that \( \Phi_t \not\in M \). Lemma 3. Let \( f \) be a monotone arithmetic function. Then \( f \in G \) only if \( f \in M \) only if \( f \in C \). Corollary 3. Let \( f \) be monotone and (generalized) multiplicative. Then \( f(n) = n^\alpha \) for some real \( \alpha \). Lemmas 1 and 2 give sharper results than previously known results for \( s \in \{0,1,2,\ldots,8\} \) in the more general context of \( G \). The result of loc. cit. is a corollary of Lemma 2. (Received June 11, 1974.)

74T-A193 DENNIS P. GEOFFROY and DAVID P. SUMNER, University of South Carolina, Columbia, South Carolina 29208. The edge nucleus of a point determining graph. Preliminary report.

A graph \( G \) is called point determining if \( x^* = y^* \) implies \( x = y \). If \( G \) is a connected, non-complete, point determining graph then the edge nucleus of \( G \), denoted \( E^0(G) \), is the set of all those edges of \( G \) whose removal leaves \( G \) point determining. Theorems. 1. \( |E^0(G)| = 1 \) iff \( G \) is the path on four points. 2. \( |E^0(G)| = 2 \) iff \( G \) is the path on five points. 3. If \( \delta(G) \leq 2 \) then \( |E^0(G)| \geq 2 \delta(G) - 1 \). 4. If \( \delta(G) \geq 3 \) then \( |E^0(G)| \geq 2 \delta(G) \). 5. \( |E^0(G)| \geq \left\lceil \frac{\text{diam } G}{2} \right\rceil \). The results in 3, 4 and 5 are sharp. 6. Every clique of size \( n \geq 3 \) has at least \( n - 2 \) removable edges. 7. The maximal clique size of an edge nucleus is at most two less than the total number of points in the edge nucleus. (Received June 21, 1974.)

*74T-A194 W. KEITH NICHOLSON, Department of Mathematics, The University of Calgary, Calgary, Alberta T2N 1N4, Canada. Semiperfect rings with abelian adjoint group.

A ring \( R \) (possibly with no identity) is semiperfect if \( R/J(R) \) is semisimple artinian and idempotents can be lifted modulo \( J(R) \). The set \( R^0 \) of invertible elements of \( R \) under the
composition $z = y = x + y - xy$ is called the adjoint group of $R$. An $R$-module is called $G$-unitai if it is annihilated by $R$. A previous theorem [Fac. J. M. 49 (1973), 191-198] on the structure of semiperfect rings (with identity) with an abelian group of units is extended as follows:

**THEOREM.** Let $R$ be semiperfect. Then $R^0$ is abelian if and only if $R = \sum_{x \in A} T X$, where $T$ is a finite direct sum of commutative local rings, $A$ is commutative with $J(A) = A$, $S$ is semiperfect with identity and abelian group of units and $S$, $X$ and $Y_s$ are $G$-unitai $S$-modules with $S X = 0$ (in the matrix multiplication).

**COROLLARIES:** Let $R$ be semiperfect with $R^0$ abelian:

1. $R$ is commutative if either $2x = 0$ implies $x = 0$ in $R$ or $R$ has no direct factor each element of which has order 2.
2. If $R^0$ is finitely generated then $R = \sum_{x \in A} T X$ when $F$ is finite and $A$ is commutative, nilpotent and $A^*$ is finitely generated. (Hence, if $R$ has an identity it is finite).
3. If $R^0$ is cyclic then $R$ is finite or $R$ is the zero ring on the integers. (If $R$ is finite the structure is well known but the theorem simplifies the proof).

(Received June 21, 1974.)


Let $K$ be a field contained in $Q(\varepsilon)$ where $\varepsilon$ is a primitive $n$-th root of unity. Suppose that $n$ is odd, and that $Q(\varepsilon)$ is a cyclic extension of $K$ of degree $m$. Then the 2-primary part of the Schur group of $K$ consists of all classes $A$ in the Brauer group of $K$ with uniformly distributed invariants of value 0 or $\pm 1$ which satisfy the following conditions. (1) For a prime $p$ which divides $n$, $\text{inv} A = 0$ if $e(p, Q(\varepsilon)/K)$ is odd, or if $m/e(p, Q(\varepsilon)/K)$ is even. (2) For any prime $q$, $\text{inv} A = 0$ if $f(q, K/Q)$ is even and a Frobenius automorphism of $q$ in $Q(\varepsilon)/K$ is a square in $\text{Gal}(Q(\varepsilon)/K)$. (3) Let $p$ be a prime which divides $n$ to which (1) does not apply. Suppose that $f(p, K/Q)$ is odd and that the power of 2 which divides $e(p, K/Q)$ is greater than or equal to the power of 2 dividing $p^{1/2}$ for every prime $p$ which divides $n$ and is unequal to $p$. Then the invariant of $A$ is $\pm 1$ at an even number of primes in the set \{p\} \cup \{q: (q/p) = -1 \text{ and } (q,n) = 1\} where $(q/p)$ is the Legendre symbol.

Similar results hold in the case where $n$ is even. The Schur group of $K$ has also been determined whenever $K$ is a subfield of $Q(\varepsilon p^a q^b)$.

(Received July 1, 1974.)

74T-A196 DR. ARTHUR YANUSHKA, University of Illinois, Urbana, IL 61801 A characterization of the groups $PSp(2m,q)$ as rank three permutation groups. Preliminary report.

The rank of a transitive permutation group is the number of orbits of the stabilizer of a point. The projective classical groups of symplectic type $PSp(2m,q)$ for $m > 2$ are primitive of rank 3 when considered as groups of permutations of the absolute points. In Math Z. 96(1964), 145-156, D. Higman characterized $PSp(4,q)$ as rank 3 group. The author characterizes $PSp(2m,q)$ for $m > 2$.

**Theorem.** Let $G$ be a transitive rank 3 permutation group on a set $X$ such that the orbit lengths for $G_b$, the stabilizer of a point $b$ of $X$ are 1, $q(qd-2-1)/(q-1)$ and $qd$ for integers $q > 1$ and $d > 4$. Let $z^*$ denote the union of $b$ and the $G_b$ orbit of length $q(qd-2-1)/(q-1)$. Let $R(bc)$ denote $\{z^*: b, c \in z^*\}$. Assume $R(bc) \neq \{b, c\}$. Assume that the pointwise stabilizer of $b^*$ is transitive on the points unequal to $b$ of $R(bc)$ for $c$ not in $b^*$. Then $d$ is even, $q$ is a prime power and $G$ is isomorphic with a group of symplectic collineations containing $PSp(d,q)$. The proof involves the construction of a polar space on $X$ and the use of J. Tits and F. Veldkamp's classification of polar spaces. Furthermore the author notes that similar characterizations hold for the projective classical groups of unitary (resp. orthogonal) type of degree at least 4 (resp. 5) when considered as groups of permutations of the absolute (resp. singular) points.

(Received July 1, 1974.)
Joh Lawrence, Carleton University, Ottawa, Canada. Primitive free algebra. Preliminary report.

Let $R$ be a ring with unity and $X$ a set of indeterminates, with $|X| \geq |R|$. The class $C$ of rings $R$ for which the free $R$-algebra $R[X]$ is (right) primitive is characterized and is shown to be closely related to the class of strongly prime (SP) rings (Notices, Oct. 1973). $C$ properly contains the class of primitive rings, and the intersection of $C$ with the class of regular rings is precisely the class of primitive rings. If $S$ is a semigroup such that the semigroup ring $R[S]$ is primitive, then $R \in C$, and if $R \in C$, then there is a free group $G$ such that the group ring $R[G]$ is primitive. If the left zero-divisors of $R$ form a proper left ideal and $R$ is right SP, then $R[X]$ is left primitive. As an application, we construct a simple example of a singular primitive ring. (Received July 2, 1974.)

This monograph is divided into three main sections. The first deals with strongly prime (SP) rings (Notices, Oct. 1973), with applications to simple and primitive rings. The second section uses SP rings to classify and study simple self-injective rings. In the third section we look at torsion theory properties of SP rings and completely torsion-free rings, i.e., rings in which the only torsion ideals are $(0)$ and the ring. Particular classes of CTF rings, such as commutative rings and rings with chain conditions, are studied in depth. The monograph is in the Carleton Mathematical Series. (Received July 2, 1974.)

G.J. Reiger, Techn.Universität, D-3 Hannover. On two theorems of Erdös about the representation by Liouville-numbers.

According to an interesting note by Erdös (Michigan Math. J. 9 (1962), 59-60), every real number resp. real number $\neq 0$ is the sum resp. product of two Liouville-numbers. Denote by $c$ the cardinality of $[0,1]$. Theorem. For natural $k$, let $f_1, \ldots, f_k$ be real, continuous, strictly monotone functions on $[0,1]$; then there exist $c$-many $L$-numbers $t \in [0,1]$ such that $f_1(t), \ldots, f_k(t)$ are $L$-numbers also. The proof is constructive, we proceed cyclically and put in growing blocks of zeros followed by some non-zero digit into the decimal expansion of $t, f_1(t), \ldots, f_k(t)$ successively. There are plenty of applications to linear and other systems of equations. Corollary 1. For arbitrary real numbers $a, b$ there are $c$-many $L$-numbers $x, y, z$ such that $x + y = a, y + z = b$. Corollary 2. For arbitrary real numbers $a \neq 0, b$ there exist $c$-many $L$-numbers $x, y, z$ such that $xy = a, y + z = b$. Corollary 3. For every real number $a > 1$ there exist $c$-many $L$-numbers $x, y$ such that $a = x^y$. (Received June 10, 1974.)
Let $R$ be an $(\text{hnp})$-ring which is not right primitive. Let $E$ be an indecomposable injective torsion $R$-module and $0 = x_0 < x_1 R < \cdots < x_m R < \cdots < E$ be the infinite composition series of $E$ [Abstract 711-16-21 these Notices Jan., 1974]. It is proved that $E$ has finite periodicity $n$. If $P_i = \text{ann}(x_i R/R)$ for $1 \leq i \leq n$, then these $P_i$ are distinct maximal ideals of $R$ such that $P_1, P_2, \ldots, P_n$ constitute a cycle in the sense of Eisenbud and Robson, and $B = \cap P_i$ is an invertible ideal of $R$. If $Q$ is the classical quotient ring of $R$ it is shown that every primary component of the $R$-module $Q/R$ has finitely generated socle which equals $B^{-1}/R$, for some $B$ which equals intersection of a cycle in $R$. Let $M$ be a torsion $R$-module. A submodule $B$ of $M$ is a basic submodule of $M$ if it satisfies the following conditions (i) $B$ is decomposable (ii) $H_n(B) = B \cap H_n(M)$ for all $n$ and (iii) $M/B$ is a divisible $R$-module. It is shown that $M$ has a basic submodule and any two basic submodules of $M$ are isomorphic, this result generalizes corresponding result for $p$-abelian groups due to Kulikov. Further any complement of $H_n(M)$ is a direct summand of $M$. For definition of $H_n(M)$ refer to Abstract 713-All, these Notices April, 1974. (Received June 28, 1974.)
**Identities for integer sequences involving the greatest integer function. VI.**

M and Q are positive integers; \( W_n \) is an integer sequence given by \( W_{n+2} = MW_{n+1} + SQW_n \), \( S = \pm 1 \), where \( W_0 \) and \( W_1 \) are integers; if \( W_0 = 0 \), \( W_1 = 1 \), then \( W_n = U_n \); if \( W_0 = 2 \), \( W_1 = M \), then \( W_n = V_n \).

Set \( B(i,j) = W_j W_{j+1} + W_j W_{j+1} \), \( A(x) = \left| x^2 W_1 W_3 - xB(i,j) + W_{1+1} W_{j+1} \right| \), \( D(j) = (1+ V_2)W_{k+j} \), \( P = V_2^j / (1+ V_2) \), \( x_0 = M^2 + SQ0 \). \( B(i,j) = W_{1+1} W_{j+1} - (M/2)B(i,j) - SQW_j \), \( Z_1 = (i,j)/1 \), and \( \lfloor y \rfloor \) the greatest integer function. *Case 1.* \( S = 1 \), with \( 1 \leq Q < M+1 \) and \( n \geq 1 \); \( P > 0 \) is the root of \( x^2 - x - Q = 0 \). *Case 2.* \( S = -1 \), with \( 1 \leq Q < M-1 \) and \( n \geq 1 \). \( P > 1 \) is the root of \( x^2 - x - Q = 0 \). **Theorem 3** (for both cases). If \( A(x) < ((TP)^k)/(D(k)U)^2k \), then \( \left| x^2 W_{n+1} W_{n+2} + 224P U_k (-SQ)^n \right| = W_{n+k+1} W_{n+k+2} \) for \( n \geq k \geq 0 \) and integers \( i \) and \( j \). *Example 1.* Fibonacci sequences, with \( S = M = Q = 1 \), \( U_n = F_n \), \( V_n = L_n \), and \( P > 0 \) is the root of \( x^2 - x - 1 = 0 \). For \( C = \sqrt{5} \), \( (i,j) = (1,2) \), and \( n \geq 1 \), \([P^2 F_{2n+1} F_{2n+2} - (C/2)^2 25] = L_{n+2}^2 - L_{n+1}^2 \). *Example 2.* \( W_n+2 = W_{n+1}^2 - W_n \), \( W_0 = 1 \), \( W_1 = 3 \), and \( P > 1 \) is the root of \( x^2 - 4x - 1 = 0 \). For \( B = 3/2 \), \( (i,j) = (1,2) \), and \( n \geq 1 \), \( [P^2 W_{n+1} W_{n+2} - B (46/15)] = W_{n+2} W_{n+3} \). *Remark.* Theorem 3, for \( i = j = 0 \), gives Theorem 1 in IV, these NOTICES, 21(1974), A-367.

(Received July 15, 1974.)

*74T-A204*  ROLANDO CHUAQUI, Universidad Católica de Chile, Casilla 114-D, Santiago, Chile.

**Completely Divisible Cardinal Algebras**

The theory of Cardinal Algebras (CA) was developed by Tarski in "Cardinal Algebras", Oxford U. Press (1949). Let \( \Omega = \{ A, +, \Sigma \} \in CA \). From Bradford, "Cardinal Addition and the Axiom of Choice" Ann. of Math. Logic 3 (1971) 111-196, theorem IX, it is easy to deduce: **Lemma 1.** If \( 0 < n \leq \infty \), \( a, b \in A \) and \( n \cdot b \geq a \geq n \cdot b \), then there are \( d, e \in A \) such that \( a = n \cdot d + e \) and \( e \leq n \cdot d \). An interesting type of CA is the following: **Definition 2.** \( \Omega \) is completely divisible iff for every \( a \in A \) and every \( n \in \infty \), there is a \( b \in A \) with \( a = n \cdot b \). The interest of such CAs is that every nonidemmultiple element belongs to a subalgebra isomorphic to the CA of nonnegative real numbers \( \bar{\Omega} \) (see R. Chuaqui, "Cardinal Algebras and Measures Invariant under Equivalence Relations", Trans. Amer. Math. Soc. 142 (1969) 61-79, 1, 8 and 1, 19). From 1 and axiom 1, 1 VII and axiom 1, 1 VII (See Tarski's book) it is possible to obtain a characterization of these CAs. **Theorem 3** \( \Omega \) is completely divisible iff for every \( a \in A \), there is a \( b \in A \) such that \( 2 \cdot b \geq a \geq \infty \cdot b \). (Received July 16, 1974.)

*74T-A205*  DAVID E. DOBBS, Rutgers University, New Brunswick, New Jersey, 08903. **Ascent and descent of going-down rings for integral extensions.**

An integral domain \( R \) is called a going-down ring (write: \( R \) is GD) if \( R \subset T \) satisfies going-down for each domain \( T \) containing \( R \). (By a recent theorem of the author and I. J. Papick, this terminology is consistent with that introduced by the author in Comm. in Algebra I (1974), 439-458.) We investigate conditions which, for an integral extension \( A \subset B \) of domains, imply that \( A \) (resp., \( B \)) is GD whenever \( B \) (resp., \( A \)) is GD. (This explains the "descent" (resp., "ascent") in the title.) Example 2.2 of W. Heitner and J. Ohm, Proc. Amer. Math. Soc. 35 (1972), 1-8, shows that, without further assumptions, both descent and ascent fail. **Theorem.** Let \( R \subset T \) be an integral extension of domains, with \( T \) being GD. If either \( T \) is quasi-local or \( R \) is integrally closed, then \( R \) is GD.

**Corollary.** If the integral closure of a domain \( R \) is a valuation ring, then each overring of \( R \) is GD. **Theorem.** Let \( R \) be an integrally closed domain with quotient field \( K \),
and let $T$ be the integral closure of $R$ in an algebraic field extension $L$ of $K$. If the group of $K$-algebra automorphisms of the normal closure of $L/K$ is finite of order $2^{a_1 b}$ and if $R$ is GD, then $T$ is GD. Finally, an ascent result is given, generalizing Proposition 2.7 of the author, loc. cit. (Received July 17, 1974.)

74T-A206 ADAMS, Michael E., Univ. of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada. The Frattini subalgebra of a Heyting algebra.

Let $\mathfrak{F}(H)$ denote the Frattini subalgebra of a Heyting algebra $H$. A topological approach is used to characterize the maximal subalgebras of a Heyting algebra. We prove that there exists a Heyting algebra $H_1$ such that $H \equiv \mathfrak{F}(H_1)$ iff $H$ has a meet irreducible zero. (Received July 18, 1974.)


Let $K$ be a finite extension of $\mathbb{Q}$ with $[K: \mathbb{Q}] = n$ and let $D$ be any order of $K$. For each algebraic integer $\lambda \in D$ the ring $\mathbb{Z}[\lambda]$ is a finitely generated $\mathbb{Z}$-module and the index of $\lambda$ in $D$ is defined by $\text{Index}_D(\lambda) = (D: \mathbb{Z}[\lambda])$. If the algebraic integers $\alpha_1, \alpha_2$ differ by a rational integer then $\mathbb{Z}[\alpha_1] = \mathbb{Z}[\alpha_2]$ and they have the same index in $D$. Call $\alpha_1, \alpha_2$ equivalent if $\alpha_1 - \alpha_2$ is a rational integer. If $n < 3$ there exist only a finite number of inequivalent algebraic integers $\lambda$ satisfying $\text{Index}_D(\lambda) = c \neq 0$ [M. Hall, Indices in Cubic Fields, American Math. Soc. Bull., 43 (1937), pp 104-108]. Using results of Dade and Taussky [E. C. Dade and O. Taussky, On the different in orders in an algebraic number field and special units connected with it, Acta Arithmetica, IX (1964), pp 47-51] and Schmidt [W. M. Schmidt, Norm form equations, Ann. of Math. 96, 1972, pp 526-551] several general types of fields are proved to have this property. In particular, any fourth degree field, any field of degree $n$ with galois group $A_n$ or $S_n$, and any field with galois group cyclic of prime degree. (Received July 22, 1974.)

74T-A208 DAVID A. SIBLEY, Yale University, New Haven, Connecticut 06520 Finite Groups with an Abelian Sylow Group

Let $G$ be a finite group with a Sylow $p$-group $P$ satisfying $C_G(x) = C_G(P)$ for all $x \in P - \{1\}$. R. Brauer and H. S. Leonard, Jr. have described some of the character theory of such groups. ("On Finite Groups with an Abelian Sylow Group," Canad. J. Math. 14 (1962), 436-450.) We deduce an additional important property. Theorem: Suppose $G$ has at least three classes of $p$-elements. If $X$ is an exceptional character of $G$, there is an exceptional character $Y$ of $N_G(P)$ such that for all $x \in P - \{1\}$ we have $X(x) = \pm Y(x)$. As an application, we prove Theorem: Suppose $G$ has a faithful complex representation of degree $d < \frac{1}{2} (|P|-1)$. Then $P$ is normal in $G$. (Received July 22, 1974.)

74T-A209 JOHN M. GROVER, University of California, Irvine, California 92664. Epimorphisms of Units Groups.

The restriction $\phi^*$ to the units groups of a ring epimorphism $\phi$ from $R$ to
R/I carries R* into (R/I)*. Let I' be the intersection of the ideal I with the Jacobson radical J of R. Here we show that \( \phi^* \) is epi under the conditions: (i) If \( \phi(x) \) is in \( (R/I)^* \), then the set of commutators \([x,R]\) is contained in the intersection of \( xR + I' \) and \( Rx + I' \). (ii) The descending chain condition holds on ideals having the form of an intersection of I with a finite number of ideals of the form \( (x)+I' \), \( x \) in \( R \). This generalizes somewhat Lemma 1.1.5 of (Malek, J. Algebra 23 (1972), 538-552), where \( R \) was assumed commutative, noetherian, with DCC on subideals of I. \( \phi^* \) was previously known to be epi when I is a subideal of J (Farahat, Math. Z. 87 (1965), 378-384), or when \( R/J \) is Artinian (Pearson, Bull. Australian Math. Soc. 2 (1972), 169-182). (Received July 26, 1974.)

Let \( s = \sigma + it \) (\( \sigma, t \) real) denote a complex variable \( k \) a positive integer, \( F \) an algebraic number-field of degree \( n \) and \( \zeta_F(s) \) the Dedekind zeta-function of the field \( F \). The following results have been obtained:

(1) \[ \int_0^\infty |\zeta_F(\sigma+it)|^{2k}e^{-\delta t}dt = o(\delta^{-nk/2-\varepsilon}), \] as \( \delta \to 0 \), for every \( \varepsilon > 0 \) (\( nk \geq 2 \)).

(2) If \( F \) is Galois over \( Q \), the field of rational numbers, then there exists a positive constant \( C_{n,k} \) depending only on the field \( F \) and on \( n,k \) such that for \( 0 < \delta < \delta_0(n,k) \),

\[ \int_0^{\infty} |\zeta_F(\sigma+it)|^{2k}e^{-\delta t}dt \geq \frac{C_{n,k}}{\delta} \log nk^2 \left( \frac{1}{\delta} \right). \]

The above results are generalizations of analogous results known for the Riemann zeta-function \( \zeta(s) \). (Received July 19, 1974.)

The authors have previously invented a device called a topological current graph for obtaining desired graph imbeddings in orientable surfaces, thereby generalizing Gustin's combinatorial current graph method from a way of obtaining imbeddings of Cayley graphs to a way of obtaining a much larger class of imbeddings. The present results continue that earlier work, inaugurating a systematic approach to the problem of devising appropriate current assignments. Chief results include the establishment of a bijective correspondence between the components of the derived imbedding and the cosets of the isotropy group of an arbitrary component, leading to a proof that the components are mutually isomorphic regular branched coverings of the dual of the imbedding of the current graph. Also given is a characterization of the isotropy group via a face labelling technique that aids in the construction of imbeddings. (Received July 30, 1974.)
The wreath product of two small categories is constructed, generalizing Houghton's construction of the wreath product of groupoids. It is shown how a functor to sets from a small category may be factored through a wreath product in two circumstances: (1) When a subfunctor is given, and (2) when a congruence on the image of the functor is given. These constructions generalize constructions used in the proof of the Krohn-Rhodes Prime Decomposition Theorem by Meyer-Thompson and by Lallement. (Received August 7, 1974.)

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A group-theoretic method in musical theory

Abstracting from M. Babbitt's 12-tone serial composition theory, we define a $j$-chord in a finite Abelian group $G$ as $A = \{A + x : x \in G\}$, where $A$ is any $j$-element subset of $G$. The inverse chord $-A$ is defined as $\{(A) + x : x \in G\}$ and the complementary chord $A'$ as $\{(G\setminus A) + x : x \in G\}$. For a class of $G$'s that contains all finite cyclic $Z(n)$, explicit formulas are found for: the number of all $j$-chords; the number of all $n/2$-chords ($n$ even) such that $A' = A$, or $A' = -A$, or $A = -A = A'$. For all $Z(n)$, the number of $j$-chords $A$ such that $A = -A$ is the binomial coefficient $C(n - 1, (1 - (-1)^j)/2)$ if $n$ is even and is equal to $C(n - 1, (j - 1))/2$ if $n$ and $j$ are odd. The other counting formulas are more complicated. A chord disjoint elements of which cover $G$ is called a tessellator. For "good" groups in the sense of Hajós, Sands, et al., we give an algorithm for finding the number of all tessellators and the number of all tessellators equal to their own inverses. We compute these numbers for all $j$ and $Z(n)$, $n \leq 24$. The results may be useful in delimiting options for methods of composition other than the 12-tone system. (Received July 29, 1974.)


If $H$ is an extra-special $p$-group, $p$ odd, then the automorphism group of $H$ splits over the group of inner automorphisms of $H$ (R.L.Griess,Jr., Pacific J. Math. 48(1973),403-422). An easy consequence of this is the fact that an extra-special $p$-group, $p$ odd, cannot occur as a normal subgroup contained in the Frattini subgroup of any finite group. **Theorem:** A nonabelian $p$-group, $p$ odd, with center of order $p$ cannot occur as a normal subgroup contained in the Frattini subgroup of a finite group. This extends an earlier result (W.M.Hill & C.R.B.Wright, Proc. Amer. Math. Soc. 35(1972),413-415) on $p$-groups of nilpotence class larger than 2 and with center or order $p$. (Received August 9, 1974.) (Author introduced by Dr. Robert J. Perry.)

S. B. CHILDS, Texas A & M University, % Red River Army Depot, Texarkana, Texas 75501 and M. J. MARON, University of Louisville, Kentucky 40208. An Explicit Formula for the Optimum Point of a Quadratic Subject to Linear Equality Constraints.

Using only elementary linear algebraic manipulations, the optimum point of the convex quadratic $f(x) = a + b'x + x'Ax$ ($x \in \mathbb{R}^n$) in the affine subspace defined by the linear equality $Kx = c$, where $c \in \mathbb{R}^m$ and $K$ is an $m \times n$ matrix of rank $r < n$, is shown to be given by $x = x_c - N(N'AN)^{-1}N'(Ax_c + \frac{1}{2}b)$ where $x_c$ is any particular solution of $Kx = c$ and $N$ is any $n \times (n-r)$ matrix whose columns form a basis for the null space of $K$. Both $x_c$ and $N$ can be
obtained simultaneously from \( Kx = c \) by a single Gaussian elimination. (Received August 14, 1974.)


Lawvere's theorem (Dissertation summarised in Proc. Nat. Acad. Sci. 50) that left adjoints exist to theory morphism induced forgetful functors between categories of finite product preserving functors from an algebraic theory to \( \text{Sets} \) remains true: (1) when \( \text{Sets} \) is replaced by "a cartesian closed category \( C \) with small colimits", "algebraic theory" by "small category with finite products" and "theory morphism" by "finite product preserving functor"; and (2) when we continue, replacing "cartesian closed category" by "topos" and "product(s)" throughout by "limit(s)".

The condition on a category \( C \) with small colimits in (1) (resp. (2)) may be weakened to: \( C \) has finite products (resp. limits) and product preserves colimits (resp. pullback preserves colimits and subobjects of colimits are formed "as in a topos"). This condition is equivalent to: The left Kan extension of a finite product (resp. limit) preserving functor from a category with finite products (resp. limits) to \( C \) along any functor preserves finite products (resp. limits). If \( C \) has a small dense subcategory the condition is also equivalent to: \( C \) is cartesian closed (resp. \( C \) is a topos). (Received July 24, 1974.) (Author introduced by Dr. Brian Rotman.)

*74T-A217*  EARL S. KRAMER and DALE M. MESNER, University of Nebraska, Lincoln, Nebraska 68508. **t-designs on hypergraphs.**

A \( t \)-design \( T = (X, \mathcal{B}) \), denoted by \((\lambda; t, k, v)\), is a system \( \mathcal{B} \) of subsets of size \( k \) from a \( v \)-set \( X \), such that each \( t \)-subset of \( X \) is contained in exactly \( \lambda \) elements of \( \mathcal{B} \). A hypergraph \( H = (Y, \mathcal{E}) \) is a finite set \( Y \) where \( \mathcal{E} = \{E_i | i \in I\} \) is a family of subsets (which we assume here are distinct) of \( Y \) such that \( E_i \neq \emptyset \), \( i \in I \), and \( \bigcup E_i = Y \). Let \( G \) be an automorphism group of \( H = (Y, \mathcal{E}) \) where \( 0_i^k \) is the \( i \)-th orbit of \( k \)-subsets of \( \mathcal{E} \). Let \( A(G; H; t, k) = (a_{ij}) \) be an \( m \) by \( n \) matrix, where \( a_{ij} \) is the number of copies of \( 0_i^t \) that occur in the system of all \( t \)-subsets of all elements of \( 0_j^k \). Then there is a \( t \)-design \( T = (X, \mathcal{B}) \) with parameters \((\lambda; t, k, v)\), and with \( G \) an automorphism group of \( T \) if and only if there is an \( m \) by \( s \) submatrix \( M \) of \( A(G; H; t, k) \) where \( M \) has uniform row sums \( \lambda \). The calculus for applying this theorem is illustrated and numerous \( t \)-designs for \( 10 \leq v \leq 16 \) are found and presented. Using a theorem of Alltop on our \((12; 4, 6, 13)\) and \((60; 4, 7, 15)\) we obtain a \((12; 5, 7, 14)\) and a \((60; 5, 8, 16)\). (Received August 15, 1974.)

*74T-A218*  SHERMAN K. STEIN, University of California, Davis, California 95616. **Free Sets and the Capacity of a Cyclic Graph.**

A set \( B \) of elements in an abelian group is free (also called "sum-free") if distinct subsets of \( B \) have distinct sums. Let \( C(m) \) denote the cyclic group of order \( m \) as well as the cyclic graph with \( m \) vertices.

**Theorem 1.** Let \( m \) be prime and \( k \) a positive integer. Then there is a free set of \( n \) elements in the group \( C(m)^k \) if and only if there is an independent subgroup of \( C(m)^n \) that has \( m^{n-k} \) vertices. (Two vertices are independent if their difference does not have all coordinates 0, 1, or -1.)

Thus free sets may be used to construct independent sets.
THEOREM 2. If the maximal number of elements in a free set in $C(5)^k$ is asymptotic to $k \log_2 5$ as $k \to \infty$, then the capacity of $C(m)$ is $m/2$ for all odd $m \geq 5$.


THEOREM 3. \[ \lim_{m \to \infty} (\text{capacity of } C(m)) = \frac{m}{2}. \]

*74T-A219 N.S. MENDELSOHN & R. PADMANABHAN, University of Manitoba, Winnipeg, Canada, R3T 2N2

Some Varieties of Quasi-groups with Finite Basis Property.

A variety $K$ of algebras is said to have the finite basis property if the identities of an arbitrary finite member of $K$ is finitely based. In her survey article on this topic (J. Austral. Math. Soc. 16 (1973) 363-367) Shiela Macdonald mentions that varieties of quasi-groups may be the test cases for varieties having the modular congruence property but without the finite basis property. In this paper, we exhibit several varieties of idempotent quasi-groups all of which have the finite basis property. For $n \geq 2$, let $I_n$ stand for the binary identity $((xy) \cdots y = y$ where the variable $'y'$ occurs $n$ times and let $K_n$ be the variety of all idempotent, commutative self-distributive groupoids satisfying the identity $I_n$. For the case $n = 2$, Gratzer and Padmanabhan (Proc. Amer. Math. Soc. 28 (1971) 75-80) have shown that $K_n$ is precisely the variety of idempotent reducts of commutative Moufang loops of exponent 3. Using a similar argument, we show that each groupoid in $K_n$ is algebraically equivalent to a commutative Moufang loop of exponent $2^n - 1$ and that the finite basis property is invariant under this equivalence.

By a recent result of T. Evans (abstract 72T-A236, Notices AMS (1972)), it follows that the varieties $K_n$ have the finite basis property. (Received August 16, 1974.)

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Regular Identities and Finite Basis Property.

Let $K$ be a variety of algebras of some fixed finite type $\tau$. An identity "$f=g$" is called regular if the set of variables occurring in the polynomial symbol $f$ is the same as that in $g$. Let $R(K)$ denote the variety of algebras defined by all the regular identities holding in $K$. Recall that a variety $K$ is said to have the finite basis property if the identities of any finite member of $K$ is finitely based. \[ \text{THEOREM} \]

Let $K$ be a variety with finite basis property and for some binary polynomial $f$ in $K$, $f(x,y) = x$ is an identity in $K$. Then $R(K)$ has the finite basis property. Examples of such varieties include those generated by a finite group, finite ring, finite lattice, any non-constant two element algebra, quasi-primal algebra, etc. (Received August 16, 1974.)

*74T-A221 JONATHAN S. GOLAN, University of Haifa, Haifa 31999, Israel

Modules Satisfying Both Chain Conditions with Respect to a Torsion Theory

For a (hereditary) torsion theory $\tau$ on $R$-mod let $\mathcal{C}_\tau$ be the set of all modules $N$ satisfying the ascending and descending chain conditions with respect to submodules $K$ for which $K/N$ is $\tau$-torsion-free. Then $\tau \leq \tau' \Rightarrow \mathcal{C}_\tau \subseteq \mathcal{C}_{\tau'}$, and $\mathcal{C}_{\tau \land \tau'} = \mathcal{C}_\tau \cap \mathcal{C}_{\tau'}$. If $X(N)$ is the largest torsion theory relative to which $K$ is torsion-free and if $0 \neq K \in \mathcal{C}_X(N)$ then (i) the assassin $\text{ass}(N)$ of $N$ is a finite set; (ii) $N$ has finite uniform dimension; (iii) $X(N) = \text{ass}(N)$. Necessary and sufficient condition for $C \not\subseteq \mathcal{C}_X(N)$ is also proven. These results generalize some recent work of C. Goldman. (Received July 30, 1974.)
The definitions of quasi-homology modules, upper quasi-homology modules and lower quasi-homology modules of a sequence of modules and homomorphisms over a commutative ring with 1 can be found in Abstract 73T-A48, these (Notices) 20(1973), A-252. For two sequences $C, d$ and $C', d'$, define $C \otimes C'$ with $\beta$ in a usual way. $C$ and $C'$ are said to be $\otimes$-semiexact if $dd = 0$ and $d \otimes d' = 0$. For a $\otimes$-semiexact pair $C$ and $C'$, a set of conditions under which the sequence $\cdots \rightarrow \sum \{ \text{Tor}(C_{p-1}, \mathcal{K}_q(C')) \oplus \text{Tor}(\mathcal{K}_p(C), C'_{q-1}) \} \rightarrow \sum \{ \mathcal{K}_p(C) \otimes \mathcal{K}_q(C') \oplus \mathcal{K}_p(C) \otimes \mathcal{K}_q(C') \rightarrow \mathcal{K}_n(C \otimes C') \rightarrow 0 \}$, where $\sum$ indicates the direct sum over $p, q$ such that $p + q = n$, together with "induced" homomorphisms is exact is formulated. Similarly, define $\text{Hom}(C, C')$ with $\delta$ in a usual way. $C$ and $C'$ are said to be $\text{Hom}$-semiexact if $\text{Hom}(dd, d') = 0$ and $\text{Hom}(d, d'd') = 0$. For a $\text{Hom}$-semiexact pair, a statement "dual" to the above can be formulated. (Received August 15, 1974.)

Say that an algebra $\mathcal{A} = \langle A; F_1, F_2, \ldots \rangle$ is $N$-indecomposable iff one cannot write $A$ as the union of $N$ proper subuniverses, and say that a variety $V$ is $N$-indecomposable iff every $\mathcal{A} \in V$ is $N$-indecomposable. Theorem 1. The class of $N$-indecomposable varieties is Malcev-definable. Define an $N$-system as a sequence $P = \langle P_1, \ldots, P_N \rangle$ of finite families of subsets of a finite set $B$ such that $X_1 \cup \cdots \cup X_n = B$ implies for some $i$, $X_i$ contains a member of $P_i$. Theorem 2. $V$ is $N$-indecomposable iff a system of equations of the following type holds in $V$: $P_{A}(x_1, \ldots, x_n; y): \alpha \in A \Rightarrow y_{\alpha}$, with $A$ ranging over $P_1$ for a fixed $N$-system $\langle P_1, \ldots, P_n \rangle$. (Received August 20, 1974.)

Theorem 1. If a variety $V$ is 2-indecomposable [see preceding abstract] or is $k$-permutable for some $k$, then no algebra in $V$ admits a non-trivial partial order under which all operations are monotone up in each argument. Theorem 2. If the congruence relations in $V$ are modular [resp. regular, resp. factorable], then the homotopy group of every topological algebra in $V$ is nilpotent [resp. commutative, resp. trivial]. Theorem 3. If $V$ is 3-indecomposable, then no topological algebra in $V$ has homotopy group $\mathbb{Z}$. The topological results are proved by proving corresponding theorems excluding classes of groups (or groupoids) and interpreting loop spaces as groupoids in the category. Many of the exclusions are first-order and hence Malcev-definable. Theorem 4. If $V$ is $k$-permutable for some $k$, and $G$ is the homotopy group of a topological algebra in $V$, then $G$ has non-trivial center and if $G$ is finite $G$ is nilpotent. (Received August 20, 1974.)

The cyclic decomposition of polynomials.

In 'Arithmetical properties of values of sets of polynomials' (Acta Arith. 1969 pp. 91-115), M. Fried defined a polynomial $h(x) \in \mathbb{Q}[x]$ to be cyclic if $h(x) = a(x - b)^n + c$ for some $a, b, c \in \mathbb{Q}$. Consider an irreducible polynomial $h(x) \in \mathbb{Z}[x]$ of degree $n$. We say that $h(x)$ has a cyclic decomposition of degree $r$ if $h(x) = g(\text{s}(x))$ where $\text{s}(x)$ is cyclic of degree $r > 1$. If $h(x)$ has an irreducible cyclic factor $\text{s}(x) \mod (a \text{ rational prime})$ of degree strictly $> 1$, $\text{s}(x)$ is said to be a cyclic factor of $h(x)$.
If $h(x)$ has a cyclic decomposition of degree $r$ and no other decomposition of degree divisible by $r$, then the cyclic decomposition is said to be maximal. Theorem (i) If $h(x)$ has a cyclic decomposition, it has a unique maximal decomposition. (ii) The degree of this decomposition is $r$ if and only if $h(x)$ has cyclic factors of degrees $p_i \mid r, p_i$ running through all the prime factors of $r$ mod $q_i$ (iii) $h(x)$ is uniquely determined by any infinite set of cyclic factors mod $q_i$. (iv) If any polynomial of degree $n$ has a cyclic factor mod $q_i$ of degree $r$ (for infinite primes $q_i$) then it is reducible. (Received August 20, 1974.)

Vamos [J. London Math. Soc. 43(1968), 643-646] introduced the notion of finitely embedded by dualizing the concept of finitely generated. An $R$-module $M$ is said to be finitely embedded (f.e.) if $E(M) = E(S_1) \oplus \ldots \oplus E(S_k)$ where $E(M)$ denotes the injective hull of $M$ and each $S_i$ is a simple $R$-module. It is well known that rings all of whose ideals are finitely generated are Noetherian. Dually, Vamos proved that a ring $R$ is Artinian if and only if each factor ring of $R$ is f.e. However, rings all of whose ideals are f.e. need not satisfy any chain condition. Rings with this property in fact, properly contain the class of Artinian rings. The purpose of this paper is to prove that each ideal of a commutative hypercyclic ring is f.e. Necessary and sufficient condition on a finitely generated module over a commutative local hypercyclic ring to be f.e. will also be obtained. (Received August 12, 1974.) (Author introduced by Professor Russell L. Merris.)

J. Sheehan and E.M. Wright. University of Aberdeen, Aberdeen, U.K. The number of Hamiltonian circuits in thickly edged graphs. $G$ is a graph on $n$ nodes and $q$ edges without slings or multiple edges. We write $M = (n-1)/2, \beta = q/n, \beta$ for the maximum degree of any node in $G$ and $H$ for the number of Hamiltonian circuits in $\tilde{G}$, the complement of $G$. We show that, if $\alpha \rightarrow a < \omega$ and $\beta = o(n)$ as $n \rightarrow \infty$, then $H/M \sim e^{-2\alpha}$. Among special cases of this result already known are (i) $G$ a Hamiltonian circuit (E.M. Wright, Journ. London Math. Soc. 8(1974), 44-48) and (ii) $G$ a 1-factor (D. Singmaster, oral communication). If $\beta \neq o(n)$, there are graphs $G$ for which the result is false. If $A, B, \infty$ are any fixed positive numbers, $A < \alpha < B \log n$ and $\beta = O(n^{1-\infty})$, then $H \sim Me^{-2\alpha}$. (Received August 26, 1974.)

Goro Azumaya, Indiana University, Bloomington, Indiana 47401. Further characterization of semi-perfect modules. Preliminary report.

Let $R$ be a ring with radical $J$. As was announced in Abstract 74T-A30 in the Notices (vol. 21, no. 2, p. A-288), a left $R$-module $P$ is semi-perfect if and only if (a) $P$ is a direct sum of local $R$-modules and (b) $JP$ is small in $P$. Let $E$ be a complete set of non-isomorphic local idempotents of $R$. Then the condition (a) is equivalent to that $P = \Sigma \oplus (Re)_{u(e)}$, where $\Sigma \oplus$ means the direct summation extended over all $e \in E$ and $u(e)$ is the multiplicity of $Re$. It is now proved that such a module $P$ satisfies the other condition (b) (i.e., $P$ is semi-perfect) if and only if the following two conditions hold: (i) For each $e \in E$ with infinite $u(e)$, $Je$ is left $T$-nilpotent; (ii) For any sequence $a_1, a_2, a_3, \ldots$ of elements in $R$
and for any sequence $e_1, e_2, e_3, \ldots$ of mutually distinct elements in $E$ with $u(e_i) \neq 0$, there exists an $n$ such that $a_1 e_1 a_2 e_2 \ldots a_n e_n = 0$.

(Received August 26, 1974.)

*74T-A229 JOE V. PETTY, Texas Instruments, Inc., MS 907, Dallas, Texas 75222. A Weak Homomorphic Image Closure Property of $Z$-groups, $S_1$-groups.

Definitions not given here can be found in Robinson["Finiteness Conditions and Generalized Soluble Groups", Springer-Verlag, Berlin, 1972]. Let $P$ be a property of group homomorphisms such that all isomorphisms satisfy $P$. Define a class operator $Q_P$ by $G$ is in $Q_PX$ if there exist $K$ in $X$ and a homomorphism $h$ of $K$ such that $h$ satisfies $P$ with $G=(K)h$, where $X$ is any class of groups. If $Q_PX = X$, then we say that $P$ is a weak homomorphic image closure property of $X$. A homomorphism $h$ of a group $G$ satisfies $H$ whenever the kernel of $h$ is contained in the hypercenter of $G$. Ayoub[ J. Austral. Math. Soc. 9(1969), 218-227] has proven that $H$ is a weak homomorphic image closure property of the class of all residually central groups. By using characterizations of $Z$-groups, $S_1$-groups, resp., given by Hickin and Phillips[Arch. Math. 24(1973),346-350], we are able to obtain the following results. THEOREM. $H$ is a weak homomorphic image closure property of the class of all $Z$-groups and the class of all $S_1$-groups. The behavior possible for $H$-homomorphic images of $Z$-groups is illustrated by the following example. For each natural number $n$, let $D_n$ be a dihedral group of degree $2^n$. If $G$ is the complete direct product of the $D_n$'s and $N$ is the hypercenter of $G$, then $G/N$ is neither a $ZD$-group nor a $Z$-group.

(Received August 27, 1974.)


An $S$-lattice is a lattice in intuitionistic mathematics analogous to the distributive complemented lattice in classical mathematics. Representation theorem. Every $S$-lattice is isomorphic to a subalgebra of species of all subspecies of the species of all ultrafilters in the given $S$-lattice. The proof of the theorem, based on intuitionistic logic, is carried out by showing that: (i) If $F$ is a filter in an $S$-lattice, then $F$ is an ultrafilter in the $S$-lattice iff for every element $x$ of the lattice either $x \in F$ or the complement of $x$ is an element of $F$, but not both. (ii) For any two distinct elements of the $S$-lattice, an ultrafilter can be constructed which contains one but not the other. (iii) Every $S$-lattice can be mapped isomorphically into a subalgebra of the algebra of species of all subspecies of the species of all ultrafilters in the given $S$-lattice. (Received July 15, 1974.)

*74T-A231 B. N. DATTA and KARABI DATTA, Ahmadu Bello University, Zaria, Nigeria. An algorithm for computing powers of a Hessenberg matrix and its applications.

A simple algorithm for computing the first $n$ powers of a $n$-square Hessenberg matrix with unit codiagonal or for evaluating a polynomial of degree less than or equal to $n$ in such a matrix is proposed. Once the first row of $A^K$ is computed, the remaining rows are given by a simple recursive relation. The algorithm is found to be computationally more efficient than the existing procedures of matrix multiplication and its chief characteristic is that the computation of $A^K$ does not depend upon the computation of previous powers of $A$. Several applications of the algorithm are mentioned including the one for solving Lyapunov matrix equations associated with stability problems. (Received August 5, 1974.)

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Analysis

74T-B181 S.J. POREDA, Clark University, Worcester, MA 01610. A Counterexample for Approximation on a Real Interval.

Let I be a closed real interval and I* any nonempty subinterval of I. An example of a real valued function f(x) continuous on I is constructed which has the property that for all n ∈ Z⁺, if pₙ is the polynomial of degree n of best uniform approximation to f on I then, |f-pₙ| attains its maximum only on I*. Furthermore, f has the property that there exists a sequence of polynomials \{qₙ(x)\}_{n=0}^∞ of respective degrees n such that

\[
\lim_{n \to \infty} \left( \frac{\|f-qₙ\|}{\|f-pₙ\|} / \left( \frac{\|qₙ-pₙ\|}{\|qₙ\|} \right) \right) = 0
\]

where pₙ is as above and \| \cdot \| denotes the uniform norm on I. (Received June 17, 1974.)

*74T-B182 GRAHAME BENNETT, Indiana University, Bloomington, Indiana 47401. Some ideals of operators on Hilbert space.

For q an even integer and q < p ≤ ∞, it is shown that \( \mathcal{P}_{p,q} \), the class of (p,q) - absolutely summing operators on Hilbert space, coincides with the ideal generated by the Lorentz sequence space \( L^{2p/q} \). This differs from all previously known results (wherein \( \mathcal{P}_{p,q} \) turns out to be a Schatten r - class for some \( r = r(p,q) \)) and settles negatively a conjecture of Kwapien and a problem of Pietsch. (Received June 21, 1974.)

*74T-B183 N.K. SHARMA, Pahlavi University, Shiraz, Iran. Banach Algebra of Conservative Hausdorff Matrices, Preliminary report.

Let \( \mathcal{H} \) denote a function of bounded variation over \([0,1] \), \( H \) the conservative Hausdorff method corresponding to \( \mathcal{H} \) the Banach algebra of conservative Hausdorff matrices and \( \mathcal{S} = \{ H : \mathcal{H} \text{ absolutely continuous over } [0,1] \} \). One assumes without loss of generality that \( \mathcal{H}(0) = 0 \) and \( \mathcal{H}(t) = \mathcal{H}(t+0) \) for 0 < t < 1. Let \( \| \mathcal{H} \| \) be the usual Banach norm for \( H \). Theorem 1: There exists a positive real number k such that \( k\|\mathcal{H}\| \leq \|H\| \leq k\|\mathcal{H}\| \). Theorem 2: \( \mathcal{S} \) is norm closed in \( \mathcal{H} \). Theorem 3: The weak closure of \( \mathcal{S} = \mathcal{H} \). Similar results are obtained for Hausdorff matrices as operators on \( L^p \), 1 ≤ p ≤ ∞. (Received July 1, 1974.) (Author introduced by Dr. M. H. Afgahi.)

74T-B184 PROFESSOR WILLIAM D. L. APPLING, North Texas State University, Denton, Texas 76201. Absolute Continuity Characterizing Sets.

U, F, F_B, F_AB, F_A⁺ and the notion of integral are as in previous abstracts of the author. Theorem. If \( S \subseteq F_AB \), then the following two statements are equivalent: 1) If each of m and h is in \( F_A⁺ \), then h is absolutely continuous with respect to m iff it is true that if A is in \( F_B \), each of \( \int_A(I)m(I) \) and
\( \bigcup_{I} A(I) h(I) \) exists and \( \bigcup_{m} A_m \) is in \( S \), then \( \bigcup_{h} A_h \) is in \( S \); and 2) i) If \( r \) is in \( S \), \( s \) is in \( p_{AB} \) and is absolutely continuous with respect to \( r \), then \( \bigcup_{B|s|} \) is in \( S \), where, for each \( I \) in \( F \), \( B(I) = 1 \) if \( r(I) \geq 0 \) and \( B(I) = -1 \) if \( r(I) < 0 \), and ii) if \( k \) is in \( S \cap p_{A}^{+} \) and \( k(U) > 0 \), then there is \( A \) in \( p_{B} \) such that \( \bigcup_{A} A(\bar{I}) k(I) \) exists, but \( \bigcup_{A} A h(I) \) is not in \( S \). (Received June 24, 1974.)

*74T-B185 RAJENDRA SINHA, Purdue University, Lafayette, Indiana 47907. On an infinite linear combination of partial sums of Fourier series.

For \( f \in L \), let \( \sum_{n=0}^{\infty} A_n(f, x) \) be its Fourier series. We write \( S_n(f, x) = \sum_{j=0}^{n} A_j(f, x) \).

Let \( \tilde{f} \) denote the conjugate function of \( f \). The purpose of this paper is to extend the results of Neugebauer [Studia Math. T. XLI. (1972), 137-144].

Theorem 1. Let \( f, \tilde{f} \in L \). Then for a.e. \( x \), \( \sum_{n=1}^{\infty} [S_n(f, x) - f(x)] A_n(\phi, t) \) converges uniformly in \( t \) for all \( \phi \) of bounded variations.

Theorem 2. For \( f \in L \) and \( \phi \) of bounded variation, \( \sum_{n=0}^{\infty} A_n(\phi, 0) S_n(f, x) \equiv \phi(x) \) exists for a.e. \( x \) and \( ||f(t)\phi(\phi)||_p \leq A ||f||_p \) where \( 1 \leq p \leq \infty \) and \( A \) is a constant independent of \( f \).

(Received June 24, 1974.)

*74T-B186 S. J. BERNAU and H. ELTON LACEY, The University of Texas, Austin, Texas 78712. A Local Characterization of Banach Lattices With Order Continuous Norm.

A complex Banach space \( X \) is said to have local unconditional structure if there is a \( \lambda > 1 \) such that there is an upwards directed family of finite dimensional subspaces of \( X \) whose union is dense in \( X \) and such that each member \( Y \) of the family is \( \lambda \)-isomorphic to a Banach lattice \( Z \) (i.e., \( \|T\|\|T^{-1}\| \leq \lambda \) for some isomorphism \( T \) of \( Y \) onto \( Z \)). We prove that under suitable conditions on the bonding operators \( T \) that if \( X \) has local unconditional structure for all \( \lambda \geq 1 \), then it admits a Banach lattice structure for which the norm is order continuous. Conversely, we show that if \( X \) is a Banach lattice with order continuous norm, then it has local unconditional structure for all \( \lambda > 1 \) and has bonding operators with the specified properties. This generalizes the well-known result that \( X \) is an \( L^p(\mu) \) space if and only if it is an \( L^p,\lambda \) space for all \( \lambda > 1 \). (Received June 24, 1974.)

*74T-B187 H. M. SRIVASTAVA and REKHA PANDA, University of Victoria, Victoria, British Columbia, Canada V8W 2Y2. Expansion theorems for the \( H \)-function of several complex variables. Preliminary report.

The object of this paper is to derive two general classes of expansion formulas, in series of certain generalized hypergeometric polynomials, for the \( H \)-function of several complex variables which was introduced elsewhere by the present authors [J. Reine Angew. Math. (Crelle's J.) 270 (1974), to appear; see also Abstract 74T-B13 in these NOTICES 21 (1974), A-9]. It is also shown how one of the main results, stated as Theorem 4 in this paper, would admit itself of a mild generalization, and a fairly large number of hitherto scattered results in the literature are observed to be special cases of the expansions presented. The paper is a continuation of an earlier work by the authors [H. M. Srivastava and Rekha Panda, Certain expansion formulas for the generalized Lauricella functions. II, Comment. Math. Univ. St.

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In a forthcoming sequel to this paper, it is proposed to present certain classes of expansion formulas for the multiple $H$-function in series of products of generalized hypergeometric polynomials. (Received July 1, 1974.)


Let $G$ be a locally compact group, $\mu$ a right invariant Haar measure on $G$ and $\nu$ a regular complex-valued Borel measure on $G$ absolutely continuous with respect to $\mu$. It is proved by Larsen [Portugal. Math. 33 (1974) 109-112] that the Radon-Nikodym derivative $f = d\nu / d\mu$ is equal locally a.e. to a continuous almost periodic (a.p.) function on $G$ if and only if the family of functions $s + \nu(\mathcal{K} s) / \mu(\mathcal{K})$ $(s \in G$, $\mathcal{K}$ open and relatively compact) is uniformly bounded, equicontinuous and contained in the space of continuous a.p. functions on $G$. We offer the following weakly almost periodic (w.a.p.) analog of this result. Theorem, $f$ is equal locally a.e. to a continuous w.a.p. function (resp. null function) on $G$ if and only if the family of functions $s + \mu(\mathcal{K} s) / \mu(\mathcal{K})$ $(s \in G$, $\mathcal{K}$ compact with non-empty interior) is a relatively weakly compact subset of the space of continuous w.a.p. functions (resp. null functions) on $G$. Here, we have called a function $h$ on $G$ null if $h$ is w.a.p. and $\mu(|h|) = 0$, where $\mu$ denotes the unique invariant mean on the space of continuous w.a.p. functions on $G$. (Received July 5, 1974.)

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Canonical models and self-adjoint parts of dissipative operators.

Let $A$ be a bounded operator with non-negative imaginary part acting on a complex separable Hilbert space $H$. We give a method of recapturing the spectral invariants of $A_{sa}$, the self-adjoint part of $A$, from the behavior of $A^*$ on its invariant subspaces. The methods are based on the canonical models of Sz.-Nagy -Foias and de Branges -Rovnyak and the characteristic function of Livsic and Brodskii. A formula is given for the spectral measure of $A_{sa}$ in terms of characteristic functions of restrictions of $A^*$.

Sample Theorem: Suppose that $l$ is a collection of invariant subspaces of $A^*$ such that $H$ is spanned by the vectors $P_M(A - A^*)x$ with $x \in H$, $M \in l$ and $P_M = \text{projection onto } M$. Then $A_{sa}$ is absolutely continuous. If $\Theta$ and $\Theta_M$ are the respective characteristic functions of $A^*$ and $A^*|M$, the spectrum of $A_{sa}$ is $(-\infty, \infty) \setminus J$ where $J$ is the largest open set such that the induced factorization $\Theta(x) = \Theta_M(x) \chi_M(x)$ is regular (in the sense of Sz.-Nagy, Foias) a.e. on $J$.

The spectral multiplicity function of $A_{sa}$ is partially (and sometimes completely) determined. In case $A = B + K$ with $B$ a self-adjoint multiplication operator and $K$ a Volterra-type operator on $L^2(0,1)$, the spectral invariants of $A_{sa}$ are described in terms of $B$ and $K$. (Received July 5, 1974.)

RICHARD A. VITALE, Brown University, Providence, Rhode Island 02912. Representation of a Crinkled Arc

Johnson [A crinkled arc, Proc. Am. Math. Soc. 25, 1970, pp. 375-6] has shown that under suitable normalizations all crinkled arcs are unitarily equivalent. Using this result, we find a general series expansion for a crinkled arc, namely $f(t) = \sqrt{2} \sum_{n=1}^{\infty} x_n \frac{\sin(n - \frac{1}{2}) \pi t}{(n - \frac{1}{2}) \pi}$, where $\{x_n\}$ is an orthonormal set. (Received July 5, 1974.)
H(\(R\)) denotes the class of all holomorphic functions \(f\), \(f(z) = \sum_{n=0}^{\infty} a_n z^n\) whose radius of convergence is \(R\), \(0 < R < \infty\). Let \(f \in H(\(R\))\) and \(g \in H(\(R'\))\), \(0 < R' < \infty\), \(g(z) = \sum_{n=0}^{\infty} b_n z^n\). Define the convolution \(f * g\) of \(f\) and \(g\), by \(F(z) = (f * g)(z) = \sum_{n=0}^{\infty} a_n b_n z^n\). The function \(F(z)\) is holomorphic and the radius of convergence of its power series is at least equal to \(R'\). For the definition of order \(p\) and lower order \(\lambda\) of an holomorphic function \(f \in H(\(R\))\), refer Notices 20 (1973), A-395; Notices 21(1974), A-120. The following results are proved. Theorem 1. Let \(f * g\) be in \(H(\(R\))\) and of order \(p\), then \((f * g)'\) and \(f' * g'\) are in \(H(\(R\))\) and are of order \(\rho\), where prime denotes the derivative of the function. The corresponding result for lower order \(\lambda\) also holds. Theorem 2. Let \(f\) and \(g\) be in \(H(\(R\))\) and \(H(\(R'\))\), and be of order \(\rho\) and \(\rho'\) respectively, and such that \((f * g) \in H(\(R'')\))\), \(R'' = RR'\), and of order \(\rho''\). Then (a) \(\rho''/(\rho'^{+1}) \leq \rho/(\rho^{+1}) + \rho'/(\rho'^{+1})\). (b) If \(\rho = \rho' = 0\), then \(\rho'' = 0\). (c) If \(\rho'' = \infty\), then \(\rho = \infty\) or \(\rho' = \infty\). With more restrictive hypotheses, similar results hold for lower orders. Theorem 3. Let \(f * g\) be in \(H(\(R\))\) such that \(\sup_{n \geq 0} (|a_n b_n| R^n) = \infty\), then \(2(1 + \rho(f * g)) = \lim_{r \to R} \sup \log(u(r, f * g)/u(r, f * g)) \). Similar result holds for lower order \(\lambda\) with \(\lim\sup\) replaced by \(\lim\inf\). Here \(u(r, f * g) = \max_{n \geq 0} (|a_n b_n| R^n)\), r \(> 0\). Similarly define \(u(r, f' * g')\). Examples are provided.

(Received July 5, 1974.)

Recently several authors have studied (See, A. R. Reddy and O. Shisha, J. Approximation Theory (To appear)) the problem of approximating reciprocals of certain entire functions by reciprocals of polynomials under the uniform norm on the positive real axis. The question whether it is possible to approximate under the uniform norm on the positive real axis reciprocals of certain functions which are not entire by reciprocals of polynomials is left open.

Our intention is to prove several results in this connection. For example, let \(f(z) = \sum_{k=0}^{\infty} z^k\), then there exists polynomials \(P_n(x)\) of degree \(n\) for which for all large \(n\),
\[
\left\| \frac{1}{f(x)} - \frac{1}{P_n(x)} \right\| \leq \frac{\log n}{(n-1)} .
\]
(Received June 26, 1974.)

Let \(T\) be a completely non-unitary contraction on a separable Hilbert space \(H\) and \(\theta(\lambda)\) the characteristic function of \(T\). Let \(\theta_1(\lambda) = \theta_2(\lambda)\) be the product of its outer factor \(\theta_1(\lambda)\) and inner factor \(\theta_2(\lambda)\),
\[
T = \sum_{n=0}^{\infty} T_2^n X^n T_1 \quad \text{the corresponding triangulation. Theorem 1.} \ T \text{ is a scalar type spectral operator if and only if } \theta_1(\lambda) \text{ is invertible for } |\lambda| < 1, \sup_{|\lambda| < 1} \|\theta^{-1}_1(\lambda)\| < \infty,
\]
and \(T_2\) is a scalar type spectral operator. This generalizes a theorem by Sz.-Nagy and Foiaş [Harmonic analysis of operators on Hilbert space 2 P.344].
If $T$ is of class $C$ with defect indices $n < \infty$, let $\mathfrak{m}(\lambda) = B(\lambda) \exp[- \int K(\lambda, t) dt]$ be the minimal function of $T$. For any Borel $w \subseteq \mathbb{C}$, let $\mathfrak{m}(\lambda) = B_w(\lambda) \exp[- \int_{\omega}^{\infty} K(\lambda, t) dt]$, $B_w(\lambda)$ the maximal factor of $B(\lambda)$ whose zeros lie in $w$. Let $H_0 = \{ x \in X : T x = 0 \}$. Let $\theta(\lambda) = \theta_2 (w) \theta_1 (w) = \theta_{2}' (w') \theta_1 (w')$ be the factorizations corresponding to the invariant subspaces $H_0$ and $H_0$.

**Theorem 2.** $T$ is a spectral operator if and only if for some $\delta > 0$,

$$\| \theta_2 (w) (\lambda) \| + \| \theta_2 (w') (\lambda) \|^2 \geq \delta$$

for $|\lambda| < 1$, $w \subseteq \mathbb{C}$, $\xi \in \mathbb{C}$, $\| \xi \| = 1$. (Received July 8, 1974.)

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**74T-B194**

ERWIN O. KREYSZIG, University of Windsor, Windsor, Ontario, Canada.

An equation involving a solution of Liouville's equation.

A general solution of Liouville's equation $v_{zz} = \exp 2v$ is $v = a'(z) b'(z*)/(a(z) + b(z*))^2$. Let $c = kv$. If $k = -n(n + 1)$, $n$ a positive integer, the equation $L u = u_{zz} + cu = 0$ is of class $P$, that is, there is a Bergman integral operator for representing solutions of (1) whose kernel $g$ is a polynomial in the variable of integration. A representation of $g$ is obtained. By applying a theorem on operators of class $P$ (cf. M. Kracht and E. Kreyszig, "Bergman-Operatoren mit Polynomen als Erzeugenden," Manuscripta Math. 1, 1969, 369-376) one obtains from the representation of $g$ a differential operator for representing solutions of (1); this operator is defined on the space of complex functions holomorphic on a given domain in the complex plane. This theory includes classical results by Cosserat and Moutard. (Received July 8, 1974.)

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**74T-B195**

TAI-PING LIU, Univ. of Maryland, College Park, Md. 20742. The uniqueness theorem of the Cauchy problem for general 2x2 conservation laws. Preliminary report.

Consider general 2x2 conservation laws (1) $u_t + f(u, v)_x = 0$, $v_t + g(u, v)_x = 0$, and isentropic gas equations (2) $u_t - v_x = 0$, $v_t + p(u)_x = 0$, where $(u, v) = (u, v)(x, t)$, $t \geq 0$, $-\infty < x < \infty$. Assume that $f'_v < 0$, $g'_u < 0$ and $p'(u) < 0$. The uniqueness theorem of the Cauchy problem with initial data (3) $(u(x, 0), v(x, 0)) = (u_0(x), v_0(x))$ is proved by use of Haar's method and the notion of potentials. We only consider piecewise continuous weak solutions which consist of finite number of centered rarefaction waves in each compact set of $xt$-plane. **Theorem 1.** Suppose that (1) is genuinely nonlinear. Then there exists at most one weak solution to the Cauchy problem (1) and (3) which satisfies Lax's shock inequalities (L) across every discontinuity. **Theorem 2.** There exists at most one weak solution to the Cauchy problem (2) and (3) which satisfies the extended entropy condition (E) the author proposed. (Received July 8, 1974.)
Non-equivalent metric functions.

On a finite-dimensional linear space all quasi-norms generate identical topologies. It is shown that this fails if, in the definition of quasi-norm, the joint continuity of the product of scalar and vector with respect to the scalar and vector components is relaxed to continuity with respect to either component. (Received July 10, 1974.)

A characterization of C-space maps.

Setting and notions are as in previous abstracts of W. D. L. Appling. For \( \lambda \) in \( P_A^+ \), define the mapping \( R_\lambda : P_A^+ \to P_A^+ \), \( \xi \to \sqrt{\xi \lambda} \). Let \( \alpha : P_A^+ \to P_A^+ \), then the following are equivalent: 1) \( \alpha R_\lambda = R_\lambda \alpha \) for each \( \lambda \in P_A^+ \). 2) The image of \( \alpha \) is a C-set and a linear space and \( \alpha \) is its nearest point map. (Received July 11, 1974.)

The infinite supported tree property (ISTP) for a Banach space is introduced. It is patterned after and strictly stronger than the infinite tree property of James ("Some self-dual properties of normed linear spaces," Annals of Mathematics Studies 69 (1972)). A Banach space is said to be flat if there exists a curve on the surface of its unit ball whose end-points are antipodal and whose length is 2. (These authors, Bulletin A.M.S. 76 (1970).) Theorem 1. A Banach space \( X \) is flat iff \( X \) has ISTP. Corollary. If \( X \) has ISTP, then its conjugate \( X^* \) has ISTP. Theorem 2. If \( X^* \) has ISTP, then \( X^* \) is not separable, but not conversely--not even if \( X \) is separable. Theorem 3. If \( X \) contains a subspace isomorphic to \( l_1 \), then \( X^* \) has ISTP, but not conversely. (Received July 15, 1974.)

Disconjugacy for systems.

Given an integer \( n \geq 0 \), a collection of (appropriately smooth) mappings \( y \) from an interval \( I \) to \( R^m \) will be called disconjugate if every member \( y \neq 0 \) has sum less than \( n \) of the number of zeros in \( I \) of its coordinates, counting multiplicities.

Theorem: For a system of \( m \) linear \( n \)-th order equations \( y^{(n)} = \sum_{k=0}^{n-1} A_k(t)y^{(k)} \) with \( m \)-square matrices \( A_k \) continuous and any \( t_0 \in R^1 \), there exists an \( n \)-dimensional subspace \( L \) of its space of solutions such that, in any basis for \( R^m \), the collection \( L \) is disconjugate on a neighborhood of \( t_0 \). In general the dimension of \( L \) cannot be increased. (Received July 15, 1974.)
Let \( L = \sum A_j(x)D_j + C(x) \) be a symmetrizable first-order system in the sense of Friedrichs and Lax [NR39-613] acting in \( G = \mathbb{R}^n \times \mathbb{R}^{n-n} \). Set \( \mathcal{G}_j = \partial G \times \{ x \in \mathbb{R}^n : x_j = 0 \} \), \( j = 1, \ldots, n \). On each \( \mathcal{G}_j \) let the symmetrizer satisfy the relevant hypotheses. Theorem 1. The form \( (u,\overline{u})_{\mathcal{G}_j} \) is a bounded quadratic form (in \( L^2 \)) on the functions \( u,u_1,\ldots,u_n \), where \( u \in C^0(\mathcal{G}) \) and \( u_j \) is the restriction of \( u \) to \( \mathcal{G}_j \). Now let \( L = D_t + L_0 \) be strictly and symmetric hyperbolic and consider the problem (*) \( Lu = f \) in the region \( \{ (x,t) : x \in \mathcal{G}, 0 \leq t \leq T \} \), \( u(x,0) = 0 \), and \( P_j u = g_j \) on \( \mathcal{G}_j \times [0,T], j = 1,\ldots,n \), where the boundary condition is formally dissipative. Theorem 2. Under small nonsymmetric perturbations of the \( A_j \)'s, (*) remains formally dissipative. That is, \( L \) has a symmetrizer \( R \) such that \( \int u \overline{u} \) is a strong solution of (*) and \( \int u \overline{u} \) is a form \( \mathcal{G}_j \) estimate for \( \Delta \). (Received July 17, 1974.)
\( x^y (1 + G) \) exists for \( a \leq x < y \leq b \), then \( \int_a^b S[1 + G - \pi(1 + G)]T \) exists and is zero. These
theorems are of interest because they can be applied to the solution of integral equations.

This is demonstrated by studying the solution of the Riccati integral equation
\[ f(x) = w(x) + (LRLR) \int_a^x (fH + Gf + fKf). \]
(Received July 26, 1974.)

7\textsuperscript{4T-B204} DONG S. KIM, University of Florida, Gainesville, Florida 32605.
An open Gleason part.

Let \((X, A)\) be a complex space and \(D\) be a domain in \(X\). Let \(B = B(D)\) be the algebra of bounded holomorphic functions on \(D\). Assume that \(B\) separates the points of \(D\). Let \(c\) be the Carathéodory distance of \(D\). If \(D\) is \(c\)-complete then the Gleason part containing \(D\) is \(D\) itself. Theorem. If the part containing \(D\) is \(D\) itself then \(D\) is open in the maximal ideal space of \(B\). For instance, each of analytic polyhedra or bounded convex domains in \(\mathbb{C}^n\) can be embeded homeomorphically into the corresponding maximal ideal space of \(B\) as an open subset. A criterion of \(c\)-completeness is given: \(D\) is \(c\)-complete if and only if every boundary point of \(D\) is of stably infinite distance with respect to the Carathéodory distance. (Received July 25, 1974.)

7\textsuperscript{4T-B205} G. P. KAPOOR, V.V. Postgraduate College, Shamli (Muzzafarnagar), India
On the coefficients of functions analytic in the unit disc having fast rates of growth

Let \( f(z) = \sum_{n=0}^{\infty} a_n z^n \) be analytic in the unit disc \( D \equiv \{z: |z| < 1\} \). Set
\[
M(r) = \max_{|z| = r} |f(z)|, \quad 0 < r < 1,
\]
and assume that \( M(r) \to \infty \) as \( r \to 1^- \). Let \( \rho(q) \) (= \( \lambda(q) \)) =
\[
\limsup \left( \inf \right) \left( \frac{\log[q] M(r)}{(-\log(1-r))} \right), \quad 0 < \log[q-1] x < \infty, \quad q = 1, 2, \ldots
\]
f(z) is said to be of index \( q \) if \( \rho(q) < \infty \) and \( \rho(q-1) = \infty \),
q = 2, 3, \ldots. The present paper deals with the connections of \( \rho(q) \) and \( \lambda(q) \) with the coefficients \( a_n \) and the exponents \( \lambda_n \). A sample result follows. Let \( f(z) = \sum_{n=0}^{\infty} a_n z^n (a_n \neq 0) \) for all \( n \) be analytic in the unit disc \( D \) and have the index \( q \). Then, \( \rho(q) + A(q) = \limsup \frac{\log[q-1] \lambda_n}{(\log \lambda_n - \log^+ \log^+ |a_n|)} \). Further, if \( \rho(q) > 0 \), then (1) \( \lambda(q) + A(q) = \max_{k} \left( \liminf \left( \frac{\log[q-1] \lambda_n}{(\log \lambda_n - \log^+ \log^+ |a_n|)} \right) \right) \), where \( A(q) = 1 \) if \( q = 2 \) and \( A(q) = 0 \) if \( q = 3, 4, \ldots \).
For \( q = 2 \), previous results of the author (Dissertation, Indian Institute of Technology, Kanpur, August 1972; also see these Notices 20(5), (1973), A-490 and 21(3), (1974)) follow from (1). (Received June 20, 1974.) (Author introduced by Professor J.N. Kapur.)

7\textsuperscript{4T-B206} IGOR KLUVÁNEK, The Flinders University of South Australia, Bedford Park, South Australia 5042. A measure whose range contains a ball in \( f_2 \), Preliminary report.

Let \( B \) be the \( \sigma \)-algebra of Borel sets in \([0, 1]\). Let \( \{r_n\}_{n=1}^{\infty} \) be the sequence of Rademacher functions. For every \( E \subseteq B \), let \( m(E) = (x_1, x_2, \ldots) \), where
\[
x_n = \int_{r_n(t)} dt, \quad n = 1, 2, \ldots.
\]
This defines a \( \sigma \)-additive measure \( m: B \to \ell_2 \) such that the set \( \{m(E): E \in B\} \) is bounded, closed, convex, with non-empty interior.
(Received August 2, 1974.) (Author introduced by Barbara Faires.)
We consider the Klein-Gordon equation \( \square u + m^2 u = 0 \) (\( m > 0 \)), \( \square = \frac{\partial^2}{\partial t^2} - \Delta \), \( \Delta = \frac{\alpha^2}{x^2} \) in \( \Omega = \mathbb{R}^3 - \infty < t < \infty \) perturbed by an external "repulsive" potential \( g(x) \), \( x \in \mathbb{R}^3 \), non-negative, smooth and small at infinity. We show that the scattering matrix (S-matrix) can be written as the identity plus an integral operator. The method is based essentially on an (outgoing and incoming) spectral representation of \( -\Delta + m^2 + g(x) \). In particular, when \( g(x) \) is spherically symmetric we use standard stationary methods to solve the inverse scattering problem. (Received August 5, 1974.)

Recently, H. M. Srivastava and R. Panda [Nederl. Akad. Wetensch. Proc. Ser. A 76 = Indag. Math. 35 (1973), 308-319; see also these NOTICES 20 (1973), p. A-272, Abstract 73T-B80] discussed a number of integral transformations and showed how the operational techniques provided by some of these transformations can be effectively applied to derive several linear, bilinear or bilateral generating relations, and certain reduction formulas, associated with a fairly large variety of special functions. In an attempt to give an extension of their work, the present note evaluates a double integral involving a certain product of the H-function of C. Fox [Trans. Amer. Math. Soc. 98 (1961), 395-429]. The main result can be suitably specialized to yield several known or new integral formulas of interest to mathematical analysts and applied mathematicians; it may also be looked upon as a double integral transformation which would easily lead to effective operational techniques in the theory of special functions. This paper concludes with a brief remark about some of these applications to such special functions as those that can be expressed through the \( F \), \( G \) or \( H \) symbol. (Received August 6, 1974.)

Let \( E \) be all absolutely continuous \( f: \mathbb{R} \to \mathbb{C} \) s.t. for some \( A, \alpha > 0 \), \( |f(x)| < Ae^{-\alpha|x|} \) and \( |f'(x)| < Ae^{-\alpha|x|} \) a.e. \( L \in E \) is a fundamental (orthofundamental) function if \( L(m) = \lim_{\delta \to 0} \int_{m-\delta}^{m+\delta} f(t)L(t)dt = \delta \), \( m \in \mathbb{Z} \); \( \varphi \in E \) admits a FF \( L^\varphi \) (OF \( L^\varphi \)) if \( A, B > 0 \) and a complex \( \{a_m\}_{m \in \mathbb{Z}} \) s.t. \( |a_m| < Be^{-B|m|} \) and \( \int_{-\infty}^{\infty} \varphi(x-m)dx = \frac{1}{m^\varphi} \). Let \( \varphi(u) = \sum_{m \in \mathbb{Z}} \varphi(x-m) dx \). Theorem 1. \( \varphi \in E \) admits a FF (OF) iff 
\[
\sum_{k} \phi(2\pi u k) \hat{\phi}(u+2\pi k) \phi(u+2\pi k) \varphi(x-m) \sum_{m \in \mathbb{Z}} |\varphi(x-m)|^2 \neq 0 \quad \text{for } u \in [0,2\pi].
\]

Theorem 2. Let \( \varphi \in E \) admit a FF, and let \( f: \mathbb{R} \to \mathbb{C} \) be locally integrable, with \( |f(x)| < A(1+|x|)^\gamma \) for some \( A, \gamma > 0 \). Then \( K^\varphi \int f(x)dx \approx \sum_{m \in \mathbb{Z}} f(t) L^\varphi (t-m) \varphi (x-m) \) and \( K^\varphi [f](x) \approx \sum_{m \in \mathbb{Z}} \int_s^{t} f(t) L^\varphi (t-m) \varphi (x-m) \) are uniquely determined by \( \varphi \) and \( f \), and converge absolutely and locally uniformly. If \( f \in L^2 \), then \( K^\varphi [f] \) is identical with the best \( L^2 \)-approximation to \( f \) among functions of the form \( \sum_{m \in \mathbb{Z}} a \varphi(x-m) \). Theorem 3. Let \( \varphi \in E \) admit a FF.
If \( e_u(x) \equiv e^{ixu} \), \( u, x \in \mathbb{R} \), then for \( m=0,1,2,\ldots \),

\[
e^{2\pi i k x} \sum_k [e^{i\phi_k} \cdot e^{i(\partial/\partial u)^m u}]_\phi(x) = e^{i(\partial/\partial u)^m u}(x) \sum_k e^{-2\pi i k x} \cdot e^{i(\partial/\partial u)^m u}(x)_{\phi_k}.
\]

And the series may be differentiated term by term. (Received August 6, 1974.)

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ROGER A. HORN, Department of Mathematical Sciences, The Johns Hopkins University, Baltimore, Md. 21212. Quadratic Forms in Harmonic Analysis and the Bochner-Eberlein Theorem.

New characterizations are given of the classes of functions on a locally compact Abelian group which are Fourier-Stieltjes transforms of: bounded measures, nonnegative bounded measures, and integrable functions. These characterizations are all of the same form.

(Received August 8, 1974.)

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ATHANASSIOS G. KARTSATOS, University of South Florida, Tampa, Florida 33620. The Hildebrandt-Graves theorem and existence problems. Preliminary report.

Consider the problem: \((*)\) \( x' + F(t,x) = 0 \), \((**): Lx = 0 \). Here \( F \) is an \( n \)-vector defined and continuous on \( \mathbb{R} \times \mathbb{R}^n (\mathbb{R}_+ = [0,\infty), \mathbb{R} = (-\infty,\infty)) \), and \( L \) is an operator defined and continuous on a space of bounded and continuous functions on \( \mathbb{R}_+ \). If by \( Mx \) we denote the lefthand side of \((*)\), then the problem \((**,*)\) is equivalent to the problem \((1)\) \( Ux = [0,0] \), where \( Ux = [Mx, Lx] \). The present method is based upon the Fréchet differentiability of the operator \( U \), which is defined on a suitable function space and has values in a product space. As a by-product of the main results, the existence of bounded solutions on the whole real line is shown for nonlinear systems of the form \((*)\). (Received August 12, 1974.)

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LYLE E. PURSELL, University of Missouri-Rolla, Rolla, Missouri, 65401. Isomorphisms between rings of real functions which identify fixed, maximal ideals.

A real function ring is a ring \( F \) of real functions on a non-empty set \( X \) which separates points of \( X \) and has the property: for each \( x \) in \( X \), the set \( F(x) = \{f(x) : f \in F\} \) includes all real numbers. For each \( x \) in \( X \), let \( M_x = \{f \in F : f(x) = 0\}. \) The two properties of a real function ring ensure that \( x \mapsto M_x \) is a one-to-one correspondence from \( X \) onto the set of all fixed, maximal ideals in \( F \). An isomorphism \( a \) from \( F \) onto a real function ring \( G \) (with domain \( Y \)) is conservative if \( a[M_x] \) is fixed for every \( x \) in \( X \) and every fixed, maximal ideal in \( G \) is of the form \( a[M_x] \) for some \( x \) in \( X \). Sufficient conditions for isomorphisms to be conservative are investigated. We show that a conservative isomorphism \( a \) from \( F \) onto \( G \) induces a transformation \( t \) from \( X \) onto \( Y \) such that \( af = f \circ t^{-1} \) for all \( f \) in \( F \). We investigate various relationships between \( a \) and \( t \) for a large number of choices of \( X \) and \( F \). (Received August 9, 1974.)

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ELEMER E. ROSINGER, Technion-Israel Institute of Technology, Haifa, Israel 3200. Multiplication of Dirac distributions.

Associative, commutative algebras with unit element, containing \( C^\infty(\mathbb{R}^1) \) and the distributions with finite support are constructed. For each \( T \in D'(\mathbb{R}^1) \setminus C^\infty(\mathbb{R}^1) \), \( T \) not a solution of any equation \( \lambda_0 T + \lambda_1 DT + \ldots + \lambda_P D^P T = S \), \( \lambda_1, \ldots, \lambda_P \in \mathbb{R}^1 \), \( \lambda_P \neq 0 \), \( S \in D'(\mathbb{R}^1) \), supp \( S \) finite, there exist algebras containing \( \{D^P T | q = 0,1,\ldots\} \). Each algebra has a linear mapping which is an extension of the distribution derivative and satisfies the 'rule of product derivative'. In each algebra \( \psi(x - x_0) D^P \delta_{x_0} = 0 \), \( P = 0,1,\ldots, \psi(x_0) \in \mathbb{R}^1 \), \( p = 0,1,\ldots, \psi(x_0) \in \mathbb{R}^1 \), \( p = 0,1,\ldots \). In some algebras \( (x - x_0)^P D^Q \delta_{x_0} = 0 \), \( x_0 \in \mathbb{R}^1 \), \( p = 0,1,\ldots, p > q \).
In each algebra $D_{p,q} = \frac{\partial^{q} v}{\partial x^{p}}$, $p,q = 0,1,\ldots$ The elements of the algebras are classes of sequences of functions in $C^{\infty}(R^{n})$. An interpretation of the Dirac distributions and an application to solving the Riccati differential equation $y' = x^{n} \cdot y \cdot (y + 1) + \delta_{0}$, $n = 1,2,\ldots$ are given. (Received August 14, 1974.) (Author introduced by Professor Richard R. Goldberg.)

The set of all sequences $x = (x_{n})$ with $|x_{n}|^{1/n} \to 0$ as $n \to \infty$. It is known that $\Gamma$ is an FK-space.

**Theorem.** An FK-space contains $\Gamma$ if and only if $\{ \frac{\delta_{j}}{K^{j}}, j = 1,2,3,\ldots, K > 0 \}$ is a bounded subset of $E$. **Cor.1.** Let $A$ be a matrix and $E$ an FK-space. Then $A$ maps $\Gamma$ into $E$ if and only if the columns of $A$ belong to $E$ and satisfy the condition of the theorem. **Cor.2.** A matrix $A$ maps $\Gamma$ into $C$ if and only if $|a_{i,j}|^{1/j} < M$ independent of $i$ and $j$. (ii) $\lim_{i=1} a_{i,j} = a_{j}$ for each fixed $j$.

**Cor.3.** A matrix $A$ maps $\Gamma$ into $\ell$ if and only if (i) $\sum_{i=1}^{\infty} |a_{i,j}| > K_{0}$ for each $K > 0$. Analogous results for non-archimedean FK-spaces have also been obtained. (Received August 15, 1974.) (Author introduced by Professor A. Wilansky.)

In this paper a theorem of Marcinkiewicz on entire characteristic functions is extended. **Theorem 1.** Let $f$ be an entire function defined by $f(z) = a + m \{ \exp(Q(z)) \} P(z)$ where $a$ is any complex number, $m$ a non-negative integer, $Q$ a polynomial of degree $p > 2$ and $P$ the canonical product formed with zeros of $f-a$ and is such that $\log M(r, P) = r^{p}$ and $r = |z|$, $z = x + iy$. Then $f(z)$ cannot be a characteristic function (c.f.). **Theorem 2.** Let $f$ be an entire function defined by $f(z) = a + z \{ \exp(a_{1} z + a_{2} z + a_{3}) \} P(z)$ where $P$ is the canonical product satisfying $\log M(r, P) = r^{p}$, $p = 2$ when $a_{1} \neq 0$, otherwise. Suppose that one of the following six conditions is satisfied: (a) $\text{Im} a_{1} \neq 0$; (b) $\text{Im} a_{1} = 0$, $\text{Re} a_{1} > 0$; (c) $\text{Im} a_{1} = 0$, $\text{Re} a_{1} < 0$, $|a| > 1$; (d) $a_{1} = 0$, $\text{Re} a_{2} = 0$; (e) $a_{1} = 0$, $\text{Re} a_{2} = 0$, $P(z) = 1$ and all zeros of $f-a$ lie either in the half plane $\text{Re} z \geq 0$ or in $\text{Re} z \leq 0$; (f) $a = 0 = m = a_{1} = a_{2} = a_{3}$ and $P = 1$. Then $f(z)$ cannot be a c.f. (Received August 19, 1974.)

Let $\mathcal{L}(\mathcal{H})$ be the algebra of operators in a complex Hilbert space of dimension $h$. Every operator $T$ admits a decomposition into "separable components" naturally associated to its different weighted spectra (Edgar, et al., "Weighing operator spectra", Indiana Univ.)
Math. J. 21(1971), 61-80). Operators with finitely many different weighted spectra are norm dense in \( L(\mathbb{N}) \). These properties are used to show that \( T \) is a norm-limit of algebraic (nilpotent) operators iff \( \delta(z-T) = \delta(z-T^*) \) (where \( \delta(T) = \text{approximate nullity; same reference} \) for all complex \( z \) (and all weighted spectra are connected sets containing 0, resp.). There exists a quasinilpotent \( Q \) such that \( J(Q) \) coincides with the norm-closure of the set of all nilpotents \( J(T) = [WTW^{-1}] \) is the similarity orbit of \( T \). The closure of \( J(N) \) for normal \( N \) is completely determined whenever spectrum\((N) = \text{heavy spectrum}(N) \) is connected (and determined up to compact perturbations in the general case). The results also include some information about \( J(T)^{-1} \) for arbitrary \( T \) in \( L(\mathbb{N}) \). (Received July 24, 1974.)


Let \( X \) be a compact subset of \( \mathbb{C}^m \) and let \( G(X) \) be the space of germs on \( X \) of functions holomorphic near \( X \), equipped with its natural locally convex inductive limit topology. Under a mild topological assumption on \( X \), conditions internal to \( G(X) \) are found which are necessary and sufficient for the boundedness of a subset of \( G(X) \) or the convergence of a sequence in \( G(X) \). These results follow from a general extendibility theorem. Examples are constructed to show that the topological assumption on \( X \) cannot be dispensed with. A related local extendibility result is also established. (Received August 20, 1974.)

*74T-B218 J. P. SINGH, Department of Mathematics, Kurukshetra University, Kurukshetra (India). Best approximation by a saturation class of generalized Norlund operators.

The \((N,p,q)\) transform of \( s_n = \sum_{\nu=0}^{n} a_{\nu} \) is defined by \( \hat{s}_n = (1/\lambda_n) \sum_{\nu=0}^{n} \hat{p}_{n-\nu} a_{\nu} \) where \( \hat{p}_{n-\nu} = p_{n-\nu} - \nu \) and \( \lambda_n = \sum_{\nu=0}^{n} r_{n-\nu} \nu \). A given series \( \{a_n\} \) with the sequence of partial sums \( \{s_n\} \) is said to be summable \((N,p,q)\) if \( \sum_{n=0}^{\infty} \hat{s}_n \rightarrow s \) as \( n \rightarrow \infty \). The special cases of this method are \((N,p),(N,q),(E,\epsilon)\) and \((C,\sigma)\). \( N^p,q \) is called generalized Norlund operator. In this paper following has been proved: Theorem: Let \( \{b_n\} \) and \( \{a_n\} \) be two sequences of constants such that \( a_n \) is positive and satisfying the conditions (i) \( r_{n-k}/r_n \rightarrow 1 \) as \( n \rightarrow \infty \) for fixed \( k \leq n \) (ii) \( \sum_{k=0}^{n} |r_{n-k}^* r_{n-k-1}| = O(r_n) \) where \( r_{-1} = 0 \). Then the saturation class of operators \( N_{b_n} \) relative to \( r_n \) consists of all continuous functions \( f \) for which \( \tilde{f} \in \text{Lip } 1 \), and the order of saturation is \( r_n/r_n \). Our theorem includes a result of Barnett and others [specific Math. J. to appear] and some of the previously known results as particular cases.

(Received April 26, 1974.)

*74T-B219 C. M. JOSHI, University of Jodhpur, India and M. L. PRAJAPAT, Defence Laboratory, Jodhpur, India. On generating functions for generalized Hermite, Laguerre and Bessel polynomials. Preliminary report.

Some theorems on generating functions concerning the polynomial set \( \{M_n(x,r,p,b,k,q)\}_{n=0,1,2,\cdots} \) defined in terms of the operator \( T_{k,q} = x^q(k+xD) \), \( k \) and \( q \) being constants, are proved. In the sequel new elegant generating relations involving generalized Hermite, Laguerre and Bessel polynomials are obtained. (Received April 18, 1974.)
Let \( f(z) = z + a_2 z^2 + \ldots \), be regular in \( D(\{ |z| < 1 \} \) and satisfy the conditions

\[
(1) \left| \frac{zf'(z)}{f(z)} - m \right| < M \quad \text{and} \quad (2) \left| 1 + z f''(z)/f'(z) - m \right| < M
\]

where \((m, M) \in \mathbb{R} = R_1 \cup R_2 \) and \( R_1 = \{(m, M): \frac{1}{2} < m < 1, 1 - m < M \leq m \} \), \( R_2 = \{(m, M): 1 \leq m, m - 1 < M \leq m \} \).

Denote by \( S(m, M) \) and \( K(m, M) \) the class of functions satisfying (1) and (2), respectively. In the present paper authors have proved that

\[
F(z) = \left( (c+1)/z^c \right) \int_0^z t^{-c-1} \frac{f(t)}{t} dt \in S(m, M) \text{ or } K(m, M) \text{ whenever } f \in S(m, M) \text{ or } K(m, M)
\]

for \( c > -(1-a-b) \), \( a = m^2 - 1/M, b = m - 1/M \). Authors, also prove that

\[
zf'(z)/f(z) \ll G(z) \quad \text{where } b \ll a, \quad \text{and, } G(z) = az(1-bz)^{-b}(1-bz)^{-a/b^2 -1}
\]
along with the weak converses of above mentioned results. (Received August 23, 1974.)

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**Applications of Extreme Point Theory to Classes of Multivalent Functions.**

We consider the classes of multivalent functions denoted by \( C(p, p) \), \( S(p, p) \), \( K(p, p) \) and \( T(p) \) which are respectively convex, starlike, close-to-convex, and generalized typically real which have power series developments

\[
f(z) = z^{p+1} + z^{p+2} + \ldots
\]

We determine the closed convex hulls and extreme points of these classes. We also consider functions in \( C(p, p) \), \( S(p, p) \), and \( K(p, p) \) with real coefficients and determine their closed convex hulls and extreme points. We solve extremal problems over those classes. For instance, we derive the sharp coefficient bounds on a function which is subordinate to or majorized by a function in any of the above classes. We also consider the problem of maximizing the \( L^q \) means of a function in any of the above classes. (Received August 24, 1974.)

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**p-weights for even and odd functions.** Preliminary report.

Let \( p \geq 1 \) and \( \tilde{T} \) represent the Hilbert transform of \( f \). A nonnegative even function \( W \) on \(-\infty, \infty\) is called an even (odd) \( p \)-weight for the Hilbert transform if there is \( C \) independent of \( f \) such that (1) \( \int_{-\infty}^{\infty} |\tilde{T}(\xi)|^p W(\xi) \, d\xi \leq C \int_{-\infty}^{\infty} |\xi|^p W(\xi) \, d\xi \) holds for all even (odd) \( f \). We define \( F(t) = \frac{1}{t} \int_0^t \tilde{T}(\xi) \, d\xi \) and \( F^*(t) = \int_0^t \tilde{T}(\xi) / \xi \, d\xi \).

**Theorem 1.**

a. If \( W \) is an even \( p \)-weight and if both (2) \( \int_0^\infty |F(t)|^p W(t) \, dt < A \int_0^\infty |f(t)|^p W(t) \, dt \) and (3) \( \int_0^\infty |F^*(t)|^p W(t) \, dt < A \int_0^\infty |f(t)|^p W(t) \, dt \) hold, or more generally if \( \tilde{T}(\xi) = (f(t)X[0, \infty](t)) \) and if (4) \( \int_{-\infty}^{\infty} |\tilde{T}(\xi)|^p W(t) \, dt \leq A \int_{-\infty}^{\infty} |f(t)|^p W(t) \, dt \) holds for some \( A \) independent of \( f \), then \( W(x)x^{-d} \) is also an even \( p \)-weight for \( 0 \leq q \leq p \). b. If \( W(\xi) \) is an odd \( p \)-weight satisfying (2) and (3) or only (4) then \( W(\xi)x^q \) is also an odd \( p \)-weight for \( 0 \leq q \leq p \). **Theorem 2.** If \( W \) satisfies the \( A_p \) condition of Muckenhoupt, viz: \( (b-a)^{-p} \int_a^b \frac{W(t)}{t^p} \, dt \leq A_p \int_a^b W(t) \, dt \) for all intervals \((a, b)\), then (2) and (3) hold for \( W \). (Received July 15, 1974.)

Let \( m \) be the Banach space of real, bounded sequences \( x = \left\{ x_n \right\} \); let \( \mathbf{\tau} \) be the class of regular (i.e., Toeplitz) matrices \( A = (a_{n,k}) \); and let \( \mathbf{\tau}^* \) be the subclass of \( \mathbf{\tau} \) for which \( \sum_k |a_{n,k}| \to 1 \) and \( \sum_k |a_{n,k} - a_{n,k+1}| \to 0 \). Let \( A \in \mathbf{\tau} \). In Journal London Math. Soc. (2) 7 (1974) 501-507, G. Das proved (p.503) that a sufficient condition for the inequality \( \lim_n (Ax) \leq q(x) \) to hold for all \( x \in m \) is that \( A \in \mathbf{\tau}^* \).

Here \( q(x) = \inf \sum_{k=1}^{p} \sum_{i=1}^{n_k} x_i + k \). His proof used "generalized limits", and he stated that he thought that it would be "difficult to establish the result by direct method". In the present paper a short, direct proof is given, and it is shown that \( A \in \mathbf{\tau}^* \) is also a necessary condition for the above inequality to hold for all \( x \in m \). Hence the inequality completely characterizes those matrices in \( \mathbf{\tau} \) which are in the subclass \( \mathbf{\tau}^* \). (Received August 23, 1974.)


For the differential geometry of \( SL(n), GL(n), PGL(n) \), polarity in a nondegenerate quadric of center 0 maps any Frenet matrix \( C \) onto \(-C^T \). If \( z = z(x) > 0 \) is \( C^2 \) over a convex domain \( G \subseteq \mathbb{B}^n \) and \( (\partial^2 z/\partial x_i \partial x_j) = H \) is negative definite then, for \( g = \sum x_i z_i - z \), \( \sum z_i = \sum z_i/\partial x_i \) we have \( \int z \, dV \int g^{-1} \, d\left(z g^{-1}\right) \cdots \, d\left(z g^{-1}\right) > (n+1)^{-1}V \), where the integrals are over \( G \), \( V \) is the volume of \( G \), \( V \) that of the polar body of \( G \). A smooth elliptic surface given by an at most bivalent solution of \( \det H = (g/z)^{n+2} \) and which is the affine manifold of a complete compact projective hypersurface without double tangent planes and at most one point on \( z = 0 \) is a quadric with a vertex at \( z \). A smooth hypersurface that is the affine manifold of a complete projective hypersurface and is given by a solution either of \( \det H = (g/|X|)^{n+2} \) where \( X^2 = x_1^2 + \cdots + x_n^2 + z^2 \), or of \( \det H = (1 + \sum x_i^2)^{-\left(n+2\right)/2} \), is a quadric. 4. For the Gauss curvatures of \( X \) and its polar \( X^* \), \( |X|^{n+2} K(X) \left| X^* \right|^{n+2} K(X^*) = 1 \). (Received August 26, 1974.)


A space is defined to be an ordered pair whose first component is an arbitrary set, \( X \), and whose second component is an arbitrary collection of subsets of \( X \), called the collection of closed sets and denoted by \( F(X) \), such that \( F(X) \) is closed under the formation of finite unions and countable intersections. It is important to note that a space is a generalization of a topological space. The algebra of subsets of \( X \) generated by \( F(X) \) is denoted by \( \mathcal{A}(X) \), and the set of all scalar functions on \( \mathcal{A}(X) \), which are additive, bounded, and regular is denoted by \( \sigma \)-algebra of subsets of \( X \) generated by \( F(X) \) is called the Borel algebra of \( X \) and is denoted by \( \mathcal{B}(X) \), and the set of all scalar functions on \( \mathcal{B}(X) \), which are countably additive, bounded, and regular is denoted by \( M(X) \). Theorem 1. Consider any space \( X \), which is normal. Then, a subset of \( M(\omega X) \) is \( \sigma(M(\omega X), C(\omega X)) \)-relatively compact if and only if it is norm bounded.
Theorem 2. Consider any topological space $X$, which is $T_1$ and normal. In Part I we show there exists an isometric isomorphism between $rba(X)$ and $M(tX)$, and in Part II we actually construct such an isomorphism, $T$, by using D. A. Alexandroff's approach to the Stone-Cech compactification theorem. (See D.A. Alexandroff, Additive set-functions in abstract spaces, a) Mat. Sb. (6)(50) (1940), b) Ibid. (9)(51)(1941)). Corollary. A subset of $rba(X)$ is $\sigma(rba(X),C(X))$-relatively compact if and only if $T(A)$ is $\sigma(M(tX),C(tX))$-relatively compact. (Received August 26, 1974.)

74T-B226 

ESSA AGHDASSI-ALAMDARRI, Azarabadgan University, Tabriz, Iran. On the Rademacher Fourier coefficients.

Let $\{f_n(x)\}$ be a sequence of Rademacher functions: $f_0(x) = 1$ $(0 \leq x < \frac{1}{2})$, $f_0(x) = -1$ $(\frac{1}{2} \leq x < 1)$, $f_n(x+1) = f_n(x)$ and $f_n(x) = f_0(2^n x)$ $(n=1,2,3,\ldots)$. For every Lebesgue-integrable function $f(x)$ of period 1 there is a corresponding Rademacher series $f(x) \sim \sum_{n=0}^{\infty} a_n f_n(x)$ with $a_n = \frac{1}{\pi} \int_0^1 f(t) f_n(t) dt$. A well-known problem for trigonometric Fourier series is to examine whether the $(C, 1)$ mean of Fourier coefficients of a function belonging to a certain class is also a Fourier coefficient of the function belonging to the same class. This problem has attracted much attention (cf. Bari, Trigonometric series, Fizmatgiz, Moscow, 1961; English transl; Macmillan, New York; Pergamon Press, Oxford, 1964 or Konjuškov, Izv. Akad. Nauk SSSR 21(1957), 423-448). But the Rademacher series problem has escaped attention except for some results of Siddiqi [Riv. Mat. Univ. Parma (2) 10(1969), 157-163]. In the present paper we have proved several theorems for Rademacher Fourier series concerning this problem. A typical result is: If $\sum_{n=0}^{\infty} a_n f_n(x)$ is the Rademacher Fourier series of a function $f(x)$ belonging to $Lip(x, p)$, $0 < x < 1$, $1 < p < 2$, then $\sum_{n=0}^{\infty} A_n f_n(x)$ is the Rademacher Fourier series of a function $F(x)$ belonging to $L_q$ where $A_n = n^{-1} \sum_{k=0}^{n-1} a_k$ and $1/p + 1/q = 1$. (Received August 27, 1974.) (Author introduced by Professor A.H. Siddiqi.)

*74T-B227 V.KANNAN and A.K.VIJAYAKUMAR, Madurai University, Madurai 625021 India. Non-measurable sets in LCA groups

Let $G$ be any torsion-free locally compact abelian group.

Let $E$ be any set of positive (Haar) measure. Let $A$ be a maximal independent subset of $E$. Let $A_n$ be the set of all elements in $G$ that can be written as words of length $n$ from elements of $A$ with $+$ or $-$ symbols. Then we show that $A_n$ is non-measurable for some positive integer $n$. Also the set of all those elements in $E$ for which some positive integral multiple belongs to $A_n$, is a non-measurable subset of $E$.

Corollary: Every maximal independent subset of every set of positive measure in the real line, is non-analytic (and hence non-Dorel).

(Received April 22, 1974.) (Authors introduced by Professor M. Rajagopalan.)

A-546
A finite union of circles is a set of spectral synthesis. Preliminary report.

Let \( n \) be a positive integer. For every \( 1 \leq k \leq n \) a circle of center \((x_k, y_k)\) and radius \( R_k \) and \( L_k \) is the differential operator \( \left( L_k + R_k \right)^2 \). We verify at first that the spectrum of every \( u \in L^\infty(\mathbb{R}^2) \) with \( \left( L_k + R_k \right)^2 \) is contained in \( F = S_k \cup \ldots \cup S_n \). On the other hand using the Beurling-Pollard technique we can show that every \( u \in L^\infty(\mathbb{R}^2) \) with \( \sigma_p(u) \subseteq F \) satisfies \( \left( L_k + R_k \right)^2 \) a.e. To prove that \( F \) is a set of spectral synthesis it is enough to show that \( \tilde{\gamma} \) is contained in \( F \).

Each finite set being a Wiener-Ditkin set (or a Calderon set) we get finally \( \tilde{\gamma} = 0 \). (Received July 15, 1974.)

J. ESFAHANIZADEH and A.H. SIDDIQI, Azarbadgan University, Tabriz, Iran. On the approximation of functions by de La Vallée-Poussin mean of their Walsh-Fourier series.

Let \( \sum_{n=0}^{\infty} \frac{a_n}{b_n} w_n(x) \) be the Walsh-Fourier series of the function \( f(x) \) on a dyadic group \( G \) (Fine, Trans. Amer. Math. Soc. 65(1949), 372-414). Let \( W_n \) denote the set of all Walsh polynomials of degree not greater than \( n \). A function \( f(x) \) belongs to the class \( \operatorname{Lip}_{\alpha}(W) \) if \( \sup_x |f(x) - f(x + h)| = o(|h^{-\alpha}) \), \( \alpha > 0 \) holds and \( E_n(f) = \inf \{ \sup_{x \in G} |f(x) - P_n(x)| : P_n \in W_n \} \) is called the best approximation to \( f(x) \) by polynomials from \( W_n \) (Watari, Tohoku Math. J. (2) 15(1963), 1-5). \( \tau_n(x) = (\omega_n(x) + \omega_{n+1}(x) + \ldots + \omega_{2n-1}(x))/n \), where \( \omega_n = \sum_{\nu=0}^{n} \omega_{\nu} \nu^\nu(x) \) is the nth partial sum of the Walsh-Fourier series of \( f(x) \), is called the de La Vallée-Poussin mean of the Walsh-Fourier series of \( f(x) \). In this paper we have proved the following theorem which is an analogue of a theorem of de La Vallée Poussin for trigonometric Fourier series. Theorem. If \( f(x) \in \operatorname{Lip}_{\alpha}(G) \) is bounded then the deviations of the de La Vallée-Poussin mean \( \tau_n(x) \) of this function satisfy the inequality \( |\tau_n(x) - f(x)| \leq E_n(f) \).

The following corollary results from this theorem and one of Watari. Corollary. If \( f(x) \in \operatorname{Lip}_{\alpha}(W) \) then \( \tau_n(x) - f(x) = O(n^{-\alpha}) \). (Received July 12, 1974.)

P. K. KAMTHAN and MANJUL GUPTA, Indian Institute of Technology, Kanpur–208016, India. Space of entire functions of several complex variables having finite order point. Preliminary report.

For positive numbers \( \rho_1, \rho_2 \), let \( X_1 \) be the space of entire functions \( f \) which satisfy \( M(r_1, r_2) \leq \exp[r_1^{\rho_1} + r_2^{\rho_2}] \) for large \( r_1, r_2 \) and each \( \epsilon > 0 \). Theorem. An \( f \) having the representation \( f(z_1, z_2) = \sum_{m+n \geq 0} a_{mn} z_1^m z_2^n \) is in \( X_1 \) iff for each \( \delta > 0 \), \( \exists \) an integer \( N_0 = N_0(\delta) \) such that \( |a_{mn}| \leq n^{-m/\rho_1 - n/\rho_2 + \delta} \) \( \forall m + n \geq N_0 \). With the help of this characterization, we equip \( X_1 \) with a Fréchet topology \( \mathcal{F} \) generated by the family \( \{ ||f|_{\rho_1, \rho_2} + \delta, \rho_2 + \delta || : \delta > 0 \} \), and find the forms of continuous linear functionals on \( X_1(\mathcal{F}) \). Apart from obtaining the characterization of continuous linear operators in terms of norms defining the topology \( \mathcal{F} \), we also introduce the notion of proper bases in \( X_1 \) and prove Theorem. A base \( \{ a_{mn} \} \) in a closed subspace \( X_0 \) of \( X_1 \) is proper iff \( a_{mn} \) satisfies: (A) for each \( \delta > 0 \), \( \exists K = K(\delta) > 0 \) and
a \delta = \delta_1(\delta) > 0, \exists M, n \geq 0, \|a_{mn}; \rho_1 + \delta, \rho_2 + \delta\| \equiv K m^{m/(\rho_1+\delta_1)} n^{n/(\rho_2+\delta)}; \quad \text{and} \quad (\alpha)

for \eta > 0 \text{ and all sufficiently small } \delta > 0, \delta = \delta \eta, \|a_{mn}; \rho_1 + \delta, \rho_2 + \delta\| > m^{m/(\rho_1+\eta)} \cdot n^{n/(\rho_2+\eta)}, \text{where } m + n \text{ is sufficiently large and depends upon } \delta. \text{ In the last section, we characterize linear homeomorphic mappings from } \chi_1 \text{ into itself.} \quad (\text{Received June 13, 1974.})

(Authors introduced by Professor Chris P. Tsokos.)

Applied Mathematics

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Pursuit with delayed pursuer response and effect.

We treat the pursuit game \( \dot{x} = Ax - p(t-h) + q(t) \), in \( n \)-space with player constraints \( p(t) \in P, q(t) \in Q, \) termination condition \( x \in \Omega; \) pursuer chooses \( p(t) \) possibly depending on \( q(s) \) with \( s \leq t - k \) but not on \( q(s) \) with \( s > t - k \) \( (h, k \geq 0) \). Theorem: Consider the auxiliary control system \( \dot{x} = Ax - u, u(t) \in U \) with target set \( \bar{\Sigma} \); here \( U = P \times e^{A\theta}Q \) (Pontrjagin difference, \( \theta = h + k \)) and \( \bar{\Sigma} = \Omega \times \int_{0}^{\theta} e^{A\theta}Qd\theta \) (Aumann integral). If point \( x_0 \) can be steered to \( \bar{\Sigma} \) by controls \( u \) at time \( t \), then, within the game, pursuer can force \( x_0 \) to \( \Omega \) at \( t \) against all action of quarry. Example: Torque control with delay of perturbed harmonic oscillator. Here \( \ddot{x} + x = u + v, \) \( |u| \leq a, \) \( |v| \leq \beta; \) controller \( u \) has no lag in control effect, but time-delay \( k \) in responding to changes in the perturbation \( v; \) the object is to make \( x(t) \) small. The conclusion is that, if \( 0 < \beta < a \) and \( 0 \leq k \leq \pi, \) then \( |x(t)| \leq 2\beta \) can be attained, from any initial position, against all perturbations \( v. \) \quad (\text{Received June 24, 1974.})

E. F. Assmus, Jr., Lehigh University, Bethlehem, Penna., 18015 and H. F. Mattson, Jr., Syracuse University, Syracuse, N.Y., 13210. Some 3-error-correcting \( \text{BCH} \) codes have covering radius 5. Prelim. report A code of length \( n \) is a subset of \( F^n \), where \( F \) is a finite field. The packing radius of a code is the largest integer \( r \) such that the spheres of radius \( r \) about the codewords are mutually disjoint. If \( d \) is the minimum distance between distinct codewords, then \( r = [(d-1)/2] \). (The Hamming distance \( d(x,y) \) is defined as the number of coordinate-places where \( x \) and \( y \) differ.) The covering radius of a code is the smallest integer \( s \) such that the spheres of radius \( s \) about the codewords cover \( F^n \). It has long been known that \( \text{BCH} \) codes with \( r=2 \) have \( s=3 \) (Gorenstein et.al., Inf. & Control 3(1960), 291-294). Van der Horst (Cornell, 1972) proved that \( \text{BCH} \) codes with \( n=2^m-1 \) and \( r=3 \) have \( s=5 \) when \( 4 \) divides \( m \). Our result, by different methods, is that \( s=5 \) for odd \( m \) as well. \quad (\text{Received July 15, 1974.})

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Signaling over a Gaussian channel with feedback and autoregressive noise.

The author obtains the unique optimal linear signaling scheme for this channel, and conjectures that it is the unique optimal scheme. In that case the upper bound \( C \) on possible rates for a linear scheme is the
capacity of the channel. The value of $C$ is determined. A typical result
is as follows: Let the regression be of first order, $a$ the regression
coefficient, $\sigma^2$ the variance of the noise, and $g^2\sigma^2$ the average energy
per signal. Let $b$ be the unique positive root in $x$ of
\[ x^2 = [1+g^2(1+|a|x)^2]^{-1}. \]
Then $C = -\log b = \frac{1}{2} \log (1+g^2(1+|a|b)^2)$.
(Received July 22, 1974.)

**74T-C39**  
H.K.VENKATRAMAN; India.  
Mageto-Elastic Stresses

In this paper, using the 'Method of Complex Variables' as applied to
the 'Theory of Elasticity', we find out magneto-elastic stress potentials for an infinite
elastic medium with a long elliptic cylindrical hole, stressed by uniaxial tension at
infinity, the medium being embedded in a primary magnetic field at infinity acting parallel
to the direction of tension, the hole boundary has prescribed magnetic field but is free
from mechanical stresses. (Received July 23, 1974.)

**74T-C40**  
ARIE GOLD, Technion, IIT, Haifa, Israel, and RINA COHEN, Technion, IIT, Haifa,
Israel. The Chomsky Hierarchy for $\omega$-type Languages. Preliminary report.

Generation of infinite ($\omega$-type) sequences by phrase structure grammars is defined. For each $i = 0, 1, 2, 3$, the family of $\omega$-languages generated by type $i$ grammars (herewith denoted $F_\omega (type i)$) is studied. The usual types of (deterministic as well as non-deterministic) automata are defined to work on $\omega$-length input tapes. An $\omega$-input is accepted iff there exists a computation during which the whole $\omega$-tape is scanned and the set of states repeated by the machine infinitely many times coincides with one out of a designated collection of "repetition state sets" of the automaton. Theorem 1: $F_\omega (type 0) \supseteq F_\omega (type 1) \supseteq F_\omega (type 2) \supseteq F_\omega (type 3)$. Theorem 2: The family of $\omega$-languages recognized by non-deterministic Turing machines coincides with $F_\omega (type 1)$, and properly includes the family of $\omega$-languages recognized by deterministic Turing machines. Theorem 3. $F_\omega (type 2)$ coincides with the family of $\omega$-languages recognized by non-deterministic push down automata by repetition state sets (by emptying the push down store infinitely many times). $F_\omega (type 3)$ coincides with the family of $\omega$-regular languages studied by McNaughton (Inf. & Control 9 (1966) 521). Other definitions of acceptance of $\omega$-sequences by automata are also considered (see Landweber, Math. Systems Theory III, 4 (1969), 376). The new families of $\omega$-languages obtained by the various definitions are studied and positioned in the $\omega$-language hierarchy. (Received July 1, 1974.) (Authors introduced by Mr. Igal Golan.)

**74T-C41**  

Let $(A, B)$ be an $m \times n$ bimatrix game, $\mathcal{E}$ the set of its equilibrium points, $S(y) = \{ x: (x, y) \in \mathcal{E} \}$. For $x = (\xi_1, \ldots, \xi_m)$, $M_1(x) = \{ i: \xi_i > 0 \}$, $m_1(x) = |M_1(x)|$. Let $(x, y) \in \mathcal{E}$. THEOREM 1. Suppose $S(y)$ contains no $\mathbf{r}$ with $M_1(x) \in \mathcal{E}$ for $M_1(x)$. Let $\mathbb{E}$ be obtained from $B$ by deleting the $i$-th row whenever $\xi_i = 0$. (i) If $xB \neq 0$, the rank, $\rho(\mathbb{E})$, of $\mathbb{E}$ is $m_1(x)$. (ii) If $xB = 0$, then $\rho(\mathbb{E}) = m_1(x) - 1$, and $S(y)$ contains no $x' \neq x$ with $M_1(x') = M_1(x)$. COROLLARY. Suppose $S(y)$ is completely mixed (has no vector with a zero component). (i) If $xB \neq 0$, $\rho(\mathbb{E}) = m$. (ii) If $xB = 0$ then $\rho(\mathbb{E}) = m - 1$ and $S(y) = \{ x \}$. THEOREM 2. If
\( p(B) = m \) and \( y \) is completely mixed then \( S(y) = \{ x \} \). THEOREM 3. There exists \( \mathcal{R} \) in \( S(y) \) such that \( m_1(\mathcal{R}) \leq n \). THEOREM 4. (i) If \( y \) is completely mixed and \( S(y) \) not a singleton then \( S(y) \) contains two noncompletely mixed strategies \( x^1 \) and \( x^2 \), with \( \xi_{ij}^1 = \xi_{ik}^2 = 0 \) for some \( j \neq k \). (ii) If \( y \) has just one zero component and \( S(y) \neq \{ x \} \), then \( S(y) \) has at least one noncompletely mixed strategy. These theorems extend some of T. E. S. Raghavan, J. London Math. Soc. (2), 2 (1970), 709-712. They allow a very short proof of THEOREM 5 (Raghavan): If \( E \) is completely mixed, then \( A \) and \( B \) are square, and the equilibrium point is unique.

(Received June 26, 1974.)


We prove that Shannon's entropy function is characterized by the following properties:

(i) simple grouping, (ii) 3-symmetry, (iii) normalization, and (iv) boundedness (details will appear elsewhere). This improves a result of Daróczy and Katai ("Additive zahlentheoretische Funktionen und das Mass der Information", Ann. Univ. Sci. Budapest Eötvös Sect. Math 13(1970), 83-88(1971)) who assume, besides (i)-(iv), that \( f \) is nonnegative. Previous characterizations required stronger analytic properties than boundedness, i.e. continuity, nonnegative and monotone, measurability, and small for small probabilities. For further details and references see J. Aczel's survey paper, "On measures of information and their characterizations", Proc. Meeting on Information Measures, Kitchener-Waterloo, Ontario, Canada, 1970. (Received July 26, 1974.)


We consider generalized eigenvalue problems of the form \( \lambda \psi = \lambda \psi \), resulting from the discretization of an elliptic eigenvalue problem \( L\phi = \lambda \phi \) by finite element methods. We consider also the implicit systems of ordinary differential equations \( B \frac{dv}{dt} = Av \) which arise through a similar semi-discretization of an initial value problem \( \partial u/\partial t = Pu \). The replacement in the above problems of the mass matrix \( B \) by a diagonal matrix is known as "lumping", cf. Strang and Fix, An Analysis of the Finite Element Method. Lumping is motivated by the fact that a wider repertoire of numerical procedures is available for the standard eigenvalue problem and for ODE systems of conventional form.

However lumping leads to a loss of accuracy for many finite element methods. We show that a suitable change of basis in the finite element space will allow us to lump with less or no loss of accuracy, at the expense of making the stiffness matrix \( A \) somewhat less sparse. The choice of a new basis is closely related to the work on quasi-interpolants by deBoor, Fix, and Strang. (Received August 22, 1974.) (Author introduced by Dr. Olof B. Widlund.)

Logic and Foundations


We study conditions assuring recursive presentability of models. Let \( T \) be a complete decidable theory (c.d.t.), \( \{ \varphi_n \mid m \leq n \} \) a recursive enumeration of all formulas of \( L(t) \), and \( \{ \mu_m \mid m \leq n \} \) an...
effective listing of all partial recursive functions \( N \to 2 \); an integer \( m \) is a representative of a type \( T \) if: 
\[ m(n) = 0 \iff \varphi_n \in T. \]

**Theorem 1.** Assume \( T \) is a c.d.t. with a model realizing exactly the recursive types of \( T \). Then there is a recursively presented model of \( T \) realizing exactly the recursive types if and only if there is a \( \Sigma_2^0 \) set \( A \) of representatives of types of \( T \) such that each recursive type of \( T \) has at least one representative in \( A \).

**Theorem 2.** If \( T \) is a c.d.t. and \( B \) is a \( \Sigma_2^0 \) set of representatives of limit types of \( T \), then \( T \) has a recursively presented model omitting the types represented in \( B \). The techniques of proof stem from the priority method, a program of Nerode's, an example by Peretiatkin, and a theorem by Morley. (Received June 24, 1974.) (Author introduced by Professor Anil Nerode.)

**ZF and Boolean Algebras. Preliminary report.**

The following is consistent with ZF. There is an infinite complete Boolean Algebra which is not a direct union of homogeneous complete algebras.

(Received June 25, 1974.)

**Effective isomorphisms of algebraic systems.**

There have been two commonly used definitions of effective isomorphism of algebraic systems. One definition being that an isomorphism \( I \) between algebraic systems is effective if \( I \) has a one-one partial recursive extension. The other being that an isomorphism \( I \) between algebraic systems is effective if it can be extended to a partial recursive isomorphism \( I' \) between recursively enumerable algebraic systems.

In Chapter I we show that for the case of a countably infinite vector space \( V \) with recursive basis \( B \) over a finite field \( F \), there exists an isomorphism between Dedekind (isolated) spaces which is effective by the former definition but not by the latter. We effect this by topologizing as a Cantor space a set of infinite isomorphisms \( T \). We then
show that the subset of $T$, whose elements are effective by the former definition but not by the latter, is the complement of a set of the first category.

We show that for the case of a countable dense unbounded linear ordering with recursive universe (i.e. the rationals $\mathbb{Q}$ under the usual $<$ relation) there exists an isomorphism between cosimple systems effective by the former definition but not by the latter. This is done by using a variation of a priority argument of Remmel to produce cosimple structures. (Received July 3, 1974.) (Author introduced by Professor Anil Nerode.)

*74T-E72 HARVEY FRIEDMAN, State University of New York at Buffalo, Amherst, New York 14226. The disjunction property implies the numerical existence property.

Any recursively axiomatized extension of HA which obeys the disjunction property obeys the numerical existence property. HA proves the equivalence of its existence property with its disjunction property for purely existential sentences. There is a sentence $B$ such that $\text{HAS} + B$ obeys the numerical existence property but not the set existence property. The set existence property for HAS can be proved in HA. There is an extension of HAS which obeys the disjunction property, but which contains a false purely existential numerical sentence. (Received July 8, 1974.) (Author introduced by Professor Thomas W. Cusick.)

74T-E73 SCOTT WEINSTEIN, Rockefeller University, New York, New York 10021. Some applications of Kripke models to formal systems of intuitionistic analysis. Preliminary report.

If $M$ is a Kripke model, let $\text{CL}(M)$ denote the classical structure corresponding to $M$, and if $p$ is a node of $M$, let $M^p$ denote the restriction of $M$ to the nodes $\geq p$. If $\Delta, \Delta'$ are collections of Kripke models, we say $\Delta'$ is a dissection of $\Delta$ iff $\forall M \in \Delta \forall p \in K^M \exists M' \in \Delta' (M^p \subseteq M') \land \forall M' \in \Delta' \forall M \in \Delta \exists p \in K^M (M^p \subseteq M')$. Let $\Delta$ be a collection of Kripke models for $T = \text{HA} + \text{AC} - \text{NN} + \text{WC} - \text{NN}!^C + \text{KS} + \text{TI}$, such that $\text{CL}(\Sigma \Delta)$ is $\omega_1$-saturated. Then the application of an obvious collection operation to any dissection of $\Delta$ is a model of $T$. The disjunction and numerical instantiation properties for $T$ are immediate consequences of this "collection lemma." [See Smorynski's contribution to Lecture Notes in Mathematics v. 344 for background on collection lemmas.] The methods employed also yield collection lemmas for various theories containing provably monotone and extensional generalized inductive definitions. By employing a refined collection operation for models of $\text{HA} + \text{AC} - \text{NN}$ it is shown that $\text{HA} + \text{AC} - \text{NN}!^C \not\vdash \text{AC} - \text{NN}$. Further, questions about the relation between $\text{KS}^-$ and $\text{KS}$ over fragments of intuitionistic analysis are settled e.g. $\text{HA} + \text{AC} - \text{NN}! + \text{KS}^- \not\vdash \text{KS}$. (Received July 30, 1974.) (Author introduced by Professor Leslie H. Tharp.)

*74T-E74 CARL G. JOCKUSCH, JR., University of Illinois, Urbana, Illinois 61801, and STEPHEN G. SIMPSON, University of California, Berkeley, California 94720. Degree-theoretic hierarchies.

Let $D$ be the set of all (Turing) degrees, $\equiv$ be the usual partial ordering of $D$, and $j$ the (Turing) jump operation on $D$. The following relations are shown to be first-order definable in the structure $\mathcal{B} = (D, \equiv, j); d_1$ is hyperarithmetical in $d_2$, $\hat{d}_1$ is the hyperjump of $d_2$, $d_1$ is ramified analytical in $d_2$. A first-order, degree-theoretic definition of the ramified analytical hierarchy is
obtained. A first-order sentence is found which is true in $\mathcal{B}$ if the universe is (a generic extension of) $L$, and false in $\mathcal{B}$ if $0^{#}$ exists. The question of whether the notion of uniform upper bound is degree-theoretically definable is investigated. (Received July 15, 1974.)

74T-E75 PAUL C. EKLOF, University of California, Irvine, California, 92664. An undecidability result for $\text{Ext}$, Preliminary report.

Call $G$ a Griffith group if $G$ is a non-free $\aleph_1$-separable abelian group of cardinality $\aleph_1$ constructed as in P. Griffith, "Infinite Abelian Group Theory," Univ. of Chicago Press, 1970, Theorem 147. Generalizing techniques of S. Shelah (see these Notices 20 (1973) Abstract #73T-A253) we prove Theorem (i) (V=L) For every Griffith group $G$ and every countable non-cotorsion $A$, $\text{Ext}(G, A) \neq 0$; (ii) (MA+$\sim$CH) For every Griffith group $G$ and every countable $A$, $\text{Ext}(G, A)=0$. Relevant to Problem 80 of L. Fuchs, "Infinite Abelian Groups," vol II, Academic Press, 1973: Corollary (V=L) For any countable reduced unbounded torsion group $T$, the condition "C is torsion-free and $\text{Ext}(C, T)=0$" is not an $L_{\omega_1}$ formula of group theory. Pertaining to a problem of Griffith we have Corollary. The statements "every $\aleph_1$-separable group is totally $\aleph_1$-separable" and "every Griffith group is totally $\aleph_1$-separable" are undecidable in ZFC. (Received July 15, 1974.)

*74T-E76 STEPHEN G. SIMPSON, University of California, Berkeley, California 94720. Second-order arithmetic and first-order degree theory. Preliminary report.

Write $\mathcal{B} = \langle D, \equiv, j \rangle$ where $D$ is the set of all Turing degrees and $\equiv, j$ are the usual partial ordering and jump operation on $D$. By analysis we mean second-order arithmetic. Theorem 1. Let $\varphi$ be any sentence in the language of analysis. Then we can effectively find a first-order sentence $\varphi^*$ such that $\varphi$ is true iff $\mathcal{B} \models \varphi^*$. Theorem 2. Let $S$ be a subset of the set of all Turing degrees $\equiv_{\omega}^{(\omega)}$. $S$ is definable in analysis iff $S$ is first-order definable in $\mathcal{B}$. Theorem 3. There exists a degree $\mathcal{B}$ such that the substructure of $\mathcal{B}$ determined by the set of all degrees $\equiv_{\omega}$ is not elementary equivalent to $\mathcal{B}$. Similar results are obtained with Turing degrees replaced by hyperdegrees.

(Received July 16, 1974.)


Results are for abstract logics acting on finite languages. $L$ is the standard system $L + L_{\omega\omega}$; $B$ is an arbitrary logic system absolute with respect to some true set theory. A logic system $A$ is foundational iff it contains $L$, is closed under finite conjunction, and for each binary relation symbol $R$ the class of $\langle R\rangle$-structures $M$ with $M$ well-founded is $\text{PC}(A_{\omega})$. For any system $A$, $\Delta(A)$ is a smallest system such that every class which is $\text{PC}(A)$ and $\text{cPC}(\tilde{A})$ is axiomatizable in $\Delta(A)$. Theorem 1 If $A$ is foundational then $\Delta(A_{\omega})$ extends $B_{\omega_1}$. There is a foundational $H$ such that any $H_{\omega_1}$-elementary class is $\text{cPC}(L_{\omega_1})$, so Theorem 2 $\Delta_{1}(L_{\omega_1})$ extends $B_{\omega_1}$. From a theorem of Vaught follows Theorem 3 A $B_{\omega_1}$-axiomatizable class has at most $\aleph_0$, or exactly $\aleph_1$, or exactly $2^{\aleph_0}$ isomorphism types of countable structures. The deter-
minate portion of $L^p(\omega)$ extends the chosen system $\mathcal{W}_{\omega_1}$, hence extends $\Delta(\mathcal{W}_{\omega_1})$, so Theorem 4 The determine portion of $L^p(\omega)$ extends $B_{\omega_1}$. Therefore, using terminology of Kueker Theorem 5 A $B_{\omega_1}$-axiomatizable class is closed and coclosed. Theorems 1, 2 and 5 generalize to uncountable cardinals $\kappa^+$ (rather than $\omega_1$). (Received July 16, 1974.)

74T-E78 PHILIP OLIN, York University, Downsview, Ontario, Canada M3J1P3. Elementary types of free products of Boolean algebras. Preliminary report.

Let $A, B$ be nontrivial Boolean algebras (B.a.s) and let $A*B$ denote their free product relative to the class of all B.a.s. A result of Tarski (see C.C. Chang and H.J. Keisler, Model Theory, North Holland, Amsterdam, 1973, section 5.5) states that the elementary type of a B.a. is determined by certain invariants. We show how to compute the invariants of $A*B$ from those of $A$ and $B$. Hence the Boolean free product operation on two nontrivial B.a.s preserves elementary equivalence. This contrasts with the negative result of Jönsson and Olin for any nontrivial variety of lattices (Notices A.M.S., 21(1974), p.A-370). (Received July 8, 1974.)

74T-E79 WALTER BAUR, Yale University, New Haven, Connecticut 06520 $\aleph_\kappa$-categorical modules. Preliminary report.

Let $R$ be a countable associative ring with identity. The first-order language of left $R$-modules is the language of abelian groups with additional unary function symbols $f_r(r \subseteq R)$. Theorem. For any countable $R$-module the following are equivalent (i) $\text{Th}(A)$ is $\aleph_\kappa$-categorical, (ii) there exist $n < \omega$, $\kappa_0, \ldots, \kappa_{n-1} \leq \omega$, finite modules $B_0, \ldots, B_{n-1}$ such that $A \cong \bigoplus_{\nu < n} B_\nu$. The proof uses lemma. $\text{Th}(A)$ is stable for any $R$-module $A$. (Received July 23, 1974.)

74T-E80 FRED GALVIN, University of California, Los Angeles, California 90024. Bounds for power sets of singular cardinals. Preliminary report.

Let $\kappa, \lambda$ be infinite cardinals, $\lambda$ regular, of $\kappa > \omega$. If $2^\delta < \lambda$ for all $\delta < \lambda$, and $2^\delta < \kappa_\lambda$ for all $\delta < \kappa$, then $2^\kappa < \kappa_\lambda$. This is a theorem of ZFC; Magidor and Solovay had proved it assuming the existence of a measurable cardinal. My proof uses the methods of Prikry's proof of a recent result of Silver on the singular cardinals problem for cardinals of cofinality $> \omega$. (Received July 24, 1974.)

74T-E81 JOSEPH H. DIEJ, New Mexico State University, Las Cruces, New Mexico 88003. Two definitions of finiteness.

Definitions: (1) A set $x$ is almost finite iff there is no function from $x$ onto the set of natural numbers. (2) A set $x$ is strongly Dedekind finite iff there is no function from a proper subset of $x$ onto $x$. For each set $x$, $x$ is finite only if $x$ is almost finite, only if $x$ is strongly Dedekind finite, only if $x$ is Dedekind finite. None of these implications is reversible as is shown using the technique of forcing. The proposition "for
each set \( x \), \( x \) is finite iff \( x \) is strongly Dedekind finite" is shown to be independent of the proposition "for each set \( x \), \( x \) is finite iff \( x \) is almost finite". Also, the axiom of choice is not provable from the proposition "for each set \( x \), for each ordinal number \( \alpha \), if the cardinality of \( \alpha \) is not cofinal with \( \omega \), then there exists a function from \( x \) onto \( \alpha \) iff there exists a one-one function from \( \alpha \) into \( x \)". Some of these results strengthen some of the pre-Cohen results on finiteness by A. Lévy [Fund. Math. 56 (1958), pp. 1-13].

(Received July 26, 1974.) (Author introduced by Professor Arthur H. Kruse.)

74T-E82 DALE MYERS, University of Hawaii, Honolulu, Hawaii 96822. The Boolean algebra of the theory of linear orders, Preliminary report.

Theorem. The Boolean algebra of the elementary classes of linear orders is isomorphic to the Boolean set algebra generated by the left-closed, right-open intervals of an order of type \( \omega \cdot (1+\eta) \) where \( \eta \) is the order type of the rationals. This answers Läuchli and Leonard's question [Läuchli and Leonard, "On the elementary theory of linear order," Fund. Math., 59 (1966), 111] concerning the algebra's atomicity. The proof uses Hanf's structure diagrams [Hanf, "Primitive Boolean algebras," Proc. of the Symp. in Honor of Alfred Tarski (Berkeley, 1971), vol. 25, Amer. Math. Soc., Providence, R. I., 1974].

(Received August 1, 1974.)


Let \( \mathcal{E}^* \) be the lattice of r.e. sets modulo finite sets and \( \mathcal{R}^* \subseteq \mathcal{E}^* \) the lattice of recursive sets modulo finite sets. Theorem: There is an automorphism of \( \mathcal{R}^* \) which cannot be extended to any automorphism of \( \mathcal{E}^* \).

The theorem follows from an application of the main result of "Automorphisms of the Lattice of Recursively Enumerable Sets Part I: Maximal Sets" (R.I. Soare, Ann. Math. to appear) to \( r \)-maximal rather than maximal sets. (A r.e. set is maximal \( (r \)-maximal) if its complement cannot be split into two infinite pieces by any r.e. (recursive) set.) (Received August 8, 1974.)

74T-E84 WILLIAMS FORREST, Mathematics Department, Simon Fraser University, Burnaby, B. C. V5A 1S6. A Property of Homogeneous Structures

Let \( T \) be a countable first order theory and \( \mathfrak{M} \) an uncountable homogeneous model of \( T \). Suppose that \( \mathfrak{M}_1 \) is an elementary substructure of \( \mathfrak{M} \) and \( \Gamma \in S(\mathfrak{M}_1) \) satisfies the following conditions: (i) \( \Gamma(\mathfrak{M}) > \mathfrak{M}_1 \) (ii) if \( \psi(v) \in \Gamma(\mathfrak{M}) \) then \( \psi(\mathfrak{M}_1) \cap \Gamma(\mathfrak{M}) < |\Gamma(\mathfrak{M})| \) or \( \neg\psi(\mathfrak{M}_1) \cap \Gamma(\mathfrak{M}) < |\Gamma(\mathfrak{M})| \). If \( \lambda \) is a regular cardinal with \( |\mathfrak{M}_1| < \lambda < |\Gamma(\mathfrak{M})| \) then there is an \( \{\mathfrak{M}_1\} \) indiscernible sequence \( \langle x_i \rangle_{i < \lambda} \) in \( \Gamma(\mathfrak{M}) \) such that either \( R(\mathfrak{M}, \mathfrak{M}_1) \langle x_i \rangle_{i < \lambda} \) is an \( \{\mathfrak{M}_1\} \) indiscernible set or \( \langle x_i \rangle_{i < \lambda} \) is an \( \{\mathfrak{M}\} \) definable linear order. (Received August 14, 1974.)
Let $\mathcal{M}$ be a recursively presented atomic model of a theory $T$ such that the algebraic closure of a finite set is finite and algebraic closure is effective on explicit indices of finite sets. For example, $\mathcal{M}$ may arise from the $\mathcal{K}_T$ categorical theory of an infinite set with equality, the theory of a dense unbounded linear ordering, the theory of an infinite dimensional vector space over a finite field, or the theory of an atomless Boolean algebra. We use the priority method to prove: Theorem. (i) There exists an algebraically closed set $V \subseteq \mathcal{M}$ such that $\mathcal{M} = \mathcal{M} \setminus V$ is a low hypersimple set. (ii) There exists an algebraically closed set $V \subseteq \mathcal{M}$ such that $\mathcal{M} = \mathcal{M} \setminus V$ is a complete hypersimple set. We say that an algebraically closed set $U$ is $\Sigma^0_2$ if there is a recursive predicate $R$ such that $U = \{ x \mid \exists y (\forall z) (R(x,y,z)) \}$. Theorem. Let $U$ be an infinite algebraically closed subset of $\mathcal{M}$, then $U$ is classically isomorphic to a $\Sigma^0_2$ algebraically closed set if and only if there is an algebraically closed subset $V \subseteq \mathcal{M}$ such that $\mathcal{M} = \mathcal{M} \setminus V$ is a complete hypersimple set and an elementary monomorphism $p$ mapping $U$ onto $V$. (Received August 16, 1974.)

74T-E86 MAX SHIFFMAN, California State University, Hayward, California 94542. Kinds of measure spaces.

Any measure space $(X, \mathcal{M}, \mu)$ is considered which has the countability property and the partition property. It is shown to be a direct sum of three general kinds of such measure spaces, and examples of two of them are given. A fourth possible kind is illustrated by the case where $X$ is a subset of the real number line of the first Baire category and of Lebesgue measure 0, and every intersection of $X$ by a Borel set $\in \mathcal{M}$, and $\mu$ is 0, $\infty$ two-valued. This fourth possible kind is, however, shown to be extraneous and a direct sum of the other three kinds, and this fact reduced the firstly obtained four kinds to the three kinds. No use is made of the continuum hypothesis. For a considered measure space which is also 0, $\infty$ two-valued, this is equivalent to the study of a $\sigma$-ring $\mathcal{M}$, and a sub $\sigma$-ideal $\mathcal{M}_0 \subseteq \mathcal{M}$, such that $\mathcal{M}$ has the countability and partition properties. There are certain possible logical and probabilistic applications, and in these, sets $\mathcal{M}_0 \subseteq \mathcal{M}$ may be considered to be unknown, or undetermined, or nonconstructive, etc. (Received June 28, 1974.)


Theorem 1. If $\lambda$ is a singular cardinal, $G$ an abelian group of cardinality $\lambda$, and every subgroup of $G$ of cardinality $< \lambda$ is free, then $G$ is free. Remark. This is a particular case of a general theorem, which may be applied, e.g., to any reasonable notion of free algebra, existence of transversals for families of countable sets, and coloring numbers of graphs. Theorem 2. $(V = L)$ Every Whitehead group is free. (Received August 19, 1974.)

74T-E88 ALEXANDER ABIAN, Iowa State University, Ames, Iowa 50010. Nonexistence of non-molecular generic sets.

Let $(P, \equiv)$ be a poset without a minimum element. An element $m$ of $P$ is called a molecule of $P$ iff every two elements of $P$ which are less than $m$ have a lower bound. A subset $S(m)$ of $P$ is called molecular (or generated by a molecule $m$ of $P$) iff $S(m) = \{ x \mid x \equiv y \text{ for some } y \in S(m) \}$. Theorem. A subset $G$ of $P$ is generic iff $G$ is molecular. Lemma. Let $(B, \equiv)$ be a Boolean algebra, An element $t$ of $B - \{ 0 \}$ is a molecule of $B - \{ 0 \}$ iff $t$ is an atom of $B$. Theorem. Let $B$ be a (not necessarily complete) Boolean algebra in a model $M$ of $ZF$. A subset $G$ (not necessarily in $M$) of $B - \{ 0 \}$ is $E$-generic over $M$ iff for every subset $S$ in $M$ of $G$, whenever $\inf S$ exists and $0 \neq \inf S$ then ($\inf S \in G$.

(Received August 22, 1974.)
Let $\kappa$ be any limit cardinal with $2^{\aleph_0} = \kappa$. **Theorem:** There are sets $\mathcal{A} \subseteq \kappa$ $(a < \kappa^+)$ so that (1) $|\mathcal{A}_a| = \kappa$ for every $a < \kappa^+$ (2) for all $a < \beta < \kappa^+$: $|\mathcal{A}_a \cap \mathcal{A}_\beta| < \kappa$ and (3) for all $\gamma < \delta < \alpha$ $|\mathcal{A}_\alpha \cap \mathcal{A}_\gamma| \neq |\mathcal{A}_\alpha \cap \mathcal{A}_\delta|$ if and only if the following condition holds: The set of all cardinals less than $\kappa$ has cardinality $\kappa$. This solves a problem of P. Erdős. **Theorem:** Suppose there is a non-$(\kappa, \kappa^+)$-regular uniform ultrafilter over a cardinal $\kappa$ so that $\kappa = \kappa^+$. Then $0^#$ exists. This is an immediate consequence of the more recent work of the author and R. Jensen. (Received August 23, 1974.)

**Statistics and Probability**

*74T-12* F. ALBERTO GRUNBAUM, University of California, Berkeley, California 94720. Identical Distribution vs. Orthogonal Equivalence

Let $X = (X_1, \ldots, X_n)$ be independent $(0,1)$ Gaussian variables. Two polynomials $P(X)$, $Q(X)$ are said to be orthogonally equivalent if $P = Q \cdot 0$ for some $0 \in (0(n))$. Let $l$ be the degree of the homogeneous polynomials $P$ and $Q$. For $l > 3$, $n > 4$ we construct lots of pairs $(P, Q)$ such that $P(X)$ and $Q(X)$ have identical distributions but are not orthogonally equivalent. The abundance of such pairs is in marked contrast with the classical case of $l < 3$, $n$ arbitrary, where there are no such pairs, and the cases $n = 2, 3$ where (at least for $l = 3$) there is essentially only one such pair. (Received August 22, 1974.) (Author introduced by Professor Jacob Feldman.)

*74T-13* WALTER PHILIPP*, WILLIAM F. STOUT, University of Illinois, Urbana, Illinois 61801. Almost sure invariance principles for sums of weakly dependent random variables

Let $\{X_n\}$ be a sequence of random variables, centered at expectations with finite $(2 + \delta)$ moments where $\delta > 0$. For $t \geq 0$ let $S_t = S(t) = \sum_{n \leq t} X_n$. Assume that $\lim_{n \to \infty} n^{-1} E S_n^2 = 1$ (*). We establish the following almost sure invariance principle for lacunary trigonometric, several kinds of mixing, Gaussian, and functionals of certain Markov sequences: Without changing its distribution we can redefine the process $(S(t), t \geq 0)$ on a new probability space together with standard Brownian motion $X(t)$ such that $S(t) - X(t) \ll t^{\frac{1}{2} - c\delta}$ where $c > 0$ only depends on the given sequence $\{X_n\}$. This result implies the usual upper and lower class results for partial sums and maxima of partial sums as well as the functional version of the law of the iterated logarithm and distribution type invariance principles. We do not make any stationarity assumptions. As a matter of fact we also obtain similar results when (*) is not satisfied. (Received August 23, 1974.)
Topology

We continue our study of extensions for a space \((X,T)\), where we assume no separation properties. **Definition.** An extension \((Y,T)\) of \((X,T)\) has property \(R(i)\) if for each open ultrafilter \(F_X\) on \(X\) which contains a non-clustering \(R\)-filter the open filter \(F_Y = \{U \cup T \cap U X F_X\}\) contains a non-clustering \(R\)-filter, then \((Y,T)\) will be called a **simple** \(R(i)\)-extension. Observe, that an \(R\)-extension is an \(R(i)\)-extension. **Theorem.** If \((X,T)\) is a non-\(R(i)\) space, then \(\exists Y \subset \hat{X}\) and \((i)\) \((Y,T)\) is an \(R(i)\), \(x \in T\), \(Y\) is \(T_2\) except for \(X\), \(X\) is OCS in \(Y\), \((ii)\) \(Y\) is a quasi-Urysohn-extension, \((iii)\) \(Y\) is a simple \(R\)-extension, \((iv)\) if \((Z,T')\) is an \(R\)-extension of \((X,T)\), then \(\exists\) a continuous \(\phi: Y \to Z\), fixed on \(X, \exists \phi[Y]\) is a simple \(R\)-extension of \(X\), \((v)\) \(Y\) is a projective maximum in the class of all \(T_2\) except for \(X\) simple \(R\)-extensions of \(X\). We also define the concepts of the **weak** and **simple weak** \(R\)-extensions. We show that \(\exists\) an extension \(Y \subset \hat{X}\) which is \(R(i)\), Urysohn except for \(X\) and preserves many of the usual extension properties. (Received June 20, 1974.)

**74T-G107**  RAPHAEL ZAHLER, Rutgers University (Douglass College), New Brunswick, N.J. 08903. **Fringe Families in the Stable Stems, Preliminary Report.**

The \(E_2\)-term of the \(BP\) Adams spectral sequence which converges to the stable homotopy groups of the spheres contains a family of nonzero elements \(e_1, \ldots, e_{p-1}\) for \(p\) an odd prime.

These elements are defined by the following "Adams twist" formula for short exact sequences over \(BP^*(BP)\):

\[
E_2^{p,i} = v_{p}^{i-p} \cdot (r_{E_v^p} \cdot E_{p-1}) \mod p.
\]

Furthermore, if \(p \geq 5\) the elements \(e_1, \ldots, e_{p-1}\) for \(p-1 \geq i \geq p-1\) at least, survive to represent a nontrivial family in the stable stems, of grade \(apf + (a-1)p + i(2p-2) - 2\), generalizing Toda's family \(e_1, \ldots, e_{p-1}\). We also have \(e_{p-1} = s_{apf}\). There are related results about realizing cyclic \(BP^\ast\)-modules: for example, \((p,v_1^p, v_2^p)\) is invariant but not realizable; \((p, v_1^p, v_2^p)\) is realizable for \(1 \leq i \leq p-1\), \(a \geq 1\). The Adams twist \(v_{n-p}^i \cdot (r_{E_v^p} \cdot E_{p-1}) \mod (p,v_1^p, \ldots, v_{n-2}^p)\) can also be defined, leading to elements in \(Ext^p\). Some of these results have been obtained by S. Oka and Larry Smith using other methods. (Received June 24, 1974.)

**74T-G108**  RAYBURN, M., Mathematics Department, University of Manitoba, Winnipeg, Manitoba, Canada. **R3T 2N2. Hausdorff Proximities.**

A basic proximity \(\delta\) is a set relation such that 1) \(\emptyset \not\subset X\), 2) \(A \delta B\) implies \(B \delta A\), 3) \(A \cap B \neq \emptyset\) implies \(A \delta B\), and 4) \(A \delta (B \cup C)\) iff \(A \delta B\) or \(A \delta C\). The proximity is separated if 5) \(x \neq y\) implies \(x \not\subset y\). A space is \(T_1\) iff there is a compatible separated proximity iff every compatible proximity is separated. **Definition:** An \(H\)-proximity is a basic proximity such that \(x \not\subset y\) implies an \(A\) for which \(x \not\subset A\) and \(y \not\subset (X-A)\). **Lemma 1:** For any basic \(\delta\), \(TFAE:\)

- a) \(\delta\) is an \(H\)-proximity.
- b) \(x \not\subset y\) implies \(x\) and \(y\) have disjoint proximal nbds.
- c) \(x \not\subset y\) implies a \(B\) such that \(B\) is a proximal nbhd of \(x\) and \(X-\{y\}\) is a proximal nbhd of \(B\). **Lemma 2:** In the topology generated by an \(H\)-proximity, any two
compact sets, one of which is disjoint from the closure of the other, have disjoint open nbd.s. Theorem: For any $T_1$ space $X$, $TFAE$: a) $X$ is $T_2$. b) There is a compatible H-proximity. c) Every compatible basic proximity is an H-proximity. (Every R-proximity (Harris) is an H-proximity and every separated H-proximity is an S-proximity.)

(Received June 26, 1974.)

**74T-G109** CARLOS BORGES, University of California, Davis 95616. Free Topological Groups.

Let $X$ be any Tychonoff space and $BX$ any Hausdorff compactification of $X$. Let $F(BX)$ be the Graev free group of $BX$ and let $F$ be the subspace topology on the Graev group $F(X)$. Our results demonstrate that this topology is useful and behaves extremely well; the behavior of the free topology still remains a secret.

There are various applications, some of which clarify the free topology on $F(X)$, while others improve various results recently published by B.V.S. Thomas. We also give a sufficient condition for a paratopological group to be a topological group.

(Received July 1, 1974.)

**74T-G110** DAVID HSIEH, City College of New York, CUNY, New York, N.Y. 10031. A note on the $B$-realcompact space.

Let $E$ be a set, $B$ an admissible Banach algebra of bounded real valued functions on $E$ with the sup norm. Definition. Let $F$ be a filter of zero sets of functions in $B$. $F$ is said to be a maximal $e$-filter in $(E, B)$ provided that the set $\{f \in B : f \equiv 0, [f', e] \in F \text{ s.t. } \epsilon > 0\}$ is a maximal positive cone in $B$ where $[f', e]$ denotes the set $\{x \in E : |f(x)| \leq \epsilon \}$. Definition. A family of non-negative functions $HC_B$ is said to be complete provided that given a maximal $e$-filter $F$, if for each $f$ in $H$ there is a zero set $Z$ in $F$ such that either $f$ vanishes somewhere in $Z$ or $f \not\equiv \delta$ on $Z$ for some $\delta > 0$. Theorem. The following statements are equivalent: (i) $E$ is $B$-realcompact. (ii) $F$ is a complete family. (iii) $F$ is a complete family. (iv) The set $G = \{f \in B : f \equiv 0 \text{ and for each } \epsilon > 0 \text{ there is } x \in E \text{ such that } |f(x)| < \epsilon \}$ is a complete family. (v) There exists a complete family in $B$. (Received July 8, 1974.)

**74T-G111** TEODOR C. PRZYMUSINSKI, Instytut Matematyczny PAN, 00-950 Warszawa, Poland. Normality and paracompactness in subsets of product spaces.

Let $M$ be a metric space and $G$ an open subset of the product space $M \times Y$. Theorem 1. If $Y$ is hereditarily paracompact, then: $G$ is normal iff $G$ is paracompact iff $G$ is countably paracompact.

Theorem 2. If $Y$ is hereditarily normal and $M$ is dense in itself, then: $G$ is normal iff $G$ is countably paracompact. Theorem 3. If $Y$ is hereditarily normal and hereditarily countably paracompact, then: $G$ is normal iff $G$ is countably paracompact. Corollary. If $Y$ is a generalized ordered space, then: $G$ is normal iff $G$ is countably paracompact. (Received July 10, 1974.)

**74T-G112** JAMES R. BOONE, Texas A&M University, College Station, Texas 77843. On Irreducible Spaces.

A constructive proof of a theorem of Worrell and Wicke, which states that every open

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covering of a \(\emptyset\)-refinable space has a \(c\)-distributively point-finite open refinement that covers the space minimally, is presented. Spaces for which every open covering has an open refinement which covers the space minimally are characterized by the use of discrete closed collections and some open questions relating to spaces of this type are included.

(Received July 12, 1974.)


CAT is TOP, PL or DIFF and \(H^b_{\text{CAT}}(X)\) is the space of boundary fixing CAT homeomorphisms of \(X\) (majorant topology). Let \(I = [0,1]\), \(\text{Bd}(I^{j+1}) = S^j = S^j \times [0] \subset S^j \times I\) and \(\ast = \{0\}^j \in S^j\). \(H^b_{\text{CAT}}(X)\) is CAT-LC\(j\) if for a neighborhood, \(U\), of \(id\) in \(H^b_{\text{CAT}}(X)\) there is a neighborhood \(V \subset U\) where any level preserving (on \(S^j\)) CAT homeomorphism, \(f:S^j \times X \rightarrow S^j \times X, f_* = id, f_t \in V\) (for all \(t \in S^j\)), extends to a level preserving (on \(S^j \times I\)) CAT homeomorphism, \(\overline{f}:S^j \times I \times X \rightarrow S^j \times I \times X, \overline{f}_t,u \in U\) (for all \((t,u) \in S^j \times I\), \(\overline{f}_{\ast} S^j \times [1] \times X = id\). Let \(M\) be a p.l. manifold. Theorem: If \(\dim(M) < 4\) or \(\dim(M) > 4\) and \(H^k(M,\text{Bd}(M);\mathbb{Z}_2) = 0\) for \(k = 0,1,2\), then \(H^b_{\text{PL}}(M)\) is PL-LC\(j\), \(j = 0,1,2,\ldots\). (For \(\dim(M) > 4\) this is also an unpublished result of L. C. Siebenmann). If \(\dim(M) > 4\) and \(H^2-\text{K}(M,\text{Bd}(M);\mathbb{Z}_2) \neq 0\), \(k = 0,1,2\), then \(H^b_{\text{PL}}(M)\) fails to be PL-LC\(k\). \(H^b_{\text{DIFF}}(I^n)\) fails to be PL-LC\(j\) for infinitely many integers \(n\) and \(j\) including \(j = 0\) and \(n\) any integer for which \(n^2 + 1\), the Milnor-Kervair group, is not trivial. (Received July 29, 1974.)

*74T-G114 FRANKLIN D. TALL, University of Toronto, Toronto, Canada MSS 1A1. Stalking the Souslin tree - a topological guide.

Sufficient conditions are given under which the reverse inclusion ordering on the open sets of a topological space includes a Souslin tree. Some sample results follow.

Theorem. There is a Souslin tree if and only if there is a locally connected non-separable countable chain condition space in which first category sets are nowhere dense. Theorem.

If \(X \times X\) satisfies the countable chain condition, \(X\) is locally connected, and every nowhere dense subset of \(X\) is separable, then \(X\) is separable. (Received July 29, 1974.)

74T-G115 W.A.R. WEISS and FRANKLIN D. TALL, University of Toronto, Toronto, Canada MSS 1A1. On countably compact spaces in which closed sets are \(G_\delta\). Preliminary report.

Theorem. Martin's Axiom implies every countably compact regular space in which closed sets are \(G_\delta\) and which has Lindelöf number less than continuum is compact. Theorem. Every non-Lindelöf space with no uncountable discrete subspace has a hereditarily separable non-Lindelöf subspace. In particular then, if there is a countably compact non-compact regular space in which closed sets are \(G_\delta\), there is a regular, hereditarily separable, non-Lindelöf space. (Received July 29, 1974.)
A space is Blumberg if every real-valued function is continuous on some dense set. Using various consistent axioms of set theory, assorted non-Blumberg compact Hausdorff spaces are constructed. For example, Theorem. A Souslin continuum is non-Blumberg. (This was earlier proved by H.E. White, using the continuum hypothesis.) (Received July 30, 1974.)

Evidence of a conspiracy among fixed point theorems Preliminary report.

A recent very pretty theorem is that if \((X,d)\) is a compact and connected metric space and \(f:(X,d) \to (X,d)\) is a local contraction, then \(f\) has a unique fixed point. (The statement that \(f:(X,d) \to (X,d)\) is a local contraction means that for each \(x \in X\), there is an open set \(U\) containing \(x\) and a real number \(M < 1\) so that if \(y\) and \(z\) belong to \(U\), then \(d(f(y), f(z)) < Md(y, z)\).) We intend to prove, beyond a shadow of a doubt, that this theorem is actually The Banach Contraction Theorem wearing a red wig! We submit the following evidence of a conspiracy between these two theorems: If \((X,d)\) is a compact and connected metric space, and \(f:(X,d) \to (X,d)\) is a local contraction, then it is possible to find a new metric \(D\) for \(X\) (yielding the same topology) so that \(f:(X,D) \to (X,D)\) is a contraction. Our case will use the inescapable fact that if \((X,D)\) is a compact metric space and \(f:(X,D) \to (X,D)\) is both a local contraction and contractive (that is, if \(x \neq y\), then \(D(f(x), f(y)) < D(x, y)\)), then \(f\) is a contraction with respect to \(D\). The prosecution rests. (It is recommended that the aforementioned theorems be named as unindicted co-conspirators.) (Received August 12, 1974.)

Embeddings with Mapping Cylinder Neighborhoods

We consider topologically embedded submanifold \(M^m\) in the interior of the manifold \(N^n\) and conclude that \(M^m\) is locally homotopically unknotted in \(N^n\) under either of two hypotheses: The first is that \(M^m\) has local mapping cylinder neighborhoods and is locally free in \(N^n\); the second is that \(M^m\) is (locally) deformation-free in \(N^n\). Our assignment of meaning to the terms "free" and "deformation-free" differs slightly from that of Gillman [Pac. J. Math. 28(1969), 533-542] in that we allow the linking manifold to be any simply connected \((n-m-1)\)-manifold when \(n-m \geq 3\) and we insist on linking number \(\pm 1\) instead of Gillman's odd linking numbers in all codimensions. The proofs make use of some "degree-one map" criteria which, in one case, imply commutativity of \(\pi_1(U^N)\) (where \(U^N\) is an open, orientable manifold) and, in another case, imply that \(U^N\) is a \(K(\pi, 1)\). (Received August 12, 1974.)
Non-cellular points of a map between odd-dimensional manifolds

Think of a mapping \( f \) from a manifold \( M^{2k+1} \) onto another, \( N^n \), such that each point-inverse \( f^{-1}(y) \) has property \( U^k \). (Thus, when \( k = 1 \), assume \( f \) is monotone.) We show that if \( n > k + 1 \) and the (\( \check{\text{C}} \)-ech, mod 2) Betti numbers of each point-inverse satisfy the inequality \( \beta_k \leq \beta_{k+1} + 1 \), then \( n = 2k + 1 \) and all but a finite number of the point-inverses are cellular in \( M^{2k+1} \). The Bing "circles and figure eights" map on \( S^3 \) shows that no such conclusion is possible under the weaker inequality \( \beta_k \leq \beta_{k+1} + 2 \). The following is an application of the main result:

Suppose \( g : S^{2k+1} + S^n \) is a map between spheres each of whose point-inverses is either a point or a \( k \)-sphere; then either \( n = 2k + 1 \) (and \( g \) is a homeomorphism) or \( n = k + 1 \) (and each point-inverse is a \( k \)-sphere). (Received August 12, 1974.)

Pseudocompact cozero-fields and uniform spaces

An A-space is a set \( X \) endowed with a cozero-field \( C \) of subsets, i.e., a "completely normal space" of A.D. Aleksandrov (Mat. Sbornik 50(1940), 307-348), or a dually defined "zero-set space" of H. Gordon (Pac.J.Math 36(1971), 155-157). An A-map \( (X,C) \rightarrow (Y,D) \) is a function with \( f^{-1}(D) \subseteq C \). An A-space is pseudocompact (or semi-compact) if each A-map to \( \mathbb{R} \) is bounded. The above authors have studied these spaces: the equivalences from topology carry over. The functor \( \text{coz} \) from uniform spaces onto A-spaces is \( \text{coz} \). In contrast to the functor to Top, \( \text{coz} \) has no right adjoint; but its restrictions to precompact, and separable, spaces do. Theorem. These conditions on \( \mu_X \) are equivalent: (1) \( (X,\text{coz} \mu_X) \) is a pseudocompact A-space. (2) Each A-image in a uniform space is precompact. (3) Each uniform image in a metric space is compact. (4) \( \mu \) is the only member of its coz-class. (5) \( \mu \) is the only member of its proximity class, and each finite \( \text{coz} \mu_X \)-cover is uniform. (6) \( \mu_X \) is precompact, and each A-map out of \( \mu_X \) is uniform (i.e., \( \mu_X \) is coz-fine). (7) \( \mu_X \) is precompact and metric-fine. (8) \( \text{sam} \mu_X \) is a compactification of \( A(X,\text{coz} \mu_X) \). (9) \( X \) is \( G^\delta \)-dense in \( \text{sam} \mu_X \). See A.Hager, Some nearly fine uniform spaces, Proc. London Math. Soc. 28(1974), 517-546, and Uniformities induced by proximity, cozero and Baire sets, to appear; also Z.Frolík, Representation de Riesz des mesures uniformes, to appear. (Received August 15, 1974.)

On some properties related to compactness in hyperspaces

For a space \( X \), we denote by \( X^2 \) the space of closed subsets of \( X \) with the finite topology. If \( X \) is normal and \( T_\lambda \), the map \( F \rightarrow \text{cl}_{\beta X} F \) is an embedding of \( X^2 \) onto a dense subspace of \( X_{\beta X} \), and so \( X_{\beta X} \) is a compactification of \( X^2 \). J. Keesling has stated (Lecture Notes in Math, Vol. 171 Springer-Verlag) that if \( X^2 = \beta(X^2) \), then \( X^2 \) is pseudocompact. We give a proof of this result, and obtain a partial converse. Theorem 1 If \( X^2 \) is pseudocompact, then \( \beta(X^2) = X_{\beta X} \). Corollary 2 If \( X \) is \( N_0 \)-bounded, then \( \beta(X^2) = X_{\beta X} \). Theorem 3 If \( X^2 \) is countably compact, then all finite powers of \( X \) are countably compact. If all powers of \( X \) are countably compact, then \( X^2 \) is countably compact. A similar theorem is proved for pseudocompactness and an example is given of a space \( X \), all of whose finite powers are pseudocompact, such that \( X^2 \) is not pseudocompact.
Theorem 4 If $X$ is Lindelof, then $2^X$ is realcompact. We characterize those spaces $X$ for which $2^X$ is $G_δ$-closed in $2^2X$ and obtain the following corollary. Theorem 5 If $X$ is $σ$-compact and perfectly normal, then $2^X$ is $G_δ$-closed in $2^2X$.

(Received August 15, 1974.)

*74T-G122 ULRICH KOSCHORKE, Queens College of the City University of New York, Flushing, New York 11367. Framefields with finite singularities.

Let $M$ be a closed connected smooth $n$-dimensional manifold with zero Euler number. Assume that $M$ has a $q$-field $u$ with finite singularities where $n > 2q$. Define $e : H^1(M, \mathbb{Z}_2) \to H^2(M, \mathbb{Z}_2)$ by $e(x) = x^2 + x \cdot w^1(M)$.

Theorem 1. Let $q = 3$. If $n \not\equiv 1(4)$ and $w^1(M) \neq 0$, or if $n \equiv 1(4)$ and $w^1(M)^2 \notin \text{image} (e)$, then $\text{Span} (M) \not\subseteq 3$. Theorem 2. Let $q = 4$ and $n \equiv 1(4)$. If $M$ is a spin manifold, then the index of $u$ (cf. E. Thomas, BAMS 75, 643-683) is independent of $u$ and depends only on the spin-bordism class $[M]$ and on the real Kervaire semicharacteristic $k(M)$ of $M$. If $w^1(M) = 0$, but $w^2(M) \notin \text{image} (e)$ and $e$ is injective, then: $\text{Span} (M) \supseteq 4$ iff $k(M) = 0$. (Received August 15, 1974.)

*74T-G123 DOUGLASS L. GRANT, College of Cape Breton, Sydney, Nova Scotia, Canada. Productivity in $B(A)$ and $B(A)$ topological groups.

For definitions, see T. Husain, Introduction to Topological Groups (Saunders, Philadelphia, 1966). The example of the Cartesian product of the reals with the complex roots of unity shows that neither of the categories in the title is finitely productive. THEOREM. If $G$ is a $B(A)$ (resp., $B(A)$) topological group and $K$ is a compact Hausdorff group, then $G \times K$ is a $B(A)$ (resp., $B(A)$) group. The proof for $B(A)$ groups uses methods of D. Doitchinov [Produits des groupes topologiques minimaux, Bull. Sc. math., 2e série, 96 (1972), p. 59-64], while the $B(A)$ case relies on an extension to topological groups of an algebraic result of Heinrich Werner (Congruences on Products of Algebras and Functionally Complete Algebras, to appear in Algebra Universalis). (Received August 16, 1974.)

*74T-G124 PHILIP BACON, University of Florida, Gainesville, Florida 32611. Axiomatic shape theory.

This is a study of some aspects of shape theory that can be formulated entirely in terms of category theory. The notion of shape theory is so defined that, if $\mathcal{H}$ is a category and $\mathcal{W}$ is a subcategory of $\mathcal{H}$, all shape theories on $(\mathcal{H}, \mathcal{W})$ are isomorphic and, under a mild condition, a shape theory on $(\mathcal{H}, \mathcal{W})$ always exists. Additional theorems facilitate the comparison of shape theories constructed by various means. (Received August 16, 1974.)


In this paper we show that every homeomorphism $T$ of $\mathbb{R}^2$ onto itself, with bounded orbits and an equicontinuous family of iterates, is a conjugate of either a rotation or reflection. This theorem is related to the well-known bounded orbit problem, "Does a homeomorphism $T$ of $\mathbb{R}^2$ onto itself, with bounded
orbits, necessarily have a fixed point?" The answer is in the affirmative if T is orientation preserving, and this follows from Proposition 1.2 of Andrea [On homeomorphisms of the plane which have no fixed point, Abb. Math. Sem. Univ. Hamburg, Vol. 30, (1967), 61-74]. Here we show the answer to be also in the affirmative, if the iterates of T form an equicontinuous collection. (Received August 19, 1974.)

Let k be a locally compact, totally disconnected, non-discrete field, and assume the characteristic of the residue class field of k ≠ 2. Let G be a reductive group defined over k, and let P be a minimal parabolic subgroup of G. If λ is an irreducible finite dimensional unitary representation of P, let Tλ be the unitary representation Indλ G

In this paper, we study the question of reducibility of Tλ for G = SL(n,k), Sp(n,k) or SO(2n,k). If λ is non-singular, that is, not fixed by any non-trivial element of the restricted Weyl group, it is well known that Tλ is irreducible. Thus we are reduced to studying singular λ. For the groups studied, λ is one-dimensional and determined by its action on the diagonal. We write λ = n ∏ i=1 λi where λi is a unitary character on k×.

Theorem. Let G = Sp(n,k). If there exists an i such that λi ≠ 1 and λi2 = 1, then Tλ is reducible.

Theorem. Let G = SO(2n,k). If there exists an i and a j such that λi ≠ λj but λi2 = λj2 = 1, then Tλ is reducible.

Let G = SL(n,k), and a a function from {1,...,n-1} to {1,...,n-1}. We say a product of simple reflections pa(1)...pa(s) is in correct form if (1) a is increasing and (2) the product pa(1)⋯pa(s), as an element of Sn, leaves no element of {1,...,n} fixed.

Theorem. Let p = pa(1)...pa(s) be in correct form, and pλ = λ. Assume λ = n ∏ i=1 λi where λn = 1. Then Tλ is reducible if and only if λn-1 ≠ 1. (Received August 21, 1974.)

For integers 0 ≤ k ≤ n < ∞ let S(n,k) denote the hyperspace of all geometric k-dimensional spheres lying on the unit n-dimensional sphere Sn of euclidean (n+1)-space. Sn is contained in S(n,k) as the subspace i(Sn) of degenerate k-spheres on Sn. Theorem. S(n,k) is contained in the join Sn △ G(n+1,k+1) as the double mapping cylinder of the projection maps restricted to the total space of the canonical (n-k-1)-sphere bundle γn-k over the Grassmannian G(n+1,k+1) of (k+1)-planes in (n+1)-space. Hence the space obtained from S(n,k) by collapsing i(Sn) to a point is homeomorphic to the Thom space of the (n-k)-plane bundle γn-k. Theorem. S(n,k) is homeomorphic to the mapping cone of a map of the n-fold suspension of the Grassmannian G(n,k+1) into the stunted Grassmannian G(n+1,k+1)/G(n,k+1). For k = 0, S(n,k) is the symmetric square of Sn and this last theorem extends to k > 0 a result of James, Thomas, Toda and Whitehead, J. Math. Mech. 12(1963), 771-776. (Received August 23, 1974.)
It is known that every Hausdorff convergence space [Fund. Math. 65 (1969), 197-205] has a Hausdorff compactification [Proc. Amer. Math. Soc. 25 (1970), 403-404]. In this note it is proved that a Hausdorff convergence space \( S \) has the largest Hausdorff compactification if and only if \( S \) contains at most finitely many non convergent ultrafilters. (Received May 20, 1974.) (Author introduced by Professor S. A. Naimpally.)

It is shown that continua which are arcwise connected and contain no simple closed curves have the fixed point property for homeomorphisms, answering in the affirmative a question of Bing. The proof uses measure theoretic techniques. Given a homeomorphism \( h \) of a compact metric space \( X \) onto itself, a probability measure is constructed on \( X \) which is invariant under \( h \). (Received July 18, 1974.)

Professor G. Darbo introduced the category \( S \) of \( T_2 \)-spaces and defined a singular homology theory on this category and extended the Lefschetz fixed point theorem for single valued maps of a compact \( T \) to that of weighted maps of a compact \( W \)-space and a metric \( ANR \). In this paper the author extends his result to that of compact weighted maps of a polyhedron (not necessarily finite) and a metric \( ANR \). Moreover, the results proved by S. Masih in his paper in Fund. Math, and his Ph.D. Thesis at Indiana University also become a particular case of results for weighted maps. So the concept of \( W \)-space is defined to be a topological space in which every weighted, compact self-mapping of \( X \) is a Lefschetz map. Then the following theorem is proved: "Every (metric) \( ANR \) is a \( W \)-space". (Received July 18, 1974.)

Let \( I(M) \) denote the isometry group of a connected Riemannian \( m \)-manifold \( M \) and \( \langle k \rangle = k(k+1)/2 \) for a nonnegative integer \( k \). Rational cohomology with compact supports will be used. **Theorem 1.** If \( M \) is not diffeomorphic to \( \mathbb{C}P^k \), \( m = 19 \), and \( H^k(M;\mathbb{Q}) \neq 0 \) for some \( k \), then \( \dim I(M) \leq \langle k \rangle + \langle m-k \rangle \). **Theorem 2.** Suppose \( M \) is orientable, \( p_1(M) = 0 \), and there exists \( v_i \in H^m(M;\mathbb{Q}) \), \( i = 1, \ldots, k \), of dimensions \( \geq 5 \) and \( 0 \neq \Pi_{i=1}^k v_i \in H^m(M;\mathbb{Q}) \). Then \( \dim I(M) \leq \sum_{i=1}^k \langle m_i \rangle \). (Received August 26, 1974.)
Schubert's calculus was first interpreted and rigorously justified by van der Waerden (1929) by means of the calculus of algebraic cohomology classes developed by Lefschetz. Entirely algebraic treatments of the foundations of Schubert's calculus have become possible through the jumbled efforts of a great many mathematicians, who have contributed to the constructions of algebraic intersection rings to replace the topological cohomology ring. However, this work does not constitute a complete solution to Hilbert's fifteenth problem; for, in the statement and explanation of the problem, Hilbert makes clear his interest in the effective computability and actual verification of the geometrical numbers of classical enumerative geometry. Due primarily to Schubert (1886), the classical method of obtaining certain numbers, like the number \( \frac{(1!2!\ldots d!)(n-d)!\ldots!}{(d+1)(n-d)(n-d-1)!\ldots!} \) of \( d \)-planes in \( n \)-space meeting \( h = (d+1)(n-d) \) general \( (n-d-1) \)-planes, was vindicated topologically by Ehresmann (1934) and algebraically by Hodge (1941, 1942) by means of an explicit determination of the cohomology ring, and, respectively, of an equivalent algebraic intersection ring, on the Grassmann manifold. In the offing, there is the exciting hope of the development in algebraic geometry of a general enumerative theory of singularities of mappings, a theory of Thom polynomials, which will, among other things, unify and justify the classical work dealing with prescribed conditions of intersection and contact imposed on linear spaces. Classically, conditions of intersection and contact were imposed on other figures as well. For example, Schubert (1879), in his book, obtains the number 666,841,048 of quadric surfaces tangent to 9 given quadric surfaces in space, and the number 5,819,539,783,680 of twisted cubic space curves tangent to 12 given quadric surfaces. Today, we cannot vouch for the accuracy of these two spectacular numbers, nor do we even know whether Schubert's method is basically sound. (Received July 22, 1974.)

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**The October Meeting in Middletown, Connecticut**

**October 26, 1974**

**Algebra & Theory of Numbers**

BENJAMIN FINE, Fairfield University, Fairfield, Connecticut 06430

*Conjugacy Classes and Fuchsian Subgroups of the Picard Group*

The Picard group \( \Gamma \) is \( \text{PSL}(2, \mathbb{Z}[i]) \) where \( \mathbb{Z}[i] \) are the Gaussian integers. If \( C \) is a circle, \( P(C) \) denotes the Fuchsian stabilizer in \( \Gamma \) of \( C \) while \( P_n(C) \) is the normal closure of \( P(C) \). Waldinger (Proc. Amer. Math. Soc. 1965, 1373-1378) exhibited several classes of circles for which the index \( \Gamma : P(C) \) is finite. Here by examining the conjugacy classes of elliptic and parabolic elements in \( \Gamma \) we generalize and extend the above. First, Theorem 1: There exists only 9 conjugacy classes of elliptic elements in \( \Gamma \); 5 for those of order 2 and 4 for those of order 3. (Explicit representatives of each class are also given) Theorem 2: Any parabolic element in \( \Gamma \) is conjugate within the Picard group itself to a translation. These lead to, Theorem 3: If \( F \) is a normal subgroup of \( \Gamma \) and \( F \) contains an elliptic element then \( \Gamma : F \not\cong \mathbb{Z} \). Corollary: If \( P(C) \) contains an elliptic element \( \Gamma : P_n(C) \) is finite. Letting \( C \) be the general stabilizer in \( \Gamma \) of \( C \) and \( P_n(C) \) its normal closure we get, Theorem 4: If circle \( C \) is fixed by either an elliptic map or a parabolic map in \( \Gamma \) then \( \Gamma : L(C) \) is...
finite. Reformulating the results in terms of fundamental domains of Fuchsian groups leads to, \textbf{Theorem:} If \( F \) is a finitely generated Fuchsian normal subgroup of the Picard group, then \( F \) is either a free group or \( F \) provides a faithful representation of a fundamental group of a Riemann surface of finite genus. (The theorem is also true if \( F \) is not normal but if the index in of the normal closure of \( F \) is infinite) (Received August 27, 1974.)

716-A2 V. Sankrithi KRISHNAI, Temple University, Philadelphia, Pa. 19122. \textbf{DUALITY.}

Preliminary Report

This indicates various approaches to a notion of \textit{Duality} between a pair of Categories. Both the Stone duality between Boolean spaces and Boolean algebras and the Pontryagin duality between discrete and compact groups can be considered as part of a more general connection between two larger categories. This is the idea behind a treatment involving "dual", "Galois", "weak dual" and "weak Galois" connections between a pair of Categories with suitable "base functors". A second approach is to pass from objects of one category \( C \) to objects of another category \( C' \), or vice-versa, by considering sets of morphisms into an object which belongs to both \( C \) and \( C' \). Coming even closer to the classical case, the circle group can be replaced by a suitable ordered, semuniform semigroup or group, as the base for the duality. (Received August 7, 1974.)

716-A3 CHARLES WELLS, Case Western Reserve University, Cleveland, OH 44106. \textbf{A categorical construction with applications to automorphisms.} Preliminary report.

Let \( C \) be a small category with a subcategory \( D \) closed under right multiplication by morphisms of \( C \). A functor is constructed from \( C \) into the wreath product of the skeleton of \( D \) by the natural action of \( C \) on \( D \). Conditions for faithfulness and fullness are given. As a corollary, when \( C \) is the group of automorphisms of an object (in some larger category) which is the coproduct of a set of isomorphic subobjects, then under certain conditions the functor is an isomorphism. This has as a special case a theorem of Frucht on automorphisms of graphs, and the well-known theorem describing the centralizer of a permutation as a wreath product. It can also be applied to the study of automorphisms (in various senses) of Riemann surfaces. Another corollary is that under certain conditions the monoid of endomorphisms of an object is a wreath product. (Received August 7, 1974.)

#716-A4 JOHN KENNISON, Clark University, Worcester, Massachusetts, \textbf{Representing algebras by sections.} Preliminary report.

Categorical methods are used to construct universal sheaves with compact, hausdorff base and with stalks satisfying first order conditions. We consider the problem of classifying different ways in which an algebra can be represented as the algebra of all global sections of a suitable sheaf. This is related to a triple defined on the category of algebras. An explicit description of the triple and a complete solution of the problem can be given in some cases. The method is fairly general and applies to any finitary algebraic category or even to categories of relational structures. Ellerman's Spec functor is our starting point. (Received September 3, 1974.)

716-A5 JOHN ISBELL, State University of New York at Buffalo, Amherst, New York 14226. \textbf{Some concrete dualities.}

Given a category \( S \) of all models of a reduced ruled theory (author, Amer. J. Math. 94 (1972), 535-596) and a faithful representable contravariant functor \( H = \text{Hom}(\, ,K) \) on it, such that a morphism \( f \) is invertible if its images under \( H \) and under the forgetful functor \( U \)
are invertible, $H$ lifts to an equivalence with $S^*_T$ where $T^*$ is obtained as follows. $K$ induces an embedding of $T$ in a theory $\tilde{T}_K$ Morita-equivalent to complete atomic Boolean algebra theory (the theory of the constant $UK$-valued functor $1 \to S$); $T^*$ is the centralizer of $T$ in $\tilde{T}_K$. Under strong finiteness conditions, $T^*$ is the theory of profinite compact models of the finitary part $T^*_0$ of $T^*$ -- not, in general, the theory of Boolean spaces in $S$. Some illustrations: Boolean algebras, abelian groups, locally convex spaces, Banach spaces and linear contractions, compact spaces, partially ordered sets, distributive lattices with 0 and 1, sets. For the last two, the usual descriptions of the dual are different. The equivalence of profinite compact Boolean algebras and complete atomic Boolean algebras is known. (Received September 3, 1974.)

Analysis

*716-B1 CARL HERZ, McGill University, Montreal, Quebec and JOAN WICK PELLETIER, York University, Downsview, Ont. Dual Functors and Integral Operators in Ban.

In this paper we continue the study of the duality of functors in the category $\mathbb{B}$ of Banach spaces initiated by Mityagin and Svarc (Russian Math. Surveys 19 No. 2 (1964)). We say that an endofunctor $F$ is computable if for every $X \in \mathbb{B}$ $\lim FY = FX$, where the direct limit is taken over all finite dimensional subspaces $Y$ of $X$. Theorem: If $F$ is computable, then $DF(X') = (FX)'$. Examples are given. In particular we specialize to the study of integral operators. For $A \in \mathbb{B}$, INT$(A,-)$ is an endofunctor on $\mathbb{B}$ which is defined as the dual functor of the computable functor $A \cdot$, where $A \cdot X$ is the closure in $\text{Hom}(A',X)$ of $A \otimes X$. Standard results are easily obtained in this setting. (Received August 16, 1974.)

Applied Mathematics

*716-C1 PHILIP J. DAVIS, Brown University, Providence, Rhode Island 02912. Geometry, computer graphics, and theorems of visual type.

The author presents arguments in favor of the following two positions. (1) Visual geometry ought to be restored to an honored position in mathematics. Computer graphics comprising animation and color offers the possibility of going far beyond conventional drawings. (2) The classical notions of what constitutes a mathematical theorem or a mathematical truth need broadening. These notions should be recast so as to include a variety of phenomena which are systematically generated, perceived by the senses and interpreted by the brain. (Received August 16, 1974.)

716-C2 MARK KAC, Rockefeller University, New York, New York 10021. Some analytic problems suggested by statistical mechanics.

One of the central problems of statistical mechanics of equilibrium phenomena is to understand the mathematical mechanism of phase transitions. A study of simplified models suggests an intimate connection between phase transitions and the so-called asymptotic degeneracy of the highest (or lowest) eigenvalue of certain linear operators. One is led in this
way to a class of purely analytical problems whose solution would contribute greatly in advancing an important and fascinating branch of statistical physics while at the same time calling attention to the need of developing new analytic tools to deal with asymptotic degeneracy. (Received August 26, 1974.)

Statistics and Probability

716-F1 Joel H. PITTT, State University College, New Paltz, New York 12561
Recurrence Criteria for Random Walks on Countable Abelian Groups, II.
Preliminary Report
Flatto and Pitt (Ill. J. Math. 18 (1974), 1-19) obtain necessary and sufficient conditions for recurrence of a class of random walks on \( \mathbb{Z}_{m_1} \oplus \mathbb{Z}_{m_2} \oplus \mathbb{Z}_{m_3} \oplus \ldots \). The walks they consider are restricted by the conditions that steps fall in distinct summands of the group. We extend their results by obtaining similar criteria for recurrence of walks on \( \mathbb{Z}_{m_1} \oplus \mathbb{Z}_{m_2} \oplus \mathbb{Z}_{m_3} \oplus \mathbb{Z}_{m_4} \oplus \ldots \), not subject to this restriction. (Received September 3, 1974.)

Topology


Notation: 0. A knot group; 1. admits a homomorphism onto the symmetric group of degree; 2. two; 3. three; 4. four; 5. such that meridians map to elements of period; 6. if and only if it; 7. whenever it; 8. such that the first (integral) homology group of the associated branched 3-fold cover; 9. has as its identity the cycle carried by some odd multiple of the branch curve of index two. Theorem. 014613. Clearly 013714. We prove the converse geometrically. Lemma A. 01452613812. Lemma B. 0145471389. Note that where 013 it is either 89 or (by mapping that branch curve to the generator) 812. Perhaps 01454713. Of the seven \( S_4 \) covers belonging to coset representations by nonconjugate subgroups which contain no normal subgroup but the identity, five cover the corresponding irregular \( S_3 \) cover. [Cf. Fox, Canad. J. Math. 22 (1970), 193-201, and Burnside, Theory of groups of finite order, Ch. XII.] (Received August 16, 1974.)

*716-G2 M. RAJAGOPALAN, Memphis State University, Memphis, Tennessee, 38152.
A Chain Compact Space Which Is Not Strongly Scattered.

There exists a compact \( T_2 \) scattered separable but uncountable space such that \( x^\alpha - x^{\alpha+1} \) is countable for all \( \alpha \). This answers a problem attributed to Telgarski by Mary Ellen Rudin. (Received August 19, 1974.)
Let $G$ be a finite abelian group and $N_\ast(G)(F,F')$ denote the bordism ring of unoriented $G$-manifolds (with boundary) with isotropy subgroups in the pair of families of subgroups of $G,(F,F')$.

Theorem: $N_\ast(G)(F,F')$ is an algebra over the Hopf algebra $N_\ast(G)(\{\{1\}\},\phi)$; i.e., if

$$\Delta(a) = \sum_{i} a_i \otimes a_i'$$

denotes the action of the coproduct $\Delta$ on the element $a$ in $N_\ast(G)(\{\{1\}\},\phi)$ then $a(xy) = \sum (a'_1 x)(a''_1 y)$ for $x$ and $y$ in $N_\ast(G)(F,F')$.

Theorem: The class of the circle with the antipodal involution is primitive in $N_\ast(Z_2)(\{\{1\}\},\phi)$ and is a derivation on $N_\ast(Z_2)(All,\phi)$. The kernel of this derivation is precisely the image in $N_\ast(Z_2)(All,\phi)$ of $N_\ast(S^1)(All,\phi)$ by the reduction homomorphism.

(Received August 19, 1974.)

Let $X$ be a path connected, locally path connected space with a locally finite countable open cover, $U$. The nerve of $U$ is generalized to a semi-simplicial complex, $N$, by accounting for the path components of intersections. A technical condition on $N$ enables the construction of a covering space for $X$. If $U$ satisfies a condition requiring certain fundamental groups to inject and if $N$ satisfies a countability condition, then the theorems in Abstract 707-G6 these Notices 20(1973), A-609 apply to the covering space yielding the second homotopy group of $X$ in terms of the second homotopy groups of the intersections of elements of $U$, the indices of the fundamental group injections and the structure of $N$.

(Received August 30, 1974.)

One of the questions posed by Semadeni in his treatise on scattered spaces (Rozprawy Mat. 19 (1959)) is whether every scattered Tychonoff space can be embedded as a subspace of a scattered compact Hausdorff space. This question is answered here, in the negative. Let $X$ be a product of uncountably many two-point discrete spaces; let one point be given a base of neighborhoods as in the product topology; let all other points of $X$ be isolated. **Theorem.** Every compact Hausdorff space which contains $X$ as a subspace also has a dense-in-itself subspace. The method of proof is sufficiently general to yield the following results as well. 1. Let $Y$ be the subspace of $X$ which consists of all points which agree with the nonisolated point in all but finitely many coordinates. Then $Y$ does not have a scattered compactification. 2. Bing's Example $G$ (Canad. J. Math. 3 (1951) 175-186) does not have a scattered compactification.

(Received September 3, 1974.)
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<td>612 336-4351</td>
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<td>Newark, N. J.</td>
<td>201 643-0340</td>
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<td>New York, N. Y.</td>
<td>212 661-4242</td>
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<tr>
<td>Oklahoma City, Okla.</td>
<td>405 235-6243</td>
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<td>714 327-8441</td>
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<td>800 972-9003</td>
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<tr>
<td>San Juan, P. R.</td>
<td>725-4747</td>
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<td>Syracuse, N.Y.</td>
<td>315 476-1213 Ext. 401/402</td>
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<tr>
<td>Toronto, Ont., Canada</td>
<td>416 925-4822</td>
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<td>Tucson, Ariz.</td>
<td>602 882-0331 Ext. 375</td>
<td></td>
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<td>918 583-0928</td>
<td></td>
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<tr>
<td>Washington, D. C.</td>
<td>202 393-1166</td>
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Dept. of Mathematical Sciences
FTU
P. O. Box 25000
Orlando, Florida 32816

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The Chairman is expected to have an established record of research in mathematics or statistics and to encourage the development of the teaching and research programs of the Department. Duties to commence September, 1975.
Enquiries and applications, with curriculum vitae and the names of three referees, should be sent by November 15, 1974, to:
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College of Physical Science
UNIVERSITY OF GUELPH
Guelph, Ontario, Canada N1G 2W1

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Dr. D. G. Wertheim, Chairman
Department of Applied Mathematics
UNIVERSITY OF WATERLOO
Waterloo, Ontario, Canada N2L 3G1

A-580
Man's efforts to master the world by counting it, measuring it, and calculating its future

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For the first time, Cajori's classic survey of the history of mathematics is available in paperback. Cajori begins with the earliest recorded calculations and leads an informative tour through primitive and ancient cultures to the 19th century—from toe-counting to ornate algebraic notations. Hard-to-find facts and intriguing theories neatly compiled with elegant wit. Illustrated. $4.95, paperback.

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The position of chairman is intended to be a permanent one, with occasional reviews. Administrative duties of the chairman are shared with a vice-chairman.

The department has active undergraduate and graduate programs. There are approximately 270 undergraduate mathematics majors and 55 graduate students, many of whom are involved in the doctoral program. Our faculty is strongly committed to both scholarly research and quality teaching.

Send inquiries, applications, and nominations to:

Search Committee
Department of Mathematics & Statistics
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OF THE
PERMIAN BASIN

invites applications for anticipated teaching positions starting in the fall of 1975. UTPB, an upper division university, is in its second year of operation, with most mathematics students in applied mathematics or in preparation to be teachers. Plans are being made for starting a masters program and new faculty will be expected to participate in its development.

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INFORMATION

for mathematicians

Mathematical Sciences Employment Register

Post Office Box 6248

Providence, Rhode Island 02940

Six issues are published during the academic year, beginning with the October issue, for a subscription price for individuals of $20. Subscription rates are prorated for late orders. Single copies are not available except for the final issue. The subscription rate for institutions is based on Ph. D. production and may be obtained by writing to MSER at address given above. The chart below gives complete information for individual subscriptions.

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<tr>
<th>Academic Year</th>
<th>Deadline for receipt of order</th>
<th>Individual Subscriber</th>
<th>Book Rate Price</th>
<th>First Class (North America only)</th>
<th>Airmail</th>
<th>Issues</th>
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<tbody>
<tr>
<td>74–75</td>
<td>October 17</td>
<td>$20</td>
<td>23</td>
<td>24.35</td>
<td>10/74-7/75</td>
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ORDER FORM

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☐ Please enter a subscription to the 1974–1975 Employment Information for Mathematicians (starts with October 1974 issue)

☐ Payment enclosed (make checks payable to American Mathematical Society)

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A-582
THE LONDON MATHEMATICAL SOCIETY

Burlington House, Piccadilly, London WIV ONL

*Incorporated by Royal Charter*

The Society was established in 1865 for the promotion and extension of mathematical knowledge. Members of the American Mathematical Society are very welcome to join the London Mathematical Society under the Reciprocity Agreement, which enables certain formalities to be dispensed with and a reduced subscription to be applied (see overleaf).

Full particulars of the activities of the London Mathematical Society and various categories of membership can be obtained from the Secretary of the LMS. Members of the American Mathematical Society who are chiefly interested in subscribing to the publications may find it convenient simply to return the following form to the Treasurer (at the address given above).

APPLICATION FOR RECIPROCITY MEMBERSHIP
IN THE LONDON MATHEMATICAL SOCIETY

Name __________________________

Position _______________________

Address ______________________________________________

________________________________________________________________________

________________________________________________________________________

I am a member of the American Mathematical Society and wish to be elected a member of the London Mathematical Society. I understand that periodicals are supplied at special rates on condition that they are for personal use of members and not for the supply of libraries or similar institutions.

I have marked on the reverse of this page my choice of periodicals for 1975 and enclose my check (made out to The London Mathematical Society) for total $______ (U. S. or Canadian).

Signed _______________________

Date _______________________

A-583
THE LONDON MATHEMATICAL SOCIETY

The following are the special members rates per annum. AMS members applying for reciprocity membership in the LMS are asked to circle the appropriate items below and transfer the relevant total to the application form on the other side of this page.

**Basic subscription to the LMS**

<table>
<thead>
<tr>
<th>Subscriptions</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Members who subscribe to <strong>none</strong> of the LMS periodicals</td>
<td>$5.00</td>
</tr>
<tr>
<td>Members who subscribe to <strong>at least one</strong> of the LMS periodicals</td>
<td>$0.60</td>
</tr>
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</table>

**LMS periodicals**

<table>
<thead>
<tr>
<th>Journal</th>
<th>Price</th>
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<tbody>
<tr>
<td>The <em>Bulletin</em> of the London Mathematical Society</td>
<td>$6.25</td>
</tr>
<tr>
<td>The <em>Journal</em> of the London Mathematical Society</td>
<td>$12.50</td>
</tr>
<tr>
<td>The <em>Proceedings</em> of the London Mathematical Society</td>
<td>$12.50</td>
</tr>
</tbody>
</table>

It is expected that one volume of the *Bulletin* and two volumes each of the *Journal* and *Proceedings* will be published in 1975.

**Other periodicals**

The following special subscription rates are available to members of the London Mathematical Society:

<table>
<thead>
<tr>
<th>Journal</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>The Journal of Applied Probability</em></td>
<td>$12.75</td>
</tr>
<tr>
<td><em>The Quarterly Journal of Mathematics</em></td>
<td>$12.50</td>
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</table>

To obtain the total payable, AMS members should deduct $2.00 from the sum of the items chosen. [Note: Prospective reciprocity members who would prefer to pay in English currency may obtain a deduction of £1 sterling, which is one half of the regular dues. The dollar deduction is a little less than one half of the regular dues in dollars, to allow for bank charges.] Details of sterling subscriptions may be obtained from the Treasurer of the LMS at the address given overleaf.
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Registrants should make every attempt to find two attendees with whom they would like to share a room (it would be helpful to receive the three preregistrations at the same time), or they may request that the Mathematics Meetings Housing Bureau make these arrangements. If a registrant cannot be matched with two compatible registrants by the Housing Bureau within three weeks of receipt of the form, it will be returned to the registrant with a request that alternate housing arrangements be made.

Do not make reservations directly with the hotel. All reservations will be confirmed. A deposit may be required. At the time of cancellation is necessary after having been given a confirmed reservation please advise the Housing Bureau up to 15 days prior to the start of the meeting; within last 15 days, make cancellation directly with the hotel. In accordance with common practice, reservations will be held until 6:00 p.m. on the day of arrival unless a later hour is specified below. Please note that all rates are subject to taxes totaling 6%.

Please note that a separate registration fee is required for each of the two meetings.

<table>
<thead>
<tr>
<th>Meeting</th>
<th>Preregistration</th>
<th>At meeting</th>
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</thead>
<tbody>
<tr>
<td>Joint Mathematics</td>
<td>$1 (by mail prior to 12/20)</td>
<td>$2</td>
</tr>
<tr>
<td>Operations Research Short Course</td>
<td>$9 (by mail prior to 12/20)</td>
<td>$12</td>
</tr>
</tbody>
</table>

Make checks payable to AMERICAN MATHEMATICAL SOCIETY

MEETING PREREGISTRATION FORM

1) NAME (please print) last first middle
2) ADDRESS (for confirmation) street and number city state zip code
3) I am a student at or unemployed member Male Female
4) Member of AMS ASL MAA NCTM AMOUNT ENCLOSED $ (check or money order only)
   Charge my BankAmericard No. ___________ ___________ ___________ ___________
   Expiration date ___________ ___________ ___________ ___________
   Master Charge No. ___________ ___________ ___________ ___________
   Expiration date ___________ ___________ ___________ ___________
   Signature ___________________ Date ___________ ___________ ___________ ___________

ROOM RESERVATION FORM

5) I am a student or unemployed member and would like a room from the special Hilton Sheraton-Park Shoreham block (preferred hotel).
6) I will arrive (date) ___________ at (hour) ___________ a.m./p.m.
7) I will depart (date) ___________ at (hour) ___________ a.m./p.m.

Please list names of those persons with whom you plan to share a room. (Each participant should complete a separate preregistration form and sign an individual status verification statement.)

a. __________________________________________
   b. __________________________________________

☐ I will share a room with person(s) assigned by housing bureau.

STUDENT VERIFICATION

I am currently a student working toward a degree and do not receive annual compensation in excess of $7,000 from employment, fellowships, and scholarships.

Signature ___________________

UNEMPLOYED MEMBER VERIFICATION

I am currently unemployed and actively seeking employment. My unemployed status is not the result of voluntary resignation or retirement from my last position.

Signature ___________________

☐ I am interested in attending the luncheon in honor of H. L. Alder

A-585
PREREGISTRATION AND HOTEL RESERVATION FORM
FOR ALL PARTICIPANTS except those qualifying for special accommodations
Washington, D.C.

Operations Research Short Course
January 21–22, 1975
Joint Mathematics Meetings
January 23–27, 1975

MUST BE RECEIVED NO LATER THAN DECEMBER 20, 1974
Please complete these forms and return with your payment to
Mathematics Meetings Housing Bureau
P. O. Box 6887
Providence, Rhode Island 02940

Housing Bureau Services
Do not make reservations directly with hotels. All reservations will be confirmed. A deposit may be required by
some hotels. At time of confirmation, registrant will be informed of deposit requirement which should be sent di­
rectly to the hotel as requested. In case cancellation is necessary after you have been given confirmed reservations
at a particular hotel, please advise the housing bureau up to 15 days prior to start of meeting; within last 15 days,
make cancellation directly with hotel. All other changes (i.e. changes in arrival or departure dates) are to be made
directly with hotel. In accordance with common practice, reservations will be held until 6:00 p.m. on the day of
arrival unless a later hour is specified below. Please note that all rates are subject to taxes totaling 6%. If re­
quested rate is not available, the next available rate will be assigned.

Preregistration Only
Those participants who desire to PREREGISTER ONLY should complete the preregistration section exclusively on
the form below.

Please note that a separate registration fee is required for each of the two meetings.

Joint Mathematics Meetings
Preregistration (by mail prior to 12/20)
Member
* Student or unemployed member
Nonmember
* For definition of student and unemployed member, see section on Meeting Preregistration and Registration.

Operations Research Short Course
Preregistration (by mail prior to 12/20)

MEETING PREREGISTRATION FORM

1) NAME (please print) last first middle
2) ADDRESS (for confirmation) number and street city state zip code
3) Employing institution or unemployed
4) I am a student at 5) Accompanied by spouse (first name)
6) Accompanying children (number) 7) Names
8) Member of AMS ASL MAA NCTM AMOUNT ENCLOSED (check or money order only)
Charge my BankAmericard No. Expiration date
Master Charge No. Expiration date
Signature Date

ROOM RESERVATION FORM

9) I would like hotel accommodations at the following:
(1st choice) (4th choice)
(2nd choice) (5th choice)
(3rd choice) (6th choice)
10) Type of accommodations: Single(s) at $ Twin(s) at $
Double(s) at $ Suite(s) at $

11) I will arrive (date) at (hour) a.m./p.m.
I will depart (date) at (hour) a.m./p.m.
12) Persons for whom this reservation is made. Please list names and type of room for each (bracket the names of
those persons sharing a room). Each participant should complete separate preregistration form.
a. c.
b. d.
13) I will I will not share a room. N. B. Participants planning to stay at the Shoreham Hotel are reminded
that all rooms have two beds; double occupancy is considerably less expensive (see paragraph on accommodations
for further information).
14) I am interested in attending the luncheon in honor of H. L. Alder

A-586
SOFTWARE FOR NUMERICAL MATHEMATICS
Proceedings of the Loughborough University conference of the Institute of Mathematics and its
Applications held in April 1973
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Here is a book which is intended to promote the exchange of information and ideas on mathematical
software—a new discipline of great importance in computing science. The subject encompasses such topics as the
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programs, the user interaction and methodology involved in the interface of algorithms with application to software packages and pro-
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