Notices

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THE CALENDAR BELOW 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.

CALENDAR OF MEETINGS

MEETING NUMBER	DATE	PLACE	DEADLINE for ABSTRACTS and NEWS ITEMS
750	November 11-12, 1977	Memphis, Tennessee	EXPIRED
751	November 11-12, 1977	San Luis Obispo, California	EXPIRED
752	January 3-8, 1978 (84th Annual Meeting)	Atlanta, Georgia	OCTOBER 18
753	March 20-25, 1978	Columbus, Ohio	
754	March 28-31, 1978	New York, New York	
755	April 7-8, 1978	Houston, Texas	
756	April 14-15, 1978	San Francisco, California	
	August 8-12, 1978 (82nd Summer Meeting)	Providence, Rhode Island	
	October 20-21, 1978	Claremont, California	
	January 24-28, 1979 (85th Annual Meeting)	Biloxi, Mississippi	
	April 6-8, 1979	Honolulu, Hawaii	
	August 21-25, 1979 (83rd Summer Meeting)	Blacksburg, Virginia	
	January 3-7, 1980 (86th Annual Meeting)	San Antonio, Texas	
	January 8-12, 1981 (87th Annual Meeting)	San Francisco, California	

*Deadline for abstracts NOT presented at a meeting (by title)

November 1977 issue: EXPIRED
January 1978 issue: OCTOBER 11

OTHER EVENTS

January 3-4, 1978	Numerical Analysis (AMS Short Course) Atlanta, Georgia	
February 1978	Symposium on Some Mathematical Questions in Biology Washington, D. C.	OCTOBER 18
March 20-23, 1978	Symposium on Relations Between Combinatorics and Other Parts of Mathematics Columbus, Ohio	
March 28-29, 1978	Symposium on Mathematical Problems in Fracture Mechanics New York, New York	
August 15-23, 1978	International Congress of Mathematicians Helsinki, Finland	

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.

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Notices

OF THE AMERICAN MATHEMATICAL SOCIETY

EDITORIAL BOARD: Ed Dubinsky, Robion C. Kirby, Arthur P. Mattuck, Barbara L. Osofsky, George Piranian, Everett Pitcher (Chairman), Scott W. Williams

MANAGING EDITOR: Gordon L. Walker

ASSOCIATE EDITOR: Hans Samelson

CONTENTS

October, 1977

748TH MEETING

Wellesley College
Wellesley, Massachusetts
October 22, 1977

The seven hundred forty-eighth meeting of the American Mathematical Society will be held at Wellesley College, Wellesley, Massachusetts, on Saturday, October 22, 1977.

By invitation of the Committee to Select Hour Speakers for Eastern Sectional Meetings, there will be two invited addresses. GIAN-CARLO ROTA of the Massachusetts Institute of Technology will talk about "Recent progress in combinatorics," and JEAN E. TAYLOR of Rutgers University will speak about "The geometry of soap films and crystals." Both lectures will be presented in Room 277 in the Science Center on College Road.

GIAN-CARLO ROTA has also organized a special session on Combinatorics; the speakers will be Steve Fisk, Stephen Milne, Steven Roman, and Gregory Wulczyn. JEAN E. TAYLOR has organized a special session on Geometric problems in the calculus of variations; speakers will be F. J. Almgren, Jr., John B. Baillieul, Enrico Bombieri, Frank Morgan, and Jon T. Pitts.

There will be sessions for contributed ten-minute papers, both morning and afternoon.

REGISTRATION

The registration desk will be located in the Focus Area at the Science Center. Registration hours will be from 8:30 a.m. to noon, and from 1:30 p.m. to 3:30 p.m.

ACCOMMODATIONS

A limited number of rooms is available at the Wellesley College Club on campus; there are twelve doubles at $25-$27 per night, and four singles at $18 per night. Reservations are required and should be addressed to Carolyn Bruns, Wellesley College Club, Wellesley College, Wellesley, Massachusetts 02181, or telephone (617) 235-0320, extension 567.

Accommodations are also available at the following locations; reservations should be made directly and mention should be made of this meeting in order to obtain the quoted rates. All rooms are subject to a 5.7 percent sales tax.

WELLESLEY MOTOR INN (617) 235-8555
Route 9, Wellesley

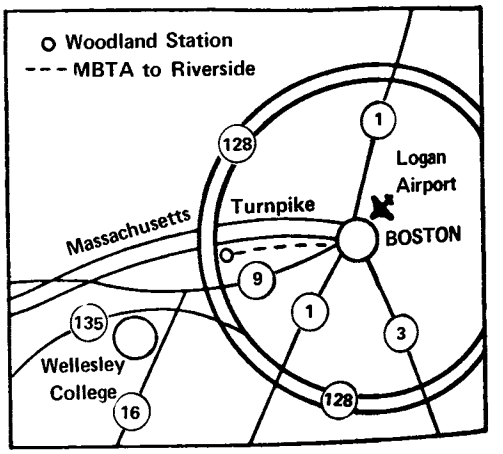
Single	$17
Double	21-$23

WELLESLEY TREADWAY INN (617) 235-0180
576 Washington Street, Wellesley

Single	$18-$20
Double	28- 30

FOOD SERVICE

Coffee and light refreshments will be served in the registration area at the Science Center during the morning. The cafeteria at Schneider College Center is open from 10:00 a.m.-11:00 p.m. for grill service, sandwiches, and salads. A buffet lunch is served at the Wellesley College Club; the cost is $3.51, which includes tax. Since a very limited number can be accommodated without prior reservations, it is requested that participants write Alice T. Schafer at the Department of Mathematics, Wellesley College, Wellesley, Massachusetts 02181, or telephone (617) 235-0320, extension 611, to make a reservation for the buffet luncheon. Payment for the buffet should be made at the registration desk at the Science Center when registering for the meeting. A list of local restaurants will also be available at the registration desk.



TRAVEL INFORMATION

Boston is served by frequent and various bus or train service and many airlines. Individuals traveling by public transportation into Boston may take the MBTA train from there to Woodland Station at Wellesley; bus service is available from the station to the college every hour beginning at 6:15 a.m. Taxi service from the station to the college is also available; the fare is $4.

Those people coming by car and driving east (from New York) on the Massachusetts Turnpike should take exit 13 to Route 9 and proceed on Route 9 until reaching Route 16 (Washington Street); turn right at Washington Street and continue on this road until reaching traffic

light at entrance to the campus, then make right turn at College Road. Persons driving west (from Boston) may take Route 9 to Route 16 and continue south until reaching College Road entrance to the campus.

PARKING

Founders parking lot is located on the left hand side of College Road, across from the Science Center. There is no charge for parking.

PROGRAM OF THE SESSIONS

The time limit for each contributed paper in the general sessions is ten minutes. In the special sessions the time varies from session to session and within sessions. To maintain the schedule, the time limits will be strictly enforced.

SATURDAY, 9:00 A. M.

Special Session on Geometric Problems in the Calculus of Variations, I, Room 266, Science Center

9:00- 9:20 (1) Multiple valued solutions to variational problems and the regularity of mass minimizing integral currents. Professor F. J. ALMGREN, Jr., Princeton University (748-B3)

9:30- 9:50 (2) Title to be announced. Professor ENRICO BOMBIERI, University of Pisa.

10:00-10:20 (3) Almost every smooth curve in $\mathbb{R}^3$ bounds a unique area minimizing surface. Dr. FRANK MORGAN, Massachusetts Institute of Technology (748-B2)

SATURDAY, 9:00 A. M.

Session on Analysis, Room 270, Science Center

9:00- 9:10 (4) The q-gamma function. Professor RICHARD ASKEY, University of Wisconsin (748-B4)

9:15- 9:25 (5) Weak and norm approximate Identities are different. Dr. CHARLES D. LAHR and Mr. CHARLES A. JONES*, Dartmouth College (748-B5)

9:30- 9:40 (6) Multipliers of L^1-algebras with order convolution. Dr. DAVID L. JOHNSON and Dr. CHARLES D. LAHR*, Dartmouth College (748-B6)

9:45- 9:55 (7) Multipliers and derivations of Hilbert algebras. Dr. DAVID L. JOHNSON* and Dr. CHARLES D. LAHR, Dartmouth College (748-B7)

10:00-10:10 (8) Buckled elastica at contact: A perturbation analysis. Preliminary report. Professor DENNIS D. BERKEY* and Professor MARVIN I. FREEDMAN, Boston University (748-B8)

10:15-10:25 (9) On infinite Nielsen Kernels. Preliminary report. Professor JUDITH C. WASON, Wellesley College (748-B9)

SATURDAY, 9:00 A. M.

Session on Algebra and Logic, Room 274, Science Center

9:00- 9:10 (10) Principal congruence subgroups of the Picard group. Professor BENJAMIN FINE, Fairfield University (748-A5)

9:15- 9:25 (11) Index two simple groups II. Dr. LEO J. ALEX, State University College, Oneonta (748-A7)

9:30- 9:40 (12) Free ideal monoid rings. Professor ROMAN W. WONG, Syracuse University (748-A9)

9:45- 9:55 (13) Recursive linear orderings. Professor JOSEPH G. ROSENSTEIN, Rutgers University (748-E2)

10:00-10:10 (14) On the second transgression of the Lyndon-Hochschild-Serre spectral sequence. Dr. JOHN G. RATCLIFFE, Massachusetts Institute of Technology (748-A10)

10:15-10:25 (15) Fine quasi resolutions of semigroups with identity. Preliminary report. Professor V. S. KRISHNAN, Temple University (748-A11)

10:30-10:40 (16) On the homomorphism relation between countable order types. CHARLES K. LANDRAITIS, Boston College (748-E1) (Introduced by J. P. Shanahan)

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

SATURDAY, 11:00 A. M.

Invited Address, Room 277, Science Center

(17) The geometry of soap films and crystals. Professor JEAN E. TAYLOR, Rutgers University (748-B1)

SATURDAY, 2:00 P. M.

Invited Address, Room 277, Science Center

(18) Recent progress in combinatorics. Professor GIAN-CARLO ROTA, Massachusetts Institute of Technology (748-A4)

SATURDAY, 3:10 P. M.

Special Session on Combinatorics, Room 270, Science Center

3:10- 3:30 (19) Four colorings: Their existence and non-existence. STEVE FISK, Bowdoin College (748-A1) (Introduced by Professor Gian-Carlo Rota)

3:40- 4:00 (20) Mappings of subspaces into subsets. Dr. STEPHEN MILNE, Yale University (748-A2)

4:10- 4:30 (21) The algebra of divided differences. Dr. STEVEN ROMAN, Massachusetts Institute of Technology (748-A3)

4:40- 5:00 (22) An application of combinatorials to the formation of like power identities in real quadratic fields. Preliminary report. Mr. GREGORY WULCZYN, Bucknell University (748-A6)

SATURDAY, 3:10 P. M.

Special Session on Geometric Problems in the Calculus of Variations, II, Room 266, Science Center

3:10- 3:30 (23) Minimal surfaces on Riemannian manifolds. Dr. JON T. PITTS, University of Rochester (748-D1)

3:40- 4:00 (24) Control problems associated to singular Riemannian metrics. Dr. JOHN B. BAILLIEUL, Georgetown University (748-D2)

SATURDAY, 3:10 P. M.

General Session, Room 274, Science Center

3:10- 3:20 (25) Uniqueness of normalization in the smooth category. Dr. TERENCE GAFFNEY*, Brown University and Professor LESLIE WILSON, University of Hawaii (748-D3)

3:25- 3:35 (26) Local triviality in codimension one. Dr. TADATOSHI AKIBA, Tufts University (748-G1)

3:40- 3:50 (27) Embedding of a pseudo-point-residual design into a Möbius plane. Professor AGNES H. CHAN, Northeastern University (748-A8)

3:55- 4:05 (28) Open 2-manifolds as covering spaces. Preliminary report. ROBERT MESSER, Dartmouth College (748-G2)

4:10- 4:20 (29) Finite group representation techniques in Lagrangian mechanics. Mr. J. N. BOYD* and Mr. P. N. RAYCHOWDHURY, Virginia Commonwealth University (748-C2)

4:25- 4:35 (30) States on quantum logics and their connection with a theorem of Alexandroff. Mrs. O. R. BEAVER and Mr. T. A. COOK*, University of Massachusetts, Amherst (748-C3)

4:40- 4:50 (31) Curvature of product 3-manifolds. Preliminary report. Dr. JAMES R. WASON, Wellesley College (748-D4)

4:55- 5:05 (32) A nonvoid partially ordered set without maximal elements. Dr. GERHARD F. KOHLMAYR, Mathmodel Consulting Bureau, Glastonbury, Connecticut (748-E3)

Raymond G. Ayoub
Associate Secretary

University Park, Pennsylvania

749TH MEETING

Purdue University
West Lafayette, Indiana
October 29, 1977

The seven hundred forty-ninth meeting of the American Mathematical Society will be held at Purdue University, West Lafayette, Indiana, on Saturday, October 29, 1977. The sessions will be held in University Hall and in the Mathematical Sciences Building.

By invitation of the Committee to Select Hour Speakers for Western Sectional Meetings, there will be two invited one-hour addresses. ALBERT BAERNSTEIN II of Washington University will speak at 11:00 a.m.; his subject will be Maximal functions in complex analysis. KAREN K. UHLENBECK of the University of Illinois at Chicago Circle will address the Society at 1:45 p.m.; her title will be Variational problems on manifolds with a conformal structure. Both hour talks will be presented in the auditorium of the Mathematical Sciences Building.

By invitation of the same committee there will be four special sessions of selected twenty-minute papers. GEORGIA M. BENKART of the University of Wisconsin has arranged a special session on Nonassociative algebras and their connections with physics; the speakers will be Harry P. Allen, Yutze Chow, Gabor Domokos, Susan Kovesi-Domokos, Pierre M. Ramond, Robert Lee Wilson, and Hans J. Zassenhaus. JOHN B. CONWAY of Indiana University has arranged a special session on Subnormal operators; the speakers will be James E. Brennan, Kevin Clancey, James A. Deddens, Ronald G. Douglas, William W. Hastings, Thomas L. Kriete III, Robert F. Olin, James E. Thompson, and Warren R. Wogen. JOSEPH B. MILES of the University of Illinois at Urbana-Champaign has arranged a special session on Functions of one complex variable; the speakers will be Joseph A. Cima, David Drasin, Peter L. Duren, Albert Edrei, Matts R. Essén, Lowell J. Hansen, Larry J. Kotman, John L. Lewis, Lee A. Rubel, Glenn E. Schober, and Allen W. Weitsman. JOHANNES C. C. NITSCHE of the University of Minnesota has arranged a special session on Methods of the calculus of variations and partial differential equations applied to geometrical or physical problems; the speakers will be Giles Auchmuty, Kenneth A. Brakke, Luis A. Caffarelli, Robert Finn, Avner Friedman, Robert D. Gulliver II, Stefan Hildebrandt, Jerry L. Kazdan, David S. Kinderlehrer, Frank Morgan, Louis Nirenberg, Nestor M. Rivière, and Henry C. Wente.

There will be one session of contributed ten-minute papers.

On Thursday and Friday, October 27–28, Purdue University will sponsor a conference on Homomorphisms of Polynomial Rings. Those interested in attending should write to Professor Meyer Jerison at Purdue University

REGISTRATION

The registration desk will be located at the entrance to the auditorium, which is on the street level at the north end of the Mathematical Sciences Building. The registration desk will be open from 8:00 a.m. to 11:00 a.m., and from 1:30 p.m. to 3:00 p.m.

Facilities for making acetate transparencies will not be available. Speakers wishing to use transparencies should prepare them at their own institutions.

ACCOMMODATIONS

A block of guest rooms has been set aside in the Purdue Memorial Union. Daily rates are $10, $11.50, and $15 for single rooms and $13.50, $15, and $19 for twin-bedded rooms. All rooms are equipped with private bath, telephone, clock radio, and color television. Requests for reservations should be received by October 14 and should be addressed to the Union Club, Purdue Memorial Union, West Lafayette, Indiana 47907; telephone (317) 494-8011. Please do not send a deposit. Union Club guests may use the adjacent Grant Street parking garage at no additional cost if they have their garage tickets validated at the Union Club desk.

FOOD SERVICE

A cafeteria on the ground level of the Memorial Union and one in Graduate House West serve from about 7:00 a.m. until 6:30 p.m. The Sagamore Room, a dining room on the second floor of the Memorial Union, will serve lunch and dinner. Snacks are available until 11:00 p.m. in the Sweet Shop on the ground level of the Memorial Union.

TRAVEL AND LOCAL INFORMATION

Lafayette is 60 miles northwest of Indianapolis and 120 miles southeast of Chicago. Public transportation includes Air Wisconsin, and Greyhound, Indiana Motor Coach, and Trailways bus lines. Lafayette is accessible by highway I-65 from Chicago and Indianapolis. Some may find it convenient to fly to Chicago or Indianapolis and rent a car to drive to West Lafayette.

After 5:00 p.m. on Friday, free parking will be available in the University parking lots and in the parking garages on University Street and Sheetz Street (but not in the one on Grant Street.

Coffee and doughnuts will be available most of the day on Saturday in the reading room of the Mathematical Sciences Library, which is located on the third floor of the Mathematical Sciences Building. To reach the library, use the south staircase or the elevators; the doors of the north staircase (adjacent to the auditorium) will be locked.

On Friday evening there will be an informal get-together for those attending the meeting. It will take place at the International Center, 124 Marstellar Street, one-half block south of State Street, beginning 8:15 p.m., and will feature a cash bar.

West Lafayette is on Eastern Standard Time, i.e., Central Daylight Time, throughout the year.

The time limit for each contributed paper in the general sessions is ten minutes. In the special sessions the time varies from session to session and within sessions. To maintain the schedule, the time limits will be strictly enforced.

SATURDAY, 8:00 A. M.

Special Session on Functions of One Complex Variable. I, Room 19, University Hall

8:00- 8:20 (1) Denting points in B^p. Professor JOSEPH A. CIMA* and Professor JAMES ROBERTS, University of North Carolina, Chapel Hill (749-B1)

8:30- 8:50 (2) Some geometric aspects of the growth of entire functions. Professor LOWELL J. HANSEN, Wayne State University (749-B17)

9:00- 9:20 (3) Nonvanishing univalent functions. Professor PETER DUREN*, University of Michigan and Professor GLENN SCHOBER, Indiana University (749-B24)

9:30- 9:50 (4) Convolutions of starlike functions. Professor JOHN L. LEWIS, University of Kentucky (749-B26)

10:00-10:20 (5) The problem of moduli for plane domains is undecidable. Preliminary report. Professor JOSEPH BECKER, Purdue University, Professor C. WARD HENSON and Professor LEE A. RUBEL*, University of Illinois (749-B27)

10:30-10:50 (6) Two examples. Professor DAVID DRASIN, Purdue University (749-B23)

SATURDAY, 8:00 A. M.

Special Session on Methods of the Calculus of Variations and Partial Differential Equations Applied to Geometrical and Physical Problems. I, Room 3, University Hall

8:00- 8:20 (7) Almost every curve in R^3 bounds a unique area minimizing surface. Dr. FRANK MORGAN, Massachusetts Institute of Technology (749-B5)

8:25- 8:45 (8) The motion of a surface by its mean curvature. Professor KENNETH A. BRAKKE, Purdue University (749-B8)

8:50- 9:10 (9) Finiteness of the number of minimal surfaces bounded by a given curve. Preliminary report. Professor ROBERT GULLIVER, University of Minnesota (749-B9)

9:15- 9:45 (10) Existence and nonexistence of capillary surfaces. ROBERT FINN, Stanford University (749-C1)

9:40-10:00 (11) The stability of the axially symmetric pendent liquid drop. Professor HENRY C. WENTE, University of Toledo (749-B10)

10:05-10:25 (12) On 't Hooft's eigenvalue problem in two-dimensional quantum chromodynamics. Professor S. HILDEBRANDT, Universität Bonn, Bonn, Germany (749-B22)

10:30-10:50 (13) Volume, injectivity radius, and Wiedersehen Flasche. Professor JERRY L. KAZDAN, University of Pennsylvania (749-D2)

SATURDAY, 8:20 A. M.

Special Session on Nonassociative Algebras and Their Connections with Physics. I, Room 101, University Hall

8:20- 8:40 (14) Local symmetries in physics. PIERRE M. RAMOND, California Institute of Technology (749-A5)

9:00- 9:20 (15) On the subalgebras of the classical Lie algebras. HANS J. ZASSENHAUS, Ohio State University (749-A9)

9:40-10:00 (16) The Octonians and exceptional simple Lie algebras over the real and complex fields. HARRY P. ALLEN, Ohio State University (749-A8)

10:20-10:40 (17) On some algebraic problems in the theory of elementary particles. Professor G. DOMOKOS, Johns Hopkins University (749-A3) (Introduced by Professor Georgia M. Benkart)

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

SATURDAY, 8:30 A. M.

Special Session on Subnormal Operators. I, Room 17, University Hall

8:30- 8:50 (18) Invariant subspaces and subnormal operators. Mr. JAMES E. BRENNAN, University of Kentucky (749-B4)

9:00- 9:20 (19) Operators with one dimensional self-commutators. Dr. KEVIN CLANCEY, University of Georgia (749-B2) (Introduced by Professor John B. Conway)

9:30- 9:50 (20) Subnormal operators and C*-algebras. Professor JAMES A. DEDDENS, University of Cincinnati (749-B16)

10:00-10:20 (21) Examples of the central decomposition for an analytic Toeplitz operator. Professor M. B. ABRAHAMSE, University of Virginia and Professor R. G. DOUGLAS*, State University of New York, Stony Brook (749-B19)

10:30-10:50 (22) On $H^2(\mu)$ for μ a pure atomic measure. Preliminary report. Dr. WILLIAM HASTINGS, Fordham University (749-B30)

SATURDAY, 8:30 A. M.

General Session on Contributed Papers, Room 117, University Hall

8:30- 8:40 (23) Intermediate logics. Preliminary report. PHYLLIS M. KITTEL, Illinois Institute of Technology (749-E1)

8:45- 8:55 (24) Enumeration of standard tableaus. Preliminary report. Professor FRANK W. OWENS, Ball State University (749-A6)

9:00- 9:10 (25) Lamination identities. Preliminary report. Professor G. L. ALEXANDERSON, University of Santa Clara and Professor JOHN E. WETZEL*, University of Illinois at Urbana-Champaign (749-A1)

9:15- 9:25 (26) A characterization of linear relations. Professor JOEL C. GIBBONS, Illinois Institute of Technology (749-D1)

9:30- 9:40 (27) Buying and selling algorithms. Preliminary report. Professor JON C. LUKE, Indiana University-Purdue University at Indianapolis (749-C3)

9:45- 9:55 (28) An analysis of a singular integral equation of electromagnetic scattering. Preliminary report. Dr. DAVID K. COHOON, USAF School of Aerospace Medicine, San Antonio, Texas (749-C2)

SATURDAY, 11:00 A. M.

Invited Address, Mathematical Science Auditorium

(29) Maximal functions in complex analysis. Professor ALBERT BAERNSTEIN, Washington University (749-B14)

SATURDAY, 1:45 P. M.

Invited Address, Mathematical Science Auditorium

(30) Variational problems on manifolds with a conformal structure. Professor KAREN K. UHLENBECK, University of Illinois at Chicago Circle (749-G1)

SATURDAY, 3:00 P. M.

Special Session on Nonassociative Algebras and Their Connections with Physics. II, Room 101, University Hall

3:00- 3:20 (31) On algebraic models in the theory of elementary particles. Professor S. KOVESI-DOMOKOS, Johns Hopkins University (749-A2) (Introduced by Professor Georgia M. Benkart)

3:40- 4:00 (32) A construction of certain Kac-Moody Lie algebras. Professor JAMES LEPOWSKY and Professor ROBERT LEE WILSON*, Rutgers University (749-A4)

4:20- 4:40 (33) On algebras, manifolds and fibre-bundles in physics. Professor YUTZE CHOW, University of Wisconsin (749-A7)

SATURDAY, 3:00 P. M.

Special Session on Functions of One Complex Variable. II, Room 19, University Hall

3:00- 3:20 (34) The Padé tables of entire functions. ALBERT EDREI, Syracuse University (749-B25)

3:30- 3:50 (35) Applications of the calculus of variations for families of quasiconformal mappings. GLENN SCHOBER, Indiana University (749-B6)

4:00- 4:20 (36) Slowly growing subharmonic functions. Professor M. ESSEN, Royal Institute of Technology, Stockholm, Sweden and University of Wisconsin, Madison (749-B12)

4:30- 4:50 (37) On spread-type relations in the theory of functions. Professor ALLEN WEITSMAN, Purdue University (749-B28)

5:00- 5:20 (38) An entire function with irregular growth and more than one deficient value. Dr. LARRY KOTMAN, University of Wisconsin-La Crosse (749-B29)

SATURDAY, 3:00 P. M.

Special Session on Methods of the Calculus of Variations and Partial Differential Equations Applied to Geometrical and Physical Problems. II, Mathematical Science Auditorium

3:00- 3:20 (39) Remarks about higher order free boundary problems. Professor DAVID S. KINDERLEHRER*, University of Minnesota and Professors LEWIS NIRENBERG and JOE SPRUCK, Courant Institute of Mathematical Sciences, New York University (749-B32)

3:25- 3:45 (40) Regularity in free boundary problems. Professor LOUIS NIRENBERG, Courant Institute of Mathematical Sciences, New York University (749-B31)

3:50- 4:10 (41) The free boundary of a quasivariational inequality. Professor AVNER FRIEDMAN, Northwestern University (749-B3)

4:15- 4:35 (42) Further regularity for the n-dimensional Signorini problem. LUIS CAFFARELLI, University of Minnesota (749-B11)

4:40- 5:00 (43) Existence and uniqueness for the problem of filtration through a porous medium. Professor L. A. CAFFARELLI and Professor N. M. RIVIÈRE*, University of Minnesota (749-B15)

5:05- 5:25 (44) Axisymmetric figures of equilibrium of rotating self-gravitating liquids. Dr. GILES AUCHMUTY, Indiana University (749-B13)

SATURDAY, 3:00 P. M.

Special Session on Subnormal Operators. II, Room 17, University Hall

3:00- 3:20 (45) The growth of point evaluation functionals in certain $H^2(\mu)$ spaces. Professor THOMAS KRIETE, University of Virginia (749-B20)

3:30- 3:50 (46) Lifting the commutant of a subnormal operator. ROBERT F. OLIN* and JAMES E. THOMSON, Virginia Polytechnic Institute and State University (749-B18)

4:00- 4:20 (47) Some index theorems for $\mathcal{S}_p(N)$. Preliminary report. ROBERT F. OLIN and JAMES E. THOMSON*, Virginia Polytechnic Institute and State University (749-B21)

4:30- 4:50 (48) Cyclic vectors for adjoints of subnormal operators. Professor W. R. WOGEN, University of North Carolina (749-B7)

Paul T. Bateman
Associate Secretary

Urbana, Illinois

PRELIMINARY ANNOUNCEMENTS OF MEETINGS

750TH MEETING

Memphis State University
Memphis, Tennessee
November 11–12, 1977

The seven hundred fiftieth meeting of the American Mathematical Society will be held at Memphis State University in Memphis, Tennessee, from noon Friday, November 11, until noon Saturday, November 12, 1977. All sessions will be held in the Winfield Dunn Building, where the mathematics department is located, and in the adjoining Psychology Lecture Hall.

By invitation of the Committee to Select Hour Speakers for Southeastern Sectional Meetings there will be three invited one-hour addresses. JONATHAN BREZIN of the University of North Carolina, Chapel Hill, will talk on "Solvmanifolds as a source of problems in analysis." RICHARD MANDELBAUM, currently of the Institute for Advanced Study, Princeton, will talk on "Algebraic surfaces, 4-manifolds and framed links." JOHN POLKING of Rice University, Houston, will talk on "Fundamental solutions of the Cauchy-Riemann equations."

By invitation of the same committee there will be at least two special sessions. RONALD KNILL of Tulane University, New Orleans, has arranged a special session on Algebraic topology and RICHARD SCHELP of Memphis State University, Memphis, has arranged a special session on Graph theory and combinatorics.

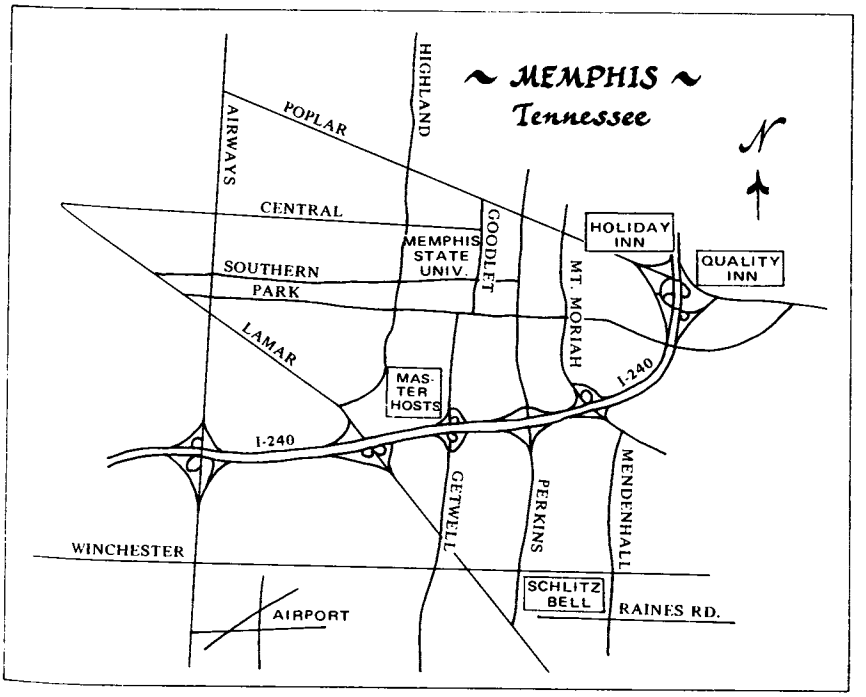
There will be sessions for contributed ten-minute papers. If necessary, late papers will be accepted for presentation at the meeting, but will not be listed in the printed program of the meeting. Abstracts should have been sent so as to arrive in the Providence office of the AMS prior to September 20, 1977.

REGISTRATION

The registration desk will be in the lobby of the Psychology Lecture Hall, which is attached to the Winfield Dunn Building. Registration hours will be from 10:00 a.m. to 1:00 p.m. and from 3:00 p.m. to 5:00 p.m. on November 11. (The registration fee is $5, of which $3 goes to the Society.) Please use the form on page A-599 of these *Notices* to preregister.

ACCOMMODATIONS

Some housing is available on campus at Richardson Towers, which is within one block of the Winfield Dunn Building. There are no motels within walking distance of the campus, but transportation will be provided to and from the motels listed below, which are three to four miles from the campus. The form on page A-599 of these



Notices should be used to obtain reservations for lodging.

RICHARDSON TOWERS (901) 454-2007

Private room and bath	$17.00
Private room w/semiprivate bath	11.15
Semiprivate room w/semiprivate bath	7.00

HOLIDAY INN-POPLAR (901) 682-7881
5679 Poplar Avenue

Single	$21.00
Double	28.00

QUALITY INN-POPLAR EAST (901) 767-6300
5877 Poplar Avenue

Single	$19.00
Double	24.00

MASTER HOSTS (901) 744-4650
1831 Getwell Road

Single	$15.95
Double	15.95

FOOD SERVICE

On-campus food service is available at the cafeteria at Richardson Towers and at the Student Center. There are also fast-food restaurants and other cafeterias within walking distance of the campus. A list of restaurants in Memphis will be available at the registration desk.

TRAVEL

Memphis may be reached by Greyhound and Trailways bus lines, by Amtrak (which connects Chicago and New Orleans), and by almost all major airlines. One-way limousine service from Memphis International Airport to the campus is $3.50.

PARKING

There is a parking lot for visitors adjacent to Richardson Towers. If a parking ticket is received, it may be turned in at the registration desk.

ENTERTAINMENT

A free beer party will be held on Friday, November 11, from 7:30 p.m. until 10:30 p.m. at the Schlitz Belle. Transportation will be provided for participants without cars.

There are numerous things to see and do in Memphis. Information on some of these opportunities will be available at the registration desk.

EMERGENCY MESSAGES

Emergency messages may be left at the office of the Department of Mathematics, (901) 454-2482.

New Orleans, Louisiana

Frank T. Birtel
Associate Secretary

751ST MEETING

California Polytechnic State University San Luis Obispo, California November 11–12, 1977

The seven hundred fifty-first meeting of the American Mathematical Society (AMS), will be held in conjunction with the Fall meeting of the Southern California Section of the Mathematical Association of America (MAA), at California Polytechnic State University in San Luis Obispo, California, on Friday and Saturday, November 11 and 12, 1977.

By invitation of the AMS Committee to Select Hour Speakers for Far Western Sectional Meetings, there will be two invited one-hour addresses. JERROLD E. MARSDEN of the University of California, Berkeley, will speak at 11:00 a.m. on Friday; the title of his address is "Some interactions between bifurcation theory and catastrophe theory." JOHN B. WALSH of the University of British Columbia will speak on "Two-parameter martingales" at 1:30 p.m. on Friday.

There will be sessions of contributed ten-minute papers on Friday, November 11. Late papers will be accepted for presentation at the meeting, but will not appear in the printed program.

There will be several special sessions of selected papers. ESTELLE BASOR of California Polytechnic State University is organizing a special session on Operator theory; a tentative list of speakers includes John A. Ernest, J. William Helton, Gerhard K. Kalisch, Ralph S. Phillips, Donald E. Sarason, V. S. Sunder, and Harold Widom. RONALD V. BOOK of the University of California, Santa Barbara, is arranging a special session on Theoretical computer science; the plan is to schedule several forty- or forty-five minute talks that will serve as high level introductions for the nonspecialist, as well as some twenty- or thirty-minute research level talks. The following are tentatively scheduled to speak: Manuel Blum, Martin D. Davis, Emily P. Friedman, Te Chiang Hu, Jonathan Goldstine, Zohar Manna, Webb C. Miller, Walter J. Savitch, and Andrew Chi-Chih Yao. THOMAS M. LIGGETT of the University of California, Los Angeles, is organizing a special session on Probability. The list of speakers is: Richard T. Durrett, Steven A. Kalikow, P. Warwick Millar, Stanley A. Sawyer, and Robert T. Smythe. STANLEY J. OSHER of the University of California, Los Angeles, is organizing a special session on Computational fluid dynamics. A tentative list of speakers includes Ray Chuck Yun Chin, Bengt Fornberg, R. W. MacCormack, Andrew J. Majda, Jr., Joseph E. Oliger, and Robert Warming. RAYMOND D. TERRY of California Polytechnic State University will organize a special session on the Qualitative theory of ordinary differential equations. The tentative list of speakers includes Clarence M. Ablow, R. Abraham, Clifford H. Anderson, Donald C.

Benson, Jim M. Cushing, Eugene M. Friedman, Vadim Komkov, Arthur James Krener, Walter T. Kyner, G. Leitman, Richard E. Plant, Thomas T. Read, and Samuel Schechter. V. S. VARADARAJAN of the University of California, Los Angeles, is arranging a special session of forty-minute talks on Representations of real semisimple groups. The tentative list of speakers includes Leon Ehrenpreis, Thomas Enright, Johan A. C. Kolk, Bertram Kostant, R. Parthasarathy, Wilfreid Schmid, and Irving E. Segal.

The general theme for the MAA meetings will be "Theoretical, practical, and pedagogical questions related to the teaching of calculus and differential equations." By invitation of the Program Committee of the Southern California Section of the MAA there will be two invited one-hour addresses Friday afternoon, and a panel discussion followed by a luncheon speaker on Saturday morning. On Friday, H. L. RESNIKOFF of the University of California, Irvine, will speak on applications of calculus and differential equations to the social sciences and PAMELA COOKIOANNIDIS of the University of California, Los Angeles, will speak on applications to the biological sciences. On Saturday DAVID L. OUTCALT of the University of California, Santa Barbara, will moderate a panel discussion on pedagogical questions related to the teaching of the basic calculus course. CONSTANCE REID will give the invited address at the MAA luncheon on Saturday.

REGISTRATION

The registration area will be at the Cal Poly Theatre and will be open on Friday from 8:00 a.m. to 3:00 p.m. and on Saturday from 8:00 a.m. to 11:00 a.m. Coffee and doughnuts will be provided.

ACCOMMODATIONS

San Luis Obispo has a large number of motels within a two-kilometer radius of campus. In view of the large tourist business, early registration is advised and encouraged. Blocks of rooms have been reserved at the first five motels listed and will be held for AMS-MAA members until October 10. Participants should make their own reservations directly with the motels and should identify themselves as participants in the AMS-MAA meetings. A one-night deposit is usually required. Some rates include the tax, while others do not. For additional information or help with accommodations, contact H. Arthur DeKleine, Mathematics Department, California Polytechnic State University, San Luis Obispo, California 93407 (phone (805) 546-2206). All the motels listed below are in San Luis Obispo, California 93401.

MADONNA INN (Ms. Maxine Emerson)
(805) 543-3000
100 Madonna Road

Single	$25.44 up
Double	33.92 up
Two Beds	36.04 up

POLY MOTEL (805) 543-7126
60 Casa Street

Single	$14.00 up
Double	16.00 up
Two Beds	22.00 up

SANDS MOTEL (805) 544-0500
1930 Monterey Street

Single	$19.00 up
Double	23.00 up
Two Beds	24.00 up

SOMERSET MANOR (Best Western)
(805) 544-0973
1895 Monterey Street

Single	$19.08 up
Double	23.32 up
Two Beds	25.44 up

VAGABOND MOTOR HOTEL (805) 544-4710
210 Madonna Road

Single	$18.00 up
Double	22.00 up
Twin Beds	24.00 up

LAMPLIGHTER MOTEL (805) 543-3709
1604 Monterey Street

Single	$17.00 up
Double	18.00–$22.00

MOTEL 6 (805) 544-8400
1433 Calle Joaquin

Single	$ 8.95
Double	10.95
Two Beds	12.95 up

TOWN AND COUNTRY MOTEL (805) 543-3170
2001 Monterey Street

Single	$20.00 up
Double	24.00 up
Two Beds	26.00 up

FOOD SERVICE

The Friday noon meal can be purchased at the Vista Grande Restaurant on campus. A Saturday noon luncheon, which will include an invited address, will be sponsored by the MAA in the Faculty Dining Hall. A special BBQ chicken dinner ($6 per person) will be held Friday evening at 7:00 p.m. at the San Luis Obispo Country Club. Free beer and a "no host" bar will be available after dinner. Tickets for the BBQ and for the Saturday luncheon will be available at the registration desk. As there will be a limited number of tickets, advance notice of intention to attend is requested.

TRAVEL

San Luis Obispo is located on the Central California Coast about 375 kilometers south of San Francisco, 300 kilometers north of Los Angeles, and 160 kilometers north of Santa Barbara. The city is served by Amtrak, Greyhound bus lines, and Swift Aire. City buses run between the bus and train depots and the campus. Taxi service is available between the airport and the campus.

Persons driving south to San Luis Obispo via Highway 101 should take the Monterey exit

to Grand Avenue, then turn right on Grand Avenue and continue to the campus. Persons driving north to San Luis Obispo via Highway 101 should take the Grand Avenue exit, turn left on Grand Avenue and continue to the campus. In order to proceed to Monterey Street (where several motels are located), turn right on Grand Avenue rather than left.

PROGRAM

FRIDAY, November 11

8:00- 3:00	Registration
8:00-10:50	AMS Special sessions and contributed papers
11:00-11:50	AMS invited hour address
12:00- 1:30	Lunch at the Vista Grande Restaurant on campus
1:30- 2:20	AMS invited hour address
2:30- 5:50	AMS Special sessions and contributed papers
2:30- 3:20	MAA invited hour address
3:30- 4:20	MAA invited hour address
7:00-10:00	Special dinner and social hour

SATURDAY, November 12

8:00-11:00	Registration
8:00-10:20	AMS Special sessions
10:30-11:50	MAA panel discussion
12:15- 1:15	MAA luncheon and invited address at the Faculty Dining Hall
1:30- 5:00	AMS Special sessions

Eugene, Oregon

Kenneth A. Ross
Associate Secretary

HOMOLOGICAL LOCALIZATION TOWERS FOR GROUPS AND Π-MODULES
by A. K. Bousfield

This Memoir investigates localizations of groups and Π-modules which have arisen in work on the localization of spaces with respect to homology. It focuses on the "HR-localization" of groups and the "HZ-localization" of Π-modules, where the coefficient ring R is a subring of the rationals or a finite cyclic ring. These localizations are closely related to Malcev completions and p-profinite completions for groups. The investigation is based on a construction of natural transfinite towers which eventually stabilize to the desired localizations. These towers are, for instance, used to show that the HR-local groups form the smallest class of groups containing the trivial group, closed under inverse limits, and closed under central R-module extensions.

68 pages
List price $7.20; member price $5.40
ISBN 0-8218-2186-5; LC 77-3716
Publication date: 6 30 77
To order, please specify MEMO 186

MODULES WITH CORES AND AMALGAMATIONS OF INDECOMPOSABLE MODULES
by R. Gordon and E. L. Green

This monograph uncovers a new class of indecomposable modules, called modules with cores, and exploits their properties. On the one hand this leads to some fresh ideas involving the internal structure of indecomposable modules and the amalgamations of such modules. For example, there is a characterization of precisely when the amalgamated sum of modules with cores has a core. On the other hand, there are some perhaps surprising applications. It is shown, for example, that over a left Artin ring, every indecomposable module has a waist if and only if every indecomposable module has either a simple socle or a simple top. The Memoir contains several conjectures, the most important of which may be that the socle of the core of a nonlocal module over an Artin algebra of finite representation type is simple. When the square of the radical is zero, this conjecture is verified, leading to a classification of modules with cores in this special case. Radical squared zero algebras such that every indecomposable module has a core are also classified. An appendix to the Memoir contains a review of diagrammatic methods and results in representation theory as well as a version of Müller's method of classifying radical squared zero algebras of finite type.

146 pages
List price $8.00; member price $6.00
ISBN 0-8218-2187-3; LC 77-3560
Publication date: 6 30 77
To order, please specify MEMO/187

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Send orders and remittances to: AMS, P. O. Box 1571, Providence, RI 02901.

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.

Memphis, Tennessee, November 1977

Jonathan Brezin
Richard Mandelbaum
John Polking

San Luis Obispo, California, November 1977

Jerrold E. Marsden
John B. Walsh

Atlanta, Georgia, January 1978

Hyman Bass (Colloquium Lecturer)
Joan S. Birman
Jeff Cheeger
Joel E. Cohen
Charles W. Curtis
Donald E. Knuth (Gibbs Lecturer)
Yum Tong Siu
Robert I. Soare
Thomas Spencer
Michael E. Taylor

Columbus, Ohio, March 1978

Peter J. Hilton
Joseph Lipman
Steven Orey
Paul J. Sally, Jr.

New York, New York, March 1978

Arthur Jaffe
Barry Simon

Houston, Texas, April 1978

Todd Dupont
Fred Galvin
John P. Hempel
Andy R. Magid

ORGANIZERS AND TOPICS OF SPECIAL SESSIONS

Abstracts of contributed papers to be considered for possible inclusion in special sessions should be submitted to the Providence office by the deadlines given below. The latest abstract form has a section for indicating special sessions. Lacking this, be sure your abstract form is clearly marked "For consideration for special session (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.

	Deadline
Memphis, Tennessee, November 1977	Expired

Ronald Knill, Algebraic topology
Richard Schelp, Graph theory and combinatorics

San Luis Obispo, California, November 1977	Expired

Estelle Basor, Operator theory
Ronald V. Book, Theoretical computer science
Thomas M. Liggett, Probability
Stanley J. Osher, Computational fluid dynamics
Raymond D. Terry, Qualitative theory of ordinary differential equations
V. S. Varadarajan, Representations of real semisimple groups

Atlanta, Georgia, January 1978	October 12

Louis Auslander, Harmonic analysis on nilpotent and solvable groups
Maurice Auslander, Representations of finite dimensional algebras and finite groups
A. T. Bharucha-Reid, Approximate solutions of random equations
Frederick Bloom, Ill-posed problems for partial differential and integrodifferential equations
Stefan A. Burr, Ramsey theory and its ramifications
Lawrence W. Conlon, Foliations
Jack D. Cowan, Mathematics of neurobiology
Ronald G. Douglas, Operator theory
Uta C. Merzbach, History of mathematics
Kenneth Rosen, Number theory
Robert J. Thompson, Nonacademic mathematical research
Pit-Mann Wong, Capacity in several complex variables

84TH ANNUAL MEETING

Hyatt Regency Atlanta
Atlanta, Georgia
January 3–7, 1978

The eighty-fourth annual meeting of the American Mathematical Society will be held in Atlanta, Georgia, from Tuesday, January 3, through Saturday, January 7, 1978. Sessions will be held in the Hyatt Regency Atlanta Hotel, located at 265 Peachtree Street, N.E.

The fifty-first Josiah Willard Gibbs Lecture will be presented by DONALD E. KNUTH of Stanford University at 8:30 p.m. on Wednesday, January 4, 1978. The title of the lecture is *Mathematical typography*.

Colloquium Lectures. There will be one series of Colloquium Lectures to be delivered by HYMAN BASS of Columbia University. The title of the series is *Algebraic K-theory*. The four lectures in the series are scheduled for 1:00 p.m. on Wednesday, Thursday, Friday, and Saturday, January 4, 5, 6, and 7.

The George David Birkhoff Prize in Applied Mathematics will be awarded at a session at 3:15 p.m. on Thursday, January 5.

Invited One-Hour Addresses. By invitation of the Program Committee, there will be nine invited one-hour addresses as follows: 9:00 a.m., Wednesday, JOEL E. COHEN, Rockefeller University, *Ergodic theorems in demography*; 10:30 a.m., Wednesday, YUM TONG SIU, Yale University, *Pseudoconvexity and the problem of Levi*; 3:30 p.m., Wednesday, THOMAS SPENCER, Rockefeller University, *Some mathematical aspects of quantum field theory*; 9:00 a.m., Thursday, JOAN S. BIRMAN, Columbia University, *Closed, orientable 3-manifolds and their representations*; 10:30 a.m., Thursday, ROBERT I. SOARE, University of Chicago, *Recursively enumerable sets and degrees*; 2:15 p.m., Thursday, JEFF CHEEGER, State University of New York at Stony Brook, *Aspects of geometry and topology of the spectrum*; 2:30 p.m., Friday, CHARLES W. CURTIS, University of Oregon, *Representations of finite groups of Lie type*; 4:00 p.m., Friday, MICHAEL E. TAYLOR, Rice University, *Propagation, reflection, and diffraction of singularities of solutions to wave equations*; 3:30 p.m., Saturday, ROBERT D. EDWARDS, University of California at Los Angeles, *Images of manifolds under cell-like maps*.

Special Sessions. Also by invitation of the Program Committee, there will be **twelve special sessions of selected twenty-minute papers.** The titles of these special sessions, the names of the mathematicians arranging them, and the times of their first meetings are as follows: *Harmonic analysis on nilpotent and solvable groups*, LOUIS AUSLANDER, Thursday morning; *Representations of finite dimensional algebras and finite groups*, MAURICE AUSLANDER, Wednesday morning; *Approximate solutions of random equations*, A. T. BHARUCHA-REID, Wednesday morning; *Ill-posed problems for partial differential and integrodifferential equations*, FREDERICK BLOOM, Thursday morning; *Ramsey theory and its ramifications*, STEFAN A. BURR, Wednesday morning; *Foliations*, LAWRENCE W. CONLON, Wednesday morning; *Mathematics of neurobiology*, JACK D. COWAN, Friday afternoon; *Operator theory*, RONALD G. DOUGLAS, Friday afternoon; *History of mathematics*, UTA C. MERZBACK, Thursday morning; *Nonacademic mathematical research*, ROBERT J. THOMPSON, Friday afternoon; *Capacity in several complex variables*, PIT-MANN WONG, Thursday morning; and *Number theory*, KENNETH ROSEN, Friday afternoon.

Most of the papers to be presented at these special sessions will be by invitation; however, 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 clearly on the abstract and submit it *by October* 12, 1977, one week before the normal deadline for contributed papers, in order that it may be considered for inclusion.

Although many of the above special sessions will include informal problem or discussion sessions, further informal sessions in other subjects are possible within limitations of space and time. Volunteers interested in chairing specific informal sessions should write to Frank T. Birtel, Provost's Office, Tulane University, New Orleans, Louisiana 70118, or telephone him at (504) 865-4191, *by October* 18, 1977.

Contributed Papers. There will be sessions for contributed ten-minute papers from 7:00 p.m. to 10:00 p.m. on Tuesday; from 8:00 a.m. to noon on Wednesday; from 2:15 p.m. to 6:00 p.m. on Wednesday; from 8:00 a.m. to noon on Thursday; from 7:00 p.m. to 10:00 p.m. on Thursday; from 2:00 p.m. to 5:30 p.m. on Friday; from 7:00 p.m. to 10:00 p.m. on Friday; and from 2:00 p.m. to 5:30 p.m. on Saturday. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in most departments of mathematics, and should be sent to the American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940, *so as to arrive by the abstract deadline of October* 18. (Recall that a typing charge of $7 is imposed on abstracts that are not in camera-ready form.) There will be

American Mathematical Society Short Course Series

Numerical Analysis
January 3–4, 1978

The American Mathematical Society will present a one and one-half day short course on "Numerical Analysis" at the Hyatt Regency Hotel in Atlanta, Georgia on January 3 and 4, 1978. This course has been designed to provide a survey of topics in numerical analysis for the nonspecialist. The speakers will survey subareas, present applications and discuss current research directions and problems. The topics have been chosen to emphasize active research areas. The talks will be directed to a mathematically mature audience without assuming knowledge of the topics to be discussed. The six seventy-five minute lectures will cover computational linear algebra, optimization theory, approximation theory and quadrature, and methods for solving ordinary and partial differential equations.

The program is under the direction of Gene H. Golub and Joseph E. Oliger of the Computer Science Department of Stanford University. The short course was recommended by the Society's Committee on Employment and Educational Policy (CEEP), whose members are Lida K. Barrett, David Blackwell, Wendell H. Fleming (chairman), Hugo Rossi, Martha K. Smith, and Robert J. Thompson.

The program will consist of six seventy-five minute lectures as follows: Cleve B. Moler (Department of Mathematics, University of New Mexico), will speak on *Numerical linear algebra*; J. E. Dennis (Department of Computer Science, Cornell University) will speak on *Nonlinear optimization*; Carl-Wilhelm de Boor (Mathematics Research Center, University of Wisconsin) will speak on *The approximation of functions and linear functionals: Best vs. good approximation*; James M. Varah (Department of Computer Science, University of British Columbia) will speak on *Numerical methods for the solution of ordinary differential equations*; Joseph E. Oliger (Department of Computer Science, Stanford University) will speak on *Methods for time dependent partial differential equations*; and George J. Fix (Department of Mathematics, Carnegie-Mellon University) will speak on *Variational methods for elliptic boundary value problems*. In addition Herbert B. Keller will present some concluding remarks.

Summaries of these talks and accompanying reading lists appear on pages A-583 through A-586 of this issue of these *Notices*.

The short course is open to all who wish to participate upon payment of the registration fee. There are reduced fees for students and unemployed individuals. Please refer to the section entitled MEETING PREREGISTRATION AND REGISTRATION for details.

no provision whatsoever for the presentation of late papers.

Poster Sessions. Those contributing abstracts are asked to consider the possibility of presenting their papers in a poster session. Authors post their material on 28" x 44" sheets of poster board, provided by the Society, set on tables. Authors may use more than one poster if necessary, and will be assisted in obtaining special equipment needed for their displays. A sign with the author's name and title of paper will be supplied at each display; posters will be arranged in the same order as they appear on the program. Authors participating in a poster session should be present at their displays for explanation and discussion. Such discussions are not restricted to ten or twenty minutes but are, instead, limited only by the length of the poster session. Deadlines and requirements for poster sessions are the same as for contributed papers. A standard abstract form marked "Poster Session" should be completed and submitted to the Society so that it arrives no later than October 18. Authors should indicate the number of sheets of poster board required and special equipment needed. If there is sufficient interest in presentation by the poster method, poster sessions will be scheduled at all the times available for sessions of contributed papers.

The AMS Committee on Employment and Educational Policy (CEEP) will sponsor a panel discussion at 8:30 p.m. on Thursday, on *An employer's viewpoint on nonacademic employment*. The panelists will be Daniel H. Wagner (moderator), Daniel H. Wagner Associates; Brockway McMillan, Bell Telephone Laboratories; Shmuel Winograd, International Business Machines; and James A. Dewar, Turpin Systems Company.

COUNCIL AND BUSINESS MEETING

The Council of the Society will meet in the Stuart Room of the Hyatt at 2:00 p.m. on Tuesday. The Business Meeting of the Society will be held in the Regency Ballroom at the Hyatt at 4:30 p.m. on Thursday. 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."

OTHER ORGANIZATIONS

The Mathematical Association of America (MAA) will hold its annual meeting on January 6–8 in conjunction with this meeting of the Society. The Business Meeting of the Association will take place at 10:00 a.m. on Saturday. A more detailed listing of the program of the Association appears in the Summary of Activities, beginning on page 330 of these *Notices*.

The Association for Women in Mathematics (AWM) will have an invited one-hour address at 5:00 p.m. on Saturday, and an open meeting of its Executive Committee at 7:30 p.m. on the same day.

The Conference Board of the Mathematical Sciences (CBMS) will sponsor a panel discussion on Friday at 2:00 p.m. The topic of the discussion is *The growing role of applications in mathematical higher education*; Clayton V. Aucoin will moderate. The CBMS Council will meet at 2:15 p.m. on Saturday.

The Mathematicians Action Group (MAG) will hold an open meeting of its Steering Committee at 9:00 a.m. on Tuesday, and its Business Meeting will be held at 4:30 p.m. on Wednesday. MAG will sponsor a panel discussion at 5:00 p.m. on Friday.

National Science Foundation (NSF) staff members will be available in Suite 346 at the Atlanta Hilton Hotel to provide counsel and information on NSF programs of interest to mathematicians from 9:00 a.m. to 5:00 p.m. on January 5, 6, and 7.

MATHEMATICAL SCIENCES EMPLOYMENT REGISTER

The Employment Register will be maintained in the Crystal Ballrooms of the Atlanta Hilton on Thursday, Friday, and Saturday, January 5-7, with interviews scheduled from 9:00 a.m. to 5:30 p.m. on Friday and Saturday. There is no fee for applicants. The preregistration fee for employers is $10, and at the meeting the fee is $15. Applicants and employers should refer to the article on page 376 of these *Notices* for more detailed information. Registration for the Joint Mathematics Meetings is also required and may be accomplished as outlined in the section titled MEETING PREREGISTRATION AND REGISTRATION.

EXHIBITS

The book and educational media exhibits will be located in Ivy Hall of the Hyatt from Wednesday through Saturday, January 4-7. The exhibits will be open from 1:00 p.m. to 5:00 p.m. on Wednesday, from 9:00 a.m. to 5:00 p.m. on Thursday and Friday, and from 9:00 a.m. to noon on Saturday. All participants are encouraged to visit the exhibits during the meeting.

BOOK AND AUDIO TAPES SALE

Books published by the Society and the Association, and audio tapes of AMS invited addresses, will be sold for cash prices somewhat below the usual prices when these same books and tapes are sold by mail. The book sales will be located in Ivy Hall of the Hyatt.

MEETING PREREGISTRATION AND REGISTRATION

Participants who wish to preregister for the meeting should complete the Preregistration Section of the form on page A-603 in the back of these *Notices*. Those who preregister will pay lower registration fees than those who register at the meeting, as indicated in the schedule. Preregistrants will be able to pick up their badges and programs when they arrive at the meeting. Complete instructions on procedures for making hotel reservations are given in the sections titled ACCOMMODATIONS.

> Checks for the preregistration fee(s) should be mailed to arrive in Providence **not later than December 2, 1977.** It is necessary to complete the Preregistration form in order to take advantage of the lower meeting preregistration fee(s), even though the services of the Housing Bureau are not required.

Registration fees. Meeting preregistration and registration fees partially cover expenses of holding the meetings. The preregistration fee does **not** represent an advance deposit for lodgings. Please note that separate registration fees are required for the Short Course and the Joint Meetings. These fees are as follows:

Numerical Analysis Short Course

	Preregistration (by mail prior to 12/2/77)	At Meeting
Members Nonmembers	$18	$20
Student Unemployed	3	5
One-day fee for second day only	—	10

Joint Mathematics Meetings

Members of AMS/MAA	$18	$25
Nonmembers	30	35
Student Unemployed	2	3

There will be no extra charge for members of the families of registered participants, except that all professional mathematicians who wish to attend sessions must register independently.

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

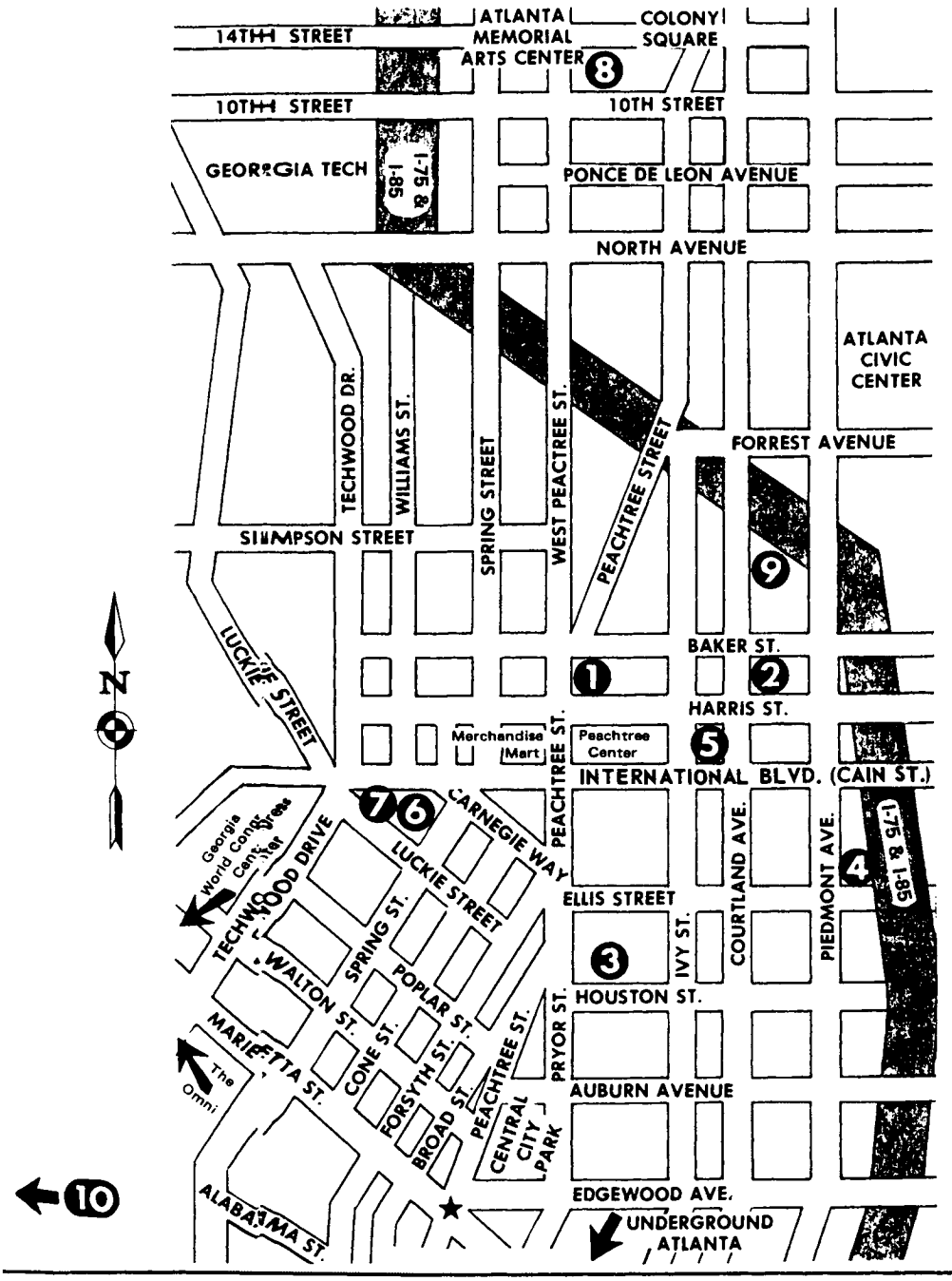
The unemployed status refers to any person currently unemployed, actively seeking employment, and who is not a student. It is not intended to include persons who have voluntarily resigned or retired from their latest position.

A fifty percent refund of the preregistration fee will be made for all cancellations received in Providence prior to January 2. There will be no refunds granted for cancellations received after that date, or to persons who do not attend the meetings.

Registration dates and locations. Registration for the short course **only** will begin on Tuesday, January 3, at 10:00 a.m. outside the Phoenix Room at the Hyatt. Participants who are not attending the short course are advised that no general meeting information (or registration material) will be available prior to the time listed below for the Joint Mathematics Meetings registration.

The Joint Mathematics Meetings registration desk will be located in Ivy Hall of the Hyatt. The

DOWNTOWN ATLANTA



HOTELS

1. Hyatt Regency Atlanta
2. Atlanta Hilton
3. Best Western White House Motor Hotel
4. Holiday Inn Downtown
5. Passport Center Inn
6. Atlanta American Motor Hotel
7. Metropolitan YMCA
8. Phoenix Halls of Atlanta
9. Atlanta Central-Travelodge
10. Paschal's Motor Hotel

desks will be open during the hours listed below:

Numerical Analysis Short Course, outside Phoenix Room

Tuesday, January 3	10:00 a.m.-8:00 p.m.
Wednesday, January 4	8:30 a.m.-9:30 a.m.

Joint Mathematics Meetings, Ivy Hall

Tuesday, January 3	2:00 p.m.-8:00 p.m.
Wednesday, January 4	8:00 a.m.-5:00 p.m.
Thursday, January 5	8:00 a.m.-4:00 p.m.
Friday, January 6	8:00 a.m.-4:00 p.m.
Saturday, January 7	8:00 a.m.-4:00 p.m.
Sunday, January 8	8:30 a.m.-2:30 p.m.

HOTEL ACCOMMODATIONS

The form for requesting accommodations will be found on page A-603 in the back of these *Notices*. The use of the housing services offered by the Mathematics Meetings Housing 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 2, 1977.** DO NOT INCLUDE PAYMENT FOR YOUR HOUSING WITH MEETING PREREGISTRATION FEE(S). All reservation requests **must** be received in writing and processed through the Mathematics Meetings Housing Bureau in Providence. Telephone requests will not be accepted. If you plan to share a double, twin, triple, quadruple or suite with other parties, please be sure to list all occupants of the room reserved in the space provided on the form. In all cases "single" refers to one person in one bed; "double" refers to two persons in one bed; and "twin" refers to two persons in two beds. A rollaway cot for an extra person can be added to double or twin rooms only.

Please make all reservation changes with the Mathematics Meetings Housing Bureau in Providence prior to December 26. After that date, cancellation must be made directly with the hotel. Participants are advised to preregister and secure room reservations before December 2; after that date participants must deal with the hotels listed on an individual basis. The rates quoted below are subject to a 7 percent sales tax.

Hyatt Regency Atlanta (headquarters)
265 Peachtree Street, NE, 30303
Telephone: (404) 577-1234
Single $29 Double $41 Twin Double $41
Triple $52 Quadruple $63
Suite (1 bedroom) $95, 110, 125, 135, 165

Atlanta American Motor Hotel (10-15 minutes)
Spring Street at Carnegie Way, 30301
Telephone: (404) 688-8600
Single $26 Double $30 Twin $30
Triple $35 Quadruple $40
Suite (1 bedroom) $65 (2 bedrooms) $250

Atlanta Central—Travelodge (10-15 minutes)
311 Courtland Street, NE, 30303
Telephone: (404) 659-4545
Single $21 Double $24 Twin Double $27
Triple $30 Quadruple $33

Atlanta Hilton (5 minutes)
Courtland and Harris Streets, NE, 30303
Telephone: (404) 659-2000
Single $29 Twin Double* $41 Twin* $41
*Extra person in room $11

Best Western White House Motor Hotel (10-15 minutes)
70 Houston Street, NE, 30303
Telephone: (404) 659-2660
Single $24 and $32 Double $28
Twin Double $32 Triple $36 Quadruple $40
Suite (1 bedroom) $95 (2 bedrooms) $125

Holiday Inn Downtown (10-15 minutes)
175 Piedmont Avenue, NE, 30303
Telephone: (404) 659-2727
Single $26 Double $29 Twin $34
Triple $38 Quadruple $42
Suite (1 bedroom) $80 (2 bedrooms) $110

Paschal's Motor Hotel (20-30 minutes)
830 Martin Luther King, Jr. Drive, SW, 30314
Telephone: (404) 577-3150
Single $18 Twin Double $21
Triple $24 Quadruple $27

Passport Center Inn (5 minutes)
231 Ivy Street, NE, 30303
Telephone: (404) 577-1510
Single $24 Double* $28 Twin* $28
*Extra person in room $4

Participants who are able to do so are urged to share a room whenever possible. This procedure will be economically beneficial. The housing form should be fully completed to ensure proper assignment of rooms. The Mathematics Meetings Housing Bureau will not match participants who wish to share rooms. Participants planning to share accommodations should provide the names of each person with whom they plan to occupy a room. Each person should, however, complete a separate preregistration form. It would be helpful to receive the forms in Providence at the same time from all parties wishing to share the same room.

INEXPENSIVE ACCOMMODATIONS

The use of some rooms has been obtained at the following facilities in Atlanta. Preference will be given to students, unemployed, and applicants participating in the Employment Register. *Since the number of these rooms is extremely limited,*

they will be assigned on a first-come, first-served basis. It is of utmost importance that **at least three** alternate choices of accommodations be indicated on the housing request form on page A-603 in the back of these *Notices* when your first choice is one of the following facilities, since by the time your form is received, these rooms may already have been filled. The Housing Bureau will then be able to attempt to secure accommodations for you in one of your next preferred choices. The Housing Bureau will return to preregistrants forms that are received indicating only one of the following facilities as an accommodation choice, asking for other choices, and thus delaying processing of your form and lessening your chances of obtaining one of these low cost rooms.

Metropolitan YMCA (men only) (10-15 minutes)
145 Luckie Street, NW, 30303
Telephone: (404) 525-5401
Single $7.50 Double $13.00

Phoenix Halls of Atlanta (women only)
(20-30 minutes)
1043 W. Peachtree Street, NE, 30309
Telephone: (404) 875-8796
Single $12 Double $24
Add $4 for breakfast (6:15 a.m.-7:45 a.m.) and dinner (5:30 p.m.-7:00 p.m.). Southbound bus on Peachtree Street stops at the Hyatt.

ENTERTAINMENT AND LOCAL INFORMATION

The Hyatt is located on Atlanta's Peachtree Street, often regarded as the Main Street of the South. The city has a full complement of museums, theater and concert groups, movie houses, serious drinking establishments, amusement parks and a zoo. The Atlanta Symphony performs at the Memorial Arts Center on the northern edge of the business district, while many sporting events are held at the Omni complex in the heart of the city.

Much of the city's center can be seen from a circular trip on the Downtown Loop bus, with service every 10 minutes between 8:00 a.m. and 6:00 p.m. on weekdays. MARTA, the Atlanta bus system, is one of the nation's best and most economical, taking riders almost anywhere in the city or suburbs for 15¢ (exact change). A MARTA information booth is but a few steps from the Hyatt.

Sightseeing tours of the area are available, appealing to a wide range of interests, from the older ("plantation tours", though not to the nonexistent Tara) to the recent (the tomb and the restored birthplace of Dr. M. L. King, Jr.) to the present (the skyline and Peachtree Center) and to the future (a subway system under construction). An all-day tour to Plains by bus is available any day, following advance registration by a group (minimum twenty-five).

Atlanta has a large number of restaurants catering to a wide spectrum of tastes, including continental, southern and ethnic. Restaurant guides and city information will be available daily at the Local Information section of the Joint Mathematics Meetings registration desk.

Other events are being considered, but plans are not complete at press time, so one should watch for details in later issues of these *Notices*.

CHILD CARE

A number of commerical child care agencies, offering hotel care at hourly rates, are available in the metropolitan Atlanta area. A list of agencies, telephone numbers, and rates will also be available at the Local Information section of the Joint Mathematics Meetings registration desk.

MAIL AND MESSAGE CENTER

All mail and telegrams for persons attending the meetings should be addressed in care of Mathematics Meetings, Hyatt Regency Atlanta Hotel, 265 Peachtree Street, N.E., Atlanta, Georgia 30303. Mail and telegrams so addressed may be picked up at the meeting registration area in Ivy Hall.

A telephone message center will be located in the same area to receive incoming calls for all participants. The center will be open from January 4 through January 8 during the same hours as the Joint Meetings registration desk. Messages will be taken down and the name of any individual for whom a message has been received will be posted until the message has been picked up at the message center. The telephone number of the center will be published in a later issue of these *Notices* .

TRAVEL

Those planning to attend the AMS short course or the early sessions of the Joint Mathematics Meetings are advised to make reservations for travel accommodations early. It should be kept in mind that Monday, January 2, will be the legal New Year's holiday, so that more people than usual will be travelling on both Monday, January 2 and Tuesday, January 3.

In winter, Atlanta is on Eastern Standard Time. Hartsfield International Airport, the second busiest in the world, is served by Braniff, Delta, Eastern, Northwest, Piedmont, Southern, TWA and United airlines. Four commuter airlines serve nearby cities. The airport is about eight miles from the city center. At press deadline, there is no limousine service to or from the airport, although regular service was expected to resume after September 1, 1977. The airport trip by taxi to or from the Hyatt will cost about $6.50 for one person, $6.75 for two persons and $3.00 each for three or more persons.

American International, Avis, Budget, Dollar, Hertz and National maintain car rental desks in the airport terminal, with a number of additional companies located adjacent to the terminal.

The Southern Railroad serves Peachtree Station, two miles from the Hyatt, as follows: thrice weekly service on the New York-Atlanta-New Orleans-Los Angeles route; one train daily on the New York-Washington-Atlanta route.

Three interstate highways intersect in downtown Atlanta a few blocks from the Hyatt, whose blue dome is visible for many miles: I-75 leads north to Cincinnati and Detroit and south to Tampa; I-85 leads northeast to Charlotte and Richmond and southwest to Montgomery; I-20 leads west to Birmingham and Jackson and east to Columbia.

WEATHER

Atlanta is located in the foothills of the Blue Ridge Moutains. With an elevation of over 328 meters (1050 feet), it enjoys a relatively mild yearly climate. Normal mean temperature during the month of January is 6°C (42°F). The average daily maximum temperature is 11°C (52°F), and the average daily minimum temperature is 1°C (34°F). The average January rainfall is 11 cm. (4.34 inches or 548 microfurlongs). Early morning fog, restricting visibility to less than one-quarter mile, occurs about five days each January. Below-freezing temperatures occur, on the average, about sixteen days in the month.

LOCAL ARRANGEMENTS COMMITTEE

Frank T. Birtel (ex officio), Joseph E. Cicero, Etta Z. Falconer, David A. Ford, H. Eugene Hall, J. L. Houston, John D. Neff (chairman), Dorothy Rutledge, David P. Roselle (ex officio), Ronald W. Shonkwiler, and William J. LeVeque (ex officio).

SUMMARY OF ACTIVITIES

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

TUESDAY, January 3	SHORT COURSE ON NUMERICAL ANALYSIS
10:00 a.m. - 8:00 p.m.	REGISTRATION (Short Course Only)
1:30 p.m. - 2:45 p.m.	Numerical linear algebra Cleve B. Moler
3:00 p.m. - 4:15 p.m.	Nonlinear optimization J. E. Dennis
4:30 p.m. - 5:45 p.m.	The approximation of functions and linear functionals: Best vs. good approximation Carl W. deBoor
7:30 p.m. - 8:45 p.m.	Numerical methods for the solution of ordinary differential equations James Varah
9:00 p.m. - 9:40 p.m.	Methods for time dependent partial differential equations I Joseph Oliger
WEDNESDAY, January 4	
8:30 a.m. - 9:30 a.m.	REGISTRATION (Short Course Only)
9:00 a.m. - 9:40 a.m.	Methods for time dependent partial differential equations II Joseph Oliger
10:00 a.m. - 11:15 a.m.	Variational methods for elliptic boundary value problems George Fix

JOINT MATHEMATICS MEETINGS

TUESDAY, January 3	American Mathematical Society	Other Organizations
9:00 a.m. - noon		Mathematicians Action Group Steering Committee - Open Meeting
2:00 p.m. - 8:00 p.m.	REGISTRATION	
2:00 p.m.	Council Meeting	
7:00 p.m. - 10:00 p.m.	Sessions for Contributed Papers Special Sessions	

WEDNESDAY, January 4	American Mathematical Society	Other Organizations
8:00 a.m. - 5:00 p.m.	REGISTRATION	
8:00 a.m. - noon	Sessions for Contributed Papers Special Sessions	
9:00 a.m. - 10:00 a.m.	INVITED ADDRESS Ergodic theorems in demography Joel E. Cohen	
10:30 a.m. - 11:30 a.m.	INVITED ADDRESS Pseudoconvexity and the problem of Levi Yum Tong Siu	
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE I Algebraic K-theory Hyman Bass	
1:00 p.m. - 5:00 p.m.	EXHIBITS	
2:15 p.m. - 6:00 p.m.	Sessions for Contributed Papers Special Sessions	
3:30 p.m. - 4:30 p.m.	INVITED ADDRESS Some mathematical aspects of quantum field theory Thomas Spencer	
4:30 p.m. - 6:30 p.m.		MAG - Business Meeting
8:30 p.m. - 9:30 p.m.	JOSIAH WILLARD GIBBS LECTURE Mathematical typography Donald E. Knuth	

THURSDAY, January 5	American Mathematical Society	Other Organizations
8:00 a.m. - noon	Sessions for Contributed Papers Special Sessions	
8:00 a.m. - 4:00 p.m.	REGISTRATION	
9:00 a.m. - 9:30 a.m.	EMPLOYMENT REGISTER ORIENTATION SESSION	
9:00 a.m. - 10:00 a.m.	INVITED ADDRESS Closed orientable 3-manifolds and their representations Joan S. Birman	
9:00 a.m. - 4:00 p.m.		Mathematical Association of America Board of Governors Meeting
9:00 a.m. - 5:00 p.m.	EXHIBITS	
9:30 a.m. - 4:00 p.m.	EMPLOYMENT REGISTER REGISTRATION	
10:30 a.m. - 11:30 a.m.	INVITED ADDRESS Recursively enumerable sets and degrees Robert I. Soare	
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE II Algebraic K-theory Hyman Bass	
2:15 p.m. - 3:15 p.m.	INVITED ADDRESS Aspects of geometry and topology of the spectrum Jeff Cheeger	
3:15 p.m. - 4:15 p.m.	Prize Session	
4:30 p.m. - 5:30 p.m.	Business Meeting	
7:00 p.m. - 10:00 p.m.	Sessions for Contributed Papers Special Sessions	
7:00 p.m. - 10:00 p.m.		MAA - Film Program
8:30 p.m. - 10:00 p.m.	Committee on Employment and Educational Policy Panel discussion: An employer's viewpoint on nonacademic employment James A. Dewar Brockway McMillan Daniel H. Wagner (moderator) Shmuel Winograd	

FRIDAY, January 6	American Mathematical Society	Other Organizations
8:00 a.m. - 4:00 p.m.	REGISTRATION	
9:00 a.m. - 10:50 a.m.		MAA - Chauvenet Symposium James C. Abbott (moderator) Martin D. Davis Lawrence A. Zalcman
9:00 a.m. - 5:00 p.m.	EXHIBITS	
9:00 a.m. - 5:30 p.m.	EMPLOYMENT REGISTER INTERVIEWS	
11:00 a.m. - 11:50 a.m.		MAA - Panel discussion: Numerical analysis in the undergraduate curriculum Gunter H. Meyer (moderator)
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE III Algebraic K-theory Hyman Bass	
2:00 p.m. - 4:00 p.m.		Conference Board of the Mathematical Sciences Panel discussion: The growing role of applications in mathematical higher education Clayton V. Aucoin (moderator)
2:00 p.m. - 5:30 p.m.	Sessions for Contributed Papers Special Sessions	
2:30 p.m. - 3:30 p.m.	INVITED ADDRESS Representations of finite groups of Lie type Charles W. Curtis	

FRIDAY, January 6	American Mathematical Society	Other Organizations
4:00 p.m. - 5:00 p.m.	INVITED ADDRESS Propagation, reflection, and diffraction of singularities of solutions to wave equations Michael E. Taylor	
5:00 p.m. - 6:30 p.m.		MAG - Panel Discussion
7:00 p.m. - 10:00 p.m.	Sessions for Contributed Papers Special Sessions	
7:00 p.m. - 10:00 p.m.		MAA - Film Program

SATURDAY, January 7	AMS	Other Organizations
8:00 a.m. - 4:00 p.m.	REGISTRATION	
9:00 a.m. - 9:50 a.m.		MAA - Panel discussion: A course in applied mathematics based on problems from regional industries Jeanne L. Agnew (moderator)
9:00 a.m. - noon	EXHIBITS	
9:00 a.m. - 5:30 p.m.	EMPLOYMENT REGISTER INTERVIEWS	
10:00 a.m. - 10:50 a.m.		MAA - Business Meeting
11:00 a.m. - 11:50 a.m.		MAA - Retiring Presidential Address Henry O. Pollak
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE IV Algebraic K-theory Hyman Bass	
2:00 p.m. - 5:30 p.m.	Sessions for Contributed Papers Special Sessions	
2:15 p.m. - 6:00 p.m.		CBMS - Council Meeting
3:30 p.m. - 4:30 p.m.	INVITED ADDRESS Images of manifolds under cell-like maps Robert D. Edwards	
5:00 p.m. - 6:00 p.m.		Association for Women in Mathematics Invited Address
7:30 p.m. - 8:30 p.m.		AWM - Executive Committee Open Meeting
8:00 p.m. - 10:00 p.m.		CBMS - Council Meeting

SUNDAY, January 8	American Mathematical Society	MAA
8:30 a.m. - 2:30 p.m.	REGISTRATION	
9:00 a.m. - 9:50 a.m.		Panel discussion: Using the history of mathematics to teach mathematics Arthur Schlissel (moderator)
10:00 a.m. - 10:50 a.m.		Invited Address Barbara L. Osofsky
10:00 a.m. - 10:50 a.m.		Panel discussion: Remediation Joseph E. Cicero (moderator)
11:00 a.m. - 11:50 a.m.		Invited Address Charles L. Fefferman
11:00 a.m. - 11:50 a.m.		Invited Address Ivan Niven
1:30 p.m. - 2:20 p.m.		Panel discussion: Credit and placement by examination Donald L. Kreider (moderator)
2:30 p.m. - 3:20 p.m.		Panel discussion: Interim report of the NRC Committee on Applied Mathematics Training Peter J. Hilton (moderator)
3:30 p.m. - 4:20 p.m.		Invited Address Combinatorial problems in elementary geometry Paul Erdos

Frank T. Birtel
Associate Secretary

New Orleans, Louisiana

1978 SYMPOSIUM | *Washington, D. C.*
February 12–17, 1978

SOME MATHEMATICAL QUESTIONS IN BIOLOGY

The twelfth annual symposium on Some Mathematical Questions in Biology will be held during the period February 12-17, 1978 in Washington, D. C., in conjunction with the annual meeting of the American Association for the Advancement of Science. It will be cosponsored by the American Mathematical Society, the Society for Industrial and Applied Mathematics, and Section A of the American Association for the Advancement of Science. The support of the National Cancer Institute is anticipated. Registration and local arrangements will be announced in Science.

The program is being arranged by the AMS-SIAM Committee on Mathematics in the Life Sciences, whose members are Hans J. Bremerman, Jack D. Cowan, Murray Gerstenhaber, Stuart Kauffman, Simon A. Levin (chairman), Robert M. May, George F. Oster, and Sol I. Rubinow.

The symposium will be divided into three half-day sessions; one half-day session of related contributed papers only, refereed in advance by the committee, and either preceded or followed by two half-day sessions, each including three hour speakers. The main topics of the symposium are problems relating to evolutionary theory, immunology, and physiology.

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 October 18, 1977. All abstracts should be clearly marked "For presentation at Symposium on Some Mathematical Questions in Biology." There will be no provision for late papers.

Invited speakers scheduled for the symposium are Stephen J. Gould, Harvard University; Joseph B. Keller, Courant Institute and Visiting Professor of Mathematics, Stanford University; Christopher Longuet-Higgins, Sussex University; George F. Oster, University of California, Berkeley; Alan S. Perelson, University of California, Los Alamos Scientific Laboratory; and Peter H. Richter, Max-Planck-Institut für Biophysikalische Chemie. The titles of the addresses will appear in a subsequent issue of these *Notices*. A complete program of the sessions will be included in the January 1978 issue of these *Notices*.

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

Ithaca, New York

Final Report on 1977 Summer Research Institute on Automorphic Forms, Representations, and L-Functions

The twenty-fifth Summer Research Institute, sponsored by the Society, was held on the campus at Oregon State University, Corvallis, Oregon, from July 11 to August 5, 1977. The topic for the institute was proposed by members of the Committee on Summer Institutes which, at the time, consisted of S. S. Chern, Daniel Gorenstein, Richard K. Lashof (chairman), Mary E. Rudin, Harold M. Stark, and Elias M. Stein. The Organizing Committee consisted of Armand Borel and William Casselman (co-chairmen), Pierre Deligne, Hervé Jacquet, Robert P. Langlands, and John T. Tate.

The central topic of the institute was the relationship between the arithmetical theory of automorphic forms, the representation theory of reductive adèle groups, and L-functions of algebraic number theory or algebraic geometry. Some other topics of considerable interest in themselves, such as algebraic groups, representations of reductive groups over local fields, and the algebraic geometry of moduli spaces, were also dealt with, but chiefly to the extent they were related to the main topics.

Nine series of lectures, that were largely reviews of or introduction to the background material, were presented by the following during the first week: Tonny A. Springer and Jacques Tits, "Linear algebraic groups"; Nolan Wallach, "Representations of real reductive groups"; Pierre Cartier, "Representations of p-adic groups"; John T. Tate, "Number theory and algebraic geometry"; I. I. Piatetski-Shapiro, "Automorphic forms and automorphic representations"; and Daniel Flath, "Decomposition of representations into tensor products." There were three main series of lectures during the second week, the first two intended to illustrate how general techniques applied in the case of GL_2, and the third explained the present general conceptual scheme of the whole theory. These were: Stephen S. Gelbart and Hervé Jacquet, "Forms of GL_2 from the analytic point of view"; William Casselman and James Milne, "Forms of GL_2 and Shimura varieties"; and Armand Borel, "L-series of automorphic representations." The third and fourth weeks were mainly devoted to lectures or series of lectures on recent and present research, open problems, and basic techniques. Included notably were the following: "Classification of tempered representations of real reductive groups," Anthony Knapp and Gregg Zuckerman (two lectures); "Cuspidal representations of p-adic reductive groups," Paul Gerardin and George Lusztig (two lectures); "Eisenstein series and the trace formula," James Arthur (six lectures); "Theta series," Stephen Gelbart, Roger Howe, and Steve Rallis (three lectures); "Base change," Paul Gerardin, Robert Kottwitz, and Jean-Pierre Labesse (four lectures); "Shimura varieties," Pierre Deligne, Robert Langlands, and Yasutaka Ihara (seven lectures); and "Work of Drinfeld on the reciprocity law for GL_2 over function fields," Pierre Deligne, Günter Harder, and David Kazhdan (six lectures).

In addition, lectures were scheduled during the second and third weeks to complement or amplify some of the material presented during the previous week. There were also some lectures or seminars outside the main program, in particular a seminar on Representations of GL_2 over non-archimedean local fields, organized by Pierre Cartier and Paul J. Sally, Jr. (nine lectures); and one on the Classification of admissible representations of real reductive groups, organized by Thomas J. Enright and Nolan Wallach (four lectures).

MATHEMATICAL REVIEWS

The Editorial Committee invites applications and recommendations for the position of Executive Editor of *Mathematical Reviews* (MR). The appointment will be for two or three years, and should commence not later than July 1, 1978. Applications will be welcomed from persons taking leave of absence from other positions, except for leaves entailing commitment of time to other activities.

The MR office is located in Ann Arbor, Michigan, adjacent to the campus of the University of Michigan, and the editors enjoy many faculty privileges at the university. At present, MR employs nine editors, about twenty consultants, and over fifty non-editorial personnel. It publishes *Mathematical Reviews, Current Mathematical Publications, Index to Mathematical Papers* and various other indexes.

The Executive Editor is responsible for all phases of the operations at MR. These include the following general areas: (1) Direction of the editorial and consulting staff and of the administrative non-editoral staff; this includes determining and maintaining work and printing schedules for all the publications. (2) Relations with reviewers and authors, and in particular recruiting new reviewers. (3) Maintaining scientific and editorial standards (this involves participation in the detailed editorial work), acquiring reviewable material and implementing general editorial policy. (4) Budget planning and control, assisting the Editorial Committee in formulating editorial policy and long-range plans, and directing the implementation of new policies and procedures, including computerization.

In view of these responsibilities, the Executive Editor needs skill as an administrator and personnel manager, broad competence in mathematics, facility with the English language, interest in bibliographic work, and reading proficiency in several foreign languages. The Editor should not expect to carry on a large research program while holding this position.

The twelve-month salary is negotiable, and will be commensurate with the experience the applicant brings to the position. Retirement and insurance plans and other fringe benefits are similar to those in universities; of special importance is a policy providing termination leave after the incumbent has held the position at least two years.

The Editor reports to the Editorial Committee and the Board of Trustees.

Applications (including curriculum vitae, bibliography, data on experience, and names and addresses of three references) and recommendations should be sent to Professor Donald J. Lewis, Mathematics Department, University of Michigan, Ann Arbor, Michigan 48109 (telephone 313-764-0366). Persons interested in applying for this position are urged to do so before December 1, 1977.

Mathematical Reviews is an equal opportunity/affirmative action employer.

ASSOCIATE EDITORS

The Editorial Committee invites applications and recommendations for positions as Associate Editor of Mathematical Reviews (MR), to commence during the summer of 1978. Applications will be welcomed from persons taking leave from other positions, and in particular from tenured faculty members who could combine a sabbatical leave with a supplementary MR appointment, to cover a period of at least 26 months.

A general description of the MR office and the scope of its activities is to be found in the preceding announcement concerning the Executive Editor. The responsibilities of Associate Editors fall primarily in the day-to-day operations of classifying articles and books, assigning these items to reviewers, and editing the reviews when they are returned. Other responsiblities evolve in accordance with the individuals' experience and capabilities. At this time, no particular area of mathematical specialization is sought, although strength in various applied areas (e.g. computer science, mechanics, economics) is particularly desirable. Considerable breadth in mathematical competence rather than special skill is sought. A reading knowledge of several foreign languages is essential. (Russian is especially desirable.)

Persons interested in combining a sabbatical or other leave with a part-time appointment as an Associate Editor should write for further details.

The description of salary and fringe benefits (including termination leave) in the preceding announcement applies also to the present positions, as does the procedure for making application.

Applications (including curriculum vitae, bibliography, data on experience, and names and addresses of three references) and recommendations should be sent to Dr. Robert G. Bartle, Executive Editor, Mathematical Reviews, 611 Church Street, Ann Arbor, Michigan 48109 (telephone 313-764-4320). Persons interested in applying for this position are urged to do so before December 1, 1977.

Mathematical Reviews is an equal opportunity/affirmative action employer.

21st ANNUAL

1977

AMS SURVEY

FIRST REPORT

The following pages contain a first report on the 1977 AMS Survey. Included in this issue are data on faculty salaries in four-year colleges and universities, a report on the 1977 survey of new doctorates, and a list of the names and thesis titles of the members of the 1976–1977 Ph.D. class.

As in 1976, the distribution of some of the questionnaires for the Annual AMS Survey was postponed several months in order to make it possible to obtain more current data on two-year colleges, fall enrollments, class size, teaching loads and faculty mobility than were obtained in previous years. These data will be included in a second report on the 1977 AMS Survey which is planned for the February or April 1978 issue of these *Notices*.

This Survey is the twenty-first 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, whose members are Lida K. Barrett, David Blackwell, Wendell H. Fleming (chairman), Hugo Rossi, Martha K. Smith, and Robert J. Thompson. The data were compiled by the AMS staff under the direction of Lincoln K. Durst.

Faculty Salaries

As has been the practice for several years, questionnaires were sent to departments in the mathematical sciences, asking for information on salaries. Departments submitted a minimum, median, and maximum salary figure for each of four academic ranks, both for staff members with and without doctorates. Annual salaries of full-time faculty members for the academic year of 9-10 months were sought. The 1977 questionnaire requested information for both the years 1976–1977 and 1977–1978. The sample in this survey is thus the same for both years and is different from the sample used in the Twentieth Salary Survey in 1976. The information reported this year on the number of faculty members is based on usable returns from 828 departments in the mathematical sciences, 110 of which did not contain usable salary information. On pages 338-340 the salary data in parentheses give the range of the middle fifty percent of salaries reported. The figures outside the parentheses represent the minimum and maximum salary listed by any reporting institution. In some categories, relatively few departments reported and, inasmuch as there were no significant figures available, salaries are not listed.

For these reports, 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 in the U.S.A. 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.A. departments of mathematics.

Group IV includes U.S.A. departments of statistics, biostatistics and biometrics.

Group V includes all other U.S.A. departments in the mathematical sciences.

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

Although Canadian doctorate granting departments are grouped separately, those granting bachelor and master degrees are included with U.S.A. departments.

*The findings were published in "A Rating of Graduate Programs" by Kenneth D. Roose and Charles J. Andersen, 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*.

NUMBER OF FACULTY REPORTED

Table 1 below provides a summary of the number of faculty members reported on the faculty salary survey questionnaires. Readers should be aware of certain limitations on these figures as indicators of the size and composition of the North American mathematical sciences faculty: (1) The samples of responding departments in each category, being self-selected, cannot be assumed to be random samples. (2) Departments in each category differ greatly in size, so that extrapolation based on the sample size is not simple. Two years ago figures were provided to indicate how great some of these deviations actually are (these *Notices*, October 1975, page 303, column 2, last paragraph). (3) In previous years, the questionnaire carried instructions to omit faculty members on leave. This year the instructions were changed: faculty members on leave were to be included at their regular full-time salary, and departments were asked to provide the total number of those on leave in each year.

TABLE 1: TOTAL FACULTY REPORTED FOR FOUR-YEAR COLLEGES AND UNIVERSITIES

	1976–1977				1977–1978			
	FACULTY		WOMEN		FACULTY		WOMEN	
	Total	With Tenure	Total	With Tenure	Total	With Tenure	Total	With Tenure
WITHOUT DOCTORATE								
Instructor	485	77	187	30	480	68	188	29
Assistant Professor	718	573	169	136	687	546	156	120
Associate Professor	532	516	68	64	524	511	69	64
Professor	131	125	9	9	136	131	9	9
	1,866	1,291	433	239	1,827	1,256	422	222
On leave	(33)	(23)	(7)	(2)	(28)	(22)	(7)	(1)
WITH DOCTORATE								
Instructor	197	9	25	1	189	8	26	1
Assistant Professor	2,363	435	234	53	2,266	387	248	44
Associate Professor	2,955	2,666	161	145	3,045	2,763	171	152
Professor	3,129	3,072	125	122	3,290	3,241	137	134
	8,644	6,182	545	321	8,790	6,399	582	331
On leave	(376)	(293)	(18)	(10)	(353)	(268)	(14)	(6)

Note. Table 1 (Total Faculty Reported) shows a modest increase in the total number of full-time faculty members among responding departments between 1976–1977 and 1977–1978. On the other hand, the data indicate that the long-term upward trend in tenure percentages may be nearing an end. Using the faculty counts shown on the left-half of the following pages, Table 2 summarizes percentages of doctorate faculty members who are tenured.

TABLE 2: PERCENT OF DOCTORATE FACULTY WITH TENURE

	Fall 1976	Fall 1977
Groups I, II, III	75.3%	75.6%
Groups IV, V	67.3%	67.8%
Group VI	77.1%	80.1%
Masters and Bachelors	67.8%	70.1%

A striking feature of Table 2 is that, for U.S. doctorate granting departments (Groups I–V), the percentage tenured scarcely changed between 1976–1977 and 1977–1978. This is contrary to an upward trend of some 2% to 3% per year in tenure percentages observed for several years (see these *Notices*, November 1974, p. 335; February 1977, p. 102). Thus it had been the case that the number of individuals granted tenure exceeded the number of positions made available by those who died or retired. Table 2 indicates that this is probably no longer possible, at least among doctorate granting departments. WHF

	SIZE OF FACULTY								SALARIES (in hundreds of dollars)					
	1976–1977				1977–1978				1976–1977			1977–1978		
	FACULTY		WOMEN		FACULTY		WOMEN							
	Total	With Tenure	Total	With Tenure	Total	With Tenure	Total	With Tenure	Minimum	Median	Maximum	Minimum	Median	Maximum
DOCTORATE GRANTING DEPARTMENTS. Group I					(19 out of 27 reporting)									
WITHOUT DOCTORATE														
Instructor	3	0	2	0	3	0	2	0						
Asst. Prof.	1	0	0	0	0	0	0	0						
	4	0	2	0	3	0	2	0						
WITH DOCTORATE														
Instructor	47	0	2	0	44	0	3	0						
Asst. Prof.	156	6	16	3	151	6	13	3	125(130-140)	(140-156)	(153-170)200	130(135-150)	(149-165)	(162-175)197
Asso. Prof.	187	177	9	9	179	168	8	8	150(158-180)	(179-201)	(198-240)274	150(166-192)	(190-210)	(210-249)300
Professor	467	467	9	9	488	487	10	10	182(200-225)	(264-309)	(383-418)450	188(208-244)	(269-313)	(395-441)480
	857	650	36	21	862	661	34	21						
On leave	(79)	(58)	(3)	(2)	(77)	(57)	(2)	(0)						
DOCTORATE GRANTING DEPARTMENTS. Group II					(32 out of 38 reporting)									
WITHOUT DOCTORATE														
Instructor	18	5	9	2	17	5	9	2	100(104-147)	(104-153)	(107-168)208	105(108-154)	(113-173)	(127-173)207
Asst. Prof.	6	4	1	1	5	3	0	0	---	---	---	---	---	---
Asso. Prof.	3	3	0	0	2	2	0	0	---	---	---	---	---	---
Professor	0	0	0	0	1	1	0	0	---	---	---	---	---	---
	27	12	10	3	25	11	9	2						
On leave					(1)	(1)								
WITH DOCTORATE														
Instructor	50	4	3	0	64	2	7	0	105(113-135)	(120-125)	(120-130)163	110(115-130)	(121-141)	(124-142)148
Asst. Prof.	254	11	12	4	267	12	16	4	114(127-141)	(137-158)	(148-179)197	98(135-150)	(144-163)	(155-187)209
Asso. Prof.	374	358	16	15	369	355	18	18	130(160-178)	(185-202)	(205-234)272	143(168-188)	(193-211)	(214-249)272
Professor	451	450	9	9	462	461	9	9	155(203-230)	(250-288)	(335-388)473	155(212-231)	(263-293)	(355-399)473
	1129	823	40	28	1162	830	50	31						
On leave	(60)	(50)	(1)	(1)	(69)	(51)	(2)	(2)						
DOCTORATE GRANTING DEPARTMENTS. Group III					(74 out of 91 reporting)									
WITHOUT DOCTORATE														
Instructor	64	15	24	10	65	14	27	10	90(103-123)	(103-128)	(110-134)148	92(100-134)	(102-136)	(109-145)171
Asst. Prof.	70	65	22	21	67	64	21	21	112(120-152)	(127-159)	(133-165)186	120(132-160)	(139-166)	(145-171)198
Asso. Prof.	49	48	6	5	47	46	5	4	145(161-193)	(177-202)	(177-207)225	166(172-203)	(184-211)	(189-219)234
Professor	10	10	0	0	9	9	0	0	183(218-285)	(218-235)	(218-235)329	192(234-300)	(234-300)	(234-300)339
	193	138	52	36	188	133	53	35						
On leave					(1)	(1)	(0)	(0)						
WITH DOCTORATE														
Instructor	23	0	3	0	23	0	5	0						
Asst. Prof.	413	91	41	6	386	76	39	6	115(125-148)	(140-162)	(155-173)198	115(132-151)	(149-167)	(163-183)213
Asso. Prof.	664	618	32	28	657	621	28	25	125(160-175)	(177-197)	(195-221)267	119(164-188)	(166-207)	(206-234)279
Professor	613	604	16	16	652	642	19	19	174(198-226)	(236-274)	(277-341)438	174(206-234)	(242-289)	(280-358)460
	1713	1313	92	50	1718	1339	91	50						
On leave	(56)	(44)	(4)	(3)	(58)	(42)	(9)	(3)						

DOCTORATE GRANTING DEPARTMENTS. Group IV (43 out of 67 reporting)

WITHOUT DOCTORATE														
Instructor	9	0	2	0	8	0	1	0						
Asst. Prof.	8	3	3	1	9	3	2	1						
Asso. Prof.	3	2	1	1	3	2	1	1						
Professor	3	3	0	0	4	4	0	0						
	23	8	6	2	24	9	4	2						
On leave					(1)	(1)	(0)	(0)						
WITH DOCTORATE														
Instructor	4	1	2	1	2	1	2	1	---	---	---	---	---	---
Asst. Prof.	133	6	17	2	139	5	19	0	122(135-156)	(144-162)	(153-179)220	135(142-164)	(150-170)	(161-183)272
Asso. Prof.	123	101	7	5	134	111	9	5	133(169-210)	(186-214)	(195-230)258	139(172-222)	(194-229)	(205-240)274
Professor	208	205	9	9	213	208	9	9	172(230-261)	(255-307)	(320-375)450	184(235-267)	(273-317)	(333-400)450
	468	313	35	17	488	325	39	15						
On leave	(22)	(16)	(2)	(0)	(22)	(12)	(0)	(0)						

DOCTORATE GRANTING DEPARTMENTS. Group V (44 out of 117 reporting)

WITHOUT DOCTORATE														
Instructor	16	0	4	0	10	0	4	0						
Asst. Prof.	3	1	0	0	2	0	0	0						
Asso. Prof.	7	7	0	0	7	7	0	0						
Professor	5	3	0	0	5	3	0	0						
	31	11	4	0	24	10	4	0						
On leave	(1)	(0)	(0)	(0)										
WITH DOCTORATE														
Instructor	3	0	0	0	2	0	0	0	---	---	---	---	---	---
Asst. Prof.	165	8	11	1	153	4	13	1	100(140-160)	(149-165)	(163-180)212	100(150-169)	(158-176)	(170-190)208
Asso. Prof.	144	118	4	4	144	117	6	5	122(175-200)	(185-215)	(195-232)260	122(181-210)	(193-220)	(205-246)271
Professor	268	266	5	5	277	275	8	8	155(218-255)	(259-290)	(303-360)440	155(228-262)	(270-310)	(315-380)478
	580	392	20	10	576	396	27	14						
On leave	(30)	(21)	(0)	(0)	(24)	(20)	(0)	(0)						

DOCTORATE GRANTING DEPARTMENTS. Group VI (20 out of 34 reporting)

WITHOUT DOCTORATE														
Instructor	8	0	2	0	5	0	0	0	---	---	---	---	---	---
Asst. Prof.	17	14	8	8	17	13	8	8	---	---	---	---	---	---
Asso. Prof.	26	23	2	2	26	23	2	2	192(203-228)	(204-241)	(204-276)310	201(205-273)	(220-295)	(239-312)329
Professor	9	8	0	0	10	9	0	0	---	---	---	---	---	---
	60	45	12	10	58	45	10	10						
On leave	(3)	(3)	(0)	(0)	(3)	(3)	(0)	(0)						
WITH DOCTORATE														
Instructor	2	0	0	0	2	0	1	0	---	---	----	---	---	---
Asst. Prof.	141	41	6	0	127	38	6	0	130(138-165)	(155-192)	(172-204)235	131(142-178)	(162-202)	(186-230)255
Asso. Prof.	238	216	5	4	246	228	6	4	160(181-208)	(204-240)	(234-287)314	173(179-226)	(215-264)	(255-312)355
Professor	164	163	0	0	179	178	0	0	213(232-265)	(272-336)	(327-400)466	217(237-291)	(291-353)	(360-420)501
	545	420	11	4	554	444	13	4						
On leave	(21)	(18)	(0)	(0)	(23)	(17)	(0)	(0)						

	SIZE OF FACULTY								SALARIES (in hundreds of dollars)					
	1976–1977				1977–1978				1976–1977			1977–1978		
	FACULTY		WOMEN		FACULTY		WOMEN							
	Total	With Tenure	Total	With Tenure	Total	With Tenure	Total	With Tenure	Minimum	Median	Maximum	Minimum	Median	Maximum
MASTER DEGREE GRANTING DEPARTMENTS					(180 out of 369 reporting)									
WITHOUT DOCTORATE														
Instructor	184	31	85	13	178	26	84	13	72(99-128)	(105-130)	(106-139)200	77(102-135)	(110-144)	(115-148)200
Asst. Prof.	311	278	81	74	297	266	69	63	102(130-158)	(135-161)	(140-168)248	107(136-162)	(143-167)	(150-177)250
Asso. Prof.	199	197	23	23	200	200	26	26	125(156-185)	(163-200)	(169-206)266	135(162-193)	(170-203)	(176-216)290
Professor	51	51	4	4	53	53	4	4	163(196-239)	(196-239)	(200-256)319	165(208-250)	(208-256)	(208-261)319
	745	557	193	114	728	545	183	106						
On leave	(13)	(12)	(3)	(2)	(12)	(9)	(3)	(1)						
WITH DOCTORATE														
Instructor	20	0	7	0	15	0	4	0						
Asst. Prof.	614	175	64	21	562	158	74	22	90(130-149)	(138-160)	(145-169)240	90(136-156)	(145-168)	(150-179)254
Asso. Prof.	758	686	50	47	807	732	51	50	110(156-177)	(169-193)	(178-213)280	117(161-185)	(175-201)	(188-222)301
Professor	584	568	39	39	632	624	43	43	113(193-235)	(208-254)	(225-270)371	124(203-245)	(219-263)	(239-280)401
	1976	1429	160	107	2016	1514	172	115						
On leave	(75)	(66)	(3)	(3)	(45)	(39)	(1)	(1)						
BACHELOR DEGREE GRANTING DEPARTMENTS					(416 out of 1047 reporting)									
WITHOUT DOCTORATE														
Instructor	183	26	59	5	194	23	61	4	60(96-120)	(100-120)	(100-125)263	60(105-125)	(106-125)	(107-126)276
Asst. Prof.	302	208	54	31	290	197	56	27	60(115-146)	(120-150)	(120-156)225	60(121-153)	(125-158)	(125-163)234
Asso. Prof.	245	236	36	33	239	231	35	31	91(136-171)	(140-173)	(140-178)287	96(141-180)	(143-183)	(147-186)287
Professor	53	50	5	5	54	52	5	5	126(126-226)	(162-226)	(163-226)344	126(173-233)	(173-233)	(173-233)373
	783	520	154	74	777	503	157	67						
On leave	(16)	(8)	(4)	(0)	(10)	(7)	(6)	(3)						
WITH DOCTORATE														
Instructor	48	4	8	0	37	5	4	0						
Asst. Prof.	487	97	67	16	481	88	68	8	90(120-140)	(125-145)	(128-153)225	100(126-147)	(130-152)	(133-159)234
Asso. Prof.	467	392	38	33	509	431	45	37	100(143-173)	(145-177)	(147-182)270	100(149-181)	(151-186)	(154-194)294
Professor	374	349	38	35	387	366	39	36	113(173-220)	(179-230)	(180-240)382	120(182-227)	(184-242)	(191-256)382
	1376	842	151	84	1414	890	156	81						
On leave	(33)	(20)	(5)	(1)	(35)	(30)	(0)	(0)						

Salary Survey for New Recipients of the Doctorate

The latest figures in this Survey were compiled from questionnaires sent to individuals who received a doctorate in the mathematical sciences during the 1976–1977 academic year from universities in the United States and Canada. This year no attempt was made to obtain information from individuals who were reported to have left the U.S.A. or Canada.

A total of 875 questionnaires was distributed to recipients of degrees using addresses provided by the departments which granted the degrees. Of these, 33 were returned by the postal service as undeliverable and could not be forwarded. Of the 490 which were returned between late June and early September, 440 (386 men and 54 women) were used in the tables below. Of the unused returns, 19 did not have sufficient information for use in this compilation, 16 persons (14 men and 2 women) reported that they were not yet employed, 3 persons (2 men and 1 woman) were not seeking employment and 12 persons (6 men and 6 women) had accepted part-time employment.

Of the doctorates included in this report, 75% accepted academic positions, 16% positions in business or industry and 9% in government, including federal, state and provincial governments. Of those reporting academic positions, 180 held positions in doctorate granting departments, 51 in departments granting masters as the highest degree, 49 in bachelor granting departments, 14 in two-year colleges, 12 in departments granting no degrees and 2 in high school.

Of all those reporting, including those whose questionnaires were not usable in the salary compilations, 92% accepted positions in the United States, 5% in Canada, and 3% were seeking employment at the time of reporting.

KEY TO TABLE

Salaries are listed in hundreds of dollars. 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 position or a position similar to the one reported; some persons receiving a doctorate had been employed in their present position for several years. (X + Y) means there are X men and Y women in the 1977 sample. Quartile figures are given only in cases where the number of responses is large enough to make them meaningful.

NINE-MONTH SALARIES

Year	Min.	Q_1	Median	Q_3	Max.
TEACHING OR TEACHING AND RESEARCH (231 + 32)					
1974	85	115	121	135	200
1975	90	120	128	135	173
1976	85	124	133	145	245
1977	72	130	140	150	328
1974M	85	115	124	137	200
1974F	90	108	115	120	145
1975M	90	120	130	137	173
1975F	95	120	126	135	160
1976M	93	125	134	145	245
1976F	85	120	125	145	168
1977M	72	130	140	150	328
1977F	72	120	135	148	170
One year experience (198 + 24)					
1977M	72	130	138	150	180
1977F	72	120	135	140	170
RESEARCH (2 + 1)					
1974	50		80		130
1975	100		-		110
1976	70		80		180
1977	80		86		160
1974M	50		81		130
1974F	-		70		-
1975M	100		-		110
1975F	-		-		-
1976M	70		80		180
1976F	-		-		-
1977M	80		-		160
1977F	-		86		-
One year experience (2 + 1)					
1977M	80		-		160
1977F	-		86		-

TWELVE-MONTH SALARIES

Year	Min.	Median	Max.
TEACHING OR TEACHING AND RESEARCH (39 + 4)			
1974	90	138	185
1975	87	145	204
1976	100	155	270
1977	111	170	260
1974M	90	146	185
1974F	106	126	145
1975M	87	145	204
1975F	145	-	185
1976M	100	150	270
1976F	100	174	240
1977M	111	170	260
1977F	125	-	182
One year experience (28 + 4)			
1977M	111	155	220
1977F	125	-	182
RESEARCH (16 + 3)			
1974	72	95	265
1975	90	119	180
1976	90	130	210
1977	100	156	250
1974M	72	95	265
1974F	90	-	180
1975M	90	119	180
1975F	-	-	-
1976M	90	121	210
1976F	-	195	-
1977M	100	139	210
1977F	190	222	250
One year experience (14 + 2)			
1977M	100	135	250
1977F	190	-	222

Year	Min.	Median	Max.
GOVERNMENT (35 + 7)			
1974	120	197	287
1975	78	182	247
1976	115	194	270
1977	105	187	330
1974M	120	199	287
1974F	-	177	-
1975M	150	185	247
1975F	78	100	145
1976M	118	194	270
1976F	115	194	200
1977M	105	192	330
1977F	115	182	204
One year experience (21 + 6)			
1977M	105	171	216
1977F	115	172	204
BUSINESS AND INDUSTRY (63 + 7)			
1974	140	190	251
1975	114	187	240
1976	120	205	400
1977	100	210	380
1974M	140	190	251
1974F	150	156	190
1975M	114	189	240
1975F	120	175	224
1976M	120	206	400
1976F	185	-	200
1977M	100	216	380
1977F	130	195	220
One year experience (48 + 7)			
1977M	100	210	330
1977F	130	195	220

Report on the 1977 Survey of New Doctorates

by Wendell H. Fleming

This report concerns employment patterns for 1976–1977 mathematical science doctorates, trends in the number of doctoral degrees granted, and sex, minority group status, and citizenship of new doctorates. The employment pattern for new doctorates is similar to that observed last year. The proportion employed in university or four-year college mathematical science departments is slightly lower. Again this year there was a drop in the number of doctorates granted, but the percentage of women doctorates continued to increase.

Employment Status of New Doctorates. Table 1 shows the employment status by type of employer and field of degree of the 972 new doctorates listed on pages 344-361 of this issue of these *Notices*. In row 1 ("University"), the recipients are counted who accepted appointments in U.S. doctorate granting mathematical science departments (Groups I–V as defined on page 336). Similarly, in row 2 ("College"), the figures represent those accepting appointments in U.S. mathematical science departments granting bachelors and masters degrees only. The information was obtained from the departments granting the degrees and from questionnaires subsequently completed by over 56% of the recipients themselves.

TABLE 1

1977–1978 EMPLOYMENT STATUS OF NEW DOCTORATES IN THE MATHEMATICAL SCIENCES

	PURE MATHEMATICS											
Type of Employer	Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability	Statistics	Computer Science	Operations Research	Applied Mathematics	Mathematics Education	Other	Total
University	40	54	41	6	15	41	37	1	25	2	11	273
College	32	31	25	4	5	18	11	2	17	4	9	158
Two-year college and high school	9	3	5	1			1		1	3	2	25
Other academic departments or research institutes	4	6	6	1	1	18	15	4	13		12	80
Government	5	6	1		1	24	6	3	8		4	58
Business and industry	3	11	5	1	2	17	50	5	23		8	125
Canada	14	12	2	4	5	9	8	2	7		6	69
Foreign	11	14	16	2	2	16	8	2	8	1	4	84
Not seeking employment	2	2	2			2						8
Not yet employed	12	14	14	2	1	10		2	9		5	69
Unknown	3	4	1		1	7	2	1	2	1	1	23
Total	135	157	118	21	33	162	138	22	113	11	62	[illegible]

Among those 1976–1977 new doctorates employed in the U.S., 60% took positions in university or college mathematical science departments. This is a decline from 63% reported in last year's survey of 1975–1976 new doctorates, and from 67% reported two years ago. About 25% of 1976–1977 new doctorates employed in the U.S. took positions in government, business, and industry, while the remaining 15% are in two-year colleges, high schools, other academic departments, or research institutes.

Table 1 shows as "not yet employed" about 10% of the 1976–1977 new doctorates (this excludes those whose employment status is unknown, and those now in Canada or other foreign countries). The data in Table 1 were in many instances obtained in early summer 1977, and do not reflect subsequent hiring during the summer; an update of Table 1 is planned for a later issue of these *Notices*. A similar update last year revealed a substantial drop between summer and winter 1976 in the number of 1975–1976 new doctorates seeking employment. See these *Notices*, October 1976, p. 318, and February 1977, p. 99.

Trends in Number of Doctorates. Table 1 shows 464 pure mathematics doctorates out of a 972 total, about 48% pure mathematics. This is approximately the same percentage reported in last year's survey, but it is lower than two years ago. Table 2 shows the number of doctorates granted by those mathematical science departments in the U.S. and Canada which reported in both of the last two years.

TABLE 2

MATHEMATICAL SCIENCE DOCTORATES

	1975–1976	1976–1977
Group I	262	223
Group II	141	147
Group III	205	204
Total I, II, III	608	574
Group IV	120	132
Group V	153	155
Group VI	57	50
Total	938	911

Table 2 indicates a modest decline in the number of new doctorates between 1975–1976 and 1976–1977, less dramatic than that observed between 1974–1975 and 1975–1976 (these *Notices*, October 1766, p. 319). The most noticeable drop in Table 2 occurred among the top-rated Group I mathematics departments. However, it should be pointed out that during recent years Group II departments had already experienced a drastic decline in the number of doctorates awarded. The 223 Group I doctorates for 1976–1977 shown in Table 2 represent 23 departments, while the 351 Group II and III doctorates represent 116 departments reporting both years. Thus the average number of doctorates produced during 1976–1977 per Group II and III department is low (only about 3 per department).

Since departments are not included in Table 2 which failed to report either 1975–1976 or 1976–1977 new doctorates, the totals do not represent all doctoral degrees granted. For Groups I–III the missing departments contributed perhaps an additional 55 to 70 doctorates. For the applications-oriented departments in Groups IV and V, there is an inherent difficulty in attempting to determine just which degrees belong in the mathematical sciences. Moreover, the Group V row in Table 2 does not include several major computer science departments and programs. Thus, the data for Group V are less reliable, either as an indicator of the number of doctorates or of trends, than are the data for the other categories of departments. A reasonable estimate of the total number of mathematical science doctorates (U.S. and Canada) would be in the 1100-1200 range for 1976–1977, down slightly from 1975–1976.

Sex, Race, and Citizenship of New Doctorates (July 1, 1976–June 30, 1977). The tables below represent an analysis according to sex, minority group and citizenship of the group of 972 recipients of doctorates in the mathematical sciences from universities in the U.S. and Canada for the academic year 1976–1977. The information summarized in the tables was obtained from department heads and in some cases from recipients themselves.

TABLE 3

SEX, RACE, AND CITIZENSHIP OF NEW DOCTORATES
July 1, 1977–June 30, 1977

U. S. DEGREES	MEN					WOMEN					TOTAL
	CITIZENSHIP					CITIZENSHIP					
RACIAL/ETHNIC GROUP	U.S.	Canada	Other	Not Known	Total Men	U.S.	Canada	Other	Not Known	Total Women	
American Indian, Eskimo	2				2	2				2	4
Black, Afro-American	9		3		12			1		1	13
Mexican American, Puerto Rican	3		4		7	1		1		2	9
Oriental, Pacific Islander	12		60	1	73	4	1	10		15	88
None of those above	530	13	93	6	642	71		16		87	729
Not Known	46	6	3	5	60	9		1	1	11	71
Total Number	602	19	163	12	796	87	1	29	1	118	914

CANADIAN DEGREES	MEN					WOMEN					TOTAL
	CITIZENSHIP					CITIZENSHIP					
RACIAL/ETHNIC GROUP	U.S.	Canada	Other	Not Known	Total Men	U.S.	Canada	Other	Not Known	Total Women	
American Indian, Eskimo		1			1						1
Black, Afro-American											
Mexican American, Puerto Rican			2		2						2
Oriental, Pacific Islander		6	2		8						8
None of those above	2	13	6		21		4			4	25
Not Known	1	14	3		18		3	1		4	22
Total Number	3	34	13		50		7	1		8	58

Table 3 shows that 13% of the new U.S. 1976–1977 doctorates are women. This compares with 9% in 1973–1974, 10% in 1974–1975, and 11% in 1975–1976. About three-quarters of the new 1976–1977 doctorates are U.S. citizens. Table 3 shows thirty-three new doctorates who are both U.S. citizens and members of a minority group listed there. As in previous years this number represents only a small percentage of the total.

Analysis of the employment forms indicate that among the new 1976–1977 doctorates from U.S. universities employed by Group I, II, and III departments, 10% are women. (The percentage remains nearly the same if Group IV and V departments are included.) Among new doctorates employed by bachelors and masters degree granting departments 16% are women, while among those employed by government, business, and industry 11% are women. Among the 69 individuals shown in Table 1 as seeking employment, 10 are women.

DOCTORATES CONFERRED IN 1976–1977

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 1, 1976–June 30, 1977. 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 (i.e., algebra, number theory, geometry, topology, analysis, functional analysis, logic, or probability), 2. Statistics, 3. Operations Research, 4. Computer Science, 5. Applied Mathematics, 6. Mathematics Education, 7. Other. Each entry contains the dissertation title. 151 universities are listed with a total of 972 individual names; 229 departments granting doctorates.

ALABAMA

Auburn University (4;3,0,0,0,1,0,0)

MATHEMATICS

Hoots, Felix Roach, Jr., *The rotational motion of an extended body in general relativity*

Phelps, Kevin Thomas, *Conjugate orthogonal quasigroups*

Smith, Ronald Lee, *Generalized circulant and block centrosymmetric matrices*

White, James Martin Stevens, Jr., *Two homogeneity conditions related to countable dense homogeneity*

University of Alabama at Tuscaloosa (1;1,0,0,0,0,0,0)

MATHEMATICS

Woo, Moo Ha, *Regular transformation groups and homomorphisms*

ARIZONA

Arizona State University (3;1,0,0,0,1,1,0)

MATHEMATICS

Cranwell, Robert M., *Limit theorems for mixing point processes*

Guymon, Vernon Melvin, Jr., *Faculty rating policies of community college mathematics students*

Shew, Steven Michael, *Transport impedance*

University of Arizona (4;1,0,0,1,2,0,0)

COMPUTER SCIENCE

Hanson, David Roy, *Procedure-based linguistic mechanisms in programming languages*

MATHEMATICS

Anderson, Ian McDonald, *Mathematical foundations of the Einstein field equations*

Noren, Paul, *Asymptotic behavior of solutions of a filtration equation*

Waymire, Edward C., *Contributions to the theory of interacting particle systems*

ARKANSAS

University of Arkansas, Fayetteville (2;1,0,0,0,1,0,0)

MATHEMATICS AND STATISTICS

Head, Richard Ray, *Projective representations for energy bond calculations*

Thompson, Wesley Travis, *The closed graph and variations of convergence*

CALIFORNIA

California Institute of Technology (2;2,0,0,0,0,0,0)

MATHEMATICS

Bloom, John Roll, *On the invariants of the sum Z extension*

Keenan, Donald Eugene, *Subsets of a finite set that intersect each other in at most one element*

Claremont Graduate School (1;1,0,0,0,0,0,0)

MATHEMATICS

Savage, Thomas R., *On some problems in the theory of von Neumann regular rings*

Naval Postgraduate School (1;1,0,0,0,0,0,0)

OPERATIONS RESEARCH

Campbell, David R., *Properties of residual mixing distributions resulting from arbitrary mixtures of exponential life distributions*

Stanford University (13;10,0,0,1,0,0,2)

MATHEMATICS

Bailey, David Harold, *Sequential schemes for classifying and predicting ergodic processes*

Feinberg, Jerry Mark, *The isoperimetric inequality for doublyconnected minimal surfaces in IR^M*

Feshbach, Mark Frederick, *The transfer and compact Lie groups*

Harrington, Andrew Neal, *Some extremal problems in conformal and quasiconformal mapping*

Horn, Julian Christiansen, *Cyclotomic units and P-adic L-functions*

LaVergne, Alan, *Subspaces of direct sums of Banach spaces*

Meadows, Douglas Shelby, *The structure of the piecewise linear homotopy complex projective spaces*

Rahe, Maurice Hampton, *Relatively finitely determined implies relatively very weak Bernoulli*

Reznick, Bruce Arie, *Banach spaces which satisfy linear identities*

Schoen, Richard Melvin, *Existence and regularity theorems for some geometric variational problems*

Strikwerda, John Charles, *Initial boundary value problems for incompletely parabolic systems*

Sverdlove, Ronald, *Inverse problems for dynamical systems in the plane*

Taliaferro, Steven Douglas, *Asymptotic behavior of solutions of $\gamma'' = \phi^{(1)}\gamma^x$*

University of California, Berkeley (42;26,7,1,0,4,0,4)

BIOSTATISTICS

Frank, Jesse, *Survival analysis with time-dependent covariates*

Hexter, Alfred, *Parameter estimation in the synthetic retrospective study*

Norwood, Charles, *Supplementary covariance adjustment by the method of maximum likelihood in matched pairs studies*

Rust, Phillip F., *On the estimation and variance of basic and derived parameters in a continuous time Markov process with an example*

LOGIC AND METHODOLOGY OF SCIENCE

Steel, John Robert, *Determinateness and subsystems of analysis*

MATHEMATICS

Adamson, Alan Aage, *Admissible sets and the saturation of structure*

Apodaca, Eugene Roger, *On the simultaneous embedding of uncountably many distinct wild arcs with one wild endpoint in E^3–a geometric approach*

Back, Allen Henry, *Involutions on Grassman manifolds*

Bass, Richard Franklin, *The decomposition of Markov processes into jump and continuous parts*

Bertiger, William Israel, *Maximum principles, gradient estimates, and weak solutions for partial differential equations of elliptic and parabolic type*

Carpano, Marie-José, *A general two-good model of economic growth*

Chachere, Gerald Raphael, *Numerical experiments concerning the eigenvalues of the Laplacian on a Zoll surface*

Curry, James Howard, *Transition to turbulence in finite-dimensional approximations to the Boussinesq equations*

Dankner, Alan, *On Smale's axiom A dynamical systems*

Eisman, Gerald Scott, *Derivation controlled Lindenmayer systems*

Green, Philip Palmer, *The structure of crossed product C^*-algebras*

Henckell, Karsten, *On the complexity of finite semigroups*

Ionio, Rafael José, Jr., *On the discrete spectrum of the three-body quantum mechanical Hamiltonian*

Jacob, John Phillip, *Geodesic symmetries of homogeneous Kähler manifolds*

Larson, David Royal, *On certain reflexive operator algebras*

Lundquist, Rune Zelow, *On the differential geometry of quasi-symmetric domains*

Mabuchi, Toshiki, *C^3-actions and algebraic threefolds with ample tangent bundle*

Malcolmson, Peter, *Algebraic closure operators and constructions in ring theory*

Melvin, Paul Michael, *Blowing up and down in 4-manifolds*

Nordstrom, David John, *An integration theory for topological manifolds*

Peterson, Brian Lee, *Extensions of pro-affine algebraic groups*

Posner, David Barnett, *High degrees*

Rao, Prabhakara Aroor, *Liaison among curves in projective three space*

Somers, Janet Ellen, *Parametric network flow problems*

Staffeldt, Ross Evon, *Reduction theory and K_3 of the Gaussian integers*

Stanley, Lee James, *"L-like" models of set theory: Forcing, combinatorial principles, and morasses*

Vogtmann, Karen Lee, *Homology stability for $O_{n,n}(F)$*

Weissler, Frederic Bennett, *Semi-groups, Sobolev inequalities, and non-linear evolution equations*

Zietz, Stanley, *Cell cycle kinetic modeling and optimal control theory in the service of cancer chemotherapy*

STATISTICS

Caby, Errol Churchill, *Convergence of measures on uniform spaces*

Chow, Winston Kai-Wan, *A new method of approximations to various distributions arising in testing problems*

Davis, Amy Poon, *Robust measures of association*

Miura, Ryozo, *Adaptive rank estimates for the one sample problem*

Moussatat, Mohamed Walid, *On the asymptotic theory of statistical experiments and some of its applications*

Persons, Richard Clark, *On the strict determination of hypothesis testing games*

Sant'Anna, Annibal Parracho, *Comultiplicative functionals*

Wu, Chien-Fu, *Contributions to optimization theory with applications to optimal design of experiments*

University of California, Davis (2;2,0,0,0,0,0,0)

MATHEMATICS

Cherkaoui, Sidi Saad, *Capacitary dimension and Hausdorff dimension of compact sets in R^n*

Simutis, Jean Susan Slaughter, *Geometric realizations of toroidal maps*

University of California, Irvine (3;2,0,0,0,0,0,1)

MATHEMATICS

Al-Zaid, Hassan Ali, *The extended Grzegorczyk hierarchy and the word problem*

Kovacich, Michael Anthony, *Foundations of a general relativistic statistical mechanics and a derivation of the general relativistic Boltzmann equation*

Shows, George Albert, Jr., *Stochastic integral of an L^2 function with respect to a Gaussian process of multidimensional time*

University of California, Los Angeles (23;5,1,2,0,9,0,6)

BIOSTATISTICS

Clarkson, Douglas B., *Estimating standard errors of factor loadings by jackknifing*

Costanza, Michael C., *Stopping rules in forward stepwise discriminant analysis*

Hill, Mary Ann, *Robust estimators of location for biomedical applications*

Lee, Sik Yum, *Some algorithms for the covariance structure analysis*

Rostami, Hojat J., *The effect of transformation for a class of non-linear regression models*

Yu, Mimi C., *Robust tests on the equality of dependent correlation coefficients*

MATHEMATICS

Cartier, Michael Francis, *Solution of pure equations in division algebras central over a number field*

Guralnick, Robert Michael, *On expressing group elements as products of commutators*

Lai, Shih-Lun, *Uniform consistency of K-nearest neighbor estimator and its rate of convergence*

Miller, Robert Lowell, *Linear codes invariant under permutation groups*

Morrison, Michael Allan, *Maximal density sequences with linear constraints*

Park, Robert Edward, *Equational classes of non-associative algebras*

Rivers, Daniel Dagfin, *Error bounds in nonlinear filtering*

SYSTEMS SCIENCE

Hedberg, David J., *Operator models of infinite dimensional systems*

Housewright, Kim B., *Rate distortion theory for information networks*

Lapp, William Saul, *Application of the epsilon technique to determine optimum open loop controls for a torpedo pursuing a target subject to state space constraints*

Lee, Sun Hwa, *Optimal capacity expansion in certain probabilistic and deterministic networks*

Martin, Donald Ray, *Robust source coding of finite alphabet sources via composition classes*

Molina, Francisco W., *A theory of resource allocation and a decomposition method for mathematical programming*

Nebeker, Henry Gleed, *A study of sequential hypothesis testing for system identification*

Nussbaum, Howard S., *Source coding and adaptive data compression for communication networks*

Thornton, Catherine Lee, *Triangular covariance factorizations for Kalman filtering*

Vera-Salazar, Alonso, *Mathematical programming and marginal cost pricing*

University of California, Riverside (6;5,0,0,0,1,0,0)

MATHEMATICS

Clinkenbeard, Dennis Jay, *Lattices of congruences on compact topological lattices*

Di Fiore, Lawrence Benjamin, *Isolated singularities and regularity for the nonlinear von Kármán equations*

Graham, Barry Glenn, *On contractible fans*

Hillmann, Theodore Robert, *Besicovitch-Orlicz spaces of almost periodic functions*

Lee, Rebecca Hancock, *Covers and associated primes in Noetherian lattice modules*

Sheets, Robert Wayne, *Special henselizations*

University of California, San Diego (5;2,0,0,0,1,0,2)

MATHEMATICS

Mitro, Joanna Burstein, *Markov processes in duality: A useful auxiliary process*

Paluszny, Marco, *Conformal structures on quadrics*

Shapiro, Joni A., *Polynomials of binomial type and the Lagrange inversion formula*

Sorensen, Danny Chris, *Updating the symmetric indefinite factorization with applications in a modified Newton's method*

Wachs, Michelle Lynn, *Discrete variational techniques in finite mathematics*

University of California, Santa Barbara (4;4,0,0,0,0,0,0)

MATHEMATICS

Andresen, Patricia, *The finite dimensional numerical range*

Chuan, Jen-chung, *One-sided ideals in a C^*-algebra*

Grone, Robert D., *Isometries of matrix algebras*

Smith, Richard F., *The construction of definite indecomposable hermitian forms*

University of California, Santa Cruz (3;1,0,0,0,1,0,1)

MATHEMATICS

Friedman, Daniel, *Disequilibrium processes in a monetary economy of pure exchange*

Morrison, Kent Evans, *Schemes of module structures and deformations of modules*

Walton, Ian Graham, *Rayleigh-Ritz saddle point method for certain singular operators*

University of Southern California (1;1,0,0,0,0,0,0)

MATHEMATICS

Lestmann, Phillip Edward, *Prime ideals in PI rings*

COLORADO

Colorado State University (2;0,2,0,0,0,0,0)

STATISTICS

Mallenby, Douglas Wayne, *Inference for the search model*

Otis, David Lee, *Ratios and outliers in linear regression*

University of Colorado, Boulder (11;9,0,0,2,0,0,0)

COMPUTER SCIENCE

Clarke, Lori A., *Test data generation and symbolic execution of programs as an aid to program validation*

Schulz, Waldean Allen, *Semantic analysis and target language synthesis in a translator*

MATHEMATICS

Barraza, Daniel, *Index theory and spectral analysis*

Diesto, Severino, *Proximity invariants and closure invariants*

Donovan, Timothy, *Some matrix congruences and equations*

Everts, Frank, *Colorings of sets*

Humburg, Fredrick W., *Lie algebras of characteristic three with nondegenerate trace form*

Kerrigan, Thomas C., *A perturbation theory for a special class of transport process*

Morgenstern, Carl F., *Compact extensions of L^{∞} and topics in set theory*

Ratliff, Michael Irven, *A power series analogue to simultaneous approximation*

Spackman, Kenneth W., *Systems of diagonal equations over finite fields*

University of Northern Colorado (14;2,2,1,1,1,7,0)

MATHEMATICS

Borden, Virginia, *Teaching decimal concepts to sixth grade students using the hand-held calculator*

Holmen, Robert L., *A study of classical statistical inference with emphasis on Neyman-Pearson theory*

Kerns, Carl, *A study of the effects of two different methods for incorporating application problems into college algebra*

Lee, Kenneth W., *S-sets and CS-sets*

Lekskul, Sompon, *Mathematics content guidelines for the collegiate training of elementary and secondary mathematics teachers in Thailand*

Olson, Frederick, *The effects of specific interest oriented exercises in a general education introductory statistics course*

Olson, Sandra Jean, *A study of the effect of two different procedures for introduction of mathematical concepts to preservice elementary school teachers*

Travis, David L., *Experiencing mathematics: The development and trial of an eclectic course*

Van Wie, Joseph L., *The development and appraisal of a unit on problem solving for engineering technology students*

RESEARCH AND STATISTICAL METHODOLOGY

Concordia, Louis R., *A mathematical model for determining the de facto faculty reward system in an institution of higher education*

Glorfeld, Louis, *A projection of employment by occupation to 1985 for Northern Colorado Planning Region 2*

Hill, W. Leland, *A Kaiser factor relating investigation of selected faculty evaluation forms at the University of Northern Colorado*

Leonardson, Gary R., *The relationship between self-concept and selected academic and personal factors*

Ott, Marvin J., *Kaiser procedure for relating factors of fixed variables, different samples: Generalized computer program and empirical examples*

CONNECTICUT

University of Connecticut (1;0,0,0,0,1,0,0)

MATHEMATICS

Rasmussen, Carl Henry, *Oscillatory and asymptotic behavior of systems of ordinary linear differential equations*

Wesleyan University (3;2,0,0,0,0,0,1)

MATHEMATICS

Acuña-Ortega, Osvaldo, *Finiteness in topoi*

Fife, Earl D., *Binary sequences which contain no BBb*

Retta, Teklehaimanot, *Topics in α-compactness and density character*

Yale University (12;8,2,0,0,0,0,2)

COMPUTER SCIENCE

Lehnert, Wendy G., *The process of question answering*

Meehan, James Richard, *The Metanovel: An interactive program that tells stories*

MATHEMATICS

Anderson, Robert Murdoch, *Star-finite probability theory*

Bix, Robert Alan, *Separable Jordan algebras over commutative rings*

Engel, Frank Phillip, *Subadditive decomposition*

Feingold, Alex Jay, *Tensor products of modules for Lie algebras*

Gregory, Thomas Bradford, *Simple Lie algebras with classical simple null component*

Haile, Darrell Eugene, *On central simple algebras of given exponent*

Kendirli, Baris, *$SL(2,F)$, $GL(2,F)$, $PGL(2,F)$*

Martin, Alvin Frank, *Multiplications on* mod *q cohomology theories*

STATISTICS

Glynn, William J., *Asymptotic distribution of latent roots in canonical correlation and discriminant analysis with applications to testing and estimation*

Wax, Yohanan, *The adjusted covariance regression estimate*

DISTRICT OF COLUMBIA

American University (6;0,6,0,0,0,0,0)

MATHEMATICS, STATISTICS AND COMPUTER SCIENCE

Baird, James, *Relative stability of selected correlation and regression statistics in complex sampling*

Depriest, Douglas, *Testing goodness-of-fit for the tail of the normal distribution*

Haider, Adnan, *On the extended Behrens-Fisher problem*

Nakkash, Kareem, *On non-null distributions of certain test criteria for covariance matrices*

Ocni, Michel K., *On extreme values of Markov maximum point processes*

Wolfsberg, Rolf M., *Stability considerations for hierarchical clustering schemes involving multidimensional categorical variables*

Catholic University of America (2;2,0,0,0,0,0,0)

MATHEMATICS

August, John E., *Bitopologies and lattices*

Gregoire, Sister Ellen Roland, *On variants of Turing machines and questions concerning recognizability of sets*

George Washington University (8;4,3,1,0,0,0,0)

MATHEMATICS

Batigne, Daniel Rucker, *Integral generalized inverses of integral matrices*

O'Brien, Robert F., Jr., *Controllability stabilization and contraction semigroups in Hilbert spaces*

Stanley, Walter Lane, *On the structure of the torsion subgroup of the group of units of a group ring.*

Tan, Henry K., M.D., *Ergodic theorems and semigroups of *homomorphisms on C*- and W*-algebras*

OPERATIONS RESEARCH

Kahn, Henry David, *A statistical analysis of some models used in accelerated life tests*

Klungle, Roger Glenn, *Optimal and heuristic algorithms for some assembly line balancing problems*

STATISTICS

Dambrosia, James M., *Early stopping and other properties of closed sequential tests for binomial distributions*

Gail, Mitchell Henry, *A scale-free goodness-of-fit test for the exponential distribution based on the sample Lorenz curve*

FLORIDA

Florida State University (4;2,2,0,0,0,0,0)

MATHEMATICS

Cruthirds, John E., *Infinite Galois theory for commutative rings*

Early, Theresa Ellen, *Galois cohomology for commutative rings*

STATISTICS

Longnecker, Michael Thomas, *Moment inequalities, maximal inequalities and their applications*

Quinzi, Anthony J., *Converting dependent models into independent ones, with applications in reliability and biometry.*

University of Florida (5;1,2,0,0,1,0,1)

MATHEMATICS

Limsui, Ebam, *Vector integration in tensor product spaces and compactness in Lebesgue-type spaces*

Sontag, Eduardo Daniel, *On the internal realization of polynomial response map*

Yong, Joon Youn, *Stability of an infinite system of differential equations*

STATISTICS

Huang, Jun Shon, *The effect of the correlated inspection for process control*

Walker, Glenn Alan, *On the distribution of a linear combination of t-distribution variables*

University of Miami (2;2,0,0,0,0,0,0)

MATHEMATICS

Piacenza, Robert, *Cohomology theories over B*

Su, Chen-Jyi, *A structure theory for partially ordered rings and algebras*

University of South Florida (4;3,1,0,0,0,0,0)

MATHEMATICS

Center, Barbara Willis, *Limit theorems for probability measures*

Rose, David Alon, *On generalizations of continuity*

Toro, Emilio, *On the periods of the cyclotomic field*

Welch, Richard L. W., *Studies in Bayesian discriminate analysis*

GEORGIA

Emory University (4;4,0,0,0,0,0,0)

MATHEMATICS

de Caux, Peter Anthony, *Two topological spaces*

Parker, George Edgar, *Construction and differentiable approximation of semigroups of nonlinear transformations*

Pate, Thomas Head, Jr., *Some improvements in Neuberger's iteration procedure for solving partial differential equations*

Stucke, Carl Henry, *Embedding one-dimensional continua in the product of an arc and a simple triod*

Georgia Institute of Technology (5;3,0,0,1,1,0,0)

INFORMATION AND COMPUTER SCIENCE

Dunlavey, Michael Robert, *Representations for vision of physical assemblies*

MATHEMATICS

Faulkner, Gary D., *Results in semi-inner product spaces and generalized cosine operator functions*

Kramarz, Luis, *Global approximations to solutions of ordinary initial value problems*

Sullivan, Joe W., Jr., *Product integral solutions of stochastic Volterra-Stieltjes integral equations with discontinuous integrators*

Summers, Richard D., *An application of a pointwise variational principle in elastodynamics*

University of Georgia (7;1,3,0,1,0,0,2)

MATHEMATICS

Hillhouse, Patricia Ann, *Numerical integration rules which combine interpolatory and minimum norm properties*

Morrel, Judith H., *A similarity theorem for polynomial Toeplitz operators*

Price, Thomas Eugene, Jr., *Complex variable techniques in numerical integration and approximation*

STATISTICS AND COMPUTER SCIENCE

Baker, Frederick Dee, *A minimax approach to data analysis*

Bond, Walter P., *Graphical aids for statistical computation*

Rana, Dharam S., *Multi-stage sampling on successive occasions*

Srivastava, Sushil S., *A statistical classification regression approach to prediction*

IDAHO

Idaho State University (1;0,0,0,0,0,0,1)

MATHEMATICS

Carnevale, Thomas A., *Order relations and measurement structures*

ILLINOIS

Northwestern University (16;4,2,0,7,2,1,0)

COMPUTER SCIENCE

Allen, James Riley, *A minimum cost path algorithm for printed circuit routing*

Ellison, Karen Starr, *Higher-order theorem proving using N-sorted logic*

Fung, Hing-Sum, *On the design of fault tolerant distributed computer systems*

Haynes, Gregory A., *A refutation procedure for w-order logic*

Kaplan, Robert S., *A relation-free query language based on functionally dependent access paths for relational data base management systems*

Michaels, Ann A., *Secondary indexes as access models for relational data base systems*

Reszka, Alfons, *The architecture of a functionally distributed computer system*

ENGINEERING SCIENCES AND APPLIED MATHEMATICS

Chang, Kin-Sheng Joseph, *The exact and approximate interior corner problem in neutron diffusion and the integral transform method*

Hulkower, Neal D., *The zero energy three body problem*

Spiegelman, Clifford Henry, *Two techniques for estimating treatment effects in the presence of hidden variables; Adaptive regression in a solution of Reiersøl's problem*

MATHEMATICS

Aghevli, Behrooz B., *Exact distribution of a sample size n from a Dirichlet process*

Chartoff, Barton Toby, *An exploratory investigation utilizing a multidimensional scaling procedure to discover classification criteria for algebra word problems used by students*

Hipps, William C., *Elementary Thom-Boardman theory for characteristic $p \neq 0$*

Narasimhan, Carolyn C., *The periodic behavior of Morse-Smale diffeomorphisms on compact surfaces*

Prather, Carl L., *On special classes of entire functions whose zeros and growth are restricted*

Suchanek, Ana Mantille, *Convergence of subsequences of vector-value random variables*

Southern Illinois University, Carbondale (5;3,0,0,0,2,0,0)

MATHEMATICS

Carmony, Lowell A., *On constructing t-designs*

Gummersheimer, Victor H., *Measures with orthogonal values*

McGlinn, Robert Joseph, *Approximation by exponential sums*

Rehmer, Karl O., *Completions of spaces of vector-valued measures*

Rodas, Hernan Rivera, *Function space controllability of a differential difference equation of neutral type*

University of Illinois, Chicago (4;3,1,0,0,0,0,0)

MATHEMATICS

Ash, Arlene S., *Constructions of generalized Youden designs*

Komornicki, Wojciech, *Multiplications in two-cell complexes and related spectra*

Shaw, Sen-Yen, *On limit theorems of semi-groups of operators in Banach spaces and related topics*

Zage, Wayne M., *Hyperbolic geometry and Luneburg's theory of binocular visual space*

University of Illinois, Urbana (36;10,1,0,23,1,0,1)

COMPUTER SCIENCE

Bitner, James Richard, *Heuristics that dynamically alter data structures to reduce their access time*

Chesson, Gregory Lawrence, *Synthesis techniques for transformations on tree and graph structures*

Culliney, Jay Niel, *Topics in MOSFET network design*

Dhall, Sudarshan Kumar, *Scheduling periodic-time-critical jobs on single processor and multiprocessor computing systems*

Embley, David Wayne, *Experimental and formal language applied to control constructs for interactive computing*

Gillett, Will Dean, *Iterative global flow techniques for detecting program anomalies*

Grapa, Enrique, *Characterization of a distributed data base system*

Irwin, Mary Jane, *An arithmetic unit for on-line computation*

Kutsch, James Albert, Jr., *A talking computer terminal*

Larson, James Burton, *Inductive inference in the variable valued predicate logic system VL_{21}: Methodology and computer implementation*

Link, Bruce David, *Numerical solution of stiff ordinary differential equations using collocation methods*

Milner, James Michael, *An analysis of rotational storage access scheduling in a multiprogrammed information retrieval system*

Rinewalt, James Richard, *Evaluation of selected features of the Eureka full-text information retrieval system*

Runge, Thomas Fred, *A universal language for continuous network simulation*

Rutter, Paul Edward, *Improving programs by source-to-source transformation*

Smith, James Edward, *The design of totally self-checking combinational circuits*

Smith, Wayne Douglass, *An investigation of the application of microprocessors to low cost area navigation capabilities for general aviation*

Stocks, Arthur Ian, *The PASCAL-11 programming system*

Tietz, Leon Clemens, *Burstlogic: Design and analysis of logic circuitry to perform arithmetic on data in the Burst format*

Weaver, Alfred Charles, *A graphically-programmed, microprocessor-based industrial controller*

Wen, Kuo Yen, *Interprocessor connections – capabilities, exploitation and effectiveness*

Whitlock, Lawrence Robert, *Interactive text construction and administration in the generative exam system*

MATHEMATICS

Barbasch, Dan M., *Fourier inversion formulas of orbital integrals*

Comerford, Jonell Duda, *Equivalence of Boolean functions under affine transformations*

Cuadrado, L. John, *Rational iterated integrals and formal power series connections.*

Duchamp, Thomas E., *Characteristic classes of G-foliations*

Dugopolski, Mark J., *Decision problems in the fundamental groups of 3-manifolds*

Gaynor, John A., *Asymptotic efficiencies of selection procedures*

Matchett, Andrew J., *Class groups of group rings*

Matheson, Alec L., *Closed ideals in Banach algebras of analytic functions satisfying a Lipschitz condition*

Miller, Jay Ian, *Just non-metabelian groups*

Nandakumar, Nagaiah R., *Semi-algebra of operators and algebra of multipliers.*

Redmond, Donald M., *On the summatory functions of a class of Dirichlet series*

Shreve, Steven Eugene, *Dynamic programming in complete separable spaces*

Townsend, Douglas W., *Imaginary values of a meromorphic function*

White, Luther William, *Control problems governed by pseudo-parabolic partial differential equations*

INDIANA

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

MATHEMATICS

Bindschadler, David Ernest, *Invariant and singular solutions to the plateau problem in Riemannian manifolds*

Franklin, LeRoy Alvin, *A Bayesian approach to randomized response sampling*

Rajaram, Navaratna S., *Stochastic integrals of weighted empirical processes and an application to the limiting distribution of linear rank statistics under alternatives*

Sander, Viakalathur Shankar, *Characterization theorems for integral operators*

Warren, Bette Louise, *A study of nilpotent and Abelian linear groups with applications to finite group structure*

Wells, Daniel R., *Some moment inequalities and a result on multivariate unimodality*

Wright, Stephen James, *Banach algebra characterizations of C^*-algebras*

Purdue University (21;7,4,4,4,2,0,0)

COMPUTER SCIENCE

Bonczek, Robert H., *Theoretical description of an access language for a general decision support system*

Fletcher, Sharon K., *A quasi-interactive approach to computer assisted instruction*

Graham, G. Scott, *A study of program and memory policy behaviour*

Kahn, Kevin C., *Program behavior and load dependent system performance*

INDUSTRIAL ENGINEERING

Gupta, Surendra Mohan, *Computer-aided selection of machining cycles and cutting conditions on multi-station synchronous machines*

Haider, Syed Wali, *An investigation of the advantages of using a man-computer interactive mode for scheduling job shops*

Shunk, Dan Louis, *The measurement of the efforts of group technology by simulation*

Wysk, Richard A., *An automated process planning and selection program APPAS*

MATHEMATICS

Dixon, David Joseph, *The fundamental divisor of normal double points of surfaces*

Hanges, Nicholas William, *Parametrices and local solvability for a class of singular hyperbolic operators*

Hopkins, Glenn Wallace, *An algebraic approach to residue symbol*

Kelley, Carl Timothy, *Convolution and H-equations for operator-valued functions with applications to neutron transport theory*

Kotman, Larry Jay, *An entire function which interpolates a family of functions with orders ranging between one and infinity*

Ladhawala, N. R., *Walsh function analogues of the Hardy space and BMO*

Pence, Dennis Dale, *Best approximation by constrained splines*

Rouch, Timothy Estel, *Hypo-convexity and lower semi-continuity*

STATISTICS

Berger, Roger Lee, *Minimax, admissible, and gamma-minimax multiple decision rules*

Casella, George C., *Minimax ridge regression estimation*

Leong, Yoon-Kwai, *Some results on subset selection problems*

Lorenzen, Thomas Jay, *Toward a more realistic formulation of the secretary problem*

Lu, Ming-Wei, *On some multiple decision problems*

University of Notre Dame (9;9,0,0,0,0,0,0)

MATHEMATICS

Barry, Michael J. J., *Parabolic subgroups of groups of Lie type.*

Bouma, Herman J., *Meromorphic functions on $M \times C^n$, M parabolic, canonical on C^n*

Harkleroad, Leon W., *Recursive equivalence types on recursive manifolds*

Kalicki, Craig A., *Infinitary propositional intuitionistic logic*

Kearns, Timothy J., Jr., *L-smooth structures for* diff(M) *orbits*

Miller, Timothy J., *Rational homotopy and Lie algebras*

Olson, Lynn J., *Blocking of the subgroup centralizer algebra*

Weyland, Nicholas John, *Construction of holomorphic functions with growth estimates to given zero sets*

Wong, Pit-Mann, *Defect relation for meromorphic maps on parabolic spaces and Kobayashi metric on projective space omitting hyperplanes*

IOWA

Iowa State University (15;0,11,0,1,3,0,0)

AEROSPACE ENGINEERING

Shankar, V. S. Vijaya, *Diffraction of a shock wave by a compression corner; regular and single Mach reflection*

Tesfamariam, Hailezghi, *The flow of a large scale general vortex near a solid boundary normal to the axis of the vortex*

COMPUTER SCIENCE

Sweet, Alan F., *Correctness in multi-user hierarchially structured information systems*

MATHEMATICS

Genalo, Lawrence James, *Optimal and suboptimal numerical solutions to a class of optimal control problems with applications to sailplane dynamics*

STATISTICS

Alders, Clarence Dean, *Generalized convex programming over cone domains*

Carter, Randy, *Instrumental variable estimation of the simple errors in variable model*

Clark, Cynthia Zang Facer, *Convergence and ergodicity for conditional distributions: Theory and applications*

Dickey, David A., *Estimation and hypothesis testing in nonstationary time series*

DuBose, Paul A., *Non-additivity in two-way experiments with multivariate data*

Emigh, Ted H., *The effects of finite population size on genetic populations with overlapping generations*

Esimai, Grace, *Regression estimation for multivariate normal distributions*

Klemm, Rebecca, *Aspects of quadratic programming with statistical applications*

Sotres, David, *Limit theorems for order statistics and rank order*

Umbach, Dale, *On the behavior of the posterior for an extreme observation in a multivariate setting*

Yang, Shie-Shien, *Concomitants of order statistics*

University of Iowa (6;4,2,0,0,0,0,0)

MATHEMATICS

Hsu, Sze-Bi, *A mathematical analysis of competition for a single resource*

Hu, Thakyin, *Isometries and mappings satisfying local Lipschitz conditions*

Merrill, Stephen J., *A mathematical model of B-cell stimulation and humoral immune response*

Rall, Douglas Frank, *A class of rings which are algebraic over the integers*

STATISTICS

Hu, Wei-Hou Cheng, *Alternatives to least squares estimates in linear regression*

O'Meara, Patrick D., *An investigation of linear rank statistics for the multiple linear regression model*

KANSAS

Kansas State University (4;1,3,0,0,0,0,0)

MATHEMATICS

Gardner, Patrick R., *Some results in Fourier analysis on groups*

STATISTICS

Applebaugh, Gwendolyn Neul, *An iterative procedure for analyzing a connected two way cross classification structure*

Houssein, Mohammed Taib, *Analysis of unbalanced models involving random effects with unequal variances*

McGee, Robert I., *Comparison of the W^* and the Z^* procedures in the covariate discriminant analysis*

University of Kansas, Lawrence (1;1,0,0,0,0,0,0)

MATHEMATICS

Gates, Catherine Louise, *A study of remote points of metric spaces*

KENTUCKY

University of Kentucky (9;3,6,0,0,0,0,0)

MATHEMATICS

Elosser, Paul Douglas, *Approximation of certain functions in the uniform and L_1 norms*

Harris, Gary Alvin, *The traces of holomorphic functions on real submanifolds*

Seeling, Ronald L., *Dirichlet series and singularities of Euler-Poisson-Darboux equations*

STATISTICS

Gupta, Ghanshyam D., *Nonparametric tests for randomness and ordered alternatives*

Lindle, Samuel Greene, *A study of orthogonal transformations and their applications to statistics*

Marx, David B., *Bayesian estimation and classification with multinomial data*

Thitakamol, Borriboon, *Extension of previous results on properties of estimators of variance components*

Venable, Thomas Calvin, Jr., *An investigation of exact tests and some asymptotic procedures for two and three dimensional contingency tables*

Weiner, Daniel Lee, *On the stochastic theory of compartments*

LOUISIANA

Louisiana State University, Baton Rouge (1;0,0,1,0,0,0,0)

QUANTITATIVE METHODS

Folse, Raymond Otis, *Quantification of selection criteria for reliability improvement warranty contracts*

Lousiana Tech University (2;1,0,0,0,1,0,0)

MATHEMATICS

Moorti, V. R. Guru, *Existence and uniqueness of solutions to certain third order boundary value problems*

Treese, George William, *The boundary of the maximal group of invertible operators and generalized Fredholm operators*

Tulane University (1;0,1,0,0,0,0,0)

MATHEMATICS

Haaland, Perry Dean, *A new approach to pattern detection*

University of Southwestern Louisiana (2;2,0,0,0,0,0,0)

MATHEMATICS

Courville, James Ronald, *On idempotents and subsystems generated by idempotents in near rings*

Khazal, Reyadh, *Periodic rings*

MARYLAND

Johns Hopkins University (6;0,5,1,0,0,0,0)

BIOSTATISTICS

DuPont, William Dudley, *A stochastic method for estimating animal abundance from catch-effort data*

Godbold, James H., Jr., *Small sample t intervals for comparisons suggested by the data*

Lee, Jeanette Yen, *Likelihood techniques for discrete distributions*

Murphy, James R., *A stochastic parameter model for fitting a non-linear function to growth in height data*

Pickle, Linda Williams, *Methods of likelihood inference for the relative risk function*

MATHEMATICAL SCIENCES

Fitzpatrick, Donwald W., *Scheduling on disjunctive graphs*

University of Maryland, Baltimore County (1;0,0,0,0,1,0,0)

MATHEMATICS

Eshleman, Linda R., *Optimal estimation and detection for rotational, directional, and axial processes*

University of Maryland, College Park (12;2,4,0,4,2,0,0)

COMPUTER SCIENCE

Davis, Larry, *Shape representation and matching*

Parikh, Josephine, *Automatic wind velocity estimation from multispectral geosynchronous satellite data: A proposal*

Stockman, George C., *A problem-reduction approach to the linguistic analysis of waveforms*

Tung, Immanuel L., *A language-acceptor type of probabilistic cellular automaton*

MATHEMATICS

Browne, Russell C., *Dynamic stability of one-dimensional non-linearly visco-elastic bodies*

Bushar, Harry, *Continuous parameter Markov chains, classification of boundary points and use of local time*

Fleming, Thomas, *Non-parametric estimation for non-time-homogeneous Markov processes in the problem of competing risks*

Harrington, David Paul, *Limit theorems for continuous time Markov branching processes with varying and random environments*

Kolata, William, *Spectral approximation and spectral properties of variationally posed, nonselfadjoint problems*

Morrison, John F., *Approximation by algebraic numbers of bounded degree*

Prestini, Elena, *On the phase problem for space curves and a restriction theorem for space curves*

MEASUREMENT AND STATISTICS

Day, Roberta, *An empirical investigation of the Fisher Z transformation in comparing two multiple correlations*

MASSACHUSETTS

Boston University (5;2,3,0,0,0,0,0)

MATHEMATICS

Heghinian, Sylva, *Empirical Bayesian estimation of a joint distribution from incomplete data*

Kenney, Margaret J., *Preparata nonlinear codes*

Marotto, Frederick R., *Chaotic behavior of linear systems with applications to ecology*

Sevin, Ann Douglas, *Small sample estimation and testing procedures for ratios of means of independent, normally distributed random variables*

Van Melle, Guy D., *Analysis of the data of the Framingham heart study by competing risks*

Brandeis University (1;1,0,0,0,0,0,0)

MATHEMATICS

Golbus, Bruce F., *Foliations and plane fields on compact manifolds*

Clark University (2;2,0,0,0,0,0,0)

MATHEMATICS

Ledbetter, Carl Scotius, Jr., *Sheaf representations and first order conditions*

Wildenberg, Gerald, *A free boundary problem for the Laplace equation: The infinite case*

Harvard University (22;11,2,0,6,3,0,0)

APPLIED MATHEMATICS

Brachman, Ronald J., *A structural paradigm for representing knowledge*

Chiou, Kuo-Liang, *The geometry of indefinite J-spaces and stability behavior of linear systems*

Davis, Mark Winslow, *Investigations in static program analysis and sharing*

Gellin, Slade, *Buckling of cylindrical shells in the plastic range*

Harrison, Don E., *On mesoscale-mean field interaction in the ocean*

Rovner, Paul, *Automatic representation selection for associative data structures*

Schutt, Clarence, *The structure of Tomato Bushy Stunt Virus*

Shum, Annie, *Queueing models for computer systems with general service time distributions*

Udin, David, *System programming languages*

MATHEMATICS

Buhler, Joe, *Icosahedral Galois representations*

Coppersmith, [illegible], *Deformations of Lie groups and Lie algebras*

Flath, Daniel Evans, *A comparison of the automorphic representations of $GL(3)$ and its twisted forms*

Goss, David, *Π-adic Eisenstein series for function fields*

Harris, Michael, *On p-adic representations arising from descent on abelian varieties*

Hoffman, Jerome William, *The Hodge theory of flat vector bundles on a complex torus*

Jochnowitz, Naomi, *Congruences between modular forms and implications for the Hecke algebra*

Kottwitz, Robert E., *Orbital integrals on GL_3*

Tunnell, Jerrold, *On the local Langlands conjecture for $GL(2)$*

Weisinger, James, *Some results on classical Eisenstein series and modular forms over function fields*

Wilson, William E., *Fusion in nonabelian groups of order p^3*

STATISTICS

Hill, Richard Walter, *Robust regression when there are outliers in the carriers*

Norton, Julia Anne, *Estimation and sequential prediction for unknown join points in broken line segment models*

Massachusetts Institute of Technology (28;21,0,0,0,2,0,5)

MATHEMATICS

Andersen, Henning Haahr, *On Schubert varieties in G B and Bott's theorem*

Dadok, Jiri, *Fourier transforms of distributions on symmetric spaces*

Diamond, Harvey Robert, *Analytic approximation in some mathematical games*

Geman, Stuart Alan, *Stochastic differential equations with smooth mixing processes*

Gessel, Ira Martin, *Generating functions and enumeration of sequences*

Griggs, Jerrold Robinson, *Symmetric chain orders, Sperner theorems, and loop matchings*

Gutmann, Samuel Chaim, *Nonstationary Markov transitions*

Hirschhorn, Philip Steven, *On the "stable" homotopy type of knot complements*

Huibregtse, Mark Edward, *The Albanese mapping for the Hilbert scheme of an algebraic surface*

Irving, Ronald Scott, *Prime ideals of skew polynomial rings*

Johnson, David Lewis, *A normal form for curvature*

Koenigsberg, Mark, *Nonlinear convective aggregation and drift of diffusive heat sources*

Krevitt, James Stephen, *The Kervaire invariant of manifolds with trivial total Stiefel-Whitney class*

Kuipers, Benjamin Jack, *Representing knowledge of large-scale space*

Leite, Maria Luiza Soares, *On metrics of R^3 with nonnegative scalar curvature*

Magnus, Alfred Ewald, *Nonspherical principal series representations of semisimple Lie groups*

Michener, Edwina Luane Rissland, *Epistemology, representation, understanding and iterative exploration of mathematical theories*

Morin-Strom, Karl Arvid, *Witt theorems for lattices over discrete valuation rings*

Neuman, Gerald L., *Extra vector fields on algebraic surfaces*

Orsted, Bent, *Wave equations, particles and chronometric geometry*

Prevot, Kenneth Joseph, *Equivariant cutting and pasting of manifolds*

Ribeiro Filho, Henrique Browne, *Hyperspace foliations and hyperbolic immersions*

Speh, Birgit Else Marie, *Some results on principal series of $GL(n, R)$*

Teleman, Neculai Sinel, *Global analysis on PL-manifolds*

Tinkelman, Robert Paul, *Some consequences of infinite exponent partition*

Uhlmann, Gunther, *Hyperbolic pseudodifferential-operators with double characteristics*

Vainsencher, Israel, *Some problems on enumerative geometry*

Vogan, David Alexander, Jr., *Lie algebra cohomology and the representations of semisimple Lie groups*

University of Massachusetts, Amherst (7;1,0,0,5,1,0,0)

COMPUTER AND INFORMATION SCIENCE

Burt, Peter J., *Stimulus organizing processes in stereopsis and motion perception*

Montalvo, Fanya S., *Visual feature organization and interaction as modelled in neural networks*

Stanley, James C., *Network models of habituation*

Hegner, Stephen J., *Applications of topological vector spaces to linear system theory*

Stemple, David W., *A database management facility and architecture for the realization of data independence*

MATHEMATICS AND STATISTICS

Harris, Mark, *A priori estimates for a class of nonlinear problems and applications*

Nyman, Terry A., *The Hasse principle and algebras over function fields of genus 0 and 1*

MICHIGAN

Michigan State University (15;2,4,0,3,4,1,1)

COMPUTER SCIENCE

Chen, Tze Tzong, *The path checking method for detection and diagnosis of faults in digital circuits*

Grover, Larry Lee, *Fault detection: State behavior, machine decomposition and economics*

Liou, Jiunn-I, *Grammatical inference by constructive method*

MATHEMATICS

Beadle, Allen Jay, *Distance preserving maps*

Green, David, Jr., *Hopf's bifurcation for non-linear functional differential equations with applications to epidemic models*

Hoover, Wayne E., *Numerical methods in multiple integration*

Lindenfeld, Israel, *A perturbation technique for ordinary differential equations with periodic coefficients*

Nelson, Roger Bruce, *Some fiber preserving involutions on 3-dimensional handlebodies*

Shaughnessy, James Michael, *A clinical investigation of college students' reliance upon the heuristics of availability and representativeness in estimating the likelihood of probabilistic events*

Stech, Harlan West, *Contributions to the theory of functional differential equations with infinite delay*

Waller, Nancy Theresa, *Bifurcation theory with applications to chemical reaction equations*

STATISTICS AND PROBABILITY

Eyster, Janet T., *Asymptotic normality of simple random rank statistics under the alternatives*

Phoha, Shashi P., *On algorithms for nonlinear prediction*

Ruppert, David F., *Stochastic approximation*

Wu, Ching-Jung, 1) *Contributions to construction of optimal design using the method of sum composition*, 2) *Contributions to the theory of repeated measurements design*

University of Michigan (19;13,0,0,4,2;0,0)

COMPUTER AND COMMUNICATION SCIENCES

Hamilton, James Arnold, *Performance analysis of multilevel paging hierarchies*

Melamed, Benjamin, *Analysis and simplifications of discrete event systems and Jackson queueing networks*

Sanguinetti, John Winston, *Performance prediction in an operating system design methodology*

MATHEMATICS

Avrunin, George Samuel, *Second degree cohomology of groups of Lie type*

Bell, Gregory Wade, *Cohomology of degree 1 and 2 of some Chevalley groups*

Bester, Michal, *Local flat duality of Abelian varieties*

Fink, John Bergeman, *Flag-transition projective planes of odd order*

Finster, Mark Philip, *Optimal stopping for autoregression schemes*

Harding, Leonard J., Jr., *Complex error analysis and the fast Fourier transform*

Jespersen, Dennis Charles, *A least squares decomposition method for the numerical solution of elliptic partial differential equations*

Kusefoglu, Ayse Soysal, *The second degree cohomology of finite orthogonal groups*

Lee, Youn Woo, *Surgery on diffeomorphism*

McKenna, Patrick Joseph, *Non-selfadjoint semilinear problems in the alternative method*

Ricci, Stephen John, *Local distribution of primes*

Roan, Raymond Craig, *Generators and composition operators*

Schonbek, Maria Elena, *Boundary value problems for the Fitzhugh-Nagumo equations*

Smith, Randolph Gordon, *The Riemann problem in gas dynamics*

Steeg, Manfred, *Finite p-groups with trivial Schur-multiplier*

Williams, Lawrence Ray, *On quasisimilarity of operations on Hilbert space*

Wayne State University (4;2,2,0,0,0,0,0)

MATHEMATICS

Grispolakis, Joachim, *Confluent and related mappings defined by means of quasi-components*

Nita, Valerian M., *Meromorphic functions whose global cluster sets contain regular points*

Radin, Ted, *The power of statistical tests computed under the null hypothesis*

Snabb, Thomas Edward, *Statistical inference concerning the change point in a sequence of independent random variables*

Western Michigan University (3;0,0,0,0,0,3)

MATHEMATICS

Benedict, James M., *On Ramsey numbers defined by factorizations of regular complete multi-partite graphs*

Garman, Brian L., *Cayley graph imbeddings and the associated block designs*

Straight, H. Joseph, *Partitions of the vertex set or edge set of a graph*

MINNESOTA

University of Minnesota, Minneapolis (12;5,2,0,1,1,0,3)

BIOMETRY

Fryd, David S., *Analysis of kidney transplant data*

Matts, John M., *Randomization theory in the analysis of accrual clinical trial designs*

Palta, Mari S., *Sample size determination for clinical trials*

COMPUTER SCIENCE

Berg, Helmut, *A computer architecture based on ordered sets as primitive data entities*

MATHEMATICS

Davis, Linda Marie, *Self-reflexive Banach spaces*

Farmer, Thomas Allen, *On certain degenerate principal series of representations of $SP(N, C)$*

Johnson, David Lee, *The theory of distributions on locally compact groups with applications to group representations*

Kang, Hee Kyung, *A general definition of convolution for distributions*

Landgren, John Jeffrey, *Essential self-adjointness of Dirac operators*

Satzer, William Joseph, Jr., *Canonical reduction of mechanical systems invariant under Abelian group actions with an application to celestial mechanics*

STATISTICS

Lin, Hsien Elsa, *On some aspects of the classification problem*

Thibodeau, Lawrence Alcidos, *Robust design for regression problems*

MISSOURI

St. Louis University (1;0,0,0,1,0,0,0)

MATHEMATICS

Kappel, Michael William, *LAPAC: A computer package for solving the Laplace transform*

University of Missouri, Kansas City (3;3,0,0,0,0,0,0)

MATHEMATICS

Berg, John, *The growth of entire and meromorphic functions and generalized exceptional values*

Sanders, Ross J., *Local connectedness properties of hyperspaces of continua*

Singh, Anand, *Applications of Nevanlinna theory to differential polynomials, differential equations, and deficient values*

University of Missouri, Rolla (4;2,0,1,0,1,0,0)

MATHEMATICS

Bruening, James T., *Inverses of transfer function matrices*

Guccione, Salvadore J., Jr., *Probabilistic foundations of general quantum theories and characterizations of representation spaces*

Huffman, Ed W., *Strict convexity in locally convex spaces and fixed point theorems in generalized Hilbert spaces*

Richards, James L., *Solving mixed-integer quadratic programs by sequential contour contraction techniques*

Washington University (2;2,0,0,0,0,0,0)

MATHEMATICS

Chao, Minna Ming Mao, *Harmonic analysis of a second-order singular differential operator associated with non-compact semi-simple rank-one Lie groups*

Cohen, Jonathan, *Multilinear singular integrals*

MONTANA

University of Montana (2;1,0,0,0,0,0,1)

MATHEMATICS

Deane, Vilas E., *Topics in categorical topology*

Smith, Henry Paul, *Resolvable and doubly resolvable designs with special reference to the scheduling of duplicate bridge tournaments*

NEBRASKA

University of Nebraska, Lincoln (5;5,0,0,0,0,0,0)

MATHEMATICS AND STATISTICS

Franke, William Tadd, *Fractional derivatives and orders of distributions*

Hardy, Bonnie R., *Arithmetical semigroup rings*

Petersen, Edith Kregelius, *On distributions of compact support*

Petersen, Loren V., *On Banach function spaces and l_p-sums of Banach spaces*

Sarma, Ivatury Ramabhadra, *Means with values in a Banach lattice and some results on tensor products*

NEW HAMPSHIRE

Dartmouth College (2;1,0,0,0,0,0,1)

MATHEMATICS

Gordon, Jean, *Applications of the exterior algebra to graphs and linear codes*

Moore, Emily Hoel, *Double circulant codes and related algebraic structures*

NEW JERSEY

Princeton University (16;14,2,0,0,0,0,0)

MATHEMATICS

Brown, Scott Shorey, *Bounds on transfer principles for algebraically closed and complete discretely valued fields*

Charney, Ruth M., *Homological stability for the general linear group of a principal ideal domain*

D'Angelo, John P., *Real hypersurfaces with degenerate Levi form*

Garrett, Paul B., *Arithmetic automorphic forms for quaternion unitary groups*

Geller, Daryl Neil, *Fourier analysis on the Heisenberg group*

Lindley, John Earle, *Fiber differential equations and Lie equations: Linear theory*

Marshall, Bernard Paul, *Tempered nontangential boundedness and pointwise differentiability of distributions*

Morgan, Frank, *Almost every curve in $\mathbf{R}^3$ bounds a unique area minimizing surface*

Norton, Vern Alan, *Moduli spaces of complex vector bundles*

Phong, Duong Hong, *On Hölder and L^p estimates for the $\bar{\partial}$ equation on strongly pseudo-convex domains*

Rasmussen, Ole Hjorth, *Non-vanishing and continuous variation of exotic characteristic classes for foliations*

Sturm, Jacob, *Eisenstein series of half integral weight*

Thomason, Robert Wayne, *Homotopy colimits in* cat, *with applications to algebraic K-theory and loop space theory*

Wolpert, Robert L., *Wiener path intersections and Euclidean field theory*

STATISTICS

Quon, Tony Kwok Sen, *Optimal invariant estimation of location for very small samples*

Turner, John Charles, *The statistical analysis of computer system behavior*

Rutgers University, New Brunswick (15;15,0,0,0,0,0,0)

MATHEMATICS

Becerra-Bertram, Edgar José, *Some homotopy equivalent knot complements*

Bergamasco, Adalberto, *Parametrices of elliptic boundary value problems*

Campoli, Oscar Antonio, *The complex Fourier transform for rank-1 semi-simple Lie groups*

Conjura, Edward J., *Solvable extensions for linear and nonlinear operators, the nature of their domains, and error analysis for approximate solutions and residuals*

Daccach, Janey A., *The signature and the Kervaire invariant as cobordism invariants*

Dotzel, Ronald, *Finite group actions and homology spheres*

Glaz, Sarah, *Finiteness and differential properties of ideals*

Grieco, Linda Anne, *Some maximal subgroups of linear groups*

Lee, Shyh-ling, *A new approach to the Daniell integral*

Mallory, Walter, *A representation theorem for Suslin cylindrical algebras*

Miatello, Isabel Graciela, *Extension of actions on Stiefel manifolds*

Miatello, Roberto Jorge, *The Minakshisundaram-Pleijel coefficients for the vector valued heat kernel on compact locally symmetric spaces of negative curvature*

Schwartz, Charles, *On rational solutions of certain Weierstrass equations*

Silverstein, Anna, *A generalization of combinatorial operators and an application to Gaussian numbers*

Wong, Roman Woon-Ching, *Some projective free ringoids*

Stevens Institute of Technology (7;5,0,0,2,0,0,0)

MATHEMATICS

Hesselgrave, Mary R., *Formal definition of programming language statements*

Kent, William H., Jr., *Asymptotic expansions of certain Fourier integrals with kernels having degenerate critical points*

Lipper, Edward H., *A multiplicative perturbation approach to backward error analysis for systems of linear algebraic equations*

Peters, James V., *Radon transforms over the real and complex domain*

Sack, Ira H., *Selected abstract logics*

Sarian, Edward, *Some applications of direct integral decompositions of W^*-algebras*

Zeitz, William A., *Generalized hierarchic retrieval language (GENHRAL)*

NEW MEXICO

New Mexico State University (4;3,0,0,0,1,0,0)

MATHEMATICAL SCIENCES

Al-Khafaji, Mahmoud, *A topological approach to the theory of distributions on o-dimensional groups and local fields*

Cooper, Yonina S., *Finite valuated groups*

Engebos, Bernard Francis, *Introduction to multiple state multiple action decision theory with relation to mixing structures*

Ota, Clem Zensho, *Spectral synthesis of bounded, coset constant functions on a local field*

University of New Mexico (6;1,4,0,0,1,0,0)

MATHEMATICS AND STATISTICS

Davis, Charles B., *The use of prior observations in constructing prediction intervals for the normal distribution*

Salazar, Tomás Eufracio, *An abstract matrix model: The column model*

Sanderson, James G., *A proof of convergence for the tridiagonal QL algorithm in floating-point arithmetic*

Tang, Chi-Ming, *Estimate hazard functions by spline functions*

Torrez, William C., *Birth and death process in a random environment*

Williams, Raymond Edward, *Estimation of parameters in acceleration models*

NEW YORK

Adelphi University (6;2,0,0,0,3,0,1)

MATHEMATICS

Jacobs, Elliott, *Nonstandard partial difference equations*

Just, Erwin, *On properties of diagonalizations of certain sequences*

Korchinski, Dennis J., *Solution of a Riemann problem for a 2×2 system of conservation laws possessing no classical weak solution*

Olayi, Gabriel Atah, *Finite elements in the finite element method*

Steuer, Michael, *The density theorems of additive number theory and Abelian groups: An historical exposition*

Vojir, William M., *Asymptotic growth of the correlation function for solutions to randomly excited undamped linear equations*

City University of New York, Graduate Center (5;3,0,0,0,2,0,0)

MATHEMATICS

Jacobs, Neal Henry, *Deep buckling of a thin oblate spheroidal shell under uniform normal pressure*

Levenglick, Arthur, *Characterizations of a social decision function*

Scholnick, Allen, *Representations in non-complete categories with applications to localization theory*

Strassberg, Helen, *L-functions and automorphic forms: An application of the Poisson summation formula*

Thomson, Michael, *Subgroups of finitely presented solvable linear groups*

Columbia University (10;7,2,0,1,0,0,0)

MATHEMATICAL STATISTICS

Lee, Neng-Rong, *Sequential test for finite population*

Proulx, Viera, *Classification of toroidal groups*

Switalski, France-Helene, *Contribution to the theory of embeddability and identification for Markov and some Markov related processes*

MATHEMATICS

Chu, Tienchen, *The Weil-Petersson metric in the moduli space*

Goldstein, Gerald, *On the real connected components of modular curves*

Huang, Julia, *Primes and zeros in short intervals*

Kupferwasser, Marcelo, *On incompressible surfaces embedded in handlebodies*

Luk, Hing-Sun, *Normalization of differential equations defining a CR structure*

Riera, Gonzalo Guillermo, *Semi-direct products of Fuchsian groups and uniformization*

Russell, Gary Lloyd, *Two generator subgroups of $SL(2, C)$ and the modulus function*

Cornell University (30;10,3,0,12,5,0,0)

APPLIED MATHEMATICS

Dechert, W. Davis, *An application of Banach space techniques to discrete time optimal control problems in economics*

Harding, Gary C., *Some budgeted optimization problems and the edge-disjoint branchings problem*

Harlow, D. Gary, *Probabilistic models for the tensile strength of composite materials*

Knopf, Peter M., *Weak-type multipliers*

Winther, Ragnar, *A numerical Galerkin method for a parabolic control problem*

BIOMETRICS

Macken, Catherine Ann, *Towards a stochastic model for the growth of a migratory bird population*

Rosenberger, James L., *Hypothesis tests of homogeneity of means versus monotone concave alternatives*

COMPUTER SCIENCE

Berman, Leonard Charles, *Polynomial reducibilities and complete sets*

Clarke, J. Edmund Melson, *Completeness and incompleteness theorems for Hoare-like axiom systems*

Duhne, Ricardo A., *Optimal design of a generalized file organization*

Howell, Thomas D., *Tensor rank and the complexity of bilinear forms*

Kozen, Dexter C., *Complexity of finitely presented algebras*

Lafuente, Juan Mendez, *The specification of data-directed interactive user-computer dialogues*

London, Thomas B., *The semantics of information flow*

Mei, Howell Hung-Wei, *An analysis and implementation of Davidon's techniques for unconstrained optimization*

O'Donnell, Michael James, *Reduction strategies in subtree replacement systems*

Pansiot, Jean-Jacques, *Some decidable cases of the reachability problem for vector addition systems*

Solomon, Marvin Harry, *Theoretical issues in the implementation of programming languages*

Tai, Kuo-Chung, *Syntactic error correction in programming languages*

MATHEMATICS

Cheng, Ching-Shui, *Optimal designs for the elimination of heterogeneity*

Ehrlich, Karel, *Finiteness obstructions of fiber spaces*

Gold, Bonnie, *Compact and w-compact formulas*

Gray, Lawrence F., *Controlled spin-flip systems*

Ichihara, Kanji, *Some global properties of symmetric diffusion processes*

Jones, Alan Kenneth, *Spaces which are Hilbert cube manifolds*

Kalantari, Iraj, *Structural properties of the lattice of recursively enumerable vector spaces*

Kleinstein, Jerrold Lewis, *Abstract Witt rings*

Lamm, Thomas Madison, *A dual reciprocity map for local fields*

MacDermot, Alan David, *A lattice approximation to the Y_2 quantum field theory and a correlation inequality*

Ritter, Grant Alden, *Random walk in a random environment, critical case*

New York University, Courant Institute (11;6,0,0,1,2,0,2)

MATHEMATICS AND COMPUTER SCIENCE

Adler, Mark A., *Some finite dimensional integrable systems*

Conn, Gerard W., *Some mathematical problems arising in the study of magnetohydrodynamics with the Hall effect*

Hyman, James M., *The method of lines solution of partial differential equations*

Karp, Leon, *Vector fields on manifolds*

McIntyre, Eldon A., Jr., *Design of transonic cascades by conformal transformation of the complex characteristics*

Paes-Leme, Paulo Jorge S., *Ornstein-Zernike and analyticity properties for classical lattice spin systems*

Rezny, Michael A., *Minimal complete cores in quadratic number fields*

Rosenberg, Richard, *Recursively enumerable images of arithmetic sets*

Rubin, Norman, *A hierarchical technique for mechanical theorem proving and its application to programming language design*

Swartz, G. Boyd, *Polling with unequal arrival rates*

Trubowitz, Eugene B., *The inverse problem for periodic potentials*

Polytechnic Institute of New York (4;3,0,0,0,1,0,0)

MATHEMATICS

Calabro, Mary, *Lattice measures on M-replete spaces*

Edelson, William, *An investigation of accelerated convergence in the Monte Carlo of algebraic eigenproblems*

Forastiero, Diane J., *Subgroups of the linear groups SL(2, I) for certain integral domains I*

Strasser, Edward F., *Lattice-regular measures*

Rensselaer Polytechnic Institute (11;1,3,2,0,5,0,0)

MATHEMATICAL SCIENCES

Barry, Marian R., *Numerical solution of a class of random boundary value problems*

Goulet, John A., *Hyperbolic boundary value problems in a complete normed linear space*

Kostreva, Michael Martin, *Direct algorithms for complementarity problems*

Mong, Christopher Chsiu, *The effects of hydrostatic pressure and wall elasticity on standing gradient (osmotically driven) flow in physiological tubules*

Nairn, Dean C., *Best simultaneous approximation in a normed linear space*

Pate, Edward F., *A new model of oscillating chemical signaling in cellular slime mold aggregation*

OPERATIONS RESEARCH AND STATISTICS

Blair, Eric L., *Planning models for burns care*

Brothers, Kent Montgomery, *Robust data analysis using alternate error models*

Bryant, John L., *Some data analysis procedures based on the empirical characteristic function*

Helme, Marcia P., *A decision model for allocating funds to family planning clinics*

Rutherford, David K., *Some new approaches to the assessment of risk in non life insurance applications*

SUNY Center at Binghamton (3;1,1,0,0,0,0,1)

MATHEMATICAL SCIENCES

Dibner, Steve, *Heegaard splittings for an infinite family of closed orientable three-manifolds*

Mukerjee, Hari G., *Stochastic approximations using isotonic regression*

Woodworth, Patricia Ann, *An analytic approach to problems connected with plane tree enumeration*

SUNY Center at Buffalo (4;0,2,0,2,0,0,0)

COMPUTER SCIENCE

Chen, David Ta-Wei, *Analogical reasoning, learning and problem solving with application to theorem proving and construction in plane geometry*

Liu, Hsun Kao, *Three-dimensional surface finding and display of moving objects*

COMPUTER SCIENCE, STATISTICAL SCIENCE DIVISION

Carmichael, Jean-Pierre, *The autoregressive method: A method of approximating and estimating positive functions*

Sommer, Charles, *Analysis of time-dependent data subject to censoring with applications to clinical trials*

SUNY Center at Stony Brook (25;9,0,0,9,7,0,0)

APPLIED MATHEMATICS AND STATISTICS

Durack, Donald Lee, *Boundary equations for the numerical solution of mixed hyperbolic problems*

Farahzad, Darviz, *On numerical solution of differential equations for a network of exchanging flow tubes*

Juang, Ling Ling Chen, *Solution of bordered type nonlinear equations*

Lee, Tze-san David, *On the optimal approximate solution of linear operator equations with inadequate data*

Tsien, Dar-Sun, *Nonlinear parameter estimation in remote sensing problems*

Tsimis, Emmanuel, *On the inverse problem by means of the integral equation of the first kind*

COMPUTER SCIENCE

Agarwal, Krishna Kumar, *Transformation and canonization algorithms for graph representable structures with applications to a heuristic program for the synthesis of organic molecules*

Anbalagan, Reddiar Seetharaman, *A sequential classifier design for automatic leukocyte recognition*

Boivie, Richard, *Heuristic search guidance and subgoal analysis in the SYNCHEM II organic synthesis discovery program*

Ekanadham, K., *Context approach to protection*

Liu, Huei-chi, *Shape description and characterization of continuous change*

Lowy, Harvey, *Design of a distributed data base management system for a distributed homogeneous computer network*

Scheuermann, Peter, *A simulation model for data base systems*

Silberschatz, Abraham, *Correctness and modularity in asynchronous systems*

Styborski, Joseph, *Denotational semantic models for high level statement oriented programming languages*

MATHEMATICS

Baker, Daniel R., *On a class of foliations and the evaluation of their characteristic classes*

Dodson, Bruce Allen, *Dirichlet series associated to affine manifolds*

Friedel, Henry Nehemiah, *One conservation law in one space variable*

Gentilesco, James A., *Automorphisms of the deformation space of a Kleinian group*

Huang, Hua-Min, *Pinching of Riemannian manifolds*

Patton, Charles, *Classification of relativistic n-particle dynamics*

Rockett, Andrew Mansfield, *The metrical theory of continued fractions to the nearer integer*

Shavel, Ira H., *On surfaces obtained from quaternion algebras over real quadratic fields*

Tupitsyn, Victor G., *The distribution connected with the dynamical system generated by a semi-group of rotations*

Zoltek, Stanley Michael, *On the zeroes of nonnegative curvature operators*

Syracuse University (8;3,0,0,5,0,0,0)

COMPUTER AND INFORMATION SCIENCE

Dasgupta, Sumit, *Dual-mode logic for function-independent*

Durgun, Kanat, *Method of repet. rank reduction and multiple correction for the numeric solution of the Fredholm integral equations of the second kind*

Gabrovsky, Peter N., *Models for an axiomatic theory of computability*

Singhania, Ashok K., *A multiple associative-memory system for pipelining a directory to a very large data base*

Tosun, Oguz, *On reliable computation via noisy devices*

MATHEMATICS

Baglivo, Jenny Antoinette, *Equivariant Wall obstruction theory*

Evans, Michael J., *Homomorphisms of Banach algebras and Banach modules*

Friske, Melvin J., *Growth and almost periodicity of Dirichlet series with random signs*

University of Rochester (4;2,2,0,0,0,0,0)

MATHEMATICS

Giuffre, Michael Salvatore, *Structurally stable approach to equilibrium in the presence of phase transitions*

Goncalves, Daciberg Lima, *Mod 2 group and Mod 2 homotopy associative H-space*

STATISTICS

Chaubey, Yogendra, *The principle of minque in linear models: Modifications, extensions and applications*

George, Ebenezer Olesegun, *Combining independent one-sided and two-sided statistical tests—some theory and applications*

Yeshiva University (3;2,0,0,0,1,0,0)

MATHEMATICS

Ben-Jacob, Marion, *Trace properties of self-commutators of hyponormal operators*

Fleischmann, Joseph, *Several limit theorems for branching random fields*

Van de Kopple, Julius, *A mathematical theory of musical combination tones*

NORTH CAROLINA

Duke University (5;5,0,0,0,0,0,0)

MATHEMATICS

Battle, Guy Arthur, III, *Application of Banach algebra techniques to the equilibrium statistical mechanics of continuous, infinite systems*

Chen, Keh-hsun, *Recursive well-founded orderings*

Cohen, Jo-Ann Deborah, *Locally bounded topologies on the quotient field of a Dedekind domain*

Conroy, Joseph Lawrence, *The finite dimensional Riesz subspace structure of Banach lattices and applications to the theory of nonstandard hulls*

Lutz, Jo Ann, *Correspondences and admissible polynomials*

North Carolina State University, Raleigh (6;0,3,0,0,0,1,2)

MATHEMATICS AND SCIENCE EDUCATION

Cole, Robert Edward, *The effects of placement and alternate methods of instruction in a community college developmental algebra course*

STATISTICS

Derrick, Frederick William, *The work decision of college students*

Kirk, Herbert Julien, *The application of trend analysis to agricultural field trials*

Miller, Frederick John, *A mathematical model of transport and removal of ozone in mammalian lungs*

Shiffer, Irwin Jack, *A mathematical model of addiction dynamics*

Zarate, Guillermo Pedro, *Directionally minimax mean square error estimation in linear models*

University of North Carolina, Chapel Hill (20;3,11,2,4,0,0,0)

BIOSTATISTICS

Blackwelder, William C., *Statistical methods for detecting genetic linkage from sibship data*

Greene, Sandra B., *Medical care utilization patterns in a rural area: A study of shopping behavior*

Majumdar, Hiranmay, *Generalized rank tests for progressive censoring procedures*

Raynor, William J., Jr., *Matching on a continuous variable in case-control studies*

Schonfeld, Warren Hal, *A stochastic model of physician distribution and its application to program planning and evaluation*

COMPUTER SCIENCE

Ahuja, Vijay, *Exposure of routed networks to deadlock*

Bentley, Jon Louis, *Multidimensional divide and conquer*

Koster vel Kotlarz, Alexis, *Study of closed applicative languages*

Zarling, Raymond Lewis, *Numerical solution of nearly decomposable queueing networks*

MATHEMATICS

Faigle, Ulrich Wolfgang, *Geometries on partially ordered sets*

Gurganus, Kenneth Rufus, *φ-like holomorphic functions*

Payne, Dean, *A differential geometric approach to hyperbolic first order systems in two independent variables*

OPERATIONS RESEARCH AND SYSTEMS ANALYSIS

Links, Graham, *A finite primal integer programming algorithm using facial cuts*

Seila, Andrew Frederick, *Quantile estimation methods in discrete event simulations of regenerative systems*

STATISTICS

Hsu, Chin-Fei, *Tests for finite mixtures of distributions*

Miller, Grady W., III, *Some results on symmetric stable distributions and processes*

Nam, Yong-Wha, *A new generalization of James and Stein's estimators in multiple linear regression*

Stokes, Sarah Lynne, *An investigation of the consequences of ranked set sampling*

Walker, Joseph James, *Some statistical procedures based on distances*

Watts, John Henry Vernon III, *Limit theorems and representations for order statistics from dependent sequences*

OHIO

Bowling Green State University (3;3,0,0,0,0,0,0)

MATHEMATICS

Blair, Janet D., *On manifold groups*

Franchello, James, *On the structure of free products of lattice ordered groups*

Smith, Jo Ellen, *The lattice of l-group varieties*

Case Western Reserve University (10;4,1,4,0,0,0,1)

MATHEMATICS AND STATISTICS

Brogan, Bryce James, *Generalized vanishing theory in the nilpotent categories*

Debanne, Sara Marta, *A queueing process in which two repairmen service several machines*

Franks, Eugene W., *Boundary behavior of a class of schlicht functions*

Haas, Robert, *Naturality of the Grothendieck spectral sequence*

Papanicolaou, Andreas C., *The distribution of the number of changes of sign for sums of random variables*

Thiel, Mark, *Invariants of graphs and combinatorial manifolds*

OPERATIONS RESEARCH

Anvari, Moshen, *The problem of collecting cash sale revenues from geographically dispersed locations*

George, Thomas, *Impact of inflation on financial statements: Implications for investors and corporate managers*

Gudapati, Krishna, *A multi-item (and multi-stage) multi-period production scheduling model with constraints*

Parakh, Bomi Pirojshaw, *Traffic signal design via interactive simulation and real-time graphical display*

Kent State University (1;1,0,0,0,0,0,0)

MATHEMATICS

Morrison, Terry J., *Denjoy integration in Frechet spaces*

Ohio State University, Columbus (14;3,0,0,5,0,0,6)

COMPUTER AND INFORMATION SCIENCE

Cheng, Tu-Ting, *Design consideration for distributed data bases in computer science*

Gudes, Ehud, *The application of cryptography to data base security*

Isaacs, Dov, *Computer operating system facilities for the automatic control and activity scheduling of computer-based management systems*

Krishnaswamy, Ramachandran, *Methodology and generation of language translators*

Leggett, Ernest W., Jr., *Tools and techniques for classifying NP-hard problems*

MATHEMATICS

Alspach, Dale Edward, *On operators on classical Banach spaces*

Astbury, Kenneth Alan, *Amarts indexed by directed sets and other topics*

Barnes, Martha Lynn, *Embedding geometric lattices and combinatorial designs into projective geometries or symmetric block designs*

Catlin, Paul Allen, *Embedding subgraphs and coloring graphs under external degree conditions*

Ching, Wai-Sin, *Linear discrete time systems over commutative rings*

Denig, William Allen, *A class of combinatorial geometries arising from partially ordered sets*

Gbur, Mary Flahive, *On the minima of indefinite binary quadratic forms*

Nemzer, Daniel Edward, *Characterization of line graphs*

Yoder, Jeffry Allgier, *Measure in locally totally bounded proximity spaces*

Ohio University, Athens (2;2,0,0,0,0,0,0)

MATHEMATICS

Davis, Sheldon W., *A study of certain classes of isocompact spaces and of the relationships among them*

Konrad, Michael D., *A mathematical structure*

University of Cincinnati (3;3,0,0,0,0,0,0)

MATHEMATICS

Coffey, Shannon, *Application of in-dimension Sturmien theory to a class of nonlinear problems*

Hollingsworth, Mark, *Typically real functions of order P*

Lyzzaik, Abdullah, *Multivalent linearly accessible functions on close-to-convex functions*

OKLAHOMA

Oklahoma State University (5;0,5,0,0,0,0,0)

STATISTICS

Chen, Pao-liang, *On the joint distribution of coverages*

DuBien, Janice Lynn, *Comparative techniques for the evaluation of clustering methods*

Gibson, James Edward, *Closed sequential procedures for testing hypothesis about the parameter of a Rayleigh distribution*

Shah, Arvind K., *Analysis of binary data in designed experiments*

Tsai, Huei-Chu, *Estimation of a linear regression model when the variance is a linear function of unknown parameters*

University of Oklahoma, Norman (3;2,0,0,1,0,0,0)

MATHEMATICS

Oldroyd, Andrew, *Algebras of a computer integer arithmetic system*

Reekie, Gilbert Michael, *Covering refinements, collectionwise normality, and related properties*

Roark, Charles Winfred, *Separable criteria for G-diagrams over commutative rings*

OREGON

Oregon State University (5;3,1,0,0,1,0,0)

MATHEMATICS

Kan, Joseph T., *Paley-Wiener theorems with convex weight functions*

Ng, Mary Jeanne Pe, *The Zp(t)-adequacy of pure polynomials*

Parker, Phillip E., *Singular geometry and geometric singularities*

Stynes, Martin J. A., *An algorithm for the numerical calculation of the degree of a mapping*

STATISTICS

Jacroux, Michael Allen, *On the theory of (M, S) optimality in incomplete block designs*

University of Oregon (4;4,0,0,0,0,0,0)

MATHEMATICS

Bhattarai, Hom Nath S., *Orbit space geometries and probability groups*

Fernandez, James William, *Decompositions of double coset and orbit spaces*

Jajodia, Sushil, *Low dimensional CW-complexes with one-relator fundamental group*

Kornya, Peter Istvan, *Transitive extensions of the symmetric and alternating groups*

PENNSYLVANIA

Bryn Mawr College (2;2,0,0,0,0,0,0)

MATHEMATICS

Navarro, Francisco J., *Topologically equivalent measures in the Cantor space*

Prasad, Vidhu Shekhar, *Homeomorphic measures in the Hilbert cube*

Carnegie-Mellon University (12;1,2,0,7,2,0,0)

COMPUTER SCIENCE

Clark, Douglas Wells, *Problems of memory design for a LISP computer*

Cohen, Ellis Saul, *Problems, mechanisms and solutions*

Levin, Roy, *Program structures for exceptional condition handling*

Mason, Philip Howard, *Design tools for evaluating multiprocessor programs*

Price, Keith Edward, *Change detection and analysis in multi-spectral images*

Rychener, Michael David, *Production systems as a programming language for artificial intelligence applications*

MATHEMATICS

Balenovich, Donald Allen, *Existence and stability results for abstract Volterra integral equations*

Berger, Marc Aron, *Stochastic Ito-Volterra equations*

Perlik, Andrew T., *Some additional remarks on hereditary laws and hereditary integral equations*

Werschulz, Arthur Gustav, *Computational complexity of one-step methods for the numerical solution of initial value problems*

STATISTICS

Monahan, John Francis, *Estimation in the presence of a mixing distribution with and without structural parameters*

Shore, Robert Wayne, *A Bayesian approach to the spectral analysis of stationary time series*

Drexel University (1;0,1,0,0,0,0,0)

MATHEMATICS

Littman, Gary Stephen, *Development and validation of a non-Markovian stochastic model for the Taichung medical IUD experiment*

Lehigh University (3;3,0,0,0,0,0,0)

MATHEMATICS

Corwin, Edward Monroe, *Rings of euclidean type*

Fadyn, Joseph Nicholas, *The module structure of* EXT(*A*,*B*) *over the endomorphism rings of A and B*

Miller, John Frederick, *Generalized Lototsky summability*

Pennsylvania State University (8;2,3,0,2,1,0,0)

COMPUTER SCIENCE

Leung, Joseph Yuk-Tong, *Fast algorithms for packing problems*

Whitten, Douglas E., *Design and implementation of a programming system for the production of transportable software*

MATHEMATICS

Kothmann, Margret Frances, *On the ranks of partitions*

Morton, Robert D., *Polynomials orthogonal with respect to weight distribution*

White, Edward Thomas, *Ordered sums of group elements*

STATISTICS

Ahn, Yunkee, *Multi-server queueing systems with various rules*

Friday, Dennis Sigmund, *A generalized multivariate life distribution and its special cases, models, properties, independent transformations and related results*

Schrader, Ronald M., *Robust inference based on M-estimates in the linear model*

Temple Universtiy (7;3,1,0,0,0,0,3)

BIOMETRICS

Altan, Stanley S., *A computer simulation study of five competing test statistics for paired comparison experiments*

Huber, Paul B., *The use and small sample properties of some nonparametrics tests in the analysis of data from multiclinic studies*

Mercado-Lugo, Roberto, *Generalized residual effects designs*

Vaisrub, Naomi, *Health status indices for metropolitan areas*

MATHEMATICS

Bressoud, David M., *Proof and generalization of certain identities conjectured by Ramanujan*

Jacobson, Elaine M., *Non-locally convex sets and a characterization of the weakly almost periodic functions*

Mucci, Richard L., *Limit theorems for extremes*

University of Pennsylvania (5;3,2,0,0,0,0,0)

MATHEMATICS

Goto, Midori, *Manifolds without foci points*

Howe, Douglas James, *Abelian group theory in a topos*

McGovern, Richard J., *Quasi-free derivations on the canonical anticommutation relation algebra*

STATISTICS

Dummer, R. Michael, *Scaling of contingency tables for discriminant analysis*

Tama, Judith T., *A theoretical investigation of stepwise linear discriminant analysis*

University of Pittsburgh (1;0,0,0,0,0,0,1)

MATHEMATICS

Leipold, Richard Allan, *Characterizations of group nets, field nets and related automorphisms and graphs*

RHODE ISLAND

Brown University (11;5,0,1,3,2,0,0)

APPLIED MATHEMATICS

Buck-Lew, Maylun, *A choreographic notation*

DiMasi, Giovanni Battista, *Convergence and approximation problems for jump-diffusion process*

Magel, Kenneth I., *A model for program optimization*

Shrier, Stefan, *Abduction algorithms for grammar discovery*

Stockenberg, John Edward, *Optimization through migration of functions in a layered firmware-software system*

MATHEMATICS

Graves, Larry K., *Codimension one isometric immersions between Lorentz spaces*

Lima, Paulo, *Hopf bifurcation in equations with infinite delays*

Polansky, Paul J., *Multi-dimensional stochastic population models*

Quart, George J., *A fixed point formula for singular varieties*

Young, Christopher A., *Function rings of algebraic varieties*

Zamlong, Stuart, *The extension of Milnor's exact sequence of Witt rings for hyperelliptic curves and the cokernel of ∂ for special hyperelliptic curves*

University of Rhode Island (2;0,0,0,0,2,0,0)

MATHEMATICS

Cohen, Jeffrey S., *Green's functions for elliptic partial differential equations*

Hsing, Deh-phone Kung, *Functional differential systems and applications to the two-body problem of classical electrodynamics*

SOUTH CAROLINA

Clemson University (2;1,1,0,0,0,0,0)

MATHEMATICAL SCIENCES

Lopez, Antonio Manuel, Jr., *Semigroups of quotients*

Tosch, Thomas James, *A bivariate failure model*

University of South Carolina, Columbia (3;2,1,0,0,0,0,0)

MATHEMATICS AND COMPUTER SCIENCE

Lau, Cony Mung-Shek, *Factorization of non-negative matrices*

Lee, Arthur Cherng Huia, *Random contractors and random nonlinear operator equations with applications*

Pearce, Lynn Hauser, *Random walks on graphs*

TENNESSEE

University of Tennessee, Knoxville (2;2,0,0,0,0,0,0)

MATHEMATICS

Chang, David Chih-Jen, *Integral inequalities associated with regular and singular boundary value problems*

Nichols, John David, *Total sequences in topological vector spaces*

Vanderbilt University (2;1,0,0,0,1,0,0)

MATHEMATICS

Ezell, Cloyd Lee, Jr., *Combinatorial construction of topologically analytic maps*

Mathis, Frank Howard, *Numerical solutions to optimal control problems governed by functional differential equations*

TEXAS

North Texas State University (1;1,0,0,0,0,0,0)

MATHEMATICS

Dorsett, Charles I., *R_0 and R_1 spaces and hyperspaces*

Rice University (7;2,0,0,2,2,0,1)

MATHEMATICAL SCIENCES

Farrow, Rodney W., *Attributed grammar models for data-flow analysis*

Grisham, Jack R., *An interior penalty H^1-Galerkin procedure for the numerical solution of elliptic partial differential equations*

Ramanathan, Jayashree, *Global data flow algorithms and their implementations*

Turbay, Gabriel Julio, *On value theories for n-person cooperative games*

Zyla, Lubomyr V., *Techniques for nonlinear system approximation and identification based on Volterra expansions*

MATHEMATICS

Myers, John Robert, *Companionship of knots and the Smith conjecture*

[illegible]ld, Alan Dean, *On certain finite subgroups of the [illegible]lizers of maximal tori*

[illegible] Methodist University (3;0,2,0,1,0,0,0)

COMPUTER SCIENCE

[illegible], Mathew Nicholas, *Automating the design of dedi[illegible] real time central systems*

STATISTICS

[illegible]on, A. Glen, *On G-spectral estimation*

[illegible], John Walter, *Inference procedures for latent root [illegible]ression analysis*

[illegible] A & M University (8;1,6,0,0,0,0,1)

MATHEMATICS

[illegible]ray, William O., *Triangulations with shellable 3-cells*

[illegible]son, Douglas L., *Hamiltonian cycles in bipartite plane [illegible]ic maps*

STATISTICS

[illegible]hannon, Tommy R., *Discriminant analysis with missing [illegible]ata*

[illegible]ick, Richard K., *A super-population approach to mul[illegible]-stage sampling*

[illegible]rson, Jon O., *On the distribution of some stochastic [illegible]compartmental models having time-dependent transition [illegible]probabilities with applications to reliability*

[illegible], Jerry L., *Optimality properties of constrained max[illegible]mum likelihood estimates when some parameter values [illegible]lie on the boundary*

[illegible], George W., *Estimation of population abundances [illegible]using auditory information*

[illegible]rico, Violetta A., *Some problems of statistical inference [illegible]in regression and discriminant analysis*

[illegible] Christian University (1;1,0,0,0,0,0,0)

MATHEMATICS

[illegible], Euda Edward, *A new class of generalized nilpotent [illegible]groups*

[illegible] Tech University (2;0,2,0,0,0,0,0)

MATHEMATICS

[illegible], Dennis Matthew, *Using biased data in linear models*

[illegible], Victor PuiMan, *The use of prior information in linear [illegible]regression*

[illegible]ersity of Houston (8;8,0,0,0,0,0,0)

MATHEMATICS

Achilles, Eva, *Doubly stochastic approximations of real [illegible]square matrices*

Calvin, Michael Roy, *Smith groups for Fredholm manifolds*

Dennis, Thomas Burrows, *Rotationally invariant kernel [illegible]ystems of analytic functions on the unit disk*

Hoffman, Charles Bonner, *Structure semigroups of convolu[illegible]tion measure algebras*

Laidacker, Michael Arlen, *Imbeddings and universal com[illegible]pacta*

Rich, William Floyd, *Timelike homotopy groups and a [illegible]characteristic class for Lorentz manifolds*

Roberts, Jean Elizabeth, *On coincidence points of a func[illegible]tion defined on a space with a finite Abelian group action*

Sachan, Gerald Edward, *Spectral vectors of doubly stochas[illegible]tic matrices*

University of Texas at Arlington (2;0,0,0,0,2,0,0)

MATHEMATICS

Pace, Deborah Ann Lewis, *Generalized stability of motion [illegible]and vector Lyapunov functions*

[illegible]ty, Dolores D., *Quasilinearization through cones in ab[illegible]stract spaces*

University of Texas at Austin (3;1,1,0,0,1,0,0)

MATHEMATICS

[illegible]wes, Robert Leon, *A degenerate evolution equation for [illegible]fluid flow in multi-porous media*

Goth, John A., *Wreath products with supersolvable automorphism groups*

Yuan, Stephen Hsin-Sun, *Topics in partially balanced designs*

UTAH

University of Utah (8;7,0,0,0,1,0,0)

MATHEMATICS

Bates, Peter William, *Projector methods for nonlinear nodal problems*

Gilliam, David S., *On integration and the Radon-Nikodym theorem in quasicomplete locally convex topological vector spaces*

Hagood, John William, *Existence of solutions of an operator value Feynman-Kac formula*

Jackson, Dennis, *Scattering theory for perturbations of the Pekeris waveguide*

Kearfott, Ralph Baker, *Computing the degree of maps and a generalized method of bisection*

Matsumoto, Allen S., *Obstruction theory for shape fibrations with applications to cell-like maps*

McMillan, Thomas Carl, *Cell-like maps which are shape fibrations*

Schwing, James L., *Numerical solutions of problems in potential theory*

VERMONT

University of Vermont (1;0,0,0,0,1,0,0)

MATHEMATICS

Auger, Normand, *A modified version of Teorell's biological cell oscillator*

VIRGINIA

University of Virginia (5;5,0,0,0,0,0,0)

MATHEMATICS

Chandler, James Dixon, Jr., *Analysis on unions of intervals*

Lohuis, David J., *Principal topological categories*

Oh, Duk-Su, *Schur indices of finite groups*

Trent, Tavan T., *$H^2(\mu)$ spaces and abounded evaluations*

Vodola, Paul A., *Some extensions of M_{22}*

Virginia Commonwealth University (1;0,1,0,0,0,0,0)

BIOSTATISTICS

Hogye, Michael, *Experimental designs in two dimensions when observations are correlated*

Virginia Polytechnic Institute and State University (8;1,6,0,0,1,0,0)

MATHEMATICS

Steel, Christopher, *Theorems of Wiener-Lévy type for integral operators in C_p*

Winfrey, William R., *Positivity properties of linear differential operators*

STATISTICS

Bakir, Saad Taha, *Nonparametric procedures for process control*

Cox, Brenda Gale, *Experimental designs for some population hybridization studies*

Hoyer, Robert William, *Some multivariate problems of a spatial model of voting under majority rule*

Khuri, Andrawus Ilias, *A robustness type optimality criterion for experimental design*

Madden, Ragan Burt, *The use of auxiliary information in the linear least-squares prediction approach to cluster sampling in a finite population*

Strub, Mike Robert, *Stochastic modeling of tree growth*

WASHINGTON

University of Washington (10;4,2,0,1,3,0,0)

BIOMATHEMATICS

Hertzberg, Richard, *A multinomial-Markov model with approximate analysis for competitive enzyme inhibition*

Murray, Leslie Craig, *Intervention tests in time series analysis*

Pearson, Nolan E., *Optimal foraging: Some theoretical consequences of different feeding strategies*

Turelli, Michael, *Random environments, stochastic calculus and limiting similarity*

COMPUTER SCIENCE

Jensen, John E., *Dynamic task scheduling in a shared resource multiprocessor*

MATHEMATICS

Aytuna, Aydin, *Some results on H^p spaces on strictly pseudoconvex domains*

Beebe, Alfred S., *Hopf invariants and basic homotopy operations in simplicial groups*

Jong, James, *Robust generalized M-estimates for the autoregressive parameter*

Rebassoo, Vaho, *Desingularization properties of the Nash blowing-up process*

Wilson, Stephen E., *New techniques for the construction of regular maps*

Washington State University (2;0,0,0,0,2,0,0)

PURE AND APPLIED MATHEMATICS

Maurer, Robert Nicholas, *Stability and perturbation methods in the natural sciences*

Oulton, David Barr, *Secular equation analysis*

WISCONSIN

University of Wisconsin, Madison (17;11,1,0,4,1,0,0)

COMPUTER SCIENCES

Bennett, John B., *Empirical studies of noun meaning for computational models of understanding*

Fleisher, Jay Mark, *New optimality conditions for integer programming and their application to test problem construction*

Maguregui, Javier, *Regular multivalued functions and algorithmic applications*

Rothstein, Michael, *Towards a canonical form for exponential and primitive functions*

MATHEMATICS

Ancel, Frederic Davis, *The locally flat approximation of cell-like embedding relations*

Carr, Ralph W., *Uniform L^p estimates for a linear integrodifferential equation with a parameter*

Chicone, Carmen C., *Topological properties of algebraic vector fields*

Everett, Daniel L., *Embedding and product theorems for decomposition spaces*

Frankel, Robert S., *Criteria for positive and ample vector bundles*

London, Steven David, *Wave propagation in a rotating fluid of spherical configuration*

McGibbon, Charles A., *Fake quaternionic projective spaces from a homotopy point of view*

Parsons, Lee, *Normality and countable paracompactness in spaces related to the Stone-Čech compactification of a discrete space*

Pierson, Harry M., *Random linear transformations of point processes*

Sadler, Walter LeVern, *The effects of instruction in modeling theory on the attitudes and achievements of college freshmen*

Shrikhande, Neelima, *Homotopy properties of decomposition spaces*

Stanton, Dennis Warren, *Some basic hypergeometric polynomials arising from finite classical groups*

Verde-Star, Luis, *Infinite matrices and representation of operators commuting with shifts*

University of Wisconsin, Milwaukee (5;4,0,0,0,1,0,0)

MATHEMATICS

Deshpande, Vithal K., *Non-commutative semi-local rings and the Noetherian chain condition*

Gerasch, Thomas Ernest, *Concerning distortion and boundary behavior under conformal mapping*

Lewis, Gilbert N., *Singular perturbations of boundary value problems with applications to turning point problems*

Mikkelson, Ruth L., *Totally and partially ambiguous points of planar functions*

Tucci, Ralph Peter, *Krull dimension and the Krull radical in arbitrary rings*

WYOMING

University of Wyoming (2;0,1,0,0,1,0,0)

MATHEMATICS

Fisk, Robert Spencer, *An application of the Keller box method and some extensions of the method to several space variables*

STATISTICS

Smidt, Robert Kenneth, *Ridge matrix inversion in discriminant analysis and related topics*

CANADA

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

MATHEMATICS

Chan, Arther Hing-Chin, *On the increments of multiparameter Gaussian*

Burke, Murry D., *Weak and strong approximations of the quantile and multivariate empirical processes where parameters are estimated*

Ivanoff, Barbara Gail, *Branching diffusion processes*

Krewski, Daniel, *Linearization and replication methods in finite population sampling*

Oltikar, Bhalachandra C., *On prosupersolvable groups and subgroups of pro-C products of pro-C groups*

Pletch, Andrew, *Profinite duality groups*

Tiwari, Umaneth, *Some distributional transformations and Abelian theorems*

Dalhousie University (3;1,1,1,0,0,0,0)

MATHEMATICS

Gray, David F., *Vector valued inverse programming*

Scobey, Porter F., *Some contributions to singular normal statistical analysis*

Wood, Richard James, *Indicial methods for relative categories*

McGill University (5;4,1,0,0,0,0,0)

MATHEMATICS

Fox, Thomas F., *Universal coalgebras*

Guruswami, Verena, *Torsion theories and localizations for M-sets*

Keviczky, Attila Bela, *The Fredholm-Carleman theory for a class of radially acting linear operators in $H^p(\pi+)$ spaces*

Thibault, Marie-France, *Représentations des fonctions récursives dans les catégories*

Yalovsky, Morty A., *Applications of characterizations to goodness-of-fit problems*

McMaster University (2;2,0,0,0,0,0,0)

MATHEMATICS

Mogyorosy, Joseph, *Covering dimension and the modelling distribution*

Srinivasan, Aravamuthan, *Numerical ranges of elements of topological algebras*

Queen's University (2;2,0,0,0,0,0,0)

MATHEMATICS

Beattie, Margaret A., *Brauer groups of H-module and H-bimodule algebras*

Buckholtz, Peter G., *Characterization of certain bivariate stochastic processes*

Simon Fraser University (3;1,0,0,0,2,0,0)

MATHEMATICS

Arya, J. C., *Certain perturbation methods in non-linear mechanics*

Hamilton, Marvin James, *On the combined Dirac-Einstein-Maxwell field equations*

Woodrow, Robert E., *Theories with a finite number of countable models and a small language*

Université de Montréal (7;7,0,0,0,0,0,0)

MATHÉMATIQUES

Boileau, André, *Types versus topos*

Bousquet, Michel, *Sur les relations entre deux structures complexes*

Bradley, Robert, *Groupes quasi-purs-projectifs et autres propriétés quasi-projectives*

Gervais, Robert, *Extensions du théorème de Carlson concernant les fonctions de type exponentiel*

Hodgson, Bernard Ralph, *Théories décidables par automate fini*

Laroche, Adèle, *Quasi-injectivité relative dans les groupes abéliens*

Wilson, Robert, *Homomorphismes maigres de groupes abéliens primaires*

Université Laval (1;0,1,0,0,0,0,0)

MATHÉMATIQUES

Nadeau, Raymond, *Jeux et programmation linéaire*

University of Alberta (2;0,0,0,2,0,0,0)

COMPUTING SCIENCE

Dasgupta, Subrata, *Parallelism in microprogramming systems*

Luk, W. S., *Analytical evaluation of information retrieval processes*

University of British Columbia (3;1,0,0,1,0,0,1)

COMPUTER SCIENCE

McCalla, Gordon, *An approach to the organization of knowledge for the modelling of conversation*

MATHEMATICS

Rains, Michael A., *Majorant problems in harmonic analysis*

Weerahandi, Samaradasa, *Bargaining solutions to the problem of uncertain values*

University of Saskatchewan (1;0,0,0,0,1,0,0)

MATHEMATICS

Ngai, Tat-Yuen, *Continuation methods for the solution of non-linear equations*

University of Waterloo (18;4,1,0,7,2,0,4)

APPLIED MATHEMATICS

Hemdan, Hamdi T., *Unsteady and steady aerodynamic forces of hypersonic slender delta wings*

Lester, June A., *On mappings which preserve quadratic cones*

COMBINATORICS AND OPTIMIZATION

Foldes, Stephane, *Symmetries*

Reilly, J. W., *An enumerative combinatorial theory of formal power series*

Rosenbloom, Earl S., *Storage reducing quasi-Newton methods for unconstrained minimization*

Thomassen, Carsten, *Paths and cycles in graphs*

COMPUTER SCIENCE

Baxter, Lewis Denver, *The complexity of unification*

Gonnet, Gaston, *Interpolation and interpolation hash searching*

Hennessy, Matthew C. B., *A formal approach to the study of parameter parsing mechanisms and nondeterminism*

Irland, Marek I., *Analysis and simulation of congestion in Packet-switched networks*

Kolanko, Richard C., *A structured approach to performance measurement of computer networks*

Mijares, Ignacio, *Structural design of logical data bases*

Szeto, W. H. David, *A functional model for data bases*

PURE MATHEMATICS

Batten, Lynn M., *d-partition geometries*

Haruki, Sigheru, *Particular difference and mean value type functional equations*

Jeffers, E. A., *Universal Horn classes of binary structures*

Sathyabhama, V., *On some algebraic structures and functional equations*

STATISTICS

Harvey, Daniel J., *Some investigations into sampling from populations meaningfully arranged in one or more dimensions*

University of Western Ontario (2;0,0,0,0,2,0,0)

APPLIED MATHEMATICS

Cook, Robert Neal, *Numerical solutions of the Navier-Stokes equations in three dimensions*

Staley, Douglas Arnold, *Conducting wall solutions for the MHD channel flow equations*

University of Windsor (2;1,0,0,0,1,0,0)

MATHEMATICS

Chaudhary, M. N., *Compactness and order properties in ordered Banach spaces*

Toop, J. H., *On the existence, uniqueness and approximation of solutions of the Boltzman equation of neutron transport applied to finite cells*

DOCTORATES CONFERRED IN 1975–1976
Supplementary List

ILLINOIS

THE UNIVERSITY OF CHICAGO (2;0, 2, 0, 0, 0, 0, 0)

Department of Statistics
Lin, Lung-Ying
Maximum likelihood estimation for exponential family with nonlinear constraints on the natural parameter space
Machado, Stella B. G.
Transformations of multivariate data and tests for multivariate normality

INDIANA

PURDUE UNIVERSITY (1;0, 1, 0, 0, 0, 0, 0)

Department of Statistics
Healy, John Douglas
Estimation and tests for unknown linear restrictions in multivariate linear models

MARYLAND

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

Department of Computer Science
Carmichael, Arthur B.
Semantic classification of features of programming languages
Nagel, Roger
Computer detection of freehand forgeries

NEW YORK

COLUMBIA UNIVERSITY, TEACHERS COLLEGE (2;0, 0, 0, 0, 0, 1, 1)

Department of Mathematical Education
Hamadanizadeh, Javad
Medieval interpolation theory
Porte de Pérez, Loreto
Different approaches to the study of plane algebraic curves

PENNSYLVANIA

TEMPLE UNIVERSITY (1;0, 1, 0, 0, 0, 0, 0)

Department of Statistics
Mendoza, Gaston
A three phase model for controlled clinical trials

WASHINGTON

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

Biomathematics Group
Aickin, Mikel
Linear exponential models and discrete prediction

WISCONSIN

UNIVERSITY OF WISCONSIN, MADISON (1;1, 0, 0, 0, 0, 0, 0)

Department of Mathematics
Wage, Michael Lee
Applications of set theory to analysis and topology

PUNCTUAL HILBERT SCHEMES
by Anthony A. Iarrobino

The Memoir is a study of primary ideals and families of primary ideals in the power series ring of two variables over a closed field, or, more globally, a study of Artin algebras having two generators. The punctual Hilbert scheme W of projective space P_2, parametrizes length-n unions of "thick points" in P_2; W is also a canonical desingularization of the n-fold symmetric product S of P_2. The fiber H of W over the singular point $s \in S$ parametrizing the cycle np on P_2, is $H = \mathrm{Hilb}^n R$, the family of colength n ideals in the power series ring. The first three chapters study the family H, which is stratified $H = \bigcup Z_T$ by the Hilbert function of the ideals. Each Z_T is a locally trivial fiber bundle with fiber an affine space k^a over the complete variety G_T parametrizing graded ideals of Hilbert function T. When $k = C$, G_T is a compact manifold; otherwise, G_T, Z_T are locally affine spaces. The proof method is to explicitly choose which coefficients of the standard generators for I, serve as parameters for I on H.

Chapter 4 bounds the number of generators of I in terms of the Hilbert function $T(I)$, and describes local parameters on W. Ideals (V) generated by a d-dimensional vector space of degree-j forms are studied: the Grassmann manifold $G = G(d, j+1)$ parametrizing these vector spaces is stratified $G = \bigcup$ Grass T by the Hilbert function of (V); the stratum Grass T and its closure are described, and related to the compact manifold G_T, which desingularizes the closure.

Chapter 5 outlines a characteristic p version of Briançon's proof that H is irreducible. Chapter 6 comprehensively surveys what is known about punctual Hilbert schemes. An extensive bibliography and index of theorems are included.

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SUGGESTIONS FOR 1978 NOMINATIONS

Each year the members of the Society are given the opportunity to propose for nomination the names of those individuals they deem both qualified and responsive to their views and needs as part of the mathematical community. Formerly, this was done through an enclosure with the ballot. It is now being done using the form printed below, in order to reduce mailing costs. Members are requested to write in the appropriate spaces their suggestions for members of the Council and Board of Trustees to replace those members whose terms expire December 31, 1978. Please consult the Bylaws and the list of members of the Council and Board of Trustees as given in the August 1977 issue of the *Notices* (pp. 272-273). The completed form should be addressed to

American Mathematical Society
Attn: The Nominating Committee
P. O. Box 6248
Providence, R. I. 02940

to arrive no later than November 10, 1977.

TO: Nominating Committee for 1978, American Mathematical Society, P. O. Box 6248, Providence, RI 02940

RE: Suggestions for members of the Council and Board of Trustees with terms beginning January 1, 1979.

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.....

Secretary (1)

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Associate Secretaries (2)

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Treasurer (1)

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Associate Treasurer (1)

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Member of the *Bulletin* Editorial Committee (1)

.....

Member of the *Colloquium* Editorial Committee (1)

.....

Member of the *Mathematical Reviews* Editorial Committee (1)

.....

Member of the *Mathematical Surveys* Editorial Committee (1)

.....

Member of the *Mathematics of Computation* Editorial Committee (1)

.....

Member of the *Proceedings* Editorial Committee (1)

.....

Members of the *Transactions* and *Memoirs* Editorial Committee (2)

.....

.....

Members of the Committee to Monitor Problems in Communication (2)

.....

.....

Members-at-large of the Council (5)

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Member of the Board of Trustees (1)

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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

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Alexander, James (U. S. A.)	Universität Bonn, West Germany	Topology	Academic yr. 77/78
Allgower, Eugene L. (U. S. A.)	Universität Bonn, West Germany	Numerical Analysis	6/77 - 8/78
Anderson, Frank W. (U. S. A.)	Aarhus University, Denmark	Algebra	12/77 - 6/78
Anderson, R. L. (U. S. A.)	Indian Statistical Institute, New Delhi	Statistics	9/77 - 12/77
Bachelis, Gregory (U. S. A.)	National Central University Chung Li, Taiwan	Harmonic Analysis	2/78 - 5/78
Barcus, William (U. S. A.)	Oxford University, England	Topology	2/78 - 6/78
Bendersky, Martin (U. S. A.)	Kyoto University, Japan	Algebraic Topology	10/77 - 12/77
Bennett, G. W. (Canada)	University of Adelaide, Australia; Cambridge, United Kingdom	Multivariate Analysis	2/78 - 4/78 4/78 - 6/78
Berg, I. David (U. S. A.)	Monash University, Australia	Functional Analysis	8/77 - 5/78
Bhapkar, V. P. (U. S. A.)	CSIRO, Australia	Statistics	1/78 - 12/78
Blei, Ron C. (U. S. A.)	Uppsala University, Sweden; Mittag-Leffler Institute, Sweden; Hebrew University, Israel	Harmonic Analysis	9/77 - 11/77 11/77 - 1/78 1/78 - 7/78
Boehme, Thomas (U. S. A.)	Cairo University, Egypt	Operational Calculus, Generalized Functions, Analytic Functions	9/77 - 6/79
Boone, William W. (U. S. A.)	Universität Bonn, West Germany	Logic	8/77 - 5/78
Browne, P. J. (Canada)	University of Dundee, Scotland	Multi-parameter Spectral Theory	8/77 - 7/78
Buntinas, Martin G. (U. S. A.)	University of Stuttgart, Germany	Topological Sequence Spaces	9/77 - 7/78
Burckel, Robert B. (U. S. A.)	Universität des Saarlandes, Federal Republic of Germany	Analysis	8/77 - 8/78
Burgess, C. E. (U. S. A.)	Institute at the University of Warwick, England	Topology	3/78 - 6/78
Carlson, James A. (U. S. A.)	Institut des Hautes Etudes Scientifiques, France	Algebraic Geometry	1/78 - 6/78
Chakravarti, Indra M. (U. S. A.)	Institut de Statistique des Universités de Paris, France	Combinatorics, Design of Experiments	1/78 - 6/78
Cheeger, Jeff (U. S. A.)	Institut des Hautes Etudes Scientifiques, France	Differential Geometry	2/78 - 5/78
Cohen, Paul (U. S. A.)	Mittag-Leffler Institute, Sweden	Harmonic Analysis, Partial Differential Equations, Set Theory	7/77 - 7/78
Comfort, W. W. (U. S. A.)	Athens University, Greece	General Topology	2/78 - 5/78
Dade, Catherine D. (U. S. A.)	University of Strasbourg, France	Probability	8/77 - 5/78
Dade, Everett C. (U. S. A.)	University of Strasbourg, France	Group Theory	8/77 - 5/78
Diestel, Joseph (U. S. A.)	University College of Dublin, Ireland	Functional Analysis	10/77 - 6/78
Eaton, Morris L. (U. S. A.)	University of Copenhagen, Denmark	Multivariate Statistics	9/77 - 6/78
Geissinger, Ladnor (U. S. A.)	University of Ulm, Federal Republic of Germany	Combinatorial Theory	8/77 - 7/78
Halberg, C. J. A., Jr. (U. S. A.)	Vid Lunds University, Sweden	Functional Analysis	8/76 - 8/78
Hampton, Charles Robert (U. S. A.)	Cuttingham College, Liberia	Algebra, Trigonometry, Calculus	7/77 - 7/78
Harrison, David K. (U. S. A.)	Kings College, England	Algebra	1/78 - 6/78
Heil, Wolfgang (U. S. A.)	University of Ljubljana, Yugoslavia	Topology	9/77 - 6/78
Higman, Donald G. (U. S. A.)	University of Tübingen, Federal Republic of Germany	Algebra	9/77 - 11/77

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Hocking, John G. (U.S.A.)	University of Dublin, Ireland	Topology	9/77 - 8/78
Holland, A.S.B. (Canada)	University of St. Andrews, Scotland	Analytic Function Theory	8/77 - 7/78
Iskander, Awad A. (U.S.A.)	University of Kuwait	Universal Algebra	8/77 - 8/78
Jackson, D. M. (Canada)	Cambridge University, England	Enumerative Combinatorial Theory	1/78 - 6/78
Jogdeo, S. S. (U.S.A.)	Gokhale Institute of Economics, India	Statistics	8/77 - 5/78
John, Floyd I. (U.S.A.)	University Dar es Salaam	Quantitative Methods	7/77 - 4/78
Kallianpur, Gopinath (U.S.A.)	Indian Statistical Institute, India	Probability Theory, Mathematical Statistics	7/77 - 6/78
Kantor, William M. (U.S.A.)	Technion Institute of Technology, Israel; Oxford University, England	Algebra	9/77 - 12/77 1/78 - 6/78
Kennison, John F. (U.S.A.)	University of Sussex, Great Britain	Category Theory	9/77 - 6/78
Kister, James M. (U.S.A.)	Oxford University, England	Topology	9/77 - 12/77
Kolmer, Shirley (U.S.A.)	University of Liberia	Algebra, Trigonometry, Number Theory	7/77 - 7/78
Kuo, Shan S. (U.S.A.)	Oxford University, England	Computer Science	9/77 - 6/78
Kydoniefs, Anastasios D. (U.S.A.)	Technical University of Athens, Greece	Elasticity	Spring 1978
Langebartel, Ray G. (U.S.A.)	University of Manchester, England	Stellar Dynamics	1/77 - 5/77
Leach, E. B. (U.S.A.)	Institut d'Electricate et d'Electronique, Algeria	Algebraic Topology; Functional Analysis	9/76 - 6/78
Lemke, Carlton E. (U.S.A.)	Institüt für Operations Research, ETH, Switzerland	Mathematical Programming	2/78 - 6/78
Levine, Harold (U.S.A.)	Centre National pour la Recherche Scientifique, France	Applied Mathematics	4/78 - 10/78
Malitz, Jerome (U.S.A.)	University of Utrecht, Holland; University of Bedford, England	Mathematical Logic	10/77 - 11/77 12/77
Markus, Lawrence (U.S.A.)	University of Warwick, England	Ordinary Differential Equations; Control Theory	12/77 - 6/78
Mayer, Meinhard E. (U.S.A.)	ETH, Switzerland; Institut des Hautes Etudes Scientifiques, France	Mathematical Physics	9/77 - 3/78 4/78 - 7/78
McLenaghan, Raymond G. (Canada)	Université Libre de Bruxelles, Belgium	General Relativity	9/77 - 8/78
Meeker, Loren D. (U.S.A.)	Heriot-Watt University, Scotland	Applied Mathematics	9/77 - 6/78
Meyer, Wolfgang (U.S.A.)	University of Münster, Federal Republic of Germany	Differential Geometry	9/77 - 8/78
Mikulski, Piotr (U.S.A.)	University of Berne, Switzerland		Academic yr. 77/78
Milne, James S. (U.S.A.)	University of Rennes, France	Algebraic Geometry	1/78 - 5/78
Minc, Henryk (U.S.A.)	Technion Institute of Technology, Israel	Linear Algebra	3/78 - 7/78
Moran, Daniel A. (U.S.A.)	University College of North Wales	Manifold Theory	4/78 - 6/78
Mozzochi, C. J. (U.S.A.)	Mittag-Leffler Institute, Sweden	Analytic Number Theory	9/77 - 5/78
Nymann, James E. (U.S.A.)	University of Malawi, Malawi	Abstract Algebra	9/77 - 6/78
Oliver, Robert (U.S.A.)	Université de Nantes, France	Topology; Transformation Groups	4/78 - 7/78
Orton, William Rolen (U.S.A.)	Tehran University, Iran	Science and Mathematics Education	9/77 - 9/78
Phelps, Robert R. (U.S.A.)	University College, London	Convexity; Extreme Point Problems	9/77 - 7/78
Phillips, Anthony (U.S.A.)	University of Paris 7	Differential Topology	8/77 - 8/78
Pinkham, Henry C. (U.S.A.)	Institut des Hautes Etudes Scientifiques, France	Algebraic Geometry	9/77 - 5/78
Pohl, William F. (U.S.A.)	Institut des Hautes Etudes Scientifiques, France	Differential Geometry	9/77 - 12/77
Rao, R. Ranga (U.S.A.)	Indian Statistical Institute; ETH, Switzerland	Lie Groups	11/77 - 3/78 4/78 - 7/78
Reade, Maxwell O. (U.S.A.)	University of Costa Rica	Complex Analysis	9/77 - 12/77
Robertson, James (U.S.A.)	Tbilisi State University, U.S.S.R.	Probability	9/77 - 1/78

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Rotman, Joseph J. (U.S.A.)	Technion Inst. of Tech., Israel	Group Theory	8/77 - 5/78
Schumaker, Larry (U.S.A.)	Free University of Berlin, Federal Republic of Germany	Approximation Theory	1/78 - 12/78
Shar, Albert O. (U.S.A.)	Math Institute, Switzerland	Topology	10/77 - 5/78
Shields, Allen L. (U.S.A.)	Institut des Hautes Etudes Scientifiques, France	Analysis	1/78 - 5/78
Shorack, Galen R. (U.S.A.)	Australian National University, Australia	Statistics	9/77 - 6/78
Slemrod, Marshall (U.S.A.)	Hebrew University, Israel; Heriot-Watt University, Scotland	Differential Equations	9/77 - 12/77 1/78 - 5/78
Smith, Martha K. (U.S.A.)	University of Warwick, England	Ring Theory	1/78
Stark, Harold (U.S.A.)	University of Paris, France	Number Theory	9/77 - 5/78
Stern, Ron J. (U.S.A.)	Institut des Hautes Etudes Scientifiques, France	Topology	9/77 - 3/78
Tompa, Frank W. (Canada)	Pontifica Universidade Catolica, Brazil	Data Structures; Data Bases	8/77 - 12/77
Van Buskirk, James M. (U.S.A.)	Aarhus University, Denmark; University of Madrid, Spain	Topology	9/77 - 12/77 1/78 - 6/78
Van Osdol, Donovan (U.S.A.)	University of Sussex, England	Category Theory	11/77 - 3/78
Verma, Ghasi (U.S.A.)	Birla Institute of Technology and Sciences, India	Applied Mathematics	8/77 - 1/78
Wade, William (U.S.A.)	Moscow State University, U.S.S.R.	Harmonic Analysis	9/77 - 1/78
Wani, J. K. (Canada)	Indian Institute of Science, India	Logarithmic Series Distribution	7/77 - 12/77
Wigner, David W. (U.S.A.)	University of Dijon, France	Geometric Topology	9/77 - 12/77
Wu, Ta-Sun (U.S.A.)	Chinese University of Hong Kong, Hong Kong	Topological Dynamics	9/76 - 6/78

Visiting Foreign Mathematicians

Agmon, Shmuel (Israel)	University of Minnesota	Partial Differential Equations	3/78 - 6/78
Allison, Donald C.S. (Ireland)	Virginia Polytechnic Institute and State University	Numerical Analysis; Computational Complexity	9/77 - 5/78
Arbex, Sami (Brazil)	New York University, Courant	Analysis and Functional Analysis	9/77 - 8/78
Artstein, Zvi (Israel)	Brown University	Differential Equations; Dynamical Systems	10/77 - 11/77
Assaf, David N. (Israel)	University of Illinois, Urbana	Statistics	8/77 - 5/78
Axelsson, Owe (Sweden)	The University of Texas at Austin	Numerical Analysis	1/78 - 5/78
Baillon, Jean (France)	New York University, Courant	Numerical Analysis	9/77 - 8/78
Banyaga, Augustin (Rwanda)	Institute for Advanced Study	Differential Topology	9/77 - 4/78
Barak, Amnon B. (Israel)	Pennsylvania State University	Computer Science	9/77 - 5/78
Barsky, Daniel (France)	Princeton University	Algebra	9/77 - 12/78
Behar, Isak (Turkey)	University of Wisconsin, Madison	Theoretical Optimization	9/77 - 8/78
Bertrand, Daniel (France)	Princeton University	Algebra	9/77 - 1/78
Bessaga, Czeslaw (Poland)	University of Michigan	Analysis and Topology	1/78 - 5/78
Bø, Ketil (Norway)	Southern Methodist University	Computer Graphics	8/77 - 6/78
Bochenek, Elzbieta Kosmulska (Poland)	Rensselaer Polytechnic Institute	Computer Science	7/77 - 6/78
Bosoh, Siegfried (Germany)	Princeton University	Algebra	9/77 - 6/78
Boutet de Monvel, Louis (France)	Princeton University	Partial Differential Equations	9/77 - 6/78
Brémaud, Pierre (France)	University of California, Berkeley	Point Processes; Applied Probability	9/77 - 12/77
Bshouty, Daoud (Israel)	Indiana University	Complex Analysis	8/77 - 6/78
Bühlmann, Hans (Switzerland)	University of California, Berkeley	Statistics	1/78 - 4/78
Bulirsch, Roland (Germany)	University of California, San Diego	Numerical Analysis	7/77 - 6/78
Burghelea, Dan (Rumania)	Institute for Advanced Study	Differential Topology; Algebraic Topology	9/77 - 11/77
Cannings, Christopher (Britain)	University of Utah	Statistics	9/77 - 6/78

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Chillingworth, David (England)	University of Cincinnati	Dynamical Systems	9/77 - 6/78
Coleff, Nicolas R. (Argentina)	University of Washington	Theory of Residues	9/77 - 6/78
Dahlberg, Björn (Sweden)	University of Michigan	Complex Analysis	9/77 - 5/78
Davies, Brian (England)	Princeton University	Mathematical Physics	9/77 - 1/78
Denef, Jan (Belgium)	Princeton University	Mathematical Logic	9/77 - 8/78
Dumer, Vishwa C. (India)	University of Illinois, Urbana	Number Theory	8/77 - 5/78
Dydak, Jerzy (Poland)	University of Washington	Topology	9/77 - 9/78
Dynin, Alexander (U.S.S.R.)	Institute for Advanced Study	Complex Analysis	9/77 - 4/78
Eells, James (England)	Institute for Advanced Study	Differential Geometry	9/77 - 12/77
Ekeland, Ivar (France)	University of British Columbia	Optimization; Functional Analysis	9/77 - 8/78
Elias, Uri (Israel)	Carnegie-Mellon University	Differential Equations	9/77 - 8/78
Elliott, Robert J. (England)	University of Kentucky	Topology	1/78 - 6/78
Enss, Volker (West Germany)	Indiana University	Mathematical Physics	8/77 - 6/78
Epelman, M. S. (Israel)	University of Waterloo	Operations Research	5/77 - 6/78
Erdős, Paul (Hungary)	University of Colorado	Number Theory	9/77 - 11/77 1/78 - 5/78
Fahrazad, Parviz (Iran)	University of Vermont	Numerical Analysis	9/77 - 5/78
Fleischner, Herbert (Austria)	Memphis State University	Graph Theory	9/77 - 12/77
Foata, Dominique (France)	University of California, San Diego	Combinatorics	7/77 - 6/78
Foguel, Shaul (Israel)	University of Maryland	Functional Analysis	8/77 - 6/78
Frohlich, A. (England)	University of Maryland	Number Theory	11/77 - 12/77
Gardner, B. J. (Australia)	Dalhousie University	Algebra	9/77 - 12/77
Gardner, Richard J. (England)	University of California, Davis	Topology	7/77 - 6/78
Gatica, Juan (Chile)	University of Iowa	Analysis	8/77 - 5/79
Gaveau, Bernard (France)	Institute for Advanced Study	Complex Analysis; Differential Geometry	9/77 - 4/78
Ghosh, M. K. (Iraq)	University of Calgary	Mathematical Theory of Pairing	9/77 - 4/78
Gibbs, Richard (England)	Indiana University	Applied Mathematics	8/77 - 6/78
Gierz, Gerhard (Germany)	Louisiana State University, Baton Rouge	Topological Algebra	8/77 - 5/78
Giles, J. (Australia)	Dalhousie University	Functional Analysis	9/77 - 12/77
Goguel, Johann H. (West Germany)	University of North Carolina at Chapel Hill	Number Theory	8/77 - 12/77
Goncalves, Daciberg L. (Brazil)	Institute for Advanced Study	Algebraic Topology	1/78 - 4/78
Good, J. Anton (Switzerland)	Institute for Advanced Study	Analytic Number Theory	9/77 - 4/78
Goodarzi, Mohammad (Iran)	Texas Tech University	Algebra (Graph Theory)	9/77 - 5/78
Gordon, Yehoram (Israel)	Ohio State University	Functional Analysis	9/77 - 6/78
Gregory, Douglas (Great Britain)	University of British Columbia	Elasticity	7/77 - 6/78
Grove, Karsten (Denmark)	SUNY, Stony Brook	Differential Geometry	9/77 - 8/78
Grunsky, Helmut (West Germany)	Washington University	Theory of Functions of a Complex Variable	10/77 - 2/78
Hansen, Idar (Norway)	University of Kentucky	Topology	8/77 - 6/78
Har'El, Zvi (Israel)	University of Illinois, Urbana	Differential Geometry	8/77 - 5/78
Herrlich, Horst (West Germany)	Kansas State University	Topology	9/77 - 1/78
Herrnegger, Franz (West Germany)	New York University, Courant	Analysis	10/77 - 3/78
Higman, Graham (England)	California Institute of Technology	Group Theory	9/77 - 8/78
Hiriart-Urruty, J. B. (France)	University of Kentucky	Stochastic Optimization	1/78 - 8/78
Hooley, Christopher (England)	Institute for Advanced Study	Theory of Numbers	9/77 - 12/77
Hörmander, Lars (Sweden)	Institute for Advanced Study	Partial Differential Equations; Analysis	9/77 - 4/78
Hulanicki, Andrzej (Poland)	SUNY at Albany	Harmonic Analysis	11/77 - 1/78
Hung, Cheng-Uan (Taiwan)	University of Wisconsin, Madison	Logic	9/77 - 5/78
Hurst, C. Angas (Australia)	Indiana University	Mathematical Physics	8/77 - 6/78

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Hüsler, Jürg R. (Switzerland)	University of Pittsburgh	Applied Statistics	9/77 - 4/78
Huzurbazar, V. (India)	University of Manitoba	Inference	9/76 - 8/78
Iden, Oddvar (Norway)	University of Iowa	Algebra	8/77 - 5/78
Iooss, Gerard (France)	University of Minnesota	Bifurcation Theory	8/77 - 9/78
Israeli, Moshe (Israel)	Massachusetts Institute of Technology	Applied Numerical Analysis	7/77 - 5/78
Jahren, Bjorn (Norway)	New York University, Courant	Topology	9/77 - 8/79
Jain, G. C. (New Zealand)	Dalhousie University	Statistics	11/77 - 5/78
Jones, Ralph (Australia)	University of Waterloo	Numerical Mathematics	9/77 - 5/78
Kalnins, E. G. (New Zealand)	University of Minnesota	Mathematical Physics	12/77 - 3/78
Kalton, Nigel J. (United Kingdom)	University of Illinois, Urbana Michigan State University	Functional Analysis	8/77 - 12/77 1/77 - 8/78
Kamin, Shoshana (Israel)	Rensselaer Polytechnic Institute	Functional Analysis	1/78 - 9/78
Kariv, Oded (Israel)	Drexel University	Combinatorial Algorithms	9/77 - 8/78
Karpinski, Marek (Poland)	University of Florida	Logic; Formal Languages; Set Theory; Recursion and Computability; Combinatorial Theories	9/77 - 6/78
Kashiwara, Masaki (Japan)	Institute for Advanced Study	Partial Differential Equations	9/77 - 4/78
Katznelson, Yitzak (Israel)	Stanford University	Harmonic Analysis; Ergodic Theory	6/78 - 9/78
Kawai, Takahiro (Japan)	Institute for Advanced Study	Analysis	9/77 - 4/78
Ko, H. (Taiwan)	Dalhousie University	Functional Analysis	2/78 - 7/78
Komatsu, Gen (Japan)	New York University, CUNY	Analysis	9/77 - 8/78
Landrock, Peter L. (Denmark)	University of Oregon	Algebra	9/77 - 12/77
Leivant, Daniel (Israel)	Ohio State University	Logic	9/77 - 6/78
Libgober, Anatoly S. (Israel)	Institute for Advanced Study	Algebraic Geometry	9/77 - 4/78
Lindenstrauss, Joram (Israel)	The University of Texas at Austin	Functional Analysis	9/77 - 5/78
Lins, R. (Brazil)	University of Waterloo	Theory of Computing	1/78 - 6/78
Lusztig, George (England)	Massachusetts Institute of Technology	Representations of Finite Groups	1/78 - 12/78
MacDonald, Ian G. (England)	Institute for Advanced Study	Automorphic Forms	9/77 - 12/77
Magerl, Berhard (West Germany)	University of Washington	Continuous Selections and Related Topics	9/77 - 8/78
Maire, Henri-Michel (Switzerland)	Institute for Advanced Study	Partial Differential Equations	9/77 - 4/78
Mankiewicz, Piotr (Poland)	University of Connecticut	Functional Analysis	9/77 - 5/78
Mardesic, Sibe (Yugoslavia)	University of Utah University of Kentucky	Topology	9/77 - 1/78 1/78 - 6/78
Martelli, Mario (Italy)	University of Colorado	Ordinary Differential Equations; Nonlinear Functional Analysis	9/77 - 5/78
Matsumoto, Yukio (Japan)	Institute for Advanced Study	Topology	9/77 - 4/78
McCullagh, Peter (England)	University of Chicago	Statistics	9/77 - 6/78
McDuff, M. Dusa (England)	Institute for Advanced Study	Differential Topology	9/77 - 12/77
Mc Leod, Bryce (England)	University of Minnesota	Differential Equations	9/77 - 6/78
Melrose, Richard B. (England)	Institute for Advanced Study	Partial Differential Equations	9/77 - 12/77
Mercier, Bertrand (France)	New York University, Courant	Numerical Methods and Applied Mathematics	9/77 - 12/77
Metelli, Claudia (Italy)	Tulane University	Abelian Groups	9/77 - 5/78
Millet, Annie (France)	Ohio State University	Probability and Ergodic Theory	9/77 - 6/78
Minemura, Katsuhiro (Japan)	Institute for Advanced Study	Representation Theory; Harmonic Analysis	9/77 - 4/78
Mond, Dean B. (Australia)	McGill University	Functional Analysis; Optimization; Approximation Theory	1/78 - 3/78
Montesinos, José María (Spain)	Institute for Advanced Study	Algebraic Topology	9/77 - 4/78
Moszynska, Maria Olga (Poland)	Auburn University	Topology	9/77 - 12/77

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Munkholm, Hans J. (Denmark)	Princeton University	Topology	9/77 - 6/78
Nakagawa, Ryosuke (Japan)	Kansas State University	Topology	8/77 - 8/78
Nishizeki, Takao (Japan)	Carnegie-Mellon University	Network Theory	5/77 - 5/78
Nobs, Alexandre (Switzerland)	SUNY, Stony Brook	Automorphic Functions	9/77 - 8/78
Ohta, Masami (Japan)	Institute for Advanced Study	Number Theory	9/77 - 4/78
Pao, Peter S. (Republic of China)	Institute for Advanced Study	Topology	9/77 - 4/78
Parthasarathy, Rajagopalan (India)	University of California, San Diego	Lie Groups	10/77 - 12/77
Pazy, Amnon (Israel)	University of Wisconsin, Madison	Analysis	9/77 - 6/78
Peters, Meinhard (West Germany)	Ohio State University	Number Theory	1/78 - 6/78
Pike, Derek (England)	University of Waterloo	Statistics	9/77 - 8/78
Plant, Andrew (England)	University of Kentucky	Partial Differential Equations	8/77 - 6/78
Pommerenke, Christian M. W. (West Germany)	University of Minnesota	Complex Analysis	3/78 - 8/78
Pridor, Adir (Israel)	Rensselaer Polytechnic Institute	Numerical Analysis	7/77 - 6/78
Pudlak, Pavel (Czechoslovakia)	Vanderbilt University	Algebra	1/78 - 6/78
Quigley, John B. (Ireland)	Michigan State University	Topology	9/77 - 8/78
Rabin, Michael O. (Israel)	Massachusetts Institute of Technology	Computer Science	9/77 - 12/77
Raghavachari, M. (India)	University of Maryland	Statistics	8/77 - 6/78
Ramanan, Sundararaman (India)	Institute for Advanced Study	Algebraic Vector Bundles Over Curves	9/77 - 4/78
Révész, György (Hungary)	Virginia Polytechnic Institute and State University	Automata Theory; Formal Languages	9/77 - 5/78
Revuz, Daniel (France)	University of British Columbia	Probability	9/77 - 8/78
Rhodin, Lennart (Sweden)	Simon Fraser University	Statistics	7/77 - 7/78
Ricci, Fulvio (Italy)	Washington University	Harmonic Analysis	10/77 - 1/78
Robson, J. C. (England)	Dalhousie University	Ring Theory	7/77 - 7/78
Rotem, D. (South Africa)	University of Waterloo	Graph Theoretical Algorithms	5/77 - 4/78
Ruhe, Axel (Sweden)	University of California, San Diego	Numerical Analysis	7/77 - 6/78
Saeki, Sadahiro (Japan)	University of Washington	Harmonic Analysis	9/77 - 8/78
Schechtman, Gideon (Israel)	Ohio State University	Functional Analysis	9/77 - 6/78
Schutzenberger, Marcel P. (France)	Bowling Green State University	Combinatorics; Semigroups; Computer Science	3/78 - 6/78
Scott, Godfrey Peter (England)	University of Wisconsin, Madison	Topology	9/77 - 7/78
Serre, Jean-Pierre (France)	Institute for Advanced Study	Algebraic Geometry	1/78 - 4/78
Sheehan, John (Scotland)	Memphis State University	Graph Theory	9/77 - 5/78
Sheil-Small, Terrence (England)	University of Kentucky	Complex Analysis	8/77 - 8/78
Shelah, Saharon (Israel)	University of Wisconsin, Madison	Logic	9/77 - 1/78
Shlue, Jau-Shyong (Taiwan)	University of Illinois, Urbana	Number Theory	8/77 - 5/78
Simões-Pereira, José (Portugal)	Western Michigan University	Graph Theory	8/77 - 4/78
Simonovits, M. (Budapest)	University of Calgary	Combinatorics	9/77 - 12/77
Sjöstrand, N. H. Johannes (Sweden)	Institute for Advanced Study	Fourier Integral Operators	9/77 - 4/78
Sleijpen, Gerard L. G. (The Netherlands)	University of Oregon	Harmonic Analysis	9/77 - 6/78
Somolinos, Alfredo (Spain)	New York University, Courant	Differential Equations	6/77 - 5/78
Sotteau, D. (France)	University of Waterloo	Graph Theory; Combinatorial Designs	9/77 - 5/78
Southern, G. W. (Australia)	University of Waterloo	Combinatorial Designs	9/77 - 12/77
Spiegelhalter, David (England)	University of California, Berkeley	Bayesian Statistics	9/77 - 6/78
Stegbauer, Werner H. (West Germany)	Yale University	Mathematical Logic	9/77 - 8/78
Stewart, Ian (Great Britain)	University of Connecticut	Lie Algebras	9/77 - 5/78

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Suhadolc, Anton (Yugoslavia)	Florida State University	Analysis	9/77 - 6/78
Sullivan, Dennis (France)	SUNY, Stony Brook	Topology	7/77 - 8/77
Thorpe, B. (England)	University of Western Ontario	Summability	7/77 - 1/78
Uhlmann, Gunther (Chile)	New York University, Courant	Analysis	9/77 - 8/79
van Hemmen, Jan L. (The Netherlands)	Duke University	Mathematical Physics	9/77 - 6/78
Van Mill, Jan (The Netherlands)	University of Wisconsin, Madison	Topology	8/77 - 6/78
Vergne, Michele (France)	Massachusetts Institute of Technology	Group Representations	7/77 - 5/78
Verma, Daya-Nand (India)	Institute for Advanced Study	Representations of Chevalley Groups	9/77 - 4/78
Viljoen, Gert (South Africa)	Tulane University	Abelian Groups	11/77 - 12/77
Vogel, Pierre (France)	Institute for Advanced Study	Geometry of Manifolds	9/77 - 12/77
Waadeland, Haakon (Norway)	University of Colorado	Complex Variables	7/77 - 8/77
Wada, Hideo (Japan)	University of Regina	Number Theory	8/77 - 8/78
Wait, Richard (United Kingdom)	University of Pittsburgh	Finite Element Methods	9/77 - 6/78
Wallace, Eric W. (England)	Michigan State University	Algebra	9/77 - 8/78
Wallis, W. D. (Australia)	University of Waterloo	Graph/Design Theory	1/78 - 6/78
Walter, Wolfgang (Germany)	University of Tennessee	Analysis	9/77 - 1/78
Wang, Hwai-chuian (Republic of China)	Princeton University	Banach Algebras	7/77 - 6/78
Watters, J. F. (England)	University of Calgary	Radicals in Rings	9/77 - 4/78
Weiss, Gideon (Israel)	University of California, Berkeley	Stochastic Processes	9/77 - 6/78
Wold, Herman (Sweden)	University of Pennsylvania	Statistics	9/77 - 5/78
Wormer, P. E. S. (The Netherlands)	University of Waterloo	Quantum Theory	9/77 - 8/78
Yildiz, Necati (Turkey)	University of Minnesota	Applied Statistics	12/76 - 6/78
Yoon, Jaihan (Korea)	Case Western Reserve University	Measure Theory	8/77 - 6/78
Zaanen, Adriaan C. (The Netherlands)	California Institute of Technology	Functional Analysis	1/78 - 3/78
Zabrodsky, Alexander (Israel)	University of California, San Diego	Algebraic Topology	7/77 - 6/78
Zaks, Joseph (Israel)	Ohio State University	Combinatories	9/77 - 6/78
Zalik, A. Ricardo (Israel)	University of Rhode Island	Approximation Theory	9/77 - 1/78
Zamfirescu, Christine (Rumania)	Western Michigan University	Graph Theory	8/77 - 4/78
Zeilberger, Doron (Israel)	Institute for Advanced Study	Partial Differential Equations	9/77 - 4/78
Zinn-Justin, Nicole (France)	Princeton University	Algebra	9/77 - 1/78
Zwahlen, Bruno (Switzerland)	University of Colorado	Operator Theory	9/77 - 5/78
Zwas, Gideon (Israel)	New York University, Courant	Numerical Analysis	8/77 - 7/78

TRANSLATION RECOMMENDATIONS

The AMS-IMS Committee on Translations from Russian and Other Foreign Languages is calling for suggestions of mathematical papers in foreign languages (other than French, German or Italian) to be translated into English.

Those wishing to respond to this invitation should first subject each proposed paper to the following general questions:

1. Does the paper contain material unavailable in English, French, German or Italian?
2. Is the subject matter of interest to a nontrivial segment of the mathematical community?

With regard to the first question, there are a number of foreign mathematical journals that are translated on a regular basis. A list may be found in any recent index issue of *Mathematical Reviews*.

If a particular paper admits an affirmative answer to the preceding questions, the proposer is asked to write a brief recommendation giving specific reasons why it should be translated. This recommendation should be sent to Professor R. G. Douglas at the following address:

Department of Mathematics
SUNY at Stony Brook
Stony Brook, New York 11794

In connection with this solicitation, beginning with material mailed in June, 1977, review forms from *Mathematical Reviews* will include a special place where reviewers can indicate that the paper in question should be translated.

MATHEMATICAL DEVELOPMENTS ARISING FROM HILBERT PROBLEMS
Edited by Felix E. Browder

In May 1974, the American Mathematical Society sponsored a special symposium on the mathematical consequences of the Hilbert problems, held at Northern Illinois University, DeKalb, Illinois. The central concern of the symposium was to focus upon those areas of importance in contemporary mathematical research which can be seen as descended in some way from the ideas and tendencies put forward by Hilbert in his speech at the International Congress of Mathematicians in Paris in 1900. The Organizing Committee's basic objective was to obtain as broad a representation of significant mathematical research as possible within the general constraint of relevance to the Hilbert problems. The Committee consisted of P. T. Bateman (secretary), F. E. Browder (chairman), R. C. Buck, D. Lewis, and D. Zelinsky.

The volume contains the proceedings of that symposium and includes papers corresponding to all the invited addresses with one exception. It contains as well the address of Professor G. Stampacchia that could not be delivered at the symposium because of health problems. The volume includes photographs of the speakers (by the courtesy of Paul Halmos), and a translation of the text of the Hilbert Problems as published in the *Bulletin* of the American Mathematical Society of 1903. The papers are published in the order of the problems to which they are filiated, and not in the alphabetical order of their authors.

An additional unusual feature of the volume is the article entitled "Problems of present day mathematics" which appears immediately after the text of Hilbert's article. The development of this material was initiated by Jean Dieudonné through correspondence with a number of mathematicians throughout the world. The resulting problems, as well as others obtained by the editor, appear in the form in which they were suggested.

The addresses were on twenty-one of Hilbert's problems. The authors of the addresses were Lipman Bers, Enrico Bombieri, Herbert Busemann, Martin Davis with Yuri Matijasevic and Julia Robinson, Nicholas M. Katz, Steven L. Kleiman, G. Kreisel, R. P. Langlands, G. G. Lorentz, Donald A. Martin, J. Milnor, Hugh L. Montgomery, David Mumford, O. T. O'Meara, Albrecht Pfister, James Serrin, Guido Stampacchia, J. Tate, R. Tijdeman, A. S. Wightman, and C. T. Yang.

For the complete table of contents see pages 272 and 273 of the August 1976 *Notices*.

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LETTERS TO THE EDITOR

For early consideration Letters to the Editor should be mailed directly to the Executive Director, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940.

Editor, the *Notices*

This letter offers a description of the current state of affairs at CUNY, and particularly of mathematics at CUNY.

Since the discovery of the city's insolvency some two years ago, CUNY has rapidly retreated from its stance as a free University, open to all. Some say it has done so with indecent haste. We have imposed tuition, as is widely known. Less well known and perhaps more significant are the admission and rate of progress (retention) standards at the senior colleges. These new standards, combined with the fact that "support services" to weaker students suffered the heaviest cuts, severely dim the prospects of these weaker (read: minority) students. While it is true that CUNY offers admission to all high school graduates at a community college, it is also true that *graduates* of these colleges must pass an entrance exam before admission to a senior college is permitted.

It would be wrong to ascribe the aforementioned policies to simple classism or racism. When a university loses 34% of its full-time instructional staff in the space of a year, there are no good answers. The university has simply put the interests of its clear majority of students (white, middle-class) first. It should be remembered that these students often have educational alternatives. The remedial students being cut adrift simply do not.

Conditions at the University have deteriorated sharply. The teaching load has gone to twelve hours; classes have between 35 and 45 students; little or no grading or math lab support is provided. Secretarial and even custodial services, in most cases, are simply no longer provided. This certainly means math typing and often includes cleaning blackboards and floors, and emptying waste baskets. Repairs to the physical plant say a broken toilet—seem interminably delayed.

Our mathematical life goes on but is in jeopardy. Firstly, this is because the Graduate Center, locus of mathematical activity, has serious political problems. By CUNY standards it is opulent; has a highly paid, senior faculty; and a declining student body. With its fine library, cloistered atmosphere, and central location, it seems essential to our scholarship. But can CUNY justify it on that or any other basis?

Secondly, ever worsening conditions and a sense of hopelessness about the future may cause our best (research) mathematicians to leave. Some of these people have actually been fired, either because of unofficial tenure and re-appointment quotas or as a result of the summer's convulsion in 1976 (strict seniority being the only significant variable in that case). CUNY's bad press, especially that summer, makes it impossible to replace these mathematicians with faculty of comparable research stature.

It is a bad time for us. It is a worse time for the students we can no longer do right by. There is an irony here. At a time Harvard, Stanford, Wellesley and Wesleyan are offering "math anxiety" labs to those who cannot add fractions, CUNY is sending these students away; too often with a feeling that they didn't belong in college.

Mark Sheingorn

Editor, the *Notices*

Two people sent me a preprint describing a computer search for a non-integer c such that 2^c and 3^c are integers, in response to my Research Problem, *Amer. Math. Monthly* **83** (1976), p. 473.

Having mislaid this preprint I ask the (unknown) authors to send this information to R. K. Guy (at Cambridge University, DPMSS-16 Mill Lane, Cambridge CB2 1SB, England) who is preparing an article about this section of the *Monthly*.

Albert Wilansky

Editor, the *Notices*

There is an anonymous mess in the front of the May 1977 *Bulletin* of the Society, attributed to "Blanche Descartes" and substituting for a review of a book on graph theory by J. Bondy and U. Murty. It is evidently intended as humor; we get two lines of Shakespeare solely because they contain the names of two of the authors of a famous paper on squared rectangles. Calling himself Blanche amplifies the author's opportunities: he is "not yet very good at drawing" matroids, but he likes them, even though this exemplifies the "feminine weakness of illogicality." At least we are spared humorous misspellings.

We are also spared almost all information about Bondy and Murty's book. It has at least eight chapters, and three appendices. "Appendix III alone (Some Interesting Graphs) is worth 'a

thousand pounds a puff.'" Descartes has opinions about graph theory, all right. He returns again and again to the theme that "my Graph Theory is being invaded" by uppity graph theorists who act as if their subject were not a joke, using determinantal identities, vector spaces modulo 2, and formal power series. "I do not object to [Whitney's] use of mathematical induction."

Probably the graph theorists know who Blanche Descartes is, since references for the review indicate that he has been publishing problems and remarks for thirty years. The general reader isn't told who is responsible except for my (former?) friend Paul Halmos, the editor. I hope he isn't thinking of doing it again.

John R. Isbell

Editor, the *Notices*

The June issue of the *Notices* contains a letter attacking Mathematicians Action Group (MAG) which we feel requires a reply.

As mentioned in the letter, MAG sponsored a panel in St. Louis at which the case of Dan Vered, an imprisoned Israeli mathematician, was discussed along with cases of political repression of mathematicians in Latin America and South Africa. Many MAG members felt it was important to inquire into the Vered case because it was otherwise unlikely to get a hearing in the mathematical community. However, a one-sided presentation was never contemplated. Indeed if he was present at the meeting your correspondent must know that, far from circulating "serious misinformation," MAG provided the forum through which he is likely to have learned of the case against Vered.

We do not know who are the unnamed "leaders of MAG" to whom your correspondent attributes statements about Soviet mathematicians, except that they include none of us. MAG's activities with respect to foreign countries have been aimed at directing the attention of the mathematical community to Chile and Uruguay, where murder and torture are widespread, and South Africa, whose apartheid and systematic oppression must have a special significance for us in the U.S. We disagree with the dangerous cold war doctrine, which is showing increasing signs of revival, that any politically oriented organization must sanitize itself by ritualistically condemning the Soviet Union. Those who wish to voice criticism of the Soviet Union have ample avenues to do so. In particular, the articulation of such criticism has been among the most conspicuous political activities of the AMS in recent years.

It is true, as your correspondent states, that Mathematicains Action Group has changed in the decade of its existence. From its earlier focus on the war in Indo-China we have gone on to the issues of employment, discrimination and affirmative action, democratization of the AMS, the relationship of the mathematical community to the military, and defense of mathematicians suffering torture and imprisonment. We are confident that the many mathematicians concerned with these issues will reject any old-fashioned appeals to red-baiting.

As a final note, we of MAG are pleased to have played a major part in opening up the letters column of the *Notices* to a wide range of issues. We regret that the usual practice of allowing those criticized to reply in the same issue has not been followed in this instance.

Judy Green
Diane Laison
Gary Laison
Co-coordinators
Mathematicians Action Group

SPECIAL MEETINGS INFORMATION CENT

THIS CENTER maintains a file on prospective symposia, colloquia, institutes, seminars, special years, and meetings of other associations, helping the organizers become aware of possible conflicts in subject matter, dates, or geographical area.

AN ANNOUNCEMENT will be published in these *Notices* if it contains a call for papers, place, date, subject (when applicable), and speakers; a second full announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in each issue until it has been held and a reference will be given in parentheses to the volume and page of the issue in which the complete information appeared.

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 are the same as the deadlines for abstracts. They appear on the inside front cover of each issue.

January 2-December 17, 1977. **Mathematisches Forschungs Institut Oberwolfach (Weekly Conferences),** Federal Republic of Germany (23, p. 275; 24, p. 70)

March 21-November 24. **European Mechanics Colloquia 1977** (24, p. 130)

Fall-Spring 1977-1978. **NSF Chautauqua-Type Short Courses for College Teachers,** Field Centers. (24, p. 218)

1977-1978. **Academic Year devoted to Analytic Number Theory and Harmonic Analysis,** The Mittag-Leffler Institute, Djursholm, Sweden (24, p. 70).

OCTOBER 1977

25-28. **Seventh Symposium on Engineering Problems of Fusion Research,** Knoxville, Tennessee.
Information: Technical Activities Board, IEEE, 345 East 42nd Street, New York, New York 10017.

31-November 2. **Society for Industrial and Applied Mathematics 1977 Fall Meeting,** Albuquerque Hilton Inn, Albuquerque, New Mexico.
Organizers: Cleve Moler and Melvin Scott, co-chairmen; Jack Warga; D. L. Thomsen, Jr.
Sponsor: Partial financial support for symposia is anticipated from the Army Research Office and the Office of Naval Research.
Program: Three symposia are planned, on Numerical Solution of Large Scale Problems, Image Processing, and Control Theory. Four special lectures will be given: History of Dynamic Programming (Richard Bellman, University of Southern California); Numerical Analysis (Germund Dahlquist, Swedish Royal Institute of Technology); Models for Natural Resource Management (Colin Clark, University of British Columbia); SIMS Lecture on Cultural Evolution (Luigi Cavalli-Sforza, Stanford University). There will also be about twenty contributed papers and poster sessions.
Information: SIAM 1977 Fall Meeting, 33 South 17th Street, Philadelphia, Pennsylvania 19103

31-November 2. **Eighteenth Annual Symposium on Foundations of Computer Science,** The Marriott Inn, Providence, Rhode Island.
Sponsors: The IEEE Computer Society Committee on Mathematical Foundations of Computing in cooperation with the ACM Special Interest Group for Automata and Computability Theory and the Program in Computer Science, Brown University.
Information: John E. Savage, FOCS '77, Program in Computer Science, Box D, Brown University, Providence, Rhode Island 02912.

NOVEMBER 1977

7-9. **Joint National ORSA/TIMS Meeting,** Atlanta, Georgia. (24, p. 134)

27-December 2. **American Nuclear Society Winter Meeting,** San Francisco, California.
Information: Sherman Naymark, Nuclear Services, 1800 Dell Avenue, Campbell, California 95008.

28-December 16. **Workshop on Boundary Value Problems for Ordinary Differential Equations and Applications,** Trieste, Italy.
Purpose: The purpose of the Workshop is to provide a panorama of the basic methods and techniques, to introduce the problems of current research and to survey the applications.
Speakers: A. Ambrosetti, R. Becker, G. Capriz, A. Cellina, G. Colombo, R. Conti, C. Corduneanu, J. Cronin Scanlon, D. De Figueiredo, T. Hallam, A. Izé, V. Lakshmikhantham, A. Lasota, S. Leela, H. V. Machado, J. Mawhin, J. Moser (tentative), L. Piccinini, P. Podio-Guidugli, R. Ramalho, G. Stampacchia, P. Villaggio, G. Vidossich, and others. A limited number of specialized talks will be arranged during the final week.
Registration and Hotel Reservations: International Centre for Theoretical Physics, Strada Costiera 11, P.O.B. 586, Miramare, Trieste, Italy.
Information: G. Vidossich, IMECC–UNICAMP, Caixa Postal 1170, 13100 Campinas, S. P., Brazil (until November 15, 1977).

DECEMBER 1977

12-17. **Australian Number Theory Conference,** University of New South Wales, Sydney, Australia. (24, p. 220)

15. **IEEE Computer Networks Symposium,** Gaithersburg, Maryland. (24, p. 281)

16-17. **London Mathematical Society Hardy Centenary on Analysis and Number Theory,** Trinity College, Cambridge, England. (24, p. 221)

18-22. **Annual Western Number Theory Conference,** University of California, Los Angeles, California. (24, p. 281)

JANUARY 1978

23-25. **Fifth Annual ACM SIGACT-SIGPLAN Symposium on Principles of Programming Languages,** Tucson, Arizona. (24, p. 281)

FEBRUARY 1978

5-8. **Applied Mathematics Conference,** Broadbeach Hotel, Gold Coast, Queensland, Australia. (24, p. 282)

MARCH 1978

6-9. **International Conference on Developing Mathematics in Third World Countries,** University of Khartoum, Khartoum, Sudan. (24, p. 282)

15-17. **Eleventh Annual Simulation Symposium,** Tampa, Florida. (24, p. 221)

29-31. **Conference on Information Sciences and Systems,** The Johns Hopkins University.

Program Directors: Frederick Davidson, Gerald M. Masson.

Program: The conference will cover new advances, applications, and ideas in the fields of computer science, digital systems, communication theory, system and control theory.

Call for Papers: Two kinds of papers are solicited: regular papers requiring thirty minutes for presentation; and short papers suitable for presentation in fifteen minutes or less.

Instructions for Authors: A "regular" or "short" designation, a title, and a summary are to be submitted by January 16, 1978. Summaries should be of sufficient detail and length to permit careful reviewing. Authors will be notified of acceptance by February 17, 1978. Instructions for the preparation of accepted papers for the Conference Proceedings will be sent to each author. Manuscripts should be sent to the address below.

Information: 1978 Conference on Information Sciences and Systems, Department of Electrical Engineering, The Johns Hopkins University, Baltimore, Maryland 21218.

APRIL 1978

4-7. **Second International Conference on Combinatorial Mathematics,** Barbizon-Plaza Hotel, New York, New York.

Chairmen: Allan Gewirtz, Brooklyn College; Louis V. Quintas, Pace University, New York.

Program: The conference will bring together leading world experts in the fields of pure and applied combinatorial mathematics to discuss and analyze their most recent work in such combinatorial fields as graph theory, coding theory, the four-color problem, block designs, game theory and programming; to describe the latest applications of combinatorics to fields outside of mathematics, such as chemistry, physics, communication networks, social sciences, electrical engineering, waste disposal, genetics, government, computation, industry and art; to describe the uses of the methods of Linear Algebra (applied and theoretic), Computers (4-color problem), Abstract Algebra, Universal Algebra, Topology, Probability and Geometry to the various combinatorial fields; and to provide organized sessions for the purpose of discussing open problems in all of these areas with the express intent of bringing new approaches and methods to bear on some of the more difficult problems that do not seem to be solvable by the methods being used by their proposers.

Information: Conference Department, The New York Academy of Sciences, 2 East 63rd Street, New York, New York 10021.

4-8. **British Mathematical Colloquium,** Lancaster, England. (24, p. 221)

MAY 1978

4-5. **Optimization Days 1978.** Ecole Polytechnique, Montreal, Canada.

Sponsors: SIAM, IEEE Control Systems Society.

Organizers: Ecole Polytechnique, McGill University, Concordia University, the University of Montreal, the Centre de Recherches Mathematiques, l'Ecole des Hautes Etudes Commerciales and the University of Quebec at Montreal.

Program: The aim of the meeting will be the interaction between theory and various areas of applications. Topics will include Mathematical Programming, Optimal Control Theory, Numerical Methods of Optimization, Systems Theory, including Large Scale Systems, Statistical Methods, Estimation and Identification, as well as Applications to Engineering, Management Sciences, Transportation, Economics, Urban and Environmental Problems, Resource Management, Biology, etc. Sessions will consist of invited and contributed talks.

Call for Papers: Papers presenting original developments as well as those of expository nature will be considered. A 200-700 word summary (either in English or in French) which clearly defines the content of the paper should be forwarded by January 31, 1978, to the address below. Authors will be notified of the acceptance of their talks by March 15, 1978.

Information: Michael P. Polis, Department of Electrical Engineering, Ecole Polytechnique, P. O. Box 6079, Succ. "A", Montreal, Quebec, Canada H3C 3A7.

14-17. **Working Conference on Codes for Boundary-value Problems for O.D.E.s,** University of Houston, Houston, Texas. (24, p. 221)

15-19. **Australasian Mathematical Convention,** Christchurch, New Zealand. (24, p. 221)

Speakers: C. P. Ormell (British Schools Council), A. H. Stone (University of Rochester), D. Maharam Stone (University of Rochester), D. V. Lindley (University College of London), D. Griffiths (CSIRO, Canberra), J. M. Hammersley (Institute of Economics and Statistics, Oxford), J. E. L. Peck (British Columbia).

Program: The Convention will emphasize both mathematical research and mathematical education. Addresses will be of three types: talks of interest to all attending, invited specialist talks and specialist splinter groups. Some of the splinter groups will be organized beforehand and some during the Convention itself.

Information: 1978 Convention Secretary, Department of Mathematics, University of Canterbury, Christchurch 1, New Zealand.

JUNE 1978

25-July 2. **Eighth International Congress on the Application of Mathematics in Engineering,** Weimar, German Democratic Republic. (24, p. 134)

26-30. **Eighth U. S. National Congress of Applied Mechanics,** University of California, Los Angeles, California. (24, p. 221)

27-29. **Symposium on Topology,** Mathematical Institute, Oxford, England. (24, p. 282)

JULY 1978

6-14. **Eighth Conference on Stochastic Processes and their Applications,** Australian National University, Canberra ACT, Australia.

Information: C. C. Heyde, Conference Organgen 1978, Division of Mathematics and Statistics, CSIRO, POB 1965, Canberra ACT 2601, Australia.

AUGUST 1978

12-14. **Helsinki Symposium on Integral Equations,** Helsinki University of Technology, Helsinki, Finland.

Program: The symposium will deal with recent developments in the qualitative theory of Volterra equations.

Information: G. Gripenberg, Institute of Mathematics, Helsinki University of Technology, Otakaari 1, 02150 Espoo 15, Finland.

15-23. **The 1978 International Congress of Mathematicians,** Helsinki, Finland. (24, p. 135).

21-25. **Third ISI COMPSTAT Symposium on Computational Statistics,** Leiden University, The Netherlands. (24, p. 282)

MATHEMATICAL SCIENCES EMPLOYMENT REGISTER

A vast majority of both applicants and employers who participated in the Employment Register at the St. Louis meeting, submitted preregistration forms well in advance and thereby avoided having to wait in line at the last minute to complete the required paperwork. Those who preregistered also enjoyed the advantage of having their listings included in the printed summary list available to participants at the beginning of the Register sessions.

This year, those who plan to participate in the Employment Register at the annual meeting, are urged to complete special forms on pages A-597 and A-598 of these *Notices* and submit them with their preregistration forms for the Joint Mathematics Meetings. Deadline for receipt of applicant and employer forms is DECEMBER 2. These special forms will also appear in the November issue of EMPLOYMENT INFORMATION FOR MATHEMATICIANS (EIM). Preregistration by both applicants and employers, will not only facilitate procedures, but will again help to cut down waiting time when the Employment Register opens in Atlanta.

The forms include a coded strip summarizing the information contained on the applicants' and employers' forms. Please be sure to provide the coded summary in addition to completing the regular form. These strips will be used to prepare printed lists of preregistered employers and applicants for the benefit of those who complete the special preregistration process for the Employment Register described above. Other participants may obtain copies of the printed lists at the meeting for $1 each.

All participants in the Employment Register are required to register for the Joint Mathematics Meetings. For applicants there is no additional fee for participation in the Employment Register. For employers additional fees for participation in the Employment Register are $10 if paid at the time of preregistration, or $15 if paid at the meeting.

The Employment Register will be in session on Thursday, Friday, and Saturday, January 5-7. A short (optional) orientation session will be held by the AMS-MAA-SIAM Joint Committee on Employment Opportunities at 9:00 a.m. on Thursday, January 5. The purpose of this session is to familiarize participants with the operation of the Employment Register and with registration procedures.

Registration for the Register will begin at 9:30 a.m. on Thursday and interviews will begin at 9:30 a.m. on Friday, January 6, and 9:30 a.m. on Saturday, January 7. Interview request cards must be turned in to the code clerk before 4:00 p.m. on the day prior to the interview. There will be no interviews scheduled for Thursday.

This year arrangements have again been made for computer scheduling of interviews. In order to allow applicants and employers to participate in as many interviews as possible, interviews are scheduled by the computer on the basis of preferences expressed by the participants. Provision has been made for scheduling of interviews in half-day modules. This allows for four half-days of interviews; Friday, A.M. and P.M., and Saturday, A.M. and P.M. This year the AMS-MAA-SIAM Joint Committee on Employment Opportunities has suggested that the Saturday, January 7, afternoon interview session allow the employer the opportunity of requesting interviews with applicants exclusively. Requests for interviews must be submitted by the employer on Friday, January 6, prior to the deadline of 4:00 p.m. in order to receive a schedule for Saturday afternoon. Applicants may not submit interview request forms for this session.

Applicants and employers should be sure to indicate exactly what times they will be available for interviews in the appropriate place on the forms. Applicants and employers are asked not to duplicate their interview requests for both morning and afternoon schedules on the same day; applicants and employers should also be advised that the program will NOT automatically reschedule a morning appointment to an afternoon session, if it could not be scheduled when requested for the morning. Interview requests should not be submitted, of course, unless the other individual requested has indicated availability during the time period desired. Morning schedules will be distributed on Friday and Saturday at 8:45 a.m.; the afternoon schedules will be distributed at 9:00 a.m. on the same days.

The Society and Association sponsor the bimonthly publication, EMPLOYMENT INFORMATION FOR MATHEMATICIANS (EIM). Information on EIM appears on page 377 of these *Notices*.

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.

RETIRED MATHEMATICIANS

The annual List of Retired Mathematicians Available for Employment will be included in the January issue of EMPLOYMENT INFORMATION FOR MATHEMATICIANS. Copies of the list are available on request from the Mathematical Sciences Employment Register, American Mathematical Society, P.O. Box 6248, Providence, R. I. 02940. Copies will also be available at the January meeting in Atlanta, Georgia.

Retired mathematicians who are interested in being included in the list may either request a form from the Employment Register or may send to the above address the following information: name, date of birth, highest degree earned and where it was obtained, most recent employment, present address, date available, names of references, preference for academic or industrial employment, and geographic location preferred. The deadline for receipt of either the completed form or the preceding information is December 1, 1977.

Employment Information for Mathematicians

401-272-9500

The American Mathematical Society and the Mathematical Association of America publish EIM six times each academic year: November, January, March, May, July and August. Each issue contains listings of departments in the mathematical sciences in the United States and Canada grouped under one of three headings: Those with positions to be filled, those with no open positions, and those not responding to requests for information. A fourth section includes information on governmental, industrial, and foreign positions.

Department heads provide information (by a specified deadline) on available openings, or state that no openings are available on preprinted forms that are mailed to them every other month. A statement that no positions are available may relieve the department of the obligation to answer letters from applicants, thus decreasing the burden of correspondence.

"The Council of the AMS adopts the principles that all positions in the mathematical sciences shall insofar as practicable be advertised, and that the standard place for the advertisements to appear is the publication EMPLOYMENT INFORMATION FOR MATHEMATICIANS."

This resolution was passed at the October 25, 1974 meeting of the Council of the American Mathematical Society.

Six issues are published during the academic year, beginning with the November issue, for a subscription price for individuals of $25 (EIM is available for half price [$12.50] to unemployed individuals who are not graduate students). Subscription rates are prorated for late orders. Single copies are not available except for the final issue. The chart below gives complete information on individual subscription rates. (The subscription rate for institutions is based on Ph.D. production and may be obtained by writing to EIM, P.O. Box 6248, Providence, Rhode Island 02940 or by telephoning 401-272-9500.)

INDIVIDUAL ORDER FORM

Beginning with	Book Rate Ind.	Book Rate Unem.*	Deadline for receipt of orders		Issue mailed from the printer
NOVEMBER	$ 25.	$12.50	10/15/77		11/1/77
JANUARY	$ 21.	$10.50	12/15/77	(Back issues of EIM are not available)	1/2/78
MARCH	$ 17.	$ 8.50	2/15/78		3/2/78
MAY	$ 13.	$ 6.50	4/15/78		5/1/78
JULY	$ 9.	$ 4.50	6/15/78		6/30/78
AUGUST	$ 5.	$ 2.50	7/15/78		8/1/78

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[ ] Unemployed rate*
Begin with issue _____ _____

Check one (None of the service charges may be prorated)

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[ ] First Class ($ 4.20) $ _____
[ ] Air Mail (Canada) ($ 6.10) _____
[ ] Air Mail (Central, South America, Europe) ($10.50) _____
[ ] Air Mail (Asia, Africa, Australia) ($13.10)

Payment enclosed TOTAL $ _____

*To qualify for this rate please complete the following form:

I am currently unemployed and actively seeking employment. My unemployed status is not the result of voluntary resignation or a retirement from my last position. I am not enrolled in a graduate study program. _____ Name

PLEASE PRINT

Name _____

Address _____

City _____ State _____ Zip _____

Check must accompany order: make payable to American Mathematical Society

Post Office Box 1571, Annex Station Providence, Rhode Island 02901

Application Deadlines for Grants and Assistantships

The following schedule gives application deadlines which occur before or near the publication date of the special December issue of the *Notices* on Assistantships and Fellowships. These dates have been compiled from the 1976 special issue, updated with information received in preparation for the 1977 issue, and from news items published during the past year. For information about the various programs the reader is referred to the issue of the *Notices* in which the news item appeared or to the appropriate section of the December 1976 issue of the *Notices* as follows: [GS] = Graduate Support Section; [PS] = Postdoctoral Support Section; [TSA] = Travel and Study Abroad Section. An asterisk (*) indicates information from the 1976 issue, not yet confirmed for this year.

1977

October 15

Oskar Morgenstern Distinguished Fellowship at Mathematica [August 1977, p. 284]

"In November"

National Academy of Sciences [TSA]*

November 1

American-Scandinavian Foundation (Marshall Fellowships for Denmark) [TSA]

E. D. Bergmann Memorial Research Grants [TSA]

Fannie and John Hertz Foundation Fellowships [GS]

National Science Foundation. Research and Travel Grants [February 1977, p. 115] [PS]*

November 15

Indo-American Fellowship Program [TSA]

November 28

North Atlantic Treaty Organization. Postdoctoral Fellowships [TSA]

December 1

American Association of University Women [TSA]

American-Scandinavian Foundation [TSA]

National Science Foundation Graduate Fellowships [GS]

Royal Norwegian Council for Scientific and Industrial Research [TSA]

Sigma Delta Epsilon. Eloise Gerry Fellowship [GS]

December 5

National Science Foundation (National Needs) [PS]

December 9

American Philosophical Society [PS]

December 13

Danforth Foundation [GS]*

December 15

Lady Davis Visiting Professorships [TSA]

National Science Foundation (SEED Program) [PS]*

Weizmann Institute of Science. Feinberg Graduate School Postdoctoral Fellowships [January 1977, p. 84] [TSA]

December 16

National Science Foundation. Science Faculty Professional Development Program [PS]

December 30

C. L. E. Moore Instructorships in Mathematics [PS]

1978

January 1

Courant Institute. Instructorships in Mathematics and Computer Science [PS]*

Courant Institute. Postdoctoral Visiting Memberships [PS]*

Lady Davis Fellowship Trust [TSA]

L. E. Dickson Instructorships in Mathematics [PS]*

Jacob David Tamarkin Instructorships [PS]

Zonta International [GS]

January 3

T. H. Hildebrandt Research Assistant Professorships [PS]

January 9

Benjamin Peirce Lectureships [PS]

January 14

Courant Institute [GS]*

January 15

Air Force Systems Command [PS]*

E. R. Hedrick Assistant Professorships in Mathematics [PS]

G. C. Evans Instructorships [PS]

IBM Thomas J. Watson Research Center [PS]

Institute for Advanced Study Memberships [PS]

Kosciuszko Foundation [PS] [TSA]

National Bureau of Standards [PS]*

National Research Council [PS]

National Research Council of Canada. Postdoctorate Fellowships [TSA]*

Smithsonian Institution [GS]

Smithsonian Institution. Postdoctoral Fellowships [PS]

January 20

State University of New York at Buffalo [PS]*

January 30

Solomon Lefschetz Research Instructorships [TSA]

January 31

American Mathematical Society Research Fellowships [PS]

Václav Hlavatý Research Assistant Professorships [PS]*

"Before February"

J. Willard Gibbs Instructorships [PS]*

NEW AMS PUBLICATIONS

CBMS REGIONAL CONFERENCE SERIES IN MATHEMATICS

BANACH SPACES OF ANALYTIC FUNCTIONS AND ABSOLUTELY SUMMING OPERATORS

by Aleksander Pełczynski

Number 30
91 pages
List price $7.60; individual price $5.70
ISBN 0-8218-1680-2; LC 77-9884
Publication date: September 30, 1977
To order, please specify CBMS 30

This is a revised version of the author's ten-lecture marathon at the American Mathematical Society Regional Conference *On Banach spaces of analytic functions* held at Kent State University, July 11-16, 1976.

§§0 and 1 have preliminary character. §§2 and 3 are devoted to studying properties of p-absolutely summing operators from the disc algebra. §§4 and 5 should convince the reader that the disc algebra is a pathological space from the point of view of Banach space theory, or at least that it is very different from $C(S)$-spaces, and that the same is true for a large class of uniform algebras. The Havin lemma is presented in §6. In §§7 and 8 the author shows that the disc algebra shares various properties of $C(S)$-spaces like the Dunford-Pettis property, characterizations of weakly compact operators, weak sequential completeness of the dual, etc. In §9 the author applies the main result of §2 to study asymptotic behavior of norms of projections from the disc algebra onto its finite dimensional subspaces as the dimensions of these subspaces tend to infinity. §10 is loosely related to other sections. It is a survey (without proofs) of results concerning bases and various approximation properties in the classical spaces of analytic functions. In §11 the author considers the problem of isomorphic classification of spaces of analytic functions of different numbers of variables.

TRANSFERENCE METHODS IN ANALYSIS

by Ronald R. Coifman and Guido Weiss

Number 31
59 pages
List price $7.60; individual price $5.70
ISBN 0-8218-1681-0; LC 77-24098
Publication date: October 30, 1977
To order, please specify CBMS 31

These ten lectures were presented by Guido Weiss at the University of Nebraska during the week of May 31 to June 4, 1976. They were a part of the Regional Conference Program sponsored by the Conference Board of the Mathematical Sciences and funded by the National Science Foundation.

The topic chosen, "the transference method", involves a very simple idea that can be applied to several different branches of analysis. The authors have chosen familiar special cases in order to illustrate the use of transference: much that involves general locally compact abelian groups can be understood by examining the real line; the group of rotations can be used to explain what can be done with compact groups; $SL(2,\mathbf{C})$ plays the same role vis-à-vis noncompact semisimple Lie groups.

The main theme of these lectures is the interplay between properties of convolution operators on classical groups (such as the reals, integers, the torus) and operators associated with more general measure spaces. The basic idea behind this interplay is the notion of transferred operator; these are operators "obtained" from convolutions by replacing the translation by some action of the group (or, in some cases, a semigroup) and give rise, among other things, to an interaction between ergodic theory and harmonic analysis. There are illustrations of these ideas.

A graduate student in analysis would be able to read most of this book. The work is partly expository, but is mostly "self-contained".

SMALL FRACTIONAL PARTS OF POLYNOMIALS

by Wolfgang M. Schmidt

Number 32
41 pages
List price $7.20; individual price $5.40
ISBN 0-8218-1682-9; LC 77-8028
Publication date: October 30, 1977
To order, please specify CBMS 32

Knowledge about fractional parts of linear polynomials is fairly satisfactory. Knowledge about fractional parts of nonlinear polynomials is not so satisfactory. In these notes the author starts out with Heilbronn's Theorem on quadratic polynomials and branches out in three directions. In §§7-12 he deals with arbitrary polynomials with constant term zero. In §§13-19 he takes up simultaneous approximation of quadratic polynomials. In §§20-21 he discusses special quadratic polynomials in several variables.

There are many open questions; in fact, most of the results obtained in these notes are almost certainly not best possible. Since the theory is not in its final form, the author has refrained from including the most general situation, i.e. simultaneous fractional parts of polynomials in several variables of arbitrary degree. On the other hand, he has given all proofs in full detail and at a leisurely pace.

For the first half of this work, only the standard notions of an undergraduate number theory course are required. For the second half, some knowledge of the geometry of numbers is helpful.

This is, mainly, not an "expository" work, but all the proofs are given.

LECTURES IN APPLIED MATHEMATICS

MODERN MODELING OF CONTINUUM PHENOMENA
edited by Richard C. DiPrima

Volume 16
251 pages
List price $30.80; member price $23.10
ISBN 0-8218-1116-9; LC 77-9041
Publication date: October 31, 1977
To order, please specify LAM 16

The articles contained in this volume follow the pattern of the lectures presented at the Ninth Summer Seminar on Applied Mathematics, sponsored jointly by the American Mathematical Society and the Society for Industrial and Applied Mathematics, held at Rensselaer Polytechnic Institute from July 7 to July 18, 1975. The articles are more detailed and include generalizations that could not be presented during the lectures.

The purposes of the seminar and therefore of this volume are (i) to introduce the participants to selected mathematical research areas of high current interest and relevance, (ii) to present the underlying fundamental laws of continuum model building, and (iii) to present selected mathematical topics particularly useful in solving modern mathematical problems of continuum phenomena.

The table of contents is: *An introduction to continuum theory* by Lee A. Segel; *Perturbation theory* by Donald S. Cohen; *Introduction to the asymptotic analysis of stochastic equations* by George C. Papanicolaou; *Lectures in population dynamics* by G. Oster; *Amoeboid motions* by Garrett M. Odell; and *Earthquake sources* by Leon Knopoff and John O. Mouton.

LECTURES ON MATHEMATICS IN THE LIFE SCIENCES

SOME MATHEMATICAL QUESTIONS IN BIOLOGY. VIII
edited by Simon A. Levin

Volume 9
186 pages
List price $14.40; member price $10.80
ISBN 0-8218-1159-2; LC 77-25086
Publication date: October 30, 1977
To order, please specify LLSCI 9

This volume contains lectures given at the Tenth Symposium on Some Mathematical Questions in Biology, held in Boston on February 24, 1976, in conjunction with the Annual Meeting of the American Association for the Advancement of Science.

Three main themes are reflected in the lectures contained in this volume. The first two papers, *Some mathematical models in immunology I* by George Bell, and *Some mathematical models in immunology II* by Byron Goldstein, present a coordinated development of mathematical models in immunology. The next two papers, *Current theories of pattern formation* by Hans Othmer, and *Dynamic models of the mitotic cycle: Evidence for a limit cycle oscillator* by Stuart Kauffman, address questions of significance for developmental biology. The final two papers address problems in biomechanics. They are *Some problems of fluid mechanics in biology* by Sol I. Rubinow and *Theories of axoplasmic transport* by Garrett M. Odell.

This is an expository work which requires a background in calculus and some differential equations.

MEMOIRS OF THE AMERICAN MATHEMATICAL SOCIETY

SURGERY ON CODIMENSION 2 SUBMANIFOLDS
by Michael H. Freedman

Number 191
93 pages
List price $7.20; member price $5.40
ISBN 0-8218-2191-1; LC 77-23944
Publication date: September 30, 1977
To order, please specify MEMO/191

This volume examines the restrictions placed on the topology of a submanifold by the class it represents in the homology of the outside manifold. Starting from the basic facts of differential topology, a geometric theory of ambient surgery is developed. The obstructions that arise are related to the G-signatures associated to the deck transformations of a branched covering space. This enables one to make computations which lead to counterexamples to the high-dimensional version of Thom's conjecture on the minimality of the genus of nonsingular algebraic curves in complex projective two-space. This material would be suitable for a second year graduate seminar.

UNRAVELING THE INTEGRAL KNOT CONCORDANCE GROUP
by Neal W. Stoltzfus

Number 192
91 pages
List price $7.20; member price $5.40
ISBN 0-8218-2192-X; LC 77-10133
Publication date: September 30, 1977
To order, please specify MEMO 192

The classification of bordism classes of diffeomorphisms of even dimensional manifolds by Lopez de Medrano and Kreck and of concordance classes of odd dimensional homotopy spheres knotted in codimension two in a standard sphere of high dimension by Fox, Milnor, Kervaire and Levine both involve a Witt group of endomorphisms, t, of ϵ-symmetric nonsingular bilinear forms, B, satisfying an adjointness condition: $B(t(x), y) = B(x, t^{-1}(y))$ in the first case and $B(t(x), y) = B(x, (\mathrm{Id}-t)(y))$ in the second. This memoir elucidates the complete structure of these groups in terms of ϵ-Hermitian forms on torsion-free modules over certain invariant orders in an arbitrary number field with a nontrivial involution. These modules are relatively projective over the integers but examples are given to show that they cannot always be chosen to be projective over the order.

§1 presents the necessary introductory material on Witt groups of endomorphisms. In §2, a similar Witt group of endomorphisms of torsion linking forms is introduced and a localization exact sequence constructed relating the group of integral and torsion structures with the Witt group of structures on a rational vector space where the endomorphism satisfies a monic polynomial with integral coefficients.

The interplay between the $Z[X]$-module structure induced by the endomorphism t and the fact that $Z[X]$ is not a PID is studied in §3. Using torsion linking structures, an algebraic obstruction (coupling invariant) to finding a representative which is the direct sum of structures with irreducible minimal polynomials is defined. Geometrically this is an obstruction to constructing a concordance of an arbitrary knot to a connected sum of knots whose Alexander polynomial is a power of an irreducible polynomial.

The fourth section is the algebraic core of the memoir. In this section, the boundary map in the localization sequence is computed, as well as the group of ϵ-Hermitian forms on torsion-free modules over an order (irreducible torsion-free $Z[X]$-module) invariant under an involution. §5 presents a complete computation of the knot concordance group. In particular, an element of order four in the symmetric case must have a nontrivial coupling invariant, hence its Alexander polynomial must have distinct factors. Many interesting numerical examples are computed, including the verification that the global boundary is onto.

The last section returns to the original geometric problem and develops a geometric localization sequence mimicing but not isomorphic to the algebraic one. This section also discusses the group of equivariant concordance classes of knots invariant under a cyclic group action. The above results further highlight the deepening interrelationship between algebraic number theory and algebraic topology.

NORMAL STRUCTURES AND BORDISM THEORY, WITH APPLICATIONS TO MSp_*
by N. Ray, R. Switzer and L. Taylor

Number 193
66 pages
List price $7.20; member price $5.40
ISBN 0-8218-2193-8; LC 77-10134
Publication date: September 30, 1977
To order, please specify MEMO 193

This volume consists of three related papers. The first discusses the general problem of realising different bordism classes on a given manifold by varing its normal structure. A limit is given to the number of classes so obtainable, and it is shown that this limit is always attainable on a suitably chosen 'pre-universal' manifold. Examples are given from unitary bordism.

The second and third papers are concerned with applying such techniques to study the symplectic bordism ring. A series of manifolds introduced by J. Alexander is examined and shown to carry an interesting set of Sp bordism classes by successive alternations of Sp structure.

PROCEEDINGS OF THE STEKLOV INSTITUTE OF MATHEMATICS

BOUNDARY VALUE PROBLEMS OF MATHEMATICAL PHYSICS. IX
edited by O. A. Ladyženskaja

Number 127 (1975)
179 pages
List price $25.60; member price $19.20
ISBN 0-8218-3027-9; LC 67-6187
Publication date: June 30, 1977
To order, please specify STEKLO 127

In this collection V. A. Solonnikov continues his investigations on overdetermined boundary value problems of elliptic type. In his paper the solvability of such problems is established in a broad scale of function spaces introduced by K. K. Golovkin (the so-called fractional spaces). Along the same lines, the paper by Š. Sahaev studies an overdetermined problem of parabolic

type arising in magnetohydrodynamics. In the paper by Sahaev and Solonnikov unique local solvability in the class of smooth functions is established for an initial-boundary value problem in magnetohydrodynamics. Unique solvability of this and two other problems in magnetohydrodynamics in certain classes of generalized solutions was proved earlier by Ladyženskaja and Solonnikov. Some generalizations of the system of Navier-Stokes equations are given by A. P. Oskolkov, establishing a number of estimates for solutions of these systems.

Quasilinear equations of elliptic type are studied in the papers of A. V. Ivanov and A. L. Treskunov.

L. Stupjalis investigates unique solvability of initial-boundary value problems for equations of mixed type.

The papers by N. K. Korenev concern the grid method.

MATHEMATICAL LOGIC, THE THEORY OF ALGORITHMS AND THE THEORY OF SETS
edited by S. I. Adjan

Number 133 (1973)
274 pages
List price $39.60; member price $29.70
ISBN 0-8218-3033-3; LC 77-3359
Publication date: June 15, 1977
To order, please specify STEKLO 133

This collection is dedicated to Academician P. S. Novikov on his seventieth birthday. It consists of 23 papers.

The collection opens with three survey articles on P. S. Novikov's scientific and pedagogical activity, on his work in descriptive set theory and in algorithmic problems of algebra. The fundamental results obtained by Novikov in these fields are described in these articles, and his outstanding role in the training of scientific personnel is shown.

The rest of the collection's papers are results of the investigations of Novikov's students in various branches of mathematical logic, set theory, the theory of algorithms and its applications. The paper by Novikov's student, V. Ja. Arsenin, in which approximate solutions to integral equations are studied, is an exception in this respect.

THEORY OF FUNCTIONS AND ITS APPLICATIONS
edited by L. S. Pontrjagin

Number 134 (1975)
458 pages
List price $50.00; member price $37.50
ISBN 0-8218-3034-1; LC 77-10017
Publication date: October 31, 1977
To order, please specify STEKLO 134

The collection begins with a review of the scientific activity of Academician S. M. Nikol'skiĭ. This review reflects his fundamental results in the theory of approximation of functions, functional analysis, imbedding of function spaces and its applications, and Nikol'skiĭ's outstanding role in training scientific personnel is evidenced.

The collection contains papers by colleagues, students and disciples of Nikol'skiĭ, representing original scientific research in the theory of functions of one and several variables, as well as applications to differential equations.

APPROXIMATIONS OF FUNCTIONS AND OPERATORS
edited by S. B. Stečkin

Number 138 (1975)
211 pages
List price $28.80; member price $21.60
ISBN 0-8218-3038-4; LC 77-8940
Publication date: October 31, 1977
To order, please specify STEKLO/138

This collection consists of original papers devoted to the investigation of approximations of functions and operators, and related problems. Approximations of functions by splines (N. L. Zmatrakov, N. I. Černyh) are studied, as well as interpolation in the mean by splines (Ju. N. Subbotin). The cycle of papers by V. V. Arestov and N. P. Kupcov is devoted to the approximation of operators, to Kolmogorov's inequality in $L_2[0,\infty)$ and to the dual problem of approximating a class by a class. The collection will be of interest to workers in the area of approximation theory and also to specialists in computational mathematics.

SELECTED TABLES IN MATHEMATICAL STATISTICS

edited by J. M. Davenport

Volume V
263 pages
List price $16.80; member price $12.60
ISBN 0-8218-1905-4; LC 74-6283
Publication date: October 31, 1977
To order, please specify TABLES/5

This volume of Selected Tables in Mathematical Statistics consists of three parts: *Variances and covariances of the normal order statistics for sample sizes 2 to 50*, by G. L. Tietjen, D. K. Kahaner and R. J. Beckman; *Means, variances and covariances of the normal order statistics in the presence of an outlier*, by H. A. David, W. J. Kennedy and R. D. Knight; *Tables for obtaining optimal confidence intervals involving the chi-square distribution*, by G. Randall Murdock and William O. Williford.

The volume also contains some preface material.

The background needed for use of these Tables is a basic knowledge of mathematical and applied statistics.

AMS TRANSLATIONS—SERIES 2

TWENTY LECTURES DELIVERED AT THE INTERNATIONAL CONGRESS OF MATHEMATICIANS IN VANCOUVER 1974

Volume 109
129 pages
List price $20.00; member price $15.00
ISBN 0-8218-3059-7; LC 77-9042
Publication date: October 30, 1977
To order, please specify TRANS2 109

This volume of the American Mathematical Society Translations, Series II, contains translations of 20 lectures delivered at the International Congress of Mathematicians held in Vancouver in 1974 (Russian originals have been published in the full Proceedings of the Congress). Following is a list of the 20 authors and the titles of the lectures:

V. D. Mazurov, *On solvable subgroups of finite simple groups*;

V. E. Voskresenskiĭ, *Some questions of the birational geometry of algebraic tori*;

A. A. Karacuba, *Trigonometric sums and their applications*;

S. A. Stepanov, *An elementary method in the theory of equations over finite fields*;

V. P. Platonov, *Arithmetic and structural problems in linear algebraic groups*;

S. S. Ryškov, *The geometry of positive quadratic forms*;

G. A. Margulis, *Discrete groups of motions of manifolds of nonpositive curvature*;

V. V. Filippov, *A survey of dimension theory*;

N. P. Korneĭčuk, *Some extremal problems in approximation theory*;

D. P. Želobenko, *Complex harmonic analysis on semisimple Lie groups*;

A. F. Leont'ev, *On the representation of analytic functions by Dirichlet series*;

M. I. Višic, *Analytic solutions of equations with variational derivatives, and their applications*;

D. V. Anosov, *Geodesics in Finsler geometry*;

N. N. Nehorošev, *On the behavior of Hamiltonian systems near integrable ones*;

A. I. Subbotin, *Control under conditions of conflict and indeterminacy*;

A. A. Samarskiĭ, *Stability theory of difference schemes and iterative methods*;

A. G. Svešnikov, *Numerical methods in diffraction theory*;

Ja. M. Barzdin', *Inductive inference of automata, functions and programs*;

E. B. Dynkin, *Stochastic dynamic models of economic equilibrium*; and

B. V. Gnedenko, *Current studies in the history of mathematics in the Soviet Union*.

NINE PAPERS ON ANALYSIS

Volume 110
188 pages
List price $28.00; member price $21.00
ISBN 0-8218-3060-0; LC 77-11203
Publication date: October 31, 1977
To order, please specify TRANS2 110

This volume consists of nine papers dealing with the topic of analysis. The authors and their articles are: M. M. Džrbašjan, *An extension of the Denjoy-Carleman quasi-analystic classes*; Vlastimil Pták, *On complete topological linear spaces*; M. S. Budjanu and I. C. Gohberg, *The factorization problem in abstract Banach algebras. I. Splitting algebras*; M. S. Budjanu and I. C. Gohberg, *The factorization problem in abstract Banach algebras. II. Irreducible algebras*; I. C. Gohberg and N. Ja. Krupnik, *On the algebra generated by Toeplitz matrices in h_p spaces*; A. S. Markus and V. A. Prigorskiĭ, *On some chains of projections in Hilbert space*; V. I. Macaev and Ju. A. Palant, *On the distribution of the spectrum of a rational operator pencil*; A. S. Markus, *On the convergence of multiple expansions in eigenvectors and associated vectors of an operator bundle*; and B. M. Levitan, *On the asympotic behavior of the spectral function of a selfadjoint differential equation of the second order and on expansion in eigenfunctions. II.*

PERSONAL ITEMS

ROGER ALEXANDER of the University of Colorado has been appointed to an assistant professorship at the Rensselaer Polytechnic Institute.

ALFRED T. BRAUER of the University of North Carolina at Chapel Hill has been honored by the renaming of the Mathematics-Physics Library at Chapel Hill to the Alfted T. Brauer Library.

LOIS M. BROUSSARD of Northern Illinois University has been appointed to an assistant professorship at Rockford College for the year 1977-1978.

DAVID E. BROWN of Rockford College has accepted a position with Artronix Corporation.

ROBERT P. BUEMI of the Massachusetts Institute of Technology has joined Daniel H. Wagner, Associates.

E. WILLIAM CHAPIN has been appointed to the chairmanship of the Mathematics and Computer Science Department at the University of Maryland–Eastern Shore.

STEPHEN D. COMER of the Citadel has been appointed to a visiting associate professorship at the University of Hawaii.

NICOLAE DINCULEANU of the University of Bucarest has been appointed to a professorship at the University of Florida.

CHARLES F. DUNKL of the University of Virginia has been appointed to a visiting associate professorship at the Georgia Institute of Technology.

THOMAS A. W. DWYER III, of Northern Illinois University has been appointed to a visiting associate professorship at the University of Maryland, College Park.

HARLEY FLANDERS of Tel-Aviv University has been appointed to a visiting professorship at the Georgia Institute of Technology.

J. SUTHERLAND FRAME of Michigan State University has retired as of July 1, 1977, and has been appointed professor emeritus by that university.

ANTHONY M. GAGLIONE of City College (CUNY), has been appointed to an assistant professorship at the U. S. Naval Academy.

LARRY K. GRAVES of Brown University has joined Daniel H. Wagner, Associates.

CHARLES R. HADLOCK of Bowdoin College has been appointed to the Physical Systems Research Section at the Arthur D. Little, Inc., Cambridge, Massachusetts.

THOMAS G. HALLAM of Florida State University and the University of Georgia, Athens, has been appointed to a professorship at the University of Tennessee, Knoxville.

DAVID K. HARRISON of the University of Oregon has been appointed to a visiting professorship at the University of Hawaii for the 1977 fall semester.

THEODORE P. HILL of the University of California at Berkeley has been appointed to a visiting assistant professorship at the Georgia Institute of Technology.

ULRICH KOSCHORKE of Bonn University has been appointed to a professorship at the Gesamthochschule Siegen, Siegen, Federal Republic of Germany.

EVERETT L. LADY of the University of Kansas has been appointed to an assistant professorship at the University of Hawaii.

JOSHUA B. LEVY of the University of Wisconsin at Madison has been appointed to a visiting assistant professorship at the Georgia Institute of Technology.

G. G. LORENTZ of the University of Texas at Austin has been awarded an honorary doctors degree by the University of Tübingen, Tübingen, Federal Republic of Germany.

SAUNDERS MAC LANE of the University of Chicago has been awarded the honorary degree, Doctor of Science by the University of Pennsylvania.

MORRIS L. MARX of Vanderbilt University has been appointed to the chairmanship of the Department of Mathematics and to a professorship at the University of Oklahoma.

BERNARD J. MATKOWSKY of Rensselaer Polytechnic Institute has been appointed to a professorship at Northwestern University.

MICHAEL H. MOORE has been appointed principal engineer at the ORINCON Corporation, La Jolla, California.

MICHAEL D. MORLEY of Cornell University has been appointed to a visiting professorship at the University of Hawaii.

PAUL NELSON, JR., of the Texas Tech University has been appointed to a visiting professorship at the Georgia Institute of Technology.

EDWARD T. ORDMAN of Memphis State University has been appointed to an assistant professorship at New England College.

C. AMBROSE ROGERS of University College, University of London, has been presented the thirty-second De Morgan Medal by the London Mathematical Society.

R. J. SERFLING of Florida State University, on leave from September 1977 to September 1978, has been appointed statistical advisor at the National Science Foundation, Division of Science Resources Studies.

MARSHALL SLEMROD of the Rensselaer Polytechnic Institute will be on leave at the Hebrew University, Jerusalem, Israel, from September to December, 1977, and at the Heriot-Watt University, Edinburgh, Scotland, from January to May, 1978.

JON E. SPINGARN of the University of Washington has been appointed to an assistant professorship at the Georgia Institute of Technology.

WALTER F. TAYLOR of the University of Colorado has been appointed to a visiting professorship at the University of Hawaii.

WESLEY E. TERRY of New Mexico State University has been appointed to a visiting assistant professorship at the University of Oklahoma.

W. R. THICKSTUN, JR., of Clarkson College of Technology has been appointed to an associate professorship at the University of Petroleum and Minerals, Dhahran, Saudi Arabia.

OLGA TAUSSKY TODD of the California Institute of Technology has retired July 1st, with the rank of professor emeritus.

IZU VAISMAN has been appointed to a professorship at the University of Haifa, Israel.

JAMES R. WEISINGER of Harvard University has joined Daniel H. Wagner, Associates.

LUTHER W. WHITE of the University of Illinois has been appointed to an assistant professorship at the University of Oklahoma.

GEORGE M. WHITSON of Kent State University has been appointed to an associate professorship at Rockford College.

JAMES A. WILSON of the University of Wisconsin at Madison has been appointed to a visiting assistant professorship at the Georgia Institute of Technology.

PROMOTIONS

To Chairman, Department of Mathematics, University of Texas at Austin: JAMES W. DANIEL.

To Chairman, Department of Mathematical Sciences, Loyola University of Chicago: RICHARD J. MAHER.

To Professor and Chairman, Department of Mathematics, University of Hawaii: JACK WILLIAMSON.

To Head, Department of Mathematics, Andhra University, Waltair, India: J. GOPALA KRISHNA; University of Saskatchewan: B. S. LALLI.

To Professor, Boston State College: SEYMOUR KASS; Stevens Institute of Technology: MILOS DOSTAL, LAWRENCE E. LEVINE; SUNY, Center at Buffalo: ALBERT G. FADELL; Syracuse University: KARL BARTH; University of Hawaii: RONALD P. BROWN; University of Maine at Orono: ERIC LANGFORD; University of North Carolina at Chapel Hill: JONATHAN P. BREZIN, ROBERT B. GARDNER, LADNOR D. GEISSINGER.

To Associate Professor, Colorado State University: MICHAEL L. KOVACIC, STEPHEN F. McCORMICK, AUBREY B. POORE; Hope College: FRANC C. SHERBURNE, JR.; Rensselaer Polytechnic Institute: NORMAN FREE, HARRY W. McLAUGHLIN; SUNY, Center at Buffalo: JONATHAN DIMOCK, CATHERINE L. OLSEN, SCOTT W. WILLIAMS; University of Florida: DOUGLAS CENZER; University of Hawaii: THOMAS C. CRAVEN, GERALD N. HILE; Wellesley College: ALAN SHUCHAT, ANN K. STEHNEY.

INSTRUCTORSHIPS

University of North Carolina at Chapel Hill: TAVAN T. TRENT.

University of Oklahoma: PIOTR BLASS, LEON HARKLEROAD, SUSHIL JAJODIA, RICHARD MAGRUDER, ROBERT STERNFELD.

DEATHS

Professor STEFAN BERGMAN of Stanford University died in June, 1977, at the age of 78. He was a member of the Society for 35 years.

Professor Emeritus EDWARD W. CHITTENDEN of the University of Iowa died on June 16, 1977, at the age of 91. He was a member of the Society for 65 years.

Professor DAMIAN CONNELLY of Lasalle College died on April 25, 1977, at the age of 68. He was a member of the Society for 28 years.

Ms. JANE L. EVANS of St. Petersburg Junior College died on October 30, 1976, at the age of 63. She was a member of the Society for 30 years.

Professor CHARLES FOX of Concordia University died on May 1, 1977, at the age of 90. He was a member of the Society for 26 years.

Mr. JOSEPH P. HECKL of the U. S. Naval Ordnance Laboratory died on April 4, 1977, at the age of 38. He was a member of the Society for 1 year.

Professor FRANZ E. HOHN of the University of Illinois, died on July 10, 1977, at the age of 61. He was a member of the Society for 38 years.

Mr. L. LAMAR LAYTON of Sun City Center, Florida, died on April 14, 1977, at the age of 63. He was a member of the Society for 28 years.

Dr. MERRY LEILA MORGAN of the New Mexico Institute of Mining and Technology died on July 9, 1977, at the age of 61. She was a member of the Society for 16 years.

Professor Emeritus SIGURD MUNDHJELD of Concordia College died on July 4, 1977, at the age of 78. He was a member of the Society for 27 years.

Dr. GEORGE R. RICH of Uhl-Hall and Rich, Boston, Massachusetts, died on June 21, 1977, at the age of 80. He was a member of the Society for 36 years.

Professor Emeritus JACOB RIDDER of the University of Groningen died on August 11, 1977, at the age of 83. He was a member of the Society for 21 years.

Dr. ALFRED SCHILD of the University of Texas at Austin died on May 24, 1977, at the age of 55. He was a member of the Society for 29 years.

Dr. RICHARD J. SEMPLE of Carleton University died on February 18, 1977, at the age of 63. He was a member of the Society for 25 years.

Professor SEYMOUR SHERMAN of Indiana University died on June 5, 1977, at the age of 60. He was a member of the Society for 40 years.

QUERIES

Edited by Hans Samelson

QUESTIONS WELCOMED 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 published or unpublished conjectures.

REPLIES from readers will be edited, when appropriate, into a composite answer and published in a subsequent column. All answers received will ultimately be forwarded to the questioner.

QUERIES AND RESPONSES should be typewritten if at all possible and sent to Professor Hans Samelson, American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940.

126. J. D. Finley and Stanley Steinberg (Department of Mathematics and Statistics, University of New Mexico, Albuquerque, New Mexico 87131). Is anything known about the solvability of the equation $\Theta_{xx}\Theta_{yy} - \Theta_{xy}^2 + \Theta_{xp} + \Theta_{yq} = 0$? Here Θ is a complex-valued function of the four complex variables (x, y, p, q), subscripts indicate partial derivatives, and solvability is desired in some sufficiently small region of (x, y, p, q) space.

In applications, Θ is used to determine a metric in complex four-space and thereby a four dimensional complex manifold. Any surface for which p and q are constant is null and extremal (see J. F. Plebanski, Some solutions of complex Einstein equations, J. Mathematical Phys. 16 (1975), 2395).

127. W. R. Allaway (Department of Mathematical Sciences, Lakehead University, Thunder Bay, Ontario). I have been collecting materials and references on the problem of transforming a linear homogeneous differential equation of the form

$$\sum_{k=0}^{n}\binom{n}{k}P_{n-k}(x)d^k y/dx^k = 0$$

into a differential equation with constant coefficients by means of changing the independent and dependent variables ($y = v(x)$, $z(t)dt/dx = u(x)$). During the late 1800s and early 1900s a number of researchers such as A. R. Forsyth, M. Laguerre and M. Halphen wrote extensively on this type of problem. I would very much like to correspond with anybody who is presently working on this type of problem. Also, I would be very grateful to anybody who could supply me with any references concerning this type of problem.

128. Stephen B. Seidman (Department of Mathematics, George Mason University, Fairfax, Virginia 22030). In Graph theory (Addison-Wesley, Reading, Mass., 1969), F. Harary presents several variants of Menger's theorem. I am interested in learning if anything is known about the following conjecture, which is clearly of Mengerian type:

Let u and v be nonadjacent points of a connected graph G. A set S of points increases the distance between u and v if $d_{G-S}(u, v) > d_G(u, v)$. Then the minimum cardinality of a set that increases the distance between u and v is equal to the maximum number of disjoint u - v paths of length $d_G(u, v)$.

129. Albert A. Mullin (6840 Todd Street, Patton Park, Fort Hood, Texas 76544). It appears to me that one can use ideas from lumped, linear, finite, passive, bilateral circuit theory as heuristic aids to enrich one's intuition concerning number theory. In this respect, I would appreciate information or references on techniques for the determination of the inverse Laplace transformation of the ordinary Riemann zeta-function. Unless I am mistaken, $L^{-1}\{\zeta(s)\}$ exists and, in some strong sense, uniquely so. Indeed, this aspect of operator theory appears to hold for many other interesting Dirichlet series. On the other hand, there does not exist a lumped, linear, passive circuit whose driving-point impedance $Z(s) = \zeta(\frac{1}{2} - s)$, where s is the complex frequency.

130. Albert A. Mullin (6840 Todd Street, Patton Park, Fort Hood, Texas 76544). While formalizing several senses of the intuitive notion of an "almost-periodic" continued fraction in order to construct infinite two-terminal networks, it occurred to me during a reductio argument that the irrational numbers whose simple continued fractions are $[1, 2, 3, \ldots, n, \ldots]$ and $[0, 1, 2, \ldots, n, \ldots]$ are both necessarily transcendental. I would appreciate references or information on whether or not the irrational number whose partial quotients form the increasing sequence of all prime numbers is transcendental. Unless I am mistaken, $[2, 3, 5, 7, 11, \ldots, p_n, \ldots]$ is not algebraic.

131. G. F. Kohlmayr (Mathmodel Consulting Bureau, Glastonbury, Connecticut 06033). P. Suppes writes (Axiomatic set theory, Dover, New York, 1972, p. 10): "The first published modern semantical paradox seems to be Richard's paradox [1905], which is related to Cantor's proof of the nondenumerability of the set of all real numbers..." Has anyone seen a paper attempting to resolve Richard's paradox, and if so, could he (she) please supply references?

132. Ron Wright (Department of Mathematics and Statistics, University of Massachusetts, Amherst, Massachusetts 01003). On page 132 of his book Foundations of quantum mechanics, Josef Jauch states that if A is a selfadjoint

operator on a Hilbert space, with spectral decomposition

$$A = \int_{-\infty}^{+\infty} \lambda \, dE_\lambda$$

and W is any density operator (positive operator with trace 1), then

$$Tr(WA) = \int_{-\infty}^{+\infty} \lambda \, dTr(E_\lambda W).$$

I can prove this if A is bounded, but I would like a literature reference for both the bounded and unbounded case.

RESPONSES

The replies below have been received to queries published in recent issues of these *Notices*. The editor would like to thank all who have replied.

120 (Vol. 24, p. 222, June 1977, Kohlmayr). One has to specify the meaning of "complete", as the following shows: It is not true that every ordered complete (in the sense of Cauchy) field is Archimedean. A counterexample is the ordered field, K, consisting of all left-finite Laurent series with real coefficients, ordered lexicographically. (See L. W. Cohen and G. Ehrlich, The structure of the real number system, p. 101, Exercise 5.16 (a); Van Nostrand, New York, 1963.)

K is non-Archimedean: For example, $0 < x < 1$ in K and $nx < 1$ for all positive integers n. But K is complete: let (ξ_n) be a Cauchy sequence in K, where $\xi_n = \sum_{-\infty}^{\infty} a_{in} x^i$ for each positive integer n. For each positive integer k, let η_k be the Laurent series x^k. Then (η_k) is a null sequence in K. Using this fact and the Cauchy condition on (ξ_n), one obtains readily that, for each integer i, the sequence (a_{in}) of ith coefficients ultimately attains a constant value, ℓ_i, in $\mathbb{R}$. The Laurent series $\lambda = \sum_{-\infty}^{\infty} \ell_i x^i$ is the limit of the given Cauchy sequence (ξ_n). (Contributed by L. W. Cohen and G. Ehrlich).

122 (Vol. 24, p. 222, June 1977, Kohlmayr). In response to Query 122, I provide the following reference:

M. Davis, Applied nonstandard analysis, Wiley, New York, 1977; Chapter 2: "Real Numbers and Hyperreal Numbers"; § 3 "The Real Numbers". (Contributed by Kenneth R. Driessel).

124 (Vol. 24, p. 271, August 1977, Golan). Computations in abstract algebra are an area of interest of the Special Interest Group on Symbolic and Algebraic Manipulation of the Association for Computing Machinery (ACM SIGSAM). This group publishes ACM SIGSAM Bull., a quarterly publication that began to be covered in the December 10, 1976 Current Mathematical Publications. The ACM also published:

R. D. Jenks, ed., Proceedings of the 1976 ACM Symposium on Symbolic and Algebraic Computation.

S. Petrick, ed., Proceedings of the Second Symposium on Symbolic and Algebraic Manipulation.

Two old bibliographies are:

J. Denes, A bibliography on non-numerical applications of digital computers, Computing Reviews 9(1968), 481-508.

Jean E. Sammet, An annotated descriptor based bibliography on the use of computers for non-numerical mathematics, Computing Reviews 7 (July-August 1966), no. 4, pp. B-1 to B-31.

Other conference proceedings include:

John Leech, ed., Computational problems in abstract algebra, Pergamon, 1970.

Garrett Birkhoff and Marshall Hall, eds., Computers in algebra and number theory, SIAM-AMS Proceedings, no. 4, 1971.

J. P. LaSalle, The influence of computing on mathematical research and education, Proceedings of Symposia in Applied Mathematics, no. 20, Amer. Math. Soc., 1974.

Some individual papers are:

John J. Cannon, Computers in group theory: a survey, Comm. Assoc. Comput. Mach. 12 (1969), 3-12.

Charles C. Sims, The influence of computers on algebra, in LaSalle, ed., op. cit., pp. 13-30.

Richard F. Stauduhar, The determination of Galois groups, Math. of Comp. 27(1973), 981-996.

Very few of these contain actual programs. In fact, the only program texts I recall seeing are two in the Sims article. They were APL programs to find the order of a permutation group given its generators and to find the structure of an abelian group given generators and relations. (Contributed by Eric Rosenthal).

125 (Vol. 24, p. 271, August 1977, Kohlmayr). The Continuum Hypothesis CH is a statement concerning "the amount" of the subsets of the (usual) reals R that can be found in a model M of ZF. Therefore "the amount" depends on the resources of model M as to how many subsets of R model M can provide. It is possible that "the amount" of the subsets of R that can be found in a model M_1 of ZF is to the tune of the first uncountable cardinal of M_1 (in which case we say that CH is valid in M_1). It is also possible that "the amount" of the subsets of R that can be found in a model M_2 of ZF is to the tune of the second uncountable cardinal of M_2 (in which case we say that CH is not valid in M_2). The situation is somewhat analogous to the following. Let B_1 be a bank which coinwise deals only with copper coins. Let B_2 be a bank which coinwise deals both with copper and silver coins. Then the amount of the subsets (in an obvious sense) of a dollar bill that can be found in banks B_1 and B_2 is to the tune of two different cardinal numbers. (Contributed by Alexander Abian).

NEWS ITEMS AND ANNOUNCEMENTS

PANEL OF VOLUNTEERS FOR CAREER INFORMATION

The American Mathematical Society and the many students who ask for career information from the Society are indebted to the volunteers listed below, who have, with impressive care and thoughtfulness, encouraged students in mathematics by answering their letters. An average of approximately seventy requests for career information are received every month. Most of these are routine in nature and are answered by sending the correspondent a brief brochure on careers in mathematics. Some of the letters, however, show a real interest in mathematics; it is these that are sent to the panel of volunteers to be answered. During the past year, 107 letters were turned over to these volunteers. The present roster includes Richard A. Alo (Lamar University), Richard V. Andree (University of Oklahoma), William F. Atchison (University of Maryland, College Park), Prem N. Bajaj (Wichita State University), Thomas L. Bartlow (Villanova University), George Berzsenyi (Lamar University), Barnard H. Bissinger (Pennsylvania State University), Wray G. Brady (University of Tennessee), Robert Carson (University of Akron), D. V. Chopra (Wichita State University), S. Charmonman (SUNY at Brockport), Romae J. Cormier (125 Delcy Drive, DeKalb, IL), Raymond Coughlin (Temple University), Charles H. Cunkle (Slippery Rock State College), Paul William Davis (Worcester Polytechnic Institute), Richard C. DiPrima (Rensselaer Polytechnic Institute), Underwood Dudley (De Pauw University), F. A. Ficken (14 Benedict Place, Pelham, NY), Herbert A. Gindler (San Diego State University), Michael A. Grajek (Hiram College), Deborah T. Haimo (University of Missouri at St. Louis), Franklin Haimo (Washington University), R. G. Helsel (Ohio University), Thomas A. Hern (Bowling Green State University), Robert A. Herrmann (53 Jordan Road, Brookline, MA), Julius Hlavaty (250 Coligni Avenue, New Rochelle, NY), Arthur M. Hobbs (Texas A & M University, College of Science), John Kenelly (327 Woodland Way, Clemson, SC), David M. Krabill (Bowling Green State University), David Kullman (Miami University), John B. Lane (Edinboro State College), Kotik K. Lee (Université d'Ottawa), Eugene H. Lehman (3435 rue Bordeaux, Trois Rivières, Québec), William F. Lucas (114 Warwick Place, Ithaca, NY), Eugene Lukacs (Bowling Green State University), Francis E. Masat (Glassboro State College), Kenneth O. May (University of Toronto), Robert A. Melter (Southampton College), Sanford S. Miller (SUNY at Brockport), Richard C. Morgan (8 Pequa Lane, Commack, NY), Zane Motteler (Michigan Technological University), Dale H. Mugler (University of Santa Clara), Weston I. Nathanson (California State University, Northridge), Abraham Nemeth (16240 Fairfield Avenue, Detroit, MI), Sam Newman (27 S. Aberdeen Place, Atlantic City, NJ), Michael Olinick (Middlebury College), Malcolm W. Oliphant (Hawaii Loa College), P. V. O'Neil (College of William & Mary), Otway Pardee (Syracuse University), George Piranian (University of Michigan), Lyle E. Pursell (University of Missouri at Rolla), Gordon Raisbeck (40 Bloomfield Street, Lexington, MA), C. J. Rhee (Wayne State University), Stewart M. Robinson (University of Wisconsin–Madison), Ervin Y. Rodin (Washington University), Alex Rosenberg (Cornell University), Paul Rotter (The Mutual Benefit Life Insurance Co.), I. Richard Savage (Yale University), Hans W. E. Schwerdtfeg (McGill University), Thomas H. Southard (California State University at Hayward), Diane M. Spresser (Madison College), Raymond A. Spong (277 Boston Post Road, East Lyme, CT), Charles J. Thorne (Pacific Missile Range), H. Westcott Vayo (University of Toledo), Daniel H. Wagner (Daniel H. Wagner Associates), Myron E. White (1363 Sussex Road, Teaneck, NJ), Gail Atneosen Williams (University of Idaho), Brian J. Winkel (Albion College), John W. Young, Jr. (P.O. Box 1661, Melbourne, FL), and W. Thurmon Whitley (Marshall University).

Anyone who would be willing to be a part of this service is invited to send his name, address, and field of interest to Career Information, American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940.

CASE STUDIES

The Society's Committee on Employment and Educational Policy (CEEP) is collecting "case studies" of Ph.D. mathematicians employed in "nontraditional" positions, i.e., neither in academic teaching or research, nor in the traditional technical areas such as industrial research and development. A recent article by R. D. Anderson and W. H. Fleming, based on the results of the 20th Annual AMS Survey (*Notices*, vol. 24, no. 2, February 1977, pp. 98-103), reports that significantly more Ph.D. mathematicians are entering nonacademic employment. The Committee therefore hopes that these case studies will prove helpful to mathematicians seeking nontraditional positions. It is considering the possibility of selecting and editing some of the case studies for publication in these *Notices*, as an extension of the "case studies" series published in the November 1974, and February, June and August 1975 issues of these *Notices*. Ph.D. mathematicians employed in such positions who feel they might be interested in participating in this project, either by preparing a case study of themselves, or who have other candidates to propose for such studies, are encouraged to write to Professor Martha K. Smith, Department of Mathematics, University of Texas, Austin, Texas 78712

AAUW FELLOWSHIPS

The American Association of University Women Educational Foundation has announced two fellowship programs: The American Fellowships and the International Fellowships. The American Fellowships program awards dissertation and postdoctoral fellowships to women who are U.S. citizens and who have achieved distinction or promise of distinction in their fields of scholarly work. The grants are for a twelve-month duration with stipends varying from $3,500 to $9,000, based on cost of living and other expenses related to the project. Fellowships at the dissertation level are to be used for the final year of doctoral work, while those at the postdoctoral level are for a full-time postdoctoral research project.

The International Fellowships are for advanced study and training and are awarded to women of outstanding ability who are citizens of countries other than the U.S. and who may be expected to give effective leadership upon return to their home countries. The period of the award is one academic year. An applicant must hold the equivalent of a bachelor's degree, be proficient in English and intend to return to her own country to pursue her professional career. The average amounts of the stipends range from $3,500 to $5,500.

For the American Fellowships the application deadline is December 15, 1977, with notification of awards by April 15, 1978, while the International Fellowship deadline is December 1, 1977 with notification of awards by March 15, 1978. Further details and application forms may be obtained from: Educational Foundation Programs Office, AAUW, 2401 Virginia Avenue, N.W., Washington, D. C. 20037. Women not residing in the U.S. may also obtain application forms from the Cultural Affairs Officer at the American Embassy in most countries.

DIRECTORY OF WOMEN MATHEMATICIANS

The AMS-MAA-SIAM Committee on Women in Mathematics oversees the publication of the *Directory of Women Mathematicians*. In bringing it up to date this year, the committee would like very much to list all women with Ph.D.s in mathematics or the equivalent in experience who have not been previously listed. The forms for those with Ph.D.s can be obtained from Ms. Ellen Swanson, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940. Anyone with the equivalent in experience should send her curriculm vitae directly to Ms. Swanson.

This directory of women Ph.D.s and Ph.D. candidates includes the name(s) by which the mathematician is known, her address, present position, degrees, field(s) of interest, bibliography, and other pertinent information. It was first published in 1973 and includes yearly supplements.

Published by the Society, the *Directory* is now available at $2.

FURTHER AID IN FILING RESEARCH GRANTS

A list of funding agencies was given on page 285 of the August 1977 issue of these *Notices*, giving addresses where instructions on the preparation of research grants could be obtained. The Office of Naval Research (ONR) has provided the addresses of four branch offices in addition to the Arlington office listed in that news item. Researchers with proposals for research in the mathematical and information sciences can contact the Mathematician:

Office of Naval Research
495 Summer St.
Boston, MA 02210

Office of Naval Research
536 South Clark St.
Chicago, IL 60605

Office of Naval Research
715 Broadway
New York, NY 10003

Office of Naval Research
1030 East Green St.
Pasadena, CA 91106

Each of these offices has scientists who are willing to discuss research with an individual. They can describe ONR's research programs, and assist in the mechanics of proposal transmission.

JOHN HAMILTON CURTISS

Professor John Hamilton Curtiss of the University of Miami died on August 13, 1977. Professor Curtiss served as Executive Director of the American Mathematical Society from 1954 through 1959. He was born in 1909 in Evanston, Illinois. He received an A.B. degree from Northwestern University and an S.M. degree from the University of Iowa. He received his Ph.D. in 1935 from Harvard University. He taught at Johns Hopkins University, Cornell University, the Courant Institute of Mathematical Sciences of New York University, and the University of Miami. From 1947 to 1953 he was chief of the Applied Mathematics Division of the National Bureau of Standards. He was awarded the Meritorious Service Medal of the U. S. Department of Commerce in 1949.

Professor Curtiss was an active member of many AMS committees. He was Associate Editor of the Bulletin from 1943–1945 and Editor of these *Notices* from 1955–1959. He was a member of many professional mathematical and scholarly associations. Professor Curtiss's death is a great loss which has deeply saddened the mathematical community.

AIR MAIL DELIVERY OF *Notices*

In order to insure that information about meetings will arrive in time, arrangements for first class or air mail delivery of the *Notices* may be made. For this class mail (U.S. and Canada only), there is an additional charge of $9 per year. Air mail rates for delivery to other countries will be provided upon request.

AMS-MAA-SIAM CONGRESSIONAL SCIENCE FELLOWSHIP 1978-1979

Applications are invited from candidates in the mathematical sciences for a Congressional Science Fellowship to be supported jointly by the American Mathematical Society (AMS), the Mathematical Association of America (MAA) and the Society for Industrial and Applied Mathematics (SIAM) for the twelve-month period beginning September 1, 1978. The AMS-MAA-SIAM Fellow will serve, along with three or four Fellows selected by the American Association for the Advancement of Science (AAAS) and around a dozen Fellows sponsored by other scientific societies, under an annual program coordinated by the AAAS. The stipend for the 1978-1979 AMS-MAA-SIAM Fellowship is $17,000, which may be supplemented by a small amount toward relocation and travel expenses. It may also be supplemented by sabbatical salary or other employer contribution in the case of a person on sabbatical leave for the 1978-1979 year.

The January 7, 1977 issue of *Science*, p. 55, gives a brief description of the overall AAAS program for 1976-1977. As indicated there, Congressional Science Fellows spend their fellowship year working on the staff of an individual congressman or a congressional committee or in the congressional Office of Technology Assessment, the objective of the program being to enhance science-government interaction, the effective use of science in government, and the training of persons with scientific background for careers involving such use. Based on information on available congressional staff positions gathered by the AAAS during the summer, each Fellow's assignment is worked out by the Fellow and the congressional office concerned following an intensive two-week orientation and interview procedure organized by the AAAS during which the Fellows encounter many facets of Congress, the Executive Branch, and people and organizations on the Washington scene. The AAAS provides advice and assistance during this process and remains in frequent and regular contact with all the Fellows throughout the fellowship year. More detailed information about the program as a whole may be requested from Dr. Richard Scribner, Director, AAAS Congressional Science Fellow Program, 1776 Massachusetts Ave., N.W., Washington, D. C. 20036; telephone (202) 467-4475.

The AMS-MAA-SIAM Congressional Science Fellowship is to be awarded competitively to a mathematically trained person at the post-doctoral to mid-career level without regard to sex, race, or ethnic group. Selection will be made by a panel of the AMS-MAA-SIAM Joint Projects Committee for Mathematics, a nine-member committee consisting of three representatives from each of these organizations, with the cooperation and advice of Dr. Scribner. Applications should be sent to the Conference Board of the Mathematical Sciences (CBMS), 2100 Pennsylvania Ave., N.W., #832, Washington, D. C. 20037. The deadline for receipt of applications is February 15, 1978, and it is anticipated that the award will be made by around April 1, 1978.

In addition to demonstrating exceptional competence in some areas of the mathematical sciences, an applicant for the AMS-MAA-SIAM Congressional Science Fellowship should have a rather broad scientific and technical background and a strong interest in the uses of the mathematical and other sciences in the solution of societal problems. He or she should also be articulate, literate, flexible and able to work effectively with a wide variety of people. An application should state why the applicant wants to be a Congressional Science Fellow, should summarize his or her qualifications, and should be accompanied by a résumé. Also, CBMS should receive by February 15, 1978 three letters from knowledgeable persons about the applicant's competence and suitability for the award.

MARSTON MORSE MEMORIAL

In order to memorialize Marston Morse (1892-1977), some of his friends are planning to make contributions to the Institute for Advanced Study for this purpose, and hope that others will join them. Herman Goldstine and Deane Montgomery of the Institute have announced that the Marston Morse Memorial Fund is designed in the first instance to establish an annual lecture series at the Institute in honor of Dr. Morse. The introductory lecture will be given on October 17, 1977, by Dr. Charles Fefferman of Princeton University.

Others who would like to contribute to this memorial are invited to send checks, payable to the Institute for Advanced Study, to Caroline Underwood, School of Mathematics Administrative Officer, Institute for Advanced Study, Princeton, New Jersey 08540.

ERRATA

The listings for the Organizing Committees of the 1978 Summer Seminar and Summer Institute, under the section INSTITUTES AND SYMPOSIA on page 301 of the August issue of these *Notices*, were incomplete. These should be corrected to read as follows:

June 1978 Summer Seminar on Nonlinear Oscillations in Biology

William S. Childress
Donald S. Cohen
Frank C. Hoppensteadt, chairman
Paul Waltman
A. S. Winfree

July 1978 Summer Institute on Harmonic Analysis in Euclidean Spaces and Related Topics

Donald Burkholder
Alberto P. Calderón
Jean-Pierre Kahane
Elias M. Stein
Stephen Wainger, co-chairman
Guido Weiss, co-chairman
Antoni Zygmund

PERSONAL COMPUTING GROUP FORMED

A new Special Interest Group on Personal Computing (SIGPC) was chartered by the Association for Computing Machinery (ACM) at their National Computer Conference in June. SIGPC will be operated exclusively for educational and scientific purposes in the design and applications of computer systems for personal uses. This includes personal computer systems for home, clerical, small business, management and recreational uses. It also includes the technology of such systems in software and hardware, and emphasizes techniques appropriate to the integration of such tools as graphics, speech, data management, and music systems. A quarterly newsletter will be published, and SIGPC will hold its first business meeting at ACM '77 in Seattle.

To join SIGPC write to the Association for Computing Machinery, P. O. Box 12105, Church Street Station, New York, New York 10249. The annual dues (which include a subscription to the newsletter) are $5 for members and $13 for nonmembers of ACM. A newsletter subscription without membership is $12 per year. For further information on SIGPC programs, contact Dr. Portia Isaacson, The Micro Store, 634 South Central Expressway, Richardson, Texas 75080.

NRC RESEARCH OPPORTUNITIES

The National Research Council (NRC) has announced it will grant approximately 250 new awards in its Research Associateship Programs for 1978. These programs are conducted in cooperation with selected federal research organizations at approximately sixty-five geographic locations in the United States, and provide opportunities for postdoctoral research on problems in the fields of chemistry, space sciences, physics, atmospheric and earth sciences, engineering, life science, and mathematics.

Appointments are made on a competitive basis and are open to recent recipients of the doctorate and, in some cases, to senior investigators. Some programs are also open to non-U.S. citizens. Stipends (subject to income tax) will range from $17,000 upwards. Grants will be provided for family relocation and for limited professional travel during tenure.

Further information about specific opportunities for research and application materials are available from the Associateship Office, (JH 606-D), National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 20418. The deadline for applications is January 15, 1978.

COLLOQUIUM LECTURES

A set of Colloquium Lectures was presented at the summer meeting in Seattle, Washington, in August 1977. A limited number of copies of the lecture notes prepared by Professor Herbert Federer, "Geometric measure theory", are still available.

Requests for copies should be accompanied by a check for one dollar per copy to cover the cost of handling; requests should be mailed to the Society, P. O. Box 1571 Annex Station, Providence, Rhode Island 02940. Please note that informally distributed manuscripts and articles should be treated as a personal communication and are not for library use. References to the contents in any informal publication should have the prior approval of the author.

AMS RESEARCH FELLOWSHIP FUND
Request for contributions

The AMS Research Fellowship Fund was established in 1973 because of the scarcity of funds for postdoctoral fellowships. From this fund AMS Research Fellowships are awarded annually to individuals who have received the Ph.D. degree, who show unusual promise in mathematical research, and who are citizens or permanent residents of a country in North America. Currently each fellowship carries a partially tax-exempt stipend of approximately $11,000.

Three Research Fellowships were awarded in 1975-1976 and two were granted in 1976-1977. In 1977-1978 it was possible to award four Fellowships, with eleven persons receiving Honorable Mention. (See the announcement in the June 1977 *Notices*, p. 227.) The Society hopes that the number of fellowships to be awarded for 1978-1979 can again be increased. This number, of course, depends on the contributions the Society receives. The Society itself contributes a minimum of $9,000 to the Fund each year, matching one-half the funds in excess of $18,000 raised from other sources, up to a total contribution by the Society of $20,000. It is hoped that every member of the Society will contribute to the Fund.

Contributions to the AMS Research Fellowship Fund are tax deductible. Checks should be made payable to the American Mathematical Society, clearly marked "AMS Research Fellowship Fund", and sent to the American Mathematical Society, P. O. Box 1571, Annex Station, Providence, Rhode Island 02901.

NSF INITIATES SCIENCE PROGRAM FOR THE PHYSICALLY HANDICAPPED

The National Science Foundation (NSF) has awarded a total of $481,155 to projects designed to increase the opportunities for physically handicapped individuals to participate in scientific careers.

A total of eleven awards were made to such organizations as the National Science Teachers Association, the American Association for the Advancement of Science, the American Foundation for the Blind, and several universities and educational groups. Areas covered by the projects include assessment of the educational and career difficulties faced by the handicapped and development of plans to overcome these difficulties; initiation of research projects in which students will participate; and the development of career guidance information and career workshops for the physically handicapped.

AMS RESEARCH FELLOWSHIPS
Invitation for Applications

A deadline of January 31, 1978, has been set for the receipt of completed applications for the 1978-1979 American Mathematical Society Research Fellowships. These postdoctoral fellowships will support research in mathematics during the year 1978-1979. The number of fellowships awarded will depend on the amount contributed to the AMS Postdoctoral Fellowship Fund.

The fellowships are open to individuals who have recently received the Ph.D. degree, regardless of age, and who are citizens or permanent residents of a country in North America. The stipend will be approximately $11,000, a portion of which is tax-exempt. Notification of awards will be made by March 1, 1978. Recipients of fellowships may not hold another grant or salaried position concurrently with the Research Fellowship.

For further information and application forms, write to Dr. William J. LeVeque, Executive Director, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940.

SMITHSONIAN OFFERS FELLOWSHIPS

The Smithsonian Institution has announced its program of higher education and research training in the History of Science and Technology for 1978-1979. Smithsonian Fellowships are awarded to support independent research using Smithsonian Institution collections, archives, laboratories, and other facilities, and pertaining to Smithsonian professional staff research interests. Proposals for research may be offered in fields in which the Institution has research strength: history of mathematics, physical sciences, medicine and pharmacy, engineering, transportation, agriculture, air and space, and electrical technology, and the history of science in America.

Smithsonian Fellowships, supported by a stipend of $10,000 per annum and research allowances, may be granted to postdoctoral scholars to pursue further training in research. Smithsonian Predoctoral Fellowships, supported by a stipend of $5,000 per annum and research allowances, may be granted to doctoral candidates to conduct research for their dissertations with the approval of their university department. Applications are due by January 15, 1978.

In selecting individuals for participation in academic programs, the Smithsonian Institution does not discriminate on grounds of race, creed, color, sex, age or national origin of any applicant. For more information and application forms write: Office of Academic Studies, Smithsonian Institution, Washington, D. C. 20560. Please indicate the particular area in which you propose to conduct research and give the dates of degrees received or expected.

INSTITUTE FOR ADVANCED STUDY ANNOUNCES MEMBERSHIPS

The School of Mathematics of the Institute for Advanced Study has announced that it will grant a limited number of memberships, some with financial support, for research in mathematics at the Institute during the academic year 1978-1979. 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 Administrative Officer 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, 1978.

AMELIA EARHART FELLOWSHIP AWARDS

The Amelia Earhart Fellowship Awards are given annually to women for graduate work in aerospace-related sciences and engineering. The $4,000 awards were established in 1938 by Zonta International, a service organization of executive women in business and the professions. Applicants must have a bachelor of science degree preparatory for graduate work in aerospace science and engineering, and must show evidence of exceptional ability and potential, and outstanding character. The grants are awarded to women beginning or continuing full-time graduate study and may be used at any institution offering accredited programs in the applicant's area. The number of fellowships awared each year is determined by the number of qualified candidates. Application forms may be obtained from Zonta International, 59 East Van Buren Street, Chicago, Illinois 60605. Applications must be completed and submitted before January 1, 1978.

AAAS MEDIA INTERNSHIP PROGRAM

The American Association for the Advancement of Science (AAAS) announces the appointment of Eric S. Lander, an A.B. candidate at Princeton University and a member of the AMS, to its Mass Media Intern Program. Lander is one of eighteen students currently participating in the program, which is in its third year.

The AAAS Mass Media Intern Program is supported by the Russell Sage Foundation and the National Science Foundation. It provides students with the opportunity to spend ten weeks working on the staffs of newspapers, magazines, and radio and television stations in order to increase their understanding of the processes involved in communicating technical information through the mass media.

Lander, who was a member of the U. S. Mathematical Olympiad team in East Germany in 1974, will serve his internship at *Business Week* in New York City.

FULBRIGHT-HAYS AWARDS FOR 1977- 1978

Fourteen Fulbright-Hays awards have been made to American scholars in the field of mathematics. The awards for lecturing, consultation, research, or travel were recently announced by the Council for International Exchange of Scholars.

Listed below are the recipients of the awards, with their fields of interest and the institutions to which they will travel. Martin G. Buntinas (Loyola University), Topological sequence spaces, Universität Stuttgart, Federal Republic of Germany; Joseph Diestel (Kent State University), Mathematics, University College of Dublin, Ireland; Charles Robert Hampton (College of Wooster), Algebra, trigonometry and calculus, Cuttington College, Monrovia, Liberia; Floyd I. John (Kindler Associates, Inc.), Quantitative methods, University of Dar es Salaam, Tanzania; Shirley Kolmer (St. Louis University), Algebra, trigonometry and number theory, University of Liberia, Monrovia, Liberia; Richard G. Larson (University of Illinois at Chicago Circle), Mathematics, Ateneo de Manila and others, Philippines; Edgar R. Lorch (Columbia University), Functional analysis, Universidad de los Andes, Bogotá, Colombia; Louise May (University of Illinois at Chicago Circle), Mathematics, Ateneo de Manila and others, Philippines; James E. Nymann (University of Texas at El Paso), Head department of mathematics, lecture on abstract algebra, University of Malawi, Blantyre; William Rolen Orton (University of Arkansas at Fayetteville), Science and mathematics education, Tehran University, Iran; James Robertson (University of California at Santa Barbara), Mathematical probability and stochastic processes, Tbilisi State University, USSR; William Wade (University of Tennessee at Knoxville), Harmonic analysis, Moscow State University, USSR; Bill Watson (Case Western Reserve University), Pure mathematics, Colombian Society of Mathematics, Universidad Nacional de Colombia, Bogotá; William O. Williams (Carnegie-Mellon University), Continuum mechanics, Università degli Studi, Pisa, Italy.

INFORMATION SOUGHT ON MATHEMATICAL SCIENCES MAJOR

The MAA's Committee on the Undergraduate Program in Mathematics (CUPM) is examining a possible recommendation that the standard collegiate mathematics major be revised to become a mathematical sciences major. The CUPM Panel considering this revision is seeking input from the mathematical community. The Panel is especially interested in hearing from mathematicians at schools that explicitly or implicitly now have a mathematical sciences major (what do's and don't's can you recommend to other schools starting math sciences programs). Successful, innovative approaches to teaching various applied mathematics courses are also sought.

Please communicate your experiences and thoughts about this revision to Professor Alan Tucker, Department of Applied Mathematics and Statistics, State University of New York, Stony Brook, New York 11794, or Professor Richard Alo, Department of Mathematics, Lamar University, Beaumont, Texas 77710.

A.M. TURING AWARD

The Association for Computing Machinery (ACM) has announced that John Backus, an IBM Fellow at the Research Center in San Jose, California, is the winner of the A.M. Turing Award for 1977. He has received the ACM's most prestigious honor for his "profound, influential, and lasting contributions to the design of practical high-level programming systems, notably through his work on FORTRAN, and for seminal publication of formal procedures for the specification of programming languages."

TRAVEL FUNDS FOR IMU CONGRESS

Requests for funds for international travel for a specific purpose may be included in the budget of research proposals to the National Science Foundation (NSF). If this is done, the proposal must contain relevant information regarding, and justification for, such travel. Any foreign travel not authorized in a grant budget must be approved in writing by the Foundation in advance of the trip.

The quadrennial International Mathematical Congress of the International Mathematical Union (IMU) will be held in the summer of 1978 in Helsinki, Finland, and it is expected that many persons whose research will at that time be supported by NSF will want to attend. The Mathematical Sciences Section of NSF asks that those persons who plan to attend the Congress supported partially by NSF funds, and who will be requesting research support for the summer of 1978 on proposals to be submitted this fall, include in their request funds for travel to the Congress.

It is possible that the Assembly of Mathematical and Physical Sciences of the National Research Council (NRC) will make a limited number of grants for travel to the Congress. If this turns out to be the case, it will not be possible for an individual to receive a grant from this source as well as funds from an NSF research grant. It is therefore requested that persons intending to apply for an NRC grant as well as request funds in a research proposal so state in the proposal. (The application form for an NRC grant will require that NSF or other Federal agency proposal requests for the same travel be noted.)

William H. Pell, Head
Mathematical Sciences Section

NATIONAL ACADEMY OF SCIENCES EXCHANGE PROGRAM

During the academic year 1978-1979, the National Academy of Sciences (NAS) will conduct an exchange program in conjunction with the Soviet Academy and the Academies of Sciences of Bulgaria, Czechoslovakia, Hungary, Poland, Romania, Yugoslavia, and possibly the German Democratic Republic. The NAS is soliciting applications from American scientists who wish to visit any of these countries. Research visits of five to twelve months' duration are encouraged. Mathematicians who wish to apply must be United States citizens and must have a docotral degree or its equivalent by the time of the intended visit. All necessary expenses will be covered by the NAS and the foreign academy, including reimbursement of salary; expenses for family members on visits of five months or longer will also be paid.

Requests for applications should be received by November 4, 1977. The deadline for receipt of completed applications is November 18, 1977. Applications may be obtained from the National Academy of Sciences, Commission on International Relations, USSR EE, 2101 Constitution Avenue, Washington, D.C. 20418.

INDIA-US RESEARCH GRANTS

The Indo-U.S. Subcommission on Education and Culture has announced it will again award grants to U.S. citizens for advanced research in India. There will be ten grants for six- to ten-month periods, and nine shorter grants (for one to six months) for research and/or professional activity.

Application forms and further information may be obtained from the Council for International Exchange of Scholars, 11 Dupont Circle, Washington, D.C. 20036. Completed applications for awards for the academic year 1978-1979 must be filed with the Council by November 15, 1977.

SIGMA DELTA EPSILON FELLOWSHIP ANNOUNCEMENT

Sigma Delta Epsilon, Graduate Women in Science, Inc., has announced that awards are available on a competitive basis to women who hold a degree from a recognized institution of higher learning in one of the mathematical, physical or biological sciences and are currently involved in research or have an approved research proposal. Appointments will be made irrespective of race, nationality, creed or marital status. Two types of awards are available: Eloise Gerry Fellowship, ($2,000 to $8,000, not to be used for a degree program, deadline for applications and credentials December 1), and Grants-in-Aid ($750, deadline February 1). Announcement of awards will be made by the following May 1. Further information and application forms may be obtained from: Sigma Delta Epsilon, Graduate Women in Science, Inc., 1346 Connecticut Avenue, N.W., Room 1102, Washington, D.C. 20036.

An individual may apply for only one of the two awards. The applicant should indicate to which type of award her inquiry is addressed.

FULBRIGHT-HAYS OPENINGS

The application deadline requirements have been waived for some Fulbright-Hays awards for 1978-1979 so that additional applications may be accepted, according to the Council for International Exchange of scholars. Some of the openings available in mathematics are: *Nigeria*: differential equations; *Thailand*: statistics, operations research and factor analysis in business and industry; *U.S.S.R.*: possible awards in theoretical mathematics, theoretical statistics, harmonic analysis, and theory of trigonometric series.

Further information is available from the Council for International Exchange of Scholars, 11 Dupont Circle, Washington, D.C. 20036.

GROUPS WITH STEINBERG RELATIONS AND COORDINATIZATION OF POLYGONAL GEOMETRIES
by John R. Faulkner

In this Memoir groups which satisfy commutator relations of the type satisfied by Chevalley groups, called here "groups with Steinberg relations", are shown to have certain nonassociative division algebras as parameters. This, in turn, allows an introduction of coordinates into certain polygonal geometries. The titles of the chapters are Groups with Steinberg relations, Groups of type A_2, Groups of type G_2, A Jordan algebra construction, Groups of type B_2, Groups of type BC_2, Groups of rank three and larger, Polygonal geometries, Coordinatization of projective planes, Coordinatization of hexagonal geometries, Coordinatization of quadrilateral geometries, A Lie algebra construction, and A construction of hexagonal geometries.

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REPORTS OF MEETINGS

THE SUMMER MEETING IN SEATTLE

The eighty-first summer meeting of the American Mathematical Society was held at the University of Washington, Seattle, Washington, from Monday, August 15, through Thursday, August 18. All sessions of the meeting took place on the campus of the university. There were 1142 registrants, including 806 members of the Society.

A set of Colloquium Lectures entitled "Geometric measure theory" was presented by HERBERT FEDERER of Brown University. The presiding officers at the four lectures in the series were R. H. Bing, Paul R. Halmos, Maxwell A. Rosenlicht, and Walter Rudin.

By invitation of the Society's Program Committee, there were five invited one-hour addresses. JAMES W. CANNON of the University of Wisconsin, Madison, gave an address entitled "What is a topological manifold? (the characterization problem)." He was introduced by R. H. Bing. JAMES M. GREENBERG of the State University of New York at Buffalo lectured on "Pattern formation and periodic structures in systems modeled by reaction-diffusion equations." He was introduced by Peter D. Lax. WILLIAM B. JOHNSON of Hebrew University, Jerusalem, and Ohio State University, Columbus, spoke on "Symmetric structures in Banach spaces" and was introduced by Robert R. Phelps. KENNETH A. RIBET of Princeton University gave an address entitled "Interplay between classical modular forms and associated Galois representations." Barbara L. Osofsky introduced him at his lecture. SHING-TUNG YAU of Stanford University lectured on "Some aspects of theory of elliptic equations in differential geometry" and was introduced by Morris W. Hirsch.

There were seventeen sessions for contributed ten-minute papers, including a late paper session. The presiding officers were Joseph Arkin, Kathleen Baxter, Ann K. Boyle, Frank H. Brownell III, Thomas W. Cusick, Thomas W. Hungerford, Ludvik Janos, Wilfred Kaplan, Peter A. McCoy, Itrel E. Monroe, Lloyd J. Montzingo, Jr., John S. Papadakis, Gideon Peyser, John Phillips, Douglas C. Ravenel, Joel L. Weiner, and Ronald H. Wenger.

There were nine special sessions of selected twenty-minute papers. MIROSLAV BENDA and ANNE C. MOREL of the University of Washington organized a special session on Boolean algebras, algebraic and metamathematical aspects. The speakers were Stanley N. Burris, Alfred W. Hales, William P. Hanf, Paul E. Howard, James T. Loats, Dale W. Myers, Richard S. Pierce, Arthur L. Rubin, Roger A. Simons, and Manfred Egon Szabo. AFTON H. CAYFORD of the University of British Columbia organized a special session on Banach spaces of analytic functions. The list of speakers is: Maynard G. Arsove, Theodore W. Gamelin, Nicholas P. Jewell, Bernt Øksendel, Walter Rudin, and Stephen Scheinberg. COLIN W. CLARK of the University of British Columbia organized a special session on Mathematical models in natural resource management. The speakers were John R. Beddington, Fred G. Brauer, Colin W. Clark, Frank H. Clarke, Paul H. Cootner, Frederick C. Johnson, Glenn C. Loury, Marc S. Mangel, William J. Reed, David A. Sánchez, Jon Schnute, William R. Smith, and Frederic Y. M. Wan. MICHEAL N. DYER and ALLAN J. SIERADSKI of the University of Oregon organized a special session on Algebraic topology; the list of speakers is: M. Bendersky, Robert F. Brown, Roy R. Douglas, Ross Geoghegan, David Handel, Alex Heller, Peter J. Hilton, Cheong Seng Hoo, G. Kozlowski, Douglas C. Ravenal, Jack Segal, Denis Sjerve, James D. Stasheff, Thomas W. Tucker, and Kalathoor Varadarajan. CARL FAITH of Rutgers University organized a special session on Module theory. The speakers were Goro Azumaya, John A. Beachy, Ann K. Boyle, Victor P. Camillo, Carl Faith, Kent R. Fuller, Melvin Hochster, Arun V. Jategaonkar, Lawrence S. Levy, Eben Matlis, V. McMaster, Barbara L. Osofsky, Zoltan Papp, J. T. Stafford, and Robert B. Warfield, Jr. Problem sessions were chaired by Mark Tepley and Sylvia Wiegand. BRANKO GRÜNBAUM of the University of Washington organized a special session on Tilings, patterns, and symmetries. The speakers were James Peter Conlan, H. S. MacDonald Coxeter, Michael Goldberg, Solomon W. Golomb, Helmut Groemer, Branko Grünbaum, William P. Hanf, Phil Huneke, Dale W. Myers, Raphael M. Robinson, Doris W. Schattschneider, Sherman K. Stein, Hao Wang, Thomas W. Wieting, and Stephen J. Willson. HENRY L. LOEB of the University of Oregon organized a special session on Approximation theory; the list of speakers is: Ian Barrodale, Richard B. Barrar, David L. Barrow, R. Creighton Buck, Hermann G. Burchard, Bruce L. Chalmers, Joel Davis, Gary A. Gislason, Allen A. Goldstein, John M. Karon, Robert P. Kurshan, John W. Lee, Lois E. Mansfield, Avraham Aharon Melkman, Larry Lee Schumaker, Ambideshwar Sharma, David A. Sprecher, Frank Stenger, Gerald D. Taylor, Jerry Wolfe, and Daniel Wulbert. CALVIN T. LONG of Washington State University organized a special session on Combinatorial number theory. The list of speakers is: George E. Andrews, Paul T. Bateman, John D. Brillhart, Richard T. Bumby, Stefan Andrus Burr, Leonard Carlitz, Solomon W. Golomb, Ronald L. Graham, Verner E. Hoggatt, Jr., James H. Jordan, Clark H. Kimberling,

Derrick H. Lehmer, Melvyn B. Nathanson, Harold G. Niederreiter, John L. Selfridge, Donald R. Snow, and William A. Webb. EDGAR LEE STOUT of the University of Washington arranged a special session on Several complex variables; the list of speakers is: Herbert J. Alexander, Lawrence J. Brenton, John Erik Fornaess, James R. King, James A. Morrow, Alexander J. Nagel, R. Michael Range, Hugo Rossi, Andrew J. Sommese, Wilhelm F. Stoll, Sidney M. Webster, and Marcus W. Wright.

This meeting of the Society was held in conjunction with the annual summer meetings of the Mathematical Association of America, the Institute of Mathematical Statistics, and Pi Mu Epsilon. The Pacific Northwest Section of the MAA also met in conjunction with the Association.

The twenty-fifth series of the Association's Earle Raymond Hedrick Lectures was given by JOSEPH B. KELLER of the Courant Institute of Mathematical Sciences, New York University. The title of his lecture series was "Mathematical aspects of athletics and of vision." The Carl B. Allendoerfer, Lester R. Ford, and George Pólya Awards were presented at the Business Meeting of the Association.

The Institute of Mathematical Statistics' (IMS) 1977 Wald Lectures were given by J. F. C. KINGMAN. The titles of the lectures in this series were "Combinatorial arguments in pure and applied probability," "Subsequences," and "Exchangeability in population genetics." BRADLEY EFRON presented the IMS Rietz Lecture. His title was "Another look at the jackknife."

The Pi Mu Epsilon J. Sutherland Frame Lecture was presented by IVAN NIVEN of the University of Oregon. His lecture was titled "Techniques for solving extremal problems."

The Association for Women in Mathematics (AWM) held a panel discussion on "Alternatives to academic employment for mathematicians." Lenore Blum served as moderator.

Meetings were also held by the Council of the Conference Board of the Mathematical Sciences and the Mathematicians Action Group and the Data Subcommittee of the Society's Committee on Employment and Educational Policy (CEEP).

Kenneth A. Ross
Associate Secretary

Eugene, Oregon

Council Meeting

The Council met at 5:00 P. M. on August 15, 1977 in the Condon Room of the University Tower Hotel in Seattle.

The Council endorsed three resolutions proposed by the Committee on Human Rights of Mathematicians and recommended them to the forthcoming Business Meeting. The texts are given with the report of that meeting.

Following the action of the Council of April 1977 in establishing the Bulletin of the American Mathematical Society/New Series and declaring that it shall contain research expository articles and book reviews, the Council established an ad hoc committee to study the problems of Research Announcements and to report to the Council of January 1978. In the meantime the Council established a moratorium on Research Announcements until the January meeting, no more being accepted until the ad hoc committee has reported.

The Council set the yearly dues of ordinary members, effective for 1979, at $36 for members with annual professional income less than $15,000 and at $48 for members whose annual professional income is $15,000 or more. This action becomes effective when the Trustees approve. An account of the need for the increase was scheduled for separate publication in a forthcoming issue of these *Notices*.

The Council has voted to continue its share of sponsorship through the Conference Board of the Mathematical Sciences of a Congressional Fellow.

The Council accepted the resignation of William J. LeVeque from the Editorial Board of Mathematical Reviews. Dr. LeVeque is replacing Dr. Walker as Executive Director on the retirement of the latter. The Council elected Professor Paul T. Bateman to fill out the term thus vacated.

The Council nominated candidates for the various offices to be filled in the election of 1977. In addition there have been nominations by petition, marked below with an asterisk. Some of the nominations have already been reported but the entire list is repeated on p. 397.

The Council adjourned at midnight.

CANDIDATES NOMINATED FOR 1977 ELECTIONS

President Elect: Peter D. Lax
Vice President (two positions):
Lee Lorch*
Jürgen K. Moser
Julia B. Robinson
John Wermer
George W. Whitehead

Note: Hans Weinberger, announced as nominated for this office, regretted that it was impossible for him to accept.

Members-at-Large
Earl R. Berkson*
Joan S. Birman
Lenore Blum*
James A. Donaldson
Clifford J. Earle, Jr.
Murray Gerstenhaber*
Daniel Gorenstein
Harold Grad
Ronald L. Graham
H. Blaine Lawson, Jr.

Associate Secretary (2 positions):
Paul T. Bateman
Kenneth A. Ross

Trustee: Joseph J. Kohn

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Victor W. Guillemin
Bulletin
Felix E. Browder
Colloquium Publications
Stephen Smale
Mathematical Reviews
D. J. Lewis
Mathematics of Computation (2 positions)
James H. Bramble
Walter Gautschi
Mathematical Surveys
Jane Cronin Scanlon
Proceedings (2 positions)
David Eisenbud
Robert R. Phelps
Transactions (2 positions)
Wilhelmus A. J. Luxemburg
James D. Stasheff
Committee to Monitor Problems in Communication (2 positions)
Robert M. Baer
Philip T. Church

Business Meeting

The Business Meeting was held on August 17, 1977 at 11:00 A. M. in Meany Hall on the campus of the University of Washington in Seattle. President R. H. Bing was in the chair.

The Secretary informed the members of various actions of the Council. Actions of the Council of April 16, 1977 were reported in these Notices of August 1977 [24, p. 309] and those of August 15, 1977 are reported above.

The Business Meeting passed three resolutions recommended by the Council, the third after a minor amendment to the text. They were as follows:

Resolution I: The 81st Summer Meeting of the American Mathematical Society reiterates the deep concern of the U. S. mathematical community about the fate of the famous Uruguayan mathematician José Luis Massera, imprisoned since 1975, for political reasons, and of Señora Massera, also jailed. We urge that the Masseras be permitted to leave for France where Professor Massera has been offered a position.

The officers of the Society are requested to communicate this motion to the government of Uruguay.

Resolution II: The 81st Summer Meeting of the American Mathematical Society reiterates its deep concern about the situation of several Soviet colleagues who are refused permission to emigrate and are penalized for asking such permission by complete exclusion from scientific activities and, in some cases, by harassment.

We are especially moved by the case of the venerable Moscow mathematician, Naum Meiman, and by the case of the two young Kiev mathematicians, David and Gregory Chudnovsky, whose work aroused admiration among mathematicians of the world, and one of whom suffers from a disabling disease (myasthenia gravis).

We request the officers of the Society, and mathematicians everywhere, to do all they can to help Meiman and the Chudnovskys.

Resolution III: The 81st Summer Meeting of the American Mathematical Society notes with dismay that the Moscow mathematician and computer scientist, Anatoli Shcharansky, known for his open legal activities on behalf of human rights, including the right to emigration, has been held in a Moscow prison since March 1977 and is said to face a possible charge of treason.

We request that our colleague be either freed or, at the very least, be permitted to see his family and friends and be given a truly open trial, with defense lawyers of his choice, from abroad if need be, and in the presence of representatives of the world mathematical community.

The Business Meeting adjourned at 11:55 A. M.

Everett Pitcher
Secretary

Bethlehem, Pennsylvania

MATHEMATICAL ASPECTS OF PRODUCTION AND DISTRIBUTION OF ENERGY

edited by Peter D. Lax

Volume 21 of the Proceedings of Symposia in Applied Mathematics contains the papers presented at the Energy Short Course held on January 20-21, 1976 in San Antonio, Texas at the Eighty-second Annual Meeting of the American Mathematical Society. The papers are grouped in two categories: those having to do with the mathematical problems involved in the technology of energy production, and those which have to do with the mathematical problems of estimating the resources of energy and the efficient distribution of available energy. In both areas we are dealing with idealized models. The models for energy production are in the form of fairly complicated systems of partial differential equations whose solutions require techniques of finite difference schemes, finite element methods, and Fourier techniques. The models of energy distribution are large networks; their analysis is based on techniques from statistics, linear programming, dynamic programming, and techniques of optimization.

The organizing committee had asked as speakers mathematicians deeply committed to energy related applications as well as experts in these fields who have a flair for mathematical ideas and techniques. Several of the speakers are not only technical experts in their field, but have also been involved in decision making. For this reason, several of the articles contained interesting remarks on public policy.

The section of the book which deals with the mathematics of energy production includes *Magnetic confinement fusion energy research* by Harold Grad, *Nuclear energy—problems and promise* by Milton S. Plesset, and *Laser fusion* by F. D. Tappert. Articles in the section dealing with mathematical problems in modeling energy production and distribution are: *Estimation of undiscovered oil and gas* by E. Barouch and G. M. Kaufman, *On a pilot linear programming model for assessing physical impact on the economy of a changing energy picture* by George B. Dantzig and S. C. Parikh, *The problem of aggregation in modeling physical and social systems and processes* by Richard L. Garwin, and *Project independence evaluation system: Structure and algorithms* by William W. Hogan.

This is expository work; for the papers on energy production, some previous knowledge of differential equations is necessary. For the problem of energy distribution, some background in operations research is needed.

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PROBABILITY

Edited by J. L. Doob

In March 1976, a symposium on probability was held at the University of Illinois at Urbana-Champaign. Following is the list of articles and authors included in these Proceedings.

Small random perturbations of dynamical systems with reflecting boundary by R. F. Anderson and Steven Orey.

Brownian motion and classical analysis by D. I. Burkholder.

A Liapunov principle for semimartingales by Hans Follmer.

Applications of dual processes to diffusion theory by R. Holley, D. Stroock and D. Williams.

A general theorem of representation for martingales by Jean Jacod.

Central limit theorem and related questions in Banach space by Naresh C. Jain.

A renewal theorem for random walk in a random environment by Harry Kesten.

On prediction processes by Frank B. Knight.

A derivation of the Boltzmann equation from classical mechanics by Oscar F. Lanford III.

Random times and decomposition theorems by P. Warwick Millar.

Stochastic stability and boundary problems by Mark A. Pinsky.

Some sample path properties of the asymmetric Cauchy processes by William E. Pruitt and S. James Taylor.

The Martin boundary of a recurrent random walk has one or two points by D. Revuz.

The cofine topology revisited by John Walsh.

Poisson point process of Brownian excursions and its applications to diffusion processes by Shinzo Watanabe.

Some Q-Matrix problems by David Williams.

Proceedings of Symposia in Pure Mathematics, Volume 31.
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ABSTRACTS

The abstracts are grouped according to subjects chosen by the author from categories listed on the abstract form and are based on the AMS (MOS) Subject Classification Scheme (1970). Abstracts for which the author did not indicate a category are listed under miscellaneous.

* *Indicates that preprints are available from author.* • *Indicates invited addresses.*

Abstracts Presented to the Society

The abstracts printed in this section were accepted by the American Mathematical Society for written presentation. 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 the same issue.

Algebra and Theory of Numbers (05, 06, 08, 10, 12–18, 20)

*77T-A184 Francis E. Masat, Glassboro State College, Glassboro, N.J. 08028.

Proper regular semigroups. Preliminary report.

An inverse semigroup S, with set of idempotents E, has been called proper iff for $e \in E$ and $a \in S$, $e = ea$ implies that $a \in E$. A regular semigroup S will be called proper iff for $e \in E$ and $a \in S$, $ea \in E$ implies that $a \in E$.

THEOREM Let S be a regular semigroup. Denote the minimum group congruence on S by σ, the kernel of σ by K, the minimum inverse congruence on S by δ, and Green's relation for principal right ideals by $\mathcal{R}$. TFAE:

(1) S is proper.
(2) $\sigma \cap \mathcal{R} \subseteq \delta$.
(3) S is orthodox and S/δ is proper.
(4) E is left unitary.
(5) $E = K$

Some corollaries and applications follow. (Received April 25, 1977.)

77T-A185 K. H. Kim and F. W. Roush, Alabama State University, Montgomery, Alabama 36101.

Enumeration of normal topologies on a finite set.

A topology is *normal* iff for any two disjoint closed sets, there exist two disjoint open sets, one containing each of the two closed sets. Let $N^c(n)$ be the number of connected normal topologies on an n-point set, and let $N(n)$ be the number of normal topologies on an n-point set. Let $Q(n)$ be the number of all topologies on such a set. We prove

$$N^c(n) = \sum_{k=1}^{n-1} \binom{n}{k} Q(k) + 1$$

$$N(n) = Y_n(N^c(1), N^c(2), \ldots, N^c(n))$$

where the Y_n are the *Bell polynomials*

$$Y_n(y_1, y_2, \ldots, y_n) = \sum_{\pi_n} \frac{n!}{k_1! \ldots k_n!} \left(\frac{y_1}{1!}\right)^{k_1} \ldots \left(\frac{y_n}{n!}\right)^{k_n}$$

in which π_n ranges over all partitions of n, and k_i is the number of occurrences of i in such a partition. (Received June 6, 1977.)

*77T-A186 Kenneth McKenna, Yale University, New Haven, Conn. 06520. Pseudo-real-closed and pseudo-p-adically closed fields.

Definition: An ordered field K with real closure $\bar{K}$ is pseudo real closed (prc) if for every absolutely irreducible polynomial $f \in K(x)$ every simple root of f in $\bar{K}$ is a limit of roots of f in K, in every affine K-open subset. Let $G = \mathrm{Gal}(\tilde{\mathbb{Q}}/\mathbb{Q})$, let μ be the Haar measure on G.

Theorem 1: $\mu\{\sigma \in G: \mathrm{Fix}\ (\sigma) \cap \bar{\mathbb{Q}}$ is prc$\} = 1$.

Theorem 2: $\mu\{\sigma \in G: \mathrm{Fix}\ (\sigma) \cap \bar{\mathbb{Q}}$ has model complete theory as an ordered field$\} = 1$.

Theorem 3: There are $2^{\aleph_0}$ model complete theories of ordered fields.

Decidability results for the theory of almost all $\mathrm{Fix}\ (\sigma) \cap \bar{\mathbb{Q}}$ are obtained. The entire analysis goes through when p adically closed fields are considered in place of real closed fields. Many results about pseudo algebraically closed fields (cf. Wheeler, these Notices, last issue) also can be obtained. (Received June 6, 1977.)

77T-A187 JOHN G. PANAGOPOULOS, University of Athens, Athens, Greece. Groups of automorphisms of standard wreath products. Preliminary report.

Let G be a group and K_G the subgroup of $\mathrm{Aut}G$, consisting of those automorphisms which induce the identity on G/G'. G is called semi-complete (s-c) iff $K_G = I(G)$, where $I(G)$ is the group of inner automorphisms of G. Theorem 1. Let $W = A \wr B$ be the wreath product of A and B, where A and B are finite and A nilpotent. Then, W is s-c iff $W = C_2 \wr C_2$ or $W = C_2 \wr C_3$ or $W = C_3 \wr C_2$. Theorem 2. Let $W = A \wr B$ where A and B are finite, A is not nilpotent. Then, W is s-c iff (i) A is s-c, directly indecomposable (ii) $(|A/A'|, |Z(A)|) = 1$ (iii) B is abelian. In the next theorem, H is the subgroup of $\mathrm{Aut}W$ consisting of those automorphisms which leave B and the diagonal elementwise fixed. Theorem 3. Let $W = A \wr B$ where (i) A, B are non trivial finite groups with $(|A/A'|, |Z(A)|) = 1$ (ii) $A = n_1 A^1 \times \ldots \times n_s A^s$ where $n_1, \ldots, n_s, s \in N$ and $A^1, \ldots, A^s$ are non isomorphic directly indecomposable groups. Then $H \cong (n_1 + \ldots + n_s)B$. Theorem 4. Let $W = A \wr B$ where A and B are finite with $(|A/A'|, |Z(A)|) = 1$. Then (i) $\mathrm{Aut}W$ is solvable iff $\mathrm{Aut}A$, $\mathrm{Aut}B$ are solvable (ii) K_W is solvable iff K_A, K_B are solvable. Theorem 5. Let W be the unrestricted or restricted wreath product of the groups A and B, where A is finite nilpotent. If W is s-c then A will be cyclic of prime order and B abelian. (Received June 7, 1977.) (Author introduced by Professor S. Negrepontis).

*77T-A188 David M. Bressoud, Penn State, University Park, Pa. 16802. Generalization of the Rogers-Ramanujan identities for all moduli.

The following generalization of the Rogers-Ramanujan identities holds for all moduli: Given positive integer k, $j = 0$ or 1, and integral r such that $0 < r < (2k+j)/2$, then for all n, the partitions of n into parts $\not\equiv 0, \pm r \pmod{2k+j}$ are equinumerous with the partitions of n $(n = d_1 + d_2 + \ldots + d_m)$ such that $d_i \geq d_{i+1}$, at most $r-1$ of the d_i equal $1, d_i \geq d_{i+k-1} + 2$, and if $d_i \leq d_{i+k-2} + 1$, then $d_i + d_{i+1} + \ldots + d_{i+k-2} \equiv r-1 \pmod{2-j}$. (Received June 8, 1977.)

77T-A189 WITHDRAWN

*77T-A190 Robert E. Jamison, L S U, Baton Rouge, Louisiana 70803. Tietze's Convexity Theorem for semilattices and lattices.

In 1928 Heinrich Tietze proved that any closed connected set in R^n which is locally convex is in fact convex. This result has since been extended by various authors: to convex sets in a t.v.s. (Klee), to L_n sets in R^d (Valentine), to pseudoconvex domains (Hörmander). This report concerns analogues of Tietze's Theorem in semi-

lattices and lattices for several natural notions of convexity: the semilattice, lattice, and order alignments as well as combinations of these. Sample result: If T is a subcontinuum of a topological lattice L and T is locally a sublattice of L, then T is a sublattice of L. (Received June 3, 1977.)

77T-A191 STEVEN E. ANACKER, The Ohio State University, Columbus, Ohio 43210. Reducible Partitions. Preliminary report.

Let G be a permutation group on a set X. Let $\{X_i: 0 \leq i \leq t\}$ be a partition of X. A partition is reducible if for every $y \in X_i$, $i \geq 1$, there exists a $g \in G$ such that: 1. $g(y) \in X_{i-1}$, 2. $g \in G_{(X_i \setminus y)}$, 3. $g \in G_{(X_{i-1} \cup y)}$, and 4. $g \in \bigcap_{j \neq i, i-1} G_{(X_j)}$. Theorem. If $\{X_i: 0 \leq i \leq t\}$ is a reducible partition of X and $t \geq 3$, then $o(G_x) \geq t!$ (June 10, 1977.)

77T-A192 Heiko Harborth, Technische Universität Braunschweig, D 3300 Braunschweig, West Germany. Prime number criteria in Pascal's triangle.

A prime number criterion ($c = 2$) in Pascal's triangle introduced by H.B. Mann and D. Shanks [J. Combinatorial Theory (A) 13 (1972), 131-134] is generalized to: Theorem. For fixed $c \geq 2$ let $k \geq 2$ be not a multiple of any prime number $\leq c^2 - c - 1$, then k is a prime number if and only if $n \mid \binom{n}{k-cn}$ for every n with $\frac{k}{c+1} \leq n \leq \frac{k}{c}$. If K_c denotes the set of all k with $n \mid \binom{n}{k-cn}$ for every n, then $K_2 = P \cup \{1\}$ (P = set of all prime numbers). $K_3 = P \cup \{1,4,25\} \cup F$ (F = set of Fermat prime numbers $p = 2^{2^s} + 1$, $s \geq 1$) was determined by the author [Arch. Math. (Basel) 27 (1976), 290-294]. Now also K_4 is determined to $K_4 = P \cup \{1,4,9,21,33,49,54,77,121,141\} \cup Q$, where Q is the set of numbers 2p with prime numbers $p = (2^{2i+2}+2^{2j+2}+1)/3$. (Received July 5, 1977.)

77T-A193 B. A. DAVEY, La Trobe University, Bundoora, Victoria, Australia and H. WERNER, Technischen Hochschule, Darmstadt, West Germany. Injectivity and Boolean Powers.

An $\exists\forall$ conjunct of equations, $\alpha(a,b)$, is a *simplicity formula* for a class A if for each $A \in A$, $\{(a,b) \mid A \models \alpha(a,b)\} = \{\omega, \iota\}$. The class A has *factorizable congruences* if every congruence on a finite product of algebras from A is induced by congruences on the factors. THEOREM. *Let K be a variety and assume* $K = ISP(A)$ *for some finite set A of finite algebras. If there is a simplicity formula for A and A has factorizable congruences, then I is [weak] injective in K iff it is isomorphic to* $\Pi(A_j[B_j]^* \mid j < n)$, *where* $A_j \in H(A) \cap Si(K)$, A_j *is [weak] injective in K,* B_j *is a complete Boolean algebra, and the algebras* A_j *are pairwise nonisomorphic.* □ Some varieties to which this result may be applied are : Boolean algebras, (bounded) distributive lattices, varieties of distributive p-algebras, double Stone algebras, varieties of Brouwerian algebras and Heyting algebras, varieties (of groups or semigroups) generated by finite simple nonabelian groups, varieties generated by planar Steiner triple systems, varieties generated by weakly independent quasi-primal algebras. (Received June 20, 1977.)

77T-A194 Dr. David Ballew and Ronald Tholen, South Dakota School of Mines and Technology, Rapid City, SD 57701. On $\pi(x+y) \leq \pi(x) + \pi(y)$.

In 1974, Bull. AMS. Vl. 80, No. 3, Richards and Hensley proved the incompatibility of the classical k-tuple hypothesis and the Hardy Littlewood conjecture $\pi(x+y) \geq \pi(x) + \pi(y)$ casting considerable doubt on the latter. This paper

considers the behaviour of the ratio $\pi(x+y)/(\pi(x)+\pi(y))$. The following observations are made. 1. The ratio appears to assume its lowest value when $x = y$. 2. As $|x-y|$ grows large, the ratio approaches 1. 3. The ratio points are irregularities in the families that could provide the necessary counter-examples discussed by Richards and Hensley. (Received June 21, 1977.)

*77T-A195 ERROL A. JEFFERS, Pure Mathematics Department, University of Waterloo, Waterloo, Ont., Canada. The Amalgamation Property in universal Horn classes of digraphs. Preliminary report.

By a digraph is meant a directed graph without loops. A digraph A is said to be minimal excluded from a class K of digraphs if $A \notin K$ and whenever $B < A$, we have that $B \in K$. Theorem. Let K be an arbitrary universal Horn class of digraphs. K satisfies the Amalgamation Property iff one of the following holds:

(i) all minimal excluded structures from K are complete

(ii) K = all transitive digraphs,

(iii) $K = SP_R(C_3)$, where C_3 is the directed 3-cycle,

(iv) $K = SP_R(G_2)$, where G_2 is the complete graph on two points,

(v) K = all 1-element digraphs.

(Received June 22, 1977.)

*77T-A196 Peter J. Slater, Sandia Laboratories, Albuquerque, New Mexico 87115. Centers to Centroids in Graphs.

For $S \subseteq V(G)$ the S-center and S-centroid of G are defined as the collection of vertices $u \in V(G)$ which minimize $e_S(u) = \max\{d(u,v): v \in S\}$ and $d_S(u) = \Sigma_{v \in S} d(u,v)$, respectively. This generalizes the standard definition of center and centroid from the special case of $S = V(G)$.

For $1 \leq k \leq |V(G)|$ and $u \in V(G)$ let $r_k(u) = \max\{\Sigma_{s \in S} d(u,s): S \subseteq V(G), |S| = k\}$. The k-centroid of G, denoted $C(G;k)$, is defined to be the subset of vertices u in G for which $r_k(u)$ is a minimum. This also generalizes the standard definitions of center and centroid since $C(G;1)$ is the center and $C(G;|V(G)|)$ is the centroid.

In this paper the structure of these sets for trees is examined. Generalizations of theorems of Jordan and Zelinka are included. (Received June 23, 1977.)

77T-A197 RONSON J. WARNE, University of Alabama, Birmingham, Alabama 35294. A class of bisimple inverse monoids. Preliminary report.

Let S be a bisimple inverse monoid and P the right unit subsemigroup of S. If P is left cancellative and $a, b \in P$ imply $aP \subseteq bP$ or $bP \subseteq aP$, we term S a strong bisimple inverse monoid. Let E be a semilattice with greatest element e_0 and let G be a group with identity 1. Let $\zeta(\theta)(g \to \varphi_g)$ be a mapping of G $(G \times G)$ (G) onto (into) (into) $E(E)$ (End E) s.t. φ_g maps E onto $\{e: e \leq g\zeta\}$; $\theta(g,h) \leq (gh)\zeta$; $e\varphi_g\varphi_h\theta(g,h) = e\varphi_{gh}\theta(g,h)$; $\theta(g,hz)\theta(h,z) = \theta(gh,z)$ $(\theta(g,h)\varphi_z)$; φ_1 is the identity map of E; $\theta(g,1) = \theta(1,g) = g\zeta$; $\theta(g^{-1},g) = g\zeta$; $g\zeta \neq e_0$ implies $g^{-1}\zeta = e_0$. Let $(E,G,\zeta,\theta,\varphi)$ denote $\{(g,e): g \in G, e \in E, g\zeta \geq e\}$ under the multiplication $(g,e)(h,f) = (gh, \theta(g,h)e\varphi_h f)$. Theorem. S is a strong bisimple inverse monoid if and only if S is isomorphic to some $(E,G,\zeta,\theta,\varphi)$. An isomorphism theorem is also given. (Received December 20, 1976.)

77T-A198 RONSON J. WARNE, University of Alabama, Birmingham, Alabama 35294 and JANE La FRANCE, 729 Jones Street, Apartment 116, San Francisco, California 94109. Natural orthodox semigroups. II.

We use the definitions and notation of R. J. Warne, "Natural orthodox semigroups." I, these *Notices*, 24(1977), A-423. A natural orthodox semigroup S is termed natural left orthodox if $\mathcal{L}$ is a congruence on the band of idempotents of S. If, furthermore, $\mathcal{R}$ if a congruence on the union of the maximal subgroups of S, S is termed a right natural left orthodox semigroup. Let X_L denote X subject to the following modifications: Just assume θ_α satisfies (1). φ_α is a homomorphism of T_γ into $T_{\alpha^{-1}\gamma\alpha}e_{\alpha^{-1}\alpha}$, and if $j \in J_{(\alpha\beta)^{-1}\alpha\beta}e_{\beta^{-1}\beta}$ and $q \in J_{\beta^{-1}\beta}$, $(jq)\varphi_\gamma = j\varphi_\gamma q\varphi_\gamma$. If $y \in T$, $y\varphi_\alpha\theta_\alpha = e_{\alpha\alpha^{-1}}ye_{\alpha\alpha^{-1}}$. Omit "e" in (3) and (4). Replace "$(jp)\varphi_\beta$" by "$j\varphi_\beta$" in (6). Let X_{RL} denote X with the modification: Replace (1) by condition: θ_α (φ_α) is a homomorphism of T_γ into $e_{\alpha\alpha^{-1}}T_{\alpha\gamma\alpha^{-1}}$ $(T_{\alpha^{-1}\gamma\alpha}e_{\alpha^{-1}\alpha})$ and $p \in I_\delta$ and $q \in e_\delta T$ $(p \in Te_\delta$ and $q \in J_\delta)$ imply $((pq)\theta_\alpha = p\theta_\alpha q\theta_\alpha)$ $((pq)\varphi_\alpha = p\varphi_\alpha q\varphi_\alpha)$. Omit "$g(\alpha, \beta)$" in (2) and "e" in (3) and (4). Replace "$pA_j\theta_\alpha$" by "$p\theta_\alpha$" and "$(jp)\varphi_\beta$" by "$j\varphi_\beta$" in (6). Theorem. X_L (X_{RL}) is a natural left orthodox (right natural left orthodox) semigroup, and, conversely, every such semigroup is isomorphic to some X_L (X_{RL}). (Received March 28, 1977.)

77T-A199 BILL JACKSON, University of Waterloo, Waterloo, Ontario N2L 3G1. Hamilton cycles in 2-connected regular graphs. Preliminary report.

We show that if G is a 2-connected k-regular graph on n vertices and $n \le 3k$ then G is hamiltonian. (Received June 27, 1977.) (Author introduced by Professor H. Shank).

77T-A200 LARY SCHIEFELBUSCH, Indiana University Northwest, Gary, Indiana 46408. Transfer and weakly closed subgroups.

Let G be a finite group, $S \in \mathrm{Syl}_p(G)$ and W a weakly closed subgroup of S. For any $x, y \in G$, let $[x, y; 1] = [x, y]$ and, for $m > 1$, let $[x, y; m] = [[x, y; m-1], y]$.

For $n \geq 0$ let Q_n be the subgroup of S generated by all $Q \lhd S$ such that if $x \in S$ and A is a maximal subgroup of $Q\langle x\rangle$ that contains x, then $[x, y; p-1] \in \Phi(A)\Omega_n(A)$ for some $y \in Q - A$.

MAIN THEOREM. If $S \cap G'\Omega_n(S) \neq S \cap N(W)'\Omega_n(S)$, then $W \not\leq Q_n$.

Several corollaries follow. Examples are

(1) If W is generated by elements y such that $[x, y; p-1]^{p^n} = 1$ for all $x \in S$ (for example, W has exponent $\leq p^n$), then $S \cap G'\Omega_n(S) = S \cap N(W)'\Omega_n(S)$.

(2) If $S' = \Omega_n(S')$, then $S \cap G'\Omega_n(S) = S \cap N(S)'\Omega_n(S)$.

(3) If $p = 2$, $S' = \Omega_n(S')$ and $S/\Omega_n(S)$ is cyclic, then G has a normal subgroup of index 2.

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77T-A201 RONSON J. WARNE, University of Alabama, Birmingham, Alabama 35294 and IRENE LOOMIS, 1101 South 26th Street, Apartment #1, Birmingham, Alabama 35205. Standard regular semigroups. II. Preliminary report.

For definitions, see R. J. Warne, "Standard regular semigroups", Pacific J. Math. 65(1976), 539-562. Let $(V, \circ)$ be a standard inverse semigroup with semilattice Y, and let $(T, *)$ be a standard semilattice Y of completely simple semigroups $(T_y : y \in Y)$ with $y * y = y \in T_y$. Suppose $T_y \cap V = H_y$ for $y \in Y$, and $(H_y, \circ)$ $((H_y, *))$ is the maximal subgroup of $(V, \circ)$ $((T, *))$ containing y. Let $H = \bigcup(H_y : y \in Y)$ and assume $a \circ b = a * b$ for all $a, b \in H$. Let I_y (J_y) denote the maximal left zero (right zero) subsemigroup of T_y containing y. For each $j \in J_y$ and $i \in I_z$, suppose $j * i \in H_{yz}$. Let (Y, V, T) denote $\{(i, b, j) : b \in V,\ i \in I_{b \circ b^{-1}},\ j \in J_{b^{-1} \circ b}\}$ under the multiplication $(i, b, j)(r, c, s) = (i * ((b \circ c) \circ (b \circ c)^{-1}), b \circ (j * r) \circ c, ((b \circ c)^{-1} \circ (b \circ c)) * s)$. Theorem. (Y, V, T) is a standard regular semigroup, and, conversely, every standard regular semigroup is isomorphic to some (Y, T, V). (Received June 27, 1977.)

77T-A202 C. L. WANGNEO and K. TEWARI, Indian Institute of Technology, Kanpur, India 208016. Right noetherian rings integral over their centers. Preliminary report.

Let A be a right noetherian ring integral over a subring R (R contains 1) of its center. For a right A module M denote by Ass M the assasinator of M. For P a prime ideal of A denote by $\mathfrak{J}_{P\cap R}$ the set of prime ideals lying above $P\cap R$. Definition. Let M be a right module over A. Localize M at the complement of $P\cap R$ in R (P a prime ideal of A) and denote the localized module by M_S. We say $P \in$ Supp M if $M_S \neq 0$. P is minimal in Supp M if $P\cap R$ is minimal such that $M_S \neq 0$. We essentially prove: Theorem 1. If M is a finitely generated module over A then Ass M $\subseteq$ Supp M. If $P \in$ Supp M is minimal then there exists an ideal in $\mathfrak{J}_{P\cap R}$ belonging to Ass M. Theorem 2. Any finitely generated module M which is critical is compressible. Theorem 3. If A is Macaulay, then A has a right artinian classical quotient ring. (Received June 30, 1977.) (Author introduced by Dr. Mrs. Prabha Sharma).

77T-A203 M. LOGANATHAN, The Ramanujan Institute, University of Madras, Madras-600 005, India. Cohomology and homology of semigroups with idempotents. Preliminary report.

Recently H. Lausch ("Cohomology of inverse semigroups", J. Algebra 35 (1975), 273-303) constructed a cohomology theory for inverse semigroups to solve the extension problem for inverse semigroups. In this paper we define a cohomology and homology theory for any semigroup with idempotents. We show that in the case of inverse semigroup this cohomology theory reduces to the cohomology theory of Lausch, and the homology theory is naturally isomorphic to the homology theory of its maximal group homomorphic image. As an application we solve the extension problem, in terms of certain second cohomology group, for orthodox semigroups and *-regular semigroups (a *-regular semigroup is a semigroup S admitting an involutorial anti-automorphism $s \to s^*$ such that $ss^*s = s$ for every s in S). Further, we establish a "Lyndon-Hochschild-Serre spectral sequence" for idempotent-separating congruence on an arbitrary inverse semigroup and minimal group congruence on E-unitary inverse semigroup. (Received July 8, 1977.) (Author introduced by Professor Vadekke K. Balachandran).

*77T-A204 D. Suryanarayana, Memphis State University, Memphis, TN 38152; Andhra University, Waltair, India. On a functional equation relating to the Brauer-Rademacher identity. (to appear in L'Inseignement Mathématique).

In this paper, we discuss the pairs (f, h) of arithmetical functions which satisfy the functional equation $F(n)\sum_{\substack{d|n\\(m,d)=1}} \frac{f(d)}{F(d)}\mu\left(\frac{n}{d}\right) = \mu(n)\sum_{d|(m,n)} f(d)h\left(\frac{n}{d}\right)$, where μ is the Möbius function and F is the product of f and h under the Dirichlet convolution; that is, $F(n) = \sum_{d|n} f(d)h\left(\frac{n}{d}\right)$. The well-known Brauer-Rademacher identity is a special case of this functional equation ($f(n) = n$, $h(n) = \mu(n)$). We also generalize the functional equation to any arbitrary regular arithmetical convolution and discuss the pairs of solutions (f, h) of the generalized functional equation and pose some problems relating to the characterization of all pairs of solutions. (Received July 1, 1977.)

*77T-A205 RUSSELL MERRIS, California State University, Hayward, CA 94542: The Structure of Higher Degree Symmetry Classes of Tensors.

Let α be a function from the first m to the first n positive integers. Suppose $e_1,\ldots,e_n$ is an o.n. basis of V. Let G be a subgroup of S_m, and $\sigma \to A(\sigma) = (a_{ij}(\sigma))$ an irreducible, unitary representation of G which affords the character χ. Assume the restriction of A to G_α is fully reduced. Then the nonzero vectors in

$$\{(\chi(id)/o(G)o(G_\alpha)^{1/2})\sum_{\sigma\in G}\bar{a}_{ij}(\sigma)e^*_{\alpha\sigma} : 1 \le i,j \le \chi(id)\}$$

form an o.n. basis of the orbital subspace $\langle e^*_{\alpha\sigma} : \sigma \in G\rangle$ in the symmetry class of tensors

$\gamma_X(G)$. Moreover, if $B = (b_{ij})$ is the matrix representation of T with respect to $e_1, \ldots, e_n$, then the $(i,j;\alpha)$, $(p,q;\beta)$ entry of the matrix representation of $K(T)$ is

$$\delta_{jq}(o(G_\alpha)o(G_\beta))^{-1/2} \sum_{\pi \in G} a_{ip}(\pi) \prod_{t=1}^{m} b_{\alpha\pi(t),\beta(t)}.$$ (Received July 11, 1977.)

77T-A206 A. Verschoren, University of Antwerp, 2610 Wilrijk, Belgium.
A Note on the Van Geel-Spectrum (preliminary report)

Let R be a not necessarily commutative ring with unit. A couple (P, R'), is said to be a prime with kernel P in the ring R if (i)R is a subring of R, (ii)P is a completely prime ideal in R', (iii) if $xy \in R'$ with $xy \in P$ then $x \notin R'$ yields $y \in P$ and $y \notin R'$ yields $x \in P$. If one endows the set of the kernels of all primes in R with a generalized Zariski-topology, then one obtains the so-called "Van Geel-spectrum" [3], thus generalizing the Harrisson-spectrum. On the other hand the "Wannier-spectrum" is defined as follows : if $P \cup N$ is a disjoint covering with $PPCP$, $P+P=P$, $0 \in P$, $NN=-N$, $-1 \in N$, then $\{P\}$ is the Wannier-spectrum [4]. Theorem 1 : The Wannier-spectrum is a Harrisson-spectrum; Theorem 2 : The finite primes ([2]) in the Wannier-spectrum form a Van Geel-spectrum. Theorem 3 : The Connell-spectrum $\mathrm{Gam}_k R$, R a k-algebra [1] is Van Geel-spectrum. References : [1] I.G.Connell, A natural transformation of the Spec-functor, J. of Alg. ; [2] D.K.Harrisson, Finite and infinite primes ; Memoirs AMS 68 ; [3] J. Van Geel, Primes in rings ; [4] M. Wannier, the Wannier-spectrum, Notices AMS, 77T-A138. (Received July 6, 1977.)

77T-A207 RONALD HIRSHON, Polytechnic Institute of New York, Brooklyn, New York 11201, The equivalence of $X^tC \approx X^tD$ and $JXC \approx JXD$. Preliminary report.

Let C satisfy the maximal condition for normal subgroups and let $X^tC \approx X^tD$ for some positive integer t. Then $CXJ \approx DXJ$ where J is the infinite cyclic group. If $X^sC \approx X^tD$ and $s \geq t$ there exists a finitely generated free abelian group S such that C is a direct factor of DXS. (Received July 11, 1977.)

77T-A208 RONSON J. WARNE, University of Alabama, Birmingham, Alabama 35294 and JEFF TOMBRELLO, 1057 Forestdale Blvd., Birmingham, Alabama 35214. Standard Cliffordian semigroups. Preliminary report.

For definitions and notation, see R. J. Warne, "Standard regular semigroups," Pacific J. Math. 65(1976), 539-562. Let Y be a semilattice with greatest element. Let I (J) be a locally inverse semilattice Y of left zero (right zero) semigroups $(I_y : y \in Y)$ $((J_y : y \in Y))$ with structure homomorphisms $\{a_{y,z}\}$ $(\{b_{y,z}\})$. Let G be a semilattice Y of groups $(G_y : y \in Y)$ with structure homomorphisms $\{c_{y,z}\}$. Let $(j,i) \to p_{j,i}$ be a function of $J \times I$ into G such that if $j \in J_y$ and $i \in I_y$, $p_{j,i} \in G_y$; if $j \in J_y$ and $i \in I_z$, $p_{j,i} = p_{jb_{y,yz}, ia_{z,yz}}$; if $j \in J_y$, $i \in I_y$, and $y \geq z$, $p_{j,i}c_{y,z} = p_{jb_{y,z}, ia_{y,z}}$. Let (Y,I,J,G,a,b,c) denote $\{(i,g,j) : i \in I_y, g \in G_y, j \in J_y, y \in Y\}$ under the multiplication $(i,g,j)(r,h,q) = (ir, gp_{j,r}h, jq)$. Theorem. (Y,I,J,G,a,b,c) is a standard Cliffordian semigroup, and, conversely, every standard Cliffordian semigroup is isomorphic to some (Y,I,J,G,a,b,c). (Received July 7, 1977.)

77T-A209 JOE W. FISHER, University of Cincinnati, Cincinnati, OH 45221 and SUSAN MONTGOMERY, University of Southern California, Los Angeles, CA 90007. Semiprime Skew Group Rings. Preliminary Report.

Let G be a finite group of automorphisms acting on a ring R. Let R*G denote the skew group ring and B the algebra of the group G. THEOREM. If R is prime and B*H is semiprime where H is the

subgroup of inner automorphisms, then R*G is semiprime. From this theorem we obtain the following corollaries. COROLLARY. If R is semiprime with no additive $|G|$- torsion, then R*G is semiprime. COROLLARY (Montgomery). If R is semiprime and G is an outer group of automorphisms, then R*G is semiprime. (Received July 18, 1977.)

77T-A210 George Grätzer and David Kelly, University of Manitoba, Winnipeg, Manitoba R3T 2N2
On the product of lattice varieties.

For classes $\underset{\sim}{V}$ and $\underset{\sim}{W}$ of lattices, $\underset{\sim}{V} \circ \underset{\sim}{W}$ is the class of all lattices L such that there exists a congruence relation Θ of L satisfying $[a]\Theta \in \underset{\sim}{V}$ for all $a \in L$ and $L/\Theta \in \underset{\sim}{W}$. If $\underset{\sim}{V}$ and $\underset{\sim}{W}$ are varieties, then $\underset{\sim}{V} \circ \underset{\sim}{W}$ is a quasivariety, but not necessarily a variety. Theorem 1. For varieties $\underset{\sim}{V}$ and $\underset{\sim}{W}$, $\underset{\sim}{V} \circ \underset{\sim}{W}$ is closed under the formation of ideal lattices. Theorem 2. $\underset{\sim}{D} \circ \underset{\sim}{D}$ and $\underset{\sim}{M} \circ \underset{\sim}{D}$ are varieties.— $\underset{\sim}{D} \circ \underset{\sim}{D}$ is a variety containing all but two covers of $\underset{\sim}{N}_5$; $\underset{\sim}{D} \circ \underset{\sim}{D}$ has infinitely many subvarieties; $\underset{\sim}{D} \circ \underset{\sim}{D}$ contains exactly one simple lattice, namely, the two-element chain, but it contains infinitely many subdirectly irreducible lattices. (Received July 20, 1977.)

*77T-A211 ELLIOT EVANS, University of Tennessee, Knoxville, TN. 37916; Median Algebras and lattices, a duality.

A ternary algebra (X,m) is a median algebra if m satisfies the equations: $m(a,a,b) = a$ and $m(m(a,b,c), m(a,b,d),e) = m(m(c,d,e),a,b)$. $\mathcal{MA}$ denotes the category of median algebras and their homomorphisms. An algebraic atomic lattice L is a median lattice if (here Greek letters denote atoms) : (i) $\alpha \leq x \vee y$, $x, y \neq 0 \Rightarrow \alpha \leq \beta \vee \gamma$ for certain $\beta \leq x$, $\gamma \leq y$, and (ii) for any α,β,γ, $M_L(\alpha,\beta,\gamma) := (\alpha \vee \beta) \wedge (\alpha \vee \gamma) \wedge (\beta \vee \gamma)$ is an atom. $\mathcal{ML}$ denotes the category of median lattices, a function $f: L \to K$ being an $\mathcal{ML}$-morphism iff (i) f preserves $\bigwedge$ and $\bigvee$, (ii) $f(0_L) = 0_K$, (iii) $\forall \beta \in K$, $\exists\, \alpha \in L$ with $\beta \leq f(\alpha)$. For $A \in \mathcal{MA}$, $\mathcal{J}(A) := \{J \subseteq A \mid m[J \times J \times A] \subseteq J\}$, the lattice of ideals of A. For $g: A \to B$, an $\mathcal{MA}$ morphism, $\mathcal{J}(g): \mathcal{J}(B) \to \mathcal{J}(A)$ is the counterimage map. Then $\mathcal{J}$ is a functor of $\mathcal{MA} \to \mathcal{ML}$. For $L \in \mathcal{ML}$, $\mathcal{A}(L) = (\text{atoms of } L, M_L) \in \mathcal{MA}$. For $f: L \to K$ in $\mathcal{ML}$ define $\mathcal{A}(f): \mathcal{A}(K) \to \mathcal{A}(L)$ by $\mathcal{A}(f)(\beta) = \alpha$ where $\beta \leq f(\alpha)$. Then $\mathcal{A}$ is a contravariant functor of $\mathcal{ML} \to \mathcal{MA}$. Theorem. The functors $\mathcal{J} \circ \mathcal{A} \cong \mathrm{Id}_{\mathcal{ML}}$ and $\mathcal{A} \circ \mathcal{J} \cong \mathrm{Id}_{\mathcal{MA}}$. Hence the categories $\mathcal{MA}$ and $\mathcal{ML}$ are dual. Cor. A lattice L is the convex subalgebra lattice of a distributive strong conditional lattice iff $L \in \mathcal{ML}$. Theorem. The above duality restricts to a duality between $\mathcal{T} = \{A \in \mathcal{MA} \mid A \text{ is a tree}\}$ and $\mathcal{SB} = \{L \in \mathcal{ML} \mid \text{comp}(L) \text{ is semi-Brouwerian}\}$ (Received July 20, 1977.)

*77T-A212 PATRICK FLEURY, SUCP, Plattsburgh, New York, 12901. On a class of idealizer rings. Preliminary report.

Let R be an associative ring with 1 and I a right ideal of R which is contained in exactly one maximal right ideal M. If M is not an ideal then there is an $r \in R$ and $rI+I=R$. Let $\mathcal{I}(I)$ be the idealizer of I. Consider the simple right R-module R/M as a right $\mathcal{I}(I)$ module and let $\hat{r}: \mathcal{I}(I) \to R/M$ be the $\mathcal{I}(I)$ homomorphism defined by $\hat{r}(x) = rx+M$. Let I_r be the kernel of $\hat{r}$ and let $M_r = \{x \mid x \in \mathcal{I}(I), rxI \subseteq M\}$. Theorem: M_r is a maximal right ideal of $\mathcal{I}(I)$ and is the only maximal right ideal containing I_r. If M_r is not an ideal, then there is an $r' \in \mathcal{I}(I)$ with $r'I_r + I_r = \mathcal{I}(I)$. In this way we obtain a chain of rings $R \supseteq \mathcal{I}(I) \supseteq \mathcal{I}(I_r) \supseteq \ldots$ Theorem: The above chain terminates if and only if R/M is a finite dimensional vector space over $\mathrm{End}_R(R/M)$ and, in that case, the number of rings in the chain is equal to the dimension of R/M. (Received July 22, 1977.)

*77T-A213 Harry Lakser, University of Manitoba, Winnipeg, Canada R3T 2N2, Semisimplicial algebras that satisfy the Kan extension condition.

Let V be a variety of (universal) algebras. A semisimplicial V-algebra is a semisimplicial complex A (see J. P. May, Simplicial objects in algebraic topology, Van Nostrand, 1967, where they are called simplicial sets) such that, for each integer $n \geq 0$, A_n is an algebra in V and the

face and degeneracy operators, d_i and s_i respectively, $0 \le i \le n$, are homomorphisms. A semisimplicial complex A is said to satisfy the Kan extension condition if for each collection of $n+1$ elements $x_0, \ldots, x_{k-1}, x_{k+1}, \ldots x_{n+1}$ of A_n satisfying the compatibility condition $d_i x_j = d_{j-1} x_i$, $i < j$ and $i \neq k$, $j \neq k$, there exists an $x \in A_{n+1}$ with $d_i x = x_i$. Theorem. If V is a variety of algebras then all semisimplicial V-algebras satisfy the Kan extension condition if and only if V is congruence permutable. —— This puts into the proper universal algebraic setting the well-known fact that semisimplicial groups satisfy the Kan extension condition. (Received July 25, 1977.) (Author introduced by Professor G.Grätzer).

77T-A214 G. Grätzer and R. Padmanabhan, University of Manitoba, Winnipeg, Manitoba R3T 2N2
Median algebras.

A median algebra $\mathfrak{A} = \langle A;Q \rangle$ is a ternary algebra where the ternary operation Q satisfies all the identities true in distributive lattices for the median polynomial $(x \vee y) \wedge (y \vee z) \wedge (z \vee x)$. G. Birkhoff and S. A. Kiss (Bull. Amer. Math. Soc. 53(1947), 749-752) and A. A. Grau (same Bulletin, pp. 567-572) characterize the bounded distributive lattices and Boolean algebras, respectively, as median algebras with two nullary operations and with an additional unary operation, respectively. We call a join-semilattice $\langle A;\vee \rangle$ median iff (i) each principal dual ideal $[p)$ is a distributive lattice (ii) for $a,b,c \in A$ there exists a $p \in A$ such that $p \le a \vee b, b \vee c, c \vee a$. We say that a median semilattice A realizes Q, Q a ternary function on A, iff $Q(a,b,c) = (a \vee b) \wedge (b \vee c) \wedge (c \vee a)$ for all $a,b,c \in A$. Theorem. An algebra $\mathfrak{A} = \langle A;Q \rangle$ is a median algebra iff it is realized by some median semilattice $\langle A;\vee \rangle$. This yields the results of Birkhoff, Kiss, and Grau and also some recent results of J. Nieminen on finite median algebras. Another corollary is that the class of median algebras is equationally complete. (Received July 25, 1977.)

77T-A215 C. R. Platt, University of Manitoba, Winnipeg, Manitoba R3T 2N2 Finite transferable lattices are sharply transferable.

A lattice L satisfies (SF) iff every principal ideal is finite. L satisfies $(R_\vee)$ iff there is a map $\rho : L \to \omega$ such that $\rho(p) < \rho(x)$ whenever $\langle p,J \rangle$ is a minimal pair and $x \in J$ (this is condition (iii) of Abstract 77T-A62, these Notices 24(1977), A228.) Theorem 1. Every lattice can be embedded in the ideal lattice of a lattice satisfying (SF) and $(R_\vee)$. Theorem 2. A sublattice of a lattice satisfying (SF) and $(R_\vee)$ satisfies $(R_\vee)$. Corollary 1. Every transferable lattice satisfies $(R_\vee)$. Corollary 2. Every finite transferable lattice is sharply transferable. (Received July 25, 1977.) (Author introduced by Professor G. Grätzer).

77T-A216 RAJ K. MARKANDA and JOAQUIN PASCUAL, Departamento de Matemáticas, UNIVERSIDAD DE LOS ANDES, MERIDA, VENEZUELA. Fixed rings of automorphisms of $k[x,y]$ (Preliminary report).

In this article we answer some of the questions raised by Fraser and Mader (J. of Algebra, 25, pp. 25-39) about the fixed Subrings of automorphisms of $R=k[x,y]$, char.k = 0. Let $M = (x,y)$ and $A_\ell = \{ \alpha \in \mathrm{Aut}_k (R) : x\alpha - x$ and $y\alpha - y$ are in $M^2 \}$. We exhibit an infinite Subfamily F of A_ℓ such that the fixed ring R^α of each α in F is k itself. Moreover $(x\alpha - x, y\alpha - y) \neq 1$. Some other questions are also considered. (Received July 28, 1977.) (Authors introduced by Irwin Fischer).

77T-A217 G. Grätzer, C.R.Platt, and B. Sands, University of Manitoba, Winnipeg, Manitoba R3T 2N2
Lattice ideal embedding theorems.

We consider the following properties for a lattice L : (X) L has no doubly reducible element; $(RD_\wedge)$ $a \wedge b = a \wedge c = d$ implies that $a \wedge (b \vee c) = d$; (SF) all principal ideals are finite;

(W) $a \wedge b \leq c \vee d$ implies that $[a \wedge b, c \vee d] \cap \{a,b,c,d\} \neq \emptyset$; (W′) is (W) with the hypothesis replaced by $c \leq a \wedge b \leq c \vee d$; $(SD_\vee)$ and (W″) are the duals of $(SD_\wedge)$ and (W′), respectively. For any property P of lattices, let $\mathcal{E}(P)$ be the assertion that every lattice can be embedded in the ideal lattice of a lattice satisfying P. If P is one of (X), $(SD_\wedge)$, $(SD_\vee)$, or (SF), then $\mathcal{E}(P)$ is known to hold (G. Grätzer, Proc. Amer. Math. Soc. 43(1974), 269-271; G. Grätzer and C. R. Platt, these Notices 24(1977), A288, Abstract 77T-A89; Ph. M. Whitman, Bull. Amer. Math. Soc. 52(1946), 507-522.) On the other hand, $\mathcal{E}$(W) fails (K. Baker and A. Hales, Alg. Univ. 4(1974), 250-258). We prove: Theorem 1. $\mathcal{E}((SD_\wedge)$ & $(SD_\vee)$ & (W′) & (W″)) holds. Theorem 2. $\mathcal{E}((SD_\vee)$ & (SF) & (X)) holds. Theorem 3. If L satisfies $(SD_\wedge)$ and (SF), then the ideal lattice of L satisfies $(SD_\wedge)$. Consequently, $\mathcal{E}((SD_\wedge)$ & (SF)) fails.— From Theorem 1 we obtain: Corollary. Every transferable lattice satisfies $(SD_\wedge)$, $(SD_\vee)$, and (W). (Received July 25, 1977.)

77T-A218 DAVID ZEITLIN, 1650 Vincent Ave. North, Minneapolis, MN., 55411. **Parametric solutions for a sum of 2n+5 cubes equal to a sum of 2n+3 cubes.**

For each n, let $P_i > 0$, $i = 1,2,\ldots,n$, be distinct integers so that $S = \sum_{i=1}^{n} P_i^3$ is an even integer. Let $S = 2R$, $W_{k+2} = RW_{k+1} + W_k$, $k = 0,1,\ldots$, where W_0 and W_1 are integers. Then, for $k = 0,1,\ldots$, the two equal sums of 2n+5 and 2n+3 cubes, respectively, are given by (*) $\sum_{i=1}^{n}(4SP_iW_{k+2})^3 + \sum_{i=1}^{n}(4P_iW_{k+1})^3 + (4W_{k+4})^3 + ((S^2-4)W_{k+2})^3 + (2S^2W_{k+2})^3 + (2SW_{k+1})^3 + (4W_k)^3 = \sum_{i=1}^{n}(4P_iW_{k+3})^3 + \sum_{i=1}^{n}(2SP_iW_{k+2})^3 + (2SW_{k+3})^3 + (S^2W_{k+2})^3 + ((2S^2+4)W_{k+2})^3$. Moreover, the two sums of the base variables are equal for all n and k. Ex. 1. For $n=1$, $S=P^3$, $k=0$, (*) gives identity (1): $(4P^7W_1+8P^4W_0)^3+(8PW_1)^3+((P^9+8P^3)W_1+(2P^6+8)W_0)^3+(2P^9W_1+4P^6W_0)^3 + ((P^9-4P^3)W_1+(2P^6-8)W_0)^3+(4P^3W_1)^3+(8W_0)^3 = ((2P^7+8P)W_1+4P^4W_0)^3+(2P^7W_1+4P^4W_0)^3+((P^9+4P^3)W_1+2P^6W_0)^3 + ((2P^9+4P^3)W_1+(4P^6+8)W_0)^3+(P^9W_1+2P^6W_0)^3$. If $P=1$, (1) gives $(4W_1+8W_0)^3+(9W_1+10W_0)^3+(8W_1)^3+(4W_1)^3+(8W_0)^3 = (3W_1+6W_0)^3+(10W_1+4W_0)^3+(5W_1+2W_0)^3+(6W_1+12W_0)^3+(W_1+2W_0)^3$. If $W_0=W_1$, (1) gives $(P^9+2P^6+8P^3+8)^3+(2P^7+8P^4)^3+(8P)^3+(P^9+2P^6-4P^3-8)^3+(2P^9+4P^6)^3+(4P^3)^3+8^3=(2P^9+4P^6+4P^3+8)^3+(2P^7+4P^4+8P)^3+(P^9+2P^6+4P^3)^3+(2P^7+4P^4)^3+(P^9+2P^6)^3$. Additional reports on equal sums of cubes are forthcoming. See these NOTICES 24(1977) August.
(Received July 29, 1977.)

77T-A219 R.N. GUPTA and JAI RAM, Panjab University, Chandigarh 160014, India. **The Jacobson radical of fixed ring of automorphisms.**

Let R be a ring, not necessarily with identity, and G a finite group of automorphisms of R. Let R^G denote the ring consisting of elements of R that are left fixed by all the automorphisms in G. It is shown that if $|G|\cdot R = R$ then the Jacobson radical of R^G is equal to the Jacobson radical of R intersected with R^G. This generalizes a recent result due to Susan Montgomery [Communications in Algebra 4(1976), 459-465]. (Received August 1, 1977.) (Authors introduced by R. P. Bambah).

*77T-A220 SYDNEY BULMAN-FLEMING and KENNETH McDOWELL, Wilfrid Laurier University, Waterloo, Ontario, Canada N2L 3C5. The Category of Mono-unary Algebras.

Let K_1 denote the variety of algebras $\langle A; \alpha\rangle$ where α is a function from A to itself. (K_1 is equivalent to the variety of all M-sets where M is the monoid $\langle \omega; +, 0\rangle$.) Theorem 1: $\langle A; \alpha\rangle$ is injective in K_1 iff (a) α possesses a fixpoint in A; (b) $A = \mathrm{im}(\alpha)$. Corollary: $\langle A; \alpha\rangle$ is absolutely pure in K_1 iff it is injective. It is easy using Theorem 1 to describe injective hulls explicitly. An algebra in K_1 is projective iff it is free. Theorem 2: $\langle A; \alpha\rangle$ has a projective cover iff $A - \alpha(A)$ generates A. Theorem 3: $\langle A; \alpha\rangle$ is pure-projective in K_1 iff it is a coproduct (disjoint union) of finitely generated algebras. (A complete description of the pure-injective (= equationally compact) algebras in K_1 exists in the literature). The tensor product $A \otimes B$ of two algebras in a variety K always exists and has the defining property that any bihomomorphism from $A \times B$ to $C \in K$ factors uniquely through $A \otimes B$.

An algebra $A \in K$ is called flat if the functor $A \otimes -$ preserves monomorphisms. Theorem 4: $\langle A; \alpha \rangle$ is flat in K_1 iff α is 1 - 1. Stenström calls an M-set A weakly flat if $A \otimes -$ preserves equalizers and pullbacks (see Math. Nachr. 48 (1970), 315-334). $\langle A; \alpha \rangle \in K_1$ is weakly flat iff it is flat and contains no cycles. (Received July 19, 1977.)

*77T-A221 THOMAS J. LAFFEY, University College, Dublin, Ireland. Two-generated subalgebras of matrix algebras. Preliminary report.

Let A,B be nxn matrices over a field F of characteristic zero and let K be the splitting field of the characteristic polynomial of A over F. Let X be the algebra generated by A,B over F. We show that if A has distinct eigenvalues in K, then X/J(X) is the direct sum of complete matrix algebras over subfields of K. (Here J(X) denotes the Jacobson radical of X). (Received August 9, 1977.)

77T-A222 D.E.G. MALM, Oakland University, Rochester, Michigan 48063. On Monte-Carlo Primality Tests

A Monte-Carlo primality test, different from the tests of Rabin and Solovay-Strassen, is described. This test is of computational cost log(n) and the probability of error on a single trial is less than 1/4. In actual trials the upper bound for error of 1/4 seems to be very conservative. The test is based upon a method (due to D.H. Lehmer) for solving $x^2 = a \pmod p$ if a is a quadratic residue modulo p. The bound for the probability of error in a single trial, 1/4, is better than the published values for the Solovay-Strassen test and the Rabin test, namely 1/2. However, if n is not an absolute pseudoprime, the probability of error on a single trial of the Solovay-Strassen test is less than 1/4. (Received August 9, 1977.)

77T-A223 C.D.Gay, G.C.Morris and I. Morris, University College of North Wales, Bangor, Gwynedd, U.K. Adams Operations on the Burnside Ring of a Finite Group.

Let G be a finite group and let Φ be the homomorphism of pre-λ-rings from the Burnside ring B(G) to the ring of supercentral functions SCF(G), as described by D. Knutson (Springer Lecture Notes No.308). The ring SCF(G) inherits Adams operations ψ_n, $n \in \mathbb{N}$, from B(G). Knutson was not able to give an explicit formula for ψ_n. The authors show that given $f \in SCF(G)$ and K a subgroup of G, then $\psi_n(f)(K) = \sum \omega_K^n(J)f(J)$. The summation is over all subgroups J of G and the ω_K^n are integer-valued functions defined on the subgroup lattice of G. The proof uses a theory of semi-symmetric functions which includes ordinary symmetric functions as a special case. A new construction for the supercharacter table of G is also obtained. (Received August 15, 1977.)

*77T-A224 DAVID F. ANDERSON, University of Tennessee, Knoxville, Tennessee, 37916. Graded Krull domains.

Let Γ be a torsionless grading monoid and $A = \bigoplus_{g \in \Gamma} A_g$ a graded Krull domain. Thm 1. Cl(A) is generated by the classes of homogeneous htl prime ideals of A. Thm 2. If $\Gamma \cap (-\Gamma) = 0$, then the map $I \to A:(A:IA)$ from $D(A_0)$ to D(A) induces an injection $Cl(A_0) \to Cl(A)$. Thm 3. Let

B be a Krull domain with quotient field K, then if $B[\Gamma]$ is a Krull domain, $Cl(B[\Gamma]) \cong Cl(B) \oplus Cl(K[\Gamma])$ and $Cl(K[\Gamma])$ is independent of K.

Also studied are subrings of $K[X_1,\ldots,X_n]$ generated by monomials and graded Krull domains in which all nonzero homogeneous elements are units. (Received August 15, 1977.)

*77T-A225 H.PETER GUMM, FB4,AG1, Technische Hochschule, D-61 Darmstadt, West Germany, A Cancellation Theorem for Finite Algebras.

Thm.: Let A,B and C be finite universal algebras. If $A\times B \cong A\times C$ then B and C are isotopic.

Algebras $B=(B,(f_i)_{i\in I})$ and $C=(C,(g_i)_{i\in I})$ are called isotopic if there exists a bijection $\Phi:B\to C$ and bijections $\Psi_i:B\to C$, $i\in I$, such that for all elements $x_1,\ldots,x_{n_i}\in B$ we have $g_i(\Phi x_1,\ldots,\Phi x_{n_i}) = \Psi_i f_i(x_1,\ldots,x_{n_i})$.

Corollary: If $A\times B \cong A\times C$ for finite algebras A, B and C and if B and C are idempotent then $B \cong C$. (Received August 16, 1977.)

*77T-A226 Alexander ABIAN, Dept. of Math. Iowa State University, Ames, Iowa 50011. Compact partially ordered sets and compactification of partially ordered sets.

In what follows a poset (i.e., a partially ordered set) need not have a zero (i.e., a minimum) element.

DEFINITION. A poset P is called compact if and only if for every subset S of P if every finite subset of S has a nonzero lower bound then S has a nonzero lower bound.

THEOREM. Every poset $(P, \leq)$ can be extended to a compact poset $(P \cup E, \leq)$ where all the existing suprema and infima of subsets of P are preserved, except perhaps the zero infima (if the zero element of poset P exists) of some infinite subsets of P.

Recalling that a poset is called complete if and only if every subset of it has an infimum (or, equivalently, a supremum) it is shown that every poset can be extended (in the above sense) to a complete and compact poset. Motivated by the above, compactness is also defined for relations other than partial orders and the corresponding compactification theorems are proved. For posets the (obvious) upper compactness is also defined. (Received August 19, 1977.)

77T-A227 Williams K. Forrest, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2. The Content of Varieties.

Let F be an algebraically closed field. Then the open topology on the n-dimensional Stone space is metrizable. Let S denote the family of all open disks in $S_A^n(F)$ relative to some fixed metric. Definition. A weight $\omega : S \to \mathbb{R}$ is a function such that $\omega(D_1) > \omega(D_2)$ iff the radius of D_1 is $>$ the radius of D_2. The weight ω is proper if $\lim_{r\to 0}\omega(D_r) = 0$ whenever $\{D_r\}$ is a sequence such that D_r has radius r. The weight ω is regular if whenever $D_1,\ldots,D_m$ are contained in D and $D_i \cap D_j = \emptyset$ then $\Sigma\,\omega(D_i) \leq \omega(D)$. Finally if V is a variety then the content $C(V) = \mathrm{glb}\{\Sigma\,\omega(D_i) : D_1,\ldots,D_m$ is a cover of $V\}$. The content is proper or regular according to whether ω is proper or regular. Theorem 1. If C is a proper content and C_1 is a curve in $S_A^n(F)$ then $C(C_1) = 0$. Theorem 2. If C is a proper regular content on $S_A^n(F)$ and V is a variety then $C(V) = 0$. (Received August 19, 1977.)

*77T-A228 Adrian R. Wadsworth, University of California, San Diego, La Jolla, California 92093. Krull dimensions of tensor products of commutative algebras over a field.

Let R_1 and R_2 be commutative algebras over field k. We give upper and lower bounds for the Krull dimension of $R_1 \otimes_k R_2$, which lead to exact values in many instances. Let $d(R)$ = Krull dimension of R, $t(R)$ = transcendence degree of R over k, $v(R)$ = valuative dimension of R, and $rk(P)$ = rank (=height) of prime ideal P. Sample theorems:

(1) If the integral domain A satisfies the altitude formula

$$rk(P) + t(A/P) = t(A), \quad \text{for each prime } P \text{ of } A, \qquad (*)$$

then $d(A \otimes_k R) = \max\{rk(PR[x_1,\ldots,x_{t(A)}]) + \min(t(A)-d(A), t(R/P)) + d(A) \mid P \text{ a prime ideal of } R\}$.

(2) If $A_1,\ldots,A_n$ are domains satisfying (*), then

$$d(A_1 \otimes_k A_2 \otimes_k \cdots \otimes_k A_n) = t(A_1) + \ldots + t(A_k) - \max_{1\le i\le n} \{t(A_i)-d(A_i)\}.$$

(3) If R is a domain, then $t(R) + d(R) \le d(R \otimes_k R) \le t(R) + v(R)$.

These results generalize a theorem of R. Y. Sharp, ["The dimension of the tensor product of two field extensions," Bull. London Math. Soc., 9 (1977), pp. 42-48.]. (Received August 19, 1977.)

*77T-A229 ALAN SPRAGUE, The Ohio State University, Columbus, Ohio 43210, 3-nets.

3-nets were defined by Laskar [Finite Nets of Dimension 3.I, J. Algebra 32(1974), 8-25]. 3-nets are a 3-dimensional analogue of the nets of Bruck. A class of examples of 3-nets follows. Let $\mathcal{P}_3$ be a projective 3-space of finite order. Let $\mathcal{P}_2$ be a projective plane of the same order, contained in $\mathcal{P}_3$. Then $\mathcal{A}_3 = \mathcal{P}_3 - \mathcal{P}_2$ is an affine 3-space. Let $\mathcal{P}_2^0$ be a subplane of $\mathcal{P}_2$. The points of the 3-net π will be the points of $\mathcal{A}_3$. Lines of π will be the lines of $\mathcal{A}_3$ which intersect $\mathcal{P}_2^0$ in a point. Planes of π will be the planes of $\mathcal{A}_3$ which intersect $\mathcal{P}_2^0$ in a line. Theorem: If π' is a 3-net with the property that the planes of π' are Bruck nets with at least 3 parallel classes of lines then π' is isomorphic to a 3-net described above. (Received August 19, 1977.)

77T-A230 Richard Resco, University of California, San Diego, La Jolla, Ca. 92093. Simple Noetherian Rings and Transcendence Degrees. Preliminary Report.

Let B be an algebra with center a field k. Let $B(x_1,\ldots,x_n)$ denote the algebra $B \otimes_k k(x_1,\ldots,x_n)$, a central localization of the polynomial ring $B[x_1,\ldots,x_n]$. A new class of simple Noetherian rings is given by the following: Theorem 1. Let B be a simple Noetherian ring which is not algebraic over its center. Then for every n, $B(x_1,\ldots,x_n)$ is simple Noetherian, not Artinian.

Further properties are obtained when B is a division ring: Theorem 2. Let D be a division algebra containing a subfield L with tr. deg. $(L/k) = n$. Then i) $D[x_1,\ldots,x_n]$ is primitive; ii) $D(x_1,\ldots,x_n)$ has Krull and global dimension n. The role of transcendence degree in the above is illustrated by the following example. Let k be an uncountable field of char. 0, let $A_1(k)$ denote the Weyl algebra over k, and let D be the quotient division ring of A_1. Then i) every maximal subfield of D has tr. deg. 1 over k; ii) $D(x_1,\ldots,x_n)$ has Krull and global dimension 1 for every n; iii) $D[x]$ is primitive, but $D[x,y]$ is not.

Thm. 2 was obtained for the case $n=1$ by Jacobson. (Received August 22, 1977.)

77T-A231 WITHDRAWN

77T-A232 W.J. BLOK, University of Amsterdam, Amsterdam, The Netherlands. The lattice of varieties of modal algebras.

A modal algebra is an algebra $(A,^{o})$ such that A is a Boolean algebra and ^{o} is a unary operation satisfying $1^{o} = 1$ and $(x\cdot y)^{o} = x^{o}\cdot y^{o}$. A variety of modal algebras is called *finite* if it is generated by a finite algebra. Let 2 be the two element modal algebra satisfying $x^{o} = x$. Theorem 1. The variety generated by 2 has a cover which is non-finite and has infinitely many finite covers. Contrast this with our result (see: Varieties of interior algebras, dissertation, Univ. of Amsterdam '76) that the finite varieties of interior algebras (i.e. modal algebras satisfying $x^{o} \leq x$ and $x^{oo} = x^{o}$) are precisely the varieties of interior algebras having finitely many subvarieties and that every finite variety of interior algebras has only finitely many covers among the varieties of interior algebras. Theorem 2. There is a variety of modal algebras having $2^{\aleph_0}$ covers. Theorem 3. There are varieties K,L of modal algebras such that $K \subsetneq L$ and such that there is no variety of modal algebras covering K and contained in L. Hence the lattice of varieties of modal algebras is not strongly atomic. (Received August 22, 1977.)

Analysis (26, 28, 30–35, 39–47, 49)

*77T-B141 Albert A. Mullin, 6840 Todd Street, Patton Park, Ft. Hood, TX 76544
On common fixed exposed points for families of mappings.

This note is a lash-up of basic results by S. Straszewicz on exposed points (exponierte Punkte) and by A. A. Markov, S. Kakutani, and F. E. Browder on the existence of common fixed points for commuting families of mappings. Lemma 1. Let S be a compact convex subset of a normed linear space. Let C be a non-empty commuting family of affine continuous mappings of S into S. Let F be the (non-empty) set of all common fixed points over C. Then F contains all exposed points of S iff $C \equiv \{I_S\}$, where I_S is the identity map on S. Lemma 2. Let B be a bounded closed convex subset of a Hilbert space. Let C be a non-empty commuting family of non-expansive mappings of B into B. Let F be the (non-empty) set of all common fixed points over C. Then F contains all exposed points of B iff $C \equiv \{I_B\}$. Problems. Determine N & S conditions on C so that F contains at least one (but not all) exposed points of S (or B). The extremal structure of various sets of common fixed points is discussed informally. (Received April 13, 1977.)

77T-B142 Roger D. Nussbaum, Rutgers University, New Brunswick, New Jersey 08903.
Differential-delay equations with two time lags. Preliminary report.

Let $f: R \to R$ be a continuous, monotonic increasing map with $f(0) = 0$; define $-b = \lim_{x\to-\infty} f(x)$, $a = \lim_{x\to\infty} f(x)$ and assume $b < \infty$. For $\alpha,\beta \geq 0$ and $1 \leq \gamma \leq 2$ consider (*) $x'(t) = -\alpha f(x(t-1)) - \beta f(x(t-\gamma))$. Theorem. For each $\varepsilon > 0$, $a_1 < a$ and $b_1 < b$ there exists a bounded set $S = S(\varepsilon,a_1,b_1,f)$ in R^2 (whose size can be explicitly estimated) such that for $(\alpha,\beta) \notin S$ (*) has a periodic solution x such that (1) $x(t) > 0$ on an interval $(0,z_1)$ with $z_1 \geq 1$ and $f(x(t)) \geq a_1$ on $(\varepsilon,z_1-\varepsilon)$, (2) $x(t) < 0$ on (z_1,z_1+z_2) with $z_2 \geq 1$ and $f(x(t)) \leq -b_1$ on $(z_1+\varepsilon,z_k+z_2-\varepsilon)$ and (3) $x(t+z_1+z_2) = x(t)$ for all t. For certain f the theorem can be combined with other arguments to obtain "sharp" results about existence of "slowly oscillating" periodic solutions, the precise range of their periods as α and β vary, and the existence of "rapidly oscillating" periodic solutions. (Received April 21, 1977.)

77T-B143 MARIO MILMAN, Universidad de Los Andes, Merida, Venezuela. Embeddings of L(p,q) spaces and Orlicz spaces with mixed norms. Preliminary report.

Let $X(0,\infty)$, $Y(0,\infty)$ be Banach function spaces of Lebesgue measurable functions. Denote by $X(Y)(0,\infty)^2$ the Banach function space determined by the norm $\| \| f(x_2-)\|_Y \|_X$, we consider the problem of embedding $X(Y)$ into another Banach function space $Z(0,\infty)^2$.

Theorem 1. (i) $L(p,q_1)(L(p,q_2)) \subset L(p,\infty)(0,\infty)^2$ if and only if $q_1 \le p$. (ii) If $q_3<\infty$, then $L(p,q_1)(L(p,q_2) \subset L(p,q_3)(0,\infty)^2$ if and only if $\max(q_1,q_2) \le p \le q_3$.

Theorem 2. The following statements are equivalent: (i) $L_A(L_B) \subset L_C(0,\infty)^2$; (ii) $L_A(M(L_B)) \subset M(L_C)(0,\infty)^2$; (iii) $K_A(M(L_B)) \subset M(L_C)(0,\infty)^2$; (iv) There exists a positive constant Q such that $A^{-1}(t)B^{-1}(s) \le Q\, C^{-1}(ts)$

These results should be compared with those obtained by R. O'Neil (Journal D'Analyse Math. 1968) for projective tensor products of these spaces. (Received May 9, 1977.)

77T-B144 James C. S. Wong, University of Calgary, Calgary, Alberta T2N 1N4. On topological analogue of left thick subsets in semigroups.

Let S be a semigroup and $T \subset S$, T is left thick if for any finite $F \subset S$, $Fs \subset T$ for some s in S. In 1965, T. Mitchell proved that if S is left amanable, then T is left thick iff $m(\chi_T) = 1$ for some left invariant mean m. Here χ_T is the characteristic function of T. He also showed that if T is a left thick subsemigroup of S, then T is left amanable iff S is. Using a single topological analogue of left thickness, we extend both of Mitchell's result to locally compact semigroups. The cases of uniform strong topological left amenability and pointwise strong left amenability are also considered. This work improves and complements previous results by this author and M. Day in Pacific Journal of Mathematics, Vol 62(1976) pp. 295-303 and pp. 87-92. (Received June 2, 1977.)

77T-B145 Mike Dombroski, 1217 N.Havenhurst Dr.#17, Los Angeles, Ca. 90046 Finite Analogues of Trigonometric Functions.

In this paper two sets of polynomials are studied:

PP) ($C_n(x)=\sum_{m=0}(-1)^m\binom{n}{2m}x^{2m}$, $S_n(x)=\sum_{m=0}(-1)^m\binom{n}{2m+1}x^{2m+1}$)

CP) ($\mathcal{C}_n(y)=\sum_{m=0}(-1)^m\binom{n+m}{2m}y^{2m}$, $\mathcal{S}_n(y)=\sum_{m=0}(-1)^m\binom{n+m}{2m+1}y^{2m+1}$)

where n is real. Both sets are shown to be analogues of cosine, sine respectively. The PP, generated by $(1+ix)^n$, become exact analogues when normalized by $(1+x^2)^{\frac{n}{2}}$. The roots of the PP: $x_m(n)=\tan\frac{m\pi}{2n}$, and those of the CP: $(2\sin\frac{(2m-1)\pi}{4n+2}$, $2\sin\frac{m\pi}{2n})$ yield groups of symmetric sum identities. With variable n, the PP wavelength of $\lambda(x)=2\pi/\tan^{-1}x$, and the CP wavelength of $\lambda(y)=\pi/\sin^{-1}(y/2)$, give minimum values, (λ_0). The phases within each set are shown to be linked. The differential equations, curve characteristics, orthogonality properties and trigonometric correspondence are also discussed. (Received June 9, 1977.)(Author introduced by Bruce Rothschild.)

77T-B146 MIGUEL DE GUZMAN, Universidad de Madrid, Madrid 3. A method for the study of convolution operators. Preliminary report.

The main idea of the paper consists in reducing the study of convolution operators in R^n to the study of their action on sums or linear combinations of Dirac deltas concentrated on a finite number of points. For example, let $\{k_j\} \subset L^1(R^n)$ be a sequence of kernels and consider the operators K_j on L^1 defined by $K_jf = k_j * f$. Let $K^*f(x) = \sup|k_j * f(x)|$. Then K^* is of weak type (1,1) if and only if K^* is of weak type (1,1) over distributions of the form $f = \sum_{h=1}^{n} \delta_{a_h}$. Theorems of this type make the study of the Hilbert transform, the Calderón-Zygmund operators, the Hardy-Littlewood maximal operator, the sums of Fourier series, etc. much more transparent and easy. (Received June 3, 1977.)

*77T-B147 A. VERMA and C.M. JOSHI, University of Roorkee, Roorkee, India. Some remarks on a paper by M. E. Cohen

Two pairs of Lagrange expansion formulae have been used by Cohen (SIAM J.Math. Anal.7(1976),702-712)in obtaining a number of general expansion theorems. It is pointed out that the pair of Lagrange expansions used by Cohen are not only special cases of a result of Gould and one of the pairs contains the other, but the expansions in each pair are equivalent to each other. The above observation leads us to conclude that a number of Cohen's theorems are either equivalent to each other or one implies the other. It is also shown that all the expansion theorems of Cohen form part of just two general expansion formulae. (Received June 6, 1977)

*77T-B148 Gary D. Faulkner and J. E. Huneycutt, Jr., North Carolina State University, Raleigh, North Carolina 27607. Translation Invarient Vector Measures.

Let E be a normed linear space, G a compact group, and M(G,E) the collection of all E-valued measures defined on the Borel sets in G having finite variation. The authors have proven the following: Proposition: If $\mu \in M(G,E)$ is translation invarient then there exists an element $x \in E$ so that $\mu(A) = m(A) \cdot x$ where m is the Haar measure on G. (Received June 6, 1977.)

77T-B149 Kenneth R. Wadland, University of New Hampshire, Durham, New Hampshire 03824 Double Commutants of $C_{.0}$ Contractions.

Let $T = S(\theta)$ be a $C_{.0}$ contraction on the separable Hilbert Space, H. Let A be an operator in the double commutant of T. Theorem 1 If T has at least one finite defect index, then $A = \psi(T)$, for some $\psi \in H^{\infty}$. This result was recently proven for the case of both defect indices finite by Uchiyama.

Theorem 2 If $T \in C_0$ and K is invariant under T, then K is also invariant under A. For the case of finite defect indices, this result was proven by P. Y. Wu. (Acta. Sci. Math., 38(1976), 193-202) (Received June 6, 1977.)

*77T-B150 ROBERT C. JAMES, Claremont Graduate School, Claremont, California 91711. Nonreflexive Banach spaces of type 2.

It is known that a Banach space is Euclidean if it is of type 2 and cotype 2, but Davis and Lindenstrauss showed that the nonreflexive and uniformly nonoctahedral spaces X_ρ are of type p if $p < 2$ and ρ is sufficiently large. It is shown that X_ρ is of type 2 if $\rho > 2$. (Received June 8, 1977.)

*77T-B151 KENNETH R. DAVIDSON, M.I.T., Cambridge, MA. 02139. Commutative Subspace Lattices

If A is an operator algebra, let Lat A denote the projections onto its invariant subspaces. Let Lat πA denote the projections in the Calkin algebra invariant for the quoitent algebra πA.
Theorem 1. If A is reflexive and Lat A is commutative, then Lat $\pi A = \pi$ Lat A.
Further, we give an elementary proof of a theorem of Arveson:
Theorem 2. Commutative (strongly closed) subspace lattices are reflexive.
(Received June 8, 1977.)

*77T-B152 Stuart P. Lloyd, Bell Laboratories, Murray Hill NJ 07974, and Charles W. Neville, Central Connecticut State College, New Britain, CT 06050. $F_\aleph$-Spaces.

Completely regular Hausdorff S is an $F_\aleph$-space if any two disjoint sets, each the union of $\leq \aleph$ cozero sets, are contained in disjoint zero sets. Real lattice C(S) has $\aleph$-mediants provided: if $\mathcal{U}, \mathcal{V} \subset C(S)$ satisfy $0 < |\mathcal{U}| \cdot |\mathcal{V}| \leq \aleph$ and also $u \leq v$, $u \in \mathcal{U}$, $v \in \mathcal{V}$, then there exists mediant $w \in C(S)$ such that $u \leq w \leq v$, $u \in \mathcal{U}$, $v \in \mathcal{V}$. Theorem 1. Completely regular Hausdorff S is an $F_\aleph$-space iff βS is an $F_\aleph$-space iff real C(S) has $\aleph$-mediants. The $\aleph$-injectives in the category $\underline{\underline{ban_1}}$ of linear contractions of real Banach spaces are defined in [C. W. Neville, Pacific J. Math. 63, 201-212 (1976).] Theorem 2. For compact Hausdorff X, C(X) is $\aleph$-injective in $\underline{\underline{ban_1}}$ iff X is an $F_\aleph$-space. Thus there exist $\aleph_0$-injective C(X) for which X is connected, e.g., $X = \beta\mathbb{R}^+ - \mathbb{R}^+$.

(Received June 6, 1977.)

*77T-B153 Charles W. Neville, Central Connecticut State College, New Britain, CT 06050 and Stuart P. Lloyd, Bell Laboratories, Murray Hill NJ 07974. $\aleph$-Projective Spaces.

In the category $\underline{\underline{cmp}}$ of continuous maps of compact Hausdorff spaces, object X is weakly [strongly] $\aleph$-projective if every morphism pair ϕ: $X \to Z$ and epic f: $Y \to Z$ such that $wt(Y) \leq \aleph$ [$wt(Z) \leq \aleph$] admits a lifting ψ: $X \to Y$ of ϕ over f, i.e., $\phi = f \circ \psi$. Theorem 1. X is weakly $\aleph$-projective in $\underline{\underline{cmp}}$ iff any two disjoint unions of $\leq \aleph$ cozero sets are contained in disjoint clopen sets (i.e., iff X is a totally disconnected $F_\aleph$-space.) Theorem 2. If X is weakly $\aleph$-projective in $\underline{\underline{cmp}}$ and $2^\aleph = \aleph^+ (GCH_\aleph)$ then X is strongly $\aleph$-projective in $\underline{\underline{cmp}}$. Theorem 3. (Without GCH.) The space $U(\aleph') \subset \beta(\aleph') - \aleph'$ of uniform ultrafilters of cardinal $\aleph'$ is $\aleph$-projective in $\underline{\underline{cmp}}$ for $\aleph = cf(\aleph')$. For example, $\beta N - N$ is strongly $\aleph_0$-projective in $\underline{\underline{cmp}}$, although it is not basically disconnected.

(Received June 6, 1977.)

*77T-B154 Bernd Eifrig, University of Oldenburg, Ammerländer Heerstrasse, 2900 Oldenburg, West Germany. Atoms of time and extensive physical quantities. Preliminary report.

Using terminology of [1] we get for two complex B-spaces X, Y: Theorem a) Let $f : X \to Y$ be analytic with $(*)$ $f(x + \mu(0)) = f(x) + \mu(0)$, $x \in {}^*X$, then f is linear; b) for real spaces a corresponding result holds. Following Carnap, let G_1, G_2 be topological (semi)-groups. $f : G_1 \to G_2$, continuous, is called extensive physical quantity, iff $f(g \circ \mu(\omega)) = f(g) \circ \mu(e))$, $g \in {}^*G_1$. If $\mathbb{R} = G_1 = G_2$ f is linear, non-degenerate in case of b). Identification with time gives time atoms $a \cdot \mu(0)$, ordered in the Reichenbach-order and each one has an order which can be identified with past, present and future. In the case of quantum-physics a unitary representation $\mathcal{U}_g : \mathcal{H} \to \mathcal{H}$, of a group G is considered. $f(\mu(e) \circ g) = \mathcal{U}_{\mu(e)} f(g)$, $f : \mathcal{H} \to \mathcal{H}$ singles out extensive physical quantities.

[1] A. Robinson, Non-Standard-Analysis, 1967, Amsterdam (Received June 14, 1977.)

*77T-B155 C. J. Mozzochi, Box 1315, Hartford, Connecticut 06101. A guide to the literature on the classical Hilbert transform.

This document (available upon request) is a supplement to my monograph: On the Pointwise Convergence of Fourier Series, Lecture Note 199 Springer-Verlag, 1971. (Received June 14, 1977.)

*77T-B156 B. E. Rhoades, Indiana University, Bloomington, Indiana 47401. A general fixed point theorem.

Let f be a continuous compact self-mapping of a metric space (X,d) satisfying: for each $x,y \in X$, $x \neq y$, there exist integers $p = p(x,y)$, $q = q(x,y)$, such that $d(f^p x, f^q y) < \max\{d(x,y), d(x,f^p x), d(y,f^q y), d(x,f^q y). d(y.f^p x)\}$. Then f has a unique fixed point. Moreover, it is possible to remetrize X so that f is a Banach contraction with respect to this new metric. A similar result is obtained for condensing mappings. This work generalizes that of L. Janos [Proc. Amer. Math. Soc. 61(1976), 171-175]. (Received June 15, 1977.)

77T-B157 JAMES WARD BROWN, 1710 Morton Avenue, Ann Arbor, Michigan 48104. A new generating function for Laguerre polynomials. Preliminary report.

We derive here the generating function given below:

$$\sum_{n=0}^{\infty} \frac{(\beta+\gamma n)^n}{(1+\alpha)_n} L_n^{(\alpha)}\left(\frac{x}{\beta+\gamma n}\right) t^n = \frac{\exp[\beta u(t)]}{1-\gamma u(t)}\, {}_0F_1\left[\frac{\quad}{1+\alpha};\, -xu(t)\right]$$

where $u(t) = t + \sum_{n=2}^{\infty} \frac{(\gamma n)^{n-1}}{n!} t^n$. If $\beta = 1$, $\gamma = 0$, then $u(t) = t$ and we have the well-known generating function $\sum_{n=0}^{\infty} \frac{1}{(1+\alpha)_n} L_n^{(\alpha)}(x)\, t^n = e^t\, {}_0F_1\left[\frac{\quad}{1+\alpha};\, -xt\right]$.
(Received July 15, 1977.)

*77T-B158 STEPHEN GROSSBERG, Boston University, Boston, Massachusetts 02215. Decisions, Patterns, and Oscillations in Nonlinear Competitive Systems with Applications to Volterra-Lotka Systems. Preliminary report.

This paper proves global limit and oscillation theorems for n-dimensional nonlinear competitive systems $\dot{x}_i = a_i(x)M_i(x)$, where $x = (x_1, x_2, \ldots, x_n)$, $\partial M_i/\partial x_j \leq 0$ if $i \neq j$, and $a_i(x)$ keeps $x_i > 0$, $i = 1,2,\ldots,n$. The theorems explicate as a method a main question about competitive systems: who is winning the competition? This is done using functions $M^+(x) = \max_k M_k(x)$ and $M^-(x) = \min_k M_k(x)$. For example, all competitive systems have the property of positive ignition: if $M^+(x(T)) \geq 0$ then $M^+(x(t)) \geq 0$ for $t \geq T$. To track who is winning at any time, positive jumps (or decisions) are defined: the system jumps from i to j at $t = T$ if there exist S and U, $S < T < U$, such that $M^+(x(t)) = M_i(x(t))$, $S \leq t < T$, and $M^+(x(t)) = M_j(x(t))$, $T \leq t < U$. Given $x(0)$, the jumps induce a directed jump diagram that replaces the continuous parallel system with a discrete serial system. Typical results: Finitely many jumps imply $\int_0^\infty M^+(x(t))dt < \infty$, which implies $x(\infty)$ exists. Thus if no directed jump cycle exists, then $x(\infty)$ exists given any $x(0) > 0$. No directed jump cycle occurs in the V-L system $\dot{x}_i = a_i(x)[1 - \sum_{k=1}^{n} B_{ik} f_k(x_k)]$ if for $i < j$, $B_{ik} \geq B_{jk}$ for $k \neq i,j$. Oscillation theorems follow from the fact that $\int_0^\infty M^+(x(t))dt = \infty$ implies infinitely many jumps occur, by constraining the ignition surface and jump sets to translate jumps into oscillations. Parametric excitations of system coefficients can yield complex changes in the jump structure as $t \to \infty$. (Received June 21, 1977.)

*77T-B159 MAHMOUD HAIFAWI, Department of Mathematics Middle East Technical Univ., Ankara- Turkey. Complementation Property in Non-archimedean Normed Spaces.

Let K be a non-archimedean valued field which is maximally complete. Let E be an infinite dimensional non-archimedean (n.a) Banach space in the n.a. mathematical model M. Let $^*E$ be its enlargement in $^*M$. It is known [Notices Feb. 1977] that $^*E$ is

spherically complete. Aside from known results for the complementation property (C.P.) in this setting we show: Theorem 1. If F is an infinite dimensional n.a. Banach space over K and is isomorphic to a complemented subspace of $\tilde{E}$, then F is complemented in F". Theorem 2. If E is spherically complete space, then every closed subspace F of E is complemented in F". Theorem 3. E has the complementation property iff E is a complemented subspace of E". Note that if E has the C.P., then no subspace of E is isomorphic to c_0. Observe here the basic difference between Archimedean and non-archimedean spaces. (Received October 27, 1977.)

77T-B160 Valerian Nita, Wayne State University, Detroit, Michigan 48202.
Meromorphic Functions Whose Global Cluster Sets Contain Regular Points. Preliminary report.

If K is a continuum on the Riemann sphere, a point p of K will be called a regular point provided that there exists a neighborhood of p of arbitrarily small diameter whose boundary intersects K in only a finite number of points. A theorem can now be proved which states that any regular point of the global cluster set of a meromorphic function is also a degenerate cluster set at a point of the boundary of the unit disc. If by a regular curve we mean a continuum each of whose points is a regular point, then it follows that if the global cluster set of a meromorphic function is a regular curve, then the function has a continuous extension to the closure of the unit disc. This last result is the strongest possible in the sense that "regular curve" cannot be replaced by a more general continuum. (Received June 27, 1977.)

*77T-B161 PEI YUAN WU, National Chiao Tung University, Hsinchu, Taiwan, Rep. of China
The hyperinvariant subspace lattice of the contraction of class $C_{\cdot 0}$.

It is shown that if T is a $C_{\cdot 0}$ contraction with finite defect indices, then Hyperlat T is (lattice) generated by those subspaces which are either ker $\psi(T)$ or $\overline{\text{ran } \xi(T)}$, where ψ and ξ are scalar-valued inner functions. This generalizes the recent result that if T is a linear transformation on a finite-dimensional space, then Hyperlat T is generated by subspaces either ker p(T) or ran q(T), where p and q are polynomials. (due to Fillmore, Herrero and Longstaff) (Received June 27, 1977.)

*77T-B162 T. W. MA, University of Western Australia, Nedlands, W.A. 6009, Australia. Total derivatives in locally convex spaces. Preliminary report.

Let E, F be separated locally convex spaces, L(E, F) the space of all continuous linear maps, and f a map on an open subset X of E into F. Then f is differentiable at $a \in X$ if $\exists$ Df(a) in L(E, F) s.t. $f(x) = f(a) + Df(a)(x - a) + S(x)(x - a)$ $\forall$ x in some neighbourhood Q of $a \in X$, where $\{S(x) : x \in Q\}$ is an equicontinuous set in L(E, F) and $x \to a$ implies $S(x) \to 0$ in L(E, F) w.r.t. the topology of bounded sets. The total derivative Df(a) is equivalent to Frechet derivatives when E, F are normed spaces. The total derivative is unique if it exists. The usual chain rule holds. Lipschitz Condition. If f is differentiable at $a \in X$ then $\exists$ an equicontinuous set H of L(E, F) s.t. $f(x) - f(a) \in H(x - a)$ holds $\forall$ x in certain neighbourhood of a and, consequently, f is continuous at a. Now let f be differentiable on X. Suppose a, b are in X s.t. the line segment [a, b] is contained in X. Mean-Value Theorem. If H is the convex hull of $\{Df(z) : z \in [a, b]\}$ then $f(b) - f(a) \in cl[H(b - a)]$ and $f(b) - f(a) - Df(x_0)(b - a) \in cl[K(b - a)]$, where x_0 is an arbitrary point of X and K is the convex hull of $\{Df(z) - Df(x_0) : z \in [a, b]\}$. Consequently, differentiable maps with vanishing total derivatives must be locally constant. Special feature. The formulation is completely independent of seminorms as in Russian Math. Surveys 23(1968), 67-113. This project was abandoned by author. Welcome to take over. (Received June 14, 1977.)

*77T-B163 GARY SAMPSON, State University of New York at Buffalo, Buffalo, New York 14214. Weak (1,1) estimates of singular convolutions and fourier transforms.

In this paper we discuss convolutions on $\mathbb{R}$. We show that a class of singular kernels map $L^p(\mathbb{R})$ into $L^p(\mathbb{R})$ weakly for all $1 \le p < \infty$. And we construct a kernel k (from the above class) which has the following properties: (i) $k(t) = 0$ for $t < 0$, (ii) $k \in L^p$ for all $1 < p \le \infty$, (iii) $\hat{k}(x)$ exists in the pointwise sense for each x, (iv) $\hat{k} \in L^\infty$,

(v) $\sup_{\rho_1, \rho_2, x} \left| \int_{\rho_1 < |t| < \rho_2} k(t)e^{-itx}dt \right| = \infty$, (vi) $\sup_{y \neq 0} \int_{|t| \ge 2|y|} |k(t) - k(t-y)|dt = \infty$,

(vii) $\sup_{\rho > 0} \int_{\rho < |t| < 2\rho} |k(t)|dt = \infty$, and (viii) k maps L^p into L^p weakly for all $1 \le p < \infty$.

(Received July 8, 1977.)

*77T-B164 Simeon Ivanov, University of Illinois, Urbana, Illionis 61801. Holomorphic relative inverses.

Let G be a domain in the complex plane, X and Y Banach spaces, $L(X,Y)$ the space of all bounded linear operators from X to Y, $\Phi_+^r(X,Y)$ and $\Phi_-^r(X,Y)$ the subsets of all projective semi-Fredholm operators of the first and of the second kind, respectively. Theorem. Let $A: G \to L(X,Y)$ be holomorphic and relatively invertible at each $\lambda \in G$. The following statements are equivalent: (1) A has a holomorphic relative inverse on G; (2) The function $\lambda \to \operatorname{Ker} A(\lambda)$ is locally holomorphic on G; (3) The function $\lambda \to \operatorname{Im} A(\lambda)$ is locally holomorphic on G. Theorem. Let $A: G \to \Phi_+^r(X,Y)$ [respectively, $\Phi_-^r(X,Y)$] be holomorphic. Then A has a holomorphic relative inverse on G if and only if $\dim \operatorname{Ker} A(\lambda)$ is constant [respectively, $\operatorname{codim} \operatorname{Im} A(\lambda)$ is constant].

We use the same basic definitions as in H. Bart, Math. Ann. 208 (1974), 179-194. (Received July 5, 1977.) (Author introduced by Professor R. G. Bartle).

77T-B165 Athanasios Tsarpalias, Athens University, Panepistemiopolis, Athens 621, Greece. *A combinatorial theorem with applications in set-theory and functional analysis.* Preliminary report.

Let α be an infinite cardinal, $\varkappa$ a cardinal, $\varkappa < \alpha$, and denote by $\mathcal{P}(\alpha)$ the power set of α. *Theorem.* Let $\varphi: p(\alpha) \to p(\alpha)$ be a function such that: (a) $A \subset B \subset \alpha \Rightarrow \varphi(A) \supset \varphi(B)$; (b) $\varphi(A \cup B) = \varphi(A) \cap \varphi(B)$ for $A, B \in p(\alpha)$; and (c) for any family $\{A_\xi : \xi < \varkappa\}$ of pairwise-disjoint subsets of α we have $\alpha = \bigcup_{\xi < \varkappa} \varphi(A_\xi)$. Then there is $\Gamma \subset \alpha$, such that $|\Gamma| = \alpha$, and $\xi \in \varphi(\Gamma \setminus \{\xi\})$ for all $\xi \in \Gamma$. *Corollary* 1. Let $\{\mu_{\xi,i} : \xi < \alpha, i < \varkappa\}$ be a family of finitely additive positive measures on $p(\alpha)$, with $\sup\{\mu_{\xi,i}(\alpha) : \xi < \alpha, i < \varkappa\} < \infty$, and $|\{i < \varkappa : \mu_{\xi,i} \neq 0\}| < \varkappa$ for all $\xi < \alpha$. Then, for every $\varepsilon > 0$, there is $\Gamma \subset \alpha$ such that $|\Gamma| = \alpha$, and $\mu_{\xi,i}(\Gamma \setminus \{\xi\}) < \varepsilon$ for all $\xi \in \Gamma$ and $i < \varkappa$. *Note.* Corollary 1 is a *uniform* extension of H. Rosenthal's result (Lemma 1.1, Studia Math. 37(1970) 13-36) to a $\varkappa$-indexed family of families of measures. *Corollary* 2. Let $\{\mu_\xi : \xi < \alpha\}$ be a family of finitely additive positive measures on $p(\alpha)$, such that $\sup\{\mu_\xi(\alpha) : \xi < \alpha\} < \infty$, and $A_\xi \in \mathcal{P}(\alpha)$, $|A_\xi| < \varkappa$ for $\xi < \alpha$. Then for every $\varepsilon > 0$ there is $\Gamma \subset \alpha$, $|\Gamma| = \alpha$, such that $\mu_\xi(\Gamma \setminus \{\xi\}) < \varepsilon$ for all $\zeta \in A_\xi$ and $\xi \in \Gamma$. *Corollary 3.* Let $\{p_\xi : \xi < \alpha\}$ be a family of ultrafilters on α, and $A_\xi \in \mathcal{P}(\alpha)$, $|A_\xi| < \varkappa$ for $\xi < \alpha$. Then there is $\Gamma \subset \alpha$, $|\Gamma| = \alpha$, such that $\Gamma \setminus \{\xi\} \notin p_\xi$ for all $\zeta \in A_\xi$ and $\xi \in \Gamma$. *Special case* of Corollary 3 (for p_ξ = the principal ultrafilter generated by $\{\zeta\}$) is the theorem of Hajnal (Fund. Math. 50(1961), 123-128) [which is also a direct consequence of our main theorem]. Various *applications* of these results (especially of Corollary 1) to Banach space theory, including generalizations of results by H. Rosenthal, and others, will be given in a subsequent abstract. (Received July 11, 1977.) (Author introduced by Professor S. Negrepontis).

*77T-B166 S. Argyros and S. Negrepontis, Athens University, Panepistimiopolis, Athens 621, Greece. *Isomorphic Embedding of $\ell^1(\Gamma)$.*

For a compact space X, set $w(X)$ its topological weight, and $\Delta w(X)$ = least cardinal α for which there are a family $\{X_i : i \in I\}$ of compact spaces with $w(X_i) < \alpha$ for $i \in I$ and a continuous function from $\Pi_{i \in I} X_i$ onto X. For a cardinal α, $\ell^1(\alpha)$ denotes the Banach space of all $f: \alpha \longrightarrow \mathbb{R}$ (or, $\mathbb{C}$) with $\Sigma_{\gamma \in \alpha} |f(\gamma)| < \infty$. A cardinal α is κ- *inaccessible* if for $\beta < \alpha$, and $\lambda < \kappa$ we have $\beta^\lambda < \alpha$. *Theorem A.* Let X be a compact space, α cardinal with $cf(\alpha) > \omega$, $\Delta w(X) \le cf(\alpha)$, and let Z be a closed subspace of the real (or complex) Banach space $C(X)$ with $\dim Z \ge \alpha$. Then (i) $\ell^1(\alpha)$ embeds isomorphically into Z; and (ii) the dyadic space $\{0,1\}^\alpha$ is homeomorphic to a compact subset of X. (cf. J. Hagler, Transactions Amer.

Math. Soc. 214 (1975), 415-427). *Theorem B.* Let μ be a σ- finite measure and Z a closed subspace of the (real or complex) Banach space $L^\infty(\mu)$. Let α be a cardinal such that both α and $cf(\alpha)$ are ω^+- inaccessible, and $\dim Z \geq \alpha$. Then $\ell^1(\alpha)$ embeds isomorphically into Z.

The proofs use (among other things) a generalized version to singular cardinals of the combinatorial theorem of Erdös-Rado on quasi-disjoint sets. These results were announced (by S.N.) on August 26, 1976 at the Fourth Symposium on General Topology and its Relations to Modern Algebra, Prague. (Received July 11, 1977.)

77T-H167 S. Argyros, Athens University, Panepistimiopolis, Athens 621, Greece. *Applications of isomorphic embeddings of $\ell^1(\Gamma)$.*

We use the notation of previous abstract. All our results use Theorem B, of previous abstract. *Theorem C.* Let μ be a σ- finite measure space, and Z a Banach space such that $L^1(\mu)$ embeds isomorphically into its dual Z^*. Let α be a cardinal such that $\alpha \leq \dim L^1(\mu)$ with α, $cf(\alpha)$ are ω^+- inaccessible. Then $\ell^1(\alpha)$ embeds isomorphically into Z. (This answers partially, i.e. for certain classes of cardinals, a conjecture of Pelczynski (Studia Mathematica 30 (1968), 231-246)). *Theorem D.* Let Z be isomorphic to a dual space and to a complementary subspace of $L^1(\lambda)$, for some (arbitrary) measure λ such that, setting $\alpha = \dim Z$, we have that $cf(\alpha) > \omega$, and α is ω^+- inaccessible. Then $\ell^1(\alpha)$ embeds isomorphically as a complementary subspace of Z. (This answers partially, i.e. for certain classes of cardinals, a conjecture of H. Rosenthal (Acta Mathematica 124 (1970), 205-248; p. 217)). A companion result is the following. *Theorem E.* Let $L^1(\lambda)$ be isomorphic to a dual space, for some (arbitrary) measure λ, and $\dim L^1(\lambda) = \alpha$. Then $\ell^1(\alpha)$ embeds isomorphically as a complementary subspace of $L^1(\lambda)$. *Corollary F.* Let Z be a Banach space such that either (a) Z^* is a complemented subspace of $L^1(\lambda)$ and $\dim Z^* = \alpha$ with $cf(\alpha) > \omega$ and α is ω^+- inaccessible or (b) Z^* is isomorphic to $L^1(\lambda)$ and $\dim Z^* = \alpha$. (e.g. $Z = C(\Omega)$ where Ω is compact); then Z^{**} is isomorphic to $\ell^\infty(\alpha)$. (Received July 11, 1977.) (Author introduced by Professor S. Negrepontis).

77T-H168 Andrew F. Acker, Mathematisches Institut I, Universität Karlsruhe, 75 Karlsruhe 1, Fed. Rep. of Germany. A free boundary optimization problem involving weighted areas.

The capacitance K of a simply-connected region $\Omega \subset [0,1] \times R$ (bounded relative to $[0,1] \times R$ by disjoint Jordan arcs Γ^* (below) and Γ (above)) is defined by $K = \int_\gamma |\nabla U(p)| \cdot |dp|$, where $U(p)$ is harmonic on Ω and satisfies $U=1$ on Γ^*, $U=0$ on Γ, $D_x U = 0$ on $\Omega \cap (\{0,1\} \times R)$, and γ is an equipotential curve of U. $S \supset \Gamma$ and $S^* \supset \Gamma^*$ are the components of $([0,1] \times R) \setminus \Omega$. $\bar{S}, \bar{K}, \Gamma_c, K_c, \tilde{S}$, etc. refer to regions $\bar{\Omega}, \Omega_c, \tilde{\Omega}$ with the same properties. For functions $a(p) > 0$, $a^*(p) > 0$ continuous on $[0,1] \times R$, we define $[\Omega, \bar{\Omega}] = |\bar{S} \setminus S| + |\bar{S}^* \setminus S^*|^* - |S \setminus \bar{S}| - |S^* \setminus \bar{S}^*|^*$, where $|M| = \int_M a^2(p)\,dxdy$ and $|M|^* = \int_M (a^*(p))^2\,dxdy$, $M \subset [0,1] \times R$ measurable. Theorem: Assume constants $B, N > 0$ exist such that $a(\frac{1}{2}, B) > a^*(\frac{1}{2}, B)$, $a(\frac{1}{2}, -B) < a^*(\frac{1}{2}, -B)$, and $a(x',y') \geq a(x,y)$ and $a^*(x',y') \leq a^*(x,y)$ for all $(x,y), (x',y') \in [0,1] \times R$ satisfying $y' - y \geq N \cdot |x' - x|$. If $A(y) := \int_0^1 a(x,y)\,dx$ is strictly increasing on R, then: (a) For each $c > 0$ $\exists$ a unique region in the form $\Omega_c = \{(x,y) : y_c^*(x) < y < y_c(x), 0 \leq x \leq 1\}$ ($y_c^*(x) < y_c(x)$ continuous) such that $|\nabla U_c(p)| = c \cdot a(p)$ on Γ_c and $|\nabla U_c(p)| = c \cdot a^*(p)$ on Γ_c^*. (b) For any region $\tilde{\Omega}$ there is a $\tilde{c} > 0$ such that $[\Omega_{\tilde{c}}, \tilde{\Omega}] = 0$. For any region $\tilde{\Omega} \neq \Omega_{\tilde{c}}$ satisfying $[\bar{\Omega}, \tilde{\Omega}] \leq 0$, we have $\bar{K} > K_{\tilde{c}}$. Thus $\Omega_{\tilde{c}}$ is uniquely capacitance minimizing in the class of all regions $\tilde{\Omega}$ satisfying $[\bar{\Omega}, \tilde{\Omega}] \leq 0$. Also, given $\tilde{\Omega}$ and $c > 0$, Ω_c uniquely minimizes $[\bar{\Omega}, \tilde{\Omega}]$ among all $\bar{\Omega}$ conformally equivalent to Ω_c. (Received July 19, 1977.)

77T-B169 Robert D. M. Accola, Brown University, Providence, Rhode Island 02912. On generalized Weierstrass points on Riemann surfaces. Preliminary Report.

For G a divisor on a Riemann surface W of genus p, $p \geq 2$, let $|G| = g^R_N$ be without fixed points with index i. Let $|K| = g^{p-1}_{2p-2}$. For $z \in W$ consider the $R+1$ integers n_j (nongaps) so that $G \equiv n_j z + F_j$ where z is not a fixed point of $|F_j|$. Def: $w(G,z) = \sum_{j=0}^{R} (n_j - j)$. Theorem 1: $w(G,z) \leq (p-i)(p-i+1)/2$. Theorem 2: If $w(K,z) = 0$ and $|G|$ is not special then $w(G,z) \leq [(p+1)^2/4]$. Equality in either theorem implies the surface is hyperelliptic. Theorem 3: If $G = Nz$ or $G = Nz + K$ and G is not special then $w(G,z) = p + w(K,z)$. Theorem 4: If $mK \equiv m(2p-2)z$, $\ell = 1,2,\ldots$ and $k = 2,3,\ldots,m-1$, then $w(kK,z) = w((\ell m + k)K,z) = w((\ell m - k + 1)K,z)$. Theorem 5: Let T be an automor-

phism of prime order n with s fixed points, z, $s \geq 3$. Suppose that $n - k < (n-1)(s-2)/2(s-1)$ and $\ell = 1,2,\ldots$. Then $w((\ell n + k)K, z) > 0$. The proof of Theorem 1 depends on Riemann-Roch's and Clifford's theorems. All the proofs use classical techniques. (Received July 25, 1977.)

*77T-B170 H. GUGGENHEIMER, Polytechnic Institute of New York, Brooklyn NY 11201. Nonoscillation of Certain Fourth Order Linear Differential Equations.

$4r + 2q' - p^2 = 0$ is a condition of nonoscillation for $y^{iv} + py'' + qy' + ry = 0$. (Received July 26, 1977.)

*77T-B171 ETHELBERT N. CHUKWU, Cleveland State University, Cleveland, Ohio 44115. On the Boundedness of Ordinary and Hereditary Systems of Lurie Type.

When the uncontrolled systems are assumed to be uniform bounded and uniform ultimate bounded and when $\int_0^\sigma f(s)ds \to \infty$ as $|\sigma| \to \infty$, $f(0) = 0$, and $\sigma f(\sigma) > 0$, if $\sigma \neq 0$, conditions are obtained for the uniform boundedness of nonlinear ordinary differential systems and hereditary systems of Lurie type described by the equations: $\dot{x} = A(t,x) + bf(\sigma)$, $\dot{\sigma} = B(t,x) - rf(\sigma)$; $\dot{x} = F(t,x_t) + bf(\sigma)$, $\dot{\sigma} = E(t,x_t) - rf(\sigma)$; $\frac{d}{dt}(D(t)x_t) = F(t,x_t) + bf(\sigma)$, $\dot{\sigma} = G(t,D(t)x_t) - rf(\sigma)$. (Received July 25, 1977.)

77T-B172 G.H. FRICKE, Wright State University, Dayton, Ohio 45431 and S.M. SHAH, University of Kentucky, Lexington, Kentucky 40506. Inequalities for entire functions of bounded index.

We improve the growth inequality for a subclass of functions of bounded index (b.i.). Let $g(z) = \sum_{n=1}^{\infty} a_n z^{\lambda_n}$ where $a_n = \exp(i\alpha_n)/d_1 d_2 \ldots d(\lambda_n)$, $d_n = d(n) \sim$ an $(0 < a < \infty)$, $\alpha_n \in R$, and $\{\lambda_n\}$ is a strictly increasing sequence of positive integers such that $\frac{\lambda_n}{\lambda_{n+1}} \to 0$, $\liminf_{n\to\infty} \frac{\log \lambda_n}{\log \lambda_{n+1}} > 0$. Then there exists an entire function $f(z)$ of b.i. such that $\log M(r,f) \sim \log M(r,g)$ and $0 < \limsup_{r\to\infty} \frac{\nu(r,f)}{r} = e \limsup_{r\to\infty} \frac{\log M(r,f)}{r} = eT$. This shows that there are functions $f(z)$ of index N (say) for which $N + 1 \geq eT$. (Received July 29, 1977.)

*77T-B173 E. B. Saff, University of South Florida, Tampa, Florida, 33620 and R. S. Varga, Kent State University, Kent, Ohio 44242. Sharpness of Lorentz's theorem on incomplete polynomials. Preliminary report.

Let $0 < \theta < 1$ be fixed, and let $P_n(x) = \sum_s^n a_k x^k$ be any sequence of polynomials for which $s \geq \theta n$ and $|P_n(x)| \leq M$ for all $x \in [0,1]$. G.G. Lorentz [Padé and Rational Approximation, ed. by E. B. Saff and R. S. Varga, Academic Press, 1977] has proved that there exists a positive $\delta = \delta(\theta)$ such that $P_n(x) \to 0$ uniformly on $[0,\delta]$ as $n \to \infty$. In fact, if $\Delta(\theta)$ denotes the supremum of all such numbers δ, Lorentz [ibid] showed that $\theta^2 \leq \Delta(\theta) < \theta$. We prove, among other results, that $\Delta(\theta) = \theta^2$ for all $0 < \theta < 1$. (Received August 1, 1977.)

*77T-B174 RIDGLEY LANGE, 1049 N. Rock Hill Road, St. Louis, Missouri 63119. 2-Decomposable operators are decomposable.

In this paper the author gives the positive solution to a problem of S. Plafker (Proc. Amer. Math. Soc. 24 (1970), 215-216), i.e. it is proved that every 2-decomposable operator is decomposable in the general sense (see Colojoară and Foiaş, Theory of generalized spectral operators, Gordon and

Breach, New York, 1968). In the process the author also solves the following other outstanding problems in the theory. 1. A decomposable operator restricted to a spectral maximal space is also decomposable. 2. Decomposable operators have decomposable adjoints. 3. Every decomposable operator is strongly decomposable. (Received August 1, 1977.)

77T-B175 ROBERT C. SHARPLEY, University of South Carolina, Columbia, South Carolina 29208. On the Failure of a Bilinear Marcinkiewicz Theorem.

A bilinear operator T is given which is bounded from $L^p \otimes_\gamma L^p$ to $L^{p,\infty}$ for $1 < p \leq 2$ but is not bounded from $L^p \otimes_\gamma L^p$ to L^p in the same range of p. Hence it is established that the Marcinkiewicz theorem can not to be extended to bilinear operators thereby settling a conjecture of Jaak Peetre presented at a special session on Interpolation of Operators and Applications of the Society at Washington, D.C. in 1975 (see these NOTICES 22 (1975), p. 125, problem k). (Received August 1, 1977.)

77T-B176 F. J. Almgren, Jr., Princeton University, Princeton, N.J. 08540. Mass minimizing integral currents in R^n are almost everywhere regular. Preliminary report.

Theorem. Suppose $2 \leq k < n$ are integers and T is a k dimensional mass minimizing integral current in R^n. Then there is an open set $U \subset R^n$ such that $\|T\|[R^n \sim (U \cup \mathrm{spt}(\partial T))] = 0$ and $\mathrm{spt}(T) \cap U$ is a k dimensional minimal submanifold of R^n. (Received August 9, 1977.)

77T-B177 David F. Dawson, North Texas State University, Denton, Texas 76203. An addendum to "Matrix maps of null sequences."

Corollary 3.2 of the paper mentioned in the title [Rendiconti di Matematica (6), vol. 9 (1976), pp. 207-214] shows the equivalence of the three sets of conditions of M. Stieglitz and H. Tietz listed under 81, 82, and 83, respectively, on page 9 of their paper [Math. Z., vol. 154 (1977), pp. 1-16]. The same corollary is used to prove the following statement: If $A(c_0) \subseteq (BV_k)_0 = c_0 \cap BV_k$, then $A(m) \subseteq (BV_k)_0$. This result shows the equivalence of the three sets of conditions of Stieglitz and Tietz listed under 101, 102, and 103, respectively, on page 11 of their paper cited above. (Received August 11, 1977.)

77T-B178 Kenneth G. Miller, University of Oregon, Eugene, OR 97403. Hypoellipticity on the Heisenberg group.

Let P be a left-invariant differential operator on the Heisenberg group H^n, homogeneous with respect to the dilations on H^n. We show that a necessary and sufficient condition for the hypoellipticity of P is that $\pi(P)$ be an injective operator for every irreducible unitary representation π of H^n (except the trivial representation).

Furthermore, hypoellipticity is preserved if the homogeneous operator P is perturbed by terms of lower order of homogeneity. (Homogeneity means homogeneity with respect to dilations on H^n.) It is also shown that if P is homogeneous, left-invariant and hypoelliptic on H^n, then its formal adjoint is hypoelliptic. This improves on the result proved by Rockland, namely that P and P^t are both hypoelliptic if and only if $\pi(P)$ has a bounded two-sided inverse for all π. Our proof makes use of the general calculus of pseudodifferential operators developed by Beals. (Received August 12, 1977.)

77T-B179 Bruce J. Aborn, Hocking Technical College, Nelsonville Oh. 45764, and Hari Shankar, Ohio University, Athens Oh. 45701. Generalised Growth and Convergence of Analytic Functions. Preliminary Report.

Let $p(x)$, $q(x)$ be real, continuous functions with the properties: (1) $p(x)$ is strictly increasing for all $x \geq x_0 > 0$; $q(x)$ is strictly decreasing from infinity for all x, $0 \leq x \leq x_1$. (2) $p(cx) \sim p(x)$ as $x \to \infty$, $q(cx) = O(q(x))$, $q(x + o(x)) \sim q(x)$ as $x \to 0^+$ for each $c > 0$. (3) $p(1/x) = O(q(x))$ as $x \to 0^+$, $p(\ln x) = o(p(x))$ as $x \to \infty$. (4) $p^{-1}(cq(x))/p^{-1}((c+\epsilon)q(x)) = o(x)$ as $x \to 0^+$ for each $\epsilon > 0$, $c > 0$. Let $f(z) = \sum_{k=0}^{\infty} a_k z^{n_k}$ be analytic on a finite open disc of finite radius $R > 1$, where $\{n_k\}$ is a subsequence of non-negative integers such that $a_k \neq 0$. Denote $E(k,f) = \max_{|x| \leq 1} \left|\sum_{j=k}^{\infty} a_j x^{n_j}\right|$ and define as $n_k \to \infty$, the real numbers: $E = \limsup (p(n_k)/q(\ln^+(E(k,f) R^{n_k})^{1/n_k}))$, $A = \limsup (p(n_k)/q(\ln^+ |a_k R^{n_k}|^{1/n_k}))$. We prove that $A = E = M = \limsup_{r \to R} (p(\ln M(r))/q(\ln (R/r)))$.

(Received August 22, 1977.)

*77T-B180 Wayne C. Bell, Murray State University, Murray, Kentucky 42071. Commutativity and representability properties of decompositions of additive set functions.

Suppose F is a field of subsets of a set S and $d: ba(F) \to ba(F)$ is such that $d(\lambda) \wedge (\lambda - d(\lambda)) = 0$ for each $\lambda \in ba(F)^+$. Theorem 1. T.A.E. a) d is linear; b) if $\mu \in ba(F)^+$, then $d(\eta) = \int (d(\mu)/\mu)\eta$ (refinement integral) for each μ-continuous η in $ba(F)$; c) if $\eta \in ba(F)$, β is a bounded function from F into the reals and $\int \beta\eta$ exists, then $d(\int \beta\eta) = \int \beta d(\eta)$. Theorem 2. T.A.E. a) if $\mu \in ba(F)^+$, λ is μ-continuous and $\int \lambda^2/\mu$ exists, then $d(\int \lambda^2/\mu) = \int [d(\lambda)]^2/\mu$; b) if μ and λ are mutually absolutely continuous elements of $ba(F)^+$ and β is a bounded function from F into the non-negative reals for which $d(\mu) = \int \beta\mu$, then $d(\lambda) = \int \beta\lambda$. Theorem 3. If d satisfies the conditions of 2 then so does the function $\lambda \to \lambda - d(\lambda)$. The function $r(\mu) = \mu_1$ (Abs. 742-28-3, NOT., Jan. '77) satisfies the conditions of 2 but not necessarily those of 1.

(Received August 22, 1977.)

*77T-B181 K. L. Singh, Texas A & M University, College Station, Texas 77843. Fixed point theorems for contractive type mappings.

Let X be a complete metric space. Let $q(x,y)$, $r(x,y)$, $s(x,y)$, $t(x,y)$, $m(x,y)$ be nonnegative functions satisfying $\sup_{x,y \in X} \{ 2((s(x,y) + t(x,y) + m(x,y)) + r(x,y) + q(x,y)\} = k < 1$. Definition. A mapping $T : X \to X$ is said to satisfy condition (A) if for each x in X, there exists an integer $n(x) \geq 1$ such that for all y in X we have $d(T^{n(x)}x, T^{n(x)}y) \leq q(x,y)d(x,y) + r(x,y)d(x, T^{n(x)}x) + s(x,y)d(y, T^{n(x)}y) + t(x,y)d(x, T^{n(x)}y) + m(x,y)d(y, T^{n(x)}x)$. Lemma. Let $T : X \to X$ be a mapping satisfying condition (A). Then for each x in X, $r(x) = \sup_n (d(T^n x, x)$ is finite. Theorem. Let $T : X \to X$ be a mapping satisfying condition (A). Then T has a unique fixed point u and $\lim_n T^n(x_0) = u$ for each x in X. The above Theorem generalizes the corresponding results of Rhoades (Notices Amer. Math. Soc. , August, pp. A-427), Guseman (Proc. Amer. Math. Soc. 26(1970), 615-618), Khazanchi (Math. Japonicae 19(1974), 283-289) and Sehgal (Proc. Amer. Math. Soc. 23(1969), 631-634). (Received August 22, 1977.)

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(65, 68, 70, 73, 76, 78, 80–83, 85, 86, 90, 92–94)

*77T-C50 VINCENT BUONOMANO, Instituto de Matematica, Universidade Estadual de Campinas, Campinas, Sao Paulo, Brasil. Low-Intensity Interference Effects and Local Hidden Variable Theories.

The double slit interference experiment and other similar experiments in the low

intensity limit (i.e. one photon in the apparatus at a time) are examined from the point of view of local hidden variable theories in the spirit of Bell's work. It is found that there exist a class of local hidden variable theories which disagree with quantum mechanics for a certain type of interference experiment. This disagreement is basically of an ergodic nature. A visualization of this class which is a particle view of interference is described. An experiment, which appears to be feasible, is proposed to examine this disagreement. (Received May 16, 1977.) (Author introduced by B. N. Datta).

*77T-C51 GANGARAM S. LADDE, State University of New York College at Potsdam Potsdam, New York 13676. Systems of Differential Inequalities and Stochastic Differential Equations IV.

Consider the stochastic functional differential system

$$\dot{x}(t,\omega) = f(t, x(t,\omega), x_t, \omega), \quad x_{t_0} = \phi_0 \qquad (1)$$

where $f(t, x(t,\omega), x_t, \omega)$ is product measurable random functional and satisfies the desired regularity conditions to assure the existence of solution processes; $\phi_0 \in C^n[-\tau, 0]$. By developing a very general comparison principle, sufficient conditions are given for stability and boundedness of solution processes of (1) in the frame-work of stochastic differential inequalities and Lyapunov-like functions as well as functionals. (Received May 16, 1977.)

*77T-C52 Matthew Witten, State University of New York at Buffalo, Buffalo, New York 14226. A discrete time model for the growth kinetics of tandem multiplicate genes as a model for the evolution of macromolecular complexity. Preliminary report.

A possible discrete time model is proposed, in an effort to explain the evolution of protein - enzyme macromolecular complexity. By macromolecular complexity we mean the evolution of more complex forms of a given protein or enzyme from its less complex ancestors. It is seen that ferrodotoxin and its family of similar proteins could have evolved in a manner along the lines presented in this model. The main building block of this model is the generation of tandem multiplicate genes through successive chromosomal recombinations. The concept of gene duplication as an evolutionary step is not a new one, and the literature on the subject is quite vast. The discrete time model presented in this paper has been shown to embody standard kinetics of multicompetitive species, when there is no recombination. And for certain specific cases, analytic solutions of the model are exhibited. (Received June 2, 1977.)

77T-C53 YUTAKA YAMAMOTO, Center for Math. System Theory, U. of Florida, Gainesville, Fla. On the Existence and Uniqueness of Canonical Realizations. Preliminary report.

Let Ω, Γ be locally convex Hausdorff topological vector spaces. An (abstract) input/output map is a continuous linear $f: \Omega \to \Gamma$. $\Sigma = (X,g,h)$ is an abstract realization of f iff X is a complete locally convex Hausdorff topological vector space and g, h are continuous linear maps, and $f = g \circ h$. Σ is canonical iff it is quasi-reachable (i.e. g has a dense image) and it is topologically observable in the sense that "small outputs imply small initial states", i.e. for any 0-neighborhood U in X, there exists a 0-neighborhood V in Γ such that $h^{-1}(V) \subset U$. This particular notion of observability, different from the naive one that h be one-to-one, has been known under different names in various contexts, such as uniform strong observability, uniform zero-input observability, etc. See, for example, "Optimal Control of Linear Systems with a Quadratic Cost Criterion", by A. Bensoussan,

M. Delfour, S. Mitter, Part II, Chapter 4, MIT Report ESL-P-603. We remark here that, with the above notion of observability, the question of existence and uniqueness of canonical realizations becomes essentially trivial. The following easy theorem seems to clarify the confusion in the literature concerning this question: THEOREM. Let Γ be complete. Then there exists a unique canonical abstract realization of f. It is interesting to remark that the definition of observability which we used above is precisely the natural one from a physical, rather than purely mathematical, viewpoint. (Received June 3, 1977.)

77T-C54 Robert G. Jeroslow, Carnegie-Mellon University, Pittsburgh, Pa. 15213. Cut form for binary variables. Preliminary report.

Consider the following constraint set BMIP : $Az + Bx + Cy = d$; $x,y \geq 0$; x integer; z binary. Assume A,B,C,d rational and write column representations $A = [a^{(j)}]$, $B = [b^{(k)}]$, $C = [c^{(p)}]$, $z = (z_1,\ldots,z_r)$. Call a collection of functions $\{F(S)(\cdot)|S \subseteq \{1,\ldots,r\}\}$ subadditive if the following two conditions hold, where $M(S)$ is the domain of $F(S)(\cdot)$: (1) All $M(S)$ contain 0, and $M(S) \supseteq M(S_1) + M(S_2)$ if $S \supseteq S_1 \cup S_2$ and $S_1 \cap S_2 = \phi$; (2) If $S \supseteq S_1 \cup S_2$ and $S_2 \cap S_2 = \phi$, then for all $v \in M(S_1)$ and $w \in M(S_2)$, we have $F(S)(v + w) \leq F(S_1)(v) + F(S_2)(w)$. Write $\overline{F}(\phi)(v) = \lim\sup \{F(\phi)(\lambda v)/\lambda | \lambda \searrow 0^+\}$. Put $J = \{1,\ldots,r\}$. Theorem : $\sum_j \pi_j z_j + \sum_k \sigma_k x_k + \sum_p \theta_p y_p \geq \pi_o$ is a valid inequality for BMIP, if and only if there is a subadditive collection $\{F(S)(\cdot)|S \subseteq J\}$ with : (α) $a^{(j)} \in M(\{j\})$, all j; $b^k \in M(\phi)$, all k; $\overline{F}(\phi)(c^{(p)})$ defined, all p; (β) $F(\phi)(0) = 0$; (γ) $F(\{j\})(a^{(j)}) \leq \pi_j$, all j; $F(\phi)(b^{(k)}) \leq \sigma_k$, all k; $\overline{F}(\phi)(c^{(p)}) \leq \theta_p$, all p; ($\delta$) $F(J)(d) \geq \pi_o$. Remark : $F(\phi)(\cdot)$ is an ordinary subadditive function, and for $r = 0$ this cut form becomes the previous one for mixed integer programs. (Received June 20, 1977.)

77T-C55 James J. Buckley, University of Alabama, Birmingham, Alabama, 35294. Arrow's Impossibility Theorem for Societal Choice Functions. Preliminary Report.

If Ω is the set of all cultures [see M. Garman and M. Kamien, Behav. Sci. 13(1968), p. 312], and if f is a probability function on Ω, then $S = (\Omega,f)$ is a society. If A is the set of all possible decisions about the issues, then $F:\Omega \to A$ is a cultural choice function. If N is the set of probability functions on A, then $\phi : (S,F) \to \mu \in N$ is a societal choice function, where $\mu(E) = \int_B f(p)dp$, $B = F^{-1}(E)$. Arrow's conditions 2, 3, and 4 (positive association, independence, and sovereignty) are extended to conditions 2′, 3′, and 4′ for cultures and societies. Theorem. Conditions 2′, 3′, and 4′ are inconsistent. Notice that condition 5 (nondictatorship) is not needed. (Received June 20, 1977.)

77T-C56 VED P. MADAN, University of Western Ontario, London, Ontario and Red Deer College Alberta. Influence of an elastic end support on the stability of viscoelastic (Voigt) column.

The influence of an elastic end support on the vibration and stability of a non-conservatively loaded (follower force) viscoelastic Voigt column has been examined by deriving equations for the lateral deflection and frequency. The results forthe corresponding elastic and viscoelastic columns with and without end support have also been deduced. (Received June 20, 1977.)

*77T-C57 ALAN D. SOLOMON, Union Carbide Corporation, Nuclear Division , P.O. Box Y, Oak Ridge, Tennessee. The applicability and extendibility of Megerlin's method for solving parabolic free boundary problems.

The method of F. Megerlin (Forsch. Ing.-Wes. 9 (1968) 40-46) for the solution of melting and solidification problems is applied to a variety of moving boundary problems for parabolic equations, yielding effective approximations for their solutions. Using a domain subdivision procedure the

method is extended to one which converges in principle to the solution. This convergence is proved for the classical Stefan problem with constant boundary and initial conditions; in this case convergence is of order $1/N$ for N the number of subdivisions used. (Received July 11, 1977.)

77T-C58 J. WOLFOWITZ, University of Illinois, Urbana, Illinois 61801. The rate distortion function for source coding with side information at the decoder.

The problem studied is that of A. D. Wyner and J. Ziv, IEEE Trans. Info. Theory, IT-22, No. 1, 1-10 (whose entire notation is adopted), except that now S, the rate of side information, satisfies $0 \leq S \leq H(Y)$, instead of merely $S = H(Y)$. Let a and b, respectively, be the number of values taken by X and Y. Let Z, X, Y, U form, in this order, a Markov chain, where Z takes $a+1$ values and U takes b values, $I(U,Y) = S$, and there exists a function ψ such that $ED(X,\psi(U,Z)) \leq d$. It is proved that $R^*(d) \leq \min [I(X,Z) - I(U,Z)]$, where the minimum is over all chance variables Z and U which satisfy the above conditions. (Received July 8, 1977.)

77T-C59 M. Neumann, The University of Nottingham, England and R.J. Plemmons, The University of Tennessee, Knoxville, Tennessee, U.S.A. Semiconvergent nonnegative matrices and iterative methods for consistent linear systems.

In this paper we study linear stationary iterative methods with nonnegative iteration matrices for solving singular, but consistent, systems of linear equations $Ax = b$. The iteration matrices for the schemes are obtained via regular and weak regular splittings of the coefficients matrix A. In certain cases when only some necessary, but not sufficient, conditions for the convergence of the iterations schemes exist, we consider a transformation on the iteration matrix and obtain new linear stationary iterative schemes which ensure convergence to a solution to $Ax = b$. This transformation is parameter-dependent, and in the case where all the eigenvalues of the iteration matrix are real, we show how to choose this parameter so that the asymptotic convergence rate of the new scheme is optimal. Finally, some applications to the problem of computing the stationary distribution vector for a finite homogeneous ergodic Markov chain are discussed. (Received July 13, 1977.)

77T-C60 PAUL C. SHIELDS, Univ. of Toledo, Toledo, Ohio, 43606 and D. L. NEUHOFF, Univ. of Michigan, Ann Arbor, Mich. 48104. A channel representation theorem.

We define a property of stationary channels called conditional almost block independence (CABI). The definition is quite technical-essentially it means that the output, given the input, is approximately independent in blocks if the blocks are long enough and independence is measured in the $\bar{d}$-sense. We show that a CABI, $\bar{d}$-continuous channel can be simulated arbitrarily well in the $\bar{d}$-sense by a memoryless channel followed by a sliding block code. The closure of the latter class in the $\bar{d}$-metric is called the class of almost finite (AF) channels. By a suitable limit argument we show that the AF channels are precisely the CABI, $\bar{d}$-continuous channels. These results may be viewed as channel analogues of the Ornstein isomorphism theory, with CABI playing the role of very weak Bernoulli or finitely determined. (Received July 18, 1977.)

77T-C61 GEORGE M. MULLER, Haimson Research Corporation, Palo Alto, CA 94303. A spline digital filter. Preliminary report.

A digital filter implements the linear transformation $\underset{\sim}{h}^*$ implied when a fixed complex sequence, the impulse response $\underset{\sim}{h} = \{h_\nu\}$, is convolved with an input sequence $\underset{\sim}{x}$ to yield an output sequence $\underset{\sim}{h}^*\underset{\sim}{x}$; filter algorithms are conveniently derived from the transfer function $H(z) = \Sigma_\nu h_\nu z^{-\nu}$. With $\bar{q}_n(z) \equiv (n!)^{-1}(zd/dz)^n(1 - z)^{-1}$ (cf. SIAM J. on Math. Analysis, 6(1975), 948-959), we define a four-parameter,

very general, spline digital filter by $H(z) = N^{2m-\ell}\,\bar{q}_{2m-1-\ell}(z^{-1})/(\bar{q}_{2m-1}(z^{-N}) + (-1)^m\varepsilon)$, N,m,ℓ integers, $m > 0$, $N > 0$, $0 \le \ell \le 2m - 1$, $\varepsilon \ge 0$; the corresponding frequency response $H(e^{2\pi i f})$, f in units of the sampling frequency, is easily estimated since $\bar{q}_{n-1}(e^{-2\pi i f}) = (2\pi i)^{-n}\,\Sigma_k\,(f + k)^{-n}$. If $N = 1$, then $\underset{\sim}{h}*\underset{\sim}{x} = \{D^{\ell}S_{2m-1}(\nu+)\}$; here S_{2m-1} is Schoenberg's cardinal spline interpolant of degree $2m - 1$ to $\underset{\sim}{x}$ if $\varepsilon = 0$, or the cardinal version of the smoothing spline of Anselone and Laurent (with uniform data weight ε^{-1}) if $\varepsilon>0$. $N > 1$, $\varepsilon = 0$, corresponds to low-pass filtering by averaging spline interpolation (SIAM Rev., 18(1976), 819); this filter approaches the ideal low-pass ℓ-th differentiator with passband $(-\eta,\eta)$, $\eta = 1/(2N)$ as $m \to \infty$, and has a simple, very stable, implementation.

(Received August 1, 1977.)

77T-C62 Eduardo D. Sontag, Dept.of Math.,Rutgers University, New Brunswick, NJ 08903.
Jet sufficiency for observability of certain nonlinear systems. Preliminary Report.

Consider a continuous-time system Σ with state set $X=\mathbb{R}^n$, input-value set U=open convex set in $\mathbb{R}^m$, output-value set $Y=\mathbb{R}^p$, and equations (*) $\dot{x}(t)=P(x(t),u(t))$, $y(t)=h(x(t))$, where P and h are polynomial in x, and P is analytic in u. Solutions of (*) are assumed to exist on $[0,T]$ for all "admissible inputs": piecewise continuous $u(.):[0,T]\to U$, some fixed T (this may be weakened in several ways). The output at time t due to state x at time 0 and (admissible) input $u=u(.)$ is $y(t,x,u)$. DEFINITION. Let $k\geq 0$, and x,x' in X. Then u distinguishes [resp. jet(k)-distinguishes; resp. jet-distinguishes] between x and x' iff $y(t,x,u)\neq y(t,x',u)$ for some t in $[0,T]$ [resp. u is analytic in t and $y^{(i)}(0,x,u)\neq y^{(i)}(0,x',u)$ some $0\leq i\leq k$; resp. some $i\geq 0$]. The system Σ is observable [jet(k)-obs.;jet-obs.] iff for each pair $x\neq x'$ there is some u distinguishing [jet(k)-distinguishing;jet-distinguishing] between x and x'.

THEOREM. Σ is observable (1)iff jet-observable, (2)iff jet(k)-observable for some k. Moreover, there is then a finite set $u_1,\ldots,u_s$ of inputs such that $u_1,\ldots,u_s$ jet(k)-dist. any pair of states, and the u_i are polynomial in t.

The proof is analogous to the discrete case in E.SONTAG and Y.ROUCHALEAU, J.Nonlinear Analysis, MTA, 1(1976):55-64. Other results in that paper also have analogies in continuous-time via the study of jets of outputs under smooth inputs. We suggest the CONJECTURE: Σ as above is observable iff there is a spline u which distinguishes any pair of states. Another result for discrete-time systems (E. SONTAG, SIAM J.Control and Opt., to appear):(multiple-input)observability implies (single-input)final-state determinability, can be also generalized via jets of state and output trajectories.

(Received August 10, 1977.)

*77T-C63 REUBEN HERSH, University of New Mexico, Albuquerque, New Mexico 87131. Higher-order approximations for C_0 semigroups, II.

If $T(t)$ is a C_0 semigroup of linear operators on a Banach space X with generator A, and $r(z)$ is a rational function such that $|r(z)| \le 1$ for $\mathrm{Re}\, z \le 0$, then $\|r^n(\frac{tA}{n})\| = O(n^3)$. By a theorem of Strang, it follows that if $|r(z) - e^z| = O|z^{\alpha}|$ as $z \to 0$, then $\|r^n(\frac{tA}{n})x - e^{tA}x\| = O(n^{-\alpha})$ for x in a dense subset of X. In particular, by a theorem of Ehle, we may choose $r(z)$ as the j, k^{th} Pade approximant to e^z if $-2 \le k - j \le 0$ and $k + j = \alpha$. The estimate is uniform in t if $T(t)$ is bounded uniformly in t. If $T(t)$ is holomorphic and $r(z)$ has degree less than zero, we can estimate the norm of $r^n(\frac{tA}{n})$ by n^q where q is an arbitrarily small positive number. (Received August 15, 1977.)

*77T-C64 ANTHONY LEUNG, University of Cincinnati, Cincinnati, Ohio 45221. Limiting Behavior for a Prey-Predator Model with Diffusion and Crowding Effects.

The Neumann problem in a bounded domain is considered for the Volterra-Lotka model $u_t = \sigma_1 \Delta u + u(a - bu - cv)$, $v_t = \sigma_2 \Delta v + v(pu - qv - r)$, where σ_1, σ_2, a, b, c, p, q, r are all positive constants. By means of maximal principle and an appropriately chosen Liapunov function, it is proved that all positive solutions tend to spatially independent equilibrium when normal derivatives are zero. This extends the results of Williams and Chow who considered the case when $b = q = 0$ and solutions were found to be oscillatory. (Received August 18, 1977.)

77T-C65 Indulis Strazdiņš, Riga Polytechnical Institute, Riga, Latvian S.S.R. 226355, U.S.S.R. Complexity of the affine prototype classes of five-variable boolean functions.

In the author's previous paper (Avtomat. i Vyčisl. Tehn., no. 1 (1975), pp. 1-9; translation in Automat. Control and Comput. Sci. to appear) a complete catalog was given of all 48 affine prototype classes (APCs) of five-variable boolean functions, including their spectral invariants, minimal representatives, and exact size. Thus a deterministic solution of R. J. Lechner's classification problem (see in Recent Developments in Switching Theory, N.Y., 1971, pp.121-228) was obtained by means of a new highly selective identification algorithm. Now, in addition, we have computed minimal polynomials modulo 2 of all APCs. Let LP(n) be the maximum of complexity of minimal polynomial representative over all APCs. It is well known that LP(2) = 2, LP(3) = 3, LP(4) = 8.

Theorem. LP(5) = 18. This maximum is reached for the class 38, having minimal polynomial $x_1x_2x_3x_4x_5 + x_1x_2x_3 + x_1x_2x_4 + x_1x_3x_5 + x_1x_4 + x_2x_5$. (Received August 18, 1977.)

Geometry (50, 52, 53)

77T-D12 Larry Graves, Daniel H. Wagner Associates, Station Square One, Paoli, PA 19301. On Isometric Immersions between Indefinite Euclidean Spaces. Preliminary Report.

The results announced in Abstract 76T-D20 (Notices, Oct. '76) can be extended as follows. Let $\mathbb{R}^n_s$ denote $\mathbb{R}^n$ together with the metric $-(dx^1)^2 - \dots - (dx^s)^2 + (dx^{s+1})^2 + \dots + (dx^n)^2$. The isometric immersions : $\mathbb{R}^n_s \to \mathbb{R}^{n+1}_s$ may be classified as follows.

(i) $id \times c : \mathbb{R}^{n-1}_{s-1} \times \mathbb{L}^1 \to \mathbb{R}^{n-1}_{s-1} \times \mathbb{L}^2$, where c is a "unit-speed" clock curve;

(ii) $id \times c : \mathbb{R}^{n-1}_s \times \mathbb{E}^1 \to \mathbb{R}^{n-1}_s \times \mathbb{E}^2$, where c is a unit-speed plane curve;

(iii) $id \times g : \mathbb{R}^{n-2}_{s-1} \times \mathbb{L}^2 \to \mathbb{R}^{n-2}_{s-1} \times \mathbb{L}^3$, where g is a B-scroll immersion.

Remarks: (1) Class (iii) consists of precisely those immersions whose relative nullities are degenerate. (2) These results may be modified in the obvious manner to classify the immersions $\mathbb{R}^n_s \to \mathbb{R}^{n+1}_{s+1}$. (Received June 17, 1977.)

*77T-D13 ROBERT CONNELLY, Syracuse University, Syracuse, New York 13210. A counterexample to the rigidity conjecture for polyhedra. Preliminary report.

An example is given of an embedded , closed, polyhedral surface (homeomorphic to the 2-sphere) which flexes in three-space. The first step is to find an immersed polyhedral surface which has only two points which are images of singular points. This is done by starting with oneof Bricard's flexible octahedra that lies at one instant in a plane and pushing out the 2-simplices. The second step is then to alter the immersed surface near the singular points so that one edge is "pushed in" (crinkled) so that the resulting surface is still flexible. This removes the singular points and gives the example. (Received June 21, 1977.)

*77T-D14 CHANDAN VORA, 29 Balgovind Square, Rajnandgoan, M. P., India. On E-C-monotone operators. Preliminary report.

In a recent paper in Rend. Sem. Mat. Padova, the author introduced the concept of comparability of two pairs of norms. For two and three norms, the author showed in general that if the pairs of norms are not comparable then there is no Lipschitz extension preserving the two Lipschitz conditions. A similar result was proved by the author for two inner products and two inner product inequalities in Jundi Shahpur Univ. Publ., 1973. In this paper, the author introduces the concepts of E-C-monotone and antimonotone operators and proves related results for them. (Received June 21, 1977.)

*77T-D15 EDGAR PECHLANER, Simon Fraser University, Burnaby 2, B.C., Canada, V5A 1S6. Geometrical meaning of the curvature scalar of a 3-space.

In a given 3-dimensional positive definite Riemannian space we study the shape of a body whose volume $V \equiv \frac{4}{3}\pi a^3$ is known, and whose surface area S is a minimum. Assuming that V is small, we obtain an approximate surface and from it we find

$$S = 4\pi a^2[1 + a^2P/30 + O(a^3)] ,$$

where P is the curvature scalar at a "center" of the body. This result may be of significance for the adaptation of the liquid drop model of the nucleus to curved space-time. (Received July 12, 1977.) (Author introduced by John Sember).

*77T-D16 NIKOS TZANAKIS, 37 Democratias St., Iraklion Crete, Greece. Circularly Convex Sets.

DEFINITION. A plane set A containing at least 2 points will be called strictly c-convex (circularly convex) set if every circle joining two arbitrary points, x, x' of A has (at least) one of its arcs between x and x' consisting of points of A. The set will be called c-convex if there is at most one circle joining two points of A and not having either of the two arcs between these points consisting entirely of points of A.

THEOREM. The only c-convex sets are sets A satisfying $K \subseteq A \subseteq \bar{K}$, where $\bar{K}$ is the closure of K and K is one of the following sets: (a) The plane with one point deleted, (b) An open circular disc, (c) The complement of a closed circular disc, and (d) The open half plane.

COROLLARY. The sets (a), (b), (c) and (d) above, are the only open strictly c-convex sets. (Received August 1, 1977.) (Author introduced by Professor Nicholas C. Petridia).

*77T-D17 F. S. CATER, Department of Mathematics, Portland State University, Portland, Oregon 97207. On desarguesian projective planes.

Let K be a skew field, K^3 be the 3-dim. rt. vector space over K, $\pi = K^3/K$ be the projective plane over K. We find geometric properties of π equivalent to certain algebraic properties of K. Some of the latter are: (1) K contains a square root of -1, (2) K contains square roots of all its elements, (3) center K contains square roots of all its elements, (4) K contains square roots of all elements of center K. We find geometric properties of π equivalent to center K containing primitive nth roots of 1 for certain n. All this is done by means of 6-figures. Definition. A 6-figure α is 6 distinct points A, B, C, A', B', C' in π where ABC is a triangle, $A' \in BC$, $B' \in CA$, $C' \in AB$. We say that α is menelaen if A', B', C' are collinear, α is cevian if AA', BB', CC' are concurrent. Sample theorems for α. (1) Some proj. coll. of π maps A, B, C, A', B', C' to B, C, A, B', C', A' resp.; (2) α is either menelaen or cevian iff (i) any proj. coll. of π fixing any 5 pts. among A, B, C, A', B', C' must fix all 6, and (ii) some proj. coll. of π maps A, B, C, A', B', C' to A, C, B, A', C', B' resp. For a cross ratio (AB:CD) we construct the point J, by drawing just 7 lines, such that $(AB:CJ) = (AB:CD)^2$ (Received August 18, 1977.)

777-E56 IRAJ KALANTARI, University of California, Santa Barbara, California 93106 and ALLEN RETZLAFF, State University of New York, Purchase, New York 10577. Recursively enumerable topological spaces. Preliminary report.

Let (X, Δ) be a fully effective topological space with a countable basis Δ equipped with an inclusion algorithm. Let Δ be coded by integers. For $\delta \in \Delta$, $\ulcorner\delta\urcorner \equiv$ Gödel number of δ. Let $\mathcal{L}(X) =$ the inclusion lattice of r.e. open subsets of X. For $\varkappa \in \mathcal{L}(X)$, define $\text{int}\ \varkappa = \{\ulcorner\delta\urcorner \mid \delta \subseteq k\}$, $\text{ext}\ \varkappa = \{\ulcorner\delta\urcorner \mid \delta \cap \varkappa = \emptyset\}$, $\text{bnd}\ \varkappa = \{\ulcorner\delta\urcorner \mid \delta \cap \varkappa \neq \emptyset \wedge \delta \cap (X - \varkappa) \neq \emptyset\}$, $\text{bor}\ \varkappa = \{\ulcorner\delta\urcorner \mid \delta \cap \varkappa \neq \emptyset \wedge (\exists \epsilon \ulcorner\epsilon\urcorner \in \text{ext}\ \varkappa \wedge \epsilon \subset \delta)\}$. Definition. $\varkappa \in \mathcal{L}(X)$ is complemented in $\mathcal{L}(X)$ if $\exists \varkappa' \in \mathcal{L}(X)\ [\varkappa \cap \varkappa' = \emptyset \wedge \varkappa \cup \varkappa'$ is dense in X]. The theory of $\mathcal{L}(X)$ is nonreducible to the theory of r.e. sets of integers. We prove Theorem. There exists $\varkappa \in \mathcal{L}(X)$ such that int $\varkappa$ is recursive but $\varkappa$ is not complemented in $\mathcal{L}(X)$. Other priority arguments yield: Theorem. (a) $\exists \varkappa \in \mathcal{L}(X)$ [int $\varkappa$, ext $\varkappa$ and bnd $\varkappa$ are r.e. but bnd $\varkappa \neq$ bor $\varkappa$]. (b) $\exists \varkappa \in \mathcal{L}(X)$ [int $\varkappa$ and ext $\varkappa$ are r.e. but bnd $\varkappa$ is not r.e.]. (c) $\exists \varkappa \in \mathcal{L}(X)$ [$\varkappa$ is complemented in $\mathcal{L}(X)$ but ext $\varkappa$ is not r.e.]. Finally, in contrast to classical results, we obtain Theorem. There exists I, an r.e. disjoint subset of Δ, such that neither any set dense in I nor any set in which I is dense can be extended to an r.e., disjoint subset of Δ whose union is dense in X. (Received June 15, 1977.)

777-E57 GEORGE D. ZAHN, 47 Perry St., New York, N. Y. 10014, Logic and Foundations, Preliminary Report.

We study and develop a *theory of triples* (F, R, P) where F is a set, R a symmetric relation on F, and P a well defined subset of F. Where terms of graph theory are used, they are as in that theory.

A *chain* $\{x_1, \ldots, x_n\}$ is a subgraph of (F, R, P) such that $(x_i, x_{i+1}) \in R$, $i = 1, \ldots, n-1$. $(F, R, P) \in T_5$ iff R is not contractible to K_5, R is totally triangulated and R contains no K_4 subgraph. $x_2 \in F \setminus P$ iff there is a chain $\{x_1, x_2, x_3\}$ and a contraction not involving x_1, x_2, or x_3 which gives elements c_1 and c_2 and such that $(c_i, x_j) \in R^1$, $i = 1, 2$, $j = 1, 2, 3$, and R^1 denotes the set of relations obtained after contraction.

We prove a number of foundation results in the theory including: (1) $F \neq P$ iff the graph is contractible to a K_4 graph. (2) (P, R, P) is 3-colorable. (3) Given any $\{a, b\} \subset P$ there is a two color chain in the coloration of P form a to b in which P is 3-colorable and which does not change the chromatic number of (P, R, P). (Received June 20, 1977.) (Author introduced by Professor Ki Hang Kim).

777-E58 Saharon Shelah, The Hebrew University of Jerusalem, Israel. Moore spaces, club, Banach space with few operators existentially closed groups in continuum, and diamond

Th. 1: It is consistent with ZFC + G.C.H. that there is a normal Moore non-separable space of cardinality $\aleph_1$ which is not metriziable. Th. 2: Club does not imply CH (Club is: there are $S_\alpha \subseteq \alpha$ unbounded in α, for limit $\alpha < \omega_1$ such that for any unbounded $S \subseteq \omega_1$ for some α $S_\alpha \subseteq S$. Th. 3: (V = L) There is a Banach space with a basis of cardinality $\aleph_1$, every operator on which is the sum of a separable operator and a multiple of the unit. Th. 4: Let M be an existentially closed countable group or skew-field or locally finite group. There is N, $N \equiv_{\infty,\omega} M$, of cardinality $\aleph_0$, e.g., with no $\aleph_1$ commuting elements. Th. 5: Diamond (λ^+) holds for any $\lambda > \aleph_0$, provided G.C.H. holds. (Received June 20, 1977.)

777-E59 Matt Kaufmann, University of Wisconsin, Madison, Wisconsin 53706. Back-and-forth systems for stationary logic. Preliminary report.

For a countable language L, let L(aa) or "stationary logic" be logic with the quantifier aa s, where aa s $\varphi(s)$ means "$\varphi(s)$ holds on a closed unbounded collection of

countable sets s." For a formula $\varphi(\vec{x})$ of L(aa), let $\varphi'(\vec{x})$ represent the formula resulting when each occurence of aa s in φ is replaced by $\ulcorner$aa s$\urcorner$; and call a structure $\mathfrak{A}$ determinate if for each formula $\varphi(\vec{x})$, $\mathfrak{A} \models \forall\vec{x}\,(\varphi(x) \leftrightarrow \varphi'(x))$. Then there are necessary and sufficient back-and-forth criteria (similar to the one for elementary equivalence) for each of the following: $\mathfrak{A}$ and $\mathfrak{B}$ satisfy the same sentences of L(aa); $\mathfrak{A}$ is determinate; and $\mathfrak{A}$ and $\mathfrak{B}$ are determinate and satisfy the same sentences of L(aa). Using the third of these, the following can be shown. Suppose that $\{\mathfrak{A}_i : i \in I\}$ and $\{\mathfrak{B}_i : i \in I\}$ are families of determinate structures, and that for each $i \in I$, $\mathfrak{A}_i$ and $\mathfrak{B}_i$ satisfy the same sentences of L(aa). Then the disjoint unions $\bigcup_{\bullet}\{\mathfrak{A}_i : i \in I\}$ and $\bigcup_{\bullet}\{\mathfrak{B}_i : i \in I\}$ are determinate and satisfy the same sentences of L(aa). (Shelah has noticed that this is false if determinacy isn't mentioned.) Back-and-forth systems can also be used to analyze the L(aa) theories of various ordinals (with their natural orderings). (Received June 20, 1977.)

*77T-B60 CHARLOTTE R. LIN, Cornell University, Ithaca, N.Y. 14853. Recursion Theory on Countable Abelian Groups.

We use recursion theory to determine the effective content of (countable abelian group) theory. Each G is presented as a quotient of the free group $\{\gamma_i\}^*$ modulo a subgroup R^*. G is recursively presented (rp) if R^* is a recursive subset of $\{\gamma_i\}^*$. An isomorphism φ between two rp groups G and H is a recursive isomorphism if $\{(x,y) \in G \times H \mid \varphi(x) = y\}$ is r.e. We investigate classical structure theorems and such notions as dependence and height.

Theorem 1: Ulm's theorem is "effectively false". For any countable recursive ordinal τ, there are two rp countable reduced p-groups G and H with Ulm type τ, and isomorphic Ulm factors G_β and H_β, $\forall\, \beta < \tau$, such that G and H are not recursively isomorphic.

Theorem 2: (i) Prüfer's first theorem is effectively true, i.e., a bounded countable rp group is an r.e. direct sum of cyclic p-groups.

(ii) Prüfer's second theorem and Kulikov's criterion are effectively false. There is an rp countable p-group with no elements of infinite height, which is not an r.e. direct sum of cyclic groups. (Received June 27, 1977.)

77T-B61 A.H. LACHLAN, Simon Fraser University, Burnaby, B.C., Canada V5A 1S6. A countable counter example to Skolemisation of elementary pairs. Preliminary report.

We construct countable structures M,N for a countable language L such that $M \prec N$ and there are no Skolem expansions M',N' of M,N such that $M' \prec N'$. (Received June 27, 1977.)

*77T-B62 ROBERT S. RUMELY, Princeton University, Princeton, New Jersey 08540. Undecidability and Elementary Definability in the Theory of Global Fields.

I. The elementary theory of global fields is essentially undecidable.

II. There is a finite collection of predicates which define every valuation, archimedean and nonarchimedean, of every global field, in terms of parameters.

III. Given a global field K:

There is a sentence which distinguishes number fields from function fields.

If K is a number field, the theory of number fields defines its algebraic integers, the rational integers, and the natural numbers.

If K is a function field, the theory of function fields defines its field of constants F, and for an arbitrary nonconstant $x \in K$, defines in terms of x the polynomial ring F[x] and a model of N given by the powers of x.

Gödel functions encoding all finite sequences of elements of K exist for each of these models of N. In consequence, a great variety of objects studied in number theory can be defined in the theory of global fields. (Received June 27, 1977.)

77T-E63 STEVEN GARAVAGLIA, University of California, Berkeley, California 94720. Elementary equivalence of modules. Preliminary report.

Theorem. If R is a commutative ring and A is an R-module, then A is elementarily equivalent to $\bigoplus_M A_M$, where M ranges over the maximal ideals of R, and A_M is the localization of A at M. Corollary. If R is a commutative von Neumann regular ring and A is an R-module, then A is elementarily equivalent to a direct sum of the form $\bigoplus_{i\in I} R/M_i$, where M_i is a maximal ideal for each $i \in I$. (Received July 11, 1977.)

77T-B64 LUDVIK JANOS, Mississippi State University, Mississippi State, Mississippi 39762. The language of inequality and topological properties.

With every metric space (X,d) there is associated the "inequality-structure" (X,I) where I is the quarternary relation on X defined by $(x_1,x_2,x_3,x_4) \in I$ iff $d(x_1,x_2) \leq d(x_3,x_4)$. Let L denote the corresponding first order language which can talk about this structure. i.e., L is based on one quarternary predicate letter I*. If S is a sentence of L and (X,d) is a nonempty metric space we write $(X,d) \models S$ iff the corresponding structure (X,I) is a model of S. To each sentence S of L there corresponds a topological property $P_S : C \to \{T,F\}$ defined on the class C of metrizable spaces as follows: A space $X \in C$ has the property P_S iff there is some metric space (Y,d) homeomorphic to X with $(Y,d) \models S$. If $P : C \to \{T,F\}$ is a given topological property and C' a subclass of C we say that P is expressible in L on C' iff there are sentences $S_1,S_2,\ldots S_k$ of L and a formula $F(p_1,p_2,\ldots p_k)$ of the propositional calculus such that for every $X \in C'$ the truth value of P(X) coincides with that of $F(P_{S_1}(X)P_{S_2}(X),\ldots P_{S_k}(X))$. Theorem. For n = 0,1,... the property dim X=n is expressible in L on the class of compact spaces. (Received July 5, 1977.)

77T-B65 ALOIS BLANC, Queens College, Flushing, New York 11367. On classes of recursive languages. Preliminary report.

Definition. A language is a triple Z=(S,T,R) where S is a recursive set of sentences of Z, $T \subset S$ is a set of valid sentences of Z, and $R \subset S$ is a set of refutable sentences of Z. Definition. Z is consistent iff $T \cap R$ is empty. Z is complete iff $T \cup R = S$. Z is saturated iff Z is consistent and complete. Definition. $Z_p=(S,T_p,R_p)$ is a product language over languages Z_i, i=1,2,3,... iff for every i=1,2,3,... $Z_i=(S,T_i,S \setminus T_i)$, T_i is recursive, $T_p=\bigcap_{i=1}^{\infty} T_i$, and $R_p=S \setminus T_p$. Corollary. Z_p is saturated. Theorem. R_p is recursively enumerable. Corollary. If Z=(S,T,R) is saturated and R is recursively enumerable but not recursive, then T is not recursively enumerable. Theorem. T_p is recursive iff T_p is recursively enumerable. Note. Examples of product languages are: the set of all first order formulas valid in all finite domains, and the set of all satisfiable formulas. (Received July 7, 1977.)

77T-B66 Andrea Maggiolo-Schettini and Giovanni Uccella, Laboratorio di Cibernetica del C.N.R., 80072 Arco Felice and Istituto di Scienze dell'Informazione dell'Università, 84100 Salerno, Italy, On some characterizations of computable functions $N^* \to N^*$.

Three classes T_C, T_L, T_P of computable functions $N^* \to N^*$, i.e. mappings that take a sequence(of natural numbers)of indefinite length to a sequence(of natural numbers)of indefinite length, are considered. The class T_C is defined as the closure of cancellation, zero, successor, predecessor and transposition with respect to left cylindrification, composition and repetition operators; T_L is defined as the closure of cancellation, zero, successor, predecessor, transposition, rotation of three elements and test on the length of the sequence with respect to composition and repetition; T_P is defined as the closure of cancellation, predecessor, rotation of three elements, length of the sequence with respect to composition and repetition. All the operations are considered to be performed on the left side of

the sequence and the repetition of a function stops when a zero is found at the extreme left hand of the sequence. It is proven that the three classes coincide. As T_C has been proven to contain all the computable functions $N^* \to N^*$ (see these Notices 23(1976), A-596) also T_L and T_P have the same property. (Received July 19, 1977.)

*77T-E67 James F. Lynch, Clarkson College, Potsdam, N.Y. 13676. Applications of 0-1 laws in finite and countable spaces.

The following are extensions of previously announced results (these Notices 742-02-6). Let $q \in \omega$, σ be a sentence over + and a q-ary relation symbol, $n = \{0, \ldots, n-1\}$, $Z = \{\ldots, -1, 0, 1, \ldots\}$. Taking the standard product measure on ${}^qZ_2$, $\{Q \subseteq {}^qZ : \langle Z, +, Q\rangle \models \sigma\}$ has measure $u/2^v$ for some nonnegative integers u and v. There is a positive integer a determined by σ such that for any $b \in \omega$, $\lim_{n\to\infty} |\{Q \subseteq {}^q(an+b) : \langle (an+b), +(\mathrm{mod}\ an+b), Q\rangle \models \sigma\}| / 2^{(an+b)^q} = u_b/2^{v_b}$ for some nonnegative integers u_b and v_b. (Received July 22, 1977.)

77T-E68 CHARLES W. LEININGER, State University of New York, Cortland, New York 13045. Relations of even order on finite domains.

A relation R of order 2n (having 2n argument places) on a domain $D = \{a_1, a_2, \ldots, a_k\}$ is represented by a Boolean matrix $B_R = [B_R(p,q)]_{(k^n, k^n)}$ in which $B_R(p,q) = 1$ if and only if $R(a_{i_1}, a_{i_2}, \ldots, a_{i_{2n}})$ where $p = \sum_{r=1}^{n-1} k^{n-r}(i_{2r-1} - 1) + i_{2n-1}$, $q = \sum_{r=1}^{n-1} k^{n-r}(i_{2r} - 1) + i_{2n}$. Remark: The collection of relations on D of order 2n may be partially ordered to form an atomic Boolean algebra. Theorem: There exists a one-one mapping φ from the collection of relations R of order 2n on D to a binary relation on the domain $\{c_1, c_2, \ldots, c_{k^n}\}$ such that $R(a_{i_1}, a_{i_2}, \ldots, a_{i_{2n}}) \equiv [\varphi(R)](c_p, c_q)$. Furthermore φ is an isomorphism with respect to complement, converse, sum, product, relative sum and relative product. Remark: It follows that, if the 12 axioms stated by A. Tarski (On the calculus of relations, J. Symb. Logic 6(1941), 73-89) are rewritten for relations of even order, then the analogues of the 32 theorems given by Tarski hold for such relations. Let '$\odot$' denote relative product. Theorem: If R belongs to the monoid $(S, \odot)$ of relations of order 2n on D, then R belongs to the maximal subgroup of S if and only if (i) $R \odot \breve{R} = \breve{R} \odot R = I$, (ii) each row and column of B_R contains exactly one 1. (Received July 18, 1977.)

77T-E69 Krister Segerberg, Åbo Akademi, 20500 Åbo 50, Finland. A completeness theorem in the modal logic of programs. Preliminary report.

Let P be the set of regular expressions in some fixed program letters. To a classical propositional language add a unary propositional operator $[\alpha]$, for each $\alpha \in P$. Let K^P be the smallest set of formulas closed under modus ponens $(A, A \to B / B)$ and α-necessitation $(A / [\alpha]A)$, for every $\alpha \in P$, and containing, for all formulas A, B and all $\alpha, \beta \in P$, the following formulas:
(1) $[\alpha](A \to B) \to ([\alpha]A \to [\alpha]B)$, (2) $[\alpha+\beta]A \leftrightarrow [\alpha]A \wedge [\beta]A$, (3) $[\alpha\beta]A \leftrightarrow [\alpha][\beta]A$, (4) $[\alpha^*]A \to A$, (5) $[\alpha^*]A \to [\alpha]A$, (6) $[\alpha^*]A \to [\alpha^*][\alpha^*]A$, (7) $A \wedge [\alpha^*](A \to [\alpha]A) \to [\alpha^*]A$. Then K^P is complete with respect to the class of frames $\langle U, R\rangle$ where U is a nonempty set and $R = \{R_\alpha : \alpha \in P\}$ is a family of binary relations on U such that, for all $\alpha, \beta \in P$, (i) $R_{\alpha+\beta} = R_\alpha \cup R_\beta$, (ii) $R_{\alpha\beta} = R_\alpha | R_\beta$, and (iii) $R_{\alpha^*} = R_\alpha{}^*$. (This answers a question raised by Michael J. Fischer and Richard E. Ladner.) (Received August 2, 1977.)
(Author introduced by Professor S. K. Thomason).

*77T-E70 PETER LA ROCHE, Cornell University, Ithaca, New York 14853. Recursively presented Boolean algebras.

A Boolean algebra is said to be recursively presented if its domain is a recursive set of positive integers and its operations are recursive. An isomorphism between

two recursively presented Boolean algebras is said to be recursive if it is a recursive function between their domains. We prove the following.

Theorem. Let A be a Boolean algebra with a recursive presentation. Then A has a unique recursive presentation up to recursive isomorphism if and only if A has finitely many atoms. (Received August 18, 1977.)

77T-E71 GERHARD F. KOHLMAYR, Mathmodel Consulting Bureau, Glastonbury, CT 06033.
Pragmatic set theory and the Boolean prime ideal theorem.

For terminology, see Abstract 747-02-6, these NOTICES, 24 (1977) p. A-447. A sketch of pragmatic set theory. Axiom 0. We have a predicate constant $\in$ (denoting membership) and two distinct kinds of objects: urelements x,y,z,... and sets X,Y, Z,...; every urelement is a set; there are sets which are not urelements. Axiom I. There is an empty set. Axiom II. There are pairs of nonempty sets. Axiom III. There is a union for every nonempty set of nonempty sets. Axiom IV. Every nonempty set has a power set. Axiom V. There is exactly one nonempty set of urelements whose members are elements of a trivial ordered differential field. Remark. I write PST behind a theorem to indicate that the axioms of pragmatic set theory are assumed to be a consistent set of sentences. Theorem (PST). Let $P(\omega)$ be the Boolean algebra of subsets of the set of nonnegative neointegers ω. Then $P(\omega)$ contains nontrivial proper ideals which are not contained in a maximal ideal. The set Υ of all nontrivial proper ideals in $P(\omega)$ constitutes a well-ordered additive monoid which is both order-isomorphic and lattice-isomorphic to ω. (Received August 18, 1977.)

Statistics and Probability (60, 62)

*77T-F16 LLOYD D. BOOKMYER and MIR M. ALI, Ball State University, Muncie, IN, 47306.
Partition Approach to Sufficiency.

Because sufficiency plays such an important role in statistical inference, it is vital that the topic be presented as clearly as possible in elementary statistics courses. With this in mind, this paper advocates an approach to sufficiency using the notion of a sample space partition. The paper points out the benefits of a partition approach and it shows how such a development complements and reinforces the more traditional analytic approach to sufficiency. Some familiar notions are discussed and a sequence of theorems by Sampson and Spencer (Amer. Stat (1976), 30(1)), are interpreted and explained in terms of partitions. (Received May 16, 1977.)

*77T-F17 Dan Sunday, Dept. Physiology, U.C.- Berkeley, CA 94720.
A Nonlinear Representation of Shape for Machine Vision. Preliminary report.

Let $f \in X = L_2[R^n, R]$, with $\|f\|_2 = 1$, be an input pattern. Consider the probability density $P(f): R^n \to R$ defined by: $P(f)(y) = \int_{R^n} F_y(x)\,dx$, where: $F_y(x) = f(x)\cdot f(2y-x)$. For y fixed, F_y is the clustering density of f about the center y. Now, let $C = \{y_0, y_1, \ldots, y_k\}$ be the ordered set of maxima of P(f), and call it the set of central vertices of f. Next, assign weights to the subsimplices of C by: (1) multiply together the clustering densities associated with the vertices of a subsimplex, and (2) integrate. Then, the resulting weighted simplex structure is a similarity-invariant representation for the "shape" of f. Further, this operator is continuous over X. (Received June 24, 1977.)

*77T-F18 M.A. AKCOGLU and L. SUCHESTON, University of Toronto and The Ohio State University. A ratio ergodic theorem for superadditive processes.

Let T be a positive linear contraction on $L_1(X,\mathfrak{F},\mu)$, with the Hopf decomposition $X = C + D$. We consider a sequence of L_1^+ functions with partial sums s_n, called superadditive iff $s_{k+n} \geq s_k + T^k s_n$ for all $k,n \geq 0$, and $\gamma = \sup_n \int \frac{1}{n} s_n \, d\mu < \infty$. δ in L_1^+ is an exact dominant iff $\int \delta \, d\mu = \gamma$, and $\delta + T\delta + \ldots + T^{n-1}\delta \geq s_n$ for each $n \geq 1$. If $X = C$, then $s_n / \Sigma_0^{n-1} T^i \delta$ converges to 1 on the set $\{\Sigma_0^{n-1} T^i \delta > 0\}$. Let s_n and s_n' be superadditive sums with respect to the same contraction operator. The following is a generalization of the Chacon-Ornstein theorem, case $T \geq 0$ of Chacon's ratio theorem, and of Kingman's ergodic theorem: Let $E = \{\sup s_n' > 0\}$. $\lim s_n/s_n' < \infty$ exists on $C \cap E$. An identification of this limit is given. $\lim s_n/s_n'$ exists on $D \cap E$ if either a) or b) holds: a) T is Markovian i.e., it preserves the integral; b) on $D \cap E$ s_n is of the form $\Sigma_0^{n-1} T^i \delta$, for some δ in L_1^+. The proof uses that if T is Markovian, then there is at least one exact dominant. (Received June 27, 1977.)

*77T-F19 Daniel Asimov, University of North Carolina, Chapel Hill, North Carolina 27514. Product measures and random integers. Preliminary report.

Let (I, m) denote a probability space. Assume that I is infinite of cardinality κ and that I is homogeneous (i.e. for any $x, y \in I$ there is a measure automorphism $A : I \to I$ with $A(x) = y$). Let B be any set of cardinality $\beta > \kappa$. Theorem. Let $\mathcal{S} \subset \mathcal{P}(I^B)$ consist of all sets of the form $S = \prod_{\alpha \in B} F_\alpha$, where for an arbitrary $B_1 \subset B$ with card $(B_1) > \kappa$ and for an arbitrary function $r : B_1 \to I$ we have $F_\alpha = I - \{r(\alpha)\}$ for $\alpha \in B_1$, and $F_\alpha = I$ for $\alpha \in B - B_1$. There is a measure μ on I^B which extends the usual product measure* and satisfies $\mu(S) = 0$ for all $S \in \mathcal{S}$. // Corollary. There is a procedure which, with probability one, results in choosing a random integer, with all integers being equally likely to be chosen. // This is in contrast to the nonexistence of a homogenous probability measure on $\mathbb{Z}$. *cf. Halmos, Measure Theory, Van Nostrand, 1950, p. 158. (Received July 22, 1977).

*77T-F20 Richard Salter, Indiana University, Bloomington, Indiana 47401. Small time limit theorems for stationary independent increment processes.

Let $X(t)$, $t \geq 0$, be a real-valued stochastic process with stationary independent increments, and $X(0) = 0$. Results analogous to the classical theorems on domains of attraction (i.e. Feller, vol. 2) are proved, and used to give necessary and sufficient conditions for the existence of weak limits of the form

$$\lim_{t \to 0} \frac{X(t)}{a_t} - b_t .$$

In addition, the sequence of processes

$$\{X_n(t)\} = \left\{\frac{X(t/n)}{a_n} - b_n\right\}$$

is considered, and necessary and sufficient conditions are given under which a weak limit exists. (Received August 11, 1977.)

77T-F21 N. GHOUSSOUB AND L. SUCHESTON, DEPARTMENT OF MATHEMATICS, THE OHIO STATE UNIVERSITY COLUMBUS, OHIO, 43210. A Refinement of the Riesz Decomposition for Amarts and Semiamarts.

For the definitions, see: Edgar-Sucheston, J. Multivariate Analysis 6, 193-221; Krengel-Sucheston, Bull. Amer. Math. Soc. 83, 745-747; A. Bellow, C. R. Ac. Sc. 84, 1295-1298.

Theorem 1: An adapted sequence (X_n) is an amart if and only if $X_n = Y_n + Z_n$ where (Y_n) is

a martingale and $|Z_n| \leq S_n$, $n=1,2,\ldots$, where (S_n) is a Doob's potential, i.e., a positive supermartingale converging to zero.

The proof uses the Riesz decomposition and the following lemma: If (X_n) is an amart and $S_n = \text{ess}_\sigma \sup E(X_\sigma/\mathcal{F}_n)$, where ess sup is over all bounded stopping times $\geq n$, then $(S_n - X_n)$ is a potential, and (S_n) is the smallest supermartingale dominating (X_n).

Theorem 2: Theorem 1 remains valid if "amart" is replaced by 'semiamart', provided that (S_n) is required to be only a positive supermartingale.

Applying A. Bellow's remarkable theory of uniform amarts and Theorem 1, we obtain:

Theorem 3: Theorem 1 remains valid if the random variables are E-valued (E a Banach space), 'amart' is replaced by 'uniform amart', and $|\ |$ is the norm in E.

Many arguments used in the proof of the lemma can be found in J. Neveu, Discrete Parameter Martingales; in part they go back to J. L. Snell. (Received August 22, 1977.)

Topology (22, 54, 55, 57, 58)

*77T-G99 J. GRISPOLAKIS and E.D. TYMCHATYN, University of Saskatchewan, Saskatoon, Sask. S7N 0W0. Confluent mappings and acyclicity of Hausdorff continua. Preliminary report.

A continuum is a connected, compact, Hausdorff space. A mapping f of a compact Hausdorff space X onto a Hausdorff space Y is said to be confluent provided for each continuum K in Y each component of $f^{-1}(K)$ maps onto K. A. Lelek had proved in a paper in Colloq. Math. (1966) that if $f:X \to Y$ is a confluent mapping of a compact metric space X onto a metric space Y, then $f^*:H^1(Y) \to H^1(X)$ is a monomorphism (Čech cohomology with integer coefficients). We extend Lelek's Theorem to the non-metric setting. This answers a question of B.A. Pasynkov. The theorem of Mazurkiewicz on the existence of indecomposable continua in metric continua of dimension ≥ 2 is extended to the non-metric case. Some theorems of Charatonik and McLean on the preservation of certain classes of continua by confluent mappings are extended to the non-metric case. (Received April 25, 1977.)

*77T-G100 Ronnie Levy, George Mason University, Fairfax, Virginia 22030. Small compact spaces. Preliminary report.

A space X is dense-separable if every dense subset of X is separable. Theorem. A compact Hausdorff space X without isolated points is a compactification of the space of rationals if and only if X is dense-separable and X has a dense set of points of first countability. Corollary 1. Assume $2^{\aleph_0} < 2^{\aleph_1}$. If X is a dense-in-itself compact Hausdorff space of cardinal $2^{\aleph_0}$, then X is a compactification of the space of rationals if and only if X is dense-separable. Corollary 2. Assume $2^{\aleph_0} < 2^{\aleph_1}$. Then every dense-in-itself compact Hausdorff space of cardinal $2^{\aleph_0}$ contains a dense-in-itself dense-separable compact subset. Theorem. Suppose X is a compact Hausdorff space. Let $\alpha = \sup\{\gamma : \text{There is a dense subset of } X \text{ with density } \gamma\}$. Then if $\text{card}(X) < 2^{\alpha^+}$, then X has a π-base of cardinal at most α. (Received June 6, 1977.)

77T-G101 ERNEST P. LANE, Appalachian State University, Boone, North Carolina 28608
Insertion of a continuous function. Preliminary report.

The last corollary of [Insertion of a continuous function, Pacific J. of Math. 66, No. 1 (1976), 181-190] is strengthened as follows:

Theorem: The following are equivalent. (1) A space X satisfies the strong insertion

property for (normal usc, continuous) [respectively, (continuous, normal lsc)]. (2) A space X satisfies the strong C insertion property for (normal usc, normal lsc). (3) Each regular closed subset of X is a zero set. (Received July 15, 1977.)

*77T-G102 PAUL BANKSTON, University of Kansas, Lawrence, Kan. 66045. The infinite distributivity of some regular open algebras.

A space X is semiregular if its regular open sets form a basis. X is k-additive (k an infinite cardinal) if the topology on X is closed under $<k$ intersections. X is k-Baire if the intersection of $<k$ dense open sets is dense. A Boolean algebra B is (k,∞)-distributive if whenever I is any set and $(a_{\xi,i}:\xi<k,\ i\in I)$ is a $k\times I$-sequence from B then the identity

$$\bigwedge_{\xi<k}\bigvee_{i\in I} a_{\xi,i} = \bigvee_{s\in I^k}\bigwedge_{\xi<k} a_{\xi,s(\xi)}$$

holds. We prove the Theorem: Let X be a k-additive semiregular space. Then X is k-Baire iff the Boolean algebra of regular open subsets of X is (k,∞)-distributive. (Received June 6, 1977.)

77T-G103 Jack Porter and Prem Sharma, University of Kansas, Lawrence, Kansas 66044. Invariance of Continuity. Preliminary report.

Let Σ be a class of spaces. For a topology τ on a space X, let τ_Σ denote the initial topology on X induced by the class of continuous functions from (X,τ) into the spaces of Σ. Let $\Sigma(\tau) = \{\sigma : \sigma$ topology on X and $\sigma_\Sigma = \tau_\Sigma\}$. Two topologies τ and σ are said to be Σ-equivalent if $\tau_\Sigma = \sigma_\Sigma$. Maximal (resp. minimal) elements in $\Sigma(\tau)$ are called Σ-maximal (resp. Σ-minimal). If Σ is the class of Tychonoff (resp. regular T_1) spaces, then Σ is replaced by $\mathbb{R}$ (resp. Reg). A semi-regular topology need not be regular-minimal. Every Tychonoff topology with at least three pairwise disjoint dense sets is shown to be regular-equivalent to a submaximal topology which is not regular-maximal (hence, not $\mathbb{R}$-maximal). In particular, the usual topology on $\mathbb{R}$ (the real line) has a submaximal $\mathbb{R}$-equivalent expansion which is not regular-maximal. This answers some questions posed by Guthrie and Stone [Gen. Top. and Appl. 7(1977), 1 - 13]. (Received June 23, 1977.)

77T-G104 PAUL R. PATTEN, University of Oklahoma, Norman, Oklahoma 73019. The refinable image of a 1-dimensional ANR. Preliminary report.

A map from a compact metric space onto a metric space is refinable provided it can be uniformly approximated by maps whose point inverses have small diameter. In a preprint, Refinable maps, by Jo Ford and J. W. Rogers, Jr., it is shown that if X and Y are both ANR's and r is a refinable map from X onto Y then X and Y have the same homotopy type. Consequently Ford and Rogers pose the following question. Is the refinable image of an ANR also an ANR?

We have an affirmative answer in the case that X is assumed to be 1-dimensional. Thus if Y is the refinable image of a 1-dimensional ANR X, Y is a 1-dimensional ANR and X and Y have the same homotopy type. (Received June 24, 1977.)

*77T-G105 LARRY BAGGETT, University of Colorado, Boulder, Colorado 80309 and KEITH TAYLOR, University of Saskatchewan, Saskatoon, Saskatchewan S7N 0W0. A sufficient condition for the complete reducibility of the regular representation.

The "Mackey Machine" is heavily employed to prove the following theorem which generalizes a theorem of Figa-Talamanca for unimodular groups.

THEOREM: Let G be a separable locally compact group. Suppose that every positive definite function on G, which vanishes at infinity, is associated with the regular representation R of G. Then R decomposes into a direct sum of irreducible representations.

In addition we show that, although the above condition on positive definite functions is sufficient for the complete reducibility of R, it is not necessary. (Received June 27, 1977.)

77T-G106 Kenneth I. Joy, University of Colorado, Boulder, Colorado 80309. A Description of the Topology on the Dual Space of a Nilpotent Lie Group. Preliminary report.

Let G be a connected simply connected nilpotent Lie group. If $\{W_n\}$ is a sequence in $\hat{G}$, the limits of $\{W_n\}$ are characterized in terms of limits of certain sequences of subgroup-representation pairs $\{(H_n, S_n)\}$ using the subgroup-representation pair topology of Fell. These results are used to give an independent proof of a conjecture of Kirillov without referring to the free nilpotent Lie algebras used by Brown (Ann. Sci. Ecole Norm. Sup., (4) 6 (1973), 407-411). (Received June 27, 1977.)

*77T-G107 S. Singh, The Pennsylvania State University, University Park, Pa. 16802. A Linking Axiom, Retracts, and Factors of E^{n+1}.

Suppose k and n are integers satisfying $1 \leq k \leq (n-1)$ and $n>3$. Suppose G is a k-UV u.s.c. decomposition of the Euclidean space E^n such that the set of all the nondegenerate elements of G is countably infinite (nonfinite). If such a decomposition G satisfies k-LA, then the decomposition space does not contain any $(k+1)$-cell. The notation of k-LA ("k-linking axiom") for an upper semicontinuous decomposition G of E^n is defined. As an application, we show that for each n, $n>3$, there exists an upper semicontinuous decomposition G of E^n into a countable null family of arcs and points such that the decomposition space E^n/G does not contain any 2-cell. It follows from a theorem of Meyer [Fund. Math. 67 (1970), 49-65], and a theorem of Klee that $E^n/G \times E^1$ is homeomorphic to E^{n+1}. It is also shown that for each n, $n>3$, there exist a decomposition G of the n-ball B^n such that the nondegenerate elements of G form a null family of arcs and the decomposition space B^n/G is an n-dimensional compact absolute retract which does not contain any disk. This answers a question of Bing and Borsuk [Fund. Math. 54 (1964), 159-174]. Furthermore, easy modifications of our earlier work [Fund. Math. 93 (1976), 23-36] show that there exists for each n an AR of dimension n which does not contain any ANR of dimension $n \geq 2$. (Received July 5, 1977.)

*77T-G108 H.H. Hung, McGill Univ., Montréal, Canada. Metric, Symmetric, Asymmetric.

We have the following characterization of Metrizability in terms of the Closure Operator. A T_0 space X is metrizable if (and only if) it has at every point $p \in X$ a countable set of neighbourhoods $\{U_n(p)\}_{n \in \mathbb{N}}$ such that $\cap_n B_n A = Cl\, A = \cap_n Cl\, B_n A$, for all $A \subset X$, where $B_n A \equiv \cup \{U_n(p) : p \in A\}$. If a non-negative real-valued function ρ on $X \times X$ that is 0 only on the diagonal is to be called an *asymmetric* on X and if the space X itself, the topology of which is the finest such that i) for all closed subsets $C \subset X$, $\rho(x,C) \equiv \inf\{\rho(x,y) : y \in C\} < 0$ if (and only if) $x \notin C$; ii) for all $r > 0$, $B_r(\xi) \equiv \{y : \rho(y,\xi) < r\}$ is a neighborhood of ξ; is called an *asymmetric space*; then we have: 1. An asymmetric space is metrizable if its asymmetric ρ has the following property. For any $r > 0$, there is some such $s > 0$ that the indexed family $\{B_s(\xi)\}_{\xi \in X}$ is cushioned in $\{B_r(\xi)\}_{\xi \in X}$. 2. An asymmetric space is metrizable if its closed balls (around any subsets) are closed, i.e., for any $r > 0$ and any subset S, the set

$$C_r S \equiv \{y : \rho(y,S) \leq r\} = \cap_{r<s} B_s S$$

is closed. (Received July 18, 1977.)

*77T-G109 S. Broverman, University of Toronto, Toronto, Canada M5S 1A1; J. Ginsburg, University of Manitoba, Winnipeg, Canada R3N 1A2; K. Kunen, University of Wisconsin, Madison, Wisconsin 53706; F.D. Tall, University of Toronto, Toronto, Canada M5S 1A1. Topologies determined by σ-ideals on ω_1.

Let $\mathcal{I}$ be a σ-ideal on ω_1. Let $\Sigma(\mathcal{I}) = \{f\in 2^{\omega_1}: \{\alpha: f(\alpha) = 1\}\in\mathcal{I}\}$. Give $\Sigma(\mathcal{I})$ the subspace topology inherited from the product. Theorem. $\Sigma(\mathcal{I})$ is normal iff $\mathcal{I}$ is all subsets of ω_1 or all countable subsets of ω_1. Theorem. $\Sigma(\mathcal{I})$ has caliber $\aleph_1$ iff each uncountable subset of ω_1 includes an uncountable member of $\mathcal{I}$. Using this idea, a natural construction of a $T_{3\frac{1}{2}}$ space with a predetermined set of calibers is given. The problem of whether $\Sigma(\mathcal{I})$ is $\aleph_1$-Baire, i.e. whether the intersection of $\leq \aleph_1$ dense open sets is always dense, is studied in various models of set theory and partial results are obtained. For example, let $\mathcal{P}$ be the assertion that there exist infinite subsets $\{A_\alpha\}_{\alpha<\omega_1}$ of ω_1 such that each uncountable set includes some A_α. Theorem. $\mathcal{P}$ implies no $\Sigma(\mathcal{I})$ is $\aleph_1$-Baire.
(Received July 20, 1977.)

77T-G110 VALERY V. MIŠKIN, Kemerovo State University, Kemerovo 650043, USSR. Closed maps of Moore spaces. Preliminary report.

A T_1-space is called a θ-space if for every countable, discrete family of its points there exists a discrete family of their neighbourhoods. All maps below are continuous. Th.1: If $f: X\to Y$ is a closed map of a developable θ-space X onto a Baire space Y, then the set $O(f)$ of all points $y\in Y$ at which f is open is a dense G_δ-set in Y. Th.2: If $f: X\to Y$ is a closed map of a Moore θ-space X onto a Baire space Y, then there exists a G_δ-set $O_p \supset f^{-1}O(f)$ such that for every $A \supsetneqq O_p$ the restriction $f|_A$ is not open. Th.3: Let $f: X\to Y$ be a closed map of a Moore θ-space X onto a Baire space Y. If $f^{-1}O(f)\subset A\subset O_p$ and $f|_A$ is closed, then $f|_A$ is open. Th.4: For every closed map $f: X\to Y$ of a normal Moore space X onto a Baire space Y there exists a maximal element in the family of all subsets $A\subset X$ on which the restriction $f|_A$ is both open and closed.
(Received July 22, 1977.)

*77T-G111 Vo Thanh Liem, Louisiana State University, Baton Rouge, LA 70803. A counter example in l_2-manifold theory. Preliminary report.

In this note, we show that there is an space X such that X×X is homeomorphic to l_2, but X itself is not homeomorphic to l_2. (Received July 25, 1977.)

77T-G112 Robert H. Lewis, Lander College, Greenwood, S.C. 29646. Homology Decompositions of Non-Simply Connected Spaces. Preliminary report.

Let X be a CW complex with finitely-related fundamental group. Then ∃ a homotopy equivalent complex K which has a normal tower of subcomplexes, i.e., a sequence of subcomplexes $K_1\subset K_2\subset\cdots$ such that $H_i(K_n) = H_i(K)$ for $i\leq n$ and $H_i(K_n) = 0$ for $i>n$. Furthermore, the relative complex (K_{n+1},K_n) consists of (n+1)- and (n+2)-cells. This generalizes a construction of Hilton in Homotopy and Duality and is the first step in the construction of a functorial homology decomposition. (Received July 26, 1977.)

77T-G113 Dennis K. Burke, Miami University, Oxford, Ohio 45056. Pseudo-open mappings from topological sums. Preliminary report.

In the following, assume that X_1 and X_2 are topological spaces on the same set X such that when S is the free topological sum of X_1 and X_2 then the canonical quotient mapping $f: S\to X$ is pseudo-open.

Theorem 1. If X_1 and X_2 are both regular developable spaces then X is developable.

Example 2. There are developable spaces X_1, X_2 with X_1 regular and X_2 Hausdorff such that X is not developable.

Example 3. There are completely regular spaces X_1, X_2, each with a σ-disjoint base such that X does not have a σ-disjoint base.

Example 4. (MA + $\neg$CH) There are metrizable Spaces X_1, X_2 such that X is normal and first countable but not metrizable.

These results answer questions 2,3,4 asked by A.V. Arhangel'skiĭ in [The intersection of topologies and pseudo-open compact mappings, Soviet Math. Dokl., 17 (1976), 160-163]

Example 5. There are locally compact paracompact spaces X_1, X_2 such that X is not subparacompact. This shows that the pseudo-open compact image of a paracompact space need not be subparacompact.

(Received July 28, 1977.)

777-G114 ERIC K. van DOUWEN, Institute for Medicine and Mathematics, Ohio University, Athens, OH 45701, Subcontinua and nonhomogeneity of $\beta\mathbb{R}^+ - \mathbb{R}^+$. Preliminary report.

$\mathbb{H}$ is the half line $\mathbb{R}^+ = [0,\infty)$, $\mathbb{H}^*$ is $\beta\mathbb{H} - \mathbb{H}$. A point of a space is called a *weak cut point* if it is a cut point of some closed connected subspace.

THEOREM 1: $\mathbb{H}^*$ is not homogeneous BECAUSE some but not all points are weak cut points.

(Any point of $\mathbb{H}^*$ that is in the closure of a closed discrete subset of $\mathbb{H}$ is a weak cut point. If $\mathcal{C}$ is a maximal chain of indecomposable subcontinua (then $\mathcal{C} \neq \emptyset$), no point of $\cap\mathcal{C}$ is a weak cut point.)

THEOREM 2: A subcontinuum of $\mathbb{H}^*$ is either irreducible between two points and has a dense set of cut points or is indecomposable. Any nondegenerate subcontinuum of one of these classes includes a nondegenerate subcontinuum of the other class.

THEOREM 3: Let S be a nondegenerate subcontinuum of $\mathbb{H}^*$, let $x \in S$ and let $C_x = \{y \in S$: no cut point of S separates x from $y\}$. Then C_x is an indecomposable continuum, and $|C_x| = 1$ iff x is a cut point of S.

DEFINITION: If S is irreducible between two points, the *uniqueness degree* of S is

$$u(S) = max\ \{n \leq 2: \text{there is } F \subseteq S \text{ with } |F| = n \text{ such that for all } a,b \in S, \text{ if } S \text{ is irreducible between } a \text{ and } b \text{ then } |F \cap \{a,b\}| \geq n\}.$$

THEOREM 4: $\mathbb{H}^*$ has (at least) five mutually nonhomeomorphic nondegenerate proper subcontinua: For each of $n=0,1,2$ there is a subcontinuum S that is irreducible between two points with $u(S) = n$, and some but not all nondegenerate proper indecomposable subcontinua have the property that every nonempty G_δ-subset has nonempty interior. (Received August 2, 1977.)

777-G115 Wesley J. Browning, Cornell University, Ithaca, New York 14853. The homotopy classification of non-minimal 2-complexes with given finite fundamental group. Preliminary report.

Let G be a finite group and let CG denote the class of finite based connected 2-dimensional CW-complexes with fundamental group isomorphic to G. Let m be the minimum Euler characteristic of spaces in CG.

Theorem: Any two spaces in CG having common Euler characteristic greater than m will have the same homotopy type. Furthermore, a homotopy equivalence between two such spaces can always be chosen to induce any desired fundamental group isomorphism.

(Received August 1, 1977.)

777-G116 R. BROWN, University College of North Wales, Bangor, North Wales and P. J. HIGGINS, Kings College, Strand, London. On homotopy excision. Preliminary report.

THEOREM: Let $X = U^\circ \cup V^\circ$, $U \cap V = W$ where U,V,W are path-connected. Let $n > 2$, and assume $\pi_i(U,W) = 0$ for $1 \leq i \leq n-1$. Then the excision map $\pi_n(U,W) \to \pi_n(X,V)$ determines $\pi_n(X,V)$ as the induced module $\lambda_*\pi_n(U,W)$ where $\lambda : \pi_1(W) \to \pi_1(V)$ is induced by inclusion. [If $n = 2$, a similar result is true but with "module" replaced by "crossed module", and the result is in the author's paper "On the connection between the

second relative homotopy groups of some related spaces "Proc.London Math. Soc. (to appear). The methods of this paper have now been generalised to all dimensions to give a generalisation of the van Kampen Theorem which includes the above Theorem as one of a number of special cases.]

(Received August 2, 1977.)

77T-G117 Themistocles M. Rassias, University of California, Berkeley, California 94720. Vector fields on smooth Banach manifolds.

Let M be a paracompact C^r Banach manifold, with $r \geq 2$. Consider X to be a C^{r-1} vector field on M. There is an open subset $\Omega(X)$ of $\mathbb{R} \times M$ called the *flow domain of* X, and a function $f: \Omega(X) \to M$ called the *flow of* X so that

$$\begin{cases} \frac{d}{dt}f(t,x) = X(f(t,x)) & \text{for all } (t,x) \in \Omega(X) \\ f(0,x) = x & \text{for all } x \in M \end{cases}$$

[See: S. Lang, *Introduction to Differentiable Manifolds*, Interscience, New York (1962)]. Let X' be another vector field on M. We say that X' *is equivalent to* X if there exists a C^{r-1} positive function $F: M \to \mathbb{R}$ so that $X' = FX$, the pointwise product of F and X.

THEOREM: *Assume* M *is a paracompact* C^r *Banach manifold, with* $r \geq 2$, *admitting* C^{r-1} *partitions of unity subordinate to any locally finite cover. Then for every* C^{r-1} *vector field* X *on* M *there exists an equivalent* C^{r-1} *vector field* X' *whose flow domain is* $\mathbb{R} \times M$.

The assumption on the manifold M to be C^r smooth with $r \geq 2$ is necessary in order for the tangent bundle of M to be of at least C^1 smoothness. The converse of the theorem has also been studied and applications of it to other similar problems have been discussed. (Received August 9, 1977.)

77T-G118 Richard E. Heisey, Vanderbilt University, Nashville, Tennessee 37235. Stability with control for Q^∞ manifolds. Preliminary report.

Let $Q^\infty = \text{dir lim } Q^n$ where Q denotes the Hilbert cube. Let M,N denote paracompact, connected Q^∞-manifolds. Let $\mathcal{V}$ be an open cover of M, and let $p: M \times Q^\infty \to M$ be the projection map.

Theorem. There is a homeomorphism $h: M \times Q^\infty \to M$ such that h and p are $\mathcal{V}$-close.

Corollary 1. There is a homeomorphism $h: M \times Q^\infty \to M$ such that h is homotopic to p. Corollary 2. Every homotopy equivalence $f: M \to N$ is homotopic to a homeomorphism. (Received August 19, 1977.)

77T-G119 D. REBHUHN, Vassar College, Poughkeepsie, New York, 12601. On Genericity and Complements of Measure Zero Sets in Function Spaces.

Generic properties of function spaces have been of particular interest in dynamical systems and singularity theory. The underlying assumption has been that the complement of a dense G_δ set is sparse enough to be considered unlikely. Nevertheless, in finite dimensional spaces, even dense G_δ's may have measure zero. Since there is no one canonical measure on an infinite dimensional Frechet space, notions of measure zero have not often been considered. Here we use a notion of Haar measure zero on abelian Polish groups due to Christensen. We show that those sections of a finite dimensional vector bundle over a compact manifold whose jets are transverse to a submanifold of the jet bundle are complements of sets of Haar measure zero. (Received August 19, 1977.)

77T-G120 J. E. VAUGHAN, University of North Carolina at Greensboro, N.C. 27412. A weak version of property D. Preliminary Report.

A countable, closed discrete set B in a space X is said to have property D in X if there exists a discrete family $\{U_b : b \in B\}$ of open sets in X such that $b \in U_b$ for all b in B. A space X has property D if each such $B \subset X$ has property D in X. X has

property wD if each such $B \subset X$ has an infinite subset $B' \subset B$ which has property D in X. In the class of regular spaces in which every point is a G_δ, property wD is hereditary and ω_1-fold productive, whereas property D is not hereditary and not finitely productive. Whether every product of perfectly normal spaces has property wD is independent of the usual axioms of set theory. Every regular, submetrizable space has property wD, but need not have property D (e.g., the Niemytzki plane does not have property D). Most of the results hold in larger classes of spaces than the one mentioned; so we also consider a heirarchy of properties concerning countable pseudocharacter. (Received August 22, 1977.)

81ST SUMMER MEETING | *University of Washington*
Seattle, Washington
August 15–18, 1977

747-05-19 F.S.Mulla, Kuwait University
P.O. Box 5969, Kuwait.
On 3- Regular Graphs. Preliminary Report:

this is a continuation of an earlier paper (procedings of the international conference on combinatorics, July 1976 , Orsay, Paris, France), in that paper it was proved with M.Pareek that the finite graphs with the degree of each vertex between 2 and 3 has two disjoint maximal stable sets. Here we prove that the vertex set of such graph can be partitioned in to 3 subsets two of which are maximal stable sets. (Received June 27, 1977.)

747-15-6 LEROY B. BEASLEY, University of Waterloo, Waterloo, Ontario, Canada.
Linear Transformations on Matrices: The invariance of commuting pairs of Matrices.

Let $M_n(F)$ represent the set of all $n \times n$ matrices over an algebraically closed field of characteristic 0, and let L be a linear transformation on $M_n(F)$. If $n \geq 3$, and either: i) L is nonsingular and $AB = BA$ implies $L(A)L(B) = L(B)L(A)$; or ii) $AB = BA$ if and only if $L(A)L(B) = L(B)L(A)$, then there exist a nonsingular matrix $S \in M_n(F)$, a scalar $c \in F$, and a linear functional f on $M_n(F)$ such that either: i) $L(X) = cS^{-1}XS+f(X)I$, for all $X \in M_n(F)$; or ii) $L(X) = cS^{-1}X^tS+f(X)I$ for all $X \in M_n(F)$, where X^t represents the transpose of X. This is an extension of a result due to William Watkins. (Received June 27, 1977.) (Author introduced by Dr. Larry J.Cummings).

747-17-1 CARLOS A. INFANTOZZI, Inst. de Estudios Superiores, Atlántico 1514, Montevideo, Uruguay. On bi-Quaternion integers: "Lattice of Hankelian near-Rings with Units"

1).- With one unit only: there is one ring Z; 2).- With two units only: there are seven sets G_n ($n=1,2,\ldots 7$) of "Gaussian" integers; $Z \subset G_n$; 3).- With four units only: there are seven sets L_n of "Lipschitz" integers and seven sets H_n of "Hurwitz" integers (H_n is generated by $(1, t_n)$ where t_n is one of the triads); $G_n \subset L_m \subset H_m$ where m has values corresponding to n as follows: $m=1$, 2,3 if $n=1$, $m=1,4,5$ if $n=2$, $m=1,6,7$ if $n=3$, $m=2,4,6$ if $n=4$, $m=2,5,7$ if $n=5$, $m=3,4,7$ if $n=6$, and $m=3,5,6$ if $n=7$; 4).- With eight units (1,i,j,k,e,f,g,h where $k=ij$, $f=ie$, $g=je$, $h=ke$): there are: one set L of "Lipschitz" integers, one set $H=(L,\omega)$ of "Hurwitz" integers ($\omega = 1/2\,(1+i+j+k+e+f+g+h)$), seven sets $D_m=(L,T_n)$ of "bi-Hamiltonian" integers (where T_n is determined by the triad t_n: $\alpha\beta\gamma$ thus: $T_n = 1/2\,(1+\alpha+\beta+\gamma)$) and seven sets $I_n=(L,Z_n)$ of "Cayleyan" integers (where $Z_1 = 1/2\,(1+i+e+g)$ and $Z_n = S_n(Z_1)$, the S_n are the substitutions which change (ijkefgh) to (ijkefgh), (jkieghf), (ihgjkfe), (fiehjgk), (kijehfg), (jfhkige) and (iefhgkj)); $L \subset H \subset D_n \subset I_m$ where $n=1,6,7$ if $m=1$, $n=1,2,3$ if $m=2$, $n=3,4,7$ if $m=3$, $n=2,4,6$ if $m=4$, $n=1,4,5$ if $m=5$, $n=3,5,6$ if $m=6$ and $n=2,5,7$ if $m=7$. Moreover: $L_m \subset L$ and $H_n \subset D_n$.// There are not such structures with 3,5,6 or 7 units only. (Received June 8, 1977.)

747-20-8 RUSSELL MERRIS, California State University, Hayward, Hayward, California 94542. Subgroups Normal Modulo the Zeros of an Irreducible Character.

Abstract. Let G be a finite group. Let χ be an irreducible complex character of the subgroup H. Extend χ to a function χ_* of G by defining $\chi_*(g)=0$ for all $g \in G \backslash H$. Then H is defined to be χ-invariant in G if $\chi_*(g^{-1}hg)=\chi(h)$ for all $g \in G$ and $h \in H$. Numerous characterizations of "χ-invariant" are discussed. (Received June 13, 1977.)

748TH MEETING

Wellesley College
Wellesley, Massachusetts
October 22, 1977

Algebra and Theory of Numbers (05, 06, 08, 10, 12–18, 20)

748-A1 STEVE FISK, Bowdoin College, Brunswick, Maine, 04011. Four Colorings: Their Existence and Non-existence.

We first show that any orientable surface of positive genus has a triangulation M such that (1) M has no four-colorings and (2) all edges of M have arbitrarily short length. To prove this, we first construct a triangulation which has exactly two vertices of odd degree, and they are adjacent. An elementary lemma on the degree of a map shows that this triangulation has no four-coloring. We next introduce a new kind of subdivision, even subdivision, which allows us to find triangulations as above with arbitrarily short edge lengths.

On the other hand, we have the "weak four color theorem": any triangulation of an orientable surface has an even subdivision with a four-coloring. This is first proved for the sphere; the general result follows from an induction on the genus. (Received July 15, 1977.) (Author introduced by Professor Gian-Carlo Rota).

*748-A2 STEPHEN C. MILNE, Yale University, New Haven, Connecticut 06520. Mappings of Subspaces into Subsets.

We construct several equivalent rank and order preserving maps from the lattice of subspaces of $V_n(q)$ onto the lattice of subsets of an n-set. By interpreting combinatorially the pair of difference equations (*) and (**), we inductively construct two such maps ϕ_1 and ϕ_2, respectively. (*), $\left[{n+1 \atop K}\right] = \left[{n \atop K-1}\right] + q^K\left[{n \atop K}\right]$ and (**), $\left[{n+1 \atop K}\right] = q^{n-K+1}\left[{n \atop K-1}\right] + \left[{n \atop K}\right]$. We next show that given a subspace $X \in V_n(q)$, $\dim X = K$, that $\phi_1(X) = \{n_1,\ldots,n_K\}$, with $n_1 = \min\{j \mid \exists(x_1,\ldots,x_n) \in X,\ x_j \neq 0\}$, and $n_i = \min\{j \mid \exists(x_1,\ldots,x_n) \in X,\ x_{n_1} = 0,\ldots,x_{n_{i-1}} = 0, x_j \neq 0\}$. For ϕ_2, we replace min by max and note that the resulting formula has been given by D. Knuth (1971) in "Subspaces, subsets, and partitions", J. C. T., A-10, 178-180. By specializing the Γ map construction given by R. Stanley in his supersolvable lattice paper to a certain pair of "dual" modular chains in $V_n(q)$, we recover our maps ϕ_1 and ϕ_2 via lattice theory. (Received July 26,1977.)

748-A3 STEVEN M. ROMAN, Massachusetts Institute of Technology, Cambridge, Mass. 02139. The algebra of divided differences.

An algebraic approach to the classical umbral calculus provides unification of the subject, as well as important new results. The techniques used in this approach apply in great measure to the study of the calculus of divided differences. We give a brief description of analogies between the two theories, comparing some of their strengths and weaknesses. (Received July 25, 1977.)

748-A4 GIAN-CARLO ROTA, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139. Recent progress in combinatorics.

A survey of some of the trends and results in combinatorics of the past five years. (Received August 17, 1977.)

*748-A5 BENJAMIN FINE, Fairfield University, Fairfield, Connecticut 06430 Principal Congruence Subgroups of the Picard Group

The Picard group Γ is PSL(2,Z[i]), the group of linear fractional transformations $z'=az+b/cz+d$, $ad-bc=\pm 1$ and a,b,c,d Gaussian integers. If (α) is an ideal in Z[i], $\Gamma(\alpha)$ the principal congruence subgroup mod α consists of those transformations congruent to the identity transformation mod α. It is well known that the principal congruence subgroups of the Modular group M=PSL(2,Z) are free groups. Here we give related results for the Picard group. Theorem 1: If $(\alpha) \neq (1+i)$ or (2), then $\Gamma(\alpha)$ is an HNN group with finitely generated free part F and base K. K is a tree product with amalgamations of finitely many free groups each of finite rank. Further both the amalgamated subgroups in K and the associated subgroups in $\Gamma(\alpha)$ are conjugates of subgroups of the Modular group.. Then the 2 special cases, Theorem 2: $\Gamma(1+i)$ has index 6 and is a free product of 2 groups with amalgamated subgroup. $\Gamma(2)$ has index 24 and a similar decomposition.. Function theoretic considerations lead to; Conjecture: A Fuchsian subgroup of Γ contained in a principal congruence subgroup is free..Along these lines we get Theorem 3: A finitely generated Fuchsian group F contained in $\Gamma(\alpha)$, $(\alpha)\neq(1+i)$ or (2), and having either trivial intersection or non-cyclic intersection with all conjugates of the Modular group in Γ, is free.. Similar is Theorem 4: A normal Fuchsian subgroup of Γ having either trivial or non-cyclic intersection with the Modular group is free.. This paper continues previous work (Can.J.Math. Vol.28,NO.3 1976) (Received August 17, 1977.)

*748-A6 Gregory Wulczyn, Bucknell University, Lewisburg, Pennsylvania 17837. An application of combinatorials to the formation of like power identities in real quadratic fields. Prelimininary report.

Type I real quadratic field identities of the form $F^{4t+2}_{n+2r(4t+1)} - F^{4t+2}_n - u_1(F^{4t+2}_{n+2r4t} - F^{4t+2}_{n+2r}) +$

$+ u_2(F^{4t+2}_{n+2r(4t-1)} - F^{4t+2}_{n+4r}) - \cdots + u_{2t}(F^{4t+2}_{n+2r(2t+1)} - F^{4t+2}_{n+2r2t}) = KF_{n(4t+2-2i)}F_{a_1}F_{a_2}\cdots F_{a_{4t+1}}$,

$i = 0, 1, 2, \ldots, 2t$. For each i value, the u_k's are determined as specific combinatorial symmetric functions. (Received August 17, 1977.) (Author introduced by Professor Gian-Carlo Rota).

*748-A7 LEO J. ALEX, State University College, Oneonta, New York, 13820. Index two simple groups II.

In earlier work of the author, the study of finite simple groups with a cyclic Sylow subgroup P which is strongly self-centralizing and has index two in its normalizer was begun. In this paper these earlier results are extended. The main result is the following. Theorem: Let G be a finite simple group such that G has a Sylow p-subgroup P satisfying 1) $|N(P)/P| = 2$ and 2) If $x \in P^{\#}$, then $C(x) = P$. Then if G has an irreducible non-identity character in the principal p-block whose degree is at most 65, then G is isomorphic to one of the groups PSL(3,4), Sz(8), or PSL(2,q) with q = 5,7,9,8,11,13,16,17,19,23,25,27,32,37, 47,49,53,59, or 61. (Received August 22, 1977.)

*748-A8 AGNES M. CHAN, Northeastern University, Boston, Mass 02115. Embedding of a Pseudo-Point-Residual design into a Möbius plane.

Let $\mathfrak{A}$ be a class of subsets of a finite set X. Elements of $\mathfrak{A}$ are called blocks. Let v,t,λ and k be nonnegative integers such that $v \geq k \geq t \geq 0$. A pair $(X,\mathfrak{A})$ is called a (v,k,λ) t-design, denoted by $S_\lambda(t,k,v)$, if (1) $|X|=v$, (2) every t-subset of X is contained in exactly λ blocks and (3) for every block A in $\mathfrak{A}$, $|A|=k$. A Möbius plane M is an $S_1(3,q+1,q^2+1)$ where q is a positive integer. Let ∞ be a fixed point in M. If ∞ is deleted from M, together with all the blocks containing ∞, then we obtain a point-residual design M^*. It can be easily checked that M^* is an $S_q(2,q+1,q^2)$. Any $S_q(2,q+1,q^2)$ is called a pseudo-point-residual design of order q, abbreviated by PPRD(q). Let A and B be two blocks in a PPRD(q) M^*. A and B are said to be tangent to each other at z if and only if $A \cap B = \{z\}$. M^* is said to have the Tangency Property if for any block A in M^*, and points x and y such that $x \in A$ and $y \notin A$, there exists at most one block containing y and tangent to A at x. This paper proves that any PPRD(q) M^* is uniquely embeddable into a Möbius plane if and only if M^* satisfies the Tangency Property. (Received August 26, 1977.)

*748-A9 Roman V. Wong, Syracuse University, Syracuse, New York 13210. Free ideal monoid rings.

A ring is a left free ideal ring (left fir) if it has the invariant basis number and every left ideal is free. THEOREM. Let R be a ring and $S \neq 1$ be a monoid. Then the monoid ring RS is a left and right fir if and only if R is a division ring and S is the free product of a free monoid and a free group. The "if" part of the theorem was first proved by P.M. Cohn. Other proofs are also given by J. Lewin, P.M. Cohn and W. Dicks, and G.M. Bergman. The "only if" part uses the theorem of Stallings and Swan on groups of cohomological dimension one. (Received August 26, 1977.)

*748-A10 JOHN G. RATCLIFFE, Massachusetts Institute of Technology, Cambridge, MA 02139. On the Second Transgression of the Lyndon-Hochschild-Serre Spectral Sequence.

Suppose G is a group, N is a normal subgroup of G, Q = G/N, and A is a Q-module. Our main result is the determination of the transgressive elements of the second transgression $\tau^2: H^2(N,A) \to H^3(Q,A)$ of the L-H-S spectral sequence. Definition: A G-crossed extension of A by N is an extension $0 \to A \xrightarrow{\nu} C \xrightarrow{\partial} N \to 1$ with operators in G, such that C is a G-crossed module as in the sense of J.H.C. Whitehead. Theorem: A central extension E of A by N represents a transgres-

sive element of τ^2 if and only if E has the structure of G-crossed extension; moreover, if E is transgressive, then the possible crossed structures on E are in one to one correspondence with $H^1(Q,H^1(N,A))$. (Received August 29, 1977.)

748-A11 V. S. Krishnan, Temple University, Philadelphia, Pa. 19122. Fine quasi resolutions of semigroups with identity. Preliminary Report.

Given a semigroup S, a "fine quasi-resolution" (C,λ,D) of S consists of two subsemigroups C, D of S and a homomorphism λ of C on a semigroup of automorphisms of D such that: (a) each s of S resolves as c.d, for c, d from C, D, (b) c.d=c'd' implies always c=c', and (c) $c.d=\lambda(c)d.c$, for all c, d. Dropping (c) and replacing (b) by: (b') c.d=d'.c' implies always c=c', we get a "quasi-resolution" (C, D) of S. In both cases the passage s to c in s=c.d gives a retraction of S on C.

A quasi resolution (C,λ,D) of S determines two mappings $\sim_l, \sim_r$ of C in the lattice of congruences of D with suitable connections to λ. By specifying these properly we can also go back from $(C,D,\lambda,\sim_l,\sim_r)$ to a semigroup S with a quasi-resolution (C,λ,D). In particular cases this construction gives a form of wreath product for semigroups C, D. The commutative cases of these have been recently studied by J. Schmidt. (Received August 29, 1977.)

Analysis (26, 28, 30–35, 39–47, 49)

748-B1 JEAN E. TAYLOR, Rutgers University, New Brunswick, New Jersey 08903. The geometry of soap films and crystals.

The approach of geometric measure theory is proving to be highly successful in dealing with a large variety of problems in the calculus of variations where the geometry of the surfaces being considered is an independent variable. Two particular such problems will be discussed: the question of the structure of singularities in mathematical models for compound soap bubbles and soap films, and that of the structure of surfaces related to crystals where the "surface energy" being minimized is highly anisotropic. Also, the somewhat surprising interplay between these soap-film-type and crystal-type problems will be outlined. (Received June 3, 1977.)

748-B2 FRANK MORGAN, M.I.T., Cambridge, Massachusetts 02139. Almost every smooth curve in $\mathbb{R}^3$ bounds a unique area minimizing surface.

A geometrically natural probabilistic measure akin to Brownian motion is defined on the space of smooth simple closed curves in $\mathbb{R}^3$. It is proved that almost every curve bounds a unique area minimizing surface. Geometric and measure theoretic methods are combined with results from the theory of partial differential equations. This theorem seems to be the first application of probability theory to geometric measure theory. (Received May 23, 1977.)

748-B3 F. J. Almgren, Jr., Princeton University, Princeton, N.J. 08540. Multiple valued solutions to variational problems and the regularity of mass minimizing integral currents.

The generalized branching structure of some of the singularities in mass minimizing integral currents in general dimensions and codimensions can be modelled by multiple valued functions minimizing a generalized Dirichlet integral. Following several examples the structure of such functions will be discussed and its application to the almost everywhere regularity of such currents. (Received June 20, 1977.)

*748-B4 Richard Askey, University of Wisconsin, Madison, Wisconsin 53706. The q-gamma function.

The q-gamma function is defined by $\Gamma_q(x) = (q:q)_\infty (q^x:q)_\infty^{-1}(1-q)^{1-x}$, $0 < q < 1$, where $(a:q)_\infty = \prod_{n=0}^{\infty}(1-aq^n)$. It satisfies the functional equation $\Gamma_q(x+1) = \frac{(1-q^x)}{(1-q)}\Gamma_q(x)$ and reduces to $1(1+q)\ldots(1+q+\ldots+q^{n-1})$ when $x = n+1$. Analogues of many of the classical facts about the gamma function are given, including the Bohr-Mollerup theorem, two forms of Stirling's asymptotic formula, the duplication formula and two extensions of $\Gamma(\frac{1}{2}+x)\Gamma(\frac{1}{2}-x) = \pi/\cos\pi x$. One is the triple product for the theta function, the other is a partial fraction decomposition of the reciprocal of the theta function which was stated by Jacobi. The inequality $\Gamma_q(x) \le \Gamma_s(x)$, $0 < q < s < 1$, $0 < x \le 1$, or $2 \le x < \infty$ and $0 < s < q < 1$, $1 \le x \le 2$ is also obtained. Two versions of the beta function are given; one is evaluated by the q-binomial theorem and the other by Ramanujan's ${}_1\Psi_1$ summation.

(Received August 5, 1977.)

*748-B5 Charles D. Lahr and Charles A. Jones, Dartmouth College, Hanover, New Hampshire 03755. Weak and Norm Approximate Identities are Different.

Let B be a commutative Banach algebra and let ΔB be its maximal ideal space. A weak approximate identity for B is a net $\{u_\alpha\}$ in B such that $\chi(u_\alpha x) \to \chi(x)$ for all $x \in B$, $\chi \in \Delta B$. A norm approximate identity is a net $\{u_\alpha\}$ such that $u_\alpha x \to x$ in the norm topology of B. Clearly a norm approximate identity is a weak approximate identity. However, an example is given of a semi-simple convolution measure algebra with a weak approximate identity (bounded by 1), but having no norm approximate identity. This algebra provides a counterexample to a theorem due to J. L. Taylor [Trans. Amer. Math. Soc. 119 (1965), 150-166. Thm. 3.1] and moreover shows that the concepts of weak and norm approximate identities are different. Finally, it is shown that B has a weak approximate identity bounded by 1 if and only if there is a net $\{a_\lambda\}$ bounded by 1 such that $|\chi(a_\lambda)| \to 1$ for all $\chi \in \Delta B$.

(Received August 25, 1977.)

*748-B6 David L. Johnson and Charles D. Lahr, Dartmouth College, Hanover, New Hampshire 03755. Multipliers of L^1-Algebras with Order Convolution.

For each n, $1 \le n \le N$, let $L^1(a_n,b_n)$ be the commutative convolution measure algebra, under order convolution, of all Lebesgue integrable functions on the interval I_n of real numbers from a_n to b_n, where I_n is a topological semigroup under max multiplication. Then the multiplier algebra $\mathfrak{M}(L^1(a_n,b_n))$ of $L^1(a_n,b_n)$ is shown to be the Banach algebra obtained from $L^1(a_n,b_n)$ by the adjunction of an identity element. Moreover, the Banach space $L^1(\Pi I_n) = \hat{\otimes}_{n=1}^N L^1(a_n,b_n)$ of Lebesgue integrable functions on the product semigroup $\Pi_{n=1}^N I_n$ becomes a commutative convolution measure algebra under order convolution, and it is shown that $\mathfrak{M}(\hat{\otimes}L^1(a_n,b_n)) = \hat{\otimes}\mathfrak{M}(L^1(a_n,b_n))$.

(Received August 25, 1977.)

*748-B7 David L. Johnson and Charles D. Lahr, Dartmouth College, Hanover, New Hampshire 03755. Multipliers and derivations of Hilbert algebras.

Let A be a Hilbert algebra. A (continuous) double multiplier of A is a pair (T_1,T_2) of (continuous) linear maps from A into A satisfying $a(T_1b) = (T_2a)b$, for all a,b in A. The algebra M(A) of all continuous double multipliers of an arbitrary Hilbert algebra A is shown to be a pre-C*-algebra. Further, for A a replete (resp., full) Hilbert algebra, it is proved that every double multiplier of A is continuous, and that M(A) is a C*-algebra (resp., a von Neumann algebra). A (continuous) derivation on a Hilbert algebra A is a (continuous) linear map δ from A into A such that $\delta(ab) = (\delta a)b + a(\delta b)$, for all a,b in A. Every

continuous derivation on A is shown to extend to a derivation Δ on M(A). We also prove that every derivation δ on a replete (resp., full) Hilbert algebra A is continuous by showing that each such δ of the form $\delta = T_1 - T_2$, for some double multiplier (T_1, T_2) of the fulfillment A_b of A. (Received August 25, 1977.)

*748-B8 Dennis D. Berkey and Marvin I. Freedman, Boston University, Boston, Ma. 02215. Buckled Elastica at Contact: A Perturbation Analysis. Preliminary Report.

We consider the problem describing the shape assumed by a slender elastic rod clamped at both ends and subjected to an axial force. For the case of the first bending mode the elastica comes into contact with itself at a critical value P_c of the applied pressure. We develop uniformly valid parameter expansions for the shape function, the contact points and the resistive force in terms of the pressure gradient $P-P_c$. The problem is of interest because the nature of the differential equation changes as P varies from subcritical to supercritical. This difficulty is overcome via a nonlinear change of independent variable (arc length) which has the effect of freezing the contact points. (Received August 29, 1977.)

748-B9 JUDITH C. WASON, Wellesley College, Wellesley, Mass. 02181. On Infinite Nielsen Kernels. Preliminary Report.

Let S_0 be the Nielsen kernel of a Riemann surface $\mathcal{S}$ of finite type (g,n,m), $6g - 6 + 2n + 3m > 0$, $m > 0$. Let S_{k-1} be the Nielsen kernel of S_k, $k = 0, -1, \ldots$ and $S_{-\infty} = S_0 \cap S_{-1} \cap S_{-2} \ldots$, the infinite Nielsen kernel. Let $C_{k,i}$ be a boundary curve of S_k. Let $L_{k,i}$ be its length in the intrinsic metric on S_k. Then $\lim_{k \to -\infty} L_{k,i} = \infty$, $i = 1, \ldots n$. For $m \geq 2$, let $P_{k,i}$ be the length of the geodesic $p_{k,i}$ around the i th handle created by forming the Schottky double of S_k. Then $\lim_{k \to -\infty} P_{k,i} = 0$, $i = 1, \ldots m-1$. The boundary curves of $S_{-\infty}$ are well defined. If $m \geq 2$, the limits of curves paired by $p_{k,i}$ are tangent. (Received August 29, 1977.)

Applied Mathematics
(65, 68, 70, 73, 76, 78, 80–83, 85, 86, 90, 92–94)

748-C1 WITHDRAWN

*748-C2 J.N. BOYD AND P.N. RAYCHOWDHURY, Virginia Commonwealth University, Richmond, Virginia, 23284. Finite Group Representation Techniques in Lagrangian Mechanics.

It is the purpose of this talk to discuss the representation theory of finite groups in the computation of the natural frequencies of classical systems of symmetrically coupled, vibrating masses. A

theoretical outline is followed by discussions of the projection operators and of the Lagrangian when the coordinates are complex. Illustrative examples of triangular, square, and tetrahedral arrays are given before the techniques are applied to the long one-dimensional crystal. (Received August 29, 1977.)

748-C3 O.R. BEAVER AND T.A. COOK, University of Massachusetts, Amherst, MA 01003. States on quantum logics and their connection with a theorem of Alexandroff.

We generalize the notion of regularity of measures to quantum logics and then prove that each regular finitely additive state on a quantum logic is countably additive. Examples are given from measure theory and quantum mechanics. (Received August 30, 1977.)

Geometry (50, 52, 53)

*748-D1 JON T. PITTS, University of Rochester, Rochester, New York 14627. Minimal surfaces on riemannian manifolds.

Let k and n be positive integers, k not exceeding n, and let M be a smooth, compact, n dimensional, riemannian manifold. We develop a calculus of variations in the large and use it to show that M supports a nonzero, stationary, k dimensional, integral varifold with strong local stability properties. These stability properties yield estimates on the singular sets. In special dimensions these estimates imply that the singular set is empty. We obtain, for example:

THEOREM. Every smooth, compact, three dimensional, riemannian manifold contains a nonempty, closed, imbedded, two dimensional, minimal submanifold without boundary. (Received August 9, 1977.)

748-D2 John B. Baillieul, Georgetown University, Washington, D.C. 20057. Control Problems Associated to Singular Riemannian Metrics.

Let M be a real analytic manifold, V(M) its real analytic vector fields, F(M) its real valued functions and $F^1(M)$ its real analytic degree 1 differential forms. A Riemannian metric may be defined either as a F(M) - bilinear symmetric map $g: V(M) \times V(M) \to F(M)$ or dually as an F(M) - bilinear symmetric map $g^d: F^1(M) \times F^1(M) \to F(M)$, such that in any local coordinate system g and g^d are represented by mutually inverse symmetric matrices. A singular Riemannian metric is a bilinear symmetric map g^d which is degenerate in the sense that there exists a point $x \in M$ and a form $\omega \in F^1(M)$ such that $\omega(x) \neq 0$ but $g^d(\omega, \theta) = 0$ for all $\theta \in F^1(M)$. (See Hermann, BAMS, 79, July 1973, p 780-82). A practical technique for computing geodesics of a singular Riemannian metric is to associate to g^d a certain class of optimal control problems. The explicit calculation is carried out for some manifolds of low dimension. (Received August 15, 1977.)

*748-D3 TERENCE GAFFNEY, Brown University, Providence, Rhode Island 02906 and LESLIE WILSON, University of Hawaii, Honolulu, Hawaii . Uniqueness of Normalization in the Smooth Category.

DEFINITION A map germ f is finitely determined of order k, if given any g whose k-th order Taylor polynominal agrees with that of f, g differs from f by smooth coordinate changes in source and target.

DEFINITION A map germ f is a fold germ, if after coordinate changes in source and target it is of the form $x_1, \ldots, x_{n-1}, x_n^2$.

THEOREM Suppose f and g are finitely determined map germs from $\mathbb{R}^n, 0 \to \mathbb{R}^p, 0, n \leq p$. If g is stable of rank n-1, but not a fold germ, and $f(\Sigma(f)) = g(\Sigma(g))$, where $\Sigma(f)$ denotes the critical set of f, then there exists a unique germ of a diffeomorphism r such that $g \circ r = f$. (If g is a fold germ one also needs $f(\mathbb{R}^n) = g(\mathbb{R}^n)$ for the theorem to hold.) This is a smooth analogue of the uniqueness of normalization theorem of complex analysis. (Received August 29, 1977.)

*748-D4 JAMES R. WASON, 21 Fiske House, Wellesley College, Wellesley, Mass. 02181. Curvature of Product 3-Manifolds. Preliminary Report.

Let g be a Riemannian metric on a compact product 3-manifold. If g has everywhere non-positive sectional curvature, then it is locally diffeomorphic to a product metric. (Received August 30, 1977.)

Logic and Foundations (02, 04)

*748-E1 CHARLES K. LANDRAITIS, Boston College, Chestnut Hill, MA. 02167. On the homomorphism relation between countable order types.

For (linear) order types $\phi = (A, \leq)$ and $\psi = (B, \leq)$, $\phi \ll \psi$ (ϕ is a homomorphic image of ψ) if there is a mapping $\sigma: A \to B$ such that $x \leq y$ implies $\sigma(x) \leq \sigma(y)$, or, equivalently, if there exists a partition $\{B_i : i \in I\}$ of B into nonempty intervals such that if $b_i \in B_i$, then the order type of $\{b_i : i \in I\}$ (as a subordering of ψ) is ϕ.

Theorem. The countable order types are better quasi-ordered by $\ll$.

Corollary. If ϕ_i, $i \in \omega$, is a sequence of countable order types, then there are integers i,j with $i<j$ such that $\phi_i \ll \phi_j$.

Corollary. Let the language L have nonlogical symbols $=, \leq$. Then for each countable order type ψ there is a sentence ψ^+ of $L_{\omega_1\omega}$ such that if ϕ is any countable order type, ϕ satisfies ψ^+ if and only if $\phi \ll \psi$. (Received August 9, 1977.) (Author introduced by J. P. Shanahan).

*748-E2 JOSEPH G. ROSENSTEIN, Rutgers University, New Brunswick, New Jersey 08904. Recursive linear orderings.

The order types of the rationals Q and the integers are denoted η and Z. Theorem 1: There is a recursive subset A of Q of order type $Z \cdot \eta$ which has no RE subset of order type η. (Note that any such A must have a Π_2 subset of order type η. Also, any recursive subset A of Q of order type $m \cdot \eta$ has an RE subset of order type η.) A subset A of Q is recursively rigid if there is no non-trivial recursive order-automorphism of A. No recursive subset of Q of order type η is recursively rigid. Theorem 2: There are recursive subsets of Q of order type $2 \cdot \eta$ and Z which are recursively rigid. (Note that any recursive subset of Q of order type $2 \cdot \eta$ is recursively embeddable into itself.) Theorem 3 (with L. Hay): There are recursive subsets of Q of order type ω and Z which are not recursively embeddable into themselves. Given a linear ordering A and $x \in A$, $c_p(x)$ is $\{y \mid$ there are finitely many elements of A between x and y$\}$ and $c_F[A]$ is the linear

ordering induced on $\{c_F(x) | x \in A\}$. An order type α is recursive if there is a recursive subset of Q of order type α. Theorem 4: There is a recursive subset A of Q such that $c_F[A]$ does not have recursive order type. These and other related results will appear in a forthcoming book on linear orderings. (Received August 29, 1977.)

748-E3 GERHARD F. KOHLMAYR, Mathmodel Consulting Bureau, Glastonbury CT 06033.
A nonvoid partially ordered set without maximal elements.

For terminology, see Abstract 747-02-6, these NOTICES, 24 (1977) p. A-447. THEOREM. Suppose there is an ordered field F. Then there is a partially ordered set P which satisfies the following two conditions: i) Every chain in P has an upper bound. ii) P has no maximal element. Proof. Suppose F is an ordered field. F contains a trivial ordered differential field K. Let ω be the set of nonnegative neointegers in K. Let Ω be the set of all maps $x:\omega \to \omega$ of the form $x = \{x(n)\} = \{\Sigma_{j=0}^{k} x_j n^j\}$, where $x_j, j, k, n \in \omega$. Define total order in Ω by $x < y$ iff $x(n) < y(n)\ \forall\ n > \max\{\Sigma_{j=0}^{k} x_j, \Sigma_{j=0}^{\ell} y_j\}$. Ω is a well-ordered additive monoid which properly contains a a copy of ω. Define multiplication in Ω by $xy = \{x(n)\ y(n)\} = \{\Sigma_{j=0}^{\ell}(\Sigma_{k=0}^{j} x_k\ y_{j-k})\ n^j\}$. Construct, in the usual way, from Ω an ordered field L. L contains properly a copy F of K. The ordered field F is a partially ordered set. F is bounded by any element $b \in L$ such that $b > x\ \forall\ x \in F$. Therefore, all chains in F are bounded. Suppose, contrary to the theorem, that there is a maximal element $m \in F$. Since F is a field, $m^2 \in F$ and $m^{-1} \in F$. Let 1 be the identity element of F. We can't have $m < m^2$ as m is maximal. We can't have $m^2 \leq m$ as $m \leq 1$ is impossible. Thus F has no maximal element. Remark. Upper bounds of chains in F were not required to be in F. The sentence "Each nonvoid partially ordered set in which each chain has an upper bound has a maximal element" is false. (Received August 29, 1977.)

Topology (22, 54, 55, 57, 58)

*748-G1 Tadatoshi Akiba, Tufts University, Medford, Mass. 02155 Local triviality in codimension one.

Let N be an (n-1)-dimensional locally flat, allowable, compact submanifold of an n-manifold M, and P be a finite subset of N. Define $E(N,M||P)$ as the semi-simplicial complex of allowable k-isotopies $f: \Delta_k \times N \to \Delta_k \times M$ which satisfy the following: (1) f is locally trivial at all points of $\Delta_k \times (N-P)$ in the sense of Hudson; (2) for each $x \in \Delta_k$, $f|x \times N: x \times N \to x \times M$ is locally flat; (3) for each $x \in \Delta_k$, $f|x \times N$ is the restriction of a homeomorphism of $x \times M$; and (4) $f|\Delta_k \times N \cap \partial M: \Delta_k \times N \cap \partial M \to \Delta_k \times \partial M$ is locally trivial. Define $\mathcal{E}(N,M)$ as the subcomplex of $E(N,M||P)$ defined by conditions (2) and (3) above, and (5) the k-isotopy f is locally trivial.

Theorem: The inclusion $\mathcal{E}(N,M) \to E(N,M||P)$ is a homotopy equivalence if $n \neq 4$.
(Received August 1, 1977.)

*748-G2 ROBERT MESSER, Dartmouth College, Hanover, New Hampshire 03755.
Open 2-manifolds as covering spaces. Preliminary report.

An open 2-manifold is a separable metric space such that each point has a neighborhood homeomorphic to R^2. A classification theorem for open 2-manifolds and a procedure for modifying a 2-sphere to obtain any open 2-manifold has been

given by Ian Richards in a paper "On the classification of noncompact surfaces", Trans. Amer. Math. Soc. 106 (1963), 259-269.

Theorem: Any connected open 2-manifold covers a compact 2-manifold. The compact 2-manifold can always be chosen to be the connected sum $T^2 \# P^2$ of a torus and a projective plane.

The proof of this theorem consists of cutting apart the universal cover $\mathbb{R}^2$ and various compact covers of $T^2 \# P^2$. The appropriate pieces are then assembled to form the given open 2-manifold. (Received August 29, 1977.)

749TH MEETING

Purdue University
West Lafayette, Indiana
October 29, 1977

Algebra and Theory of Numbers (05, 06, 08, 10, 12–18, 20)

749-A1 G. L. ALEXANDERSON, University of Santa Clara, Santa Clara, CA 95053, and JOHN E. WETZEL, University of Illinois at Urbana-Champaign, Urbana, IL 61801.
Lamination Identities. Preliminary Report.

Let σ_j be the $j^{\underline{th}}$ elementary symmetric function on the s integer variables n_i, and write $G_r^d(n) = \sum_{k=d-r}^{d} \binom{k}{d-r}\binom{n}{k}$. For fixed p, q with $0 \le p \le q \le s$, let I be a (variable) q-element subset of $S = \{1,2,\ldots,s\}$ and J a (variable) p-element subset of I, and define $\tau_q^p = \sum_{I\subseteq S}\sum_{J\subseteq I}\left(\prod_{j\in J} n_j\right)\left(\prod_{k\in I-J}(n_k - 1)\right)$. Extending our earlier results, we prove by elementary means that for $0 \le r \le d \le s$,

$$\sum_{j=d-r}^{d}\binom{j}{d-r}\sigma_j \equiv \sum_{i=0}^{d-r} G_r^{d-i}(s-i)\tau_i^0 + \sum_{i=d-r+1}^{d} G_{d-i}^{d-i}(s-i)\tau_i^{d-r} \equiv G_r^d(\sigma_1) - \sum_{j=d-r}^{d}\binom{j}{d-r}\sum_j{}^{*}\prod_{k=1}^{s}\binom{n_k}{m_k},$$

where $\sum_j^*$ means the sum over all ordered s-partitions $\langle m_1, m_2, \ldots, m_s\rangle$ of j that have non-negative entries, at least one of which is neither 0 nor 1. These are three quite different expressions for the number of r-cells formed by a simple arrangement of hyperplanes in E^d with Steiner data $\langle n_1, n_2, \ldots, n_s\rangle$. (Received June 27, 1977.)

*749-A2 S. Kovesi-Domokos, Department of Physics, Johns Hopkins University, Baltimore, Md. 21209
On algebraic models in the theory of elementary particles.

The hypothetical "fundamental building blocks" of matter ("quarks") possess unusual physical properties: for instance, physical evidence suggests that they must obey a modified form of the Pauli exclusion principle. No consistent physical theory has been constructed so far to account for their properties. We summarize some attempts made towards the resolution of the apparent paradoxes of the physical theories. The theories reviewed are based on the suggestion that the physical properties of quarks require a modification of the algebraic properties of the dynamical variables entering the theory. The restrictions imposed by physical requirements on the algebraic structure are emphasized. Some algebraic models satisfying a part of these requirements are discussed. (Received August 1, 1977.) (Author introduced by Professor Georgia M. Benkart).

*749-A3 G. Domokos, Department of Physics, Johns Hopkins University, Baltimore, Md. 21218. On some algebraic problems in the theory of elementary particles.

Physical evidence suggests that the presently observed "elementary particles" are composed of other building blocks ("quarks"). The unusual properties of quarks as inferred from indirect evidence suggests that the current theory of elementary particles has to be substantially revised. We review the algebraic concepts entering the theory, emphasizing the role of physical evidence in building up the algebraic structures. It is suggested that the physical properties of quarks lead to the use of certain not-associative algebras (related to Cayley algebras) in the description of elementary particle processes. (Received August 1, 1977.)(Author introduced by Professor Georgia M. Benkart).

*749-A4 JAMES LEPOWSKY, Rutgers University, New Brunswick, New Jersey, 08903 and ROBERT LEE WILSON, Rutgers University, New Brunswick, New Jersey 08903. A construction of certain Kac-Moody Lie algebras.

The Kac-Moody Lie algebra $\underline{g}$ defined by the generalized Cartan matrix $\begin{pmatrix} 2 & -2 \\ -2 & 2 \end{pmatrix}$ contains subalgebras isomorphic to the Heisenberg algebra on countably many variables. Using these subalgebras we give an explicit construction of $\underline{g}$ as an algebra of differential operators (on the algebra of polynomials in countably many variables). The differential operators which occur appear analogous to operators of interest in physics. These ideas generalize to other Kac-Moody Lie algebras. (Received August 3, 1977.)

749-A5 PIERRE M. RAMOND, California Institute of Technology, Pasadena, California 91125. Local Symmetries in Physics.

We review the uses of algebraic structures in particle physics, with emphasis on Lie and super Lie algebras and their local realizations. The need for new structures is underlined. (Received August 10, 1977.) (Author introduced by Professor Georgia M. Benkart).

*749-A6 Frank W. Owens, Ball State University, Muncie, Indiana 47306. Enumeration of standard tableaus. Preliminary report.

An elementary proof (without using the theory of symmetric functions) by induction will be presented of the Frame-Robinson-Thrall theorem enumerating the standard tableaus associated with a partition. (Received August 26, 1977.)

749-A7 YUTZE CHOW, University of Wisconsin, Milwaukee, WI 53201. On algebras, manifolds and fibre-bundles in physics.

The talk will survey some applications of Lie algebras, super Lie algebras and also fibre-bundles in physics with special attentin to algebraic realization, quantization problem and general relativity. (Received August 30, 1977.)

749-A8 Harry P. Allen. The Ohio State University. Columbus, Ohio 43210. The Octonians and Exceptional Simple Lie Algebras over the Real and Complex Fields.

A survey of exceptional (central) simple Lie algebras over the real and complex numbers with attention to their structure. constructability and identification. (Received August 30, 1977.)

749-A9 HANS J. ZASSENHAUS, The Ohio State University, Columbus, Ohio 43210. On the subalgebras of the classical Lie algebras.

The challenging problems of symmetry breaking called forth new methods of classifying the subalgebras of the classical Lie algebras of mathematical physics and their invariants of which a survey report is made. (Received August 30, 1977.)

Analysis (26, 28, 30–35, 39–47, 49)

749-B1 JOSEPH A. CIMA AND JAMES ROBERTS, University of North Carolina, Chapel Hill, North Carolina, 27514, Denting Points in B^p.

It is shown that in the weighted Bergmann space B^p of analytic functions all points of the unit sphere are denting points of the unit ball. (Received June 6, 1977.)

749-B2 KEVIN CLANCEY, University of Georgia, Athens, Georgia 30602. Operators with one dimensional self-commutators.

The abundance of irreducible operators on a Hilbert space with a one dimensional self-commutator is remarkable. Examples of these operators come from "all walks of life" e.g. Toeplitz operators, weighted shifts, wave operators, etc. Perhaps it is the diverse backgrounds which make it difficult to obtain spatial information about this class. Here we will examine the following question. Let T be an irreducible operator satisfying $TT^*-T^*T=(\,,\varphi)\varphi$. When is φ cyclic for T? The investigation follows two lines. In one direction, when T has a model as a "nice" singular integral operator, it is shown that φ is cyclic for T. On the other hand, when the operator TT^* has a non-trivial singular component a new proof is given of a result of Carey and Pincus which shows φ is not cyclic for T. Further examples illustrating the gap between the above results will be discussed. (Received June 17, 1977.)
(Author introduced by Professor John B. Conway).

749-B3 AVNER FRIEDMAN, Northwestern University, Evanston, Illinois 60201. The free boundary of a quasi variational inequality.

Let $\lambda_1,\ldots,\lambda_n$ be ν-vectors such that $\lambda_2-\lambda_1,\ldots,\lambda_n-\lambda_1$ are linearly independent. Then the elliptic operator

$$Mw(p) = \frac{1}{2}\Sigma\, p_i p_j(\lambda_i-\Sigma\,\lambda_\ell p_\ell)(\lambda_j-\Sigma\,\lambda_\ell p_\ell)\frac{\partial^2 w}{\partial p_i \partial p_j} + \Sigma\, q_{i,j}p_i\,\frac{\partial w}{\partial p_j} - \alpha w$$

is nondegenerate in the simplex Π: $p_i > 0$, $\Sigma\, p_i = 1$. Here $\alpha > 0$, $q_{i,j} \geq 0$ if $i \neq j$, $\Sigma_j\, q_{i,j} = 0$. On the boundary of Π, M is degenerate and no boundary conditions should be given. We study the free boundary of the quasi variational inequality $Mw + \sum_{j=1}^{n} c_j p_j \geq 0$, $w(p) \leq K + \sum_{j=1}^{n-1} p_j w(e_j)$, $(Mw + \Sigma\, c_j p_j)(w-K-\Sigma\, p_j w(e_j)) = 0$ in Π, where $c_j \geq 0$, $K > 0$ and e_j is the j-th vertex of Π. We find sufficient (and "almost" necessary) conditions on c_j, K, α, $w(e_j)$ under which the free boundary is a bounded set in the coordinates $y_j = p_j/p_1$ $(2 \leq j \leq n)$ and show that, for any i, it is given by $y_i = \Psi_i(y_2,\ldots,y_{i-1},y_{i+1},\ldots,y_n)$ where Ψ_i is analytic and strictly monotone decreasing in each variable. (Received July 1, 1977.)

*749-B4 JAMES E. BRENNAN, University of Kentucky, Lexington, Kentucky 40506. Invariant Subspaces and Subnormal operators.

Let φ be a nonnegative integrable function defined and having compact support in the complex plane. Denote by $H^2(\varphi dxdy)$ the closure of the polynomials in the $L^2(\varphi dxdy)$ norm. Theorem. If $\varphi \in L^{1+\varepsilon}(dxdy)$ for some $\varepsilon > 0$ then $H^2(\varphi dxdy)$ has a nontrivial closed subspace invariant under multiplication by z. (Received July 19, 1977.)

*749-B5 Frank Morgan, M.I.T., Cambridge, MA 02139. Almost every curve in R^3 bounds a unique area minimizing surface.

A geometrically natural probabilistic measure akin to Brownian motion is defined on the space of smooth simple closed curves in R^3. It is proved that almost every curve bounds a unique area minimizing surface.

Beginning with some uniqueness results in the theory of partial differential equations, the proof goes on to use comparison surfaces in a generalized density argument to prove that the set of curves bounding more than one area minimizing surface has measure zero. The proof depends strongly on compactness properties of spaces of curves and surfaces and on known results on regularity for area minimizing surfaces.

This theorem seems to be the first application of probability theory to geometric measure theory. (Received July 19, 1977.)

749-B6 Glenn Schober, Indiana University, Bloomington, Indiana 47401. Applications of the calculus of variations for families of quasiconformal mappings.

Classically, the calculus of variations has been used both to solve extremal problems and to provide existence theorems for solutions of differential equations. A calculus of variations has been developed for compact families of quasiconformal mappings. We shall report on recent applications both to solving extremal problems and to giving existence and representation theorems for solutions of some linear and nonlinear partial differential equations. (Received July 25, 1977.)

*749-B7 W. R. Wogen, University of North Carolina, Chapel Hill, North Carolina 27514. Cyclic vectors for adjoints of subnormal operators.

A general method is given for constructing cyclic vectors for operators which have a certain upper-triangular operator matrix representation. The construction provides cyclic vectors for many operators T such that T^* is subnormal.

Theorem. There are functions $f \in H^2$ so that if $\phi \in H^\infty$, $\phi \neq$ constant, then f is cyclic for the co-analytic Toeplitz operator $T_{\bar{\phi}}$.

Theorem. If S is in the weakly closed algebra generated by a pure quasinormal operator, the S^* is cyclic.

Theorem. If S is a bundle shift, then S^* is cyclic. (Received July 18, 1977.)

*749-B8 KENNETH A. BRAKKE, Purdue University, West Lafayette, Indiana 47907. The motion of a surface by its mean curvature.

I have developed a theory of k-dimensional surfaces in n-dimensional space that move with velocity equal to their mean curvature vectors. The migration of grain bound-

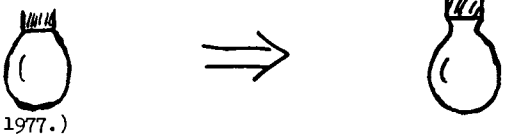
aries in an annealing metal is an example of such behavior. In my theory, surfaces are defined as varifolds, which permits much more general surfaces than does parametric representation. Mean curvature and motion by mean curvature are defined weakly. An existence theorem is proved, and a unit density varifold moving by its mean curvature is shown to be at almost all times an infinitely differentiable manifold almost everywhere. There are also barrier theorems, such as that a surface initially in a convex set will remain in that set. (Received August 3, 1977.)

*749-B9 Robert Gulliver, University of Minnesota, Minneapolis, Minnesota 55455. Finiteness of the number of minimal surfaces bounded by a given curve. Preliminary report.

Given an immersion X, all (C^1-) nearby immersed submanifolds are canonically represented by a normal vector field along X, as is well known. If X is only a branched immersion of a surface, having total order of branching q, then nearby branched immersions are represented by a normal vector field plus a vector in R^{2q}. We apply this representation to study the stability of a conformal branched minimal surface in three-dimensional euclidean space. For an appropriate, although noncanonical, choice of the representation, the additional factor R^{2q} is seen not to contribute to the kernel of the second variation of Dirichlet's integral. As a first application, we may show that a smooth Jordan curve Γ of total curvature at most 6π bounds only a finite number of minimal surfaces of the type of the disk. This was proved by Nitsche, in a somewhat analogous fashion, under the additional hypothesis that Γ is known a priori not to be the boundary of any branched minimal surface. (Received July 27, 1977.)

*749-B10 HENRY C. WENTE, University of Toledo, Toledo, Ohio 43606. The stability of the axially symmetric pendent liquid drop.

The axially symmetric pendent drop occurs as an equilibrium configuration in several physical situations. A careful study of solutions to the O.D.E. satisfied by the generating curves of these drops have recently been made by R. Finn and P. Concus, while questions of stability have been investigated by E. Pitts. Attention here is focused on two physical problems: (1) Suspension of the drop from a circular orifice with prescribed volume; (2) Suspension of the drop from a horizontal plate. For example, we have the following theorem: If in case 1 the opening is sufficiently narrow so that a stable drop may be suspended whose maximum diameter is larger than the opening (i.e. the drop bulges), then as the volume is slowly increased there will appear a stable drop which has a neck as well as a bulge.



(Received August 4, 1977.)

*749-B11 Luis Caffarelli, University of Minnesota, Minneapolis, MN 55455. Further Regularity for the n-dimensional Signorini problem.

We treat the n-dimensional Signorini problem (or similarly, the n-dimensional thin obstacle problem; (for details see the work by Frehse, at the Ann. Sc. Nor. Pisa, Vol IV, 2 pp. 343-361) for a smooth enough linear operator and data.

We prove that the solution, u, is, for some $\epsilon > 0$, of class $C^{1,\epsilon}$ (in the thin obstacle problem, of class $C^{1,\epsilon}$ at one side of the obstacle).

The technique involves obtaining estimates by below for the second tangential derivatives, a comparison lemma for the solution, u, and estimating, inductively, the Holder continuity of the normal derivative u_ν. (Received August 5, 1977.)

749-B12 M. Essén, Royal Institute of Technology, Stockholm, Sweden and University of Wisconsin, Madison, WI. Slowly growing subharmonic functions.

Let u be a subharmonic function in the plane of order 0. Let $B(r) = \max_\theta u(re^{i\theta})$. For most values of $z = re^{i\theta}$, we have $u(z) \approx B(r)$. Let $\varepsilon > 0$ be given. How can we characterize the set $E = E(\varepsilon) = \{ z : u(z) < (1-\varepsilon) B(|z|) \}$ if we know that $B(r) = O(\psi(r))$, $r \to \infty$, where ψ is a given increasing function ? Results : i) if $\psi(r) = \log r$, the set E is thin at ∞. ii) if $\psi(r) = (\log r)^2$, a generalized Wiener condition holds for E. iii) if $\psi(r) = (\log r)^\alpha$, $\alpha > 2$, the situation is different. There may exist annuli $\omega_n = \{ z : 2^n \leq |z| < 2^{n+1} \}$ which are such that $E \cap \omega_n$ is almost the whole annulus. The set E satisfies a weak condition of Wiener type. We give examples which illustrate the precision or our results. (i) above is due to Arsove and Huber and (ii) is joint work of Essén, Hayman and Huber. (Received August 5, 1977.)

*749-B13 Giles Auchmuty, Indiana University, Bloomington, IN 47401. Axisymmetric Figures of Equilibrium of Rotating Self-Gravitating Liquids.

The problem of finding the free boundary of a rotating self-gravitating liquid may be formulated as a constrained optimization problem. Using this formulation, necessary and sufficient conditions for the existence of solutions are obtained which considerably extend the previous results of Lichtenstein and Poincaré. Some regularity results are obtained and some general qualitative features of the solutions are described. (Received August 9, 1977.)

749-B14 ALBERT BAERNSTEIN II, Washington University, St. Louis, Missouri 63130. Maximal functions in complex analysis.

• Maximal functions were introduced into analysis by Hardy and Littlewood in 1930. Functions of this type have found, and continue to find, many uses, for example, in the proofs of boundedness and convergence theorems. In recent years the author has discovered a somewhat different type of maximal function, one of whose chief virtues is that it is subharmonic wherever the original function is. This subharmonicity has been the main tool in the solution of extremal problems involving univalent functions, Nevanlinna theory, and other branches of function theory. For example, here is an application to harmonic analysis. Suppose that $f(e^{i\theta})$ is a real valued integrable function on the unit circle and let g denote its symmetric decreasing rearrangement. Then, for the conjugate functions of f and g, we can prove the inequality $\int_{-\pi}^{\pi} |\tilde{f}(e^{i\theta})|\, d\theta \leq \int_{-\pi}^{\pi} |\tilde{g}(e^{i\theta})|\, d\theta$. (Received August 9, 1977.)

*749-B15 L.A. CAFFARELLI and N.M. RIVIERE, University of Minnesota, Minneapolis, MN 55455. Existence and uniqueness for the problem of filtration through a porous medium.

We consider the steady flow of an incompressible fluid in a porous medium partially surrounded by an impervious material, as described by H.W. Alt (A free boundary problem associated with the flow of ground water, Arch. Rat. Mech. Anal., 1977). We show that the minimal solution constructed by Alt

satisfies the extra property

$$p_\nu - \nu_y \geq 0 \quad \text{(a.e.)} \quad (\nu\text{-inner normal})$$

along the overflow (where it belongs to $L^p(\partial\Omega)$ for any p finite): This property asserts, from a physical point of view, that the fluid flows outwards along the overflow.

Furthermore, in the class of solutions described by Alt, the one enjoying the above property is unique.

On the other hand, if this condition is not required, it is possible, using Alt's balayage technique, to construct different solutions to the free boundary problem described by Alt, that correspond to a different physical problem (where water is poured to flow freely on some areas of the overflow). (Received August 10, 1977.)

749-B16 JAMES A. DEDDENS, University of Cincinnati, Cincinnati, Ohio 45221. Subnormal operators and C*-algebras.

An operator A on a Hilbert space H is called subnormal if it is the restriction of a normal operator N on a larger Hilbert space K to an invariant subspace, $A = N|H$. Various equivalent conditions involving positivity statements will be discussed. In particular the C*-algebra version of the Halmos-Bram condition: A is subnormal if and only if $\sum_{i,j=0}^{n} B_j^* A^{*i} A^j B_i \geq 0$ for all n and all $B_0, B_1, \ldots, B_n \in C^*(A)$. This makes clear the fact that if π is a *-representation of $C^*(A)$ and A is subnormal, then $\pi(A)$ is also subnormal. Similarly it is shown that $\sigma_\perp(\pi(A)) \subseteq \sigma_\perp(A)$ where $\sigma_\perp(S)$ denotes the spectrum of the minimal normal extension of S. Other results and problems concerning subnormal operators of a C*-algebraic nature will be discussed, including the problem of whether $p(A)$ hyponormal for all polynomials p implies A is subnormal. (Received August 19, 1977.)

749-B17 Lowell J. Hansen, Wayne State University, Detroit, Michigan 48202. Some geometric aspects of the growth of entire functions.

There are several well-known theorems (for example: Wiman's Theorem, The Phragmén-Lindelöf Theorem, The Denjoy-Carleman-Ahlfors Theorem) which can be understood as quantitative versions of the statement that if f is an entire function, then the maximum modulus function $M(R,f)$ is forced to grow "rapidly" with R if, for some $c > 0$, the set $\{z: |f(z)| > c\}$ is "small". In this talk, several recent theorems of this type will be presented. (Received August 22, 1977.)

749-B18 Robert F. Olin and James E. Thomson, Virginia Polytechnic Institute and State University, Blacksburg, Va. 24061. Lifting the commutant of a subnormal operator.

The following theorem implies that there are many cases where the commutant of a subnormal does not lift to the commutant of its minimal normal extension. Theorem. Let N be a normal operator with scalar spectral measure μ. Let S(N) denote the collection of all subnormal operators that have N as their mne. Assume the only projections in the weakly closed algebra generated by N are zero and one. T.F.A.E. (1) Every $S \in S(N)$ has a commutant which lifts to the commutant of N. (2) The linear manifold of polynomials and their conjugates is weak-star dense in $L^\infty(\mu)$. (3) $N = \varphi(U)$ where φ is a weak-star generator of the Hardy space H^∞ and U is a unitary. We conclude by constructing a pure irreducible subnormal operator whose commutant is abelian but the commutant does not lift to its mne. (Received August 22, 1977.)

749-B19 M. B. ABRAHAMSE, University of Virginia, Charlottesville, Virginia 22903 and R.G. DOUGLAS, State University of New York, Stony Brook, New York 11790 Examples of the central decomposition for an analytic Toeplitz operator.

Let R be a bounded domain in the complex plane whose boundary consists of n+1 non-intersecting analytic Jordan curves, let π be an analytic covering map from the unit disk onto R, and let T_π be the analytic Toeplitz operator on H^2 with symbol π. If $n = 1$, then T_π is unitarily equivalent to a direct integral $\int \oplus T_\lambda \, d\mu(\lambda)$ where μ is linear Lebesgue measure on the unit circle and T_λ is the bundle shift over R of multiplicity one determined by the scalar λ. Since the T_λ are irreducible and no two are unitarily equivalent, the direct integral is the central decomposition of T_π. If $n \geq 2$, then the W^*-algebra generated by T_π is a II_∞ factor. (Received August 25, 1977.)

*749-B20 THOMAS KRIETE, University of Virginia, Charlottesville, Virginia, 22903. The growth of point evaluation functionals in certain $H^2(\mu)$ spaces.

Let μ be a finite Borel measure on the closure $\bar{D}$ of the open unit disk D in the complex plane, and denote by $H^2(\mu)$ the closure in $L^2(\mu)$ of the analytic polynomials. If the linear functional "evaluation at z" is bounded on $H^2(\mu)$, denote its norm by $E(\mu,z)$; otherwise put $E(\mu,z) = \infty$. Write $\mu = \nu + \alpha$ where ν and α are carried on D and the unit circle respectively. This paper investigates the interplay between α and the growth of $E(\mu,z)$ as z tends to the circle. Examples are given in which ν is very nice, α is absolutely continuous with respect to arc-length measure $d\theta$ on the circle with $d\alpha/d\theta$ everywhere positive, but with α having only slight influence on the growth of $E(\mu,z)$. The connection with possible splitting phenomena like $H^2(\mu) = H^2(\nu) \oplus L^2(\alpha)$ is discussed. (Received August 25, 1977.)

749-B21 Robert F. Olin and James E. Thomson, Virginia Polytechnic Institute and State University, Blacksburg, Va. 24061. Some index theorems for $S_p(N)$. Preliminary report.

Let N be the normal operator multiplication by z on $L^2(\mu)$ for some measure μ with compact support K in the plane. $S_p(N)$ denotes the collection of pure subnormal operators that have N as their minimal normal extension. Let Ω be any open connected set in the plane satisfying int $\bar{\Omega} = \Omega$ and $\Omega \cap K = \square$. Let $S_p(N, \Omega) = \{S \in S_p(N): \sigma(S) \supset \Omega\}$. Fix $\lambda_0 \in \Omega$ and observe $S - \lambda_0$ is semi Fredholm for $S \in S_p(N,\Omega)$. It is natural to ask what is the set of integers $I_\Omega = \{i(S - \lambda_0): S \in S_p(N,\Omega)\}$ where i is the index. The following are two typical results. Theorem 1. Ω and N as above and $\bar{\Omega}$ is simply connected. Suppose the intersection of $\bar{\Omega}$ with the boundary of the polynomial convex hull of K contains an arc (of positive μ measure) consisting of points accessible within Ω. If $S_p(N) \neq \square$ then $S_p(N) = S_p(N,\Omega)$ and $I_\Omega = \{-1\}$. Theorem 2. Suppose the weak-star closure of the polynomials $P^\infty(\mu)$ is antisymmetric. Set $P^\infty(\mu) = H^\infty(G,\mu)$. If the Sarason hull $\tilde{K}$ for the measure $\mu|_G$ contains Ω, then I_Ω contains the negative integers and $-\infty$. (Received August 26, 1977.)

*749-B22 S. HILDEBRANDT, Universität Bonn, 5300 Bonn, Germany. On 't Hooft's eigenvalue problem in two-dimensional quantum chromodynamics.

We shall analyze the mathematical structure of the 2-dimensional QCD model for mesons due to 't Hooft (1974). Applying a variational approach, we obtain the whole spectrum and state upper and lower bounds for the eigenvalues. Moreover, the analytical behavior of the eigenfunctions will be investigated. (Received August 29, 1977.)

749-B23 DAVID DRASIN, Purdue University, West Lafayette, Indiana 47907. Two examples.

(1) Let A be the MacLane class in $\{|z| < 1\}$ (G. R. MacLane, Rice University Studies 49(1963)). MacLane proved (loc. cit.) that $f \in A$ if $\int_0^1 (1-r) \log^+ |f(re^{i\varphi})|\, dr < \infty$ for a set Φ dense on $[0, 2\pi]$. We show (in subharmonic form) that this condition is best possible. (2) For $0 < \lambda < 1$, let M_λ be the class of meromorphic functions of order λ with negative zeros and positive poles. We show that for each such λ, there exists $f \in M_\lambda$ such that $T(r,f) \sim r^\lambda$ and such that the limits of $N(2r, f)/N(r,f)$ and $N(2r, 1/f)/N(r, 1/f)$ do not exist. A. Baernstein (Trans. Amer. Math. Soc. 146(1969)) proved that if $f \in M_\lambda$ is entire, then $N(\sigma r, 1/f) \sim \sigma^\lambda N(r, 1/f)$ for every $\sigma > 0$. (Received August 29, 1977.)

749-B24 PETER DUREN, University of Michigan, Ann Arbor, Michigan 48109, and GLENN SCHOBER, Indiana University, Bloomington, Indiana 47401. Nonvanishing univalent functions. Preliminary report.

Let S_0 be the family of functions $f(z)$ analytic and univalent in the unit disk $|z| < 1$, with $f(z) \neq 0$ and $f(0) = 1$. Each extreme point of S_0 maps the disk onto the complement of an arc monotonic with respect to the family of ellipses with foci 0 and 1. Each support point of S_0 omits a single analytic arc which crosses the hyperbolae with foci 0 and 1 at angles less than $\pi/4$. Qualitative results are also obtained for the solutions to certain nonlinear extremal problems. (Received August 29, 1977.)

749-B25 ALBERT EDREI, Syracuse University, Syracuse, New York 13210. The Padé tables of entire functions.

Let (1) $f(z) = \Sigma a_j z^j$ $(a_0 \neq 0)$ represent an entire function of order $\lambda (0 \leqq \lambda < +\infty)$, and let $n \geqq 1$ be an integer such that $0 < 1 - \{\lambda n(n-1)/2\} = \xi \leqq 1$. Denote by P_{mn}/Q_{mn} the irreducible Padé approximant of (1) characterized by the conditions: P_{mn} is a polynomial of degree $\leqq m$; Q_{mn} is a polynomial of degree $\leqq n$ $(Q_{mn}(0) = 1)$. It is then possible to find an infinite sequence $S = S(n)$ of positive, strictly increasing integers having the following properties. If $\lambda > 0$ and $m \in S(n)$, then $|Q_{mn}(z) - 1| \leqq m^{-\xi/3\lambda}$ throughout the disk $|z| \leqq m^{\xi/3\lambda}$, and $|f(z)Q_{mn}(z) - P_{mn}(z)| \leqq \exp(-m + m^{\xi/2})$ in the smaller disk $|z| \leqq e^{-1} m^{\xi/3\lambda}$. In the limiting case $\lambda = 0$, there are no restrictions on n: to each $n \geqq 1$ there corresponds $S(n)$ such that $|f(z) - \{P_{mn}(z)/Q_{mn}(z)\}| \leqq \exp(-m + m^{1/2})$, provided $m \in S(n)$, $|z| \leqq m^B$ (B is an arbitrary positive constant). (Received August 29, 1977.)

749-B26 JOHN L. LEWIS, University of Kentucky, Lexington, Kentucky 40506. Convolutions of starlike functions.

Let $S(\alpha)$ denote the class of normalized starlike functions of order α, $-\infty < \alpha \leq 1$, in $\Delta = \{z: |z| < 1\}$. If $f(z) = \sum_{n=1}^{\infty} a_n z^n$ and $g(z) = \sum_{n=1}^{\infty} b_n z^n$, $z \in \Delta$, define $(f*g)_\alpha(z) = \sum_{n=1}^{\infty} [a_n b_n / A_n(\alpha)] z^n$, $z \in \Delta$, where $A_n(\alpha) = \Gamma(n+1-2\alpha)/[\Gamma(2-2\alpha)(n-1)!]$. A new proof is given of Suffridge's theorem (Springer lecture notes, 505, Thm. 7) which states that $(f*g)_\alpha \in S(\alpha)$, whenever

$f,g \in S(\alpha)$. Also a conjecture of Suffridge, concerning a representation formula for functions in $S(\alpha)$ is proved. It is shown that this formula characterizes $S(\alpha)$ for $\frac{1}{2} \leq \alpha \leq 1$. The proofs are based on a formula of Brickman, et. al. (Trans. Amer. Math. Soc. 185) for the function $z(1-xz)^{-a}(1-yz)^{-b}$, $z\varepsilon\Delta$. (Received August 29, 1977.)

749-B27 JOSEPH BECKER, Purdue University, West Lafayette, IN 47907 and C. WARD HENSON and LEE A. RUBEL, University of Illinois, Urbana, IL 61801. The problem of moduli for plane domains is undecidable. Preliminary Report.

THEOREM. (A) There exists a model N of set theory (ZFC) and two plane domains D_1 and D_2, which are not conformally equivalent (in N) but which receive (in N) exactly the same value under every well-ordered system of conformal invariants. (B) There also exists a model N* of ZFC and a certain well-ordered system of conformal invariants so that (in N*) two plane domains must be conformally equivalent if they receive exactly the same value under this system. We suppose above that for each system of invariants, the operation of taking a domain to its value is definable within set theory, and that each value is a well-ordered system of complex numbers. Under this interpretation, we believe that the above theorem gives a precise formulation of the undecidability result of the title. For many plane domains, the invariants of (B) may be taken to be first-order properties of the ring of holomorphic functions on the domain. In (A), the domains D_i are $\mathbb{C}\setminus S_i$, where the S_i are independent generic sets of integers. In part (B) we use a definable well-ordering of the universe of sets. Both parts of the theorem are independent of the continuum hypothesis. (Received August 29, 1977.)

749-B28 ALLEN WEITSMAN, Purdue University, West Lafayette, Indiana, 47907. On spread-type relations in the theory of functions.

We shall give a brief summary of recent results and mention some open problems involving the spread of a deficient value.

An inequality on the means of Green's functions will be given which yields as a simple consequence the following Theorem. Let $f(z)$ be meromorphic and of lower order μ in the plane. If $\delta(a)>0$ is the Nevanlinna deficiency for the value a and $\Theta(r,a)$ represents the angular measure of the longest arc of $|z| = r$ on which $|f(re^{i\theta})-a| < 1$ there exists $\eta=\eta(\delta(a),\mu)>0$ such that $\limsup_{r\to\infty} \Theta(r,a)>\eta$. (Received August 29, 1977.)

749-B29 LARRY J. KOTMAN, University of Wisconsin - La Crosse, La Crosse, Wisconsin 54601. An entire function with irregular growth and more than one deficient value.

W. K. Hayman in Research Problems in Function Theory poses the question of existence of meromorphic functions of finite order with at least two deficient values and characteristics satisfying $\overline{\lim_{r\to\infty}} \frac{T(\sigma r)}{T(r)} = \infty$ $(\sigma > 1)$. A. A. Goldberg in "The Possible Magnitude of the Lower Order of an Entire Function with a Finite Deficient Value" poses the question of existence of entire functions of infinite order, finite lower order, and having a finite deficient value. We prove existence in both cases by constructing an explicit infinite product representation of an entire function to meet the requirements. (Received August 29, 1977.) (Author introduced by Professor Joseph Miles).

*749-B30 WILLIAM HASTINGS, Fordham University, Bronx, New York 10458. On $H^2(\mu)$ for μ a pure atomic measure. Preliminary report.

For μ a positive, finite Borel measure with compact support in the complex plane, let $H^2(\mu)$ denote the $L^2(\mu)$-closure of the analytic polynomials. Various possible

criteria for determining when $H^2(\mu) \neq L^2(\mu)$ are discussed for μ a pure atomic measure. In particular, suppose μ is the atomic measure with $\mu\{\alpha_n\} = w_n$, where $\{w_n\}$ is a sequence of distinct points in the unit disk such that $|\alpha_n| \to 1$. Results of Brown, Shields and Zeller ("On Absolutely Convergent Exponential Sums." Trans. Amer. Math. Soc. 96(1960), 162-183) show that $H^2(\mu)$ may not be all of $L^2(\mu)$ in this case. The difficulty of finding necessary and/or sufficient conditions is illustrated by examples such as the following: If $w_n = o(r^n)$ for some r, $0 < r < 1$, then $H^2(\mu) = L^2(\mu)$ no matter how the points α_n are placed in the unit disk (with $|\alpha_n| \to 1$).
(Received August 30, 1977.)

749-B31 LOUIS NIRENBERG, New York University, Courant Institute of Mathematical Sciences, New York, New York 10012. Regularity in free boundary problems.

This is a report on joint work with D.Kinderlehrer and, in part, with J. Spruck, on the regularity of free boundaries in a variety of problems. These may occur for example in obstacle problems or as separation of different media. Assuming some initial regularity we prove that the free boundaries are analytic. The equations involved are of second or higher order. (Received August 30, 1977.)

749-B32 DAVID S. KINDERLEHRER, University of Minnesota, Minneapolis, Minnesota 55455 and LEWIS NIRENBERG and JOE SPRUCK, Courant Institute of Mathematical Sciences, New York University, New York, New York 10012. Remarks about higher order free boundary problems.

We introduce a generalized hodograph method to study free boundaries governed by elliptic equations of order higher than two. The given problem is seen to be equivalent to a nonlinear elliptic system the smoothness of whose solution implies the smoothness of the free boundary. In this brief exposition we give several examples of the method. (Received August 30, 1977.)

Applied Mathematics
(65, 68, 70, 73, 76, 78, 80–83, 85, 86, 90, 92–94)

*749-C1 ROBERT FINN, Stanford University, Stanford, California 94305. Existence and non-existence of capillary surfaces.

In the absence of gravity, a capillary surface u(x) in a domain Ω, making contact angle γ with cylinder walls Z lying over $\Sigma = \partial\Omega$, is determined by the relations $\operatorname{div} Tu = |\Sigma/\Omega| \cos\gamma$ in Ω, $\nu \cdot Tu = \cos\gamma$ on Σ, $Tu = Du/\sqrt{1+|Du|^2}$, ν = exterior normal. Let γ_0, $0 < \gamma_0 < \pi/2$, be defined by $\cos\gamma_0 = \operatorname{lub}_{\{w\}} \, 1/\operatorname{lub}_{\Omega} |w|$, among all vector fields w in Ω, with $\nu \cdot w = 1$ on Σ, $\operatorname{div} w = |\Sigma/\Omega|$ in Ω. It is shown a solution u(x) exists for any γ in $\gamma_0 < \gamma \leq \pi/2$, and that no solution exists in $0 < \gamma < \gamma_0$. If Ω is a circle, then $\gamma_0 = 0$. If Ω is a triangle or parallelogram with minimum angle α, then $\gamma_0 = \frac{1}{2}(\pi - \alpha)$. If Ω is a regular polygon with interior angle α, then again $\gamma_0 = \frac{1}{2}(\pi - \alpha)$. However, for any $\varepsilon > 0$, there is a trapezoid for which $\alpha > \frac{1}{2}(\pi - \varepsilon)$ and also $\gamma_0 > \frac{1}{2}(\pi - \varepsilon)$; thus, in this case, $\gamma_0 > \frac{1}{2}(\pi - \alpha) + \frac{1}{4}(\pi - 3\varepsilon)$.
(Received August 2, 1977.)

*749-C2 DAVID K. COHOON, USAF School of Aerospace Medicine, San Antonio, Texas 78235. An Analysis of a Singular Integral Equation of Electromagnetic Scattering. Preliminary report

Let Ω be that region of three dimensional space supporting the function f defined by the rule, $f(x) = (\varepsilon(x) - \varepsilon_0, \mu(x) - \mu_0, \sigma(x) - \sigma_0)$, where $(\varepsilon(x), \mu(x), \sigma(x))$ is a three tuple containing the

values of the usual electrical parameters (permittivity, conductivity, and permeability) at the point x and $(\varepsilon_0, \mu_0, \sigma_0)$ is a three tuple containing the values of these electrical parameters in free space. Maxwell's equations are used to derive an integral equation whose solution is the electric field E induced in a heterogeneous-penetrable-nonmagnetic body by an impinging field E^i. The integral equation is of the form $(L - N)E = E^i$, where L is an index-zero Fredholm operator and N is a strongly-singular integral operator acting on the space $L^2(\Omega)$. Existence and uniqueness of solutions of the integral equation are shown when $\|N\|$ is small. A scheme for the discretization of the integral equation is analyzed and tested on a computer. (Received August 9, 1977.)

749-C3 JON C. LUKE, Indiana University--Purdue University at Indianapolis, Indianapolis, Indiana 46205. Buying and selling algorithms. Preliminary report.

Algorithms for buying and selling of commodities and securities are discussed in the context of generalized commodity reserve currencies. Examples are given which relate to stock market fluctuations. (Received August 29, 1977.)

Geometry (50, 52, 53)

*749-D1 Joel C. Gibbons, Illinois Institute of Technology, Chicago, Illinois 60616. A Characterization of Linear Relations.

A subset, X, of the plane is an F2 set if, given any line l, X-l contains at least two points. If f is a set-to-set relation of the plane for which 1) the image of a line lies in a line and 2) the image of f is an F2 set, f is an affine transformation. An easy corollary is that if X is a fixed quadrangle, a line-preserving function f of the plane is affine if and only if f(X) is a quadrangle. (Received June 6, 1977.)

749-D2 Jerry L. Kazdan, University of Pennsylvania, Philadelphia, PA. 19174 Volume, Injectivity Radius, and Wiedersehen Flasche.

Let (M, g) be an n dimensional compact Riemannian manifold with volume V and injectivity radius $\mathrm{inj}(g)$. Combining a geometric idea of Marcel Berger with an inequality for Sturm-Liouville equations, one proves that $V > \frac{1}{2}V_0(\mathrm{inj}(g))$, where $V_0(r)$ is the volume of the standard sphere $S^n \subset R^{n+1}$ of radius r/π. This is sharp, except for the factor $\frac{1}{2}$ which can be deleted if (M, g) is a Wiedersehen Flasche, i.e. the cut locus of every point x is a single point x'. Following Berger, one can use the inequality to prove: if n is even, then the only Wiedersehen Flasche is the sphere S^n with the standard metric. (Received August 9, 1977.)

Logic and Foundations (02, 04)

*749-K1 Phyllis M. Kittel, Illinois Institute of Technology, Chicago, Illinois 60616. Intermediate Logics. Preliminary Report.

A propositional calculus is compact if whenever a wff F is deducible from a set of wffs $\mathcal{S}$, there is a finite subset of $\mathcal{S}$ from which F is deducible; normal if the set of tautologies is closed under substitution for variables. Propositional calculi intermediate between the intuitionistic and the classical are presented which are not required to be compact or normal. Theorem 1. An intermediate propositional calculus is normal if and only if it has a characteristic pseudo-complemented lattice. Theorem 2. Among those normal successors of a compact, normal intermediate propositional calculus $\mathcal{P}$ with the same tautologies as $\mathcal{P}$, there is a maximal, noncompact intermediate propositional calculus. (Received August 26, 1977.)

Topology (22, 54, 55, 57, 58)

*749-G1 KAREN K. UHLENBECK, University of Illinois at Chicago Circle, Box 4348, Chicago, Illinois 60680. Variational problems on manifolds with a conformal structure.

Unlike many other subjects in mathematics, the calculus of variations does not at the moment exist in a coherent theory which can automatically be applied successfully to a wide range of problems. At the best one can hope for a complete Morse theory; at the worst one many not know whether an integral is bounded below. Separate techniques often need to be developed for each problem. This talk describes one technique of proving existence of stationary functions for certain geometrical variational problems on manifolds. Both the success and the limitation of the approach are due to the fact that only the conformal structure of the manifold is used in the definition of the integral. The main geometric results obtained are existence theorems for closed minimal surfaces in Riemannian manifolds. However, there may be applications to the space of conformal structures on manifolds of dimension larger than two. (Received August 30, 1977.)

American Mathematical Society Short Course Series
Numerical Analysis
January 3–4, 1978

SC-1 CLEVE MOLER, University of New Mexico, Albuquerque, New Mexico 87131. Numerical linear algebra.

This lecture will present the background necessary to consider three research problems in numerical linear algebra.

1. Estimating condition. The condition number of a matrix is a measure of the sensitivity of the solution of a system of equations to errors, including roundoff errors. The calculation of the exact value of the condition number requires the inverse of the matrix, but the exact value is rarely necessary. Is it possible to compute a reasonably accurate estimate of the condition number with less work than is required to compute the inverse?

2. Singular value decomposition. The singular value decomposition of a matrix is a diagonalization by orthogonal transformations that is related to an eigenvalue decomposition. Many applications have been discovered in recent years, including digital image processing and cryptography. Attempts to assess the success of these applications lead to some interesting mathematical questions.

3. The QR algorithm. The QR algorithm is now regarded as the best general-purpose method for computing matrix eigenvalues. Its convergence properties are well understood in the symmetric case, but in the non-symmetric case there is neither a proof of convergence nor any known examples on which the complete algorithm fails to converge.

Reading List

1. H. C. Andrews and C. L. Paterson, Outer product expansions and their uses in digital image processing, Amer. Math. Monthly 82(1975), 1-12.

2. G. E. Forsythe, M. A. Malcolm and C. B. Moler, Computer methods for mathematical computations, Prentice-Hall, Englewood Cliffs, N. J., 1977, Chaps. 3, 9.

3. G. H. Golub and C. Reimsch, Singular value decomposition and least squares solution, Handbook for Automatic Computation. Vol. 2: Linear Algebra (J. H. Wilkinson and C. Reimsch, editors), Springer, New York and Berlin, 1971.

4. C. L. Lawson and R. J. Hanson, Solving least squares problems, Prentice-Hall, Englewood Cliffs, N. J., 1974.

5. G. W. Stewart, Introduction to matrix computation, Academic Press, New York, 1973.

SC-2 J. E. DENNIS, Department of Computer Science, Cornell University, Ithaca, New York 14853. Nonlinear optimization.

This lecture will center on a discussion of three problems which have been the subject of much recent progress in numerical analysis. These three problems, unconstrained minimization, nonlinear least squares, and nonlinear simultaneous equations, are all usually attacked numerically by iterative methods. We will outline some successful computer algorithms and contrast them with the convergence theory for the same methods. The narrowing gap between the 'numerical' algorithm and its 'analysis' indicates the degree and direction of theoretical progress. We will also mention some instances of algorithmic deficiencies being certified by the theory. (Received August 29, 1977)

Reading List

1. J. E. Dennis and J. J. Moré, Quasi-Newton methods, motivation and theory, SIAM Review 19(1977), 46-89.

SC-3 CARL DE BOOR, University of Wisconsin-Madison, Madison, Wisconsin 53706. The approximation of functions and linear functionals: Best vs. good approximation.

The standard theory [1], [3], [4] of best approximation from a finite dimensional linear subspace in a normed linear space is reviewed briefly, with special emphasis on the numerical construction of best approximants. It is then shown that, for specific approximating families, chiefly polynomials and piecewise polynomials, and for standard norms, satisfactory "nearly best" approximations can be constructed much more cheaply. The theory of optimal approximation to linear functionals, in the sense of Sard (see, e.g., [5]) and of Golomb and Weinberger [2], is reviewed next and, with numerical quadrature as an example, is contrasted with actual practice. (Received August 29, 1977.)

Reading List

1. E. W. Cheney, Introduction to approximation theory, McGraw-Hill, New York, 1966.

2. M. Golomb and H. F. Weinberger, Optimal approximations and error bounds, On Numerical Approximation (R. E. Langer, ed.), University of Wisconsin Press, Madison, Wis., 1959, pp. 117-190.

3. J. R. Rice, The approximation of functions, Vol. I, Addison-Wesley, Reading, Mass., 1964.

4. T. J. Rivlin, An introduction to the approximation of functions, Blaisdell, Waltham, Mass., 1969.

5. A. Sard, Linear approximation, Math. Surveys, no. 9, Amer. Math. Soc., Providence, R. I., 1963.

SC-4 JAMES M. VARAH, Computer Science Department, University of British Columbia, Vancouver, B.C., Canada V6T 1W5. Numerical methods for the solution of ordinary differential equations.

This lecture will attempt to survey the methods presently used for the numerical solution of both initial and boundary value problems in ordinary differential equations. We will try to discuss both the fundamental concepts

and the practical computational aspects involved in such methods as: multistep and Runge-Kutta for initial value problems, and shooting, finite-differences, and collocation for boundary value problems. Special mention will be made of stiff equations, singular perturbation problems, and extrapolation and deferred correction techniques. (Received August 26, 1977.)

Reading List

Books and Monographs:

C. W. Gear, Numerical initial value problems in ordinary differential equations, Prentice-Hall, Englewood Cliffs, N. J., 1971.

J. D. Lambert, Computational methods in ordinary differential equations, Wiley, New York.

H. J. Stetter, Analysis of discretization methods for ordinary differential equations, Springer-Verlag, New York, 1973.

H. B. Keller, Numerical methods for two-point boundary-value problems, Blaisdell, Waltham, Mass., 1968.

A. K. Aziz (Editor), Numerical solutions of boundary value problems for ordinary differential equations, Academic Press, New York, 1975.

H. B. Keller, Numerical solution of two-point boundary value problems, CBMS Regional Conf. Ser. in Appl. Math., SIAM.

Survey Papers:

G. Dahlquist, Problems related to the numerical treatment of stiff differential equations, Proc. Internat. Computing Sympos. 1973 (Davos, Switzerland), North-Holland, Amsterdam; American Elsevier, New York.

L. F. Shampine, H. A. Watts and S. M. Davenport, Solving nonstiff ordinary differential equations - the state of the art, SIAM Review 18(1976), 376-411.

H. O. Kreiss, Difference methods for stiff ordinary differential equations, MRC Technical Report, Madison, Wis., 1976; SIAM J. Numer. Anal. (to appear).

SC-5 JOSEPH OLIGER, Stanford University, Stanford, California 94305. Methods for time dependent partial differential equations.

Methods for the approximate solution of time dependent partial differential equations, such as those arising in continuum mechanics, will be discussed. After introducing the basic properties of accuracy, stability and convergence, several techniques for deriving methods will be considered—the method of lines, finite difference methods, finite element methods, and global expansion methods will result. The efficiency of methods will be considered as they relate to the problem of interest and its computational environment. Existing theory, and its limitations, will be examined as it applies to a problem in weather prediction. (Received August 19, 1977.)

Reading List

1. P. D. Lax, Applied mathematics and computing, Proc. Sympos. Appl. Math., Vol. 20, Amer. Math. Soc., Providence, R. I., 1974, pp. 57-66.

2. R. D. Richtmyer and K. W. Morton, Difference methods for initial value problems, 2nd ed., Interscience, New York, 1967. MR 36 #3515.

3. Gilbert Strang and G. J. Fix, An analysis of the finite element method, Prentice-Hall, Englewood Cliffs, N. J., 1973.

4. O. B. Widlund, Introduction to finite difference approximations to initial value problems for partial differential equations, Lecture Notes in Math., Vol. 193, Springer-Verlag, New York, 1973, pp. 111-152.

SC-6 GEORGE J. FIX, Department of Mathematics, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213. Variational methods for elliptic boundary value problems.

The mathematical theory of accuracy and stability for numerical solutions of elliptic boundary value problems has seen remarkable development over the last decade. The theory, as it relates to methods based on classical minimization principles such as Dirichlet's principle, is complete in all essential respects. These lectures will start with a brief survey of these results. The duals of classical minimum principles are mixed—or so-called hybrid—principles such as Kelvin's principle. The latter are widely used and very important in practice. Never-

theless, the sharp mathematical theory is still lacking. This is a very active area of research in numeric analysis and the bulk of these lectures will be devoted to this topic, including some very important recent as well as a discussion of major open questions. (Received August 29, 1977.)

Reading List

1. Gilbert Strang and G. J. Fix, An analysis of the finite element method, Prentice-Hall, Englewoo N. J., 1973.

2. P. G. Ciarlet, The finite element method for elliptic problems, North-Holland, Amsterdam, 197

3. F. Brezzi, On the existence, uniqueness, and approximation of saddle point problems, Rev. Fra Automat. Informat. Recherche Opérationelle Sér. Rouge 8(1974), 129-151.

4. G. J. Fix, M. Gunzburger and R. A. Nicolaidas, On mixed finite element methods, I: Least squa approximation of elliptic systems; II: Galerkin approximation of elliptic systems, NASA-ICASE Reports No 77-17 and 77-18, August 1977.

ERRATA—Volume 24

J. B. BAILLON, R. E. BRUCK and S. REICH, Asymptotic behavior of nonexpansive mappings and semigro Banach spaces. Abstract 77T-B123, Page A-427.

In Theorem 2, C = E.

RONALD E. BRUCK and SIMEON REICH, Nonexpansive projections and resolvents of accretive operators i Banach spaces. Abstract 77T-B128, Page A-428.

In Theorem 2(b), E is uniformly convex.

XAVIER CAICEDO, On extensions of $L(Q_1)$. Preliminary report. Abstract 77T-E49, Page A-437.

Add to Theorem 3 the hypothesis that the structures are determinate. Add the remark that th results were obtained using back and forth methods.

HOWARD W. LAMBERT, A class of nonsplittable links.

Abstract 77T-G97, page A-445.

Line 3 after the final word "with", add "a graph made from"

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Edited by H.F. Walker & W.E. Fitzgibbon, University of Houston. 244 pp/0-273-01066-2/$13.50. Publication: October 1977.

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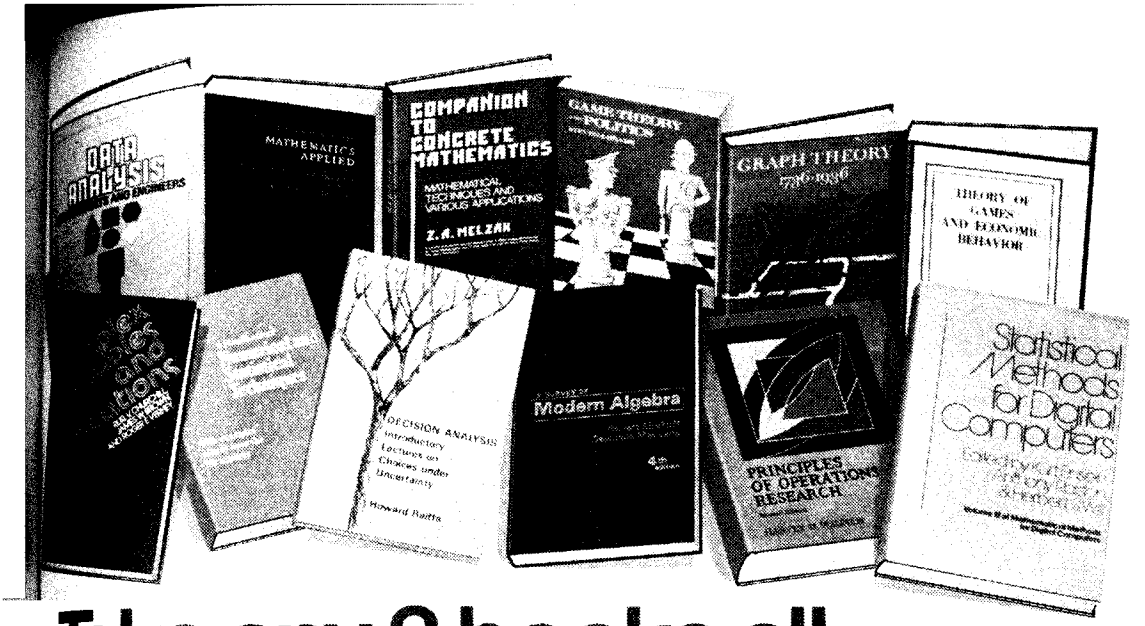

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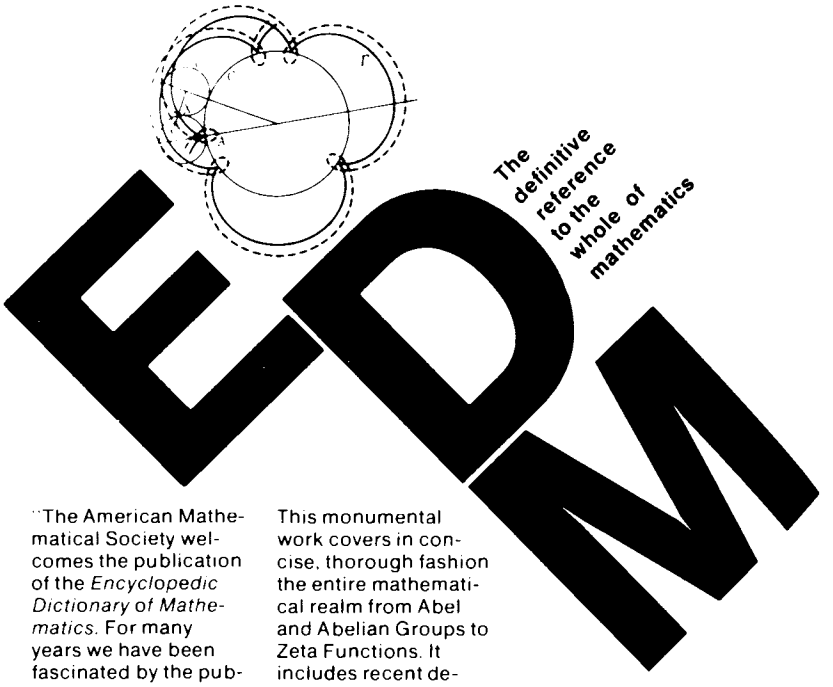

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(See page 376.) Address _____

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Ⓒ Institution (39) | Ⓓ (42) | Ⓔ (45) | Ⓕ (48) | Ⓖ Most recent employer | Ⓗ Present duties | Ⓘ Desired duties (59) | Ⓙ Available Mo. / Yr. (64) | Ⓛ (69) | Ⓜ (71)

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(See page 376.)

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