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, or 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

<table>
<thead>
<tr>
<th>MEETING NUMBER</th>
<th>DATE</th>
<th>PLACE</th>
<th>DEADLINE for ABSTRACTS and NEWS ITEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>750</td>
<td>November 11-12, 1977</td>
<td>Memphis, Tennessee</td>
<td>EXPIRED</td>
</tr>
<tr>
<td>751</td>
<td>November 11-12, 1977</td>
<td>San Luis Obispo, California</td>
<td>EXPIRED</td>
</tr>
<tr>
<td>752</td>
<td>January 3-8, 1978</td>
<td>Atlanta, Georgia</td>
<td></td>
</tr>
<tr>
<td>753</td>
<td>March 26-25, 1978</td>
<td>Columbus, Ohio</td>
<td>OCTOBER 18</td>
</tr>
<tr>
<td>755</td>
<td>April 7-9, 1978</td>
<td>Houston, Texas</td>
<td></td>
</tr>
<tr>
<td>756</td>
<td>April 14-15, 1978</td>
<td>San Francisco, California</td>
<td></td>
</tr>
<tr>
<td>757</td>
<td>August 8-12, 1978</td>
<td>Providence, Rhode Island</td>
<td></td>
</tr>
<tr>
<td>758</td>
<td>October 20-21, 1978</td>
<td>Claremont, California</td>
<td></td>
</tr>
<tr>
<td>759</td>
<td>January 24-28, 1979</td>
<td>Biloxi, Mississippi</td>
<td></td>
</tr>
<tr>
<td>760</td>
<td>April 6-8, 1979</td>
<td>Honolulu, Hawaii</td>
<td></td>
</tr>
<tr>
<td>761</td>
<td>August 21-25, 1979</td>
<td>Blacksburg, Virginia</td>
<td></td>
</tr>
<tr>
<td>762</td>
<td>January 3-7, 1980</td>
<td>San Antonio, Texas</td>
<td></td>
</tr>
<tr>
<td>763</td>
<td>January 8-12, 1981</td>
<td>San Francisco, California</td>
<td></td>
</tr>
</tbody>
</table>

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

---

### OTHER EVENTS

- **January 3-4, 1978**: Numerical Analysis (AMS Short Course) - Atlanta, Georgia
- **March 20-23, 1978**: Symposium on Relations Between Combinatorics and Other Parts of Mathematics - Columbus, Ohio
- **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.

The * Notices * of the American Mathematical Society is published by the American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940, in January, February, April, June, August, October, November, and December. Subscription prices for the 1977 volume (Volume 24) are list $19.00, member $9.50. The subscription price for members is included in the annual dues. Back issues of the * Notices * are available for a two year period only and cost $3.65 per issue list price, $2.74 per issue member price for Volume 22 (1975) and $6.00 per issue list price, $4.50 per issue member price for Volume 23 (1976). Orders for subscriptions or back issues must be accompanied by payment and should be sent to the Society at P. O. Box 1671, Annex Station, Providence, Rhode Island 02901. Other correspondence should be addressed to P. O. Box 6248, Providence, Rhode Island 02940. Second class postage paid at Providence, Rhode Island, and additional mailing offices. U.S. Postal Service Publication Number: 3388200.

Copyright © 1977 by the American Mathematical Society

Printed in the United States of America
EMETINGS
Calendar of Meetings ................................................. Inside Front Cover
Program for the October Meeting in Wellesley, Massachusetts .......... 312
Abstracts for the Meeting; A-562-A-571
Program for the October Meeting in West Lafayette, Indiana .......... 315
Abstracts for the Meeting; A-571-A-583
PRELIMINARY ANNOUNCEMENTS OF MEETINGS ...................... 319
ORGANIZERS AND TOPICS OF SPECIAL SESSIONS ..................... 323
INVITED SPEAKERS AT AMS MEETINGS ................................ 323
FINAL REPORT ON THE 1977 SUMMER RESEARCH INSTITUTE ON
AUTOMORPHIC FORMS, REPRESENTATIONS, AND L-FUNCTIONS ........... 334
MATHEMATICAL REVIEWS, Editor and Associate Editors ............... 335
TWENTY-FIRST ANNUAL AMS SURVEY: First Report ................... 336
Report on 1977 Survey of New Doctorates ........................... 342
Doctorates Confirmed in 1976-1977 .................................. 344
DOCTORATES CONFERRED IN 1975-1976, Supplementary List ............ 362
SUGGESTIONS FOR 1978 NOMINATIONS ................................ 363
VISITING MATHEMATICIANS ............................................ 364
TRANSLATION RECOMMENDATIONS ................................... 371
LETTERS TO THE EDITOR .............................................. 372
SPECIAL MEETINGS INFORMATION CENTER ............................ 374
MATHEMATICAL SCIENCES EMPLOYMENT REGISTER .................... 376
EMPLOYMENT INFORMATION FOR MATHEMATICIANS ................. 377
APPLICATION DEADLINES FOR GRANTS AND ASSISTANTSHIPS ......... 378
NEW AMS PUBLICATIONS .............................................. 379
PERSONAL ITEMS ...................................................... 384
ERIES ............................................................. 386
NEWS ITEMS AND ANNOUNCEMENTS ................................ 388
AMS REPORTS AND COMMUNICATIONS .................................. 395
The Summer Meeting in Seattle, Washington .......................... 395
ABSTRACTS .................................................................. A-519
ABSTRACTS FOR THE SHORT COURSE ON NUMERICAL ANALYSIS (Atlanta Meeting) A-583
ERRATA TO ABSTRACTS ............................................... A-586
SITUATIONS WANTED ................................................ A-586
CLASSIFIED ADVERTISEMENTS ..................................... A-587
EMPLOYMENT REGISTER PREREGISTRATION FORMS: Applicant/Employer A-597/A-598
PREREGISTRATION AND HOTEL RESERVATION FORMS (Memphis Meeting) A-599
PREREGISTRATION AND HOTEL RESERVATION FORMS (Atlanta Meeting) A-603
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. Baillieu, 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

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.

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. to 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.
light at entrance to the campus, then make right

at College Road. Persons driving west

from Boston) may take Route 9 to Route 16 and

continue south until reaching College Road en-

trance 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 Keremels. 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)


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.

313
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 Mobius 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)

University Park, Pennsylvania
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. GLENECKE 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 F. Allen, Yutze Chow, Gabor Domokos, Susan Kovacs-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. Kliree 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, Marts R. Essen, Lowell J. Hansen, Larry J. Kotman, John L. Lewis, Lee A. Rubel, Glenn E. Schober, and Allen W. Witnams. JOHANNES C. C. NITSCH 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 Gilea Auchmuty, Kenneth A. Babke, 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. Rindler, and Henry C. Wente.

There will be one session of contributed twenty-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-occupied 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.
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, 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 SCHOFER, 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) '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 $\mu$ 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

8:40 - 9:00 (23) Intermediate logics. Preliminary report. PHYLLIS M. KITTEL, Illinois Institute of Technology (749-E1)

8:45 - 9:05 (24) Enumeration of standard tableaus. Preliminary report. Professor FRANK W. OWENS, Ball State University (749-A6)

9:00 - 9:20 (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)

8:30 - 9:40 (27) Buying and selling algorithms. Preliminary report. Professor JON C. LUKE, Indiana University-Purdue University at Indianapolis (749-C3)

8:45 - 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

4:00 - 4:20 (34) The Pade tables of entire functions. ALBERT EDREI, Syracuse University (749-B25)

317
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)

3:00- 3:20 (45) The growth of point evaluation functionals in certain $L^2(\mu)$ 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 $L^p(N)$. 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)

Urbana, Illinois

Paul T. Bateman
Associate Secretary
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," and 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 foliai (Noes) 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
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 Yung 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.

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
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 COOK-BoNNIDIS 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 motel 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) 543-3060
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

VAGABOND MOTOR HOTEL (805) 544-4710
210 Madonna Road
Single $18.00 up
Double 22.00 up
Twin Beds 24.00 up

LAMPLITER MOTEL (805) 543-3709
1604 Monterey Street
Single $17.00 up
Double 18.00-$22.00 up

Motel 6 (805) 544-8400
1433 Callio 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

Kenneth A. Ross
Associate Secretary

Eugene, Oregon

HOMOLOGICAL LOCALIZATION TOWERS FOR GROUPS AND \( \Pi \)-MODULES
by A. K. Bousfield

This Memoir investigates localizations of groups and \( \Pi \)-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 \( \Pi \)-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 Muller'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

Prepayment is required for all AMS publications.
Send orders and remittances to: AMS, P. O. Box 1571, Providence, RI 02901.
INVITED SPEAKERS AT AMS MEETINGS

This section of these 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.

<table>
<thead>
<tr>
<th>Location</th>
<th>Date</th>
<th>Speakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Luis Obispo, California, November 1977</td>
<td></td>
<td>Jerrold E. Marsden, John B. Walsh</td>
</tr>
<tr>
<td>Atlanta, Georgia, January 1978</td>
<td></td>
<td>Hyman Bass (Colloquium Lecturer), Donald Knuth (Gibbs Lecturer), Yum Tong Siu, Robert I. Soare, Thomas Spencer, Michael E. Taylor</td>
</tr>
<tr>
<td>Columbus, Ohio, March 1978</td>
<td></td>
<td>Peter J. Hilton, Joseph Lipman, Steven Orey, Paul J. Sally, Jr.</td>
</tr>
<tr>
<td>New York, New York, March 1978</td>
<td></td>
<td>Arthur Jaffe, Barry Simon</td>
</tr>
<tr>
<td>Houston, Texas, April 1978</td>
<td></td>
<td>Todd Dupont, Fred Galvin, John P. Hempel, Andy R. Magid</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Location</th>
<th>Date</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memphis, Tennessee, November 1977</td>
<td></td>
<td>Expired</td>
</tr>
<tr>
<td>San Luis Obispo, California, November 1977</td>
<td></td>
<td>Expired</td>
</tr>
<tr>
<td>Atlanta, Georgia, January 1978</td>
<td></td>
<td>October 12</td>
</tr>
</tbody>
</table>

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

Estelle Basor, Operator theory
Donald 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

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
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 CHEGER, 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; Pollutions, 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-533 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, 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. 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 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 Meeting announcements 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 Meeting announcements. 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:

<table>
<thead>
<tr>
<th>Numerical Analysis Short Course</th>
<th>Preregistration Fee</th>
<th>At Meeting Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>(by mail prior to 12/2/77)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Members Nonmembers</td>
<td>$18</td>
<td>$20</td>
</tr>
<tr>
<td>Student Unemployed</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>One-day fee</td>
<td></td>
<td></td>
</tr>
<tr>
<td>for second day only</td>
<td>$5</td>
<td>10</td>
</tr>
</tbody>
</table>

Joint Mathematics Meetings

<table>
<thead>
<tr>
<th>Members of AMS MAA</th>
<th>Nonmembers</th>
<th>Student Unemployed</th>
</tr>
</thead>
<tbody>
<tr>
<td>$18</td>
<td>30</td>
<td>5</td>
</tr>
<tr>
<td>$25</td>
<td>35</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

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.
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
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.

<table>
<thead>
<tr>
<th>Hotel</th>
<th>Location</th>
<th>Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Atlanta American Motor Hotel</strong></td>
<td>(10-15 minutes)</td>
<td></td>
</tr>
<tr>
<td>Spring Street at Carnegie Way, 30301</td>
<td></td>
<td>Single $29 Double $30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Twin $30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quadruple $40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2 bedrooms) $250</td>
</tr>
<tr>
<td><strong>Atlanta Central—Travelodge</strong></td>
<td>(10-15 minutes)</td>
<td></td>
</tr>
<tr>
<td>311 Courtland Street, NE, 30303</td>
<td></td>
<td>Single $21 Double $24 Twin $27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Twin $27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quadruple $33</td>
</tr>
<tr>
<td><strong>Atlanta Hilton</strong></td>
<td>(5 minutes)</td>
<td></td>
</tr>
<tr>
<td>Courtland and Harris Streets, NE, 30303</td>
<td></td>
<td>Single $29 Twin Double $41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Twin $41</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*Extra person in room $11</td>
</tr>
<tr>
<td><strong>Best Western White House Motor Hotel</strong></td>
<td>(10-15 minutes)</td>
<td></td>
</tr>
<tr>
<td>70 Houston Street, NE, 30303</td>
<td></td>
<td>Single $24 and $32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Twin $28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Double $28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Twin Double $32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quadruple $40</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suite (1 bedroom) $95</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(2 bedrooms) $125</td>
</tr>
<tr>
<td><strong>Holiday Inn Downtown</strong></td>
<td>(10-15 minutes)</td>
<td></td>
</tr>
<tr>
<td>175 Piedmont Avenue, NE, 30303</td>
<td></td>
<td>Single $18 Twin Double $21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Twin $24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quadruple $27</td>
</tr>
<tr>
<td><strong>Paschal’s Motor Hotel</strong></td>
<td>(20-30 minutes)</td>
<td></td>
</tr>
<tr>
<td>830 Martin Luther King, Jr. Drive, SW, 30314</td>
<td></td>
<td>Single $24 Double $28 Twin $28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Passport Center Inn</strong></td>
<td>(5 minutes)</td>
<td></td>
</tr>
<tr>
<td>231 Ivy Street, NE, 30303</td>
<td></td>
<td>Single $24 Double $28 Twin $28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 make reservations for those 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,

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
Spring Street at Carnegie Way, 30301
Telephone: (404) 688-8600
Single $26 Double $30
Triple $35 Quadruple $40
Suite (1 bedroom) $65 (2 bedrooms) $250

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

Atlanta Hilton
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
70 Houston Street, NE, 30303
Telephone: (404) 659-2660
Single $24 and $32 Twin $28
Twin Double $32 Triple $36 Quadruple $40
Suite (1 bedroom) $95 (2 bedrooms) $125

Holiday Inn Downtown
175 Piedmont Avenue, NE, 30303
Telephone: (404) 659-2727
Single $26 Double $29 Twin $34
Twin Double $32 Triple $36 Quadruple $42
Suite (1 bedroom) $80 (2 bedrooms) $110

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

Passport Center Inn
231 Ivy Street, NE, 30303
Telephone: (404) 577-1510
Single $24 Double $28 Twin $28
*Extra person in room $4
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-403 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) 165 Luckie Street, NW, 30303 Telephone: (404) 525-5401 Single $7.50 Double $13.00
Phoenix Halls of Atlanta (women only) (20-30 minutes) (04) 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 Metropolitan 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 at 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 commercial 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 Mountains. 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 1.1 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


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**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:00 a.m. - 8:00 p.m.</td>
<td>REGISTRATION (Short Course Only)</td>
</tr>
<tr>
<td>1:30 p.m. - 2:45 p.m.</td>
<td>Numerical linear algebra</td>
</tr>
<tr>
<td>3:00 p.m. - 4:15 p.m.</td>
<td>Nonlinear optimization</td>
</tr>
<tr>
<td>4:30 p.m. - 5:45 p.m.</td>
<td>The approximation of functions and linear functionals: Best vs. good approximation</td>
</tr>
<tr>
<td>7:30 p.m. - 8:45 p.m.</td>
<td>Numerical methods for the solution of ordinary differential equations</td>
</tr>
<tr>
<td>9:00 p.m. - 9:40 p.m.</td>
<td>Methods for time dependent partial differential equations I</td>
</tr>
</tbody>
</table>

**WEDNESDAY, January 4**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30 a.m. - 9:30 a.m.</td>
<td>REGISTRATION (Short Course Only)</td>
</tr>
<tr>
<td>9:00 a.m. - 9:40 a.m.</td>
<td>Methods for time dependent partial differential equations II</td>
</tr>
<tr>
<td>10:00 a.m. - 11:15 a.m.</td>
<td>Variational methods for elliptic boundary value problems</td>
</tr>
</tbody>
</table>

**JOINT MATHEMATICS MEETINGS**

**TUESDAY, January 3**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00 a.m. - noon</td>
<td>American Mathematical Society</td>
</tr>
<tr>
<td>2:00 p.m. - 8:00 p.m.</td>
<td>Council Meeting</td>
</tr>
<tr>
<td>7:00 p.m. - 10:00 p.m.</td>
<td>Sessions for Contributed Papers Special Sessions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:00 p.m.</td>
<td>Mathematicians Action Group</td>
</tr>
<tr>
<td>2:00 p.m.</td>
<td>Steering Committee - Open Meeting</td>
</tr>
</tbody>
</table>

REGISTRATION
### SUMMARY OF ACTIVITIES

#### WEDNESDAY, January 4

<table>
<thead>
<tr>
<th>Time</th>
<th>American Mathematical Society</th>
<th>Other Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 a.m. - 5:00 p.m.</td>
<td>Sessions for Contributed Papers Special Sessions</td>
<td>REGISTRATION</td>
</tr>
<tr>
<td>9:00 a.m. - 10:00 a.m.</td>
<td>INVITED ADDRESS Ergodic theorems in demography</td>
<td>Joel E. Cohen</td>
</tr>
<tr>
<td>10:30 a.m. - 11:30 a.m.</td>
<td>INVITED ADDRESS Pseudoconvexity and the problem of Levi</td>
<td>Yum Tong Siu</td>
</tr>
<tr>
<td>1:00 p.m. - 2:00 p.m.</td>
<td>COLLOQUIUM LECTURE I Algebraic K-theory</td>
<td>Hyman Bass</td>
</tr>
<tr>
<td>1:00 p.m. - 5:00 p.m.</td>
<td>Sessions for Contributed Papers Special Sessions</td>
<td>EXHIBITS</td>
</tr>
<tr>
<td>2:15 p.m. - 6:00 p.m.</td>
<td>INVITED ADDRESS Some mathematical aspects of quantum field theory</td>
<td>Thomas Spencer</td>
</tr>
<tr>
<td>6:30 p.m. - 9:30 p.m.</td>
<td>JOSIAH WILLARD GIBBS LECTURE Mathematical typography</td>
<td>Donald E. Knuth</td>
</tr>
</tbody>
</table>

#### THURSDAY, January 5

<table>
<thead>
<tr>
<th>Time</th>
<th>American Mathematical Society</th>
<th>Other Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 a.m. - noon</td>
<td>Sessions for Contributed Papers Special Sessions</td>
<td>REGISTRATION</td>
</tr>
<tr>
<td>8:00 a.m. - 4:00 p.m.</td>
<td>EMPLOYMENT REGISTER ORIENTATION SESSION</td>
<td></td>
</tr>
<tr>
<td>9:00 a.m. - 10:00 a.m.</td>
<td>INVITED ADDRESS Closed orientable 3-manifolds and their representations</td>
<td>Joan S. Birman</td>
</tr>
<tr>
<td>2:00 a.m. - 4:00 p.m.</td>
<td>INVITED ADDRESS Recursively enumerable sets and degrees</td>
<td>Robert I. Soare</td>
</tr>
<tr>
<td>2:15 p.m. - 3:15 p.m.</td>
<td>COLLOQUIUM LECTURE II Algebraic K-theory</td>
<td>Hyman Bass</td>
</tr>
<tr>
<td>4:15 p.m. - 6:00 p.m.</td>
<td>INVITED ADDRESS Aspects of geometry and topology of the spectrum</td>
<td>Jeff Cheeger</td>
</tr>
<tr>
<td>4:15 p.m. - 5:30 p.m.</td>
<td>Prize Session</td>
<td></td>
</tr>
<tr>
<td>7:00 p.m. - 10:00 p.m.</td>
<td>Sessions for Contributed Papers Special Sessions</td>
<td>MAA - Film Program</td>
</tr>
<tr>
<td>1:00 p.m. - 2:00 p.m.</td>
<td>INVITED ADDRESS Panel discussion: An employer's viewpoint on nonacademic employment</td>
<td>James A. Dewar</td>
</tr>
<tr>
<td>1:00 p.m. - 10:00 p.m.</td>
<td>Committee on Employment and Educational Policy Panel discussion: An employer's viewpoint on nonacademic employment</td>
<td>Brockway McMillan Daniel H. Wagner (moderator) Shmuel Winograd</td>
</tr>
<tr>
<td>Time</td>
<td>Event</td>
<td>Organizer/Details</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>8:00 a.m. - 4:00 p.m.</td>
<td><strong>REGISTRATION</strong></td>
<td>MAA - Chauvenet Symposium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Martin D. Davis, Lawrence A. Zalcman</td>
</tr>
<tr>
<td></td>
<td><strong>EXHIBITS</strong></td>
<td>MAA - Panel discussion: Numerical analysis in the undergraduate curriculum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gunter H. Meyer (moderator)</td>
</tr>
<tr>
<td></td>
<td><strong>EMPLOYMENT REGISTER INTERVIEWS</strong></td>
<td>Conference Board of the Mathematical Sciences</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Panel discussion: The growing role of applications in mathematical higher education</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clayton V. Aucoin (moderator)</td>
</tr>
<tr>
<td>1:00 p.m. - 2:00 p.m.</td>
<td><strong>COLLOQUIUM LECTURE III</strong></td>
<td>Hyman Bass</td>
</tr>
<tr>
<td>2:00 p.m. - 4:00 p.m.</td>
<td><strong>CONTRIBUTED PAPERS</strong></td>
<td>Special Sessions</td>
</tr>
<tr>
<td>2:00 p.m. - 5:30 p.m.</td>
<td><strong>INVITED ADDRESS</strong></td>
<td>Representations of finite groups of Lie type</td>
</tr>
<tr>
<td>2:30 p.m. - 3:30 p.m.</td>
<td><strong>INVITED ADDRESS</strong></td>
<td>Charles W. Curtis</td>
</tr>
<tr>
<td></td>
<td><strong>INVITED ADDRESS</strong></td>
<td>Propagation, reflection, and diffraction of singularities of solutions to wave equations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Michael E. Taylor</td>
</tr>
<tr>
<td>7:00 p.m. - 10:00 p.m.</td>
<td><strong>sessions for Contributed Papers Special Sessions</strong></td>
<td></td>
</tr>
<tr>
<td>7:00 p.m. - 10:00 p.m.</td>
<td><strong>MAG - Panel Discussion</strong></td>
<td></td>
</tr>
<tr>
<td>8:00 a.m. - 4:00 p.m.</td>
<td><strong>REGISTRATION</strong></td>
<td>MAA - Panel discussion: A course in applied mathematics based on problems from regional industries</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jeanne L. Agnew (moderator)</td>
</tr>
<tr>
<td>9:00 a.m. - 10:50 a.m.</td>
<td><strong>EXHIBITS</strong></td>
<td></td>
</tr>
<tr>
<td>9:00 a.m. - 5:00 p.m.</td>
<td><strong>MAA - Business Meeting</strong></td>
<td></td>
</tr>
<tr>
<td>9:00 a.m. - 5:30 p.m.</td>
<td><strong>MAA - Retiring Presidential Address</strong></td>
<td>Henry O. Pollak</td>
</tr>
<tr>
<td>10:00 a.m. - 10:50 a.m.</td>
<td><strong>CBMS - Council Meeting</strong></td>
<td></td>
</tr>
<tr>
<td>1:00 p.m. - 2:00 p.m.</td>
<td><strong>COLLOQUIUM LECTURE IV</strong></td>
<td>Hyman Bass</td>
</tr>
<tr>
<td>2:00 p.m. - 5:30 p.m.</td>
<td><strong>CONTRIBUTED PAPERS</strong></td>
<td>Special Sessions</td>
</tr>
<tr>
<td>2:15 p.m. - 6:00 p.m.</td>
<td><strong>INVITED ADDRESS</strong></td>
<td>Images of manifolds under cell-like maps</td>
</tr>
<tr>
<td>3:30 p.m. - 4:30 p.m.</td>
<td></td>
<td>Robert D. Edwards</td>
</tr>
<tr>
<td>5:00 p.m. - 6:00 p.m.</td>
<td><strong>sessions for Contributed Papers Special Sessions</strong></td>
<td></td>
</tr>
<tr>
<td>7:30 p.m. - 8:30 p.m.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:00 p.m. - 10:00 p.m.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1978 | Washington, D. C.
SYMPÓSIUM | 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
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 adele 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).
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-editorial 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 responsibilities 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.
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 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

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FACULTY</td>
<td>WOMEN</td>
</tr>
<tr>
<td></td>
<td>With</td>
<td>With</td>
</tr>
<tr>
<td></td>
<td>Tenure</td>
<td>Tenure</td>
</tr>
<tr>
<td>WITHOUT DOCTORATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td>485</td>
<td>77</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>718</td>
<td>573</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>532</td>
<td>516</td>
</tr>
<tr>
<td>Professor</td>
<td>131</td>
<td>125</td>
</tr>
<tr>
<td>On leave</td>
<td>1,866</td>
<td>1,251</td>
</tr>
<tr>
<td>WITH DOCTORATE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td>197</td>
<td>9</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td>2,363</td>
<td>435</td>
</tr>
<tr>
<td>Associate Professor</td>
<td>2,955</td>
<td>2,666</td>
</tr>
<tr>
<td>Professor</td>
<td>3,129</td>
<td>3,072</td>
</tr>
<tr>
<td>On leave</td>
<td>8,644</td>
<td>6,182</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Fall 1976</th>
<th>Fall 1977</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups I, II, III</td>
<td>75.3%</td>
<td>75.6%</td>
</tr>
<tr>
<td>Groups IV, V</td>
<td>67.3%</td>
<td>67.8%</td>
</tr>
<tr>
<td>Group VI</td>
<td>77.1%</td>
<td>80.1%</td>
</tr>
<tr>
<td>Masters and Bachelors</td>
<td>67.8%</td>
<td>70.1%</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>DOCTORATE GRANTING DEPARTMENTS</th>
<th>Group I (19 out of 27 reporting)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WITH DOCTORATE</strong></td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td>3 0</td>
</tr>
<tr>
<td>Asst. Prof.</td>
<td>0 0</td>
</tr>
<tr>
<td><strong>WITH DOCTORATE</strong></td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td>47 0</td>
</tr>
<tr>
<td>Asst. Prof.</td>
<td>156 6</td>
</tr>
<tr>
<td>Asso. Prof.</td>
<td>187 9</td>
</tr>
<tr>
<td>Professor</td>
<td>467 9</td>
</tr>
<tr>
<td>On leave</td>
<td>(69) (0)</td>
</tr>
<tr>
<td>**DOCTORATE GRANTING DEPARTMENTS</td>
<td>Group II (32 out of 38 reporting)</td>
</tr>
<tr>
<td><strong>WITH DOCTORATE</strong></td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td>18 5</td>
</tr>
<tr>
<td>Asst. Prof.</td>
<td>6 4</td>
</tr>
<tr>
<td>Asso. Prof.</td>
<td>3 3</td>
</tr>
<tr>
<td>Professor</td>
<td>0 0</td>
</tr>
<tr>
<td>On leave</td>
<td>(1) (1)</td>
</tr>
<tr>
<td>**DOCTORATE GRANTING DEPARTMENTS</td>
<td>Group III (74 out of 91 reporting)</td>
</tr>
<tr>
<td><strong>WITHOUT DOCTORATE</strong></td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td>64 15</td>
</tr>
<tr>
<td>Asst. Prof.</td>
<td>70 6</td>
</tr>
<tr>
<td>Asso. Prof.</td>
<td>49 6</td>
</tr>
<tr>
<td>Professor</td>
<td>10 0</td>
</tr>
<tr>
<td>On leave</td>
<td>(1) (1)</td>
</tr>
<tr>
<td><strong>WITH DOCTORATE</strong></td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td>413 91</td>
</tr>
<tr>
<td>Asso. Prof.</td>
<td>604 615</td>
</tr>
<tr>
<td>Professor</td>
<td>613 604</td>
</tr>
<tr>
<td>On leave</td>
<td>(66) (44)</td>
</tr>
</tbody>
</table>

### Salaries (in hundreds of dollars)

<table>
<thead>
<tr>
<th>DOCTORATE GRANTING DEPARTMENTS</th>
<th>Group I (19 out of 27 reporting)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Without Doctorate</strong></td>
<td><strong>With Doctorate</strong></td>
</tr>
<tr>
<td>Instructor</td>
<td>125(130-140) 140-156 153-170200</td>
</tr>
<tr>
<td>Asst. Prof.</td>
<td>150(158-180) 179-201 198-240274</td>
</tr>
<tr>
<td>Professor</td>
<td>182(200-225) 264-309 383-41850</td>
</tr>
<tr>
<td>On leave</td>
<td>(69) (0)</td>
</tr>
<tr>
<td><strong>Without Doctorate</strong></td>
<td><strong>With Doctorate</strong></td>
</tr>
<tr>
<td>Instructor</td>
<td>100(104-147) 104-155 107-168208</td>
</tr>
<tr>
<td>Asst. Prof.</td>
<td>114(127-141) 137-158 148-179197</td>
</tr>
<tr>
<td>Asso. Prof.</td>
<td>130(160-178) 185-202 205-234272</td>
</tr>
<tr>
<td>Professor</td>
<td>155(203-230) 250-288 335-388473</td>
</tr>
<tr>
<td>On leave</td>
<td>(1) (1)</td>
</tr>
<tr>
<td><strong>Without Doctorate</strong></td>
<td><strong>With Doctorate</strong></td>
</tr>
<tr>
<td>Instructor</td>
<td>90(103-123) 103-128 110-134148</td>
</tr>
<tr>
<td>Asst. Prof.</td>
<td>112(120-152) 127-159 133-165186</td>
</tr>
<tr>
<td>Asso. Prof.</td>
<td>145(161-193) 177-202 177-207225</td>
</tr>
<tr>
<td>Professor</td>
<td>183(218-285) 218-235 218-235329</td>
</tr>
<tr>
<td>On leave</td>
<td>(1) (1)</td>
</tr>
<tr>
<td><strong>With Doctorate</strong></td>
<td></td>
</tr>
<tr>
<td>Instructor</td>
<td>115(125-148) 140-162 155-173198</td>
</tr>
<tr>
<td>Asst. Prof.</td>
<td>125(160-175) 177-197 196-221287</td>
</tr>
<tr>
<td>Asso. Prof.</td>
<td>174(198-228) 236-274 277-341485</td>
</tr>
<tr>
<td>Professor</td>
<td>1713(1313) 197 195 50 1718 1339 91 50</td>
</tr>
</tbody>
</table>
### DOCTORATE GRANTING DEPARTMENTS. Group IV

**Without Doctorate**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Asst. Prof.</th>
<th>Asso. Prof.</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>8</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>0</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**With Doctorate**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Asst. Prof.</th>
<th>Asso. Prof.</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**On Leave**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Asst. Prof.</th>
<th>Asso. Prof.</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(1)</td>
<td>(0)</td>
<td>(0)</td>
</tr>
</tbody>
</table>

### DOCTORATE GRANTING DEPARTMENTS. Group V

**Without Doctorate**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Asst. Prof.</th>
<th>Asso. Prof.</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**With Doctorate**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Asst. Prof.</th>
<th>Asso. Prof.</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**On Leave**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Asst. Prof.</th>
<th>Asso. Prof.</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(0)</td>
<td>(0)</td>
<td>(0)</td>
</tr>
</tbody>
</table>

### DOCTORATE GRANTING DEPARTMENTS. Group VI

**Without Doctorate**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Asst. Prof.</th>
<th>Asso. Prof.</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>17</td>
<td>23</td>
<td>9</td>
</tr>
<tr>
<td>0</td>
<td>8</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**With Doctorate**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Asst. Prof.</th>
<th>Asso. Prof.</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>14</td>
<td>23</td>
<td>9</td>
</tr>
<tr>
<td>0</td>
<td>8</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**On Leave**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Asst. Prof.</th>
<th>Asso. Prof.</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2)</td>
<td>(3)</td>
<td>(0)</td>
<td>(0)</td>
</tr>
</tbody>
</table>

### DOCTORATE GRANTING DEPARTMENTS. Group VII

**Without Doctorate**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Asst. Prof.</th>
<th>Asso. Prof.</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**With Doctorate**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Asst. Prof.</th>
<th>Asso. Prof.</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>14</td>
<td>23</td>
<td>9</td>
</tr>
<tr>
<td>0</td>
<td>8</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**On Leave**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Asst. Prof.</th>
<th>Asso. Prof.</th>
<th>Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2)</td>
<td>(3)</td>
<td>(0)</td>
<td>(0)</td>
</tr>
</tbody>
</table>
## Size of Faculty

<table>
<thead>
<tr>
<th>Faculty with Doctorate</th>
<th>Women with Doctorate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>With Total Tenure</strong></td>
<td><strong>Total Tenure</strong></td>
</tr>
</tbody>
</table>

### Without Doctorate

<table>
<thead>
<tr>
<th>Instructor</th>
<th>184</th>
<th>31</th>
<th>85</th>
<th>13</th>
<th>178</th>
<th>26</th>
<th>84</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asst. Prof.</td>
<td>311</td>
<td>278</td>
<td>81</td>
<td>74</td>
<td>297</td>
<td>266</td>
<td>69</td>
<td>63</td>
</tr>
<tr>
<td>Asso. Prof.</td>
<td>199</td>
<td>197</td>
<td>23</td>
<td>23</td>
<td>200</td>
<td>200</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Professor</td>
<td>51</td>
<td>51</td>
<td>4</td>
<td>4</td>
<td>53</td>
<td>53</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

| On leave   | (13) | (12) | (5) | (5) | (12) | (9) | (5) | (1) |

### With Doctorate

<table>
<thead>
<tr>
<th>Instructor</th>
<th>20</th>
<th>0</th>
<th>7</th>
<th>0</th>
<th>15</th>
<th>0</th>
<th>4</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asst. Prof.</td>
<td>614</td>
<td>175</td>
<td>64</td>
<td>21</td>
<td>562</td>
<td>158</td>
<td>74</td>
<td>22</td>
</tr>
<tr>
<td>Asso. Prof.</td>
<td>758</td>
<td>688</td>
<td>50</td>
<td>47</td>
<td>807</td>
<td>732</td>
<td>51</td>
<td>50</td>
</tr>
<tr>
<td>Professor</td>
<td>584</td>
<td>568</td>
<td>39</td>
<td>39</td>
<td>632</td>
<td>624</td>
<td>43</td>
<td>43</td>
</tr>
</tbody>
</table>

| On leave   | (75) | (66) | (3) | (3) | (45) | (39) | (1) | (1) |

## Salaries

### Without Doctorate

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimum</strong></td>
<td>72(99-128)</td>
<td>77(102-135)</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>100(130-158)</td>
<td>107(136-162)</td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>163(196-239)</td>
<td>165(208-250)</td>
</tr>
</tbody>
</table>

### Bachelor Degree Granting Departments

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimum</strong></td>
<td>60(96-120)</td>
<td>60(105-125)</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>60(115-146)</td>
<td>60(121-153)</td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>125(196-239)</td>
<td>125(208-250)</td>
</tr>
</tbody>
</table>

### Master Degree Granting Departments

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimum</strong></td>
<td>90(130-149)</td>
<td>90(136-156)</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>110(155-177)</td>
<td>117(161-185)</td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>113(193-235)</td>
<td>124(203-245)</td>
</tr>
</tbody>
</table>

### With Doctorate

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Minimum</strong></td>
<td>90(130-149)</td>
<td>90(136-156)</td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td>110(155-177)</td>
<td>117(161-185)</td>
</tr>
<tr>
<td><strong>Maximum</strong></td>
<td>113(193-235)</td>
<td>124(203-245)</td>
</tr>
</tbody>
</table>

### On Leave

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Instructor</strong></td>
<td>(75)</td>
<td>(66)</td>
</tr>
<tr>
<td><strong>Asst. Prof.</strong></td>
<td>(75)</td>
<td>(66)</td>
</tr>
<tr>
<td><strong>Asso. Prof.</strong></td>
<td>(75)</td>
<td>(66)</td>
</tr>
<tr>
<td><strong>Professor</strong></td>
<td>(75)</td>
<td>(66)</td>
</tr>
</tbody>
</table>
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 an attempt was made to obtain information from individuals who were reported to have left the U.S. 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 842 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

<table>
<thead>
<tr>
<th>Year</th>
<th>Min.</th>
<th>Q₁</th>
<th>Median</th>
<th>Q₃</th>
<th>Max.</th>
<th>Year</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>50</td>
<td>80</td>
<td>-130</td>
<td></td>
<td>-</td>
<td>1974</td>
<td>72</td>
<td>95</td>
<td>265</td>
</tr>
<tr>
<td>1975</td>
<td>70</td>
<td>80</td>
<td>-130</td>
<td></td>
<td>-</td>
<td>1975</td>
<td>90</td>
<td>119</td>
<td>180</td>
</tr>
<tr>
<td>1976</td>
<td>70</td>
<td>80</td>
<td>-130</td>
<td></td>
<td>-</td>
<td>1976</td>
<td>90</td>
<td>130</td>
<td>210</td>
</tr>
<tr>
<td>1977</td>
<td>70</td>
<td>80</td>
<td>-130</td>
<td></td>
<td>-</td>
<td>1977</td>
<td>100</td>
<td>156</td>
<td>250</td>
</tr>
</tbody>
</table>

### TWELVE-MONTH SALARIES

<table>
<thead>
<tr>
<th>Year</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
<th>Year</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>90</td>
<td>138</td>
<td>185</td>
<td>1974</td>
<td>120</td>
<td>197</td>
<td>287</td>
</tr>
<tr>
<td>1975</td>
<td>100</td>
<td>155</td>
<td>270</td>
<td>1975</td>
<td>78</td>
<td>182</td>
<td>247</td>
</tr>
<tr>
<td>1976</td>
<td>111</td>
<td>170</td>
<td>260</td>
<td>1976</td>
<td>115</td>
<td>194</td>
<td>270</td>
</tr>
<tr>
<td>1977</td>
<td>105</td>
<td>187</td>
<td>350</td>
<td>1977</td>
<td>105</td>
<td>182</td>
<td>204</td>
</tr>
</tbody>
</table>

### RESEARCH (2 + 1)

<table>
<thead>
<tr>
<th>Year</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>72</td>
<td>95</td>
<td>265</td>
</tr>
<tr>
<td>1975</td>
<td>90</td>
<td>119</td>
<td>180</td>
</tr>
<tr>
<td>1976</td>
<td>90</td>
<td>130</td>
<td>210</td>
</tr>
<tr>
<td>1977</td>
<td>100</td>
<td>156</td>
<td>250</td>
</tr>
</tbody>
</table>

### RESEARCH (2 + 1)

<table>
<thead>
<tr>
<th>Year</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>140</td>
<td>190</td>
<td>251</td>
</tr>
<tr>
<td>1975</td>
<td>115</td>
<td>187</td>
<td>240</td>
</tr>
<tr>
<td>1976</td>
<td>120</td>
<td>205</td>
<td>400</td>
</tr>
<tr>
<td>1977</td>
<td>100</td>
<td>210</td>
<td>380</td>
</tr>
</tbody>
</table>

### BUSINESS AND INDUSTRY (63 + 7)

<table>
<thead>
<tr>
<th>Year</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>140</td>
<td>190</td>
<td>251</td>
</tr>
<tr>
<td>1975</td>
<td>115</td>
<td>187</td>
<td>240</td>
</tr>
<tr>
<td>1976</td>
<td>120</td>
<td>205</td>
<td>400</td>
</tr>
<tr>
<td>1977</td>
<td>100</td>
<td>210</td>
<td>380</td>
</tr>
</tbody>
</table>

341
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**

<table>
<thead>
<tr>
<th>1977–1978 EMPLOYMENT STATUS OF NEW DOCTORATES IN THE MATHEMATICAL SCIENCES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PURE MATHEMATICS</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Type of Employer</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Algebra and Number Theory</td>
</tr>
<tr>
<td>Analysis and Functional Analysis</td>
</tr>
<tr>
<td>Geometry and Topology</td>
</tr>
<tr>
<td>Probability</td>
</tr>
<tr>
<td>Statistics</td>
</tr>
<tr>
<td>Computer Science</td>
</tr>
<tr>
<td>Operations Research</td>
</tr>
<tr>
<td>Applied Mathematics</td>
</tr>
<tr>
<td>Mathematics Education</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

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.
mathematics departments had already experienced a drastic drop. It pointed out that during recent years Group II departments failed to report either 1975-1976 or 1976-1977. The 223 doctorates produced during 1976-1977 represent 23 departments, while the 351 Group II and III doctorates represent 116 departments reporting both years. Thus, the average number of departments is low (only about 3 per department).

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 Notes, October 1976, 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 1 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).

Table 2

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>262</td>
<td>223</td>
</tr>
<tr>
<td>Group II</td>
<td>141</td>
<td>147</td>
</tr>
<tr>
<td>Group III</td>
<td>265</td>
<td>264</td>
</tr>
<tr>
<td>Total I, II, III</td>
<td>668</td>
<td>574</td>
</tr>
<tr>
<td>Group IV</td>
<td>120</td>
<td>132</td>
</tr>
<tr>
<td>Group V</td>
<td>153</td>
<td>155</td>
</tr>
<tr>
<td>Group VI</td>
<td>57</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td>938</td>
<td>911</td>
</tr>
</tbody>
</table>

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.

Table 3

<table>
<thead>
<tr>
<th>SEX, RACE, AND CITIZENSHIP OF NEW DOCTORATES</th>
<th>July 1, 1977-June 30, 1977</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. DEGREES</td>
<td>MEN</td>
</tr>
<tr>
<td>RACIAL/ETHNIC GROUP</td>
<td>CITIZENSHIP</td>
</tr>
<tr>
<td></td>
<td>U.S., Canada, Other, Not Known</td>
</tr>
<tr>
<td>American Indian, Eskimo</td>
<td>2</td>
</tr>
<tr>
<td>Black, Afro-American</td>
<td>9</td>
</tr>
<tr>
<td>Mexican American, Puerto Rican</td>
<td>3</td>
</tr>
<tr>
<td>Oriental, Pacific Islander</td>
<td>12</td>
</tr>
<tr>
<td>Asian of those above</td>
<td>530</td>
</tr>
<tr>
<td>Not Known</td>
<td>46</td>
</tr>
<tr>
<td>Total Number</td>
<td>642</td>
</tr>
<tr>
<td>CANADIAN DEGREES</td>
<td>MEN</td>
</tr>
<tr>
<td>RACIAL/ETHNIC GROUP</td>
<td>CITIZENSHIP</td>
</tr>
<tr>
<td></td>
<td>U.S., Canada, Other, Not Known</td>
</tr>
<tr>
<td>American Indian, Eskimo</td>
<td>1</td>
</tr>
<tr>
<td>Black, Afro-American</td>
<td>2</td>
</tr>
<tr>
<td>Mexican American, Puerto Rican</td>
<td>6</td>
</tr>
<tr>
<td>Oriental, Pacific Islander</td>
<td>2</td>
</tr>
<tr>
<td>Asian of those above</td>
<td>14</td>
</tr>
<tr>
<td>Not Known</td>
<td>3</td>
</tr>
</tbody>
</table>

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.
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)

MATHMATICS

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)

Woo, Moo Ha, Regular transformation groups and homomorphisms

ARIZONA

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

MATHMATICS

Cranwell, Robert M., Limit theorems for mixing point processes
Guymon, Vernon Melvin, Jr., Faculty rating policies of community college mathematics students
Hew, 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

MATHMATICS

Anderson, Ian McDonald, Mathematical foundations of the Einstein field equations
Shew, Steven Michael, Transport impedance

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

MATHMATICS

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)

MATHMATICS 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)

MATHMATICS

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)

MATHMATICS

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)

MATHMATICS

Bailey, David Harold, Sequential schemes for classifying and predicting ergodic processes
Feinberg, Jerry Mark, The isoperimetric inequality for double-connected minimal surfaces in IR4
Feshbach, Mark Frederick, The transfer and compact Lie groups
Harrington, Andrew Neal, Some extremal problems in conformal and quasiconformal mapping
Horn, Julian Christian, 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
Rae, Maurice Hampton, Relatively finitely determined implies relatively very weak Balnoulli
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 \( y'' = \alpha y' + \beta y \)

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, Philip 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

MATHMATICS

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
Buck, Allen Henry, Involutions on Grassman manifolds
Buss, 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

344
Carpano, Marie-José. *A general two-good model of economic growth*.

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

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

Denis, Alan. *On Smale's axiom A dynamical systems*.

Emanuel, Gerald Scott. *Derivation controlled Lindenmayer systems*.


Hennell, Karsten. *On the complexity of finite semigroups*.

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

Jacob, John Philip. *Geodesic symmetries of homogeneous Kähler manifolds*.

Jones, David Royall. *On certain reflexive operator algebras*.

Kuniest, Raff Lee. *On the differential geometry of quasi-symmetric domains*.

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

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

Melnik, Paul Mikhail. *Blowing up and down in 4-manifolds*.


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

Poon, David Burnett. *High degrees*.


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

Vogtmann, Karen Lee. *Homology stability for O_n, GL(F)*.


Ziez, Stanislas. *Cell cycle kinetic modeling and optimal control theory in the service of cancer chemotherapy*.

**STATISTICS**

Cady, Enrol Churchill. *Convergence of measures on uniform spaces*.


Davis, Amy Poons. *Robust measures of association*.

Mura, Ryozo. *Adaptive rank estimates for the one sample problem*.

Mossett, Mohamed Wali. *On the asymptotic theory of statistical experiments and some of its applications*.

Peters, Richard Clark. *On the strict determination of hypotheses testing games*.

San'Anna, Annibal Parra. *Commutative functional networks*.

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

**UNIVERSITY OF CALIFORNIA, DAVIS (23:5.1.2.0.9.0.6)**

**MATHEMATICS**

Chatkante, Sidi Saut. *Capacitary dimension and Hausdorff dimension of compact sets in R^n*.

Simms, Jean Susan Slaughter. *Geometric realizations of toroidal maps*.

**University of California, Irvine (3:2.0.0.0.0.0.1)**

**MATHEMATICS**


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

Show, 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)**

**BIONASTATISTICS**

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 biomedically 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 for O_n, GL(F)*.

Miller, Robert Powell. *Linear codes invariant under permutation groups*.

Morison, Michael Allan. *Maximal density sequences with linear constraints*.


Rivers, Daniel Dagin. *Error bounds in nonlinear filtering*.

**SYSTEMS SCIENCE**

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

Houserwright, 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*.

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

Neheket, Henry Geld. *A study of sequential hypothesis testing for system identification*.

Nussbaun, 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 (6:5.0.0.1.0.0)**

**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*.


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

Palmu, 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

Schultz, 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

Humbrug, 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

Rutliff, 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 effects 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 topos

Fite, Earl D. Binary sequences which contain no BBb

Reita, Teklehaimanot. Topics in e-complexity and density character

Yale University (12;8.2.0.0,0.0,0)  
COMPUTER SCIENCE
Lehert, 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 Philip. 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

Kendtli, 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
DISTRIBUTION OF COLUMBIA

American University (6:0.6.0.0.0.0)

MATHEMATICS, STATISTICS AND COMPUTER SCIENCE

Arend, James. Relative stability of selected correlation and regression statistics in complex sampling

Delevit, Douglas. Testing goodness-of-fit for the tail of the normal distribution

Haddad, Adnan. On the extended Behrens-Fisher problem

Kareem, Usama. On one-null distributions of certain test criteria for covariance matrices

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

Wallsten, Rolf. Stability considerations for hierarchical clustering schemes involving multidimensional categorical variables

Catholic University of America (2:2.0.0.0.0.0)

MATHEMATICS

August, John E. Bitopologies and lattices

Gregorie, Susan 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

Burg, Daniel Racker. Integral generalized inverses of matrices

O'Brien, Robert L. Controllability stabilization and controllable semigroups in Hilbert spaces

Stanley, Walter E. 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 and in accelerated life tests

Kung, Roger Cwem. Optimal and heuristic algorithms for some assembly line balancing problems

STAISTICS

Dundon, James M. Early stopping and other properties of data sequential tests for binomial distributions

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

FLORIDA

Florida State University (4:2.0.0.0.0.0)

MATHEMATICS

Cruthirds, John L. Infinite Galois theory for commutative rings

Early, Theresa Ellen. Galois cohomology for commutative rings

STASTICS

Longue, Michael Thomas. Moment inequalities, maximal inequalities and their applications

Obremski, 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

Liu, Wee. Vector integration in tensor product spaces and comparison in Lebesgue-type spaces

Sonnenberg, Eduardo. Daniel. On the internal realization of polynomial response map

Yang, Joon Yoon. Stability of an infinite system of differential equations

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

Piarenza, 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 discriminant 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 triad

Georgia Institute of Technology (5:3.0.0.1.1.0.0)

INFORMATION AND COMPUTER SCIENCE

Dunlavay, Michael Robert. Representations for vision of physical assemblies

STASTICS

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

347
Allen, James Riley, A minimum cost path algorithm for printed circuit routing
Ellison, Karen Starr, Higher-order theorem proving using N-sorted logic
Fang, Hsing-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, Alfonz, The architecture of a functionally distributed computer system
Spiegelman, Clifford Henry, Characteristic classes of Gjoliatiotlf differential equations using collocation methods
Suchanek, Ana, On the summatorr functions of multipliers, r

Southern Illinois University, Carbondale (5:3.0.0.0.2.0.0)

University of Illinois, Chicago (4:3.1.0.0.0.0.0.0)

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 patterns
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 VLP; 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
Rung, 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 general purpose computer systems

Pennsylvania State University (8:5.0.0.0.0.0.0.0.0)

University of Illinois, Carbondale (4:1.0.0.0.0.0.0.0.0)

University of Illinois, Urbana (36:10.1.0.23.1.0.1)

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
Gajewski, John A., Asymptotic efficiencies of selection procedures
Mayhew, 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, Naqshab R., Semi-algebra of operators and algebra of multipliers
Redmond, Donald M., On the summatorr functions of a class of Dirichlet series
Shreve, Steven Eugene, Dynamic programming in complete separable spaces
Townsend, Douglas W., Imaginary values of a birational partial differential equations

Indiana University (7:6.1.0.0.0.0.0.0)

Mathematics

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

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

Kalicki, Craig A., Infinitary propositional intuitionistic logic

Kears, Timothy J., Jr., L-smooth structures for $\text{diff}(M)$ 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 simple Mach reflection

Taslamam, Hulieogh, 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 hierarchically 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 and 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 extreme observation in a multivariate setting

Yang, Shie-Shien, Concomitants of order statistics

University of Iowa (6:4.2,0.0,0.0,0.0)

Mathematics

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

Hu, Thaykin, 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, 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

Houssen, Mohammed Taib. Analysis of unbalanced models involving random effects with unequal variances

McGee, Robert L. 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 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

Lindel, Samuel Greene. A study of orthogonal transformations and their applications to statistics

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

Thitakamol, Borrihoon. 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 warranties contracts

Louisiana 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

Tresse, George William. The boundary of the maximal group of invertible operators and generalized Fredholm operators

Tulane University (1:0.0.1.0.0.0.0)

Mathematics

Haidland, 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, Jeannette 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, Don Walsh. 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 syntactic analysis of waveforms

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

Mathematics

Brownie, Russell C. Dynamic stability of one-dimensional non-linear 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-linear 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

Preistii, Elena. On the phase problem for space curves and a restriction theorem for space curves

Measurment and Statistics

Dux, 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

Heighnian, Silvia. Empirical Bayesian estimation of a joint distribution from incomplete data

Kenne, Margaret J. Preparation of random codes

Matotio, 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, Gus D. Analysis of the data of the Framingham heart study by competing risks

Brandeis University (1:1.0.0.0.0.0.0)

Mathematics
Galbraith, Bruce F. Foliations and plane fields on compact manifolds.

Clark University (2:2,0,0,0,0,0,0)
MATHEMATICS

Laflamme, Carl Scottie, Jr. Sheaf representations and first order conditions.


Harvard University (2,2,1,2,0,6,3,0,0)
APPLIED MATHEMATICS

Bruchmann, Ronald L. A structural paradigm for representing knowledge.

Chou, Kuo-Tung. The geometry of indefinite J-spaces and stability behavior of linear systems.

Davis, Mark Winstead. Investigations in static program analysis and sharing.

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

Harrison, Don E. On metascale-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. Geometry models for computer systems with general sensor time distributions.

Udin, David. Nested programming languages.

RESEARCH INSTITUTE

Bohler, Joe. Group cohomology representations.

Coppersmith, Dan. 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. Dradic Eisenstein series for function fields.

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


Kottwitz, Robert F. Orbital integrals on GL.

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

Weisnger, James. Some results on classical Eisenstein series and modular forms over function fields.

Wilson, William F. Fusion in nonabelian groups of order p.

Hirschborn, Philip Steven. On the “stable” homotopy type of knot complements.

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


Johnson, David Lewis. A normal form for curvature.

Koensgberg, Mark. Nonlinear convective aggregation and drift of diffusive heat sources.

Krevitt, James Stephen. The Kervaire invariant of manifolds with trivial total Siefel-Whitney class.

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

Leite, Maria Lusia Soares. On metrics of $R^1$ with nonnegative scalar curvature.

Magnus, Alfred Ewald. Nonstandard principal series representations of semisimple Lie groups.


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.

Prevost, Kenneth Joseph. Equivariant cutting and pasting of manifolds.

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

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

Telenman, Neculai Sinel. Global analysis on PL-manifolds.

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

Ulmann, Gunther. Hyperbolic pseudodifferential-operators with double characteristics.

Vainsncher, Israel. Some problems on enumerative geometry.

Vogon, 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.


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.

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 zero and 1.

MICHIGAN

Michigan State University (15:2,4,0,3,4,1,1)
COMPUTER SCIENCE

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


Liou, Jium-I. Grammatical inference by constructive methods.

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 involution on 3-dimensional handlebodies
Shaughnessy, James Michael, A clinical investigation of college students' resilience 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
Wa, 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 multi-level paging hierarchies
Melamed, Benjamin, Analysis and simplifications of discrete event systems and Jackson queuing networks
Sanguinetti, John Winston, Performance prediction in an operating system design methodology

**MATHEMATICS**

Arrunin, 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
Kuseloglu, Ayse Syrisal, 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 quasimilarity of operations on Hilbert space

**Wayne State University (4.2,2.0,0.0,0.0)**

**MATHEMATICS**

Grigpolakis, 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; 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
Paltu, 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-reflective 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 (1,0,0,1,1.0,0,0)

**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)**

**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 (4,2,0,1,1.0,0,0)**

**MATHEMATICS**

Bruening, James T., Inverses of transfer function matrices
Guccione, Salvadore J., Jr., Probabilistic foundations of general quantum theories and characteristics 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

Desai, 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

Frink, William Todd, Fractional derivatives and orders of distributions
Handy, Bonnie R., Arithmetical semigroup rings
Peterson, Edith Kregelius, On distributions of compact support
Peterson, Loren V., On Banach function spaces and \( l^p \)-sums of Banach spaces
Sarma, Iyavuty Ramabhadr, 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 Shor, Bounds on transfer principles for algebraically closed and complete discrete 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
Gartrell, Paul B., Arithmetic automorphic forms for quaternion unitary groups
Geller, Daryl Neil, Fourier analysis on the Heisenberg group
Lindley, John Earl, Fiber differential equations and Lie equations: Linear theory
Marshall, Bernard Paul, Tempered nonontangential boundedness and pointwise differentiability of distributions
Morgan, Frank, Almost every curve in \( \mathbb{R}^2 \) 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
Wolf, Robert L., Wiener path intersections and Euclidean field theory

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
Daccah, 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, Shy-hing, A new approach to the Daniell integral
Mallory, Walter, A representation theorem for toroidal 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 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 (GENHRL)

NEW MEXICO

New Mexico State University (4,3,0,0,1,0,0)
MATHEMATICAL SCIENCES

Al-Khafaji, Mahmoud, A topological approach to the theory of distributions on \( \mathbb{R}^n \)-dimensional groups and local fields
Cooper, Yeonina S., Finite valued groups
Engelsos, 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, Tomas Efrain, 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 x 2 system of conservation laws possessing no classical weak solution
Olaya, 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
Schonbek, 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, Tien Chen, 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
Kuperwasser, 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 (30,10.3,0.0,12.5,0.0)**

**APPLIED MATHEMATICS**

Deichert, W. Davis, An application of Banach space techniques to discrete time optimal control problems in economics

**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
Adler, 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
Rezn. Michael A., Minimal complete cores in quadratic number fields
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

Gonzales, Daichberg Lima. Mod 2 group and Mod 2 homotopy associative H-space

Statistics

Chaubey, Yogendra. The principle of minge in linear models: Modifications, extensions and applications

George, Ebenezer. 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 minmax mean square error estimation in linear models

University of North Carolina, Chapel Hill (20,3,1,1,2,4,0,0,0)

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 censoring procedures

Raynor, William J., Jr. Matching on a continuous variable in case-control studies

Schoenfeld, 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 Kotzarz, 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

Gurungam, Kenneth Rufus. Q-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 estimations 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

Francello, James. On the structure of free products of lattice ordered groups

Smith, Jo Ellen. The lattice of 1-group varieties

Case Western Reserve University (10,4,1,4,0,0,0,1)

Mathematics and Statistics

Brogan, Bruce James. Generalized vanishing theory in the nilpotent categories

Debane, 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. Naturalness of the Grothendieck spectral sequence

Papamichael, 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

Avanti, Moshe. 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 (1,4,0,0,0,0,0,0)

Mathematics

Morrison, Terry J. Derivatives 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, E hud. The application of cryptography to data base security
In the provided document, the text is a list of academic works and contributions from various universities. The text is categorized by discipline, such as Mathematics, Statistics, Computer Science, and others. Each entry includes the name of the institution, the author(s), and a brief description of the work. For example, an entry might read: "Oregon State University (5:3.1.0,0.1.0.0) Mathematics Kan, Joseph T. Paley-Wiener theorems with convex weight functions." This format is repeated throughout the document, highlighting contributions from Oregon, Oregon State, and other institutions like Pennsylvania, Oklahoma, and more.

The text is a compilation of academic works, possibly from a Ph.D. thesis or a similar document, detailing research contributions across various disciplines and institutions.
Pennsylvania State University (8;2,3,0,2,1,0,0)

Computer Science
Leung, Joseph Yuk-Tong, Fast algorithms for packing problems
Whetten, 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

Temple University (7;3,1,0,0,0,0,0)

Biometrics
Altun, 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 multilincic studies
Muccio, Richard L., Limit theorems for extremes

University of Pennsylvania (5,3,2,0,0,0,0,0)

Mathematics
Goto, Midori, Manifolds without focal 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
Sama, 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, Maylan, 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
Zambrong, Stuart, The extension of Minor's exact sequence of Witt rings for hyperelliptic curves and the cokernel of $\kappa$ 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, Dih-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
Toschi, Thomas James, A bivariate failure model

University of South Carolina, Columbia (3,2,1,0,0,0,0,0)

Mathematics and Computer Science
Lau, Cory Mung-Shek, Factorization of non-negative matrices
Lee, Arthur Chering Huia, Random contractors and random nonlinear operator equations with applications
Peart, Lynn Hauser, Random walks on graphs

TENNESSEE

University of Tennessee, Knoxville (2,2,0,0,0,0,0,0)

Mathematics
Ging, 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
Dorfett, Charles I., $R_d$ and $R$ spaces and hyperspaces

Rice University (7,2,0,0,2,2,0,1)

Mathematical Sciences
Farlow, Rodney W., Attribution grammar models for dataflow 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
Turba, Gabriel Julio, On value theories for n-person cooperative games
Zyla, Lubomir V., Techniques for nonlinear system approximation and identification based on Volterra expansions

Mathematics
Myers, John Robert, Companionship of knots and the Smith conjecture

358
On certain finite subgroups of the groups of maximal tori

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

COMPUTER SCIENCE

Mathew Nitscholas, Automating the design of dedicated real-time control systems

John Walter, Inference procedures for latent root regression analysis

A & M University (8;1,6,0,0,0,0,1)

A. Glen, On G-spectral estimation

John Walter, Inference procedures for latent root regression analysis

A & M University (8;1,6,0,0,0,0,1)

A. Glen, On G-spectral estimation

John Walter, Inference procedures for latent root regression analysis

University of Utah (8;7,0,0,0,0,0,0)

MATHEMATICS

Bates, Peter William, Projector methods for nonlinear nodal problems

Gilliam, David S., On integration and the Radon-Nikodym theorem in quasiconvex 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;0,0,0,0,0,1,0,0)

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(1) spaces and abounded evaluations

Vodola, Paul A., Some extensions of $M_2$

Virginia Commonwealth University (1;0,1,0,0,0,0,0,0)

BIOSTATISTICS

Hogye, Michael, Experimental designs in two dimensions when observations are correlated

Virginia Polytechnic Institute and State University (8;1,6,0,0,1,0,0,0)

MATHEMATICS

Steel, Christopher, Theorems of Wiener-Lévy type for integral operators in $C_p$

Winfrey, William R., Positivity properties of linear differential operators

STATISTICS

Bukir, Saad Tahm, 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 Iliaas, 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

Goth, John A., Wreath products with supersolvable automorphism groups
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**

Aytaa, 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*

Rebasso, Vahid. *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 SCIENCE**

Bennett, John B. *Empirical studies of noun meaning for computational models of understanding*

Fleischer, Jas Mark. *New optimality conditions for integer programming and their application to test problem construction*

Maguregui, Javier. *Regular multivalued functions and algorithmic applications*

Ruthstein, Michael. *Towards a canonical form for exponential and primitive functions*

**MATHEMATICS**

Aucel, Frederic Davis. *The locally flat approximation of cell-like embedding relations*

Carr, Ralph W. *Uniform $L^p$ estimates for a linear integro-differential 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, Luc. *Normality and countable paracompactness in spaces related to the Stone-Cech 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. *Singlar perturbations of boundary value problems with applications to turning point problems*

Mikkelsen, 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, Arthur Hing-Chin. *On the increments of multi-parameter Gaussian*

Burke, Murty 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 pro-super-solvable groups and subgroups of pro-C products of pro-C groups*

Petch, Andrew. *Profinite duality groups*

Tiwari, Umanath. *Some distributional transformations and Abelian theorems*

**Dalhousie University (3:1.1.0.0.0.0.0)**

**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*

Kecic, Attila Bela. *The Fredholm-Carleman theory for a class of radially acting linear operators in $L^p(\mathbb{R})$ spaces*

Tibulok, Marie-France. *Représentations des fonctions récatives 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**

Mogyoryusi, Joseph. *Covering dimension and the modelling distribution*
University of Waterloo (1894.1.0.7.2.0.4)

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

Rosenblooms, 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

Donnet, Gaston, Interpolation and interpolation hash searching

Hennayake, 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

Hari, Sigur, Particular difference and mean value type functional equations

Jeffers, E. A., Universal Horn classes of binary structures

Satharabham, 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 (2094.0.0.2.0.0)

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 (2094.0.0.1.0.0)

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 Boltzmann equation of neutron transport applied to finite cells

University of Saskatchewan (1994.0.0.1.0.0)

MATHEMATICS

Ngai, Tat-Yuen, Continuation methods for the solution of non-linear equations

University of Alberta (2094.0.0.2.0.0)

COMPUTING SCIENCES

Dasgupta, Subrata, Parallelism in microprogramming systems

Rai, W. S., Analytical evaluation of information retrieval processes

University of British Columbia (3194.0.1.0.0)

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

Wetzbandi, Samaranadasa, Bargaining solutions to the problem of uncertain values

University of Saskatchewan (1994.0.0.1.0.0)

MATHEMATICS

Ngai, Tat-Yuen, Continuation methods for the solution of non-linear equations

University of Waterloo (1894.1.0.7.2.0.4)

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

Rosenblooms, 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

Donnet, Gaston, Interpolation and interpolation hash searching

Hennayake, 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

Hari, Sigur, Particular difference and mean value type functional equations

Jeffers, E. A., Universal Horn classes of binary structures

Satharabham, 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 (2094.0.0.2.0.0)

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 (2094.0.0.1.0.0)

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 Boltzmann equation of neutron transport applied to finite cells

University of Saskatchewan (1994.0.0.1.0.0)

MATHEMATICS

Ngai, Tat-Yuen, Continuation methods for the solution of non-linear equations
**DOCTORATES CONFERRED IN 1975–1976**

**Supplementary List**

**ILLINOIS**

**THE UNIVERSITY OF CHICAGO**

Department of Statistics

Lin, Long-Ying

- Maximum likelihood estimation for exponential family with nonlinear constraints on the natural parameter space

Machado, Stella R. G.

- Transformations of multivariate data and tests for multivariate normality

**INDIANA**

**PURDUE UNIVERSITY**

Department of Statistics

Healy, John Douglas

- Estimation and tests for unknown linear restrictions in multivariate linear models

**MARYLAND**

**UNIVERSITY OF MARYLAND**

Department of Computer Science

Carmichael, Arthur B.

- Semantic classification of features of programming languages

Nagel, Roger

- Computer detection of freetland longswee

**NEW YORK**

**COLUMBIA UNIVERSITY, TEACHERS COLLEGE**

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**

Department of Statistics

Mendoza, Gaston

- A three phase model for controlled clinical trials

**WASHINGTON**

**UNIVERSITY OF WASHINGTON**

Biomathematics Group

Aickin, Mikel

- Linear exponential models and discrete prediction

**WISCONSIN**

**UNIVERSITY OF WISCONSIN, MADISON**

Department of Mathematics

Wag, Michael L.

- 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 $P$, parametrizes length-$n$ unions of \"thick points\" in $P$: $W$ is also a canonical desingularization of the $n$-fold symmetric product $S$ of $P$. The fiber $H$ of $W$ over the singular point $s \in S$ parametrizing the cycle $n p$ on $P$, is $H = \text{Hilb}^n \mathbb{R}$, the family of colength $n$ ideals in the power series ring. The first three chapters study the family $H$, which is stratified $H = \bigcup Z_l$ by the Hilbert function of the ideals. Each $Z_l$ is a locally trivial fiber bundle with fiber an affine space $k^r$ over the complete variety $G_l$ parametrizing graded ideals of Hilbert function $T$. When $k = \mathbb{C}$, $G_l$ is a compact manifold; otherwise, $G_l, Z_l$ 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 $G = \bigcup T$ by the Hilbert function of $(V)$; the stratum Grass $T$ and its closure are described, and related to the compact manifold $G$, 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.

112 pages

List price $7.60; member price $5.70

ISBN 0-8218-2188-1; LC 77-3947

Publication date: 6 30 77

To order, please specify MEMO188
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 the 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. |
| Vice President (1) | Member of the Mathematics of Computation Editorial Committee (1) |
| Secretary (1) | Member of the Proceedings Editorial Committee (1) |
| Associate Secretaries (2) | Members of the Transactions and Memoirs Editorial Committee (2) |
| Treasurer (1) | Members of the Committee to Monitor Problems in Communication (2) |
| Associate Treasurer (1) | Members-at-large of the Council (5) |
| 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 Board of Trustees (1) |

363
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

<table>
<thead>
<tr>
<th>Name and Home Country</th>
<th>Host Institution</th>
<th>Field of Special Interest</th>
<th>Period of Visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alexander, James (U.S.A.)</td>
<td>Universität Bonn, West Germany</td>
<td>Topology</td>
<td>Academic yr. 77/78</td>
</tr>
<tr>
<td>Allgower, Eugene L. (U.S.A.)</td>
<td>Universität Bonn, West Germany</td>
<td>Numerical Analysis</td>
<td>6/77 - 8/78</td>
</tr>
<tr>
<td>Anderson, Frank W. (U.S.A.)</td>
<td>Aarhus University, Denmark</td>
<td>Algebra</td>
<td>12/77 - 6/78</td>
</tr>
<tr>
<td>Anderson, R. L. (U.S.A.)</td>
<td>Indian Statistical Institute, New Delhi</td>
<td>Statistics</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Bachelis, Gregory (U.S.A.)</td>
<td>National Central University</td>
<td>Harmonic Analysis</td>
<td>2/78 - 5/78</td>
</tr>
<tr>
<td>Barcus, William (U.S.A.)</td>
<td>Oxford University, England</td>
<td>Topology</td>
<td>2/78 - 6/78</td>
</tr>
<tr>
<td>Bendersky, Martin (U.S.A.)</td>
<td>Kyoto University, Japan</td>
<td>Algebraic Topology</td>
<td>10/77 - 12/77</td>
</tr>
<tr>
<td>Bennett, G. W. (Canada)</td>
<td>University of Adelaide, Australia; Cambridge, United Kingdom</td>
<td>Multivariate Analysis</td>
<td>2/78 - 4/78</td>
</tr>
<tr>
<td>Berg, I. David (U.S.A.)</td>
<td>Monash University, Australia</td>
<td>Functional Analysis</td>
<td>8/77 - 5/78</td>
</tr>
<tr>
<td>Bhapkar, V. P. (U.S.A.)</td>
<td>CSIRO, Australia</td>
<td>Statistics</td>
<td>1/78 - 12/78</td>
</tr>
<tr>
<td>Blei, Ron C. (U.S.A.)</td>
<td>Upsala University, Sweden; Mittag-Leffler Institute, Sweden; Hebrew University, Israel</td>
<td>Harmonic Analysis</td>
<td>9/77 - 11/77</td>
</tr>
<tr>
<td>Boehme, Thomas (U.S.A.)</td>
<td>Cairo University, Egypt</td>
<td>Operational Calculus, Generalized Functions, Analytic Functions</td>
<td>9/77 - 6/79</td>
</tr>
<tr>
<td>Boone, William W. (U.S.A.)</td>
<td>Universität Bonn, West Germany</td>
<td>Logic</td>
<td>8/77 - 5/78</td>
</tr>
<tr>
<td>Browne, P. J. (Canada)</td>
<td>University of Dundee, Scotland</td>
<td>Multi-parameter Spectral Theory</td>
<td>8/77 - 7/78</td>
</tr>
<tr>
<td>Bunin, Martin G. (U.S.A.)</td>
<td>University of Stuttgart, Germany</td>
<td>Topological Sequence Spaces</td>
<td>9/77 - 7/78</td>
</tr>
<tr>
<td>Burckel, Robert B. (U.S.A.)</td>
<td>Universität des Saarlandes, Federal Republic of Germany</td>
<td>Analysis</td>
<td>8/77 - 8/78</td>
</tr>
<tr>
<td>Burgess, C. E. (U.S.A.)</td>
<td>Institute at the University of Warwick, England</td>
<td>Topology</td>
<td>3/78 - 6/78</td>
</tr>
<tr>
<td>Carlson, James A. (U.S.A.)</td>
<td>Institut des Hautes Études Scientifiques, France</td>
<td>Algebraic Geometry</td>
<td>1/78 - 6/78</td>
</tr>
<tr>
<td>Chakravarti, Indra M. (U.S.A.)</td>
<td>Institut de Statistique des Universités de Paris, France</td>
<td>Combinatorics, Design of Experiments</td>
<td>1/78 - 6/78</td>
</tr>
<tr>
<td>Cheeger, Jeff (U.S.A.)</td>
<td>Institut des Hautes Études Scientifiques, France</td>
<td>Differential Geometry</td>
<td>2/78 - 5/78</td>
</tr>
<tr>
<td>Cohen, Paul (U.S.A.)</td>
<td>Mittag-Leffler Institute, Sweden</td>
<td>Harmonic Analysis, Partial Differential Equations, Set Theory</td>
<td>7/77 - 7/78</td>
</tr>
<tr>
<td>Dade, Catherine D. (U.S.A.)</td>
<td>University of Strasbourg, France</td>
<td>Probability</td>
<td>8/77 - 5/78</td>
</tr>
<tr>
<td>Dade, Everett C. (U.S.A.)</td>
<td>University of Strasbourg, France</td>
<td>Group Theory</td>
<td>8/77 - 5/78</td>
</tr>
<tr>
<td>Diestel, Joseph (U.S.A.)</td>
<td>University College of Dublin, Ireland</td>
<td>Functional Analysis</td>
<td>10/77 - 6/78</td>
</tr>
<tr>
<td>Eaton, Morris L. (U.S.A.)</td>
<td>University of Copenhagen, Denmark</td>
<td>Multivariate Statistics</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Geissinger, Ladnor (U.S.A.)</td>
<td>University of Ulm, Federal Republic of Germany</td>
<td>Combinatorial Theory</td>
<td>8/77 - 7/78</td>
</tr>
<tr>
<td>Halberg, C.J.A., Jr. (U.S.A.)</td>
<td>Väst Lunds University, Sweden</td>
<td>Functional Analysis</td>
<td>8/76 - 8/78</td>
</tr>
<tr>
<td>Hampton, Charles Robert (U.S.A.)</td>
<td>Cuttingham College, Liberia</td>
<td>Algebra, Trigonometry, Calculus</td>
<td>7/77 - 7/78</td>
</tr>
<tr>
<td>Harrison, David K. (U.S.A.)</td>
<td>Kings College, England</td>
<td>Algebra</td>
<td>1/78 - 6/78</td>
</tr>
<tr>
<td>Heil, Wolfgang (U.S.A.)</td>
<td>University of Ljubljana, Yugoslavia</td>
<td>Topology</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Higman, Donald G. (U.S.A.)</td>
<td>University of Tubingen, Federal Republic of Germany</td>
<td>Algebra</td>
<td>9/77 - 11/77</td>
</tr>
<tr>
<td>Name and Home Country</td>
<td>Host Institution</td>
<td>Field of Special Interest</td>
<td>Period of Visit</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Becking, John G. (U.S.A.)</td>
<td>University of Dublin, Ireland</td>
<td>Topology</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Holland, A.S.B. (Canada)</td>
<td>University of St. Andrews, Scotland</td>
<td>Analytic Function Theory</td>
<td>8/77 - 7/78</td>
</tr>
<tr>
<td>Blundar, Awad A. (U.S.A.)</td>
<td>University of Kuwait</td>
<td>Universal Algebra</td>
<td>8/77 - 8/78</td>
</tr>
<tr>
<td>Jackson, D. M. (Canada)</td>
<td>Cambridge University, England</td>
<td>Enumerative Combinatorial Theory</td>
<td>1/78 - 6/78</td>
</tr>
<tr>
<td>Jageo, S. S. (U.S.A.)</td>
<td>Gokhale Institute of Economics, India</td>
<td>Statistics</td>
<td>8/77 - 5/78</td>
</tr>
<tr>
<td>John, Floyd I. (U.S.A.)</td>
<td>University Dar es Salaam</td>
<td>Quantitative Methods</td>
<td>7/77 - 4/78</td>
</tr>
<tr>
<td>Kalliaspur, Gopinath (U.S.A.)</td>
<td>Indian Statistical Institute, India</td>
<td>Probability Theory, Mathematical Statistics</td>
<td>7/77 - 6/78</td>
</tr>
<tr>
<td>Kato, William M. (U.S.A.)</td>
<td>Technion Institute of Technology, Israel; Oxford University, England</td>
<td>Algebra</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1/78 - 6/78</td>
</tr>
<tr>
<td>Kemison, John F. (U.S.A.)</td>
<td>University of Sussex, Great Britain</td>
<td>Category Theory</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Kiter, James M. (U.S.A.)</td>
<td>Oxford University, England</td>
<td>Topology</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Kolmer, Shirley (U.S.A.)</td>
<td>University of Liberia</td>
<td>Algebra, Trigonometry, Number Theory</td>
<td>7/77 - 7/78</td>
</tr>
<tr>
<td>Ko, Shan S. (U.S.A.)</td>
<td>Oxford University, England</td>
<td>Computer Science</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Kydonieas, Anastasios D. (U.S.A.)</td>
<td>Technical University of Athens, Greece</td>
<td>Elasticity</td>
<td>Spring 1978</td>
</tr>
<tr>
<td>Lagebartel, Ray G. (U.S.A.)</td>
<td>University of Manchester, England</td>
<td>Stellar Dynamics</td>
<td>1/77 - 5/77</td>
</tr>
<tr>
<td>Leach, E. B. (U.S.A.)</td>
<td>Institut d'Electrique et d'Electronique, Algeria</td>
<td>Algebraric Topology; Functional Analysis</td>
<td>9/76 - 6/78</td>
</tr>
<tr>
<td>Lemke, Carlton E. (U.S.A.)</td>
<td>Institut fur Forschungen, ETH, Switzerland</td>
<td>Mathematical Programming</td>
<td>2/78 - 6/78</td>
</tr>
<tr>
<td>Levine, Harold (U.S.A.)</td>
<td>Centre National pour la Recherche Scientifique, France</td>
<td>Applied Mathematics</td>
<td>4/78 - 10/78</td>
</tr>
<tr>
<td>Malitz, Jerome (U.S.A.)</td>
<td>University of Utrecht, Holland; University of Bedford, England</td>
<td>Mathematical Logic</td>
<td>10/77 - 11/77</td>
</tr>
<tr>
<td>Marcus, Lawrence (U.S.A.)</td>
<td>University of Warwick, England</td>
<td>Ordinary Differential Equations; Control Theory</td>
<td>12/77 - 6/78</td>
</tr>
<tr>
<td>Meyer, Meinhard E. (U.S.A.)</td>
<td>ETH, Switzerland; Institut des Hautes Etudes Scientifiques, France</td>
<td>Mathematical Physics</td>
<td>9/77 - 3/78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4/78 - 7/78</td>
</tr>
<tr>
<td>McLeanaghan, Raymond G. (Canada)</td>
<td>Universite Libre de Bruxelles, Belgium</td>
<td>General Relativity</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Meeker, Loren D. (U.S.A.)</td>
<td>Heriot-Watt University, Scotland</td>
<td>Applied Mathematics</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Mikulski, Piotr (U.S.A.)</td>
<td>University of Berne, Switzerland</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mine, James S. (U.S.A.)</td>
<td>University of Rennes, France</td>
<td>Algebraic Geometry</td>
<td>1/78 - 5/78</td>
</tr>
<tr>
<td>Mac, Henryk (U.S.A.)</td>
<td>Technion Institute of Technology, Israel</td>
<td>Linear Algebra</td>
<td>3/78 - 7/78</td>
</tr>
<tr>
<td>Moran, Daniel A. (U.S.A.)</td>
<td>University College of North Wales</td>
<td>Manifold Theory</td>
<td>4/78 - 6/78</td>
</tr>
<tr>
<td>Mozocchi, C. J. (U.S.A.)</td>
<td>Mittag-Leffler Institute, Sweden</td>
<td>Analytic Number Theory</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Nynask, James E. (U.S.A.)</td>
<td>University of Malawi, Malawi</td>
<td>Abstract Algebra</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Oliver, Robert (U.S.A.)</td>
<td>Universite de Nantes, France</td>
<td>Topology; Transformation Groups</td>
<td>4/78 - 7/78</td>
</tr>
<tr>
<td>Otoe, William Rosen (U.S.A.)</td>
<td>Tehran University, Iran</td>
<td>Science and Mathematics Education</td>
<td>9/77 - 9/78</td>
</tr>
<tr>
<td>Phelps, Robert R. (U.S.A.)</td>
<td>University College, London</td>
<td>Convexity; Extreme Point Problems</td>
<td>9/77 - 7/78</td>
</tr>
<tr>
<td>Phillips, Anthony (U.S.A.)</td>
<td>University of Paris 7</td>
<td>Differential Topology</td>
<td>8/77 - 8/78</td>
</tr>
<tr>
<td>Pitchham, Henry C. (U.S.A.)</td>
<td>Institut des Hautes Etudes Scientifiques, France</td>
<td>Algebraic Geometry</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Poli, William F. (U.S.A.)</td>
<td>Institut des Hautes Etudes Scientifiques, France</td>
<td>Differential Geometry</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Rho, R. Ranga (U.S.A.)</td>
<td>Indian Statistical Institute; ETH, Switzerland</td>
<td>Lie Groups</td>
<td>11/77 - 3/78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4/78 - 7/78</td>
</tr>
<tr>
<td>Roade, Maxwell O. (U.S.A.)</td>
<td>University of Costa Rica</td>
<td>Complex Analysis</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Robertson, James (U.S.A.)</td>
<td>Tbilisi State University, U.S.S.R.</td>
<td>Probability</td>
<td>9/77 - 1/78</td>
</tr>
<tr>
<td>Name and Home Country</td>
<td>Host Institution</td>
<td>Field of Special Interest</td>
<td>Period of Visit</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------</td>
<td>--------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Rotman, Joseph J. (U.S.A.)</td>
<td>Technion Inst. of Tech., Israel</td>
<td>Group Theory</td>
<td>8/77 - 5/78</td>
</tr>
<tr>
<td>Schumaker, Larry (U.S.A.)</td>
<td>Free University of Berlin, Federal Republic of Germany</td>
<td>Approximation Theory</td>
<td>1/78 - 12/78</td>
</tr>
<tr>
<td>Shar, Albert O. (U.S.A.)</td>
<td>Math Institute, Switzerland</td>
<td>Topology</td>
<td>10/77 - 5/78</td>
</tr>
<tr>
<td>Shields, Allen L. (U.S.A.)</td>
<td>Institut des Hautes Etudes Scientifiques, France</td>
<td>Analysis</td>
<td>1/78 - 5/78</td>
</tr>
<tr>
<td>Shorack, Galen R. (U.S.A.)</td>
<td>Australian National University, Australia</td>
<td>Statistics</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Semrod, Marshall (U.S.A.)</td>
<td>Hebrew University, Israel; Heriot-Watt University, Scotland</td>
<td>Differential Equations</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Smith, Martha K. (U.S.A.)</td>
<td>University of Warwick, England</td>
<td>Ring Theory</td>
<td>1/78 - 5/78</td>
</tr>
<tr>
<td>Stark, Harold (U.S.A.)</td>
<td>University of Paris, France</td>
<td>Number Theory</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Stern, Ron J. (U.S.A.)</td>
<td>Institut des Hautes Etudes Scientifiques, France</td>
<td>Topology</td>
<td>9/77 - 3/78</td>
</tr>
<tr>
<td>Tompa, Frank W. (Canada)</td>
<td>Pontifica Universidade Catolica, Brazil</td>
<td>Data Structures; Data Bases</td>
<td>8/77 - 12/77</td>
</tr>
<tr>
<td>Van Buskirk, James M. (U.S.A.)</td>
<td>Aarhus University, Denmark; University of Madrid, Spain</td>
<td>Topology</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Van Osdol, Donovan (U.S.A.)</td>
<td>University of Sussex, England</td>
<td>Category Theory</td>
<td>11/77 - 3/78</td>
</tr>
<tr>
<td>Verma, Ghasi (U.S.A.)</td>
<td>Birla Institute of Technology and Sciences, India</td>
<td>Applied Mathematics</td>
<td>8/77 - 1/78</td>
</tr>
<tr>
<td>Wade, William (U.S.A.)</td>
<td>Moscow State University, U.S.S.R.</td>
<td>Harmonic Analysis</td>
<td>9/77 - 1/78</td>
</tr>
<tr>
<td>Wani, J. K. (Canada)</td>
<td>Indian Institute of Science, India</td>
<td>Logarithmic Series Distribution</td>
<td>7/77 - 12/77</td>
</tr>
<tr>
<td>Wigner, David W. (U.S.A.)</td>
<td>University of Dijon, France</td>
<td>Geometric Topology</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Wu, Ta-Sun (U.S.A.)</td>
<td>Chinese University of Hong Kong, Hong Kong</td>
<td>Topological Dynamics</td>
<td>9/76 - 6/78</td>
</tr>
</tbody>
</table>

**Visiting Foreign Mathematicians**

<table>
<thead>
<tr>
<th>Name and Home Country</th>
<th>Host Institution</th>
<th>Field of Special Interest</th>
<th>Period of Visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agmon, Shmuel (Israel)</td>
<td>University of Minnesota</td>
<td>Partial Differential Equations</td>
<td>3/78 - 6/78</td>
</tr>
<tr>
<td>Allison, Donald C. S. (Ireland)</td>
<td>Virginia Polytechnic Institute and State University</td>
<td>Numerical Analysis; Computational Complexity</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Arbex, Sami (Brazil)</td>
<td>New York University, Courant</td>
<td>Analysis and Functional Analysis</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Artstein, Zvi (Israel)</td>
<td>Brown University</td>
<td>Differential Equations; Dynamical Systems</td>
<td>10/77 - 11/77</td>
</tr>
<tr>
<td>Assaf, David N. (Israel)</td>
<td>University of Illinois, Urbana</td>
<td>Statistics</td>
<td>8/77 - 5/78</td>
</tr>
<tr>
<td>Axelsson, Ove (Sweden)</td>
<td>The University of Texas at Austin</td>
<td>Numerical Analysis</td>
<td>1/78 - 5/78</td>
</tr>
<tr>
<td>Baillou, Jean (France)</td>
<td>New York University, Courant</td>
<td>Numerical Analysis</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Banyaga, Augustin (Rwanda)</td>
<td>Institute for Advanced Study</td>
<td>Differential Topology</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Barak, Amnon B. (Israel)</td>
<td>Pennsylvania State University</td>
<td>Computer Science</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Barsky, Daniel (France)</td>
<td>Princeton University</td>
<td>Algebra</td>
<td>9/77 - 12/78</td>
</tr>
<tr>
<td>Behar, Isak (Turkey)</td>
<td>University of Wisconsin, Madison</td>
<td>Theoretical Optimization</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Bertrand, Daniel (France)</td>
<td>Princeton University</td>
<td>Algebra</td>
<td>9/77 - 1/78</td>
</tr>
<tr>
<td>Bessaga, Czeslaw (Poland)</td>
<td>University of Michigan</td>
<td>Analysis and Topology</td>
<td>1/78 - 5/78</td>
</tr>
<tr>
<td>Bé, Ketil (Norway)</td>
<td>Southern Methodist University</td>
<td>Computer Graphics</td>
<td>8/77 - 6/78</td>
</tr>
<tr>
<td>Bochenek, Elzbieta Kosmulski (Poland)</td>
<td>Rensselaer Polytechnic Institute</td>
<td>Computer Science</td>
<td>7/77 - 6/78</td>
</tr>
<tr>
<td>Bosoh, Siegfried (Germany)</td>
<td>Princeton University</td>
<td>Algebra</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Boutet de Monvel, Louis (France)</td>
<td>Princeton University</td>
<td>Partial Differential Equations</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Brémaud, Pierre (France)</td>
<td>University of California, Berkeley</td>
<td>Point Processes; Applied Probability</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Bshouty, Daoud (Israel)</td>
<td>Indiana University</td>
<td>Complex Analysis</td>
<td>8/77 - 6/78</td>
</tr>
<tr>
<td>Bühlmann, Hans (Switzerland)</td>
<td>University of California, Berkeley</td>
<td>Statistics</td>
<td>1/78 - 4/78</td>
</tr>
<tr>
<td>Bulirsch, Roland (Germany)</td>
<td>University of California, San Diego</td>
<td>Numerical Analysis</td>
<td>7/77 - 6/78</td>
</tr>
<tr>
<td>Burghelea, Dan (Rumania)</td>
<td>Institute for Advanced Study</td>
<td>Differential Topology; Algebraic Topology</td>
<td>9/77 - 11/77</td>
</tr>
<tr>
<td>Cannings, Christopher (Britain)</td>
<td>University of Utah</td>
<td>Statistics</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Name and Home Country</td>
<td>Host Institution</td>
<td>Field of Special Interest</td>
<td>Period of Visit</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------</td>
<td>---------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Callingsworth, David (England)</td>
<td>University of Cincinnati</td>
<td>Dynamical Systems</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Callens, Nicolas R. (Argentina)</td>
<td>University of Washington</td>
<td>Theory of Residues</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Dahlberg, Björn (Sweden)</td>
<td>University of Michigan</td>
<td>Complex Analysis</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Davies, Brian (England)</td>
<td>Princeton University</td>
<td>Mathematical Physics</td>
<td>9/77 - 1/78</td>
</tr>
<tr>
<td>Deef, Jan (Belgium)</td>
<td>Princeton University</td>
<td>Mathematical Logic</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Dauer, Vishwa C. (India)</td>
<td>University of Illinois, Urbana</td>
<td>Number Theory</td>
<td>8/77 - 5/78</td>
</tr>
<tr>
<td>Dobik, Jerzy (Poland)</td>
<td>University of Washington</td>
<td>Topology</td>
<td>9/77 - 9/78</td>
</tr>
<tr>
<td>Dynis, Alexander (U.S.S.R.)</td>
<td>Institute for Advanced Study</td>
<td>Complex Analysis</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Elkins, James (England)</td>
<td>Institute for Advanced Study</td>
<td>Differential Geometry</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Eland, Ivar (France)</td>
<td>University of British Columbia</td>
<td>Optimization; Functional Analysis</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Eells, John (England)</td>
<td>University of Kentucky</td>
<td>Topology</td>
<td>1/78 - 6/78</td>
</tr>
<tr>
<td>Ekeland, Ivar (France)</td>
<td>Indiana University</td>
<td>Mathematical Physics</td>
<td>8/77 - 6/78</td>
</tr>
<tr>
<td>Egorova, Svetlana (Ukraine)</td>
<td>University of Waterloo</td>
<td>Operations Research</td>
<td>5/77 - 6/78</td>
</tr>
<tr>
<td>Elsner, Paul (Hungary)</td>
<td>University of Colorado</td>
<td>Number Theory</td>
<td>9/77 - 11/77</td>
</tr>
<tr>
<td>Eshragh, Parviz (Iran)</td>
<td>University of Vermont</td>
<td>Numerical Analysis</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Feichtner, Herbert (Austria)</td>
<td>Memphis State University</td>
<td>Graph Theory</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Fasta, Dominique (France)</td>
<td>University of California, San Diego</td>
<td>Combinatorics</td>
<td>7/77 - 6/78</td>
</tr>
<tr>
<td>Faugel, Shaol (Israel)</td>
<td>University of Maryland</td>
<td>Functional Analysis</td>
<td>8/77 - 6/78</td>
</tr>
<tr>
<td>Focke, A. (England)</td>
<td>University of Maryland</td>
<td>Number Theory</td>
<td>11/77 - 12/77</td>
</tr>
<tr>
<td>Gardner, B. J. (Australia)</td>
<td>Dalhousie University</td>
<td>Algebra</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Gardner, Richard J. (England)</td>
<td>University of California, Davis</td>
<td>Topology</td>
<td>7/77 - 6/78</td>
</tr>
<tr>
<td>Gareia, Juan (Chile)</td>
<td>University of Iowa</td>
<td>Analysis</td>
<td>8/77 - 5/79</td>
</tr>
<tr>
<td>Gaudio, Bernard (France)</td>
<td>Institute for Advanced Study</td>
<td>Complex Analysis; Differential Geometry</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Gobin, M. K. (Iraq)</td>
<td>University of California</td>
<td>Mathematical Theory of Pairing</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Gibbs, Richard (England)</td>
<td>Indiana University</td>
<td>Applied Mathematics</td>
<td>8/77 - 6/78</td>
</tr>
<tr>
<td>Gerdt, Gerhard (Germany)</td>
<td>Louisiana State University, Baton Rouge</td>
<td>Topological Algebra</td>
<td>8/77 - 5/78</td>
</tr>
<tr>
<td>Gores, J. (Australia)</td>
<td>Dalhousie University</td>
<td>Functional Analysis</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Gopal, Johann H. (West Germany)</td>
<td>University of North Carolina at Chapel Hill</td>
<td>Number Theory</td>
<td>8/77 - 12/77</td>
</tr>
<tr>
<td>Goes, Daciberg L. (Brazil)</td>
<td>Institute for Advanced Study</td>
<td>Algebraic Topology</td>
<td>1/78 - 4/78</td>
</tr>
<tr>
<td>Good, J. Anton (Switzerland)</td>
<td>Institute for Advanced Study</td>
<td>Analytic Number Theory</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Goochea, Mohammad (Iran)</td>
<td>Texas Tech University</td>
<td>Algebra (Graph Theory)</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Gordon, Yehoram (Israel)</td>
<td>Ohio State University</td>
<td>Functional Analysis</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Gregory, Douglas (Great Britain)</td>
<td>University of British Columbia</td>
<td>Elasticity</td>
<td>7/77 - 6/78</td>
</tr>
<tr>
<td>Grove, Karsten (Denmark)</td>
<td>SUNY, Stony Brook</td>
<td>Differential Geometry</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Grundy, Holmut (West Germany)</td>
<td>Washington University</td>
<td>Theory of Functions of a Complex Variable</td>
<td>10/77 - 2/78</td>
</tr>
<tr>
<td>Hansen, Einar (Norway)</td>
<td>University of Kentucky</td>
<td>Topology</td>
<td>8/77 - 6/78</td>
</tr>
<tr>
<td>Hartel, Zvi (Israel)</td>
<td>University of Illinois, Urbana</td>
<td>Differential Geometry</td>
<td>8/77 - 5/78</td>
</tr>
<tr>
<td>Herrlich, Horst (West Germany)</td>
<td>Kansas State University</td>
<td>Topology</td>
<td>9/77 - 1/78</td>
</tr>
<tr>
<td>Herrweger, Franz (West Germany)</td>
<td>New York University, Courant</td>
<td>Analysis</td>
<td>10/77 - 3/78</td>
</tr>
<tr>
<td>Hijman, Graham (England)</td>
<td>California Institute of Technology</td>
<td>Group Theory</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Hibi-Izumi, J. B. (France)</td>
<td>University of Kentucky</td>
<td>Stochastic Optimization</td>
<td>1/78 - 8/78</td>
</tr>
<tr>
<td>Hooley, Christopher (England)</td>
<td>Institute for Advanced Study</td>
<td>Theory of Numbers</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Hormander, Lars (Sweden)</td>
<td>Institute for Advanced Study</td>
<td>Partial Differential Equations; Analysis</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Hulanicki, Andrzej (Poland)</td>
<td>SUNY at Albany</td>
<td>Harmonic Analysis</td>
<td>11/77 - 1/78</td>
</tr>
<tr>
<td>Hung, Cheng-Tian (Taiwan)</td>
<td>University of Wisconsin, Madison</td>
<td>Logic</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Hurst, C. Angas (Australia)</td>
<td>Indiana University</td>
<td>Mathematical Physics</td>
<td>8/77 - 6/78</td>
</tr>
<tr>
<td>Name and Home Country</td>
<td>Host Institution</td>
<td>Field of Special Interest</td>
<td>Period of Visit</td>
</tr>
<tr>
<td>----------------------</td>
<td>------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Hüsler, Jürg R. (Switzerland)</td>
<td>University of Pittsburgh</td>
<td>Applied Statistics</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Huzurbazar, V. (India)</td>
<td>University of Manitoba</td>
<td>Inference</td>
<td>9/76 - 5/78</td>
</tr>
<tr>
<td>Iden, Oddvar (Norway)</td>
<td>University of Iowa</td>
<td>Algebra</td>
<td>8/77 - 5/78</td>
</tr>
<tr>
<td>Iooss, Gerard (France)</td>
<td>University of Minnesota</td>
<td>Bifurcation Theory</td>
<td>8/77 - 9/78</td>
</tr>
<tr>
<td>Israeli, Moshe (Israel)</td>
<td>Massachusetts Institute of Technology</td>
<td>Applied Numerical Analysis</td>
<td>7/77 - 5/78</td>
</tr>
<tr>
<td>Jahren, Bjorn (Norway)</td>
<td>New York University, Courant</td>
<td>Topology</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Jones, Ralph (Australia)</td>
<td>University of Waterloo</td>
<td>Numerical Mathematics</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Kalnins, E. G. (New Zealand)</td>
<td>University of Minnesota</td>
<td>Mathematical Physics</td>
<td>12/77 - 3/78</td>
</tr>
<tr>
<td>Kalton, Nigel J. (United Kingdom)</td>
<td>University of Illinois, Urbana-Champaign</td>
<td>Functional Analysis</td>
<td>8/77 - 12/77</td>
</tr>
<tr>
<td>Kamen, Shoshana (Israel)</td>
<td>Rensselaer Polytechnic Institute</td>
<td>Functional Analysis</td>
<td>1/78 - 9/78</td>
</tr>
<tr>
<td>Kariv, Oded (Israel)</td>
<td>Drexel University</td>
<td>Combinatorial Algorithms</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Karpinski, Marek (Poland)</td>
<td>University of Florida</td>
<td>Logic; Formal Languages; Set Theory; Recursion and Computability; Combinatorial Theories</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Kashin, Masaki (Japan)</td>
<td>Institute for Advanced Study</td>
<td>Partial Differential Equations</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Katnelson, Yitzak (Israel)</td>
<td>Stanford University</td>
<td>Harmonic Analysis; Ergodic Theory</td>
<td>6/78 - 9/78</td>
</tr>
<tr>
<td>Kawai, Takahiro (Japan)</td>
<td>Institute for Advanced Study</td>
<td>Analysis</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Ko, H. (Taiwan)</td>
<td>Dalhousie University</td>
<td>Functional Analysis</td>
<td>2/78 - 7/78</td>
</tr>
<tr>
<td>Komatsu, Gen (Japan)</td>
<td>New York University, CUNY</td>
<td>Analysis</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Landrock, Peter L. (Denmark)</td>
<td>University of Oregon</td>
<td>Algebra</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Leibovitz, Daniel (Israel)</td>
<td>Ohio State University</td>
<td>Logic</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Libgober, Anatoly S. (Israel)</td>
<td>Institute for Advanced Study</td>
<td>Algebraic Geometry</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Lindenstrauss, Joram (Israel)</td>
<td>The University of Texas at Austin</td>
<td>Functional Analysis</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Links. R. (Brazil)</td>
<td>University of Waterloo</td>
<td>Theory of Computing</td>
<td>1/78 - 6/78</td>
</tr>
<tr>
<td>Lustig, George (England)</td>
<td>Massachusetts Institute of Technology</td>
<td>Representations of Finite Groups</td>
<td>1/78 - 12/78</td>
</tr>
<tr>
<td>MacDonald, Ian G. (England)</td>
<td>Institute for Advanced Study</td>
<td>Automorphic Forms</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Magerl, Berkh (West Germany)</td>
<td>University of Washington</td>
<td>Continuous Selections and Related Topics</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Mainf, Henri-Michel (Switzerland)</td>
<td>Institute for Advanced Study</td>
<td>Partial Differential Equations</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Mankiewicz, Piotr (Poland)</td>
<td>University of Connecticut</td>
<td>Functional Analysis</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Mardus, Siegfried (Yugoslavia)</td>
<td>University of Utah</td>
<td>Topology</td>
<td>9/77 - 1/78</td>
</tr>
<tr>
<td>Martelli, Mario (Italy)</td>
<td>University of Colorado</td>
<td>Ordinary Differential Equations; Partial Differential Equations; Nonlinear Functional Analysis</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Matsumoto, Yukio (Japan)</td>
<td>Institute for Advanced Study</td>
<td>Topology</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>McCullagh, Peter (England)</td>
<td>University of Chicago</td>
<td>Statistics</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>McDuff, Dusa (England)</td>
<td>Institute for Advanced Study</td>
<td>Differential Topology</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>McLeod, Bruce (England)</td>
<td>University of Minnesota</td>
<td>Differential Equations</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>McKean, R. B. (England)</td>
<td>Institute for Advanced Study</td>
<td>Partial Differential Equations</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Mercier, Bertrand (France)</td>
<td>New York University, Courant</td>
<td>Numerical Methods and Applied Mathematics</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Metelli, Claudia (Italy)</td>
<td>Tulane University</td>
<td>Abelian Groups</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Millet, Annie (France)</td>
<td>Ohio State University</td>
<td>Probability and Ergodic Theory</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Minemura, Katsuhiro (Japan)</td>
<td>Institute for Advanced Study</td>
<td>Representation Theory; Harmonic Analysis</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Mond, Dean B. (Australia)</td>
<td>McGill University</td>
<td>Functional Analysis; Optimization</td>
<td>1/78 - 3/78</td>
</tr>
<tr>
<td>Montesinos, José María (Spain)</td>
<td>Institute for Advanced Study</td>
<td>Approximation Theory</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Moszyńska, Maria Olga (Poland)</td>
<td>Auburn University</td>
<td>Algebraic Topology</td>
<td>1/78 - 12/77</td>
</tr>
<tr>
<td>Name and Home Country</td>
<td>Host Institution</td>
<td>Field of Special Interest</td>
<td>Period of Visit</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------</td>
<td>--------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Makhoul, Hans J. (Denmark)</td>
<td>Princeton University</td>
<td>Topology</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Maigaia, Ryosuke (Japan)</td>
<td>Kansas State University</td>
<td>Topology</td>
<td>8/77 - 8/78</td>
</tr>
<tr>
<td>Nakatsukasa, Tatsuro (Japan)</td>
<td>Carnegie-Mellon University</td>
<td>Network Theory</td>
<td>5/77 - 5/78</td>
</tr>
<tr>
<td>John, Alexandre (Switzerland)</td>
<td>SUNY, Stony Brook</td>
<td>Automorphic Functions</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Pan, Peter S. (Republic of China)</td>
<td>Institute for Advanced Study</td>
<td>Number Theory</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Parthasarathy, Rajagopalan (India)</td>
<td>Institute for Advanced Study</td>
<td>Topology</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Parry, Amsden (Israel)</td>
<td>University of California, San Diego</td>
<td>Lie Groups</td>
<td>10/77 - 12/77</td>
</tr>
<tr>
<td>Peters, Meinhard (West Germany)</td>
<td>University of Wisconsin, Madison</td>
<td>Analysis</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Pelete, Derek (England)</td>
<td>Ohio State University</td>
<td>Number Theory</td>
<td>1/87 - 6/78</td>
</tr>
<tr>
<td>Platt, Andrew (England)</td>
<td>University of Kentucky</td>
<td>Statistics</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Pomeranc, Christian M. W. (West Germany)</td>
<td>University of Minnesota</td>
<td>Partial Differential Equations</td>
<td>8/77 - 6/78</td>
</tr>
<tr>
<td>Prasad, Adir (Israel)</td>
<td>Rensselaer Polytechnic Institute</td>
<td>Complex Analysis</td>
<td>3/78 - 8/78</td>
</tr>
<tr>
<td>Politak, Pavel (Czechoslovakia)</td>
<td>Vanderbilt University</td>
<td>Numerical Analysis</td>
<td>7/77 - 6/78</td>
</tr>
<tr>
<td>Pogly, John H. (Ireland)</td>
<td>Michigan State University</td>
<td>Algebra</td>
<td>1/78 - 6/78</td>
</tr>
<tr>
<td>Rotman, Michael O. (Israel)</td>
<td>Massachusetts Institute of Technology</td>
<td>Topology</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Saghavachi, M. (India)</td>
<td>University of Maryland</td>
<td>Computer Science</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Banasik, Sundaraman (India)</td>
<td>Institute for Advanced Study</td>
<td>Statistics</td>
<td>8/77 - 6/78</td>
</tr>
<tr>
<td>Heier, Gyorgy (Hungary)</td>
<td>Virginia Polytechnic Institute and State University</td>
<td>Algebraic Vector Bundles</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Breu, Daniel (France)</td>
<td>University of British Columbia</td>
<td>Automata Theory; Formal Languages</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Bodin, Lennart (Sweden)</td>
<td>Simon Fraser University</td>
<td>Probability</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Betti, Fulvio (Italy)</td>
<td>Washington University</td>
<td>Statistics</td>
<td>7/77 - 7/78</td>
</tr>
<tr>
<td>Bobon, J. C. (England)</td>
<td>Dalhousie University</td>
<td>Harmonic Analysis</td>
<td>10/77 - 1/78</td>
</tr>
<tr>
<td>Beton, D. (South Africa)</td>
<td>University of Waterloo</td>
<td>Ring Theory</td>
<td>7/77 - 7/78</td>
</tr>
<tr>
<td>Bue, Axel (Sweden)</td>
<td>University of California, San Diego</td>
<td>Graph Theoretical Algorithms</td>
<td>5/77 - 4/78</td>
</tr>
<tr>
<td>Seiki, Sadahiro (Japan)</td>
<td>University of Washington</td>
<td>Numerical Analysis</td>
<td>7/77 - 6/78</td>
</tr>
<tr>
<td>Schectman, Gideon (Israel)</td>
<td>Ohio State University</td>
<td>Harmonic Analysis</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Schutzenberger, Marcel P. (France)</td>
<td>Bowling Green State University</td>
<td>Functional Analysis</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Scott, Godfrey Peter (England)</td>
<td>University of Wisconsin, Madison</td>
<td>Combinatorics; Semigroups; Computer Science</td>
<td>3/78 - 6/78</td>
</tr>
<tr>
<td>Serre, Jean-Pierre (France)</td>
<td>Institute for Advanced Study</td>
<td>Topology</td>
<td>9/77 - 7/78</td>
</tr>
<tr>
<td>Sheen, John (Scotland)</td>
<td>Memphis State University</td>
<td>Algebraic Geometry</td>
<td>1/78 - 4/78</td>
</tr>
<tr>
<td>Sell, Small, Terence (England)</td>
<td>University of Kentucky</td>
<td>Graph Theory</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Selig, Sabaron (Israel)</td>
<td>University of Wisconsin, Madison</td>
<td>Complex Analysis</td>
<td>8/77 - 8/78</td>
</tr>
<tr>
<td>Shao, Jiu-Shyang (Taiwan)</td>
<td>University of Illinois, Urbana</td>
<td>Logic</td>
<td>9/77 - 1/78</td>
</tr>
<tr>
<td>Smoes-Pereira, Jose (Portugal)</td>
<td>Western Michigan University</td>
<td>Number Theory</td>
<td>8/77 - 5/78</td>
</tr>
<tr>
<td>Simonyi, M. (Budapest)</td>
<td>University of Calgary</td>
<td>Graph Theory</td>
<td>8/77 - 4/78</td>
</tr>
<tr>
<td>Strombland, K. H. Johannes (Sweden)</td>
<td>Institute for Advanced Study</td>
<td>Combinatorics</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Seljen, Gerard L. G. (The Netherlands)</td>
<td>University of Oregon</td>
<td>Fourier Integral Operators</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Somolinos, Alfredo (Spain)</td>
<td>New York University, Courant</td>
<td>Harmonic Analysis</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Sotteau, D. (France)</td>
<td>University of Waterloo</td>
<td>Differential Equations</td>
<td>6/77 - 5/78</td>
</tr>
<tr>
<td>Southern, G. W. (Australia)</td>
<td>Yale University</td>
<td>Graph Theory; Combinatorial Designs</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Spiegelhalter, David (England)</td>
<td>University of California, Berkeley</td>
<td>Combinatorial Designs</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Strehlau, Werner H. (West Germany)</td>
<td>University of Connecticut</td>
<td>Bayesian Statistics</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Stewart, Ian (Great Britain)</td>
<td>University of Oregon</td>
<td>Mathematical Logic</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lie Algebras</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Name and Home Country</td>
<td>Host Institution</td>
<td>Field of Special Interest</td>
<td>Period of Visit</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-----------------------------------</td>
<td>--------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Suhadolc, Anton (Yugoslavia)</td>
<td>Florida State University</td>
<td>Analysis</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Sullivan, Dennis (France)</td>
<td>SUNY, Stony Brook</td>
<td>Topology</td>
<td>1/77 - 8/77</td>
</tr>
<tr>
<td>Thorpe, B. (England)</td>
<td>University of Western Ontario</td>
<td>Summability</td>
<td>7/77 - 1/78</td>
</tr>
<tr>
<td>Uhmann, Gunther (Chile)</td>
<td>New York University, Courant</td>
<td>Analysis</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>van Hemmen, Jan L. (The Netherlands)</td>
<td>Duke University</td>
<td>Mathematical Physics</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Van Mill, Jan (The Netherlands)</td>
<td>University of Wisconsin, Madison</td>
<td>Topology</td>
<td>8/77 - 6/78</td>
</tr>
<tr>
<td>Vergne, Michele (France)</td>
<td>Massachusetts Institute of Technology</td>
<td>Group Representations</td>
<td>7/77 - 5/78</td>
</tr>
<tr>
<td>Verma, Daya-Nand (India)</td>
<td>Institute for Advanced Study</td>
<td>Representations of Chevalley Groups</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Viljoeen, Gert (South Africa)</td>
<td>Tulane University</td>
<td>Abelian Groups</td>
<td>11/77 - 12/77</td>
</tr>
<tr>
<td>Vogel, Pierre (France)</td>
<td>Institute for Advanced Study</td>
<td>Geometry of Manifolds</td>
<td>9/77 - 12/77</td>
</tr>
<tr>
<td>Waadeland, Haakon (Norway)</td>
<td>University of Colorado</td>
<td>Complex Variables</td>
<td>7/77 - 9/77</td>
</tr>
<tr>
<td>Wada, Hide (Japan)</td>
<td>University of Regina</td>
<td>Number Theory</td>
<td>8/77 - 8/78</td>
</tr>
<tr>
<td>Wait, Richard (United Kingdom)</td>
<td>University of Pittsburgh</td>
<td>Finite Element Methods</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Wally, W. D. (Australia)</td>
<td>University of Waterloo</td>
<td>Graph/Design Theory</td>
<td>1/78 - 6/78</td>
</tr>
<tr>
<td>Waller, Wolfgang (Germany)</td>
<td>University of Tennessee</td>
<td>Analysis</td>
<td>9/77 - 1/78</td>
</tr>
<tr>
<td>Wang, Hwai-chuian (Republic of China)</td>
<td>Princeton University</td>
<td>Banach Algebras</td>
<td>7/77 - 6/78</td>
</tr>
<tr>
<td>Watters, J. F. (England)</td>
<td>University of Calgary</td>
<td>Radicals in Rings</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Weiss, Gideon (Israel)</td>
<td>University of California, Berkeley</td>
<td>Stochastic Processes</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Wold, Herman (Sweden)</td>
<td>University of Pennsylvania</td>
<td>Statistics</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Wormer, P. E.S. (The Netherlands)</td>
<td>University of Waterloo</td>
<td>Quantum Theory</td>
<td>9/77 - 8/78</td>
</tr>
<tr>
<td>Yildiz, Necati (Turkey)</td>
<td>University of Minnesota</td>
<td>Applied Statistics</td>
<td>12/76 - 6/78</td>
</tr>
<tr>
<td>Yoon, Jaihan (Korea)</td>
<td>Case Western Reserve University</td>
<td>Measure Theory</td>
<td>8/77 - 6/78</td>
</tr>
<tr>
<td>Zaanen, Adriaan C. (The Netherlands)</td>
<td>California Institute of Technology</td>
<td>Functional Analysis</td>
<td>1/78 - 3/78</td>
</tr>
<tr>
<td>Zabrodsky, Alexander (Israel)</td>
<td>University of California, San Diego</td>
<td>Algebraic Topology</td>
<td>7/77 - 6/78</td>
</tr>
<tr>
<td>Zaia, Joseph (Israel)</td>
<td>Ohio State University</td>
<td>Combinatorics</td>
<td>9/77 - 6/78</td>
</tr>
<tr>
<td>Zalik, A. Ricardo (Israel)</td>
<td>University of Rhode Island</td>
<td>Approximation Theory</td>
<td>9/77 - 1/78</td>
</tr>
<tr>
<td>Zamfirescu, Christine (Rumania)</td>
<td>Western Michigan University</td>
<td>Graph Theory</td>
<td>8/77 - 4/78</td>
</tr>
<tr>
<td>Zeilberger, Doron (Israel)</td>
<td>Institute for Advanced Study</td>
<td>Partial Differential Equations</td>
<td>9/77 - 4/78</td>
</tr>
<tr>
<td>Zinn-Justin, Nicole (France)</td>
<td>Princeton University</td>
<td>Algebra</td>
<td>9/77 - 1/78</td>
</tr>
<tr>
<td>Zvahalen, Bruno (Switzerland)</td>
<td>University of Colorado</td>
<td>Operator Theory</td>
<td>9/77 - 5/78</td>
</tr>
<tr>
<td>Zwas, Gideon (Israel)</td>
<td>New York University, Courant</td>
<td>Numerical Analysis</td>
<td>8/77 - 7/78</td>
</tr>
</tbody>
</table>
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 submit 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 question, 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.

MATHMATICAL 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.

628 pages
List price $37.60; member price $28.20
ISBN 0-8218-1428-1: LC 76-20437
Publication date: 8 31 76
To order, please specify PSPUM 28

This volume is being reprinted in paper back, bound in two parts.
List price $20.00; individual price $10.00
Publication date: 8 12 77
To order, please specify PSPUMS 28

Prepayment is required for all AMS publications.

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

Editor, the Notices

Two people sent me a preprint describing a computer search for a non-integer c such that 2c and 3c 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
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 in 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 Mathematicians 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 Notes 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.

March 21-November 24. European Mechanics Colloquia Fall-Spring 1977-1978. Academic 7-9. Joint National Institutes of Health and the Office of Naval Research, Washington, D.C. (When announced, 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).

OCTOBER 1977
Information: Technical Activities Board, IEEE, 345 East 42nd Street, New York, New York 10017.

Organizers: Cleve Moler and Melvin Scott, co-chairmen; Jack Warga; D. L. Thomasen, 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 (Gustav 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.

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

Information: Sherman Naymark, Nuclear Services, 1800 Dell Avenue, Campbell, California 95008.

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.
Registration and Hotel Reservations: International Centre for Theoretical Physics, Strada Costiera 11, P.O. B 586, Miramare Trieste, Italy.

DECEMBER 1977
15. IEEE Computer Networks Symposium, Gaithersburg, Maryland. (24, p. 281).

JANUARY 1978

FEBRUARY 1978

MARCH 1978
Program Directors: Frederick Davidson, Gerald M. Mason.
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

47. 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.

MAY 1978


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.

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)
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


26-30. Eighth U. S. National Congress of Applied Mechanics, University of California, Los Angeles, California. (24, p. 221)


JULY 1978

6-14. Eighth Conference on Stochastic Processes and their Applications, Australian National University, Canberra ACT, Australia.

AUGUST 1978

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)

A vast majority of both applicants and employers who participated in the Employment Register at the St. Louis meeting, submitted pre-registration 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 Notes 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 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 Notes.

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.
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

<table>
<thead>
<tr>
<th>Beginning with</th>
<th>Book Rate</th>
<th>Deadline for receipt of orders</th>
<th>Issue mailed from printer</th>
</tr>
</thead>
<tbody>
<tr>
<td>November</td>
<td>$25.00</td>
<td>10/15/77</td>
<td>11/1/77</td>
</tr>
<tr>
<td>January</td>
<td>$21.00</td>
<td>12/15/77</td>
<td>1/2/78</td>
</tr>
<tr>
<td>March</td>
<td>$17.00</td>
<td>2/15/78</td>
<td>3/2/78</td>
</tr>
<tr>
<td>May</td>
<td>$13.00</td>
<td>4/15/78</td>
<td>5/1/78</td>
</tr>
<tr>
<td>July</td>
<td>$9.00</td>
<td>6/15/78</td>
<td>6/30/78</td>
</tr>
<tr>
<td>August</td>
<td>$5.00</td>
<td>7/15/78</td>
<td>8/1/78</td>
</tr>
</tbody>
</table>

**Check one (None of the service charges may be prorated)**

- Individual rate
  - Begin with issue _______ $ _______

- Unemployed rate
  - Begin with issue _______ $ _______

**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.
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]*
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,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 would be suitable for a second year seminar.
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, Ker­ vaire and Levine both involve a Witt group of endomorphisms, \( t \), of \( \mathbb{C} \)-symmetric nonsingular bilinear forms. \( B \), satisfying an adjoint-ness condition: \( B((x), y) = B(x, t(y)) \) in the first case and \( B((x), y) = B(x, (t(y)) \) in the second. This memoir elucidates the complete structure of these groups in terms of \( \mathbb{C} \)-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 \( \mathbb{Z}[\mathcal{X}] \)-module structure induced by the endomorphism \( t \) and the fact that \( \mathbb{Z}[\mathcal{X}] \) 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 \( \mathbb{C} \)-Hermitian forms on torsion-free modules over an order (irreducible torsion-free \( \mathbb{Z}[\mathcal{X}] \)-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 mimicking 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 \( M_{Sp} \)**

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 varying 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. G. Golovkin (the so-called fractional spaces). Along the same lines, the paper by S. 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. Nikolskií. This review reflects his fundamental results in the theory of approximation of functions, functional analysis, imbedding of function spaces and its applications, and Nikolskií's outstanding role in training scientific personnel is evidenced.

The collection contains papers by colleagues, students and disciples of Nikolskií, 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. Černyíh) 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 77-6283
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.

382
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 transla-
tions 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. Voskresenskii, Some questions of the
functional 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 quad-
artic forms;

G. A. Margulis, Discrete groups of motions
of manifolds of nonpositive curvature;

V. V. Filippov. A survey of dimension
theory;

N. P. Kornečuk, Some extremal problems in
approximation theory;

D. P. Zelobenko, 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 applica-
tions;

D. V. Anosov, Geodesics in Finsler geometry;

N. N. Nenchrushyn, On the behavior of Hamil-
tonian systems near integrable ones;

A. I. Subbotin, Control under conditions of
conflict and indeterminacy;

A. A. Samarskii, Stability theory of difference
schemes and iterative methods;

A. G. Sveshnikov, Numerical methods in dif-
fraction theory;

Ja. M. Barzdin', Inductive inference of auto-
amata, functions and programs;

E. B. Dynkin, Stochastic dynamic models of
economic equilibrium; and

B. V. Gnedenko, Current studies in the histo-
ry 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-analytic classes;
Vlastimil Ptáč. On complete topological linear
spaces; M. S. Budjanu and I. C. Gohberg. The
factorization problem in abstract Banach alge-ras. I. Splitting algebras; M. S. Budjanu and I.
C. Gohberg. The factorization problem in ab-
tract Banach algebras. II. Irreducible algebras;
I. C. Gohberg and N. Ja. Krupnik. On the algebra
generated by Toeplitz matrices in $h_\infty$ spaces;
A. S. Markus and V. A. Prigorskii. 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 asymptotic 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 Alfred 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 Citadell has been appointed to a visiting associate professorship at the University of Hawaii.

NICOLAE DINCULEANU of the University of Bucharest 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 doctorate degree by the University of Tubingen, Tubingen, 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, Ashhra University, Waltair, India: J. GOPALA KRISHNA; University of Saskatchewan: B. S. LALLI.

To Professor, Boston State College: SEYMOUR KASS; Skooks 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 AJODIA, 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.
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 $\Theta_{\alpha\beta} - \Theta_{\alpha\beta}^* = \Theta_{\alpha\beta} + \Theta_{\alpha\beta}^*$? Here $\Theta$ 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, $\Theta$ 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 $\sum_{k=0}^{n} \left( \frac{d^n y}{dx^n} \right) + \cdots + a_n \frac{dy}{dx} + a_0 y = 0$ into a differential equation with constant coefficients by means of changing the independent and dependent variables $(y = v(x), z(t) = u(x))$. 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, $\zeta^{-1}(s)$ 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 06035). 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 self-adjoint
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
\[ \text{Tr}(WA) = \int_{-\infty}^{\infty} \lambda \, d\text{Tr}(E_\lambda W). \]

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 (Note: this is a placeholder for actual queries). The editor would like to thank all who have replied.

102 (Vol. 24, p. 222, June 1977, Kohlmayr). One can 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, Exercises 5, 16(a); Van Nostrand, New York, 1963.)

\( K \) is non-Archimedean: For example, \( \epsilon < 1 \) in \( K \), and \( nx \epsilon \) for all positive integers \( n \). But \( K \) is complete: let \( (\epsilon_n) \) be a Cauchy sequence in \( K \), where \( \epsilon_n = \sum_{i<n} \epsilon_i \) for each positive integer \( n \). For each positive integer \( k \), let \( \eta_k \) be the Laurent series \( \sum_{i=1}^{k} \epsilon_i \). Then \( (\eta_k) \) is a null sequence in \( K \). Using this fact and the Cauchy condition on \( (\epsilon_n) \), one obtains readily that, for each integer \( i \), the sequence \( (a_1, a_2, \ldots, a_i) \) of \( i \) coefficients ultimately attains a constant value, \( a_i \), in \( K \). The Laurent series \( \sum_{i=1}^{\infty} a_i \epsilon_i \) is the limit of the given Cauchy sequence \( (a_i) \). (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:


The ACM also published:

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. Charmo (SUNY at Brockport), Romae J. Cormier (125 Delcy Drive, DeKalb, IL), Raymond Coughlin (Temple University), Charles H. Cunke (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. Helser (Ohio University), Thomas A. Herr (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, Itaca, 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 Moteler (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. Olphant (Hawaii Loa College), P. V. O’Neil (College of William & Mary), Otway Pandee (Syracuse University), George Piranian (University of Michigan), Lyle E. Purcell (University of Missouri at Rolla), Gordon Raisbeck (40 Bloomfield Street, Lexington, MA), C. J. Rhe (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), Hane W. E. Schwerdt (McGill University), Thomas H. Southard (California State University at Hayward), Diane M. Spresser (Madison College), Raymond A. Sprow (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, Tearneck, NJ), Gail Ateneew Williams (University of Idaho), Brian J. Winkel (Albion College), John W. Young, Jr. (P.O. Box 1661, Melbourne, FL), and W. Thurston 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. in mathematics or the equivalent in experience who have not been previously listed. The forms for those with Ph. D. 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 curriculum 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 255 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., 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 SYMPOSIUMS 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 use. 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 non-members of ACM. A newsletter subscription without membership is $12 per year. For further information on SIGPC programs, contact Dr. Potta 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. 20415. 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.) 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 Office 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, given annually to women for graduate work in aerospace-related sciences and engineering, have been established in 1938 by Zonta International, a service organization of executive women in business and the professions. Applicants must be a student at the time of application, be citizens or permanent residents of the United States, have given evidence of ability in research comparable at least with that expected for the Ph.D. degree, and must have given 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 awarded 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 Cirele). 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 Circular). 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 doctorate 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.

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.


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.

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 $A_r$, Groups of type $G_m$, A Jordan algebra construction, Groups of type $B$, Groups of type $BC_1$, 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.

136 pages
List price $8.00; member price $6.00
ISBN 0-8218-2185-7; LC 77-4192
Publication date: 6/30/77
To order, please specify MEMO/185

Prepayment is required for all AMS publications.
Send orders and remittances to: AMS, P. O. Box 1571, Providence, RI 02901.
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 86 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. Ososky 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, Irel 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.

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 this Bulletin.

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

Publication Committees
American Journal
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 NEWs 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 its deep concern 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.

Bethlehem, Pennsylvania

Everett Pitcher
Secretary
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.

138 pages
List price $14.40; member price $10.80
ISBN 0-8218-0121-X; LC 77-7174
Publication date: 7/31/77
To order, please specify PSAPM/21

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 cofinite topology revisited by John Walsh.

Poisson point process of Brownian excursions and its applications to diffusion processes by Shizuo Watanabe.

Some Q-Matrix problems by David Williams.


To order, please specify PSPUM/31

Prepayment is required for all AMS publications.

Send orders and remittances to: AMS. P. O. Box 1571, Providence, R1 02901.

398
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 for papers presented at

- 747 meeting in Seattle, August 14-18, 1977 A-561
- 748 meeting in Wellesley, October 22, 1977 A-562
- 749 meeting in West Lafayette, October 29, 1977 A-571
- Short course in Atlanta, January 3-4, 1978 A-583

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 journal, 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)


A semigroup S with a set of idempotents E, has been called proper iff for e ∈ E and a ∈ S, e = ea implies that ae ∈ E. A regular semigroup S will be called proper iff for e ∈ E and a ∈ S, e = ea implies that ae ∈ E.


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 NC(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

\[ NC(n) = \sum_{k=1}^{n-1} \binom{n}{k} Q(k) + 1 \]

\[ N(n) = Y_n NC(1), NC(2), \ldots, NC(n) \]

where the \( Y_n \) are the Bell polynomials

\[ Y_n(y_1, y_2, \ldots, y_n) = \sum_{\pi} \frac{n!}{k_1! \ldots k_n!} \frac{y_1}{1!} \ldots \frac{y_n}{n!} \]

in which \( \pi \) ranges over all partitions of \( n \), and \( k_i \) is the number of occurrences of \( i \) in such a partition. (Received June 6, 1977.)
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 $G = \text{Gal}(\bar{K}/\bar{F})$, let $\mu$ be the Haar measure on $G$.

Theorem 1: $\mu(\sigma \in G: \text{Fix}(\sigma) \cap \bar{F} \text{ is prc}) = 1$.

Theorem 2: $\mu(\sigma \in G: \text{Fix}(\sigma) \cap \bar{F} \text{ has model complete theory as an ordered field}) = 1$.

Theorem 3: There are $2^\aleph_0$ model complete theories of ordered fields.

Decidability results for the theory of almost all $\text{Fix}(\sigma) \cap \bar{F}$ 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.)


Let $G$ be a group and $K_G$ the subgroup of $\text{Aut}G$, consisting of those automorphisms which induce the identity on $G/G$. $G$ is called semi-complete (s-cl) iff $K_G = I(G)$, where $I(G)$ is the group of inner automorphisms of $G$. Theorem 1. Let $W = A \bowtie B$ be the wreath product of $A$ and $B$, where $A$ and $B$ are finite and $A$ nilpotent. Then, $W$ is s-cl iff $W = C_2 \times C_2$ or $C_3 \times C_3$ or $W = C_2 \times C_3$. Theorem 2. Let $W = A \bowtie B$ where $A$ and $B$ are finite, $A$ is not nilpotent. Then, $W$ is s-cl iff (i) $A$ is s-cl, directly indecomposable (ii) $[A/K, Z(A)] = 1$ (iii) $B$ is abelian. In the next theorem, $H$ is the subgroup of $\text{Aut}W$ consisting of those automorphisms which leave $B$ and the diagonal elementwise fixed. Theorem 3. Let $W = A \bowtie B$ where $A$, $B$ are non-trivial finite groups with $[A/K, Z(A)] = 1$ (i) $A = n_1A_1 \times \cdots \times n_sA_s$ where $n_1, \ldots, n_s \notin 2$ and $A_1, \ldots, A_s$ are non isomorphic directly indecomposable groups. Then $\text{Hom}(n_1, \ldots, n_s) \bowtie B$. Theorem 4. Let $W = A \bowtie B$ where $A$ and $B$ are finite with $[A/K, Z(A)] = 1$. Then (i) $\text{Aut}W$ is solvable iff $\text{Aut}A$, $\text{Aut}B$ are solvable (ii) $\text{Kw}$ 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-cl 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 $0 < r < (2k+1)/2$, then for all $n$, the partitions of $n$ into parts $\neq 0$, $\equiv r \pmod{2k+1}$ are equinumerous with the partitions of $n$ that contain $d = d_1 + d_2 + \cdots + d_m$ such that $d_1 \geq d_1 + 1$, at most $r-1$ of the $d_1$ equal $1$, $d_1 \geq d_1 + k + 2$, and if $d_1 \leq d_1 + k - 2 + 1$, then $d_1 + d_1 + 1 + \cdots + d_1 + k - 2 \equiv r-1 \pmod{2-j}$. (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 $L_1$ 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,
metrized, 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
do L, then T is a sublattice of L. (Received June 3, 1977.)

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 \( \{X_i: \text{0} \leq i \leq \} \) be a partition of X. A parti-
tion \( \pi \) is reducible if for every \( y \in X_i \), \( 1 \leq i \leq \), there exists a \( g \in G \) such that: 1. \( g(y) \in X_{i-1} \),
2. \( g \in G(X_i) \), and 3. \( g \in G(X_{i-1} \cup X_j) \). Theorem. If \( \{X_i: \text{0} \leq i \leq \} \) is
a subcontinuum of a topological lattice \( L \), then \( T \) is locally a sublattice
of \( L \). (Received June 3, 1977.)

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 \( \{X_i: \text{0} \leq i \leq \} \) be a partition of \( X \). A parti-
tion \( \pi \) is reducible if for every \( y \in X_i \), \( 1 \leq i \leq \), there exists a \( g \in G \) such that: 1. \( g(y) \in X_{i-1} \),
2. \( g \in G(X_i) \), and 3. \( g \in G(X_{i-1} \cup X_j) \). Theorem. If \( \{X_i: \text{0} \leq i \leq \} \) is
a subcontinuum of a topological lattice \( L \), then \( T \) is locally a sublattice
of \( L \). (Received June 3, 1977.)

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
A. H. Wiens [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 \( n \left\lfloor \frac{n}{k-cn} \right\rfloor \) for every \( n \) with \( \frac{k}{c+1} \leq n \leq \frac{k}{c} \).
If \( K_0 \) denotes the set of all \( k \) with \( n \left\lfloor \frac{n}{k-cn} \right\rfloor \) for every \( n \), then \( K_2 = \mathcal{P} \cup \{1\} \) (\( \mathcal{P} \) is the set
of all prime numbers). \( K_3 = \mathcal{P} \cup \{1, 4, 25\} \) (\( \mathcal{F} \) is the set of Fermat prime numbers
\( 2^{2^s} + 1 \), \( s \geq 1 \)) was determined by the author [Arch. Math. (Basel) 27 (1976),
247-254]. Now also \( K_4 \) is determined to
\( K_4 = \mathcal{P} \cup \{1, 4, 9, 21, 33, 49, 54, 77, 121, 141\} \).

B. A. DAVEY, La Trobe University, Bundoora, Victoria, Australia and H. WERNER,
Technische Hochschule, Darmstadt, West Germany. Injectivity and Boolean Powers.

A conjunction of equations, \( a \cdot a, b \), is a simplicity formula for a class \( A \) if for each \( A \in A \),
\( \{a, b\} \in \{a \cdot a, b\} \). 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
finite and assume \( K = ISP(A) \) for some finite set \( A \) of finite algebras. If there is a simplicity
formula for \( A \) and \( K \) has factorizable congruences, then \( I \) is [weak] injective in \( K \) iff it is
isomorphic to \( \prod_{j=1}^d (B_j \cdot B_j) \), where \( A_j \in M(A) \cap IS(K) \), \( A_j \) is [weak] injective in \( K \), \( B_j \) is a
complete Boolean algebra, and the algebra \( A_j \) 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.

B. A. DAVEY, La Trobe University, Bundoora, Victoria, Australia and H. WERNER,
Technische Hochschule, Darmstadt, West Germany. Injectivity and Boolean Powers.

A conjunction of equations, \( a \cdot a, b \), is a simplicity formula for a class \( A \) if for each \( A \in A \),
\( \{a, b\} \in \{a \cdot a, b\} \). 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
finite and assume \( K = ISP(A) \) for some finite set \( A \) of finite algebras. If there is a simplicity
formula for \( A \) and \( K \) has factorizable congruences, then \( I \) is [weak] injective in \( K \) iff it is
isomorphic to \( \prod_{j=1}^d (B_j \cdot B_j) \), where \( A_j \in M(A) \cap IS(K) \), \( A_j \) is [weak] injective in \( K \), \( B_j \) is a
complete Boolean algebra, and the algebra \( A_j \) 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.

Dr. David Ballew and Ronald Tholen, South Dakota School of Mines and
Technology, Rapid City, SD 57701. On \( 77(x+y) \leq \pi(x) + \pi(y) \).

In 1974, Bull. AMS. V1. 80, No. 3, Richards and Hensley proved the incompati-
bility of the classical \( k \)-tuple hypothesis and the Hardy Littlewood conjecture
\( 77(x+y) \leq \pi(x) + \pi(y) \) casting considerable doubt on the latter. This paper

A-521
considers the behaviour of the ratio $\frac{\pi(x+y)}{\pi(x)+\pi(y)}$. 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 counterexamples discussed by Richards and Hensley. (Received June 21, 1977.)

*77T-A195  ERKOL  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) $K$ is the family of all transitive digraphs,

(iii) $K$ is the family of 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 $d_0(u) = \max\{d(u,v) : v \in S\}$ and $d_\infty(u) = \max\{d(u,v) : v \in S\}$. 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 $r_k(u) = \max\{d(u,v) : v \in S, |S| = k\}$. 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.)


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 $\zeta: (g \mapsto \phi_g)$ be a mapping of $G \times \bar{G}$ onto $\mathbb{R}^2$ (End $E$) s.t. $\phi_g$ maps $E$ onto $\{e \mathbin{\mathcal{R}} g \zeta\}$; $\theta(gh) = \theta(g, h) \zeta$ $\phi_e \circ \theta(g, h) = \phi_h \circ \theta(g, h)$; $\theta(g, h) = \theta(h, g) \zeta$; $\theta(g, h) = g \zeta$; $\phi_e \circ \theta(g, h) = \phi_h \circ \theta(g, h)$; $\theta(g, h) = \theta(h, g) \zeta$. Theorem. $S$ is a strong bisimple inverse monoid if and only if $S$ is isomorphic to some $(E, G, \zeta, \theta, \phi)$. An isomorphism theorem is also given. (Received December 20, 1976.)
A natural orthodox semigroup S is termed natural left orthodox if is a congruence on the band of idempotents of S. If, furthermore, is a congruence on the union of the maximal subgroups of S, S is termed a right natural left orthodox semigroup. Let denote X subject to the following modifications: Just assume satisfies (1). is a homomorphism of into and if and q


Let denote X with the modification: Replace (1) by condition: is a homomorphism of into and p and q denote (6). Let denote X with the modification: Replace "e" in (3) and (4). Replace "pA" by and "pA" by in (6). Theorem. is a natural left orthodox (right natural left orthodox) semigroup, and, conversely, every such semigroup is isomorphic to some . (Received March 28, 1977.)

We show that if G is a 2-connected k-regular graph on n vertices and n ≤ 3k then G is hamiltonian. (Received June 27, 1977.) (Author introduced by Professor H. Shank).

Let G be a finite group, and W a weakly closed subgroup of S. For any x, y ∈ G, let

\

For n ≥ 0 let be the subgroup of S generated by all for such that if x ∈ S and A is a maximal normal subgroup of that contains x, then

\[ x, y; p - 1 \in \Phi(A)_{n} \] for some y ∈ Q - A.

Theorem. If S ∩ C(Y_n) ≠ S ∩ N(W)'Y_n (S), then W ∈ Q_n.

Several corollaries follow. Examples are

(1) If is generated by elements y such that \[ \{x, y; p - 1\}^n = 1 \] for all x ∈ S (for example, W has exponent ≤ \[ n! \]), then S ∩ C(Y_n) (S) = S ∩ N(W)'Y_n (S).

(2) If S' = \( q_1(S') \), then S ∩ C(Y_n) (S) = S ∩ N(S'S') (S).

(3) If p = 2, S' = \( q_1(S') \) and S(Y_n) (S) is cyclic, then G has a normal subgroup of index 2.

(Received July 5, 1977.) (Author introduced by Dr. Abe Mizrahi).


Let (V,*) be a standard inverse semigroup with semilattice Y, and let (T,*) be a standard semilattice of completely simple semigroups (T_y : y ∈ Y) with y*y = y ∈ T_y. Suppose T_y ∩ V = H_y for y ∈ Y, and (V,*) ((Y, *)) is the maximal subgroup of (V,*) (T,*) containing y. Let H = \( \bigcup \{H_y : y ∈ Y\} \) and assume

\[ T_{ab} = \left\{ a \cdot b \mid a, b ∈ T \right\} \]

under the multiplication \( (i, b, j) \cdot (r, c, s) = ((b \cdot c)^{-1} \cdot (b \cdot c)^{-1}) \cdot \left( (b \cdot c)^{-1} \cdot (b \cdot c)^{-1} \right) \). Theorem.

(V, T) is a standard regular semigroup, and, conversely, every standard regular semigroup is isomorphic to some (V, T, Y). (Received June 27, 1977.)
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 $\text{Ass } M$ the assassinator of $M$. For $P$ a prime ideal of $A$ denote by $\text{NP}^R_P$ the set of prime ideals lying above $P^R$. Definition. Let $M$ be a right module over $A$. Localize $M$ at the complement of $P^R$ in $R$ (P a prime ideal of $A$) and denote the localized module by $M_{P^R}$. We say $P \in \text{Supp } M$ if $P^R$ is minimal such that $M_{P^R} \neq 0$. We essentially prove: Theorem 1. If $M$ is a finitely generated module over $A$ then $\text{Ass } M \subseteq \text{Supp } M$. If $P \in \text{Supp } M$ is minimal then there exists an ideal $I$ belonging to $\text{Ass } M$. 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).

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 $s \mapsto a^*$ such that $ss^* = s$ 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).

Let $\alpha$ 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 $\alpha \rightarrow \chi(\alpha) = (a_{ij}(\alpha))$ an irreducible, unitary representation of $G$ which affords the character $\chi$. Assume the restriction of $\chi$ to $G_{1/2}$ is fully reduced. Then the nonzero vectors in 
\[
\{(x(id)/\alpha(\sigma))\alpha(\alpha_{ij})_{ij}^{1/2} \sum_{\sigma \in G_{ij}} \alpha(\sigma)e_{\sigma_e} : 1 \leq i, j \leq \chi(id)\}
\]
form an o.n. basis of the orbital subspace $<e_{\alpha} : \sigma \in G>$ in the symmetry class of tensors.
IV. Moreover, if $B = (b_{ij})$ is the matrix representation of $T$ with respect to $\{e_1, \ldots, e_n\}$, then the $(i, j; a), (p, q; b)$ entry of the matrix representation of $K(T)$ is

$$
\delta_{ij} (a_0 c_0^{-1})^{-1/2} \sum_{\pi \in G} \alpha (\pi) \prod_{t=1}^{m} b_{\lambda(t), \delta(t)}.
$$

(Received July 11, 1977.)

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 $(R')$ 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 $x, y \in R'$ with $xy \in P$ then $xP'$ yields $y \in P$ and $yP'$ yields $x \in P$. If one considers the set of the kernels of all primes in $R$ with a generalized semilattice topology, then one obtains the so-called "Van Geel-spectrum" [3], thus generalizing the Harrison-spectrum. On the other hand the "Wannier-spectrum" is defined as follows: if $P \cup N$ is a disjoint covering with $PP = P, P + P = N, N = P + N$, then $(P)$ is the Wannier-spectrum [4]. Theorem 1: The Wannier-spectrum is a Harrison-spectrum.


Let $C$ satisfy the maximal condition for normal subgroups and let $X^t = X^tD$ for some positive integer $t$. Then $C = D$ where $J$ is the infinite cyclic group. If $X^s = X^tD$ and $s \geq t$ there exists a finitely generated free abelian group $S$ such that $C$ is a direct factor of $DS$. (Received July 11, 1977.)


Let $Y$ be a semilattice with greatest element. Let $I (J)$ be a locally inverse semilattice $Y$ of left (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 $(i, j) = p_j, i$ be a function from $I$ to $G$ such that if $j \in J_y$ and $i \in I_y$, $p_j, i \in G_y$ if $j \in J_y$ and $i \in I_z$, $p_j, i = p_j b_y, yz, i a_z, yz$; if $j \in J_y$ and $i \in I_y$, $p_j, i c_y, z = p_j b_y, yz, i a_z, yz$. Let $(Y, I, J, G, a, b, c)$ denote $(i, j) (r, h, g) = (i r, g p_j, r' h, j q)$. 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.)

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 $R \cdot G$ denote the skew group ring $M_G$ of the algebra of the group $G$. THEOREM. If $R$ is prime and $B \cdot H$ 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 \( \mathcal{V} \) and \( \mathcal{W} \) of lattices, \( \mathcal{V} \circ \mathcal{W} \) is the class of all lattices \( L \) such that there exists a congruence relation \( \Theta \) of \( L \) satisfying \( \{a\} \Theta \mathcal{V} \) for all \( a \in L \) and \( \mathcal{L} \in \mathcal{W} \). If \( \mathcal{V} \) and \( \mathcal{W} \) are varieties, then \( \mathcal{V} \circ \mathcal{W} \) is a quasivariety, but not necessarily a variety. Theorem 1.

**COROLLARY.** If \( D \) is a variety containing all but two covers of \( \mathcal{M} \), \( D \circ \mathcal{D} \) has infinitely many subvarieties; \( D \circ \mathcal{D} \) 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 \( m(m(a,b,c), m(a,b,d), e) = m(m(c,d,e), a, b) \). \( \mathcal{M} \) 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) \( a \leq x \land y, x, y \neq 0 \Rightarrow a \leq x \land y \) for certain \( b \leq x, y \leq a \), and (ii) for any \( a, b, y, M_L(a,b,y) = (a \lor b) \land (a \lor y) \lor (b \lor y) \) is an atom. \( \mathcal{L} \) denotes the category of median lattices, a function \( f: L \rightarrow K \) being an \( \mathcal{M} \rightarrow \mathcal{L} \)-morphism if (i) \( f \) preserves \( \land \) and \( \lor \), (ii) \( f(0)_L = 0_k \), (iii) \( \forall b \in K, \exists a \in L \) with \( a \leq f(a) \). For \( A \in \mathcal{M} \), \( f(A) = \{J \subseteq A \mid m[A \times J \times A] \subseteq J \} \), the lattice of ideals of \( A \). For \( g: A \rightarrow B \), an \( \mathcal{M} \rightarrow \mathcal{L} \)-morphism, \( f(g): f(B) = f(A) \) is the counterimage map. The \( J \) is a functor of \( \mathcal{M} \rightarrow \mathcal{L} \). For \( L \in \mathcal{L} \), \( a_L \) (atom of \( L \), \( M_L \)) \( \in \mathcal{M} \). For \( f: L \rightarrow K \) in \( \mathcal{L} \), define \( \mathcal{M}(f): M_K \rightarrow M_L \) by \( \mathcal{M}(f)(a) = a \) where \( a \leq f(a) \). Then \( \mathcal{M} \) is a contravariant functor of \( \mathcal{L} \rightarrow \mathcal{M} \). Theorem. The functors \( f \circ g \rightarrow \text{Id}_{\mathcal{M}} \) and \( \mathcal{M} \circ f \rightarrow \text{Id}_{\mathcal{M}} \) are dual. Cor. A lattice \( L \) is the convex subalgebra lattice of a distributive strong conditional lattice if \( L \in \mathcal{L} \). Theorem. The above duality restricts to a duality between \( f = \{A \in \mathcal{M} \mid A \) is a tree \} and \( \mathcal{B} = \{L \in \mathcal{L} \mid \text{comp}(L) \) 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 \( I+rI=R \). Let \( I(I) \) be the idealizer of \( I \). Consider the simple right \( R \)-module \( R/M \) as a right \( I(I) \) module and let \( \bar{r}:I(I) \rightarrow R/M \) be the \( I(I) \) homomorphism defined by \( \bar{r}(x)=rx+M \). Let \( I_r \) be the kernel of \( \bar{r} \) and let \( M_r=(x|xI(I), rx+M) \). Theorem. \( M_r \) is a maximal right ideal of \( I(I) \) and is the only maximal right ideal containing \( I_r \). If \( M_r \) is not an ideal, then there is an \( r'\in I(I) \) with \( r^1+r^1=r(I) \). In this way we obtain a chain of rings \( R[I(I)2(I_r)\ldots \). Theorem: The above chain terminates if and only if \( R/M \) is a finite dimensional vector space over \( \text{End}_R(R/M) \) 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
Two degeneracy operators, \( d_i \) and \( s_i \) respectively, \( 0 \leq i \leq n \), are homomorphisms. A semisimplicial complex \( A \) is said to satisfy the Kan extension condition if for each collection of \( + 1 \) elements \( x_0, \ldots, x_{k-1}, x_{k+1}, \ldots, x_n + 1 \) of \( A_n \) satisfying the compatibility condition
\[
d_i(x_j) = s_j(x_k), \quad i \neq k, \quad j \neq k,
\]
there exists an \( x \in A_{n+1} \) with \( d_i x = x_j \). 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).

A median algebra \( A = (A;Q) \) is a ternary algebra where the ternary operation \( Q \) satisfies all the identities true in distributive lattices for the median polynomial \((x \lor y) \land (y \lor z) \land (z \lor x)\).

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 \((A;\lor)\) median if (i) each principal dual ideal \([p]\) is distributive lattice.

We say that a median semilattice \( A \) realizes \( Q \), \( Q \) a ternary function on \( A \), iff \( Q(a,b,c) = (ab) \lor (bc) \lor (ca) \) for all \( a,b,c \in A \). Theorem. An algebra \( A = (A;Q) \) is a median algebra iff it is realized by some median semilattice \((A;\lor)\). 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.)

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 \((R_a)\) iff there is a map \( \rho : L \to w \) such that \( \rho(p) < \rho(x) \) whenever \( \langle p, x \rangle \) is a minimal pair and \( x \in J \) (this is condition (111) 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 \((R_a)\). Theorem 2. A sublattice of a lattice satisfying (SF) and \((R_a)\) satisfies \((R_a)\). Corollary 1. Every transferable lattice satisfies \((R_a)\). Corollary 2. Every finite transferable lattice is sharply transferable. (Received July 25, 1977.) (Author introduced by Professor G. Grätzer).

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 \( R = k[x,y] \).

Let \( k = 0 \). Let \( M = (x,y) \) and \( A_k = \{ a \in Aut_k(R) : x a = x \text{ and } ya = y \} \) in \( M^2 \). We exhibit an infinite subfamily \( F \) of \( A_k \) such that the fixed ring \( R^F \) of each \( a \) in \( F \) is \( k \) itself. Moreover \( (xa - x, ya - y) \neq 1 \). Some other questions are also considered.

(Received July 28, 1977.) (Authors introduced by Irwin Fischer).

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;
(1) \( a \land b = a \land c = d \) implies that \( a \land (b \lor c) = d \); (SF) all principal ideals are finite;
Let $I$ be the ideal lattice of a lattice satisfying (W) iff (a) $I$ possesses a fixpoint in $A$; (b) $I$ is a function from $A$ to itself. Then the ideal lattice of $L$ satisfies (SD$_p$). Consequently, $E(SD_p)$ fails. From Theorem 1 we obtain: Corollary. Every transferable lattice satisfies (SD$_p$), (SF), and (W). (Received July 25, 1977.)

777-A218

DAVID ZEITLIN, 1650 Vincent Ave., North, Minneapolis, M.N., 55411. Parametric solutions for a sum of 2n+5 subvectors equal to a sum of 2n+3 subvectors.

For each $n$, let $P_n = 2, 3, \ldots, n$, be distinct integers so that $S = \sum_{i=1}^{n} \frac{n}{i}$ is an even integer. Let $S = 2R, W_{k+2} = W_k + W_k$; $k = 0, 1, \ldots$, where $W_k$ and $W_{k+1}$ are integers. Then, for $k = 0, 1, \ldots$, the two equal sums of 2n+5 and 2n+3 subvectors, respectively, are given by

\[ (W_{k+4})^3 + (W_{k+2})^3 + (W_{k+1})^3 + (W_{k})^3 + \sum_{i=1}^{n} (W_i)^3 \]

Moreover, the two sums of the base variables are equal for all $n$ and $k$. For example, if $n = 3$, $k = 0$, (*) gives identity (1): $(W_3 + W_1)^3 + (W_2 + W_0)^3$ $\equiv (W_2 + W_1 + W_0)^3 + (W_1 + W_0)^3 + (W_0)^3$. If $P_n = 1$ gives $(W_4)^3 + (W_2)^3 + (W_0)^3$, $n = 3$. Additional reports on equal sums of subvectors are forthcoming. See these NOTICES 24(1977) August (Received July 29, 1977.)

777-A219

R.N. GUPTA and JAI RAM, Panjab University, Chandigarh 160014, India. The Jacobson radical of fixed rings 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 $|G| = R$ is 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.)

777-A220

SYDNEY BULMAN-FLEMMING 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 $<A; \alpha>$ where $\alpha$ is a function from $A$ to itself. (K$_1$ is equivalent to the variety of all $M$-sets where $M$ is the monoid $<a; +, 0>$.) Theorem 1: $<A; \alpha>$ is injective in $K_1$ iff (a) $\alpha$ possesses a fixpoint in $A$; (b) $A = im(\alpha)$. Corollary: $<A; \alpha>$ 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 if it is free. Theorem 2: $<A; \alpha>$ has a projective cover iff $A - a(A)$ generates $A$.

Theorem 3: $<A; \alpha>$ is pure-projective in $K_1$ iff it is a coproduct (disjoint union) of finitely generated algebras. (A complete description of the pure-projective (= equational compact) algebras exists and exists in the literature.) The tensor product $A \otimes B$ of two algebras in a variety $K$ always has the defining property that each bihomomorphism from $A \times B$ to $C \in K$ factors uniquely through $A \otimes B$. (Received August 1, 1977.)
An algebra $A \in K$ is called flat if the functor $A \otimes -$ preserves monomorphisms. Theorem 4: $\langle A; a \rangle$ is flat in $K_1$ iff $a$ is 1 - 1. Stenström calls an $A$-set $A$ weakly flat if $A \otimes -$ preserves equalizers and pullbacks (see Math. Nachr. 68 (1970), 315-334). $\langle A; a \otimes K_1 \rangle$ is weakly flat iff it is flat and contains no cycles. (Received July 19, 1977.)


Let $A, B$ be $n \times n$ 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.)

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 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.)


Let $G$ be a finite group and let $\theta$ be the homomorphism of pre-$\lambda$-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 $\psi_\lambda$, $\lambda \in \mathbb{N}$, from $B(G)$. Knutson was not able to give an explicit formula for $\psi_\lambda$. The authors show that given $f \in SCF(G)$ and $K$ a subgroup of $G$, then $\psi_n(f)(K) = \sum \psi_k(J)f(J)$.

The summation is over all subgroups $J$ of $G$ and the $\psi_k$ 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.)

DAVID F. ANDERSON, University of Tennessee, Knoxville, Tennessee, 37916. Graded Krull domains.

Let $\Gamma$ be a torsionless grading monoid and $A = \bigoplus_{\gamma \in \Gamma} A_{\gamma}$ a graded Krull domain. Thm 1. $Cl(A)$ is generated by the classes of homogeneous prime ideals of $A$. Thm 2. If $\gamma'(-r) = 0$, then the map $I - A:(A:IA)$ from $D(A_0)$ to $D(A)$ induces an injection $Cl(A_0) \rightarrow Cl(A)$. Thm 3. Let
B be a Krull domain with quotient field K, then if B[r] is a Krull domain, Cl(B[r]) ∈ Cl(K[r]) and Cl(K[r]) is independent of K.

Also studied are subrings of K[X_1, ..., 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×B ≅ A×C then B and C are isotopic.

Algebras B=(B,(f_i)_{i∈I}) and C=(C,(g_i)_{i∈I}) are called isotopic if there exists a bijection φ:B→C and bijections ψ_i:B→C, i∈I, such that for all elements x_1, ..., x_n ∈ B we have g_i(φx_1, ..., φx_n) = ψ_i f_i(x_1, ..., x_n).

Corollary: If A×B ≅ A×C for finite algebras A, B and C and if B and C are idempotent then B ≅ 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, ≤) can be extended to a compact poset (P∪E, ≤) 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 S^n(F) is metrizable. Let S denote the family of all open disks in S^n(F) relative to some fixed metric.

**Definition.** A weight w:S→R is a function such that w(D_1) > w(D_2) iff the radius of D_1 is > the radius of D_2. The weight w is proper if \lim_{r→0} w(D_r) = 0 whenever \{D_r\} is a sequence such that D_r has radius r. The weight w is regular if whenever D_1, ..., D_m are contained in D and D_1 ∩ D_2 = ∅ then \sum w(D_i) ≤ w(D). Finally if V is a variety then the content C(V) = glb{s w(D_1): D_1, ..., D_m is a cover of V}. The content is proper or regular according to whether w is proper or regular.

**Theorem 1.** If C is a proper content and C_1 is a curve in S^n(F) then C(C_1) = 0. **Theorem 2.** If C is a proper regular content on S^n(F) and V is a variety then C(V) = 0. (Received August 19, 1977.)
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 \( d(R) = \text{Krull dimension of } R \) over \( k \), \( v(R) = \text{valuative dimension of } R \), and \( \text{rk}(P) = \text{max (height) of prime ideal } P \). Sample theorems:

1. If the integral domain \( A \) satisfies the altitude formula
   \[ \text{rk}(P) + t(A/P) = t(A), \]
   for each prime \( P \) of \( A \), (*)
   then \( d(A \otimes_k R) = \max \{ \text{rk}(P) + \min(t(A) - d(A), t(R/P)) + d(A) \mid P \text{ a prime ideal of } R \} \).

2. If \( A_1, \ldots, A_n \) are domains satisfying (*), then
   \[ d(A_1 \otimes_k A_2 \otimes_k \ldots \otimes_k A_n) = t(A_1) + \ldots + t(A_n) - \max_{i \leq n} \{ t(A_i) - d(A_i) \}. \]

3. If \( \mathbb{R} \) is a domain, then \( t(\mathbb{R}) + d(\mathbb{R}) = d(\mathbb{R} \otimes_k \mathbb{R}) \leq t(\mathbb{R}) + v(\mathbb{R}). \)


**3-nets**

3-nets were defined by Laskar ["Finite Nets of Dimension 3.1", 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 \( \mathcal{G}_3 = \mathcal{P}_3 - \mathcal{P}_2 \) is an affine 3-space. Let \( \mathcal{P}_2^0 \) be a subplane of \( \mathcal{P}_2 \). The points of the 3-net \( \pi \) will be the points of \( \mathcal{G}_3 \). Lines of \( \pi \) will be the lines of \( \mathcal{G}_3 \) which intersect \( \mathcal{P}_2^0 \) in a point. Planes of \( \pi \) will be the planes of \( \mathcal{G}_3 \) which intersect \( \mathcal{P}_2^0 \) in a line. Theorem: If \( \pi' \) is a 3-net with the property that the planes of \( \pi' \) are Bruck nets with at least 3 parallel classes of lines then \( \pi' \) is isomorphic to a 3-net described above. (Received August 19, 1977.)

**Simple Noetherian Rings and Transcendence Degrees**

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 \( \text{tr. deg.}(L/k) = n \). 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 \( A_\lambda(k) \) denote the Weyl algebra over \( k \), and let \( D(k) \) be the quotient division ring of \( A_\lambda \). Then i) every maximal subfield of \( D \) has \( \text{tr. deg.} 1 \) over \( k \); ii) \( D[x_1, \ldots, x_n] \) has Krull and global dimension 1 for every \( n \); iii) \( D[x] \) is primitive, but \( D[x, x^2] \) is not.

Thm. 2 was obtained for the case \( n=1 \) by Jacobson. (Received August 22, 1977.)
A modal algebra is an algebra \((A, 0)\) such that \(A\) is a Boolean algebra and \(0\) is a unary operation satisfying \(1^0 = 1\) and \((x \cdot y)^0 = x^0 \cdot y^0\). A variety of modal algebras is called finite if it is generated by a finite algebra. Let \(\mathbb{2}\) be the two element modal algebra satisfying \(x^0 = x\). Theorem 1. The variety generated by \(\mathbb{2}\) 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 \(x^0 \leq x\) and \(x^{00} = x^0\)) 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 \(K \neq L\) 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)

On common fixed exposed points for families of mappings.

This note is a mash-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 \(F \subseteq \{I_S\}\), 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 \(F \subseteq \{I_B\}\). 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.)

Differential-delay equations with two time lags. Preliminary report.

Let \(f: \mathbb{R} \to \mathbb{R}\) 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 \(a, b > 0\) and \(1 \leq \gamma \leq 2\) consider (*) \(x'(t) = -\alpha f(x(t-1)) - \beta f(x(t-\gamma))\). Theorem. For each \(\epsilon > 0, a_1 < a\) and \(b_1 < b\) there exists a bounded set \(S = S(\epsilon, a_1, b_1, f)\) in \(\mathbb{R}^2\) (whose size can be explicitly estimated) such that for \((a, b) \notin S\) (*) 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 \((\epsilon, z_1 - \epsilon)\), (2) \(x(t) < 0\) on \((z_1, z_1 + z_2)\) with \(z_2 \geq 1\) and \(f(x(t)) \leq -b_1\) on \((z_1 - \epsilon, z_1 + z_2 - \epsilon)\) 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 \(a\) and \(b\) vary, and the existence of "rapidly oscillating" periodic solutions. (Received April 21, 1977.)
Let \( X(0,\omega) \), \( Y(0,\omega) \) be Banach function spaces of Lebesgue measurable functions. Denote by \( X(Y)(0,\omega) \) the Banach space function space determined by the norm \( \| f \| = \| X(Y) f \| \). We consider the problem of embedding \( X(Y) \) into another Banach function space \( Z(0,\omega) \).

**Theorem 1.**
(i) If \( (p_1,q_1) \) \( (p_2,q_2) \) \( L^p(0,1) \) and \( L^q(0,1) \) respectively, then \( L^p(0,1) \subset L^q(0,1) \) if and only if \( q_1 < p < q_2 \).
(ii) If \( q_3 < \infty \), then \( L^p(0,1) \subset L^q(0,\omega) \) if and only if \( q_1 < p < q_3 \).

**Theorem 2.**
(i) The following statements are equivalent:
   (i) \( L^p_\infty L^q_\infty (0,\omega) \subset L^q_\infty (0,1) \); (ii) \( L^q_\infty (0,\omega) \subset M^p_\infty (0,\omega) \); (iii) \( K^p_\infty (M^q_\infty (0,\omega)) \subset M^q_\infty (0,\omega) \); (iv) There exists a positive constant \( Q \) such that \( A^p_\infty (t) \leq Q A^q_\infty (ts) \).

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.)

**77-B143**

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 \( T \in S \), \( T \) is left thick if for any finite \( F \subset S \), \( F \subset T \) for some \( s \in S \). In 1965, T. Mitchell proved that if \( S \) is left amenable, then \( T \) is left thick iff \( m(xT) \leq 1 \) for some left invariant mean \( m \). Here \( xT \) is the characteristic function of \( T \). He also showed that if \( T \) is a left thick subgroup of \( S \), then \( T \) is left amenable if \( S \) 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.)

**77-B144**

Mike Dombroski, 1217 N. Havenhurst Dr. #17, Los Angeles, Ca. 90046

Finite Analogue of Trigonometric Functions.

In this paper two sets of polynomials are studied:

- \( \{ C_n(x) \} \) = \( \sum_{m=0}^{\infty} (-1)^m (n^{2m+1}) x^{2m+1} \)
- \( \{ S_n(x) \} \) = \( \sum_{m=0}^{\infty} (-1)^m (2m+1)^m x^{2m} \)
- \( \{ e_n(\gamma) \} \) = \( \sum_{m=0}^{\infty} (-1)^m (n^{2m}) \gamma^{2m} \)
- \( \{ \beta_n(\gamma) \} \) = \( \sum_{m=0}^{\infty} (-1)^m (n^{2m}) \gamma^{2m+1} \)

where \( n \) is real. Both sets are shown to be analogues of cosine, sine respectively. The \( \{ C_n(x) \} \), generated by \( (1+ix)^n \), become exact analogues when \( \{ e_n(\gamma) \} \) are normalized by \( (1+ix)^n \). The roots of the \( \{ C_n(x) \} \) become \( \tan \frac{n\pi}{2n} \), and those of the \( \{ e_n(\gamma) \} \) yield groups of symmetric sum identities.

With variable \( n \), the \( \{ C_n(x) \} \) wavelength of \( \lambda(x) = n / \tan^{-1} x \) and the \( \{ e_n(\gamma) \} \) wavelength of \( \lambda(y) = n / \sin^{-1} (y/2) \) give minimum values, \( \{ \lambda_n \} \). 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)

**77-B145**


The main idea of the paper consists in reducing the study of convolution operators in \( \mathbb{R}^n \) to the study of their action on sums or linear combinations of Dirac deltas concentrated on a finite number of points. For example, let \( \{ k_j \} \subset L^1(\mathbb{R}^n) \) be a sequence of kernels and consider the operators \( K_j \) on \( L^1 \) defined by \( K_j f = k_j * f \). Let \( Kf(x) = \sup \| k_j * f(x) \| \).

Then \( K \) is of weak type \((1,1)\) if and only if \( Kf \) is of weak type \((1,1)\) over distributions of the form \( t = \frac{1}{h^{n-1}} \delta \). Theorems of this type make the study of the Hilbert transform, the Calderon-Zygmund operators, the Hardy-Littlewood maximal operator, the sums of Fourier series, etc. much more transparent and easy. (Received June 3, 1977.)
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)


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 invariant 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.)


Let $T = \mathcal{S}(\mathcal{H})$ be a $C^*$ contraction on the separable Hilbert Space, $\mathcal{H}$. Let $A$ be an operator in the double commutant of $T$. Theorem 1 If $T$ has at least one finite defect index, then $A = \phi(T)$, for some $\phi \in \mathcal{H}^*$. This result was recently proven for the case of both defect indices finite by Uchiyama.

Theorem 2 If $T : C^*$ 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.)

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 $X_p$ are of type $p$ if $p < 2$ and $p$ is sufficiently large. It is shown that $X_p$ is of type 2 if $p > 2$. (Received June 8, 1977.)

KENNETH R. DAVIDSON, M.I.T., Cambridge, MA. 02139. Commutative Subspace Lattices

If $A$ is an operator algebra, let $\text{Lat } A$ denote the projections onto its invariant subspaces. Let $\text{Lat } \pi A$ denote the projections in the Calkin algebra invariant for the quotient algebra $\pi A$.

Theorem 1. If $A$ is reflexive and $\text{Lat } A$ is commutative, then $\text{Lat } \pi A = \pi \text{Lat } A$.

Further, we give an elementary proof of a theorem of Arveson:

Theorem 2. Commutative (strongly closed) subspace lattices are reflexive. (Received June 8, 1977.)
F~ -Spaces.

Completely regular Hausdorff S is an $F_{N}$-space if any two disjoint sets, each the union of $\leq N$ cozero sets, are contained in disjoint zero sets. Real lattice $\mathcal{C}(S)$ has $\omega$-mediants provided:

if $U, V \subseteq \mathcal{C}(S)$ satisfy $0 < |U| \cdot |V| < \omega$ and also $u \leq v$, $u \in U$, $v \in V$, then there exists mediator $w \in \mathcal{C}(S)$ such that $u \sim w \sim v$.

Theorem 1. Completely regular Hausdorff S is an $F_{N}$-space iff $SS$ is an $F_{11}$-space iff real $\mathcal{C}(S)$ has $\omega$-mediants.

Theorem 2. For compact Hausdorff $X$, $\mathcal{C}(X)$ is $\omega$-injective in Ban iff $X$ is an $F_{N}$-space. Thus there exist $\omega_0$-injective $\mathcal{C}(X)$ for which $X$ is connected, e.g., $X = B\mathbb{R}^{+} - \mathbb{R}^{+}$.

(Received June 6, 1977.)

~\text{Projective}~Spaces.

In the category $\text{cmp}$ of continuous maps of compact Hausdorff spaces, object $X$ is weakly [strongly] $\mathcal{N}$-projective if every morphism pair $\psi: X \rightarrow Z$ and epic $f: Y \rightarrow Z$ such that $\psi \circ f$ admits a lifting $\Sigma: X \rightarrow Y$ of $\psi$ over $f$, i.e., $\psi = f \circ \Sigma$. Theorem 1. $X$ is weakly $\mathcal{N}$-projective in $\text{cmp}$ iff any two disjoint unions of $\leq N$ cozero sets are contained in disjoint clopen sets (i.e., iff $X$ is a totally disconnected $F_{N}$-space.) Theorem 2. If $X$ is weakly $\mathcal{N}$-projective in $\text{cmp}$ and $2^{\mathcal{N}} = N^{+}(\text{GCH})$, then $X$ is strongly $\mathcal{N}$-projective in $\text{cmp}$.

Theorem 3. (Without GCH.) The space $U(\mathcal{N}) \subseteq \mathcal{B}(\mathcal{N}) - \mathcal{N}$ of uniform ultrafilters of cardinal $\mathcal{N}$ is $\mathcal{N}$-projective in $\text{cmp}$ for $\mathcal{N} = \text{cf}(\mathcal{N})$. For example, $B\mathbb{N} - \mathbb{N}$ is strongly $\mathcal{N}$-projective in $\text{cmp}$; although it is not basically disconnected.

(Received June 6, 1977.)

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 11, 1977.)

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.)


We derive here the generating function given below:
\[
\sum_{n=0}^{\infty} \left( \frac{\alpha + \gamma}{n!} \right)^n L_n^{(\alpha)}(x) = \exp\left[ (\beta + \gamma)(\beta + \gamma + 1) \cdots (\beta + \gamma + n) \right]
\]
where \( \alpha = t + \sum_{k=2}^{n} \frac{y_k}{n!} \). If \( \beta = 1, \gamma = 0 \), then \( u(t) = t \) and we have the well-known generating function
\[
\sum_{n=0}^{\infty} \left( \frac{1}{n!} \right)^n L_n^{(\alpha)}(x) = e^{t/1+\gamma(1)} x^t.
\]
(Received July 15, 1977.)

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 $E'$, 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.)

Valerian Nita, Wayne State University, Detroit, Michigan 48202.

Meromorphic Functions Whose Global Cluster Sets Contain Regular Points.

If $E$ 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.)

FEI YUAN WU, National Chiao Tung University, Hsinchu, Taiwan, Rep. of China

The hyperinvariant subspace lattice of the contraction of class C.o.

It is shown that if $T$ is a C.o contraction with finite defect indices, then Hyperlat $T$ is (lattice) generated by those subspaces which are either ker $\Phi(T)$ or ran $\xi(T)$, where $\Phi$ and $\xi$ 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.)

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 $x - a$ implies $S(x) \rightarrow 0$ 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 $(b) - f(a) \in c_l(H(b - a))$ and $(b) - f(a) = Df(x_0)(b - a) \in c_l(K(b - a))$, 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.)
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 $1 \leq p < \infty$. 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 $1 < p < \infty$, (iii) $\hat{k}(x)$ exists in the pointwise sense for each $x$, (iv) $\hat{k} \in L^\infty$, (v) $\sup \int |k(t)e^{-itx}dt| = \infty$, (vi) $\sup \int |k(t) - k(t-y)|dt = \infty$, (vii) $\sup \int |k(t)|dt = \infty$, and (viii) $k$ maps $L^p$ into $L^p$ weakly for all $1 \leq p < \infty$.

(Received July 8, 1977.)

Simeon Ivanov, University of Illinois, Urbana, Illinois 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 $Y$, $\phi^*_+(X,Y)$ and $\phi^*_-(X,Y)$ the subsets of all projective and Fredholm operators of the first and of the second kind, respectively. Theorem. Let $A: G \rightarrow L(X,Y)$ 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 $\lambda \mapsto \ker A(\lambda)$ is locally holomorphic on $G$; 3. The function $\lambda \mapsto \text{codim} \ker A(\lambda)$ is locally holomorphic on $G$. Theorem. Let $A: G \rightarrow \phi^*_+(X,Y)$ [respectively, $\phi^*_-(X,Y)$] be holomorphic. Then $A$ has a holomorphic relative inverse on $G$ if and only if $\text{dim} \ker A(\lambda)$ is constant [respectively, $\text{codim} \ker A(\lambda)$ 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.)

777-R65


Let $\kappa$ be an infinite cardinal, $\kappa > \omega$, and denote by $\mathfrak{p}(\kappa)$ the power set of $\kappa$. Theorem. Let $\mathfrak{q}(\kappa)$ be a function such that: (a) $\mathfrak{q}(\kappa) = \omega$; (b) $\mathfrak{q}(\kappa) = \omega$; (c) for any family $\{A_\alpha : \alpha < \kappa\}$ of pairwise-disjoint subsets of $\kappa$ we have $\mathfrak{p}(\kappa) = \omega(A_\alpha)$. Then there is a sequence $\{\kappa_\alpha : \alpha < \kappa\}$ such that $\kappa_\alpha = \kappa$, and $\kappa_\alpha \in \mathfrak{q}(\kappa)$ for all $\alpha < \kappa$. Then, for every $\alpha > 0$, there is $\kappa_\alpha$ such that $\kappa_\alpha = \kappa$, and $\kappa_\alpha \in \mathfrak{q}(\kappa)$ for all $\alpha < \kappa$. Note. Corollary 1 is a uniform extension of H. Rosenthal's result (Lemma 1.1, Studia Math. 37 (1970) 13-36) to a $\kappa$-indexed family of families of measures. Corollary 2. Let $\mathfrak{p}(\kappa)$ be a family of finitely additive positive measures on $\kappa$, such that $\mathfrak{p}(\kappa) = \omega$. Then, for every $\alpha > 0$, there is $\kappa_\alpha$ such that $\kappa_\alpha = \kappa$, and $\kappa_\alpha \in \mathfrak{q}(\kappa)$ for all $\alpha < \kappa$. Then there is $\kappa_\alpha$ such that $\kappa_\alpha = \kappa$, and $\kappa_\alpha \in \mathfrak{q}(\kappa)$ for all $\alpha < \kappa$. Special case of Corollary 3 (for $\mathfrak{q}(\kappa)$).

Corollary 3. Let $\mathfrak{p}(\kappa)$ be a family of finitely additive positive measures on $\kappa$, such that $\mathfrak{p}(\kappa) = \omega$. Then, for every $\alpha > 0$, there is $\kappa_\alpha$ such that $\kappa_\alpha = \kappa$, and $\kappa_\alpha \in \mathfrak{q}(\kappa)$ for all $\alpha < \kappa$. Then there is $\kappa_\alpha$ such that $\kappa_\alpha = \kappa$, and $\kappa_\alpha \in \mathfrak{q}(\kappa)$ for all $\alpha < \kappa$. Special case of Corollary 3 (for $\mathfrak{q}(\kappa)$).

[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.)

777-B66

S. Argyros and S. Negrepontis, Athens University, Panepistemioiopolis, Athens 621, Greece. Isomorphism Embedding of $C^1(\Gamma)$.

For a compact space $X$, set $w(X)$ its topological weight, and $\Delta w(X)$ least cardinal $\alpha$ for which there are a family $\{x_\alpha : \alpha < \kappa\}$ of compact spaces with $w(X_\alpha) = \alpha$ for $\alpha < \kappa$ and a continuous function from $\Delta w(X)$ onto $X$. For a cardinal $\alpha$, $C^1(\alpha)$ denotes the Banach space of all $f: \alpha \rightarrow \Gamma$, $f(\kappa) = 0$. A cardinal $\alpha$ is $\kappa$-accessible if for $\alpha$, and $\kappa < \alpha$, we have $\kappa \times \gamma < \alpha$. Theorem A. Let $\Gamma$ be a compact space, a cardinal with $\text{cf}(\alpha) > \omega$, $\Delta w(\alpha)^{<\alpha}$, and let $\Delta$ be a closed subspace of the real space $C(\Gamma)$ with $\dim 2\alpha$. Then (1) $C^1(\alpha)$ embeds isomorphically into $\Delta$; and (ii) the dyadic space $[0,1]^\alpha$ is homeomorphic to a compact subset of $X$. (cf. J. Hagler, Transactions Amer.
Theorem B. Let \( u \) be a \( \sigma \)-finite measure and \( Z \) a closed subspace of the (real or complex) Banach space \( L_1(u) \). Let \( a \) be a cardinal such that both \( a \) and \( cf(a) \) are inaccessible, and \( dimZ \alpha \). Then \( k'(\alpha) \) embeds isomorphically into \( Z \).

The proofs use (among other things) a generalized version to singular cardinals of the combinatorial theorem of Erdős-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.)
PHILOM THEOREM 1 depends on Riemann-Roch's and Clifford's theorems. All Proof rely on classical techniques. (Received July 25, 1977.)


4y + 2qy' - p^2 = 0 is a condition of nonoscillation for \( y'' + py' + ry = 0 \).
(Received June 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 \( \int_0^T f(s)ds \to \infty \), conditions are obtained for the uniform boundedness of nonlinear ordinary differential systems and hereditary systems of Lurie type described by the equations:

- \( \dot{x} = A(t,x) + b(\sigma) \)
- \( \dot{\sigma} = B(t,x) - rf(\sigma) \)
- \( \dot{\sigma} = C(t,D(t)x) - rf(\sigma) \).
(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 \( g(z) = \sum_{n=1}^{\infty} a_n z^n \) where \( a_n = \exp(i\alpha_n)/d_1 d_2 \ldots d_n \). Then there exists an entire function \( f(z) \) of b.i. such that \( \log M(r,f) \leq \log M(r,g) \).
(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 \( P_n(x) = \sum_{s=0}^{n-1} a_s x^s \) be any sequence of polynomials for which \( \sum_{s=0}^{n-1} a_s x^s \leq M \) 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 \([0,\theta]\) as \( n \to \infty \). In fact, if \( \Delta(\theta) \) denotes the supremum of all such numbers \( \delta \), Lorentz [ibid] showed that \( \delta^2 \leq \Delta(\theta) < \theta \). We prove, among other results, that \( \Delta(\theta) = \theta^2 \) for all \( 0 < \theta < 1 \). (Received August 1, 1977.)

*77T-B174 RIDGELY LANGE, 1049 N. Rock Hill Road, St. Louis, Missouri 63110. 2-Decomposable operators are decomposable.

In this paper the author gives the positive solution to a problem of S. Flaker (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 Chicago, 1971).
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.)

ROBERT C. SHARPLEY, University of South Carolina, Columbia, South Carolina 29208. On the Failure of a Bilinear Marcinkiewicz Theorem.

Bilinear operator $T$ is given which is bounded from $L^p \oplus L^p$ to $L^{p_\infty}$ for $1 < p < 2$ but is not bounded from $L^p \oplus L^p$ to $L^p$ in the same range of $p$. Hence it is established that the Marcinkiewicz theorem cannot 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.)

F. J. Almgren, Jr., Princeton University, Princeton, N.J. 08540. Mass minimizing integral currents in $\mathbb{R}^n$ are almost everywhere regular. Preliminary report.

(Received August 9, 1977.)

David F. Dawson, North Texas State University, Denton, Texas 76203. An addendum to "Matrix maps of null sequences."

A corollary of the paper mentioned in the title (Rendiconti di Matematica (6), 9 (1966), pp. 207-214) shows the equivalence of the three sets of conditions cited above. (Received August 11, 1977.)

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 $\mathbb{H}^n$, homogeneous with respect to the dilations on $\mathbb{H}^n$. 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 $\pi$ of $\mathbb{H}^n$ (except the trivial representation).

Furthermore, hypoellipticity is preserved if the homogeneous operator $P$ is expressed by terms of lower order of homogeneity. (Homogeneity means homogeneity with respect to dilations on $\mathbb{H}^n$.) It is also shown that if $P$ is homogeneous, left-invariant and hypoelliptic on $\mathbb{H}^n$, then its formal adjoint is hypoelliptic. Our proof makes use of the general calculus of pseudodifferential operators developed by Beals. (Received August 12, 1977.)
Let \( p(x) \), \( q(x) \) be real, continuous functions with the properties: (1) \( p(x) \) is strictly increasing for all \( x \geq x' \geq 0 \); \( q(x) \) is strictly decreasing from infinity for all \( x \), \( 0 \leq x \leq x' \). (2) \( p(x) + p(x) = x \rightarrow \infty \), \( q(x) = 0(q(x)) + q(x) \) as \( x \rightarrow 0^+ \) for each \( c > 0 \). (3) \( p(\frac{1}{x}) = 0(q(x)) \) as \( x \rightarrow \infty \). \( p(\ln x) = o(p(x)) \) as \( x \rightarrow \infty \). (4) \( p^{-1}(cq(x))/p^{-1}((c + \epsilon)q(x)) = o(x) \) as \( x \rightarrow 0^+ \) for each \( \epsilon > 0, c > 0 \).

Let \( f(z) = \sum_{k=0}^{\infty} a_k z^k \) be analytic on a finite open disc of finite radius \( R > 1 \), where \( \{n_k \} \) is a subsequence of non-negative integers such that \( a_{n_k} \neq 0 \). Denote \( E(k,z) = \max_{x \leq x \leq 1} \left| \sum_{j=k}^\infty a_j x^j \right| \) and define \( n_k \rightarrow \infty \), the real numbers: \( E = \limsup (p(n_k)/q(\ln (E(k,n)/R^k))), A = \limsup (p(n_k)/q(\ln M(r))/q(\ln (R/r))) \).

(Received August 22, 1977.)

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 \( d: ba(F) + ba(F) \) 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 \( d(\mu) = \int d(\mu)/\mu \) (refinement integral) for each \( \mu \)-continuous \( \eta \) in \( ba(F) \); c) if \( \eta \in ba(F) \), \( \beta \) is a bounded function from \( F \) into the reals and \( \beta \eta \) exists, then \( d(\beta \eta) = \beta d(\eta) \). **Theorem 2. T.A.E. a) if \( \mu \in ba(F) \), \( \lambda \in \mu \)-continuous and \( \int \lambda^2/\mu \) exists, then \( d(\int \lambda^2/\mu) = \int d(\lambda)^2/\mu \); b) if \( \mu \) and \( \lambda \) are mutually absolutely continuous elements of \( ba(F) + \beta \) is a bounded function from \( F \) into the non-negative reals for which \( d(\mu) = \beta \mu \), then \( d(\lambda) = \beta \lambda \). **Theorem 3. If \( d \) satisfies the conditions of 2 then so does the function \( \lambda - \lambda - d(\lambda) \). The function \( r(\mu) = u_1 \) (Abs. 742-28-3, NOT., Jan. '77) satisfies the conditions of 2 but not necessarily those of 1. (Received August 22, 1977.)

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 \( \sup \{ 2((s(x,y) + t(x,y) + m(x,y)) + r(x,y) + q(x,y)) = k < 1 \). **Definition.** A mapping \( T : X \rightarrow X \) 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 \( d(T^n(x) x, T^n(y) y) \leq q(x,y)d(x,y) + r(x,y)d(x,T^n(x)x) + s(x,y)d(y,T^n(x)y) + t(x,y)d(x,T^n(y)y) + m(x,y)d(y,T^n(x)x) \). **Lemma.** Let \( T : X \rightarrow X \) be a mapping satisfying condition \( (A) \). Then for each \( x \in X \), \( r(x) = \sup_{n \in \mathbb{N}} d(T^n(x), x) \) is finite. **Theorem.** Let \( T : X \rightarrow X \) be a mapping satisfying condition \( (A) \). Then \( T \) has a unique fixed point \( u \) and \( \lim_{n \rightarrow \infty} T^n(x_0) = u \) 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.)

**Applied Mathematics**

(65, 68, 70, 73, 76, 78, 80-83, 85, 86, 90, 92-94)

Vincent Buonomano, Instituto de Matematica, Universidade Estadual de Campinas, Campinas, Sao Paulo, Brazil. **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).

GANGARAM S. LADDE, State University of New York College at Potsdam, New York 13676. Systems of Differential Inequalities and Stochastic Differential Equations IV.

Consider the stochastic functional differential system

\[ x(t, \omega) = f(t, x(t, \omega), x_t(\omega), x_{t_0} = \Phi_0 \]  

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; \( \Phi_0 \in C([0, \infty), 0) \). By developing a very general comparison principle, sufficient conditions are given for stability and boundedness of solution processes of (1) in the framework of stochastic differential inequalities and Lyapunov-like functions as well as functionals. (Received May 16, 1977.)

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 multicompeting species, when there is no recombination. And for certain specific cases, analytic solutions of the model are exhibited. (Received June 2, 1977.)


Let \( X, g, h \) be locally convex Hausdorff topological vector spaces. An (abstract) input/output map \( E \) is a continuous linear map \( f: \mathbb{R}^n \rightarrow \mathbb{R} \) is an abstract realization of \( f \) 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 \( \epsilon \)-neighborhood \( U \) in \( X \), there exists a \( \delta \)-neighborhood \( V \) in \( \mathbb{R}^n \) such that \( f(V) \subset U \). This particular notion of observability, different from the naive one that \( h^{-1}(V) \subset U \), 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,
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 $f$ 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.)

Consider the following constraint set BMEP: 

$$A x + B x + C y = d; \quad x, y \geq 0; \quad x \text{ integer}; \quad z \text{ binary.}$$

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 $(F(S)(\bullet))_{S \subseteq \{1, \ldots, r\}}$ subadditive if the following two conditions hold, where $M(S)$ is the domain of $F(S)(\bullet)$:

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 $S_1 \cap S_2 = \emptyset$.
2. If $S \supseteq S_1 \cup S_2$ and $S_2 \cap S_2 = \emptyset$, then for all $v \in M(S_1)$ and $v \in M(S_2)$, we have $F(S)(v + u) \leq F(S_1)(v) + F(S_2)(u)$.

Put $J = \{1, \ldots, r\}$. Theorem: $\sum_{j=1}^{r} z_j + \sum_{k=1}^{r} b_k x_k + \sum_{p=1}^{r} c_p y_p \geq 0$ is a valid inequality for BMEP, if and only if there is a subadditive collection $(F(S)(\bullet))_{S \subseteq J}$ with:

- (a) $a(j) \in M(j)$, all $j$;
- (b) $b^k \in M(\emptyset)$, all $k$;
- (c) $F(\emptyset)(c) = \sigma_0$, all $c$;
- (d) $F(J)(d) \geq 0$.

Remark: $F(\emptyset)(\bullet)$ is an ordinary subadditive function.

If $\Omega$ 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 $\Omega$, then $S = (\Omega, f)$ is a society. If $A$ is the set of all possible decisions about the issues, then $F: \Omega \rightarrow A$ is a cultural choice function. If $N$ is the set of probability functions on $A$, then $\phi: (S, F) \rightarrow N$ 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.)

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 for the corresponding elastic and viscoelastic columns with and without end support have also been deduced. (Received June 20, 1977.)
...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.)

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, 17-22, No. 1, 1-10 (whose entire notation is adopted), except that now $S$, the rate of side information, satisfies $0 < S \leq H(Y)$, 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 $\psi$ such that $ED(X,\psi(U,Z)) \leq d$. It is proved that $1'(d) \leq \min \{I(X,Z) - I(U,Z)\}$, where the minimum is over all chance variables $Z$ and $U$ which satisfy the above conditions. (Received July 8, 1977.)

N. 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.)

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 $\delta$-sense. We show that a CABI, $\delta$-continuous channel can be simulated arbitrarily well in the $\delta$-sense by a memoryless channel followed by a sliding block code. The closure of the latter class in the $\delta$-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, $\delta$-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.)

GEORGE M. MULLER, Haimson Research Corporation, Palo Alto, CA 94303. A spline digital filter. Preliminary report. A digital filter implements the linear transformation $h^*$ implied when a fixed complex sequence, the impulse response $h = \{h_v\}$, is convolved with an input sequence $x$ to yield an output sequence $h^*x$. Digital algorithms are conveniently derived from the transfer function $H(z) = \sum_{n=-\infty}^{\infty} h_n z^{-n}$. With $\tilde{h}(z) = \sum_{n=0}^{\infty} h_n (1 - z)^{-1}$ (cf. SIAM J. on Math. Analysis, 6(1975), 948-959), we define a four-parameter,
very general, spline digital filter by \( H(z) = R^{2m+k,2m-1} z^{-1} / (q^{2m+1} z^{-N} + (-1)^{N} z^{1}) \). For integers, \( m > 0, N > 0, 0 \leq l \leq 2m - 1, c \geq 0 \); the corresponding frequency response \( H(e^{2\pi i f}) \), \( f \) in units of the sampling frequency, is easily estimated since \( q^{2m-1} e^{-2\pi i f} = (2\pi)^n \). If \( \Delta = 1 \), then \( H(z) = ((1) z^{-1} + \ldots + (1) z^{-N}) \); here \( z^{2m-1} \) is Schoenberg's cardinal spline interpolant of degree \( 2m - 1 \) to \( x \) if \( c = 0 \), or the cardinal version of the smoothing spline of Anseline and Laurent (with uniform data weight \( e^{-1} \)) if \( c > 0 \). \( N > 1, c = 0 \), corresponds to low-pass filtering by averaging spline interpolation (SIAM Rev., 1976, 189); this filter approaches the ideal low-pass \( t \)-th differentiator with passband \((-\infty, \infty)\) as \( m \to \infty \), and has a simple, very stable, implementation. (Received August 1, 1977.)

Eduardo D. Sontag, Dept. of Math., Rutgers University, New Brunswick, NJ 08903.

Consider a continuous-time system \( \Sigma \) with state set \( X \subset \mathbb{R}^n \), input-value set \( U \subset \mathbb{R}^m \), output-value set \( Y \subset \mathbb{R}^p \), and equations (**) \( x(t) = f(x(t), u(t)) \), \( y(t) = h(x(t)) \), where \( f \) and \( h \) are polynomial in \( x \) and \( u \) are analytic in \( u \). Solutions of (**) are assumed to exist on \([0, T] \) for all "admissible inputs": piecewise continuous \( u(\cdot) \subset [0, T] \) - \( U \), 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 \( u(t) \) is \( y(t, x, u) \). DEFINITION. Let \( S \subset U \), and \( x, x' \in X \). Then \( u \) distinguishes \( [0, T] \) 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 \( y^k(0, x, u) \neq y^k(0, x', u) \) some \( 0 \leq k \leq \mathcal{S} \), resp. some \( 0 \leq j \leq \mathcal{S} \)). The system \( \Sigma \) is observable \( [k(j)-obs.; jet-obs.] \) iff for each pair \( x, x' \), there is some \( u \) distinguishing \( [k(j)-distinguishing;jet-obs.] \) between \( x \) and \( x' \).

THEOREM. \( \Sigma \) is observable \( [k(j)-obs.; jet-obs.] \) iff \( k(j)-dist. \) any pair of states, and the \( u \) are polynomial in \( t \).

The proof is analogous to the discrete case in S. Sontag and Y. Roux, J. Nonlinear Analysis, MCA, 1976, 1:5-12. 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: As above, observability iff there exist a 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.)

Reuben Hersch, 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 \( |r(z)| \leq 1 \) for \( \Re z \leq 0 \), then
\[ r^n(\frac{tA}{n}) = 0 \text{ for } n \geq 0 \text{ and } z = 0 \text{ is } \mathcal{O}(n^{-1}). \] By a theorem of Strang, it follows that if \( |r(z)| - e^z = 0, z | \leq 0 \), then \( r^n(\frac{tA}{n}) - e^{tA} = \mathcal{O}(n^{-1}) \) 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 Padé approximant to \( e^z \) if \( -2 \leq k - j \leq 0 \) and \( k + j = m \). 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.)

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
\[ u_t = a_1 u + u(a - bu - cv), \] \[ v_t = a_2 v + v(pu - qv - r) \] where \( a_1, a_2, a, b, c, p, q, r \) are all positive constants. By means of maximal principle and an appropriate choice of 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.)
Indulis Strazdītis, Riga Polytechnic Institute, Riga, Latvian S.S.R. Complexity of the affipe prototype classes of five-variable boolean functions.

In the author's previous paper (Avtomat. i Vyčisl. Tekhn., no. 1 (1975), pp. 1-5; 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 $LP(a)$ 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 $x_1 x_2 x_3 x_4 x_5 + x_1 x_2 x_3 + x_1 x_2 x_4 + x_1 x_3 x_5 + x_1 x_4 + x_2 x_5$. (Received August 18, 1977.)

**Geometry (50, 52, 53)**


The results announced in Abstract 76T-D20 (Notices, Oct. '76) can be extended as follows. Let $\mathbb{E}^n_s$ denote $\mathbb{E}^n$ together with the metric $-\langle dx^1 \rangle^2 - \cdots - \langle dx^n \rangle^2 + \langle dx^{n+1} \rangle^2 + \cdots + \langle dx^{2n} \rangle^2$. The isometric immersions $\mathbb{E}^n_s \to \mathbb{E}^{n+1}_s$ may be classified as follows.

(i) $id \times c : \mathbb{E}^{n-1}_s \times \mathbb{E}^1_s + \mathbb{E}^{n-1}_s \times \mathbb{E}^2_s$, where $c$ is a "unit-speed" clock curve;

(ii) $id \times c : \mathbb{E}^{n-1}_s \times \mathbb{E}^1_s + \mathbb{E}^{n-1}_s \times \mathbb{E}^2_s$, where $c$ is a unit-speed plane curve;

(iii) $id \times g : \mathbb{E}^{n-2}_s \times \mathbb{E}^2_s + \mathbb{E}^{n-2}_s \times \mathbb{E}^3_s$, where $g$ is a $n$-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 $\mathbb{E}^n_s \to \mathbb{E}^{n+1}_s$. (Received June 17, 1977.)

ROBERT CONNELLY, Syracuse University, Syracuse, New York 13210. A counterexample to the rigidity conjecture for polyhedra. Preliminary report.

A counterexample to the rigidity conjecture for polyhedra. First 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 one of Bricard's flexible octahedra that lies in one 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.)
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.)

In a given 3-dimensional positive definite Riemannian space, we study the shape of a body whose volume $V = \frac{4}{3} \pi a^3$ 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

$$S = 4\pi a^2 \left[ 1 + a^2 P/30 + O(a^3) \right],$$

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.)

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 $A$.

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.

The sets (a), (b), (c) and (d) above, are the only open strictly $c$-convex sets. (Received August 1, 1977.)

Let $K$ be a skew field, $K^2$ be the 3-dim. rt. vector space over $K$, $\pi = K^2/K$ be the projective plane over $K$. We find geometric properties of $\pi$ 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. $K$ contains square roots of all elements of center $K$.

We find geometric properties of $\pi$ equivalent to center $K$ containing primitive $n$th roots of 1 for certain $n$. All this is done by means of 6-figures. Definition. A 6-figure $\alpha$ is 6 distinct points $A, B, C, A', B', C'$ in $\pi$ where $ABC$ is a triangle, $A' \in BC$, $B' \in CA$, $C' \in AB$. We say that $\alpha$ is menelaen if $A', B', C'$ are collinear, $\alpha$ is cevian if $AA', BB', CC'$ are concurrent. Sample theorems for $\alpha$. (1) Some proj. coll. of $\pi$ maps $A, B, C, A', B', C'$ to $A, B, C, A', B', C'$ resp.; (2) $\alpha$ is either menelaen or cevian iff (i) any proj. coll. of $\pi$ fixing any 5 pts. among $A, B, C, A', B', C'$ must fix all 6, and (ii) some proj. coll. of $\pi$ maps $A, B, C, A', B', C'$ to $A, B, C, A', B', C'$ resp. For a cross ratio $(AB:CD)$ we construct the point $J$, by drawing just 7 lines, such that $(AB:CD) = (AB:CD)$.

(Received August 18, 1977.)
Logic and Foundations (02, 04)

MT-556  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 relation. Let Δ be coded by integers. For δ ∈ Δ, let δ = Godel number of δ. Let ℒ(X) = the inclusion lattice ℒ(Δ). For x ∈ ℒ(X), define int x = {δ ∈ Δ | δ ⊆ x}, ext x = {δ ∈ Δ | δ ∩ x = ∅}, and x = int x ∪ ext x, where x ∈ ℒ(X) is complemented in ℒ(X) if 3x ∈ ℒ(X) [x ∩ x' = ∅ ∧ x ∪ x' is dense in X]. The theory of ℒ(X) is nonreducible to the theory of r.e. sets of integers. We prove Theorem. There exists x ∈ ℒ(X) such that int x is recursive but is not complemented in ℒ(X). Other priority arguments yield: Theorem. (a) 3x ∈ ℒ(X) [int x, ext x and bor x are r.e., but bor x is not r.e.]. (b) 3x ∈ ℒ(X) [int x and ext x are r.e., but bor x is not r.e.]. Finally, in contrast to classical results, we have Theorem. There exists a r.e. disjoint subset of Δ, such that neither any set dense in I nor any set which is dense can be extended to an r.e., disjoint subset of Δ whose union is dense in X. (Received June 15, 1977.)


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. Terms of graph theory are used, they are as in that theory.

A chain (x1, ..., xₙ) is a subgraph of (F, R, P) such that (xᵢ, xᵢ₊₁) ∈ R, i = 1, ..., n - 1. (F, R, P) ∈ T₅ iff R is not contractible to K₅, i.e., totally triangulated and R contains no K₄ subgraph. x₂ ∈ F \ P iff there is a chain (x₁, x₂, x₃) and a contraction not involving x₁, x₂, or x₃ which gives elements c₁ and c₂ and such that (c₁, c₂) ∈ R₁, i = 1, 2, 3, and R₁ denotes the set of relations obtained after contraction.

We prove a number of foundation results in the theory including:

1. (F, P) is contractible to a K₅ graph. (2) (P, R, P) is 3-colorable. (3) Given any (a, b) ⊆ 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 K. Kang Kim.)

MT-558  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 ℵ₁ which is not metrizable. Th. 2: Club does not imply CH (Club is: there are Sₐ ⊆ a unbounded in a, for limit α < ω₁ such that for any unbounded S ⊆ ω₁ for some α Sₐ ⊆ S.)

Th. 3: (V = L) There is a Banach space with a basis of cardinality ℵ₁, 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 = ℵ₀, of cardinality ℵ₀, e.g., with no ℵ₁ commuting elements. Th. 5: Diamond (λ⁺) holds for any λ > ℵ₀, provided G.C.H. holds. (Received June 20, 1977.)


For a countable language L, let L(aa) or "stationary logic" be logic with the quantifier aas, where aas φ(s) means "φ(s) holds on a closed unbounded collection of
countable sets s." For a formula \( \varphi(x) \) of L(aa), let \( \varphi'(x) \) represent the formula resulting when each occurrence of aa in \( \varphi \) is replaced by \( taas^s \), and call a structure \( \mathcal{M} \) determinate if for each formula \( \varphi(x) \), \( \forall x \varphi(x) \leftrightarrow \varphi'(x) \). Then there are necessary and sufficient back-and-forth criteria (similar to the one for elementary equivalence) for each of the following: \( \mathcal{M} \) and \( \mathcal{N} \) satisfy the same sentences of L(aa); \( \mathcal{M} \) is determinate; and \( \mathcal{M} \) and \( \mathcal{N} \) are determinate and satisfy the same sentences of L(aa). Using the third of these, the following can be shown. Suppose that \( \{\mathcal{M}_1: i \in I\} \) and \( \{\mathcal{N}_1: i \in I\} \) are families of determinate structures, and that for each \( i \in I \), \( \mathcal{M}_i \) and \( \mathcal{N}_i \) satisfy the same sentences of L(aa). Then the disjoint unions \( \bigcup\{\mathcal{M}_1: i \in I\} \) and \( \bigcup\{\mathcal{N}_1: i \in I\} \) 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.)


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 \( \{v_1\}^\ast \) modulo a subgroup \( S \). \( G \) is recursively presented (rp) if \( S^\ast \) is a recursive subset of \( \{v_1\}^\ast \). An isomorphism \( \varphi \) 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 \( \tau \), there are two \( \tau \)-countable reduced p-groups \( G \) and \( H \) with Ulm type \( \tau \), and isomorphic Ulm factors \( \beta \) and \( \alpha \), \( \forall \beta \tau \), such that \( G \) and \( H \) are not recursively isomorphic.

Theorem 2: (1) Pr"fer's first theorem is effectively true, i.e., a bounded countable rp group is an r.e. direct sum of cyclic p-groups.

(11) Pr"fer'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.)

**771-B51** 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 \( M \triangleleft N \) and there are no Skolem expansions \( M', N' \) of \( M, N \) such that \( M' \triangleleft N' \). (Received June 27, 1977.)


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.)
If \( R \) is a commutative ring and \( A \) is an \( R \)-module, then \( A \) is elementarily equivalent to
\[
\bigoplus_{M_i \text{ maximal ideal for each } i \in I} \frac{A}{M_i}
\]
where \( M_i \) ranges over the maximal ideals of \( R \), and \( A_{M_i} \) is the localization of \( A \) at \( M_i \).

\textbf{Definition.} A language is a triple \( \mathbb{Z} = (S, T, R) \) where \( S \) is a recursive set of sentences of \( \mathbb{Z} \), \( T \subseteq S \) is a set of valid sentences of \( \mathbb{Z} \), and \( R \subseteq S \) is a set of refutable sentences of \( \mathbb{Z} \).

\textbf{Theorem.} If \( \mathbb{Z} \) is consistent and complete, \( \mathbb{Z} \) is complete iff \( \mathbb{Z} \) is complete.

\textbf{Corollary.} \( \mathbb{Z} \) is complete iff \( \mathbb{Z} \) is complete.

\textbf{Theorem.} If \( \mathbb{Z} \) is recursively enumerable, \( \mathbb{Z} \) is recursively enumerable.

\textbf{Corollary.} \( \mathbb{Z} \) is recursively enumerable.

\textbf{Theorem.} \( \mathbb{Z} \) is recursively enumerable iff \( \mathbb{Z} \) is recursively enumerable.

\textbf{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.

\textbf{Definition.} A language is a triple \( \mathbb{Z} = (S, T, R) \) where \( S \) is a recursive set of sentences of \( \mathbb{Z} \), \( T \subseteq S \) is a set of valid sentences of \( \mathbb{Z} \), and \( R \subseteq S \) is a set of refutable sentences of \( \mathbb{Z} \).

\textbf{Theorem.} If \( \mathbb{Z} \) is consistent and complete, \( \mathbb{Z} \) is complete iff \( \mathbb{Z} \) is complete.

\textbf{Corollary.} \( \mathbb{Z} \) is complete iff \( \mathbb{Z} \) is complete.

\textbf{Theorem.} If \( \mathbb{Z} \) is recursively enumerable, \( \mathbb{Z} \) is recursively enumerable.

\textbf{Corollary.} \( \mathbb{Z} \) is recursively enumerable.

\textbf{Theorem.} \( \mathbb{Z} \) is recursively enumerable iff \( \mathbb{Z} \) is recursively enumerable.

\textbf{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.

\textbf{Definition.} A language is a triple \( \mathbb{Z} = (S, T, R) \) where \( S \) is a recursive set of sentences of \( \mathbb{Z} \), \( T \subseteq S \) is a set of valid sentences of \( \mathbb{Z} \), and \( R \subseteq S \) is a set of refutable sentences of \( \mathbb{Z} \).

\textbf{Theorem.} If \( \mathbb{Z} \) is consistent and complete, \( \mathbb{Z} \) is complete iff \( \mathbb{Z} \) is complete.

\textbf{Corollary.} \( \mathbb{Z} \) is complete iff \( \mathbb{Z} \) is complete.

\textbf{Theorem.} If \( \mathbb{Z} \) is recursively enumerable, \( \mathbb{Z} \) is recursively enumerable.

\textbf{Corollary.} \( \mathbb{Z} \) is recursively enumerable.

\textbf{Theorem.} \( \mathbb{Z} \) is recursively enumerable iff \( \mathbb{Z} \) is recursively enumerable.

\textbf{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.

\textbf{Definition.} A language is a triple \( \mathbb{Z} = (S, T, R) \) where \( S \) is a recursive set of sentences of \( \mathbb{Z} \), \( T \subseteq S \) is a set of valid sentences of \( \mathbb{Z} \), and \( R \subseteq S \) is a set of refutable sentences of \( \mathbb{Z} \).

\textbf{Theorem.} If \( \mathbb{Z} \) is consistent and complete, \( \mathbb{Z} \) is complete iff \( \mathbb{Z} \) is complete.

\textbf{Corollary.} \( \mathbb{Z} \) is complete iff \( \mathbb{Z} \) is complete.

\textbf{Theorem.} If \( \mathbb{Z} \) is recursively enumerable, \( \mathbb{Z} \) is recursively enumerable.

\textbf{Corollary.} \( \mathbb{Z} \) is recursively enumerable.

\textbf{Theorem.} \( \mathbb{Z} \) is recursively enumerable iff \( \mathbb{Z} \) is recursively enumerable.

\textbf{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.
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 $N^* \rightarrow N^*$ (see these Notices 23(1976), A-596), also $T_L$ and $T_P$ have the same property. (Received July 19, 1977.)


The following are extensions of previously announced results (these Notices 742-02-6). Let $\sigma, \psi$ be a sentence over $+$ and a p-ary relation symbol, $n=\{0, \ldots, n-1\}$, $Z=\{\ldots, -1, 0, 1, \ldots\}$. Taking the standard product measure $\mu$ on $\mathbb{Q}_Z$, $(\sigma, \psi)$ has measure $u^2/v^2$ for some nonnegative integers $u$ and $v$.

There is a positive integer $a$ determined by $\sigma$ such that for any $b, c$, $\lim_{n \to \infty} |\{q \in \mathbb{Q}_Z : (an+b)c \in \sigma \psi\}| = u^2/v^2$ for some nonnegative integers $u$ and $v$. (Received July 22, 1977.)

77T-B58  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 $B_R = [B_R(p, q)]_{(k, n)}$, in which $B_R(p, q) = 1$ if and only if $R(a_{1p}, a_{2q}, \ldots, a_{kn})$ where $p = \sum_{r=1}^{k} p_r + (t_{2r-1} + 1)z_{n-1}$, $q = \sum_{r=1}^{k} q_r + (t_{2r-1} + 1)z_{n}$. 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 $\psi$ from the collection of relations $R$ of order $2n$ on $D$ to a binary relation on the domain $\{c_1, c_2, \ldots, c_{kn}\}$ such that $R(a_{1p}, a_{2q}, \ldots, a_{kn}) \in \psi(R)(c_p, c_q)$. Furthermore $\psi$ 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), 75-89) are rewritten for relations of even order, then the analogues of the 32 theorems given by Tarski hold for such relations. Let $\mathcal{R}$ denote relative product. Theorem: If $R$ belongs to the monoid $(\mathcal{S}, \mathcal{R})$ of relations of order $2n$ on $D$, then $R$ belongs to the maximal subgroup of $\mathcal{S}$ if and only if (i) $R \mathcal{R} R = \mathcal{I}$, (ii) each row and column of $B_R$ contains exactly one 1. (Received July 18, 1977.)

77T-B59  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 $(A, A \rightarrow B / B)$ and $\alpha$-necessitation $(A / [\alpha]A)$, for each $\alpha \in P$, and containing, for all formulas $A, B$ and all $\alpha, \beta \in P$, the following formulas:


Then $K^P$ is complete with respect to the class of frames $(U, R)$ 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) $R_\alpha + R_\beta = R_\alpha \cup R_\beta$, (ii) $R_\alpha \cdot R_\beta = R_\alpha R_\beta$, 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).


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...
A recursively presented Boolean algebra 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.)

**Gerhard P. Kohlmayr**, Mathmodel Consulting Bureau, Glastonbury, CT 06033. **Pragmatic set theory and the Boolean prime ideal theorem.**

For terminology, see Abstract 747-02-6, these ECONLO, 24 (1977) p. A-447. A sketch of pragmatic set theory. Axiom 0. We have a predicate constant $e$ (denoting membership) and two distinct kinds of objects: urelements $x, y, z, \ldots$ and sets $X, Y, \ldots$; 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. Here in 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 $e$ behind a theorem to indicate that the axioms of pragmatic set theory are assumed to be a consistent set of sentences. Theorem (A-T). Let $I^0(\omega)$ be the Boolean algebra of subsets of the set of nonempty neighborhoods $\omega$. Then $I^0(\omega)$ contains nontrivial proper ideals which are not contained in a maximal ideal. The set $\mathcal{T}$ of all nontrivial proper ideals in $I^0(\omega)$ constitutes a well-ordered additive monoid which is both order-isomorphic and lattice-isomorphic to $\omega$. (Received August 16, 1977.)

---

**Statistics and Probability (60, 62)**

**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.)


Let $f : x = L_{C}(R^{n}, R)$, with $\|f\|_{2} = 1$, be an input pattern. Consider the probability density $P(f): R^{n} \rightarrow R$ 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.)

A-553
Let \( T \) be a positive linear contraction on \( L_1(X, \mathcal{A}, \mu) \), with the Hopf decomposition \( X = C + D \). We consider a sequence of \( L_1 \) functions with partial sums \( s_n \), called \textit{superadditive} if
\[
s_{k+n} \geq s_k + T^{k}_{s_n} \text{ for all } k,n \geq 0, \quad \text{and} \quad \gamma = \sup_n \frac{1}{n} \sum_{k=0}^{n-1} s_k < \infty. \]
It follows that \( s_n \) is an \textit{exact dominant} if
\[
\sum_{k=0}^{n-1} s_k \geq \sum_{k=0}^{n-1} T^{k}_{s_n} \text{ for each } n \geq 1. \]
If \( X = C \), then
\[
s_n/T^{n}_{s_n} \text{ converges to } 1 \text{ on the set } \{ \sum_{k=0}^{n-1} T^{k}_{s_n} > 0 \}. \]

The following is a generalization of the Chacon-Ornstein theorem, case \( T \neq 0 \) of Chacon's ratio theorem, and of Kingman's ergodic theorem: Let \( E = \{ s_n > 0 \} \). \( \lim s_n/s_n' \) 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 \textit{Markovian}, i.e., it preserves the integral; b) on \( D \cap E \) \( s_n \) is of the form \( \sum_{k=0}^{n-1} T^{k}_{s_k} \), for some \( b \) in \( L_1^+ \). The proof uses that if \( T \) is Markovian, then there is at least one exact dominant. (Received June 27, 1977.)

**Product measures and random integers.** Preliminary report. Let \((I, \mu)\) denote a probability space. Assume that \( I \) is infinite of cardinality \( k \) and that \( I \) is homogeneous (i.e., for any \( x, y \in I \) there is a measure automorphism \( A : I \to I \) with \( A(x) = y \)).

**Theorem.** Let \( S = \{B \subseteq I \} \) consist of all sets of the form \( \alpha \cap B \) for an arbitrary \( \alpha \subseteq B \) with card \( (B_1) > k \) and for an arbitrary function \( r : B_1 \to I \) we have \( F_0 = I - \{ r(a) \} \) for \( a \in B_1 \), and \( F_0 = I \) for \( a \in B - B_1 \). There is a measure \( \nu \) on \( B \) which extends the usual product measure* and satisfies \( \nu(S) = 0 \) for all \( S \in \mathcal{J} \). //

**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 \( Z *. \) cf. Halmos, \textit{Measure Theory}, Van Nostrand, 1950, p. 158. (Received July 22, 1977.)

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.)


**Theorem 1:** An adapted sequence \( (X_n) \) is an amart if and only if \( X_n = Y_n + Z_n \) where \( (Y_n) \) is

\[ A-554 \]
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 $\operatorname{ess sup}_{\mathcal{F}} E[X_n/\mathcal{F}_n]$, where ess sup is over all bounded stopping times $\mathcal{F}_n \geq \mathcal{F}_n$, 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.

**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 $E$.

Any 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)**

**Theorem:** A continuous $f$ of a compact Hausdorff space $X$ onto a Hausdorff space $Y$ is said to be confluent if 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 (Eech cohomology with integer coefficients).

We extend Lelek's Theorem to the non-metric setting. This answers a question of A.A. Pasynkov. The theorem of Mazurkiewicz on the existence of indecomposable continua in metric continua of dimension $\geq 2$ 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.)

**Small compact spaces.**

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** $2^\omega \neq 2^{\aleph_1}$. If $X$ is a dense-in-itself compact Hausdorff space of cardinal $2^\omega$, then $X$ is a compactification of the space of rationals if and only if $X$ is dense-separable. Corollary 2.

**Assume** $2^\omega < 2^{\aleph_1}$. Then every dense-in-itself compact Hausdorff space of cardinal $2^\omega$ contains a dense-in-itself dense-separable compact subset. Theorem. Suppose $X$ is a compact Hausdorff space. Let $\gamma = \sup \{\gamma : \text{There is a dense subset of } X \text{ with density } \gamma\}$. Then if $\operatorname{card}(X) < 2^{\aleph_1}$, then $X$ has a $\gamma$-base of cardinal at most $\gamma$. (Received June 6, 1977.)

**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 BANKSTCL, 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 \((k, \omega)\)-distributive if whenever \( I \) is any set and \((a_i, i \in I \text{ or } k < k, i \in I) \) is a \( k \times I \)-sequence from \( B \) then the identity
\[
\bigwedge_{i<k} \bigwedge_{i \in I} a_i = \bigwedge_{i<k} \bigwedge_{i \in I} a_i, i
\]
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 \((k, \omega)\)-distributive. (Received June 6, 1977.)

77T-G103 Jack Porter and Prem Sharma, University of Kansas, Lawrence, Kansas 66044. Invariance of Continuity. Preliminary report.

Let \( \Sigma \) be a class of spaces. For a topology \( \tau \) on a space \( X \), let \( \Sigma(\tau) \) denote the initial topology on \( X \) induced by the class of continuous functions from \( (X, \tau) \) into the spaces of \( \Sigma \). Let \( \Sigma(\tau) = [\sigma: \sigma \text{ topology on } X \text{ and } \sigma_\Sigma = \tau]. \) Two topologies \( \tau \) and \( \sigma \) are said to be \( \Sigma \)-equivalent if \( \Sigma(\tau) = \Sigma(\sigma). \) Maximal (resp. minimal) elements in \( \Sigma(\tau) \) are called \( \Sigma \)-maximal (resp. \( \Sigma \)-minimal). If \( \Sigma \) is the class of Tychonoff (resp. regular \( T_1 \)) spaces, then \( \Sigma \) is replaced by \( \mathbb{R} \) (resp. \( \operatorname{Reg} \)). 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.

A-556
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.)


Let $G$ be a connected simply connected nilpotent Lie group. If $\{W_i\}$ is a sequence in $G$, the limits of $\{W_i\}$ are characterized in terms of limits of certain sequences of subgroup-representation pairs $\{(H_i, S_i)\}$ using the subgroup-representation pair topology of $G$. These results are used to give an independent proof of a conjecture of Milnor without referring to the free nilpotent Lie algebras used by Brown (Ann. Sci. École Norm. Sup., (4) 6 (1973), 407-411). (Received June 27, 1977.)


Suppose $k$ and $n$ are integers satisfying $1 \leq k < n$ and $n \geq 3$. Suppose $G$ is a $k$-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 $n$, $n \geq 3$, 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 $n$, $n \geq 3$, 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 $n+2$. (Received July 5, 1977.)


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 $\cap_{n \in \mathbb{N}} B_n A = \emptyset$ for all $A \subset X$, where $B_n A = \bigcup_{n \in \mathbb{N}} U_n(p) : p \in A$. If a non-negative real-valued function $\rho$ on $X \times X$ that is 0 only on the diagonal is 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 $C \subset X$, $\rho(x,C) = \inf \{\rho(x,y) : y \in C \times 0 \}$ if (and only if) $x \notin C$; ii) for all $r > 0$, $B_r(x) = \{y : \rho(y,x) < r\}$ is a neighborhood of $x$; is called an asymmetric space; then we have: 1. An asymmetric space is metrizable if its asymmetric $\rho$ has the following property. For any $r > 0$, there is some such $s > 0$ that the indexed family $\{B_s(x)\}_{x \in X}$ is cushioned in $\{B_r(x)\}_{x \in X}$. 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 $C_r S = \{y : \rho(y,S) \leq r\} = \bigcap_{r < s} B_s S$ is closed. (Received July 18, 1977.)
Let \( \mathfrak{I} \) be a \( \sigma \)-ideal on \( \omega_1 \). Let \( \mathbb{I}(\mathfrak{I}) = \{ f : f(a) = 1, a \in \mathfrak{I} \} \). Give \( \mathbb{I}(\mathfrak{I}) \) the subspace topology inherited from the product. \textbf{Theorem.} \( \mathbb{I}(\mathfrak{I}) \) is normal iff \( \mathfrak{I} \) is all subsets of \( \omega_1 \) or all countable subsets of \( \omega_1 \). \textbf{Theorem.} \( \mathbb{I}(\mathfrak{I}) \) has caliber \( \kappa \) iff each uncountable subset of \( \omega_1 \) includes an uncountable member of \( \mathfrak{I} \). 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 \( \mathbb{I}(\mathfrak{I}) \) is \( \kappa \)-Baire, i.e., whether the intersection of \( \mathfrak{I} \)-Baire subsets of \( \omega_1 \) is \( \mathfrak{I} \)-Baire, is studied in various models of set theory and partial results are obtained. For example, let \( \mathcal{A} \) be the assertion that there exist infinite subsets \( \{ A \} \subseteq \omega_1 \) such that each uncountable set includes some \( A \). \textbf{Theorem.} \( \mathcal{A} \) implies no \( \mathcal{V} \) is \( \mathfrak{I} \)-Baire.

\( \text{Received July 20, 1977.} \)

\( \text{Valery V. Miskin, Kemerovo State University, Kemerovo 650043, USSR. Closed maps of Moore spaces. Preliminary report.} \)

A \( T_1 \) space is called a \( \Theta \)-space if for every countable, discrete family of its points there exists a discrete family of their neighbourhoods. All maps below are continuous. \textbf{Theorem.} If \( f : X \to Y \) is a closed map of a developable \( \Theta \)-space \( X \) onto a Baire space \( Y \), then the set \( 0(f) \) of all points \( y \in Y \) at which \( f \) is open is a dense \( G_\delta \)-set in \( Y \). \textbf{Theorem.} If \( f : X \to Y \) is a closed map of a Moore \( \Theta \)-space \( X \) onto a Baire space \( Y \), then there exists a \( G_\delta \)-set \( 0_p \supseteq f^{-1}(0(f)) \) such that for every \( A \subseteq X \), the restriction \( f\big|_A \) is not open. \textbf{Theorem.} For every closed map \( f : X \to Y \) of a normal Moore \( \Theta \)-space \( X \) onto a Baire space \( Y \), there exists a maximal element in the family of all subsets \( A \subseteq X \) on which the restriction \( f\big|_A \) is both open and closed.

\( \text{Received July 22, 1977.} \)

\( \text{Vo Thanh Liem, Louisiana State University, Baton Rouge, LA 70803. A counterexample in } l_2 \text{-manifold theory. Preliminary report.} \)

In this note, we show that there is a space \( X \) such that \( X \times X \) is homeomorphic to \( l_2 \), but \( X \) itself is not homeomorphic to \( l_2 \). (Received July 25, 1977.)


Let \( X \) be a \( CW \) complex with finitely-related fundamental group. Then there is a homotopy equivalent complex \( K \) which has a normal tower of subcomplexes, i.e., a sequence of subcomplexes \( K_1 \subseteq K_2 \subseteq \cdots \) 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.)

\( \text{Dennis K. Burke, Miami University, Oxford, Ohio 45056. Pseudo-open mappings from topological sums. Preliminary report.} \)

In the following, assume that \( X_1 \) and \( X_2 \) are topological spaces on the same set \( X \) such that \( f : S \to X \) is pseudo-open. The free topological sum of \( X_1 \) and \( X_2 \) then the canonical quotient mapping
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 separable.

Example 3. There are completely regular spaces \( X_1, X_2 \), each with a \( \sigma \)-disjoint base such that \( X \) does not have a \( \sigma \)-disjoint base.

Example 4. (\( \mathbb{R} + \mathbb{CH} \)) 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'skii 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.)

**77-GL14** Eric K. van Douwen, Institute for Medicine and Mathematics, Ohio University, Athens, OH 45701. Subcontinua and nonhomogeneity of \( S^m - R^m \). Preliminary report.

\( \mathbb{R} \) is the half line \( \mathbb{R} = [0, \infty) \), \( \mathbb{R} \) is \( \mathbb{R} - \mathbb{N} \). 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 \( \mathbb{H} \) has no maximal chain of indecomposable subcontinua (then \( \mathbb{C} \) 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 \( C_x = \{ y \in S : \text{no cut point of } S \text{ separates } x \text{ from } y \} \). Then \( C_x \) is an indecomposable continuum, and \( C_x \) is a cut point of \( S \).

**Definition:** If \( S \) is irreducible between two points, the uniqueness degree of \( S \) is \( \omega(S) = \max \{ n \geq 2 : \text{there is } F \subset S \text{ with } |F| = n \text{ such that for all } a, b \in S, \text{if } S \text{ is irreducible between } a \text{ and } b \text{ then } |F \cap \{a, b\}| \geq n \} \).

**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 \( \omega(S) = n \), and some but not all nondegenerate proper indecomposable subcontinua have the property that every nonempty \( G \)-subset has nonempty interior. (Received August 2, 1977.)


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.)


**Theorem:** Let \( X = U \cup V \), \( U \cup V = W \) where \( U, V, W \) are path-connected.

Let \( n > 2 \), and assume \( i_1(U, W) = 0 \) for \( 1 \leq i \leq n - 1 \). Then the excision morphism \( i_1(U, W) + i_1(X, V) \) determines \( i_n(X, V) \) as the induced module \( i_n(U, W) \) where \( \lambda : i_1(W) + i_1(V) \) 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..."

A-559
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 H. 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

$$\begin{align*}
\frac{d}{dt} f(t,x) &= X(f(t,x)) \\
f(0,x) &= x
\end{align*}$$

for all $(t,x) \in \Omega(X)$ for all $x \in M$

[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.)


Let $Q^\infty = \operatorname{dir lim} Q^n$ where $Q$ denotes the Hilbert cube. Let $M,N$ denote paracompact, connected $Q^\infty$-manifolds. Let $V$ 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 $V$-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.)


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 $G_\delta$ set is sparse enough to be considered unlikely. Nevertheless, in finite dimensional spaces, even dense $G_\delta$'s may have measure zero. Since there is no 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.)


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

the class of regular spaces in which every point is a \( G_\delta \), property \( wD \) is hereditary

and \( k \)-fold productive, whereas property \( D \) is not hereditary and not finitely productive.

Neither every product of perfectly normal spaces has property \( wD \) is independent of the usual

rules of set theory. Every regular, submetrizable space has property \( wD \), but need not have

property \( D \) (e.g., the Niemytski 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 hierarchy of

properties concerning countable pseudocharacter. (Received August 22, 1977.)

81ST SUMMER MEETING
University of Washington
Seattle, Washington
August 15-18, 1977

F. S. Mulla, Kuwait University
P.O. Box 5969, Kuwait.
On \( 3 \)-Regular Graphs. Preliminary Report:

this is a continuation of an earlier paper (proceedings 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.)

I. FROY 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 \( L(A)L(B) = L(B)L(A) \);

ii) \( AB = BA \) if and only if \( L(A)L(B) = L(B)L(A) \), then there exist a nonsingular

matrix \( S \subset M_n(F) \), 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).
1. With one unit, there is one ring $Z$; 2. With two units only, there are seven sets $G_n (n=1,2,...)$ of "Gaussian" integers; 3. With three units only, there are seven sets $L_n$ of "lattice" integers and seven sets $H_n$ of "Hurwitz" integers ($H_n$ is generated by $(1,t)$, where $t$ is one of the units); $G_n \subset L_n \subset H_n$ where $m$ has values corresponding to $n$ as follows: $n=1$, $2,3$ if $m=1,2,3$ if $n=2$, $m=1,2$ 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 $n=7$. -- With eight units, there are one set $L$ of "lipschitz" integers, one set $H=(L,T)$ of "Hurwitz" integers ($(T)=1/2 ((1+i+j+k+e+f+g+h))$, seven sets $D_n=(L,S)$ of "bi-Hamiltonian" integers (where $T$ is determined by the triple $(l,i,j)$, thus $T=1/2 ((l+i+j))$ and seven sets $I_n=(L,Z)$ of "Cayleyan" integers (where $Z=1/2 ((1+i+j))$ and $Z_n=S((Z)$, the $S_n$ are the substitutions which change $(ijk)$ to $(ijk)$), $(ijk)$, $(ijk)$, $(ifehgh)$, $(ije)$, $(jef)$, $(fiehgh)$, $(ifeh)$, $(jef)$ and $(ifeh)$); $L \subset C \subset D_n$ where $m=1,2,3$ if $n=1$, $m=1,2$ if $n=2$, $m=1,2$ if $n=3,4,6$ if $m=4$, $m=1,2,3$ if $n=5$, $m=3,5,6$ if $m=6$ and $m=3,5,7$ if $n=7$. Moreover $L \subset C \subset D_n$. // There are not such structures with 3,5,6 or 7 units only. (Received June 8, 1977.)

RUSSELL MERRIS, California State University, Hayward, Hayward, California 94542.

Abstract. Let $G$ be a finite group. Let $\chi$ be an irreducible complex character of the subgroup $H$. Extend $\chi$ to a function $\chi_H$ of $G$ by defining $\chi_H(g) = 0$ for all $g \in G\setminus H$. Then $H$ is defined to be $\chi$-invariant in $G$ if $\chi_H(g^{-1}h) = \chi(h)$ for all $g \in G$ and $h \in H$. Numerous characterizations of "$\chi$-invariant" are discussed. (Received June 13, 1977.)

Algebra and Theory of Numbers (05, 06, 08, 10, 12–18, 20)

SŁAVKO PISK, Bowdoin College, Brunswick, Maine, 04011. Four Coloring: 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 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.)
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 $\phi_1$ and $\phi_2$, respectively. (*) $[n;l] = [K-l] + q[K]$ and (**), $[n;l] = q[K-l] + [n]$. We next show that given a subspace $X \subseteq V_n(q)$, dim $X = K$, that we inductively construct two such maps $\phi_1$ and $\phi_2$ via lattice theory. (Received July 26, 1977.)

**A.43 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.)

**A.44 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.)

**A.45 BENJAMIN PINE, Fairfield University, Fairfield, Connecticut 06430. Principal Congruence Subgroups of the Picard Group**

The Picard group $\Gamma$ is $\text{PSL}(2,\mathbb{Z}[i])$, the group of linear fractional transformations $z \mapsto az+b/z-c$, $a, b, c, d \text{ Gaussian integers. If } (\alpha) \text{ is an ideal in } \mathbb{Z}[i], \Gamma(\alpha)$ the principal congruence subgroup mod $\alpha$. It is well known that the principal congruence subgroups of the Modular group $\text{PSL}(2,\mathbb{Z})$ are free groups. Here we give related results for the Picard group. Theorem 1: If $(\alpha) \neq (1+i)$ then $\Gamma(\alpha)$ is an HNN group with finitely generated free part $\mathbb{Z}$ 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 two special cases, Theorem 2: $\Gamma(1+i)$ has index 6 and is a product of two groups with amalgamated subgroup $\Gamma(2)$ has index 12 and a similar decomposition. Function theoretic considerations lead to Conjecture: A Fuchsian subgroup of $\Gamma$ contained in a principal congruence subgroup is free. Along these lines we get Theorem 3: A finitely generated Fuchsian group $\Gamma$ 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 $\Gamma$, is free. Similar is Theorem 4: A normal Fuchsian subgroup of $\Gamma$ 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.)

**A.46 Gregory Wulczyn, Bucknell University, Lewisburg, Pennsylvania 17837. An application of combinatorials to the formation of like power identities in real quadratic fields.**

A preliminary report.

Type I real quadratic field identities of the form $F_{n+2}^{ht+2} - F_{n+2r(ht+1)}^{ht+2} - u_1(F_{n+2r(ht+1)}^{ht+2} + n+2r)$. (Received August 17, 1977.)
+ u_2((h+n+2r)(h-n-1) - p^{h+n+2r} - \cdots - u_2((h+n+2r(n+2r+1)) = \prod_{k=1}^{2t} F_k^{h+n+2r-1} a_1 a_2 \cdots a_{2t},

i = 0, 1, 2, \ldots, 2t. For each i value, the u_i'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 h is 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 n-subgroup P satisfying 1) |G(P)| = 2 and 2) If x \in P, then C_G(x) \leq P. Then G is isomorphic to one of the groups SL(3,4), Sz(2), or SL(2,5) with q = 5, 7, 9, 11, 13, 17, 19, 23, 25, 29, 31, 37, 47, 49, 53, 59, or 61. (Received August 26, 1977.)

+748-A8 AGNES M. CHAN, Northeastern University, Boston, Mass 02115. Embedding of a Pseudo-Point-Residual design into a Möbius plane.

Let \Omega be a class of subsets of a finite set \Sigma. Elements of \Omega are called blocks. Let v, t, \lambda, and k be nonnegative integers such that \lambda v = t k. A pair (X, \Omega) is called a \lambda, v, t, k, \Sigma-plane, denoted by \lambda, v, t, k, \Sigma-plane. (1) Every \lambda-subset of \Sigma is contained in exactly \lambda blocks. (2) Every block \lambda is in \Omega. \Omega is a Möbius plane if \Sigma is an \lambda, v, t, k, \Sigma-plane where \lambda is a positive integer. Let \omega be a fixed point in \Sigma. If \omega is deleted from \Sigma, together with all the blocks containing \omega, then we obtain a point-residual design \Sigma'. It can be easily checked that \Sigma' is an \lambda, v, t, k, \Sigma-plane. Any \Sigma' is called a pseudo-point-residual design of order \lambda, abbreviated by PPBD(\lambda). Let A and B be two blocks in a PPBD(\lambda) \Sigma'. A and B are said to be tangent to each other at \omega if and only if \omega A = \omega B. \Sigma' is said to have the Tangency Property if for any block A in \Sigma', and points \omega and \omega such that \omega A \omega and \omega B \omega, there exists at most one block containing \omega and tangent to \omega A at \omega. This paper proves that any PPBD(\lambda) \Sigma' uniquely embeddable into a Möbius plane if and only if \Sigma' satisfies the Tangency Property. (Received August 26, 1977.)

+748-A9 Roman IV. HONG, Syracuse University, Syracuse, New York 13210. Free ideal monoid rings.

A ring R is a left free ideal ring (left fir) if it has the invariant basis number and every left ideal is free. This also. Let R be a ring and \lambda \neq 1 be a monoid. Then the monoid ring \lambda R is a left and right fir if and only if \lambda is a division ring and \lambda is the free product of a free monoid and a free group. The "if" part of the theorem was first proved by P. I. Cohn. Other proofs are also given by J. Lewin, P. I. Cohn and W. Dicks, and G. A. Bergman. The "only if" part uses the theorem of Stallings and Swan on groups of cohomological dimension one. (Received August 26, 1977.)


Suppose \Omega is a group, \Sigma is a normal subgroup of \Omega, G = \Omega/\Sigma, and A is a G-module. The result is the determination of the transgressive elements of the second transgression \tau^2: H^2(\Omega, A) \rightarrow H^2(\Sigma, A) of the L-H-S spectral sequence. Definition: A G-crossed extension of A by \Sigma is an extension 0 \rightarrow A \rightarrow C \rightarrow \Sigma \rightarrow 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 \Sigma represents a transgression.
Given a semigroup $S$, a "fine quasi-resolution" $(C, \lambda, D)$ of $S$ consists of two sub-semigroups $C, D$ of $S$ and a homomorphism $\lambda$ of $C$ on a semigroup of automorphisms of $S$ 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) $c . d = c . d'$, 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 $(C, \lambda, D)$ of $S$ determines two mappings $\sim_1, \sim_1'$ of $C$ in the lattice of congruences of $D$ with suitable connections to $\lambda$. By specifying these properly we can also go back from $(C, D, \sim_1, \sim_1')$ to a semigroup $S$ with a quasi-resolution $(C, \lambda, D)$. 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)**

**N6-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.)

**N6-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.)

**N6-B3**


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.)
The q-gamma function is defined by \( \Gamma_q(x) = (q;q)_\infty (q^x;q)_\infty (1 - q)^{-x} \), 0 < q < 1, where \((a;q)_\infty = \prod_{n=0}^{\infty} (1 - aq^n)\). It satisfies the functional equation \( \Gamma_q(x + 1) = (1 - q)^x \Gamma_q(x) \) and reduces to \( \Gamma(x) \) when \( x = n + 1 \). Analogues of many of the classical facts about the gamma function are given, including the Bohr-Møllerup theorem, two forms of Stirling's asymptotic formula, the duplication formula and two extensions of \( \Gamma(x) \Gamma(1/2 - x) = \pi / \cos \pi x \). 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 \( \Gamma_q(x) \leq \Gamma_s(x) \), 0 < q < s < 1, or \( 2 < x < \infty \) and \( 0 < s < q < 1 \), \( 1 \leq x \leq 2 \) 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 \([n]_q \) summation. (Received August 5, 1977.)

Let B be a commutative Banach algebra and let \( \hat{B} \) be its maximal ideal space. A weak approximate identity for B is a net \( \{u_\alpha\} \) in B such that \( x(u_\alpha x) \to x \) for all \( x \in B \), \( x \in \hat{B} \). A norm approximate identity is a net \( \{u_\alpha\} \) such that \( \|u_\alpha x + x\| \) 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 \( \|x(a_\lambda)\|_1 \leq 1 \) for all \( x \in \hat{B} \).(Received August 25, 1977.)

For each \( n, 1 \leq n \leq N \), 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 semi-group under max multiplication. Then the multiplier algebra \( \mathcal{M}(L^1(a_n, b_n)) \) 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 \( L^1(\bigcap_{n=1}^N I_n) = \bigotimes_{n=1}^N L^1(a_n, b_n) \) of Lebesgue integrable functions on the product semi-group \( \bigcap_{n=1}^N I_n \) becomes a commutative convolution measure algebra under order convolution, and it is shown that \( \mathcal{M}(\bigotimes_{n=1}^N L^1(a_n, b_n)) = \bigotimes_{n=1}^N \mathcal{M}(L^1(a_n, b_n)) \). (Received August 25, 1977.)

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 \( a(T_1 b) = (T_2 a)b \), 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 \( \delta \) 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 \( \Delta \) on \( M(A) \). We also prove that every derivation \( \delta \) on a replete (resp., full) Hilbert algebra \( A \) is continuous by showing that each such \( \delta \) of the form \( \delta = T_1 - T_2 \), for some double multiplier \((T_1, T_2)\) of the fulfillment \( A_0 \) of \( A \). (Received August 25, 1971.)


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.)


Let \( S_0 \) be the Nielsen kernel of a Riemann surface \( \Sigma \) of finite type \((g,n,m)\), \( 6g - 6 + 2n + 3m > 0 \), \( m > 0 \). Let \( S_{-1} \) be the Nielsen kernel of \( \Sigma_k \), \( k = 0, -1, \ldots \) and \( S_{-\infty} = S_c \cap S_{-1} \cap S_{-2} \ldots \), the infinite Nielsen kernel. Let \( S_{k,1} \) be a boundary curve of \( S_k \). Let \( L_{k,1} \) be its length in the intrinsic metric on \( \Sigma_k \). Then \( \lim_{k \to -\infty} L_{k,1} = \infty \), \( i = 1, \ldots n \). For \( m \geq 2 \), let \( P_{k,1} \) be the length of the geodesic \( P_{k,1} \) around the \( i \)th handle created by forming the Schottky double of \( S_k \). Then \( \lim_{k \to -\infty} P_{k,1} = \infty \), \( i = 1, \ldots m-1 \). The boundary curves of \( S_{-\infty} \) are well defined. If \( m > 2 \), the limits of curves paired by \( P_{k,1} \) are tangent. (Received August 29, 1977.)

Applied Mathematics

(65, 68, 70, 73, 76, 78, 80–83, 85, 86, 90, 92–94)

WITHDRAWN


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.)

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)

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.)

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)x V(M)→F(M) or dually
as an F(M) - bilinear symmetric map g^d:F^1(M) x F^1(M)→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∈M and a form ω^F^1(M) such that ω(x)≠0 but g^d(ω,ω) = 0
for all ω∈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.)

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
polynomial agrees with that of f, g differs from f by smooth coordinate changes in source and tar-
get.
Definition: A map germ \( f \) is a fold germ, if after coordinate changes in source and target it is of the form \( x_1, \ldots, x_n, x_{n+1} \).

Theorem: Suppose \( f \) and \( g \) are finitely determined map germs from \( \mathbb{R}^n \) to \( \mathbb{R}^p \). 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.)


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)

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 \( \psi = (B, \leq) \), \( \phi \sqsubseteq \psi \) (\( \psi \) is a homomorphic image of \( \phi \)) 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 \( B_i \cap B_j \), then the order type of \( \{B_i : i \in I\} \) (as a subordering of \( \psi \)) is \( \phi \).

Theorem. The countable order types are better quasi-ordered by \( \sqsubseteq \).

Corollary. If \( \phi_1, \ldots, \phi_n \) is a sequence of countable order types, then there are integers \( i, j \) with \( i < j \) such that \( \phi_i \not\sqsubseteq \phi_j \).

Corollary. Let the language \( L \) have nonlogical symbols \( =, \leq \). Then for each countable order type \( \psi \) there is a sentence \( \psi^+ \) of \( L_{\omega,1}^\omega \) such that if \( \phi \) is any countable order type, \( \phi \) satisfies \( \psi^+ \) if and only if \( \phi \leq \psi \). (Received August 9, 1977.) (Author introduced by J. F. Shahan.)

Joseph G. Rosenstein, Rutgers University, New Brunswick, New Jersey 08904. Recursive linear orderings.

The order types of the rationals \( \mathbb{Q} \) and the integers are denoted \( \mathbb{Q} \) and \( \mathbb{Z} \). Theorem 1: There is a recursive subset \( A \) of \( \mathbb{Q} \) of order type \( \mathbb{Z} \cdot \mathbb{N} \) which has no RE subset of order type \( \mathbb{N} \). (Note that any such \( A \) must have a \( \Pi_2 \) subset of order type \( \mathbb{N} \).) Also, any recursive subset \( A \) of \( \mathbb{Q} \) of order type \( \mathbb{N} \cdot \mathbb{N} \) has an RE subset of order type \( \mathbb{N} \).) A subset \( A \) of \( \mathbb{Q} \) is recursively rigid if there is no non-trivial recursive order-automorphism of \( A \). No recursive subset of \( \mathbb{Q} \) of order type \( \mathbb{N} \) is recursively rigid. Theorem 2: There are recursive subsets of \( \mathbb{Q} \) of order type \( \mathbb{Z} \cdot \mathbb{N} \) and \( \mathbb{Z} \) which are recursively rigid. (Note that any recursive subset of \( \mathbb{Q} \) of order type \( \mathbb{Z} \cdot \mathbb{N} \) is recursively embeddable into itself.) Theorem 3 (with L. Hay): There are recursive subsets of \( \mathbb{Q} \) of order type \( \omega \) and \( \mathbb{Z} \) which are not recursively embeddable into themselves. Given a linear ordering \( \mathcal{A} \) and \( x \in \mathcal{A} \), \( \mathcal{A}(x) = \{ y | \text{there are finitely many elements of } \mathcal{A} \text{ between } x \text{ and } y \} \) and \( c_f[A] \) is the linear

A-569
ordering induced on \([c_F(x)|x \in A]\). An order type \(a\) is recursive if there is a recursive subset \(Q\) of order type \(a\). 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-B3

GERMANY P. KUHLMAN, Kastmodel Consulting Bureau, Glastonbury CT 06033.

A nonvoid partially ordered set without maximal elements.

For terminology, see Abstract W47-06-6, these Notices, 24 (1977) p. A-447.\[\text{THEOREM.}\]

Suppose there is an ordered field \(F\). Then there is a partially ordered set \(P\), which satisfies the following two conditions: 1) every chain in \(P\) has an upper bound. 2) \(P\) has no maximal element. Suppose \(F\) is an ordered field. \(P\) contains a trivial ordered differential field \(K\). Let \(\omega\) be the set of nonnegative integers in \(K\). Let \(\Omega\) be the set of all maps \(x: \omega \to \omega\) of the form \(x = \{x(n)\} = \{\Sigma_{j \in \omega} x_j n^j\}\), where \(x_{j}, j, k, n \in \omega\). Define total order in \(\Omega\) by \(x < y\) iff \(x(n) < y(n)\) \(\forall n \in \omega\). \(\max\{\Sigma_{j \in \omega} x_j, \Sigma_{j \in \omega} y_j\}\). \(\Omega\) is a well-ordered additive monoid which properly contains a copy of \(\omega\). Define multiplication in \(\Omega\) by \(xy = \{x(n)y(n)\} = \{\Sigma_{j \in \omega} x_j n^j y_j n^j\}\).

Construct, in the usual way, from \(\Omega\), an ordered field \(L\). \(L\) contains properly a copy \(\Omega\) of \(\omega\), the ordered field \(\omega\) is a partially ordered set, \(\omega\) is bounded by any element \(b \in \omega\) such that \(b > x \forall x \in \omega\). Therefore, all chains in \(\omega\) are bounded. Suppose, contrary to the theorem, that there is a maximal element \(m \in \omega\). Since \(\omega\) is a field, \(m^2 \in \omega\) and \(m^{-1} \in \omega\), but 1 is the identity element of \(\omega\). We can't have \(m \leq m\) as \(m^2 = 1\) is impossible. Thus \(\omega\) has no maximal element.

Remark. Upper bounds of chains in \(\omega\) were not required to be in \(\omega\). The sentence "Each nonvoid partially ordered set in which every chain has an upper bound has a maximal element" is false. (Received August 29, 1977.)

Topology (22, 54, 55, 57, 58)

*748-01* Tatadoshi 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) \(|f| \Delta_k \times N \cap \Delta_k \times M\) is locally trivial. Define \(e(N,M)\) 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 \(e(N,M) \to E(N,M||P)\) is a homotopy equivalence if \(n \neq 4\). (Received August 1, 1977.)

*748-02* 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 \(\mathbb{R}^2\). A classification theorem for open 2-manifolds and a procedure for modifying a 2-sphere to obtain any open 2-manifold has been

A-570

*Theorem:* Any connected open 2-manifold covers a compact 2-manifold. The compact 2-manifold can always be chosen to be the connected sum $T^2 \# R^2$ of a torus and a projective plane.

The proof of this theorem consists of cutting apart the universal cover $R^2$ and various compact covers of $T^2 \# R^2$. 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 $\sigma_j$ be the $j^{th}$ elementary symmetric function on the $s$ integer variables $n_1$, and write $G^d_r(n) = \sum_{k=d-r}^d \frac{(k)_n}{(k)(n)}$. For fixed $p$, $q$ with $0 \leq p \leq q \leq s$, 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 $\tau_p^q = \sum_{I \subset S} \sum_{J \subset I} \prod_{j \in J} n_j \prod_{k \in I-J} (n_k - 1)$. Extending our earlier results, we prove by elementary means that for $0 \leq r \leq d \leq s$,

$$
\sum_{j=d-r}^d (j_{d-r}) \sigma_j = \sum_{i=0}^{d-r} G^{d-1}_{d-r}(s-i) \tau_i^0 + \sum_{i=d-r+1}^d G^{d-1}_{d-r}(s-i) \tau_i^d = G^d_r(\sigma_1) - \sum_{j=d-r}^d (j_{d-r}) \sum_{k=1}^s \prod_{m_k}(n_k),
$$

where $\sum_\ast$ means the sum over all ordered $s$-partitions $(m_1, m_2, \ldots, m_s)$ 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 $(n_1, n_2, \ldots, n_s)$. (Received Aug 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.)

---

A-571
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).

A construction of certain Kac-Moody Lie algebras.

The Kac-Moody Lie algebra $\mathfrak{g}$ 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 $\mathfrak{g}$ 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.)

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).

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.)

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 attention to algebraic realization, quantization problem and general relativity. (Received August 30, 1977.)

Harry P. Allen. The Ohio State University, Columbus, Ohio 43210. The Octonions 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.)
HANS J. ZASSENHAUS, The Ohio State University, Columbus, Ohio 43210. On the subalgebras of the classical Lie algebras.

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 was made. (Received August 30, 1977.)

Analysis (26, 28, 30–35, 39–47, 49)


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.)

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 $TT^*-T^*T=\lambda\phi$. When is $\phi$ 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 $\phi$ 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 $\phi$ is not cyclic for $T$. Further examples illustrating the gap between the above results will be discussed. (Received June 17, 1977.)

AVNER FRIEDMAN, Northwestern University, Evanston, Illinois 60201. The free boundary of a quasi variational inequality.

Let $\lambda_1,\ldots,\lambda_n$ be $\nu$-vectors such that $\lambda_2-\lambda_1,\ldots,\lambda_n-\lambda_1$ are linearly independent. Then the elliptic operator

$$L\omega(p) = \frac{1}{\nu} \sum_{j=1}^{n-1} \omega(P_j \lambda_j - \Sigma \lambda_k P_k) \frac{\partial^2 \omega}{\partial p_j \partial p_k} + \Sigma q_{ij} P_j \frac{\partial^2 \omega}{\partial p_j} - \omega$$

is nondegenerate in the simplex $\Pi$: $p_1 > 0, \Sigma p_1 = 1$. Here $\alpha > 0, q_{ij} > 0$ if $i \neq j$, $q_{ij} = 0$. On the boundary of $\Pi$, $M$ is degenerate and no boundary conditions should be given. We study the free boundary of the quasi variational inequality

$$(w + \sum_{j=1}^{n-1} c_j P_j \geq 0, w(p) \leq K + \Sigma P_j (e_j), (w + \Sigma c_j P_j)(w-K-\Sigma P_j (e_j)) = 0)$$

in $\Pi$, where $c_{ij} \geq 0$, $K > 0$ and $e_j$ is the $j$-th vertex of $\Pi$. We find sufficient (and "almost necessary") conditions on $c_j, K, \alpha, w(e_j)$ 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 $y_i = \gamma_i(y_2,\ldots,y_{i-1},y_{i+1},\ldots,y_n)$ where $\gamma_i$ is analytic and strictly monotone decreasing in each variable. (Received July 1, 1977.)
Let ω be a nonnegative integrable function defined and having compact support in the complex plane. Denote by $H^2(ωdx)$ the closure of the polynomials in the $L^2(ωdx)$ norm. \textbf{Theorem.} If $ω \in L^{1+ε}(dx)$ for some $ε > 0$ then $H^2(ωdx)$ has a nontrivial closed subspace invariant under multiplication by $z$. (Received July 19, 1977.)

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.)

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 non-linear partial differential equations. (Received July 25, 1977.)

A general method is given for constructing cyclic vectors for operators which have a certain triangular operator matrix representation. The construction provides cyclic vectors for many operators $T$ such that $T^*$ is subnormal. \textbf{Theorem.} There are functions $f \in H^2$ so that if $φ \in H^2$, $φ$ constant, then $f$ is cyclic for the co-analytic Toeplitz operator $T_φ$.

\textbf{Theorem.} If $S$ is in the weakly closed algebra generated by a pure quasinormal operator, the $S^*$ is cyclic.

\textbf{Theorem.} If $S$ is a bundle shift, then $S^*$ is cyclic. (Received July 16, 1977.)

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-
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.)

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 \(\Gamma\) of total curvature at most \(6\pi\) 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 \(\Gamma\) is known a priori not to be the boundary of any branched minimal surface. (Received July 27, 1977.)

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.)

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 \( u_n \). (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 \( B(r) = \max u(re^{i\theta}) \). 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 \( \psi \) is a given increasing function? Results: i) if \( \psi(r) = \log r \), the set \( E \) is thin at \( \infty \). ii) if \( \psi(r) = (\log r)^2 \), a generalized Wiener condition holds for \( E \). iii) if \( \psi(r) = (\log r)^a, 0 < a < 2 \), the situation is different. There may exist annuli \( \omega_n = \{ z : z = n < 2n+1 \} \) 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 of 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 \( \frac{1}{2\pi} \int |F(e^{i\theta})| d\theta \geq \frac{1}{2\pi} \int |g(e^{i\theta})| d\theta \). (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...
the extra property
\[ P_0 - v_y \geq 0 \quad \text{(a.e.)} \quad (v-\text{inner normal}) \]
along the overflow (where it belongs to \( P(\mathbb{R}) \) 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.)

---

**S0-056** JAMES A. DEDEENS, 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
\[
\sum_{i,j=0}^{n} B_i^*A_iA_jB_j \geq 0 \quad \text{for all } n \quad \text{and all } B_0, \ldots, B_n \in C^*(A).
\]
This makes clear the fact that if \( \pi \) is a \( * \)-representation of \( C^*(A) \) and \( A \) is subnormal, then \( \pi(A) \) is also subnormal. Similarly it is shown that \( \sigma_A(\pi(A)) \subseteq \sigma_A(A) \) where \( \sigma_A(S) \) 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 \( A \) hyponormal for all polynomials \( p \) implies \( A \) is subnormal. (Received August 19, 1977.)

---

**S0-057** 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 Phragmen-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.)

---


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 polar spectral measure \( \mu \). Let \( S(N) \) denote the collection of all subnormal operators that have \( N \) at their core. 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 \( \varphi \) is a weak-star generator of the Hardy space \( H^\infty \) and \( U \) is a unitary. We conclude by constructing a non-irreducible subnormal operator whose commutant is abelian but the commutant does not lift to its core. (Received August 22, 1977.)
Let $R$ be a bounded domain in the complex plane whose boundary consists of $n+1$ non-intersecting analytic Jordan curves, let $\nu$ be an analytic covering map from the unit disk onto $R$, and let $T_\nu$ be the analytic Toeplitz operator on $H^2$ with symbol $\nu$. If $n=1$, then $T_\nu$ is unitarily equivalent to a direct integral $\int \Theta_{\nu} \, d\mu(\lambda)$ where $\mu$ is linear Lebesgue measure on the unit circle and $T_{\nu}$ is the bundle shift over $R$ of multiplicity one determined by the scalar $\lambda$. Since the $T_{\nu}$ are irreducible and no two are unitarily equivalent, the direct integral is the central decomposition of $T_\nu$. If $n \geq 2$, then the $\pi^*$-algebra generated by $T_\nu$ is a $\Pi_\infty$ factor. (Received August 25, 1977.)

**#749-B20** THOMAS KRIETE, University of Virginia, Charlottesville, Virginia, 22903. The growth of point evaluation functionals in certain $H^2(u)$ spaces.

Let $\mu$ be a finite Borel measure on the closure $D$ of the open unit disk $D$ in the complex plane, and denote by $H^2(u)$ the closure in $L^2(\mu)$ of the analytic polynomials. If the linear functional "evaluation at $z"$ is bounded on $H^2(u)$, denote its norm by $E(u,z)$; otherwise put $E(u,z) = \infty$. Write $\mu = v + \alpha$ where $v$ and $\alpha$ are carried on $D$ and the unit circle respectively. This paper investigates the interplay between $\alpha$ and the growth of $E(u,z)$ as $z$ tends to the circle. Examples are given in which $v$ is very nice, $\alpha$ is absolutely continuous with respect to arc-length measure $d\theta$ on the circle with $dv/d\theta$ everywhere positive, but with $\alpha$ having only slight influence on the growth of $E(u,z)$. The connection with possible splitting phenomena like $H^2(u) = H^2(v) \oplus L^2(\alpha)$ is discussed. (Received August 25, 1977.)

Let $N$ be the normal operator multiplication by $z$ on $H^2(\Omega)$ where $\Omega$ is a finite Borel measure on the closure $D$ of the open unit disk $D$ in the complex plane, and let $E(\Omega,z)$ be its norm. Fix $\lambda_0 \in \Omega$ and observe $S - \lambda_0$ is semi-Fredholm for $S \in \Sigma_p(\Omega)$. It is natural to ask what is the set of indices $I_{\Omega}^* \equiv \{i(S - \lambda_0): S \in \Sigma_p(\Omega)\}$ where $i$ is the index. The following are two typical results. Theorem 1. $\Omega$ and $N$ as above and $\Omega$ is simply connected. Suppose the intersection of $\Omega$ with the boundary of the polynomial convex hull of $K$ contains an arc of positive $\mu$ measure consisting of points accessible within $\Omega$. If $E_{\Sigma_p}(\Omega) = \emptyset$ then $E_{\Sigma_p}(\Omega) = \Sigma_p(\Omega)$ and $I_{\Omega}^* = \{-1\}$. Theorem 2. Suppose the weak-star closure of the polynomials $F^0(\mu)$ is antisymmetric. Set $F^0(\mu) = H(G,\omega)$. If the Sarason hull $K$ for the measure $\mu|\Omega$ contains $\Omega$, then $I_{\Omega}^*$ contains the negative integers and $-\infty$. (Received August 26, 1977.)

**#749-B22** S. HILDEBRANDT, Universit\"at 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.)
DAVID DRASIN, Purdue University, West Lafayette, Indiana 47907. Two examples.

(1) Let $A$ be the MacLane class in $\{|z| < 1\}$ (G. R. MacLane, University Studies 49(1963)). MacLane proved (loc. cit.) that $f \in A$ if
\[ \int_0^1 (1-r) \log^+ |f(re^{i\theta})| \, dr < \infty \text{ for a set } \Phi \text{ dense on } [0, 2\pi]. \]
We show (in subharmonic form) that this condition is best possible. (2) For $0 < \lambda < 1$, let $M_\lambda$ be the class of meromorphic functions of order $\lambda$ with negative zeros and positive poles. We show that for each such $\lambda$, there exists $f \in M_\lambda$ such that $T(r, f) - r^\lambda$ 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 $N(2r, 1/f) - o^\lambda N(r, 1/f)$ for every $g > 0$. (Received August 29, 1972.)

PETER DUREN, University of Michigan, Ann Arbor, Michigan 48109, and GLENN SCHOFER, 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 $f(0) = 0$ 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 $S_0$ maps 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.)

ALBERT EDREI, Syracuse University, Syracuse, New York 13210. The Padé tables of entire functions.

Let $f(z) = \sum_{n=0}^{\infty} a_n z^n$ ($a_0 \neq 0$) represent an entire function of order $\lambda (0 < \lambda < +\infty)$, and let $n$ be an integer such that $0 < 1 - (\lambda n(n-1)/2) = \xi < 1$. Denote by $P_{mn}/Q_{mn}$ the irreducible polynomial of degree $\leq m$ ($Q_{mn}(0) = 1$). It is possible to find an infinite sequence $S = S(n)$ of strictly increasing integers having the following properties. If $\lambda > 0$ and $m \in S(n)$,
\[ |Q_{mn}(z) - 1| \leq m^{-L/3} \]
throughout the disk $|z| \leq m^{E/3}$, and $|f(z)Q_{mn}(z) - P_{mn}(z)| \leq em^{-L/2}$ in the smaller disk $|z| \leq m^{-1} E/3$. In the limiting case $\lambda = 0$, there are no restrictions on $n$: to each $n > 1$ there corresponds $S(n)$ such that $|f(z) - \{P_{mn}(z)/Q_{mn}(z)\}| \leq Bm^{-L/2}$, provided $m \in S(n)$, $|z| \leq m^B$ ($B$ is an arbitrary positive constant). (Received August 29, 1977.)

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 $\alpha$, $-\infty < \alpha \leq 1$, in $S(z)$, $|z| < 1$. If $f(z) = \sum_{n=1}^{\infty} a_n z^n$ and $g(z) = \sum_{n=1}^{\infty} b_n z^n$, $z \in \Delta_\alpha$, define $(f*g)_\alpha(z) = \sum_{n=1}^{\infty} a_n b_n z^n$, $z \in \Delta_\alpha$, where $A_\alpha(\alpha) = (n+2\alpha)/\Gamma(2-2\alpha)(n-1)!$. 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
Also a conjecture of Suffridge, concerning a representation formula for functions in \( S(a) \) is proved. It is shown that this formula characterizes \( S(a) \) for \( \frac{1}{2} \leq a \leq 1 \). The proofs are based on a formula of Brickman, et. al. (Trans. Amer. Math. Soc. 185) for the function 
\[
z(1-xz)^{-a}(1-yz)^{-b}, z \in \mathbb{D}.
\]
(Received August 29, 1977.)

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 \( D_1 \) are \( \mathcal{O}_S \), 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.)

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 \( \mu \) in the plane. If \( \delta(a)>0 \) is the Nevanlinna deficiency for the value \( a \) and \( \mathcal{O}(r,a) \) represents the angular measure of the longest arc of \( |z|=r \) on which \( |f(re^{i\theta})-a|<1 \) there exists \( \eta(\delta(a),\mu)>0 \) such that \( \limsup_{r \to \infty} \mathcal{O}(r,a) > \eta. \) (Received August 29, 1977.)

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 \( \lim_{r \to \infty} \mathcal{O}(r) = (o > 1) \). 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.)

WILLIAM HASTINGS, Fordham University, Bronx, New York 10458. On \( H^2(\mu) \) for \( \mu \) a pure atomic measure. Preliminary report.

For \( \mu \) 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 $H^2(u) \neq L^2(u)$ are discussed for $u$ a pure atomic measure. In particular, suppose $u$ is the atomic measure with $u(\alpha_n) = \omega_n$, where $\{\omega_n\}$ is a sequence of distinct points in the unit disk such that $|\alpha_n| = 1$. Results of Brown, Shields and Zeller ("On Absolutely Convergent Exponential Sums." Trans. Amer. Soc. 96 (1960), 162-183) show that $H^2(u)$ may not be all of $L^2(u)$ in this case. The difficulty of finding necessary and/or sufficient conditions is illustrated by examples such as the following: If $\omega_n = o(r^n)$ for some $r$, $0 < r < 1$, then $H^2(u) = L^2(u)$ no matter how the points $\alpha_n$ are placed in the unit disk (with $|\alpha_n| = 1$).

Revised August 30, 1977.


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 in 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.)

David S. Kinderlehrer, University of Minnesota, Minneapolis, Minnesota 55455 and Louis 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 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)

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 $\Omega$, making contact angle $\lambda$ with cylinder walls $Z$ lying over $\Sigma = \partial \Omega$, is determined by the relations $\nabla \cdot T u = \frac{\Sigma|\Sigma|}{\partial \Omega} \cos \lambda$ in $\Omega$, $\nabla \cdot T u = \cos \lambda$ on $\Sigma$, $T u = D u / \sqrt{1 + |D u|^2}$, $\nu$ exterior normal. Let $h_0, h_0 \in \partial \Omega$, be defined by $\cos \gamma = \frac{1}{|g|} \frac{h_0}{h}$ among all vector fields $\omega$ in $\partial \Omega$, with $\omega \cdot \nu = 1$ on $\Sigma$, $\nabla \cdot \omega = \frac{\Sigma|\Sigma|}{\partial \Omega} \omega \cdot \nu$. It is shown a solution $u(x)$ exists for any $\gamma$ in $h_0 \leq h_0 \leq \frac{\pi}{2}$, and that no solution exists in $0 \leq \gamma < h_0$. If $\partial \Omega$ is a circle, then $h_0 = \pi / 2$. If $\partial \Omega$ is a triangle or parallelogram with minimum angle $\alpha_1$, then $h_0 = \frac{\pi}{2}(\pi - \alpha_1)$. If $\partial \Omega$ is a regular polygon with interior angle $\alpha$, then again $h_0 = \frac{\pi}{2}(\pi - \alpha)$. However, for any $\epsilon > 0$, there is a trapezoid for which $3 > \frac{\pi}{2}(\pi - \epsilon)$ and also $h_0 > \frac{\pi}{2}(\pi - \epsilon); \theta$, thus, in this case, $h_0 > \frac{\pi}{2}(\pi - \epsilon) + \frac{\pi}{4}(\pi - 2 \epsilon)$. (Received August 2, 1977.)


Let $\Omega$ be that region of three dimensional space supporting the function $f$ defined by the rule, $f(x) = (\xi(x) - \xi_0, \nu(x) - \nu_0, \sigma(x) - \sigma_0)$, where $(\xi(x), \nu(x), \sigma(x))$ is a three tuple containing the

A-581
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 JOM 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)


A subset, \(X\), of the plane is an F2 set if, given any line \(l\), \(X\) 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.)


Let \((M, g)\) be an \(n\) dimensional compact Riemannian manifold with volume \(V\) and injectivity radius \(\text{inj}(x)\). Combining a geometric idea of Marcel Berger with an inequality for Sturm-Liouville equations, one proves that \(V \geq \frac{\pi}{2} V_0(\text{inj}(x))\), where \(V_0(r)\) is the volume of the standard sphere \(S^{C} H^{n+1}\) of radius \(r/\pi\). This is sharp, except for the factor \(\frac{\pi}{2}\) 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.)
A propositional calculus is **compact** if whenever a wff $F$ is deducible from a set of wffs $\mathcal{A}$, there is a finite subset of $\mathcal{A}$ 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)**

**MA-GI** KAREN K. UHLENBECK, University of Illinois at Chicago Circle, Box 4348, Chicago, Illinois 60680.

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**

**K-1** CLEVE MOLER, University of New Mexico, Albuquerque, New Mexico 87131.

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

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


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 [7], is reviewed next and, with numerical quadrature as an example, is contrasted with actual practice. (Received August 29, 1977.)

Reading List

SC-4 JAMES M. VARAH, Computer Science Department, University of British Columbia, Vancouver, B.C.


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:

Survey Papers:

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


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 numerical analysis and the bulk of these lectures will be devoted to this topic, including some very important recent results as well as a discussion of major open questions. (Received August 29, 1977.)

Reading List


ERRATA—Volume 24


In Theorem 2, $C = E$.


In Theorem 2(b), $E$ is uniformly convex.


Add to Theorem 3 the hypothesis that the structures are determinate. Add the remark that the results were obtained using back and forth methods.


Line 3 after the final word "with", add "a graph made from".

---

SITUATIONS WANTED

**UNEMPLOYED MATHEMATICIANS**, or those under notice of involuntary unemployment, are allowed two free advertisements during the calendar year. The service is not available to professionals in other disciplines, nor to graduate students seeking their first positions; however, veterans recently released from service will qualify. Applicants must provide:

1. name of institution where last employed; 2. date of termination of service; 3. highest degree; 4. field.

**APPLICATIONS FROM NONMEMBERS** must carry the signature of a member. Free advertisements may not exceed fifty words (not more than ten lines), including address of advertiser; excess words are charged at the rate of $0.15 per word (minimum charge $1). Anonymous listings are carried with an additional fee of $5; correspondence for such applicants will be forwarded to them.

**EMPLOYED MEMBERS** of the Society may advertise at the rate of $0.50 per word; nonmembers, currently employed, $0.50 per word (minimum $1).

**DEADLINE** for receipt of advertisements is the same as that for abstracts; date appears inside front cover of each issue of the *Notices*.

**APPLICATION FORMS** may be obtained from, and all correspondence should be directed to, the Editorial Department, American Mathematical Society, Box 6248, Providence, Rhode Island 02940.

**CORRESPONDENCE TO APPLICANTS LISTED ANONYMOUSLY** should be directed to the Editorial Department; the code which is printed at the listing should appear on an inside envelope in order that correspondence can be forwarded.

ANONYMOUS


A-586
FOR SALE

Math Reviews from the first and many other mathematical publications for sale. Reprints of mid-20th century to now, free to anyone interested. Mrs. Richard Brauer, 15 Franklin Street, Belmont, MA 02178 (617-484-6856).

IS THE OPTIMUM NUMBER SYSTEM BASE? The Theory and Applications of Constants Analysis by T. S. Davis, 224 pages of classical and original themes exhibiting the mathematical and physical constants. Send $10 to THE CONSTANT SOCIETY, P.O. Box 5513, D-21, 54 University Way, N.E., Seattle, WA 98105.

1978 MATHEMATICAL CALENDAR

Informative and attractive calendar for the desk of the mathematician. Each month displays a different, colorful constellation of the plane. In the centerfold is an original composite portrait of Gauss with a full-page biography, tables and biographical sketches of 188 famous mathematicians are included. Other features are meeting dates, quotations, humor and problems. 28 pages, $1/2 in January; $4.50 plus 50¢ postage. N. C. residents add 18¢.

FOR SALE OR GIFT TO AN INSTITUTION

MATH REVIEWS, vols. 1-53 (40-77); bound (46-47), bound (48-49), 2 part Index 40-59, minus nos. 4 & 5 vol. 37; BULLETIN OF AMS, vols. 43-53 (37-77), plus no. 9 of vol. 45, nos. 3, 4, 10, of vol. 46, no. 7, vol. 47; ANNALS OF MATH STAT (30-77) from vol. 1 to date; ANNALS OF PROB. (75-77) vols. 1-5; ASA (52-77) vols. 1-25, plus IFOFS, INTERFACES, ADVANCES IN MATH. Sherman, 1312 Nancy St., Somerville, IN 47401 (317) 334-2771.

NEW JOURNALS

Issued quarterly, CRYPTOLOGIA, emphasizing historical and computational aspects of cryptography. $16 ($8) per year. Write for information: CRYPTOLOGIA, Union College, Albany, N.Y. 12203.

POSITIONS AVAILABLE

SST. PROF., TENURE TRACK. PH. D. Demonstrated competence in research and teaching, capability and willingness to work directly with other science faculty. Position in elementary and advanced courses, further the development of applied math curriculum and instructional facilities, especially as related to applications biology, chemistry and geology. Work load equivalent to 11 hrs./wk. Teaching: Apply to J. T. Smith, Chairman, Math Dept., San Francisco State University, San Francisco, CA 94132. Equal Opportunity/Affirmative Action Employer.

CHAIRPERSON, Mathematics Department

Ph. D. in Mathematics. Interested in administrative work or some administrative experience preferred. Appreciation for good teaching and scholarship. Broad interest with the ability to direct and encourage the continued growth of all the department's programs. Consideration will be given to candidates with doctorates who have strong holdings in mathematics.

APPLICATION DEADLINE: November 10, 1977

BEGINNING DATE: Spring Semester 1978 or later

Send credentials to: Dr. Katharine Hodgkin, Chairperson, Search Committee, Mathematics Department, East Carolina University, Greenville, North Carolina 27834.

AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER

Benjamin Peirce Lectureships. Rank of Assistant Professor. The appointments are for three years with a starting salary of $14,000 (for the nine-month academic year) and can be augmented during the summer by teaching in the summer school or by work on a research contract if funds are available. The teaching commitment is six hours a week, including a graduate course on a subject of the lecturer's choice, if desired. Application forms may be obtained by writing to: Harvard University, Department of Mathematics, Benjamin Peirce Lectureships, 1 Oxford Street, Cambridge, MA 02138. Applications must be filed by January 9, 1978. Harvard is an Equal Opportunity/Affirmative Action Employer.

MATH DEPARTMENT HEAD

THE UNIVERSITY OF ALABAMA IN BIRMINGHAM

Applications and nominations are invited of mathematicians with proven ability in research, a commitment to effective teaching, administrative skills, and experience appropriate for appointment at the rank of associate or full professor, to head the university department with nineteen full-time faculty and offering bachelor's degrees in Mathematics and Applied Mathematics, and the master's degree in Mathematics. Twelve-month appointment.

Salary range: $28,000 - $35,000. Fringe benefits. Applications and nominations should be received by November 15. Send to:

Richard J. Crittenden, Search Committee for Math Chair, Department of Mathematics, The University of Alabama in Birmingham, Birmingham, AL 35294

AN AFFIRMATIVE ACTION/EQUAL OPPORTUNITY EMPLOYER

One LEVERHULME COMMONWEALTH/U. S. A. VISITING FELLOWSHIP 1978/1979 available for recent doctorate (any subject). £2,520 for ten months, plus travel expenses plus spouse allowances (£49 p. m.). Curriculum vitae, and two referees' reports, to Prof. R. Brown, S. M. C. S., University College of North Wales, Bangor LL57 2UW, U. K., by Nov. 15, 1977.
PUBLICATIONS FROM
UNITED NATIONS

STATISTICAL YEARBOOK 1976

Important compilation of statistics from countries throughout the world covering a wide range of economic and social subjects, including: population, agriculture, manufacturing, construction, transport, trade, balance of payments, national income, education and culture. Improved statistical coverage has enabled the YEARBOOK to widen the territorial scope of many of its tables and to provide more comprehensive and accurate world and continental aggregates.

Order No. E/F.77.XVII.1

UNITED NATIONS PUBLICATIONS
Room A-3315
New York, N.Y. 10017

FUNDAMENTALS
OF NUMBER THEORY

by William J. LeVeque, Executive Director, American Mathematical Society

A one-semester, junior/senior or graduate level text suitable for a first course in number theory. Introduces the language of abstract algebra — defines terms and provides examples. History of number theory is emphasized. Student aids include problems (with hints for solutions), notes and references, and an extensive bibliography.

280 pp, hardbound, 1977 Price: $12.95

If you would like to be considered for complimentary examination copies or would like more information, write to Alfred Walters, Information Services, Addison-Wesley. Please include course title, enrollment, and author of text now in use.

ADDISON-WESLEY PUBLISHING COMPANY
Reading, Massachusetts 01867

POST
DOCTORAL
RESEARCH

The National Research Council is now accepting applications for the Research Associateship Programs for 1978. The programs provide scientists and engineers opportunities for postdoctoral research on problems in the fields of CHEMISTRY — SPACE SCIENCES — PHYSICS — ATMOSPHERIC & EARTH SCIENCES — ENGINEERING — LIFE SCIENCES — MATHEMATICS and ENVIRONMENTAL SCIENCES.

Complete details including information on specific research opportunities and application materials may be obtained by writing:

Associateship Office (JH606-M)
NATIONAL RESEARCH COUNCIL
2101 Constitution Avenue, N.W.
Washington, D.C. 20418
Announcing...

The Library of Mathematical Sciences

the only book club devoted to mathematics.

Birkhoff...Knuth...Magnus...Von Neumann...

yes, you'll find all the people who have changed—and are changing—
mathematics represented in this new book service. The Library of Mathematical Sciences is designed to bring you all the most useful, most
important books in this fast-changing field—and at money-saving prices
too. Here are the books you need to keep up on new mathematical tools
and techniques...evolving interdisciplinary studies...emerging concepts and methods in computer sciences. Books that will spur your
enjoyment of mathematics. Ideas that will excite your students. Problems
to challenge you. Join the Library of Mathematical Sciences today, and
see for yourself.

(Publishers' Prices shown)

<table>
<thead>
<tr>
<th>ISBN</th>
<th>Title</th>
<th>Author(s)</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>83820</td>
<td>THEORY OF GAMES AND ECONOMIC BEHAVIOR</td>
<td>John Von Neumann and Oskar Morgenstern</td>
<td>$25.00</td>
</tr>
<tr>
<td>70190</td>
<td>PRINCIPLES OF OPERATIONS RESEARCH</td>
<td>Harvey Wagner</td>
<td>$21.50</td>
</tr>
<tr>
<td>80530</td>
<td>STATISTICAL METHODS FOR DIGITAL COMPUTERS</td>
<td>Edited by Kurt Enstein, Anthony Ralston, and Herbert Wilf</td>
<td>$19.95</td>
</tr>
<tr>
<td>41610</td>
<td>DATA ANALYSIS FOR SCIENTISTS AND ENGINEERS</td>
<td>Stuart Meyer</td>
<td>$19.95</td>
</tr>
<tr>
<td>39837</td>
<td>THE COMPLEXITY OF COMPUTING</td>
<td>John E. Savage</td>
<td>$22.95</td>
</tr>
<tr>
<td>60670</td>
<td>MATHEMATICS APPLIED TO DETERMINISTIC PROBLEMS IN THE NATURAL SCIENCES</td>
<td>C. C. Lin and L.A. Segel</td>
<td>$16.95</td>
</tr>
<tr>
<td>50051</td>
<td>GAME THEORY AND POLITICS/DECISION ANALYSIS</td>
<td>Steven Brams and Howard Raiffa</td>
<td>$15.90</td>
</tr>
<tr>
<td>42010</td>
<td>THE DESIGN AND ANALYSIS OF COMPUTER ALGORITHMS</td>
<td>Aho, Hopcroft, Ulman</td>
<td>$18.95</td>
</tr>
<tr>
<td>73191</td>
<td>QUEUEING SYSTEMS. Vol. II, Computer Applications</td>
<td>Leonard Kleinrock</td>
<td>$25.00</td>
</tr>
<tr>
<td>52292</td>
<td>A HANDBOOK OF NUMERICAL AND STATISTICAL TECHNIQUES</td>
<td>J. H. Pollard</td>
<td>$24.95</td>
</tr>
</tbody>
</table>
Take any 3 books all for only $3.95 (values to $66.95)

if you will agree to join now for a trial
of 3 months' membership, at
handsome discounts, over the next 12 months.

9818. COMBINATORIAL GROUP THEORY. Wilhelm Magnus, Abraham Karrass, and Donald Solitar. Factor groups, subgroups, Nielsen transformations, commutator calculus, and more. $6.00


8575. GRAPHS, MODELS AND FINITE MATHEMATICS. Joseph Malkevitch and Walter Meyer. Delightful introduction to practical finite mathematics, using current examples (traffic routes, predator-prey interaction). $12.50

7039. AN INTRODUCTION TO PROBABILITY THEORY AND ITS APPLICATIONS, Vol. 1. 3rd Edition. Sidney F. X. Ross. Broadsheet of practical problems and latest techniques for solving them. $15.00

6061. ORDINARY DIFFERENTIAL EQUATIONS, V. I. Arnold. $17.50

4410. ELEMENTARY NUMBER THEORY. Joe Roberts. Softbound. $12.50

1875. SURREAL NUMBERS. Donald Knuth. Mathematical creativity is explained and taught in this unique mathematical work. Softbound. $3.95

The Library of Mathematical Sciences
Riverside, New Jersey 08075

M-44A

Please accept my application for membership and send me the three volumes indicated, billing me only $3.95. I agree to purchase at least three additional books during the first 12 months. I am a member under the membership plan described in this ad. Savings range up to 30% and occasionally even more. My membership is cancelable any time after I buy these three books. A shipping and handling charge is added to all shipments.

3 books for only $3.95.

Indicate by number the 3 books you want.

50660. GRAPH THEORY. E. N. G. Bries, E. K. Lloyd and R. J. Wilson. An introduction to and history of graph theory. $22.50

39745. COMPANION TO CONCRETE MATH, Vol. 1. Mathematical Techniques and Various Applications. Z. A. Melzak $16.50

61310. MATHEMATICAL IDEAS, MODELING AND APPLICATIONS, Vol. 1. $15.00

29835. COMPLEX VARIABLES AND APPLICATIONS. Z. A. Melzak. The accompanying volume to Companion to Concrete Math, Vol. 1. Counts as 2 of your 3 books. $29.95

84396. TOPICS IN ALGEBRA. I. N. Herstein. Stimulating explorations of advanced algebra. $17.50


MEMBERSHIP BENEFITS

- You begin by choosing any three of these exciting books for only $3.95 as your introductory offer.
- You keep saving substantially on the books you buy. Savings range up to 30% and occasionally even more.
- If you continue your membership past the trial period, you will be eligible for our Bonus Book Plan— an important way to save more, at least 70% off publishers' prices.
- At 3-4 week intervals (15 times per year) you will receive the Book Club News, describing the coming Main Selection and Alternate Selections, together with a dated reply card. In addition, up to 4 times a year, you may receive offers of special selections, always at substantial discounts. If you want the Main Selection, do nothing and it will be sent to you automatically. If you prefer another selection, or no book at all, simply indicate your choice on the card, and return it by the date specified. You will have at least 10 days to decide. If, because of late mail delivery of the News, you should receive a book you do not want, we guarantee return postage.
VOLUMES 3 and 4 now ready
ENCYCLOPEDIA OF MATHEMATICS and Its Applications

The Encyclopedia of Mathematics and Its Applications inaugurates a new style of mathematical exposition. Concentrating on those fields of pure and applied mathematics which are rich in concrete, factual material, each volume gives a detailed, thorough, and insofar as possible, definitive presentation of a subject which is at present of active interest both in mathematics and science generally. It is hoped that this Encyclopedia will become the outstanding medium of mathematical exposition at a level accessible to the widest public and will be indispensable on the shelf of every mathematician.

GIAN-CARLO ROTA, Editor
Department of Mathematics, M.I.T.

Editorial Board

Janos D. Aczel, Waterloo
Richard Askey, Madison
Michael F. Atiyah, Oxford
Edwin F. Beckenbach, U.C.L.A.
Lipman Bers, Columbia
Arne Beurling, Inst. for Advanced Study
Garrett Birkhoff, Harvard
Salomon Bochner, Rice
Raoul Bott, Harvard
Felix E. Browder, Chicago
A. P. Calderón, Buenos Aires
S. Chandrasekhar, Chicago
S. S. Chern, Berkeley
Hermann Chernoff, M.I.T.
Paul Cohen, Stanford
P. M. Cohn, Bedford College, London
H. S. MacDonald Coxeter, Toronto
Nelson Dunford, Sarasota, Florida
F. J. Dyson, Inst. for Advanced Study
Giovanni Gallavotti, Naples
Andrew M. Gleason, Harvard
A. González Domínguez, Buenos Aires
M. Gordon, Essex
Nathan Jacobson, Yale
Mark Kac, Rockefeller
Shizuo Kakutani, Yale
Robert Kalaba, U.S.C.
Samuel Karlin, Stanford
J. F. C. Kingman, Oxford

Donald E. Knuth, Stanford
Peter D. Lax, Courant
Joshua Lederberg, Stanford
André Lichnerowicz, Collège de France
M. J. Lighthill, Cambridge
Chia-Chiao Lin, M.I.T.
Jacques-Louis Lions, Paris
Roger Lyndon, Ann Arbor
Marvin Marcus, Santa Barbara
N. Metropolis, Los Alamos Scientific Lab.
Jan Mycielski, Boulder
Steven A. Orszag, M.I.T.
Alexander Ostrowski, Basle
Roger Penrose, Oxford
Carlo Pucci, Florence
C. R. Rao, Indian Statistical Institute
Fred S. Roberts, Rutgers
Abdus Salam, Trieste
M. P. Schützenberger, Paris
Jacob T. Schwartz, Courant
Irving Segal, M.I.T.
Beniamino Segre, Accademia dei Lincei
Olga Taussky, Cal Tech
René Thom, Bures-sur-Yvette
John Todd, Cal Tech
John W. Tukey, Princeton
Stanislaw Ulam, Colorado
Veeravalli S. Varadarajan, U.C.L.A.
Antoni Zygmund, Chicago

The Encyclopedia is open-ended — continuation orders are invited.

Detailed brochure available upon request from:

ADDISON-WESLEY PUBLISHING COMPANY
Advanced Book Program, Department M
Reading, Massachusetts 01867
London · Amsterdam · Don Mills, Ontario · Sydney · Tokyo

A-592
VOLUMES 3 and 4 now ready

ENCYCLOPEDIA OF MATHEMATICS and Its Applications

Volume 3
THE THEORY OF INFORMATION AND CODING
A Mathematical Framework for Communication
Section: Probability
Robert J. McEliece, Jet Propulsion Laboratory, California Institute of Technology
With a Foreword by Mark Kac, The Rockefeller University

The theory of information is one of the great intellectual conquests of this century. It has made possible complex high-speed telecommunications between continents, as well as error-proof transmission in outer space exploration.

Robert McEliece of the Jet Propulsion Laboratory gives a self-contained survey. The first part deals with the development of coding theorems centering on the application of the notion of entropy. The second part deals with the practicalities of coding, assuming a minimum of abstract algebra.

Contents
INFORMATION THEORY: Entropy and Mutual Information · Discrete Memoryless Channels and Their Capacity-Cost Functions · Discrete Memoryless Sources and Their Rate-Distortion Functions · The Gaussian Channel and Source · The Source-Channel Coding Theorem · Survey of Advanced Topics for Part I · CODING THEORY: Linear Codes, BCH, Goppa, and Related Codes · Convolutional Codes · Variable-Length Source Codes · Survey of Advanced Topics for Part II · Appendices · References · Index

The method of separation of variables is familiar to anyone who has ever had to solve a differential equation. It is often conceived as a bag of tricks to be remembered rather than understood. Willard Miller, the foremost expert on the subject, gives the first systematic survey. He shows how old and new techniques for separation of variables can be traced back to a few successful general principles.

Contents
Preface · The Helmholtz Equation · The Schrödinger and Heat Equations · The Three-Variable Helmholtz and Laplace Equations · The Wave Equation · The Hypergeometric Function and Its Generalizations · Appendices · References · Index

Including exercises at the end of each chapter. Nov., 1977, c. 320 pp., illus.

Volume 1: INTEGRAL GEOMETRY and GEOMETRIC PROBABILITY
Section: Probability
Luis A. Santalo, University of Buenos Aires
1976, 422 pp., illus.
Hardbound ISBN 0-201-13500-0, $19.50

Volume 2: The THEORY OF PARTITIONS
Section: Number Theory
George E. Andrews, The Pennsylvania State University
Hardbound ISBN 0-201-13501-9, $16.50

The Encyclopedia is open-ended — continuation orders are invited
Other volumes in preparation

ADDISON-WESLEY PUBLISHING COMPANY
Advanced Book Program, Department M
Reading, Massachusetts, 01867
London · Amsterdam · Don Mills, Ontario · Sydney · Tokyo
Richard L. Wheeden and Antoni Zygmund

MEASURE AND INTEGRAL
(Pure and Applied Mathematics Series, Volume 43)
An introduction to real analysis for students interested in mathematics, statistics, or probability, Measure and Integral requires only a basic familiarity with advanced calculus in order to serve as an excellent textbook for advanced undergraduate or first year graduate students. The book develops the classical theory of the Lebesgue integral and some of its applications, presenting the integral initially in the context of n-dimensional Euclidean space, following a thorough study of the concepts of outer measure and measure. A more general treatment of the integral based on an axiomatic approach is later given. 1977, 288p, $16.75

Soon to be published . . .

Marvin Marcus

INTRODUCTION TO MODERN ALGEBRA
(Pure and Applied Mathematics Series)
A text for a basic one-year course in algebra at the advanced undergraduate or beginning graduate level, the presentation incorporated in this important volume is oriented toward the applications of algebra to other branches of mathematics and to science in general. Considerable space is devoted to such topics as permutation groups and the Polya counting theory; polynomial theory; canonical forms for matrices; applications of linear algebra to differential equations; representations of groups. Prerequisites for a course based on the book are minimal. 390 exercises constitute an integral part of the volume. Introduction to Modern Algebra is still in preparation, but examination copies can be requested now.

Charles O. Christenson and William L. Voxman

ASPECTS OF TOPOLOGY
(Pure and Applied Mathematics Series, Volume 39)
Providing lucid coverage of the standard topics of general topology, as well as an introduction to continua, inverse systems, homotopy theory, covering spaces, triangulation and classification of 2-manifolds, and the topology of n-manifolds, Aspects of Topology is the first book at its level to include Brown's proof of the Schoenflies Theorem, the algorithm for computing the fundamental group of the complement of a graph (in \( E^3 \)), and a convincing example with argument of a wild arc and wild 2-sphere. An excellent textbook for a senior level or graduate course, the book can be used as a self-instruction manual or as a reference source. 1977, 536p, $19.75

Joseph E. Kuczkwowski and Judith L. Gersting

ABSTRACT ALGEBRA: A First Look
(Pure and Applied Mathematics Series, Volume 38)
This book offers careful and detailed development of material as well as motivation for the study of new topics. An excellent textbook for junior or senior mathematics majors or beginning graduate students in mathematics, the volume's highly readable style—which utilizes a dialogue approach between text and student—makes it particularly well suited for individualized instruction or use with the small-groups method. 1977, 336p, $17.50
LARRY E. MANSFIELD

LINEAR ALGEBRA WITH GEOMETRIC APPLICATIONS
(Pure and Applied Mathematics Series, Volume 34)

A modern, theoretically-gearred textbook that approaches its subject through the study of vector
space, the level of this volume requires a standard high school background in algebra and geo-
metry, with calculus included only as an option for the student. "This book is intended to serve
as an introduction to linear algebra at an elementary level and also as a means for students to
acquire the mathematical maturity that they need. Both aims are attained...." (Mathematical
Reviews) 1976, 512p, $14.50

MAX AGOSTON

ALGEBRAIC TOPOLOGY: A First Course
(Pure and Applied Mathematics Series, Volume 32)

Based on material developed for a semester course at two universities, this volume examines in
detail the early development of algebraic topology. It is suitable for courses in combinatorial,
algebraic, and geometric topology. Advanced undergraduates and graduate students seeking to
supplement their regular course reading will find Algebraic Topology: A First Course highly sig-
nificant in their understanding of the topic. 1976, 376p, $23.50

ICHIRO SATAKE

LINEAR ALGEBRA
(Pure and Applied Mathematics Series, Volume 29)

This volume provides the student with a thorough, self-contained introduction to the basic
theories of matrices and determinants along with the underlying concepts of vector spaces and
linear mappings—methods that are in constant use in every field of modern mathematics. Linear
Algebra is the ideal textbook or self-study guide for undergraduate students majoring in various
branches of mathematics, science, and engineering. 1975, 392p, $13.75

MARVIN MARCUS

FINITE DIMENSIONAL MULTILINEAR ALGEBRA (in two parts)
(Pure and Applied Mathematics Series, Volume 23)

Intended as a textbook for advanced undergraduate and graduate students and as a reference
work for mathematicians in universities and industrial research companies, this book consists of
notes compiled by the author throughout his years of teaching. Requiring only a moderate
knowledge of linear and general algebra, Finite Dimensional Multilinear Algebra renders often
difficult material accessible to advanced undergraduate and beginning graduate students.
Part I: 1973, 310p, $17.50
Part II: 1975, 736p, $36.50 (contact publisher about special adoption discount on this title)

MARCEL DEKKER, INC.
270 Madison Avenue
New York, N.Y. 10016

Please send me a 90-day examination copy of the volume(s) indicated:

- Measure and Integral
- Introduction to Modern Algebra (in preparation)
- Aspects of Topology
- Abstract Algebra: A First Look
- Linear Algebra with Geometric Applications
- Algebraic Topology: A First Course
- Linear Algebra
- Finite Dimensional Multilinear Algebra
  - Part I
  - Part II

Name
Department/Institution
Address
City State Zip

A-595
Encyclopedic Dictionary of Mathematics

by the Mathematical Society of Japan
edited by Shôkichi Iyanaga and Yukiyosi Kawada
translated by the Mathematical Society of Japan with the cooperation of the American Mathematical Society
translation reviewed by Kenneth O. May
two volumes
7 x 11¼ inches each
840 pages each
436 articles—appendices
27,000 index entries
ISBN 0 262 09016 3
$125.00

"The American Mathematical Society welcomes the publication of the Encyclopedic Dictionary of Mathematics. For many years we have been fascinated by the publication in Japanese because we saw that this was an encyclopedia that contained effective and penetrating information about all the fields of advanced mathematical research." — Saunders MacLane, Past President, American Mathematical Society

"It is impossible for the modern mathematician to be well versed in more than one or two areas of mathematics. But he cannot be ignorant of what has been achieved in other areas. The EDM is the most practical and effective resource to keep abreast. Its coverage is excellent . . . ." — Morris Kline, Courant Institute of Mathematical Sciences, New York University.

This monumental work covers in concise, thorough fashion the entire mathematical realm from Abel and Abelian Groups to Zeta Functions. It includes recent developments in the most active fields, articles on mathematical programming and theoretical physics, and historical perspectives. It is the most highly concentrated distillation of mathematical knowledge ever prepared. The Encyclopedic Dictionary of Mathematics will be consulted—and consulted often—by mathematicians and students as varied in their specialties and interests as the articles are in their subject matter. More than a few will one day ask how they ever managed without the EDM!

The editors describe the work as "an encyclopedic dictionary with articles of medium length aimed at presenting the whole of mathematics in a lucid system, giving exact definitions of important terms in both pure and applied mathematics, and describing the present state of research in each field, together with some historical background and some perspectives for the future."
**APPLICANT PREREGISTRATION FORM**  
**MATHEMATICAL SCIENCES EMPLOYMENT REGISTER**  
**ATLANTA, GA.**  
**January 9-11, 1978**

**INSTRUCTIONS:** Please read carefully before completing forms below. Circled letters identify corresponding items in the FORM and the SUMMARY STRIP; abbreviations to be used are provided in the notes below. Please print or type in black ink. Block capitals are suggested. The FORM itself will be placed on display exactly as submitted at the Register sessions in Atlanta. The SUMMARY STRIP will be used to prepare a computer printed list of summaries for distribution at the Register sessions.

**APPLICANT FORM:**

(See page 376.)

- **Name:**
- **Address:**

**Specialties**

- Career objectives - ACADEMIC [ ] Research, [ ] Teaching; NON-ACADEMIC [ ] Research and Development, [ ] Consulting, [ ] Supervision

**Near-term career goals**

- Significant achievements: Significant projects, including role

**Honors and offices**

- Others

**Selected Titles of Papers, Reports, Books, Patents**

- Degree [ ] Year [ ] Inst.
- Number of Abstracts and Internal Reports
- Number of Papers Accepted
- Number of Books and Patents

**Employment:**

- Present Position [ ] Employer [ ] Duties [ ] Years
- Previous

**Desired Position**

- Duties [ ] Available mo. / yr. [ ] Location [ ] Salary

**References**

- Available for Interviews

**Citizenship**

- Available for Interviews
- Summer

**SUMMARY STRIP**

<table>
<thead>
<tr>
<th>Institution</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most recent employer</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Present duties</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
</tr>
<tr>
<td>Desired duties</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td>31</td>
<td>32</td>
<td>33</td>
<td>34</td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td>Available</td>
<td>No.</td>
<td>Yrs.</td>
<td>37</td>
<td>38</td>
<td>39</td>
<td>40</td>
<td>41</td>
<td>42</td>
<td>43</td>
</tr>
</tbody>
</table>

**NOTES:**


*Interviews are scheduled in this session on the basis of employer's requests only.
### Employer Form:

Employers should duplicate this page if listings requiring more than one description are being submitted.

- **Institution:**
- **Department:**
- **Interviewer:**
- **Title:**
- **City, State, Zip:**

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title of Position</strong></td>
<td><strong>Number of Positions</strong></td>
<td><strong>Starting Date</strong></td>
<td><strong>Term of Appointment</strong></td>
<td><strong>Teaching Hrs./Wk.</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Specialties Sought</strong></td>
<td><strong>Degree Preferred</strong></td>
<td><strong>Degree Accepted</strong></td>
<td><strong>Duties</strong></td>
<td><strong>Experience</strong></td>
<td><strong>Citizenship Restriction</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
<th>P</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Available for Interviews</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Summary Strip

- **Institution:**
- **City, State:**
- **Title of Position:**
- **No. Mo./Yr.:**
- **Specialties Sought:**
- **Duties:**
- **Experience:**
- **Citations:**
- **Interviews:**

### Notes:

- **Possible=P, Impossible=I,**
- **Interviews are scheduled in this session on the basis of employers' requests only.**
PREREGISTRATION AND MOTEL RESERVATION FORMS

Memphis State University
Memphis, Tennessee

MUST BE RECEIVED BY NOVEMBER 4, 1977

Please complete and send to:

Continuing Education
Memphis State University
P. O. Box 81360
Memphis, Tennessee 38152

Make checks payable to MEMPHIS STATE UNIVERSITY

MEETING PREREGISTRATION FORM

1. NAME (please print) last first middle

2. ADDRESS (for confirmation) number and street city state zip code

3. Affiliation

4. Accompanied by spouse (first name)

5. Signature ___________________________ Date ________________

6. My fee of $5.00 is enclosed ________________

7. I plan to attend the beer party ________________, Need transportation ________________.

ROOM RESERVATION FORM

8. I would like motel accommodations at the following:
   (1st choice) ____________________________ (3rd choice) ____________________________
   (2nd choice) ____________________________

9. Type of accommodation: ____________________________ Single(s) at $ ________________

                                ____________________________ Double(s) at $ ________________

10. I will arrive (date) ____________________________ at (hour) __________________________ a.m./p.m.
    I will depart (date) ____________________________ at (hour) __________________________ a.m./p.m.

11. My roommate will be ____________________________

   (If you will be traveling by plane, please complete the following.)

12. I will arrive at Memphis International Airport on ____________________________ Airlines, Flight No. ______
    at _______ a.m./p.m. on November ____________, 1977, and I will depart on Flight No. ______
    at _______ a.m./p.m. on November ____________, 1977.
DEPARTMENT OF MATHEMATICS
COLORADO STATE UNIVERSITY
invites applications for the position of DEPARTMENT HEAD

Qualifications include continuing excellence in mathematical research, a capacity for leadership, and some administrative experience. The Head will be expected to effectively represent the Department and promote continued growth of theoretical and applied research programs.

The Department has 33 full time faculty and offers programs of study in both pure and applied mathematics leading to the B.S., M.S., and Ph. D. degrees. Position available August 20, 1978: application deadline is December 15, 1977. Applications should include a vita and four letters of recommendation. Applications or inquiries should be sent to:

Dr. H. R. Kaufman — Chairman of Mathematics Search Committee — Department of Mathematics — Colorado State University — Fort Collins, Colorado 80523

Colorado State University is an equal opportunity employer.

KATHOLIEKE UNIVERSITEIT NIJMEGEN

full professor
of numerical
analysis

Applications are invited for the position (with tenure) of full professor of numerical analysis. Applicants must have considerable experience in research and teaching in this area and be capable of directing doctoral dissertations.

The appointee will perform his duties as a mathematics department faculty member. The University Computing Center is equipped with an IBM computer model 370/158 with 3M bytes central storage.

All interested and qualified persons are encouraged to contact: Henry O. Singh Varma, Chairman Department of Mathematics, Toernooiveld, Nijmegen (The Netherlands).

Applicants for this position should submit curriculum vitae, copies of publications, and list of three references, preferably before December 1, 1977.

university of
nijmegen
holland
faculty of
sciences

DEPARTMENT OF MATHEMATICS
OREGON STATE UNIVERSITY
Corvallis, Oregon 97331

Applications are invited for the position of Chairman, Department of Mathematics. The chairman should have leadership ability, administrative experience, and an appreciation of the role of pure and applied mathematics in a modern university. The chairman should be a nationally recognized research mathematician.

Application closing date: November 1, 1977.
Write to

F. J. Flaherty
Chairman, Search Committee
An Affirmative Action Employer.

The Department of Mathematics
of the
Universidad de Los Andes
Merida, Venezuela

requires the services of able Mathematicians who can enhance the knowledge and research abilities of our working groups in the fields of:

DIFFERENTIAL EQUATIONS
TOPOLOGY
FUNCTIONAL ANALYSIS
PROBABILITY THEORY
ALGEBRA

Some knowledge of Spanish is advantageous but not essential. Send Curriculum Vitae to the above mentioned address.
Lattice Theory
edited by A. P. HUHN and E. T. SCHMIDT
COLLOQUIA MATHEMATICA SOCIETATIS JANOS BOLYAI. Vol. 14
This volume grew out of the lectures given at a colloquium in Szeged, Hungary, within the framework of the famous international colloquia organized in this country by the Janos Bolyai Society. Experts in lattice theory and universal algebra review important new developments in topics like modular lattices, congruence varieties, algebraic lattices, congruence lattices, Stone and post algebras. The volume is directed mainly to the advanced student and research scholar specializing in the above areas. It will also serve as a valuable reference in the mathematics library.

Enveloping Algebras
by JACQUES DIXMIER
NORTH-HOLLAND MATHEMATICAL LIBRARY. Vol. 14
1977. xvi + 376 pages. Price US $35.00/Dfl. 90.00 ISBN 0-7204-0430-4
Since the works of Gel'fand, Harish-Chandra, Konstant and Duflo, a new theory has earned its place in the field of mathematics, due to the abundance of its results and the coherence of its methods: the theory of enveloping algebras. This study is the first to present the whole subject in textbook form. The most recent results are included, as well as complete proofs, starting from the elementary theory of Lie algebras. Chapter 1 establishes those properties of Lie algebras which are necessary to the rest of the work. Chapter 2 introduces the enveloping algebras. To study their primitive ideals, information about their general two-sided ideals is needed and this is provided in Chapter 3. Chapter 4 deals with just one of the links between enveloping algebras and commutative algebras. In Chapters 5 and 6, simple representations of Lie algebras are constructed and hence the primitive ideals (solvable case) of enveloping algebras. Chapters 7, 8 and 9 deal with the case where 9 is semisimple. Chapter 10 is based on the whole of Chapters 1-8 and covers the primitive ideals (general case). The book is intended for graduate students in pure mathematics and for research workers.

Differential Equations
edited by M. FARKAS
COLLOQUIA MATHEMATICA SOCIETATIS JANOS BOLYAI. Vol. 15
The Hungarian Bolyai Society organizes a series of international colloquia of which the first on differential equations was held at Keszthely in 1974. The present volume contains an edited version of papers presented at this event. Application areas such as Hamiltonian mechanics, hydrodynamics, gyroscopic problems, etc., have given rise to mathematical treatment by some authors, while other topics include stability, oscillation, local equivalence, asymptotic behaviour, boundary value problems, existence, uniqueness and continuation problems. The volume is directed towards the advanced student and the research scholar specializing in differential equations.

CONTRIBUTORS

A Course in Mathematical Logic
by J. BELL, and M. MACHOVER, United Kingdom
This book constitutes a comprehensive, up-to-date, one year graduate (or advanced undergraduate) course in mathematical logic and foundations of mathematics. It is based on a M.Sc. programme which the authors have conducted at London University for several years. Designed for self-study, no previous knowledge of logic is needed and the student should be able to work through the text in approximately one academic year. Many exercises (with hints) are included. The outstanding advantage of the text is its combination of comprehensiveness and intelligibility. No unreasonable demands are made on the reader. Furthermore, it will be seen that although the book represents an integrated and balanced account of the most important aspects of logic and foundations, it is arranged so that parts can be taken as separate smaller courses, as required: Chapters 1 to 3: First-order logic up to the completeness theorem, with additional material on tableaux etc. Chapter 4: A self-contained course on Boolean algebras. Chapter 5: Model theory. Chapters 6 and 8: A self-contained course on recursion theory with emphasis on register machines and an account of Matiyasevich’s results and its systematic use in proving incomplete-ness results. (This is the first general text in logic to include such an account.) Chapter 7: The limiting results of logic - undecidability and incompleteness. Chapter 9: An introduction to intuitionistic first-order logic. Chapter 10: Development of axiomatic set theory, with proof of the consistency of the axiom of choice and the generalized continuum hypothesis. Chapter 11: A coherent and readable introduction to non-standard analysis with applications to general topology and topological groups.

NORTH-HOLLAND PUBLISHING COMPANY
52 Vanderbilt Ave., New York, N.Y. 10017 or P.O. Box 211, Amsterdam, The Netherlands A-601
THE UNIVERSITY OF MARYLAND
at College Park

Two distinguished professorships available

Algebra and number theory

Of particular interest is a number theorist or an algebraist or an algebraic geometer with collateral interests in number theory.

Functional analysis

Of particular interest is a person who works in harmonic analysis or topological dynamics or in the interactions of functional analysis with other fields.

The University of Maryland is an equal opportunity employer.

Nominations, applications, and inquiries should be addressed to:

W. E. Kirwan, Chairman
Department of Mathematics
UNIVERSITY OF MARYLAND
College Park, Maryland 20742

THE DEPARTMENT OF MATHEMATICS
of
SOUTHERN METHODIST UNIVERSITY

announces openings at either the junior or senior level beginning in the academic year 1978-79. Visiting appointments may be possible. Those with orientation toward applications, demonstrated research achievement, and ability to interact with disciplines other than mathematics are preferred. Superior teaching ability and interest in curriculum development are expected.

Curriculum vitae should be sent by Feb. 1, 1978 to:

Professor G. Milton Wing, Chairman
Department of Mathematics
Southern Methodist University
Dallas, Texas 75275

An Equal Opportunity Employer

Symplectic Geometry and Fourier Analysis

by N. Wallach

with an appendix on quantum mechanics by R. Hermann. $22.

The Ames Research Center (NASA) Conference on

Geometric Control Theory
ed. by C. Martin & R. Hermann. $35.

The Ames Research Center (NASA) Conference on

Geometric Nonlinear Wave Theory
ed. by R. Hermann. $11.

Toda Lattices, Cosymplectic Manifolds, Backlund Transformations and Kinks

part A.,
by R. Hermann. $20.

MATH SCI PRESS
53 Jordan Road
Brookline, Ma. 02146

25% cash discount for individuals (40% students)

MATHEMATICAL SURVEYS

GEOMETRIC ASYMPTOTICS
by V. Guillemin and S. Sternberg

Symplectic geometry and the theory of Fourier integral operators are modern manifestations of themes that have occupied a central position in mathematical thought for the past three hundred years—the relations between the wave and the corpuscular theories of light. The purpose of this book is to develop these themes, and present some of the recent advances, using the language of differential geometry as a unifying influence.

Number 14
474 pages
List price $34.40; member price $25.80
ISBN 0-8218-1514-8; LC 77-8210
Publication date: 8 31 77
To order, please specify SURV/14

AMERICAN MATHEMATICAL SOCIETY
P. O. Box 1571 Annex Station
Providence, Rhode Island, 02901
PREREGISTRATION AND HOUSING FORM, Atlanta, Georgia

PREREGISTRATION is required in order to obtain hotel reservations through the Housing Bureau. Do not make reservations directly with hotels. All reservations will be confirmed. A deposit may be required by some hotels. At the time of confirmation, registrants will be informed of any deposit requirements. This payment should be sent directly to the hotel and is requested. In case cancellation is necessary after you have received your confirmation, please make your request in writing to the Mathematics Meetings Housing Bureau prior to December 26. After that date, cancellation must be made directly with hotel. In accordance with common practice, reservations will be held until 6:00 p.m. on the day of arrival unless a later hour is specified below. Please note that hotel rates are subject to taxes totaling 7 percent. Those participants who desire to PREREGISTER ONLY should complete only the preregistration section of the form below. Please note that separate preregistration fees are required for the Short Course, for the Joint Meetings, and for employers preregistering for the Employment Register.

Please check the function(s) you are preregistering for:
- Joint Mathematics Meetings
- Short Course on Numerical Analysis
- Employment Register: Applicant (no charge)
- Employment Register: Employer (fee $10)
- Please be sure to complete and return herewith the appropriate Employment Register form (see pages A-597, A-598).

NAME (Please print) surname first middle

ADDRESS number and street city state zip code

Employing institution ____________________________

Unemployed [ ]

I am a student at ____________________________ (5) Name of spouse

Accompanying children (number) ___ (7) Member of: AMS [ ] MAA [ ] (Member discount applies only to members of these organizations) or Nonmember [ ]

Member of other organizations: AWM [ ] MAG [ ] NAM [ ]

Amount enclosed for contribution to AMS Research Fellowship Fund $ _______

Amount enclosed for preregistration fees (check or money order only) $ _______

TOTAL AMOUNT ENCLOSED (check or money order only) $ _______

(For personal checks payable to AMERICAN MATHEMATICAL SOCIETY.)

HOUSING SECTION: Please indicate at least three choices in order of preference by writing numbers 1, 2, and 3 in order at left and by circling the requested type of room and rate. If less than three choices are given, or if first three choices are no longer available, the Housing Bureau will make your room assignment at the next available hotel with lowest rates. Preference will be given to students, unemployed, and applicants attending the Employment Register.

Assignment of rooms at the Phoenix Halls and Metropolitan YMCA.

1. I will arrive (date) (hour) a.m./p.m. and depart (date) (hour) a.m./p.m.
2. Please secure accommodations for me as ranked below: (Confirmation will be sent only to individual submitting form.)

<table>
<thead>
<tr>
<th>Number</th>
<th>Code</th>
<th>Name of Hotel</th>
<th>Single</th>
<th>Double</th>
<th>Twin</th>
<th>Triple</th>
<th>Quad</th>
<th>Suite</th>
</tr>
</thead>
<tbody>
<tr>
<td>470</td>
<td>75</td>
<td>Hyatt Regency Atlanta</td>
<td>$25</td>
<td>$41</td>
<td>$41</td>
<td>$52</td>
<td>$63</td>
<td>$95/165</td>
</tr>
<tr>
<td>420</td>
<td>70</td>
<td>Atlanta Motor Hotel</td>
<td>$20</td>
<td>$30</td>
<td>$30</td>
<td>$40</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>420</td>
<td>70</td>
<td>Atlanta Central-Motor Hotel</td>
<td>$21</td>
<td>$24</td>
<td>$27</td>
<td>$30</td>
<td>$33</td>
<td>N/A</td>
</tr>
<tr>
<td>420</td>
<td>70</td>
<td>Atlanta Hilton</td>
<td>$29</td>
<td>$41</td>
<td>$41</td>
<td>$52</td>
<td>$63</td>
<td>N/A</td>
</tr>
<tr>
<td>420</td>
<td>70</td>
<td>Best Western Motor Hotel</td>
<td>$24</td>
<td>$32</td>
<td>$32</td>
<td>$40</td>
<td>$55</td>
<td>N/A</td>
</tr>
<tr>
<td>420</td>
<td>70</td>
<td>Holiday Inn Downtown</td>
<td>$26</td>
<td>$29</td>
<td>$34</td>
<td>$38</td>
<td>$42</td>
<td>$95/125</td>
</tr>
<tr>
<td>420</td>
<td>70</td>
<td>Metropolitan YMCA</td>
<td>$6,50</td>
<td>$8,50</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>420</td>
<td>70</td>
<td>Peachtree Motor Hotel</td>
<td>$18</td>
<td>$21</td>
<td>$24</td>
<td>$27</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>420</td>
<td>70</td>
<td>Passport Center Inn</td>
<td>$24</td>
<td>$32</td>
<td>$32</td>
<td>$36</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

PHOENIX HALLS OF ATLANTA

1. Other room occupants, if sharing:
   - Full name
   - Address
   - Arrival date
   - Departure date

I will not require a room.

A-603
PROCEEDINGS OF THE CONFERENCE ON STOCHASTIC DIFFERENTIAL EQUATIONS AND APPLICATIONS

by J. DAVID MASON

CONTENTS:

A. B. Darst, The Deterministic Integral is Equivalent to the Lebesgue Integral.
A. Friedman, Optimal Stopping.
C. J. Holley, Quasi-Variational Inequalities.
B. J. Holley, The Regular Expansion in Singularly Good Elliptic Equations.

1977, 260 pp., $10.50/£7.45 ISBN: 0-12-478050-4

ALGORITHMS FOR THE COMPUTATION OF MATHEMATICAL FUNCTIONS

by YDELL L. LUKE

The main purpose of this volume is to provide FORTRAN IV programs in single, double, or extended precision with real or complex arithmetic. These programs allow for the evaluation of numerous mathematical functions by means of expansions in series of Chebyshev polynomials of the first kind, Padé approximations, or certain rational approximations not of the same class. The author covers virtually all the functions for which explicit coefficients were tabulated in his previous volumes, The Special Functions and Their Approximations, Volumes 1 and 2 (Academic Press, 1969) and Mathematical Functions and Their Approximations (Academic Press, 1975). The programming of the routines in the present work was done for use by the IBM 370/168 operating under OS/VS Release 1.7 on the FORTRAN IV H-Extended Compiler, Release 2.1. The programs may be used on other types of equipment with minimal adjustments.

1977, 298 pp., $15.00/£10.65 ISBN: 0-12-459940-0

ALGEBRAIC NUMBER FIELDS

by A. FROLICH

This volume is the outcome of a research seminar in algebraic number theory, held at the University of Durham, England, in early 1975. Almost all the lectures given are reproduced here, and in many cases they have been expanded and new, relevant material added. The specific topic of the symposium was the algebraic number fields of a symposium organized by the London Mathematical Society with the support of the Research Council and the Royal Society.

1977, 714 pp., $31.25/£16.00 ISBN: 0-12-268960-7

Send payment with order and save postage plus 50c handling charge. Orders under $15.00 must be accompanied by payment. Prices are subject to change without notice.

ACADEMIC PRESS, INC.
A Subsidiary of Harcourt Brace Jovanovich, Publishers
111 FIFTH AVENUE, NEW YORK, N.Y. 10003
24-28 OVAL ROAD, LONDON NW1 7DX

A-605
CONTRIBUTIONS TO ALGEBRA

A COLLECTION OF PAPERS DEDICATED TO ELLIS KOLCHIN

Edited by HYMAN BASS, PHYLLIS J. CASSIDY and JERALD KOVACIC


1977, 448 pp., $39.50/£28.05 ISBN: 0-12-080550-2

Send payment with order and save postage plus 50¢ handling charge. Orders under $15.00 must be accompanied by payment. Prices are subject to change without notice.

ACADEMIC PRESS, INC.
A Subsidiary of Harcourt Brace Jovanovich, Publishers
111 FIFTH AVENUE, NEW YORK, N.Y. 10003
24-28 OVAL ROAD, LONDON NW1 7DX

A-606