NOTICES OF THE AMERICAN MATHEMATICAL SOCIETY

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Calendar of AMS Meetings and Conferences

This calendar lists all meetings which have been approved prior to the date this issue of *Notices* was sent to the 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 been assigned. *Programs* of the meetings will appear in the issues indicated below. *First* and *supplementary* announcements of the meetings will have appeared in earlier issues.

Abstracts of papers presented at a meeting of the Society are published in the journal *Abstracts of papers presented to the American Mathematical Society* in the issue corresponding to that of the *Notices* which contains the program of the meeting. Abstracts should be submitted on special forms which are available in many departments of mathematics and from the headquarters office of the Society. Abstracts of papers to be presented at the meeting must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline given below for the meeting. Note that the deadline for abstracts for consideration for presentation at special sessions is usually three weeks earlier than that specified below. For additional information, consult the meeting announcements and the list of organizers of special sessions.

Meetings

Meeting #		Date	Place	Abstract Deadline	Program Issue
853	*	November 18–19, 1989	Los Angeles, California	Expired	November
854	*	January 17–20, 1990	Louisville, Kentucky	October 11	December
	†	(96th Annual Meeting)			
855	*	March 16–17, 1990	Manhattan, Kansas	December 12	February
856	*	March 23–24, 1990	Fayetteville, Arkansas	December 12	February
857	*	April 7–8, 1990	University Park, Pennsylvania	January 25	March
858	*	April 19–22, 1990	Albuquerque, New Mexico	January 25	March
859	*	August 8–11, 1990 (93rd Summer Meeting)	Columbus, Ohio	May 18	July/August
		November 2–3, 1990	Denton, Texas		
		January 16–19, 1991 (97th Annual Meeting)	San Francisco, California		
		August 8-11, 1991 (94th Summer Meeting)	Orono, Maine		
		January 8-11, 1992 (98th Annual Meeting)	Baltimore, Maryland		
		June 29-July 1, 1992 (Joint Meeting with the London Mathematical Society)	Cambridge, England		
		January 13-16, 1993 (99th Annual Meeting)	San Antonio, Texas		
		January 5-8, 1994 (100th Annual Meeting)	Cincinnati, Ohio		

* Please refer to page 1238 for listing of special sessions.

† Housing deadline is November 17

Conferences

January 16–17, 1990: AMS Short Course on Mathematical Questions in Robotics, Louisville, Kentucky.

June 7–July 4, 1990: Joint Summer Research Conferences in the Mathematical Sciences, University of Massachusetts at Amherst, Massachusetts.

June 1990: AMS-SIAM Summer Seminar on Vortex Dynamics and Vortex Methods, location to be announced.

July 1990: AMS Summer Research Institute on Differential Geometry, University of California, Los Angeles, California

Events Cosponsored by the Society

February 15–20, 1990: Section A (Mathematics) Sessions at the AAAS Annual Meeting, New Orleans, Louisiana.

Deadlines

	January Issue	February Issue	March Issue	April Issue
Classified Ads*	Nov 27, 1989	Jan 10, 1990	Feb 8, 1990	March 6, 1990
News Items	Nov 27, 1989	Jan 2, 1990	Feb 9, 1990	March 5, 1990
Meeting Announcements**	Nov 20, 1989	Dec 21, 1989	Jan 29, 1990	February 27, 1990

* Please contact AMS Advertising Department for an Advertising Rate Card for display advertising deadlines.

** For material to appear in the Mathematical Sciences Meetings and Conferences section.

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Mentoring and the Mathematics Postdoc

By most accounts, mathematics receives an improved report on the health of its postdoctoral program. Maybe mathematics does not compare so well to disciplines in the natural sciences, but in sheer numbers it has shown a dramatic increase in postdocs since the first "David Report". Yet, data showing numerical increases provide little insight into the health of the postdoctoral program in mathematics. Indeed, mathematics as a discipline possibly has the lowest expectations from the structure of its postdoctoral program and, therefore, possibly one of the least effective postdoctoral programs. In contrast to related disciplines, we do not view the postdoc as a continuing education/training period with a mentor but rather an opportunity to be free from non-research demands.

One of the reasons for the recent increase in the number of postdocs in mathematics is that, for statistical purposes, some funding agencies designate a researcher who receives financial support as a postdoc or a senior researcher simply by consideration of the number of years since the Ph.D. degree. (There have been some real increases with the NSF Postdoctoral Research Fellowships and the various institute postdocs.) Apart from this relabelling, there is a rather established image of a postdoc appointment in mathematics. One is a postdoc if one receives financial support for research (meaning, generally, a reduced teaching assignment), one does not hold a "tenure-track" appointment at the same institution as the postdoc appointment, and one has a title that includes in it somewhere the word "postdoc" or "fellow".

Postdoctoral appointments in mathematics, in general, have no active component of mentoring. They function more as recognition programs for the very select. Often the same individuals move from one postdoc appointment to the next, maintaining non-tenure-track academic appointments for many years past the Ph.D. In the natural sciences, a postdoctoral appointment is ordinarily expected upon earning the Ph.D. degree. There is a period of continuing education/training with an active mentoring component and then the opportunity for a postdoc no longer exists. This is not the case in mathematics.

Should the postdoctoral position in mathematics be less-the-exception and more-the-rule upon receipt of the Ph.D.? Should there be active mentoring that not only concerns development of research potential but emphasizes development of teaching skills and preparation for the new Ph.D. to address the myriad of professional expectations?

The whole subject of mentoring in the mathematics profession is being discussed by various groups in our community. In particular, the AMS Committee on Science Policy debated several aspects of the issues mentioned above at their recent meeting. This subject will be a major topic of discussion at the Committee's next meeting, and it is very likely that these discussions will lead to recommendations for Society action.

William Jaco
Executive Director

Letters to the Editor

Comment on Report of NSF Advisory Committee Meeting

The American Mathematical Society exists to support mathematical research. Such research requires publication and papers. It is thus troubling to find in these *Notices* (Vol. 36, No. 5, May/June 1989, p. 541) a report of a meeting at the National Science Foundation of the NSF advisory committee for Mathematics, in which one of the members of that committee "questioned the success of the current system, which he says 'produces papers but not people' ".

I submit that no system can produce mathematical people without producing the corresponding papers. The opposite opinion seems dangerous and counterproductive–especially at this time when NSF support for individual research is erratic, inadequate, and apparently subservient to the interest of industry, and when there is no mathematical scientist on the policy setting National Science Board.

Saunders Mac Lane
University of Chicago
(Received August 28, 1989)

A Bibliography on Stochastic Orderings

Stochastic orderings and related topics have been extensively studied and used in different disciplines like probability, statistics, operations research, finance, economics, mathematical physics, etc. It is often difficult for researchers to keep track of the developments of the field, since results are published in many different journals in seemingly unrelated areas.

In order to render the availability of results easier, we have planned to write a bibliography of publications about stochastic orderings (in the broad sense) and applications. All the scholars who have written papers in this area are kindly requested to send us reprints (or, at least, a list of their relevant papers). Of course, we would greatly appreciate to receive partial bibliographies, whenever they exist.

Suggestions and indications of researchers in the field are as welcome as reprints.

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Policy on Letters to the Editor

Letters submitted for publication in *Notices* are reviewed by the Editorial Committee, whose task is to determine which ones are suitable for publication. The publication schedule normally requires from two to four months between receipt of the letter in Providence and publication of the earliest issue of *Notices* in which it could appear.

Publication decisions are ultimately made by majority vote of the Editorial Committee, with ample provision for prior discussion by committee members, by mail or at meetings. Because of this discussion period, some letters may require as much as seven months before a final decision is made. Letters which have been, or may be, published elsewhere will be considered, but the Managing Editor of *Notices* should be informed of this fact when the letter is submitted.

The committee reserves the right to edit letters.

Notices does not ordinarily publish complaints about reviews of books or articles, although rebuttals and correspondence concerning reviews in *Bulletin of the American Mathematical Society* will be considered for publication. All published letters must include the name of the author.

Letters should be typed and in legible form or they will be returned to the sender, possibly resulting in a delay of publication.

Letters should be mailed to the Editor of *Notices*, American Mathematical Society, P.O. Box 6248, Providence, RI 02940, and will be acknowledged on receipt.

Newton's Principia Read 300 Years Later

V. I. Arnol'd and V. A. Vasil'ev

Abstract. Analyzing Kepler's law in two dimensions, Newton discovered an astonishingly modern topological proof of the transcendence of Abelian integrals. Newton's theorem was not really understood by mathematicians at that time, since it was based on the topology of Riemann surfaces. Thus, it was incomprehensible both for Newton's contemporaries and for 20th century mathematician who were bred on set theory and the theory of functions of a real variable, and who were afraid of multivalued functions.

In our paper we describe Newton's theorem and also some other new mathematical theorems, partially (more or less explicitly) contained in the Principia and partially suggested by Newton's text.

1. Newton's Theorem on the Nonintegrability of Ovals

An algebraic oval in the plane R^2 is part of a real algebraic curve (i.e., the zero set of a polynomial), homeomorphic to a circle. An oval is called nonsingular if it is C^∞-diffeomorphic to the circle.

An oval is called algebraically integrable if the area of its segment is an algebraic function of the secant line (i.e., there exists a nontrivial polynomial $F(V, a, b, c)$ which vanishes if V is the area cut by the line $ax + by = c$). An oval is locally algebraically integrable if the area of its segments coincides with an algebraic function in a neighborhood of any line (but these functions may be different for different lines).

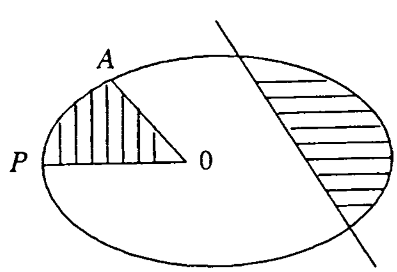

Fig. 1

Theorem 1 (Newton 1687, see **[N]**, Lemma XXVIII). *There exists no algebraically integrable convex nonsingular algebraic curve.*

(There exist compact integrable algebraic curves, C^∞-smooth at all their points but one, at which they have any prescribed finite number of derivatives. Example: the curve

$$y^m = x^{(n-1)^m}(a^n - x^m)$$

where m, n are even, see **[BR]**. If $m = n = 2$, it is the Huygens lemniscate; see Fig. 2.)

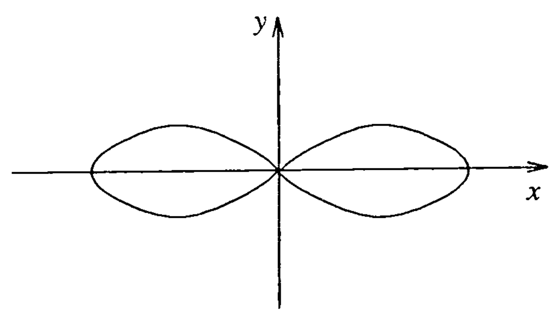

Fig. 2

Newton's Proof. Let us fix a point O inside the oval, and a ray with the origin O. Consider the function on the oval (or, equivalently, on the space of all the rays issuing from the origin), whose value at the point A equals the area of the sector bounded by the fixed ray, the radius OA and the oval, see Fig. 1. If the oval is integrable, this function is algebraic: a sector consists of the segment and a triangle, and the areas of both of these depend algebraically on the point A: this follows from the algebraicity and the integrability of the oval. Let us move the point A along the oval. After any complete cycle, the area of the sector increases by the area bounded by the oval. In particular, for the same point A this function has an infinite number of values which contradicts its algebraicity.

Moreover, the same reasoning proves the following stronger statement.

Theorem 2 (see [A_1], [A_5]). There exists no locally algebraically integrable nonsingular convex algebraic oval.

Does there exist any obstacle to applying the preceding argument to a singular oval, e.g. to the curve of Fig. 2? Indeed, we have used the fact that the area of a sector is an analytic function of the point A. In the case of singular curves the area is, in general, nonanalytic: when A crosses the singular point, the area function may jump from one local branch to another.

Lemma. Let the area of the sector (POA on Fig. 1) in a C^∞-smooth algebraic convex oval be a locally algebraic function of the point A. Then this function is even globally algebraic.

Proof. For a C^∞-smooth oval, the area of the sector, considered as a function of the point A, has an asymptotic* expansion

$$V = a_0 + a_1 t + a_2 t^2 + \cdots \tag{1}$$

near any point. Indeed, Newton discovered that any branch of an algebraic function has an asymptotic Puiseux expansion

$$V = c_0 + c_1 t^{1/p} + c_2 t^{2/p} + \cdots, \quad p \in \mathbf{Z}_+,$$

near any point (it follows from the method of the "Newton parallelogram"). But, if such an expansion for the graph of the area contains a term with a noninteger degree of t, then our oval will not be smooth. It will also be nonsmooth if the expansions (1) for the two branches of this graph at two sides of our point are different.

However, a locally algebraic function, having an expansion (1) at any point, is globally algebraic. Indeed, in the opposite case there would exist a point on the two sides of which the graph would coincide with two different algebraic curves. Both curves having the same expansion (1) now implies their order of tangency at this point would be infinite. This contradicts Bézout's theorem (formulated by Newton in the same paragraph of Principia): the number of (perhaps, confluent) intersection points of different irreducible algebraic curves is majorized by the product of their degrees; this proves the lemma.

Newton was led to his theorem by a particular case: the position of a planet on the Kepler ellipse cannot depend algebraically on the time (or on the area of the sector, swept by the radii, which is proportional to the time according to the two-dimensional Kepler law). Newton also noted that the length of an arc of an oval, cut by a line, cannot be an algebraic function of the line.

*In fact, this series converges in the neighborhood of the point, i.e., the area function is analytic; but in the proof that follows we only use the existence of an asymptotic series.

Some of the above requirements on the oval may be omitted. Newton himself does not require either nonsingularity or convexity. He only indicates that the oval should not touch any conjugate branch connecting it with infinity. (This requirement was added in 1713 and appears only in the second edition of the Principia.) Huygens wrote in a letter to Leibniz (1691) that Newton's argument is wrong, because it may be applied even to a triangle (which is, of course, integrable). Leibniz had answered that a triangle may hardly be considered as an oval. He suggested a more dangerous counterexample—the Huygens lemniscate curve (described in one of his preceding letters to Leibniz). The lemniscate curve evidently satisfies Newton's definition of an oval but it is algebraically integrable.*

Leibniz also conjectured the transcendence of the area of almost any segment, which a line with rational (or algebraic) coefficients cuts from an oval, given by an algebraic equation with rational coefficients. For instance, he conjectured the transcendence of the area π bounded by a circle of radius 1. The general problem of Leibniz contains Hilbert's seventh problem, but, unlike Hilbert's problem, Leibniz' problem seems to be still unsolved.

The requirement of algebraicity of ovals in Theorem 1 is unnecessary, since a smooth integrable oval is algebraic.

Indeed, let us consider the zero set of the area function on the space of lines in $\mathbf{R}^2$. This set is a (semi)algebraic curve C on the dual projective plane of the plane where the initial oval lives. This initial oval is the envelope of the lines belonging to the algebraic set C of lines. Such an envelope (the dual curve of C) is algebraic.

The algebraicity of the dual curve K of an algebraic curve C was evident to Newton. Indeed, the envelope is the limit for $h \to 0$ of the curves K_h, formed by the intersections of the lines belonging to C, having the angular coefficients t and $t + h$. The degree of the curves K_h being independent of h, the limit curve K is algebraic.

The independence of the degree on h follows from the calculation of the degree of a resultant (that is, the very calculation, which proves the "Bézout" theorem, majorizing the number of intersection points of two curves of degrees m and n by mn; this theorem is explicitly formulated and used by Newton on the same page of the Principia that we discuss here).

Newton's theorem can be extended to nonconvex curves, and also to multidimensional hypersurfaces. The proofs are based on monodromy theory (or Picard–Lefschetz theory), i.e., on the study of the ramification

*Newton's argument proves the transcendence of the area function for any oval, which is an immersed circle closed on its Riemann surface and which bounds a nonzero area on the plane.

of integrals along circles depending continuously on a parameter (see **[Ph]**, **[M]**, **[AVG]**, **[AVGL]**, **[D]**, **[F]**).

2. Generalizations of Newton's Theorem to Hypersurfaces in Even-dimensional Spaces

An ovaloid (a convex compact hypersurface) in $\mathbf{R}^n$ is called locally algebraically integrable, if the volume of the segment cut off the ovaloid by a hyperplane, coincides with an algebraic function near any fixed hyperplane.

Theorem 3 (V. A. Vasil′ev, see **[AVGL]**). *For n even, there does not exist any smooth convex locally algebraically integrable ovaloid in* $\mathbf{R}^n$.

We can choose a linear function x in $\mathbf{R}^n$, whose restriction to the ovaloid has the nondegenerate (Morse) minimum m and maximum M. Let us consider a path, going around the interval mM on the complexification on the axis x (Fig. 3).

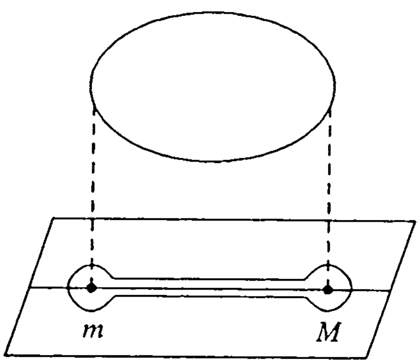

Fig. 3

Lemma 1. *The increment along the path of Fig. 3 of the volume $V(t)$ of the segment $x \leq t$ (or of the analytic continuation of this volume along the paths in the neighborhood of the interval mM in the complex plane t) is twice as large as the volume bounded by the ovaloid.*

Theorem 3 follows immediately from this lemma, which is based on the following fact.

Lemma 2. *For n even, the analytic continuation of the function $V(t)$ along the small circles centered at the points m, M, equals correspondingly the functions $-V(t)$, $V(M) - V(t)$.*

In other words, the power series of the function $V(t)$ in the neighborhoods of the points m, M contain only half-integer (but not integer!) degrees of $t - m$, $M - t$.

Conjecture 1. *For n even, there exist neither convex nor nonconvex smooth locally algebraically integrable ovaloids in* $\mathbf{R}^n$.

This is true for the usual ovals. The proof is similar to that of Theorem 3. We choose a more complicated path in the complex line x; see Fig. 4. This path turns around the critical values of the restriction of x to the oval, consecutively in the order of the corresponding critical points on the oval. When t returns to its initial value along this path, the analytic continuation of the area function increases by twice the area bounded by the oval.

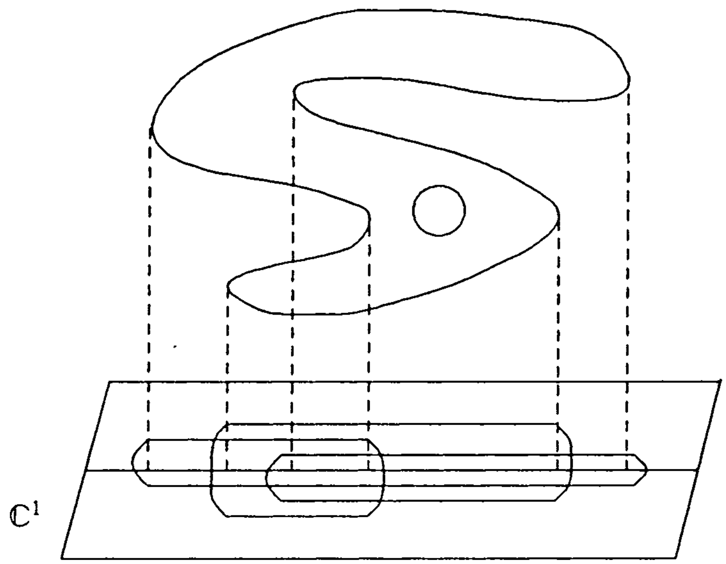

Fig. 4

Conjecture 1′. *A path with this property exists for any even n.*

3. Integrable Ovaloids in Odd-Dimensional Spaces

Unlike the even-dimensional spaces, the odd-dimensional spaces contain algebraically integrable ovaloids. A sphere in $\mathbf{R}^3$ is integrable (by a theorem of Archimedes). The same holds for any ellipsoid in any odd-dimensional space; see **[$\mathbf{A}_1$]**.

Conjecture 2. *Any irreducible smooth locally algebraically integrable ovaloid in $\mathbf{R}^{2k+1}$ is an ellipsoid.*

Theorem 4. *Almost all algebraic ovaloids of degree $d \geq 3$ in $\mathbf{R}^{2k+1}$, $k \geq 1$, are not algebraically integrable.*

The smooth algebraically integrable irreducible ovaloids of degrees ≥ 3 (if they do exist) are very special algebraic surfaces. For instance, their tangent planes at their complex parabolic points should be tangent to the (complexified) ovaloid along the curves of parabolic points, and so on (see **[AVGL]**).

The proof of Theorem 4 depends on the ramification properties of the volume of the segment continued analytically to the complex projective space of the cutting hyperplanes. The analytic continuation of the volume function along a path X_t in the space of hyperplanes is equal to the integral of the holomorphic differential n-form dx along an n-chain $\mathcal{X}_t$. This chain is bounded by the union of the complexified ovaloid hypersurface and the hyperplane X_t. The ramification hypersurface consists of those planes which are not general with respect to the complexified ovaloid hypersurface. The ramification at the tangents at the generic parabolic points of the complexified ovaloid is logarithmical. Hence the continuation of the volume function is infinitely multivalued. This implies Theorem 4.

The difference between the cases of even and odd n is due to the n-dependent sign in the Picard-Lefschetz formula, describing the ramification of the relative homology class of the chain $\mathcal{X}_t$. The same sign is responsible for the existence of a sharp back front of a wave in three space dimensions (and for its absence in a two-dimensional space). The existence of a sharp back front makes it possible to communicate acoustically in the spaces of odd dimensions (and makes it impossible to communicate in even-dimensional spaces).

The relation of Newton's theorem to the theory of hyperbolic PDE's is deeper than it seems. The same mathematical structure is even more transparent in another of Newton's creations—in his attraction theory.

4. Newton's Theorem on the Attraction by Spheres and Hyperbolic Surfaces

First we recall the following results of Newton.

Theorem 5 ([N], Theorem XXX). *If toward the individual points of a spherical surface are directed forces decreasing inversely proportional to the distances from these points, then a particle inside this surface is not attracted to any side.*

Indeed, for any infinitely narrow cone with the wedge at this particle the intersections of the sphere with the opposite parts of the cone attract the particle with equal forces, since the areas of these intersections are proportional to the squares of distances.

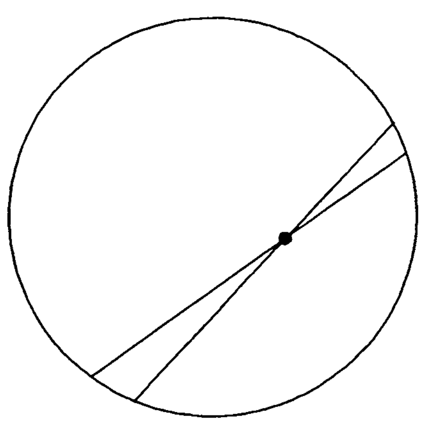

Fig. 5

Theorem 6 ([N], Theorem XXXI). "*With the same assumptions, I affirm that a particle outside a spherical surface is attracted to the center with the force inversely proportional to its squared distance from the center.*"

Proof. A spherically symmetric noncompressible (of divergence zero) vector field decreases inversely proportional to the squared distance to the center (since its flows through all the spheres are the same). The attraction field of any particle is noncompressible. Hence, the attraction field of any body is noncompressible outside this body. Thus, the attraction field of any sphere is noncompressible outside the sphere. Being obviously spherically symmetric, it coincides with the attraction field of a particle in the center.

These theorems together with the corresponding proofs hold in n-dimensional space, if the attraction force is inversely proportional to the $n-1$-th power of the distance.

Moreover, these theorems may be extended to the case of any ellipsoid in $\mathbf{R}^n$, if the density of the distribution of the matter on its surface is inversely proportional to the length of the gradient of the quadratic form defining this ellipsoid in the corresponding point. In this case, inside the ellipsoid the attraction is absent, and outside it is constant on the ellipsoids confocal with the initial one. (Ivory's theorem, [**I**].)

Newton's theorems on the attraction of ellipsoids may be extended to hyperbolic surfaces of arbitrary degree in $\mathbf{R}^n$.

Definition. An algebraic hypersurface of degree d in $\mathbf{R}^n$ is called hyperbolic with respect to a point x, if any real line containing this point intersects the surface exactly d times (possibly, at infinity). Such points x form the hyperbolicity set of the surface. This set is a union of some connected components of the complement to the hypersurface (see [**ABG**]); such components are called hyperbolicity domains.

For example, an ellipsoid has one hyperbolicity domain, and a two-sheeted hyperboloid—two such domains.

A smooth hyperbolic surface given by a polynomial equation $F = 0$ partitions $\mathbf{R}^n$ into the components which we shall call zones. Let us order them according to the minimal number of intersections with the hypersurface of a path connecting a point of a component with a point of a fixed hyperbolicity domain. This hyperbolicity domain will be called the 0-th zone.

The standard charge on the hyperbolic surface $F = 0$ is defined by the form dx/dF (i.e., as the limit of a homogeneous charge between the surfaces $F = 0$ and $F = \varepsilon$ with density $1/\varepsilon$ and the signs equal to ± 1 depending on the parity of the number of the corresponding component of the surface).

Theorem 7 (see [A_2]). *The standard charge on a hyperbolic surface does not attract the points in the hyperbolicity domain. Moreover, the same holds for the product of the standard charge and a polynomial of degree $d-2$ (where d is the degree of the surface)*

For an ellipsoid $d = 2$, hence only the standard density is admissible, but for $d = 4$ we have many admissible densities.

If the degree of the polynomial-multiplier is m units more than the critical value $d-2$, then the potential in the hyperbolicity domain is a polynomial of degree at most m; see [G].

The Newton-Coulomb potential (the attractive power in $\mathbf{R}^n$ is proportional to r^{1-n}) may be replaced here by any Green's function G in $\mathbf{R}^n - \{0\}$, which is homogeneous of degree $s-n$ (or, for $s = n$, proportional to the logarithm on any ray) and satisfies the equation $G(-x) = (-1)^s G(x)$ (s being a natural number). In this case the critical degree $d-2$ is replaced by $d-s$.

Theorem 8 ([G]). *A G-potential of the charge, which is the product of the standard one and of a polynomial of degree $d-s+m$, coincides with a polynonmial of degree $\leq m$ in the hyperbolicity domain.*

Is there any trace of the algebraicity of the potential in the other domains? (The simplest example is the logarithmic potential of a uniform circle in the outer domain.)

Theorem 9 (V. A. Vasil'ev). *In the k-th zone of a hyperbolic curve of degree d in $\mathbf{R}^2$, any partial derivative of the Newton potential of the standard charge coincides with a sum of two algebraic functions, having at most C_d^k values. Moreover, the same holds for the partial derivatives of order $q+2-d$ of the potential of the charge which is the product of the standard one and of a polynomial of degree q.*

For instance, for the circle all the derivatives of the potential are single-valued functions so that our majorization of the number of the values $(C_2^1)^2 = 4$ is not attained. It is related with the fact that the functions F and G are not in general position: the singular lines of the function $G = \ln|x|$ in C^2 are asymptotic with respect to the equation of the circle. In the case of a typical ellipse our majorization is the best possible: the analytic continuations of the derivatives of the potential are 4-valued functions.

The idea of the proof is very close to that for Theorems 1–4 (although it provides the opposite answer). Namely, for any point $x \in \mathbf{R}^2 - \{F = 0\}$, consider two complex lines $\{\xi \mid |x-\xi| = 0\}$ (i.e., $(x_1-\xi_1)^2+(x_2-\xi_2)^2 = 0$) and the intersection set of these lines with the surface $\{F = 0\} \subseteq C^2$. This set consists of $2d$ points (possibly, infinitely distant): d points on any line. If x belongs to the k-th zone and is "generic" (i.e., all these $2d$ intersection points are distinct and finite), then the μ-th partial derivative ($|\mu| > q-d+r$) of the potential is given by the integral of a suitable differential form along a chain which consists of $2k$ small standard circles near some $2k$ of these intersection points—k points on any line. The motion of the point x in the complex domain may only permute these points and the corresponding circles.

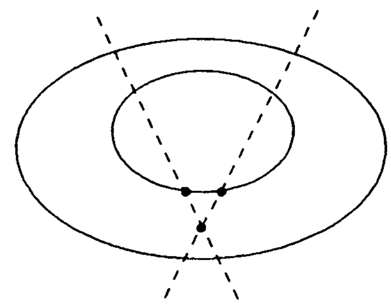

Fig. 6

5. Magnetic Field Analogues of Newton's and Ivory's Theroems

In one other generalization of the theorems of Newton and Ivory, the attracting ellipsoid is replaced by a hyperboloid of an arbitrary signature. In this case, the potential function is replaced by a differential form of a suitable degree (depending on the signature). Consider for instance the one-sheeted hyperboloid in three-dimensional Euclidean space. It is fibered in a natural way into two families of curves—the meridians and the parallels, diffeomorphic correspondingly to the lines and to the circles (these curves are the traces on the hyperboloid of the family of the ellipsoids and of the two-sheeted hyperboloids, confocal to it; they are also called the elliptic coordinate curves). The family of meridians may be extended to the family of elliptic coordinate lines fibering into the lines of the interior of the hyperboloid. The family of parallels may be extended to an analogous fibration of the exterior part of the hyperboloid into the closed elliptic coordinate lines. (See Fig. 7)

Theorem 10 ([A_3]). *There exists an electric current along the meridians (along the parallels) of the hyperboloid, whose magnetic field vanishes in the interior domain and is directed along the parallels in the exterior one (vanishes in the exterior domain and is directed along the meridians in the interior one).*

In [VS] this result is extended to the case of hyperboloids of arbitrary signatures in spaces of arbitrary dimensions.

It would be interesting to transfer these "magnetic" generalizations of Newton's and Ivory's theorems to the case of the "generalized hyperbolic" surfaces of higher degree.

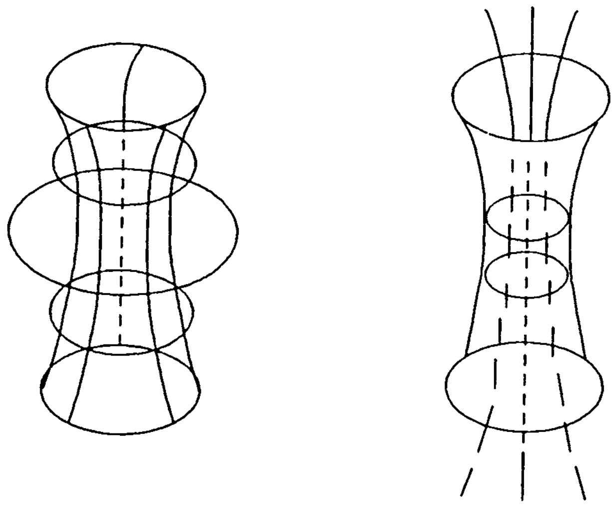

Fig. 7

6. Duality Between the Attraction Laws

Consider a point moving on a plane under the action of an attractive force directed toward the origin and proportional to the a-th degree of the distance from the origin. It turns out, that for any such attraction law there exists a dual one; the orbits of the motion under the dual force fields are related by a simple conformal mapping. For instance, the universal attraction law and Hooke's law are dual to each other. Let us introduce on the plane a complex coordinate w.

Theorem 11 ([A_4], [A_5]). *Any orbit of the motion of the point w on the plane of complex numbers in a central attraction field in which the force is proportional to w^a, is transformed into an orbit of the motion in a central field proportional to z^A by the map $z = w^\alpha$, provided that*

(2) $\qquad (a+3)(A+3) = 4, \qquad \alpha = (a+3)/2.$

The proof is an immediate calculation. (See Fig. 8)

Theorem 11 is not formulated in the Principia. But is was guessed thanks to Newton's formula for the angle between the consequent apocenters of an almost round orbit.

Example. If $a = 1$ (Hooke's law) then formula (2) gives $A = -2$ (the universal attraction law) and $\alpha = 2$. We get **Theorem 12** (Bohlin, see [**B**]). *The transformation $wpAw^2$ transforms an ellipse centered at the origin of the complex plane into an ellipse having a focus at the origin.*

Proof. The Zhukovsky function $w = \xi + \xi^{-1}$ transforms a circle $|\xi| = r > 1$ into a Hooke's ellipse centered at 0 with foci ± 2. But $w^2 = \xi^2 + \xi^{-2} + 2$—the squaring of w translates the focus of the ellipse to the origin.

Remark 1. The motion of a free point (along a straight line on the plane) may be considered as the motion in the zero field of arbitrary degree. Applying Theroem 11, we obtain special orbits of the motion in a central field of an arbitrary degree A on the plane. These orbits are obtained from the straight lines by the mapping $wpAw^\alpha$, $\alpha = 2/(A+3)$.

In the case of the universal attraction law these special trajectories are parabolas ($\alpha = 2$). In the general case, the equation of these generalized parabolic orbits in the polar coordinates is $r^\alpha = \sec\alpha\phi$.

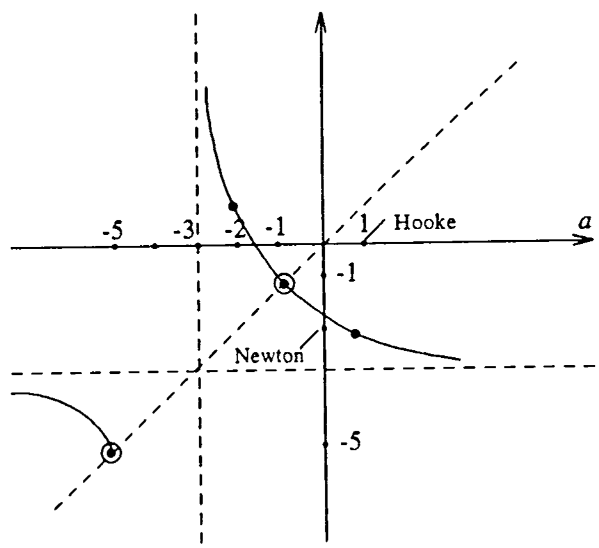

Fig. 8

Remark 2. Newton had considered in the Principia the values $a = 1, -1, -2, -3, -5$. The values $a = -1$ and -5 are special for the duality law (2) as the self-dual ones. For $a = -5$, the formula (2) gives $\alpha = -1$.

Corollary. *The orbits of motions in a central field, whose force is inversely proportional to the 5-th degree of the distance from the origin, are transformed by the inversions to the orbits of the same kind.*

Example. The straight lines of motion in the zero field which do not contain the origin are transformed by the inversion into the circles containing the origin. Hence the motion along a circle containing the attracting point is possible in a field inversely proportional to the 5-th degree of the distance—this corollary is also due to Newton [N].

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1989 Annual AMS-MAA Survey

(First Report)

Report on the 1989 Survey of New Doctorates,
Edward A. Connors
Salary Survey for New Doctorates
Faculty Salary Survey
Doctoral Degrees Conferred, 1988–1989

Highlights

1. 904 doctorates in the mathematical sciences were awarded by U.S. institutions in the period July 1, 1988 through June 30, 1989. This is a 12% increase over last year and an 18% increase over the average of the fall counts for the last four years.

2. 411 U.S. citizens received doctorates in the mathematical sciences. This is only 46% of the total awarded by U.S. institutions, however.

3. 24% of the U.S. citizen doctorates were awarded to women. This is the largest percentage ever and a significant increase over the 20 to 21% awarded in the last six years.

4. Although women comprise 24% of the U.S. citizens receiving doctorates, only 16% of the new doctorate hires in the U.S. doctorate-granting departments were women.

5. 9 of the 411 U.S. citizen doctorates were black, 7 of whom were women. Black women account for 7% of the doctorates awarded to women U.S. citizens.

6. Median starting salary for new doctorates reporting teaching (or teaching and research) employment was $30,500 (men) and $31,000 (women).

Report on the 1989 Survey of New Doctorates

Edward A. Connors

This report presents a statistical profile of new doctorates in the mathematical sciences awarded by universities in the United States and Canada during the period July 1, 1988, through June 30, 1989. It includes the employment status of recipients of 1988-1989 doctorates in the mathematical sciences (as of August 31, 1989), an analysis of the data by sex, minority group, and citizenship, and reports trends in the number of doctoral degrees for each of Groups I through V (see box on next page for description of groups). Table 1 provides the response rates for the 1989 Survey of New Doctorates.

TABLE 1: Response Rates

Group I	39 of 39
Group II	42 of 43 including 5 with 0 degrees
Group III	73 of 84 including 19 with 0 degrees
Group IV	55 of 72 including 7 with 0 degrees
Group Va	12 of 16 including 2 with 0 degrees
Group Vb	15 of 31 including 2 with 0 degrees
Group VI	24 of 29 including 6 with 0 degrees

Doctorates Granted

For the first time, we report separately the number of new doctorates granted by U.S. and Canadian institutions. These fall counts will, as is customary, be updated in the Second Report of the 1989 Survey, to appear in a spring 1990 issue of *Notices*.

TABLE 2A: New Doctorates, Fall Counts

	84-85	85-86	86-87	87-88	88-89
U.S.	732	756	779	804	904
Canada	37	45	66	52	53
Total	769	801	845	856	957

TABLE 2B: New Doctorates, Fall and Spring Counts

	84-85		85-86		86-87		87-88		88-89	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
U.S.	732	765	756	782	779	808	804	828	904	*
Canada	37	42	45	45	66	66	52	55	53	*
Total	769	807	801	827	845	874	856	883	957	*

*To appear in a spring 1990 issue of *Notices*.

In Table 2C we record the number of new doctorates in the mathematical sciences in the U.S. and Canada from the years 1984-1985, exclusive of Group Vb. The response rate for Group Vb, which includes departments in engineering and management science, is the lowest of all groups.

TABLE 2C: New Doctorates Awarded by Groups I–Va

	84-85	85-86	86-87	87-88	88-89
I-Va	712	698	743	760	838**

** This is a fall count. The other entries in Table 2C are spring counts. Table 2C will be updated to include a spring count for 1988-1989 in a spring 1990 issue of *Notices.*

Employment Status of New Doctorates, 1988-1989

Table 3A shows the employment status, by type of employer and field of degree, of the 957 recipients of doctoral degrees conferred by the mathematical sciences departments in the U.S. and Canada between July 1, 1988, and June 30, 1989. The names of these individuals are listed with their thesis titles in a later section of this First Report of the 1989 Annual Survey. Again this year we present the employment status of the 179 women new doctorates in Table 3B.

There was an increase in new doctorates hired in Groups I-V (240 compared to 207 last year), with a significant increase in those hired by Group I departments (100 compared to 73). There was a slight increase in new doctorates hired by government and business (103 compared to 96). Although women comprise 24% of the new doctorates, only 16% of the new doctorates hired by Groups I-V were women.

In rows 1 through 5 of Table 3A the numbers represent those who have accepted appointments in U.S. doctorate-granting mathematical sciences departments (Groups I-V). In the next two rows the figures represent those accepting appointments in U.S. mathematical sciences departments granting masters and bachelors as the highest degree. The information was initially obtained from the department granting the degrees and from data subsequently supplied by recipients themselves.

Of the 619 new doctorates employed in the U.S. 68% (422) assumed academic positions in university or four-year college mathematical sciences departments (a three percentage point increase over last year), and 17% (103) took employment in government, business, or industry (a four percentage point decrease).

Table 3A shows as "not yet employed" about 4% of the 1988-1989 new doctorates, excluding those whose employment status is unknown. The data in Table 3A were obtained in many instances early in the summer of 1989 and do not reflect subsequent hiring; an update of Table 3A is planned for the Second Report in a spring 1990 issue of *Notices.* A similar update last year revealed that all but 11 new 1987-1988 doctorates found positions by fall 1988 (see *Notices*, November 1988, page 1303, and May/June 1989, page 535).

This first report on the 1989 Survey includes a report on the 1989 survey of new doctorates, a report on salaries of new doctorates, salary and on faculty members in four-year colleges and universities, and a list of names and thesis titles for members of the 1988-1989 Ph.D. class. The report is based on information collected from questionnaires distributed in May to departments in the mathematical sciences in colleges and universities in the United States and Canada, and later to the recipients of doctoral degrees granted by these departments between July 1988 and June 1989, inclusive. A second round of questionnaires was distributed in September, concerned with data on fall enrollments, majors, and departmental size. This data will appear in the second report on the 1989 Survey, in a spring 1990 issue of *Notices*.

For these reports, departments are divided into groups according to the highest degree offered in the mathematical sciences. The groups are described in the box in this report.

The 1989 Annual AMS-MAA Survey represents the thirty-third in an annual series begun in 1957 by the Society. The 1989 Survey is under the direction of the AMS-MAA Committee on Employment and Educational Policy (CEEP), whose members are Donna L. Beers, Morton Brown, Stefan A. Burr, Edward A. Connors (chair), Philip C. Curtis, Jr., David J. Lutzer, and James J. Tattersall. The questionnaires were devised by CEEP's Data Subcommittee whose members are Edward A. Connors (chair), Lincoln K. Durst (consultant), John D. Fulton, James F. Hurley, Charlotte Lin, Don O. Loftsgaarden, David J. Lutzer, James W. Maxwell (ex officio), Donald E. McClure, and Donald C. Rung. Comments or suggestions regarding this Survey may be directed to the subcommittee.

Groups I and **II** include the leading departments of mathematics in the U.S. according to the 1982 assessment of Research-Doctorate Programs conducted by the Conference Board of Associated Research Councils in which departments were rated according to the quality of their graduate faculty.[1]
Group I is composed of 39 departments with scores in the 3.0–5.0 range.
Group II is composed of 43 departments with scores in the 2.0–2.9 range.
Group III contains the remaining U.S. departments reporting a doctoral program.
Group IV contains U.S. departments (or programs) of statistics, biostatistics and biometrics reporting a doctoral program.
Group V contains U.S. departments (or programs) in applied mathematics/applied science, operations research and management science which report a doctoral program.
Group Va is applied mathematics/applied science; **Group Vb** is operations research and management science.
Group VI contains doctorate-granting departments (or programs) in the mathematical sciences in Canadian universities.
Group M contains U.S. departments granting a master's degree as the highest graduate degree.
Group B contains U.S. departments granting a baccalaureate degree only.

[1] These findings were published in *An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences*, edited by Lyle V. Jones, Gardner Lindzey, and Porter E. Coggeshall, National Academy Press, Washington, D.C., 1982. The information on mathematics, statistics and computer science was presented in digest form in the April 1983 issue of *Notices*, pages 257–267, and an analysis of the above classifications was given in the June 1983 *Notices*, pages 392–393. For a listing of departments in Groups I and II see April 1988 *Notices*, pages 532-533.

TABLE 3A: Employment Status of 1988–1989 New Doctorates in the Mathematical Sciences

Type of Employer	Algebra and Number Theory	Real and Complex Analysis	Geometry and Topology	Logic	Probability and Statistics	Applied Mathematics	Discrete Mathematics and Combinatorics	Numerical Analysis	Linear and Nonlinear Optimization	Other	Total
Group I	12	32	22	7	4	18		2		3	100
Group II	8	8	7	2	5	13	2	1	1		47
Group III	10	10	2	1	9	8	1	3	1	3	48
Group IV	1				30						31
Group V					4	7				3	14
Masters	7	18	9	2	12	21	4	3	1	2	79
Bachelors	21	18	15	1	16	8	12	1	2	9	103
Two-year Colleges	2	1	1		1	2		1			8
Other Academic Departments	2		3		22	13	2	4	7	9	62
Research Institutes	3		8		6	3		2		2	24
Government		1			9	6			1		17
Business and Industry	1	2	4	2	43	15	1	2	9	7	86
Canada, Academic	2	8	1		10	1	3	1			26
Canada, Nonacademic					2	4					6
Foreign, Academic	18	22	19	1	39	24	6	3	6	6	144
Foreign, Nonacademic		2	2	1	5	5		1	3	3	22
Not seeking employment	1		1		2	2	1	1			8
Not yet employed	7	6	11	1	17	9		2	1	6	60
Unknown	5	14	5	4	21	6	2	10	2	3	72
Total	100	142	110	22	257	165	34	37	34	56	957

TABLE 3B: Employment Status of 1988–1989 New Doctorates in the Mathematical Sciences Females Only

Type of Employer	Algebra and Number Theory	Real and Complex Analysis	Geometry and Topology	Logic	Probability and Statistics	Applied Mathematics	Discrete Mathematics and Combinatorics	Numerical Analysis	Linear and Nonlinear Optimization	Other	Total
Group I	1	3	1	2	1	1					9
Group II	1	3	2	1	1	2					10
Group III	2		1		2			1		1	7
Group IV					9						9
Group V					1	2				1	4
Masters	2	5	2	1	3	5	1				19
Bachelors	6	3	5		3	7	7			5	36
Two-year Colleges	2	1			1						4
Other Academic Departments					6	3		1	1	1	12
Research Institutes					1	1					2
Government					2	1					3
Business and Industry			2		12				3		17
Canada, Academic			1		3						4
Canada, Nonacademic											
Foreign, Academic		3	5		7	4				1	20
Foreign, Nonacademic											
Not seeking employment			1								1
Not yet employed		1	2		9	2					14
Unknown		1			3			2	1	1	8
Total	14	20	22	4	64	28	8	4	5	10	179

TABLE 4: Sex, Minority Group, and Citizenship of New Doctorates
July 1, 1988–June 30, 1989

U.S. DEGREES	MEN					WOMEN					TOTAL
	CITIZENSHIP					CITIZENSHIP					
RACIAL/ETHNIC GROUP	U.S.	Canada	Other	Not Known	Total Men	U.S.	Canada	Other	Not Known	Total Women	
Asian, Pacific Islander	5		216	1	222	2		39	2	43	265
Black	2		8		10	7		3		10	20
American Indian, Eskimo, Aleut			1		1						1
Mexican American, Puerto Rican, or other Hispanic	4	1	18		23	4		7		11	34
None of those above	281	9	134	1	425	82	1	16	1	100	525
Unknown	21	2	15	13	51	3	2	1	2	8	59
Total Number	313	12	392	15	732	98	3	66	5	172	904

CANADIAN DEGREES	MEN					WOMEN					TOTAL
	CITIZENSHIP					CITIZENSHIP					
RACIAL/ETHNIC GROUP	U.S.	Canada	Other	Not Known	Total Men	U.S.	Canada	Other	Not Known	Total Women	
Asian, Pacific Islander		1	8		9		1			1	10
Black			1		1						1
American Indian, Eskimo, Aleut											
Mexican American, Puerto Rican, or other Hispanic								1		1	2
None of those above		15	9		24		2	1		3	27
Unknown	1	10	1		12		1	2		3	15
Total Number	1	26	19		46		4	3		7	53

Sex, Minority Group, and Citizenship of New Doctorates, 1988-1989

Table 4 presents a breakdown according to sex, minority group, and citizenship of the new doctorates. The information reported in this table was obtained from departments granting the degrees and in some cases from the recipients themselves.

Of the 904 doctorates awarded by U.S. universities, the citizenship is reported as known for 884 recipients, with 411 reporting U.S. citizenship. Thus, only 46% of the doctorates awarded by U.S. institutions went to U.S. citizens. The percentage of U.S. citizens receiving doctorates in the mathematical sciences, having declined consistently, from 73% in 1979-1980 to 45% in 1987-1988, now shows a slight increase, to 46%. For the first time since 1984-1985 the number of U.S. citizen doctorates is over 400. Refer to Table 5 and the accompanying graphs.

Among the U.S. citizens receiving doctorates in the mathematical sciences, 9 were black (7 women, 2 men) and 8 were Hispanic (4 women, 4 men).

Women comprise 24% of the U.S. citizens receiving doctorates in the mathematical sciences, a three to four percentage point increase over the 20 to 21% reported for the last six years. Table 6 presents data for the period 1973-1974 through 1988-1989.

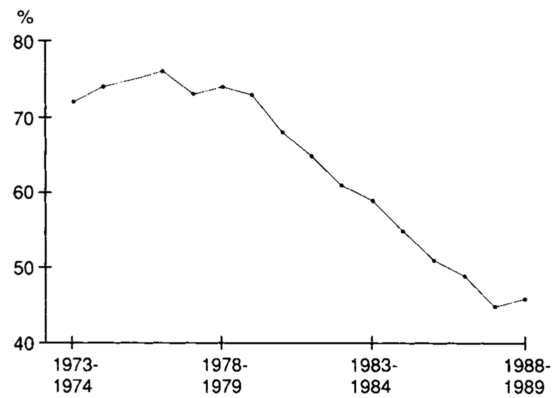
Citizenship and Sex of U.S. Doctorates, 1973 to 1989

Again this year, information is presented on the annual number of doctorates granted by U.S. universities to U.S. citizens since 1973 (Table 5). This number is divided into male and female doctorates (Table 6). In Table 5 the column headed Adjusted Total of Doctorates given by U.S. Universities gives the number of doctorates granted between July 1 and June 30 of the indicated years *whose citizenship is known.* Column 2 gives the number who are U.S. citizens and column 3 the percentage that this represents. In Table 6 the number in column 2 of Table 5 is further divided into men and women. Note that in both tables *all years prior to* 1982-1983 include doctorates granted by computer science departments.

TABLE 5: U.S. Citizen Doctorates

	Adjusted Total of Doctorates given by U.S. universities	Total of Doctorates who are U.S. citizens	%
1973-1974	938	677	72%
1974-1975	999	741	74%
1975-1976	965	722	75%
1976-1977	901	689	76%
1977-1978	868	634	73%
1978-1979	806	596	74%
1979-1980	791	578	73%
1980-1981	839	567	68%
1981-1982	798	519	65%
1982-1983	744	455	61%
1983-1984	738	433	59%
1984-1985	726	396	55%
1985-1986	755	386	51%
1986-1987	739	362	49%
1987-1988	798	363	45%
1988-1989	884	411	46%

Graph for Table 5: U.S. Citizen Doctorates Total of Doctorates by Percent



Graph for Table 5: U.S. Citizen Doctorates

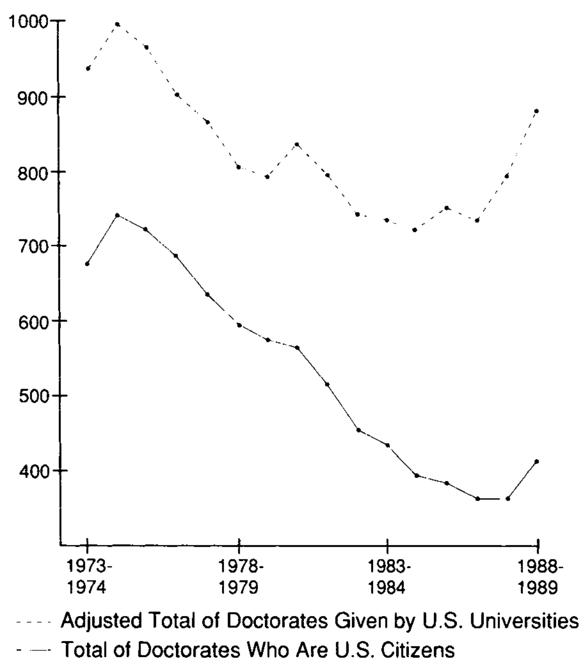


TABLE 6: U.S. Citizen Doctorates, Male and Female

	Doctorates who are U.S. Citizens	Male	Female	% Female
1973-1974	677	618	59	9%
1974-1975	741	658	83	11%
1975-1976	722	636	86	12%
1976-1977	689	602	87	13%
1977-1978	634	545	89	14%
1978-1979	596	503	93	16%
1979-1980	578	491	87	15%
1980-1981	567	465	102	18%
1981-1982	519	431	88	17%
1982-1983	455	366	89	20%
1983-1984	433	346	87	20%
1984-1985	396	315	81	20%
1985-1986	386	304	82	21%
1986-1987	362	289	73	20%
1987-1988	363	287	76	21%
1988-1989	411	313	98	24%

Concluding Remarks

We view with guarded optimism the small increase in the number of U.S. citizens receiving doctorates in the mathematical sciences. It is encouraging to note the increase in the number of women among the new doctorates, but it remains to be seen if this gain can be sustained. Perhaps the proportionately large number of women new doctorates hired by the Group B departments, the wellspring of American mathematics, will result in larger numbers of women enrolling in graduate programs (35% of the new doctorates hired by Group B departments were women).

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[17] National Research Council. *Summary Report 1986, Doctorate Recipients from United States Universities*, National Academy Press, Washington, DC, 1987.

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[25] *Meeting the Needs of a Growing Economy: The CORETECH Agenda for the Scientific and Technical Workforce.* CORETECH, Washington, D.C. 1988.

[26] *Measuring National Needs for Scientists to the Year 2000.* Report to the National Science Foundation. Commission on Professionals in Science and Technology, Washington, D.C., July 1989.

Salary Survey for New Recipients of Doctorates, 1988-1989

The figures for 1989 were compiled from questionnaires sent to individuals who received a doctorate in the mathematical sciences during the 1988-1989 academic year from universities in the United States and Canada.

Questionnaires requesting information on salaries and professional experience were distributed to 769 recipients of degrees using addresses provided by the departments which granted the degrees. Of these, 8 were returned by the postal service as undeliverable and could not be forwarded. There were 406 individuals who returned forms between late June and early September. The tables below are based on the responses from 351 of these individuals (269 men and 82 women). Data from 55 responses were not used in the compilation of the tables below; forms with insufficient data, or from individuals who had indicated they had part-time employment, were not yet employed, or were not seeking employment were considered unusable.

Readers should be warned that the data in this report are obtained from a self-selected sample and inferences from them may not be representative of the population. For more comprehensive information on the recipients of new doctorates granted last year in the mathematical sciences in the U.S. and Canada, see the preceding article by E. Connors.

Key to Tables. *Salaries* are listed in hundreds of dollars. *Years* listed refer to the academic year in which the doctorate was received. 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 1989 sample. Quartile figures are given only in cases where the number of responses is large enough to make them meaningful.

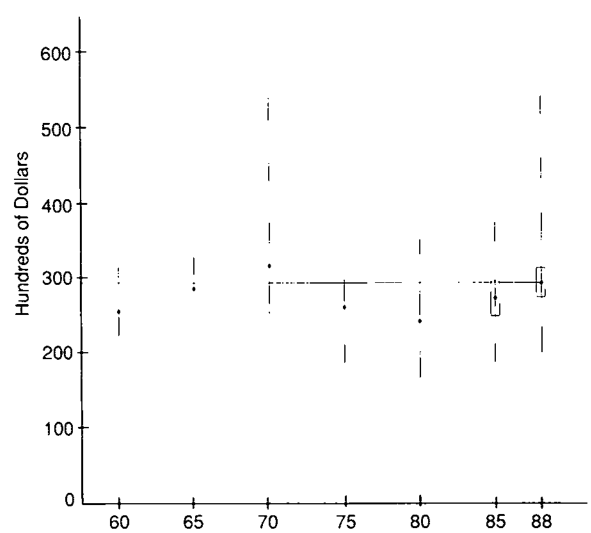
Graphs. The horizontal line represents the median salary for 1988 in hundreds of dollars. The points plotted are the relevant data for each year converted to 1988 dollars using the implicit price deflator prepared annually by the Bureau of Economic Analysis, U.S. Department of Commerce. Where available, first and third quartiles appear as boxes along the vertical lines. (Because the deflator is not yet available for this year, the 1989 figures do not appear on the graphs.)

Note that salaries for teaching, or teaching and research, have yet to return to their high point of 1970, although steady progress has been made since 1980. (For further details, see Donald Rung's article, "A Fifteen Year Retrospective on Academic Salaries of U.S. Doctorate Holding Faculty," in the November 1985 issue of *Notices*, pp. 772-773.)

Nine-Month Salaries

Ph.D. Year	Min	Q_1	Median	Q_3	Max	Reported Median in 1988 $
TEACHING OR TEACHING AND RESEARCH (162 + 35)						
1960	49		65		80	255
1965	70		80		105	287
1970	85		110		195	318
1975	90	120	128	135	173	262
1980	105	155	171	185	250	242
1984	140	215	230	255	380	259
1985	170	23	250	270	380	272
1986	170	250	269	290	400	287
1987	165	260	280	300	517	289
1988	200	275	293	314	575	293
1989	200	290	310	330	478	—
1986M	170	250	269	290	400	
1986F	230	250	268	294	270	
1987M	165	260	280	300	517	
1987F	230	251	280	325	420	
1988M	200	274	290	315	520	
1988F	216	275	299	314	575	
1989M	200	290	305	330	478	
1989F	220	295	310	330	470	
One Year Experience (145 + 43)						
1989M	200	290	303	330	470	
1989F	220	290	310	325	450	

Nine-Month Teaching



Nine-Month Salaries

Ph.D. Year	Min	Median	Max	Reported Median in 1988 $
		RESEARCH (6 + 0)		
1960	52	65	80	255
1965	71	81	90	291
1970	78	105	160	303
1975	100	—	110	—
1980	125	137	180	194
1984	205	205	205	231
1985	205	235	250	257
1986	215	245	280	261
1987	250	300	300	309
1988	260	280	385	280
1989	235	270	330	—
1986M	215	250	280	
1986F	240	240	240	
1987M	250	300	300	
1987F	—	—	—	
1988M	260	280	385	
1988F	—	—	—	
1989M	235	270	330	
1989F	—	—	—	
One Year Experience (6 + 0)				
1989M	235	270	330	
1989F	—	—	—	

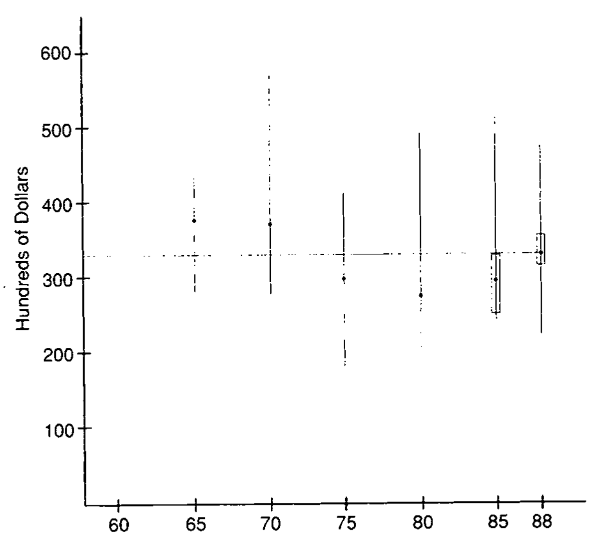
Nine-Month Research

Graph omitted because sample size too small.

Twelve-Month Salaries

Ph.D. Year	Min	Q_1	Median	Q_3	Max	Reported Median in 1988 $
		TEACHING OR TEACHING AND RESEARCH (40 + 14)				
1960			NO DATA			
1965	78		104		121	373
1970	95		128		200	370
1975	87		145		204	297
1980	143		195		350	276
1984	134		260		450	293
1985	220	230	273	300	470	299
1986	220	265	320	360	480	341
1987	200	283	315	357	520	325
1988	220	313	330	360	480	330
1989	238	290	315	370	620	—
1986M	220	270	321	360	480	
1986F	240	245	285	340	360	
1987M	200	270	300	358	520	
1987F	300	320	339	357	450	
1988M	220	308	330	355	480	
1988F	329	335	350	365	441	
1989M	238	295	315	370	620	
1989F	275	290	314	380	435	
One Year Experience (34 + 10)						
1989M	260	300	318	370	495	
1989F	275	290	320	380	435	

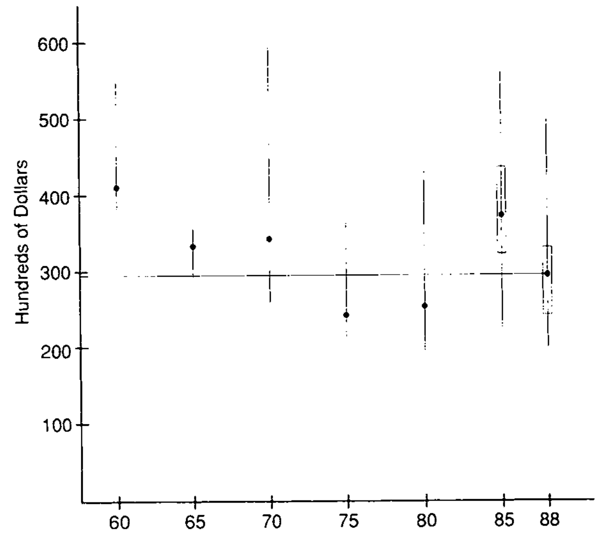
Twelve-Month Teaching



Twelve-Month Salaries

Ph.D. Year	Min	Q_1	Median	Q_3	Max	Reported Median in 1988 $
			RESEARCH (19 + 7)			
1960	97		105		140	412
1965	81		93		107	334
1970	90		120		205	347
1975	90		119		180	243
1980	120		180		321	255
1984	145		261		415	294
1985	190	295	342	400	520	374
1986	160	240	300	325	510	296
1987	200	260	287	337	430	320
1988	200	245	295	331	505	295
1989	180	250	317	385	623	—
1986M	160	240	300	330	510	
1986F	240	240	270	300	300	
1987M	200	250	282	337	400	
1987F	300	308	316	373	430	
1988M	200	240	280	330	505	
1988F	280	320	330	350	360	
1989M	180	250	300	393	623	
1989F	200	295	350	373	400	
One Year Experience (16 + 7)						
1989M	180	250	300	361	522	
1989F	200	295	350	373	400	

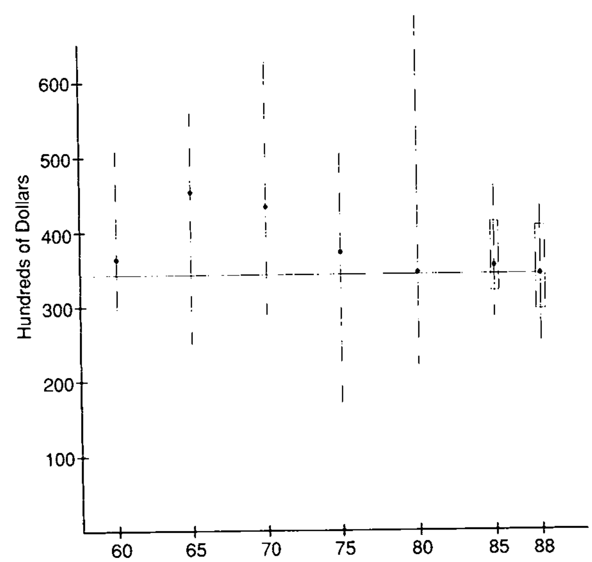
Twelve-Month Research



Twelve-Month Salaries

Ph.D. Year	Min	Q_1	Median	Q_3	Max	Reported Median in 1988 $
			GOVERNMENT (10 + 0)			
1960	72		93		130	365
1965	70		126		160	452
1970	100		150		223	433
1975	78		182		247	372
1980	156		244		501	345
1984	140		315		490	355
1985	263	294	325	381	440	356
1986	270	330	400	449	610	426
1987	200	290	360	465	500	371
1988	240	298	343	405	436	343
1989	330	363	378	438	540	—
1986M	270	330	400	449	610	
1986F	—	—	—	—	—	
1987M	200	290	360	465	500	
1987F	—	—	—	—	—	
1988M	240	290	332	360	436	
1988F	380	380	405	430	430	
1989M	330	363	378	438	540	
1989F	—	—	—	—	—	
One Year Experience (7 + 0)						
1989M	330	367	375	403	540	
1989F	—	—	—	—	—	

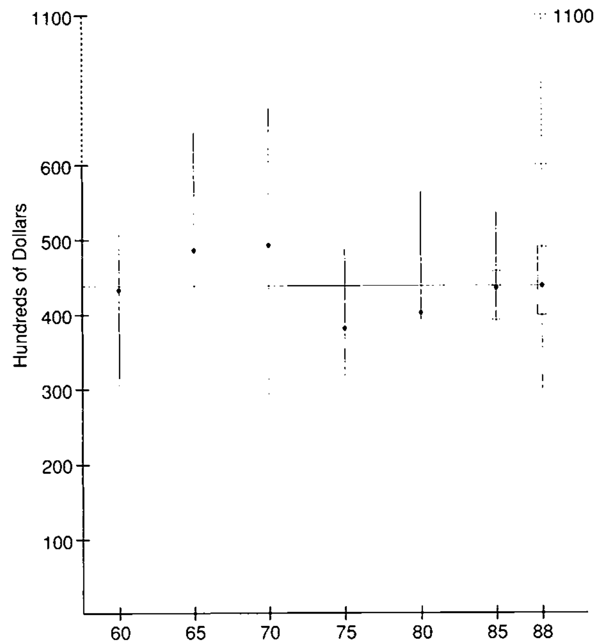
Twelve-Month Government



Twelve-Month Salaries

Ph.D. Year	Min	Q_1	Median	Q_3	Max	Reported Median in 1988 $
			BUSINESS AND INDUSTRY (32 + 8)			
1960	78		110		150	432
1965	100		136		180	488
1970	96		170		235	491
1975	114		187		240	383
1980	190		284		400	402
1984	180		378		660	426
1985	260	360	400	420	493	438
1986	324	373	425	477	750	453
1987	290	400	451	500	1500	464
1988	300	400	440	490	1100	440
1989	250	420	464	505	5250	—
1986M	324	390	453	492	750	
1986F	350	357	375	400	440	
1987M	290	400	465	517	1500	
1987F	300	394	424	466	502	
1988M	300	400	431	490	1100	
1988F	375	437	454	495	660	
1989M	250	420	464	513	5250	
1989F	375	430	470	500	516	
One Year Experience (17 + 7)						
1989M	250	420	450	510	580	
1989F	375	430	480	500	516	

Twelve-Month Industry



Faculty Status Survey

Salaries

The questionnaire sent to departments in the mathematical sciences this year was substantially changed from previous years. Departments were asked to report the number of faculty whose academic-year salaries fell within given salary intervals. The charts on the following four pages display data for all eight groups - faculty salaries by rank, mean salaries by rank, the number within that rank, and the number of usable returns for the group. Note that we no longer collect or report salary information for two years. See Tables on the following pages.

Age

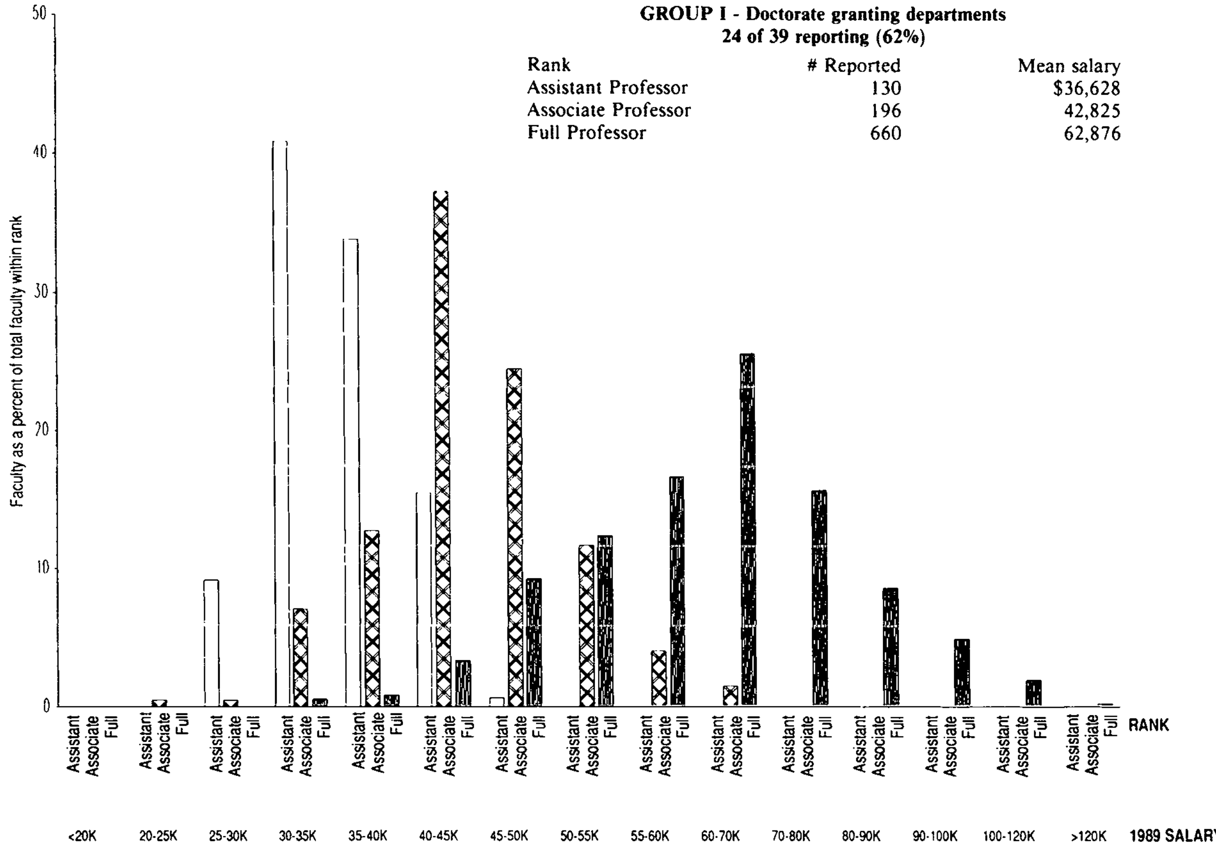
Age data collected on the Faculty Status questionnaire will be reported in the Second Report in a spring 1990 issue of *Notices*, with other departmental information currently being collected.

Acknowledgement

The Annual AMS-MAA Survey attempts to provide an accurate appraisal and analysis of various aspects of the academic mathematical scene vital to the entire mathematical community. Yearly, collegiate departments in the United States, and the doctorate-granting departments in Canada, are provided the opportunity to respond. The quantity and quality of the responses directly determine the quality of the information in these reports. Without the dedicated cooperation of the secretarial and administrative support staff in the mathematical science departments we would not be able to conduct a survey, nor be confident in our analysis of its results. We are, unfortunately, unable to thank personally all the departmental assistants for their cooperation, but it is nonetheless appreciated. However, we are able to thank the administrative support staff of the AMS, especially Marcia Almeida, Monica Foulkes, and James W. Maxwell, whose efforts are acknowledged and appreciated.

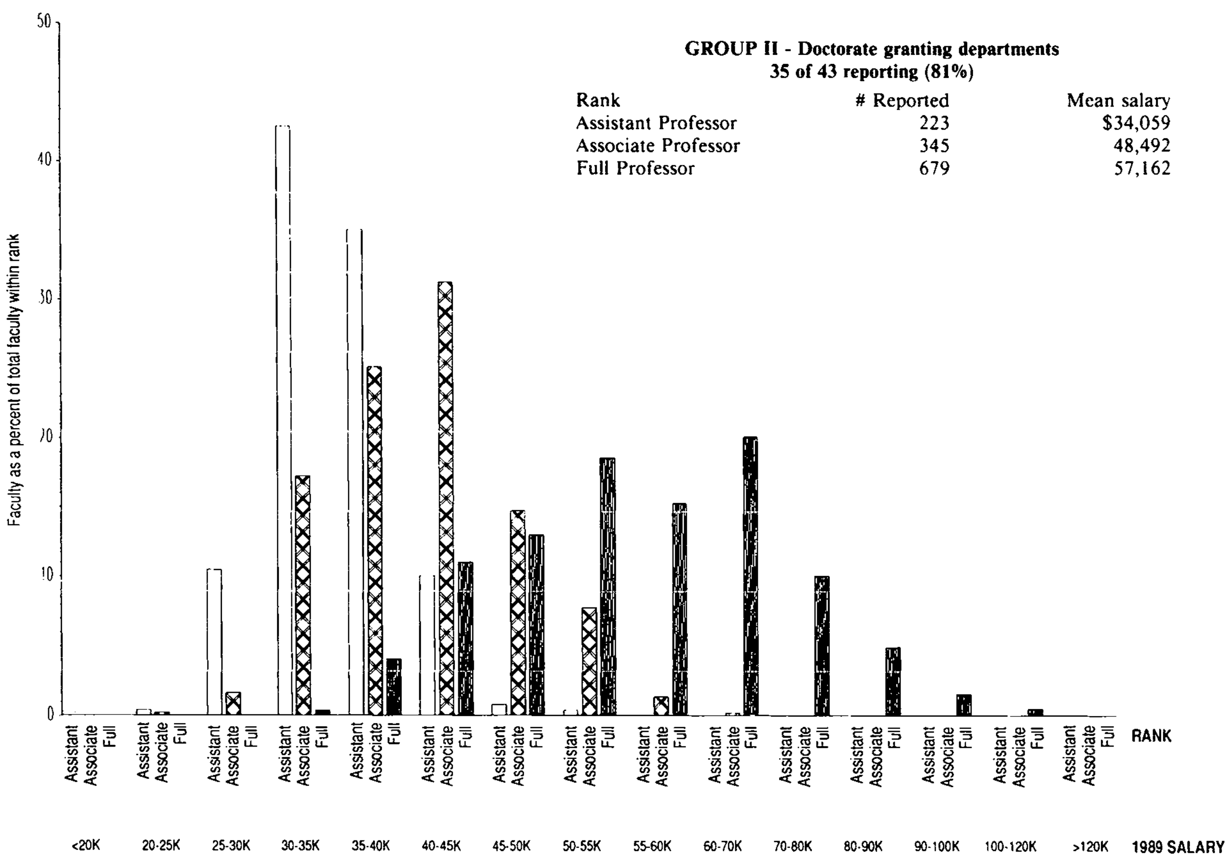
GROUP I - Doctorate granting departments
24 of 39 reporting (62%)

Rank	# Reported	Mean salary
Assistant Professor	130	$36,628
Associate Professor	196	42,825
Full Professor	660	62,876



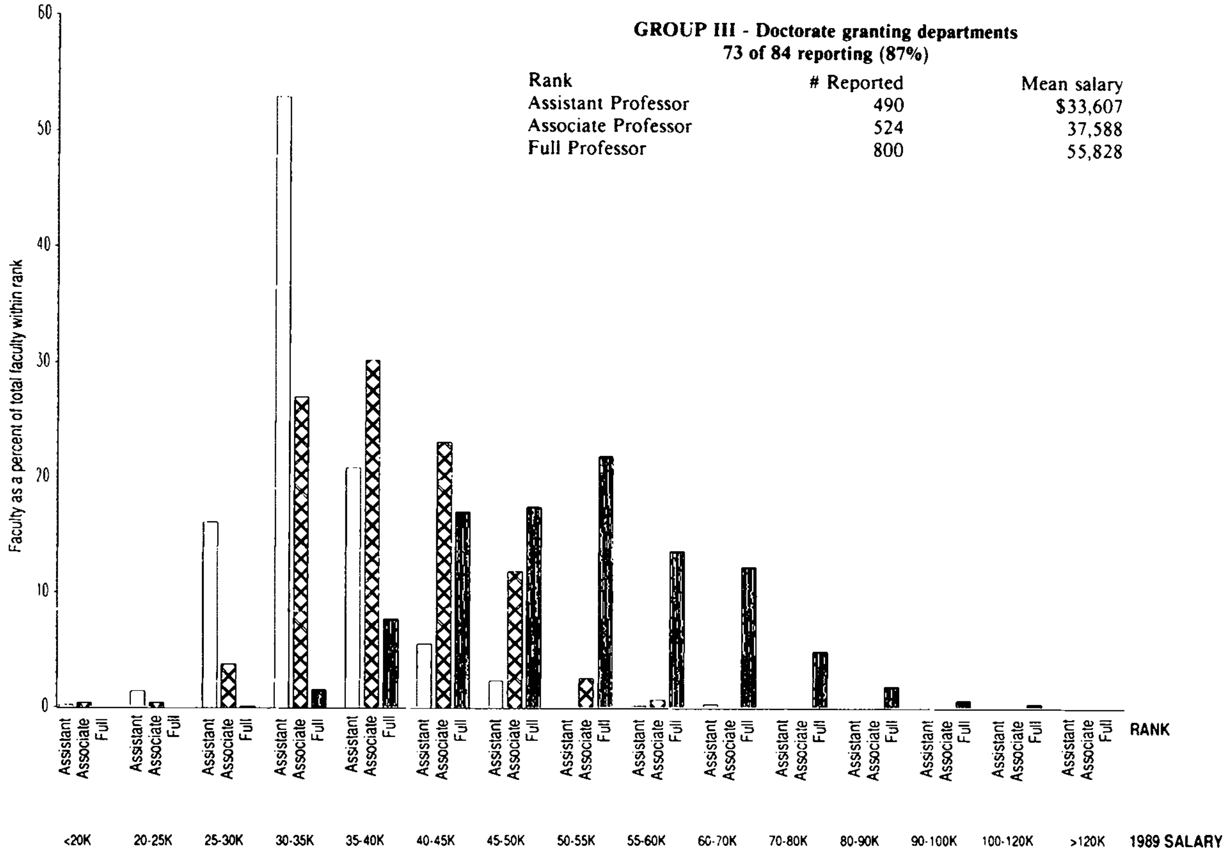
GROUP II - Doctorate granting departments
35 of 43 reporting (81%)

Rank	# Reported	Mean salary
Assistant Professor	223	$34,059
Associate Professor	345	48,492
Full Professor	679	57,162



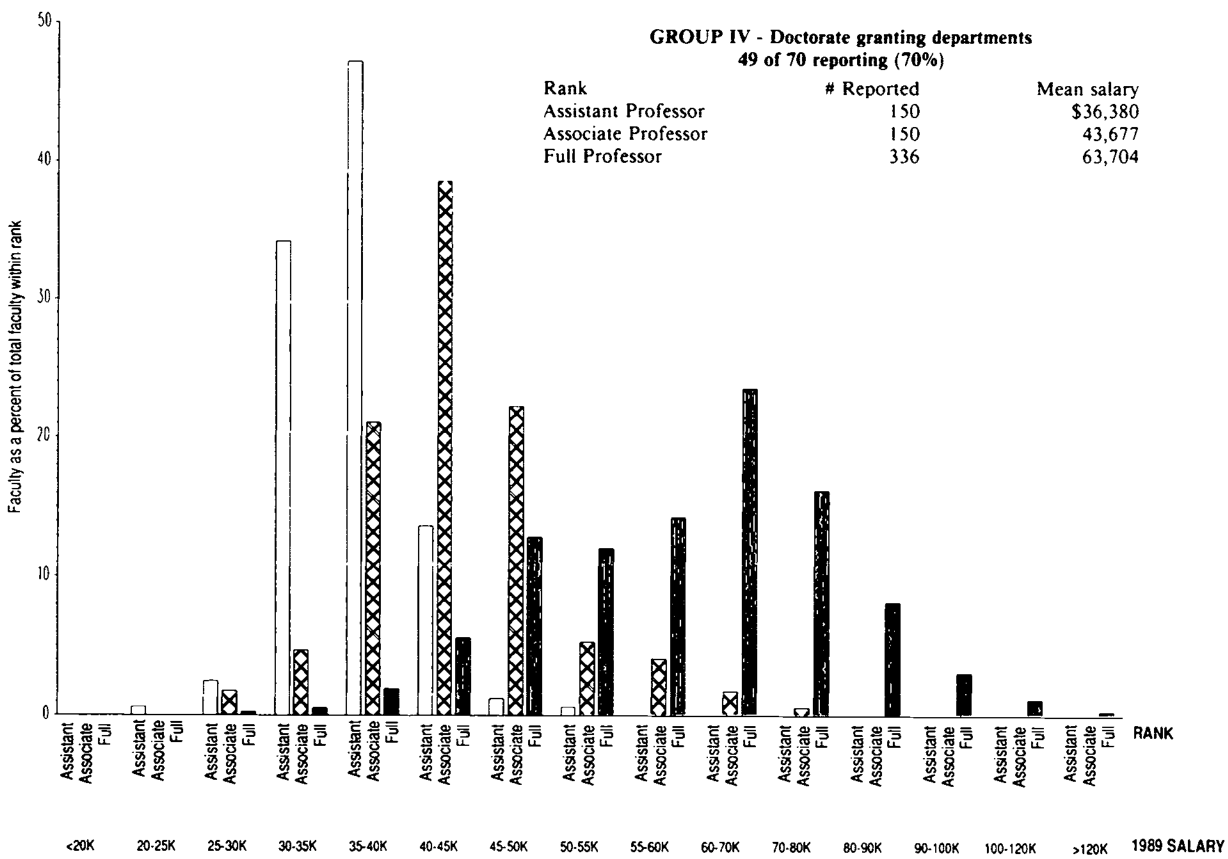
GROUP III - Doctorate granting departments
73 of 84 reporting (87%)

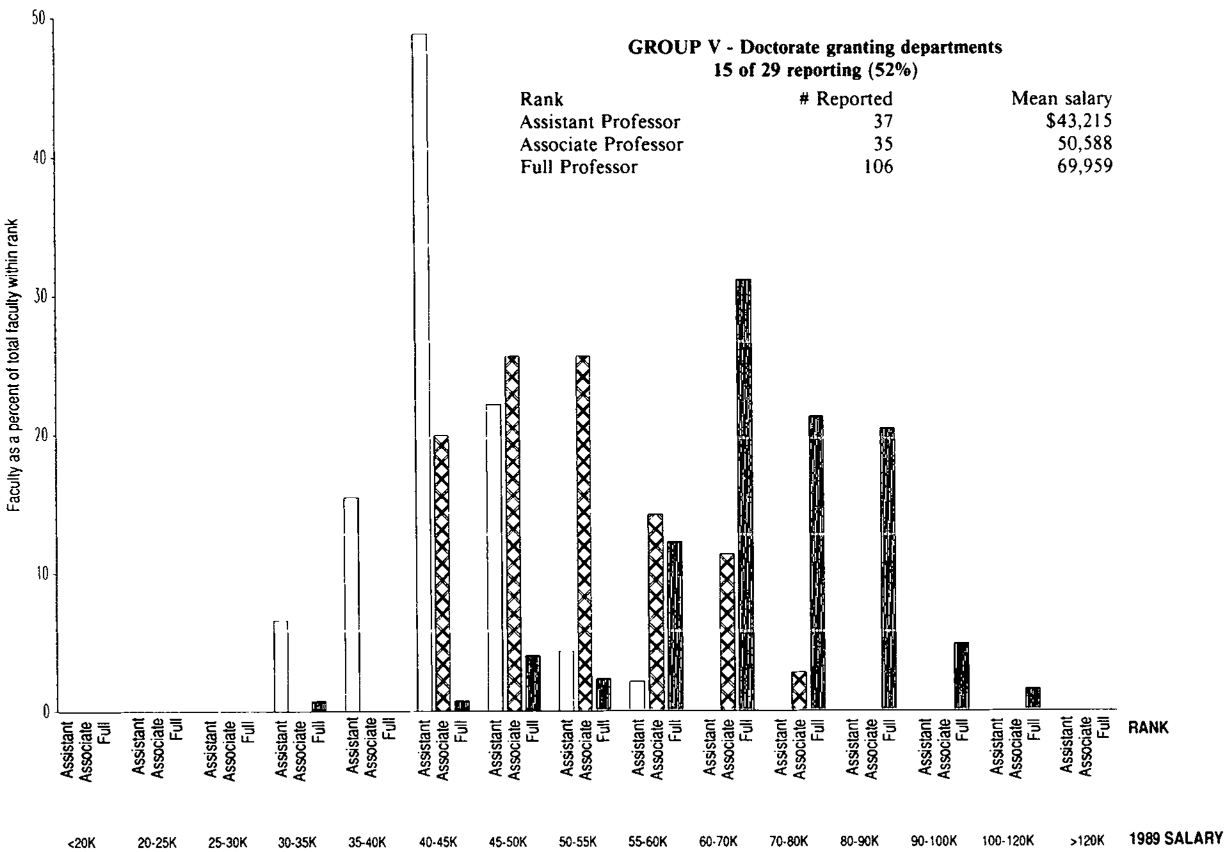
Rank	# Reported	Mean salary
Assistant Professor	490	$33,607
Associate Professor	524	37,588
Full Professor	800	55,828

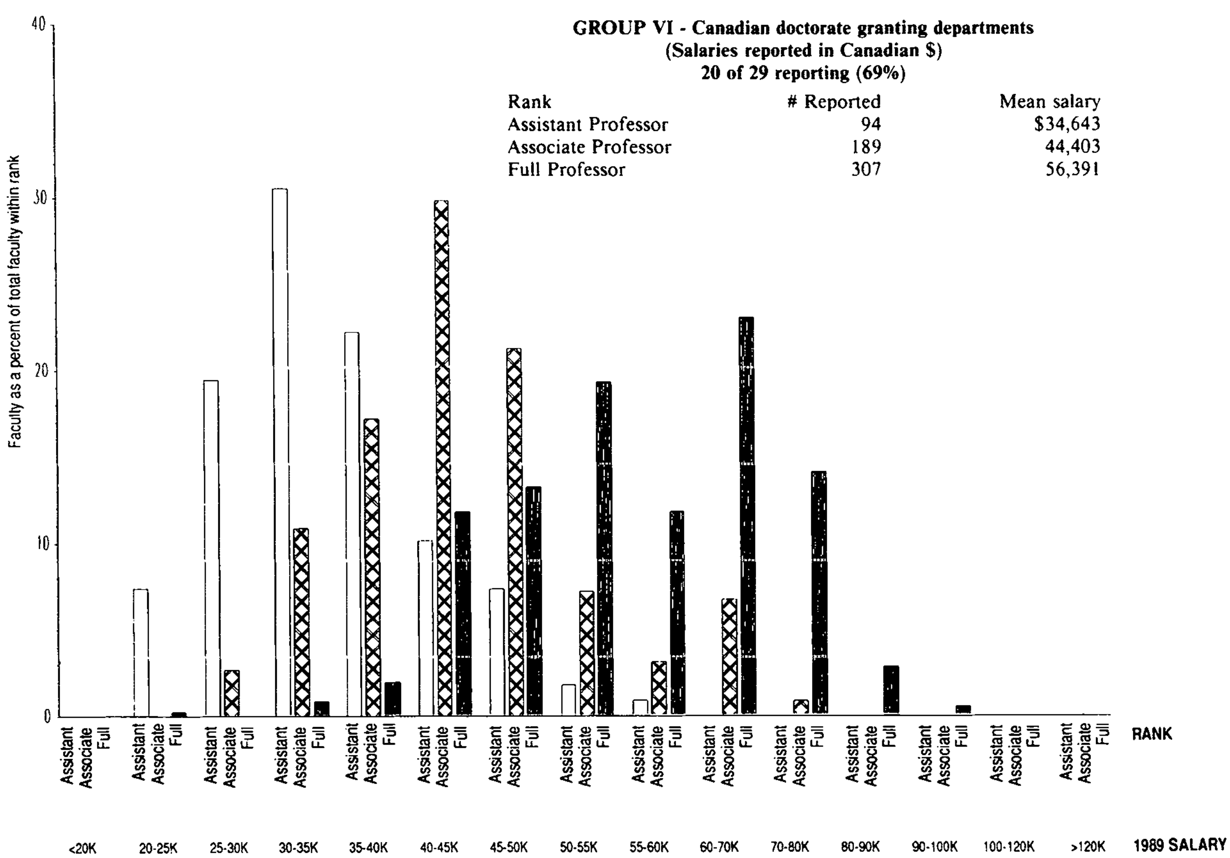


GROUP IV - Doctorate granting departments
49 of 70 reporting (70%)

Rank	# Reported	Mean salary
Assistant Professor	150	$36,380
Associate Professor	150	43,677
Full Professor	336	63,704

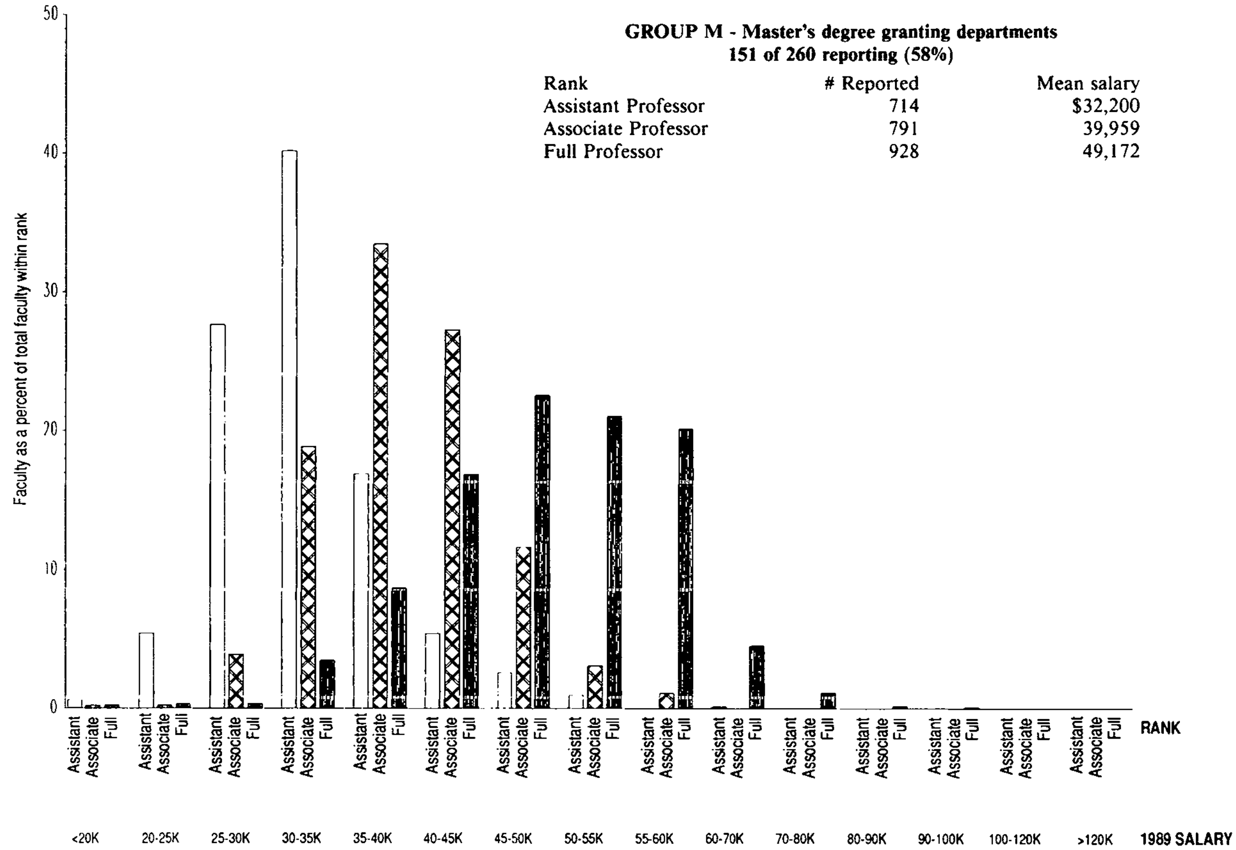



GROUP V - Doctorate granting departments
15 of 29 reporting (52%)
Rank | # Reported | Mean salary
Assistant Professor | 37 | $43,215
Associate Professor | 35 | 50,588
Full Professor | 106 | 69,959
Faculty as a percent of total faculty within rank
0
10
20
30
40
50
Assistant
Associate
Full
RANK
<20K
20-25K
25-30K
30-35K
35-40K
40-45K
45-50K
50-55K
55-60K
60-70K
70-80K
80-90K
90-100K
100-120K
>120K
1989 SALARY


GROUP VI - Canadian doctorate granting departments
(Salaries reported in Canadian $)
20 of 29 reporting (69%)
Rank | # Reported | Mean salary
Assistant Professor | 94 | $34,643
Associate Professor | 189 | 44,403
Full Professor | 307 | 56,391
Faculty as a percent of total faculty within rank
0
10
20
30
40
Assistant
Associate
Full
RANK
<20K
20-25K
25-30K
30-35K
35-40K
40-45K
45-50K
50-55K
55-60K
60-70K
70-80K
80-90K
90-100K
100-120K
>120K
1989 SALARY

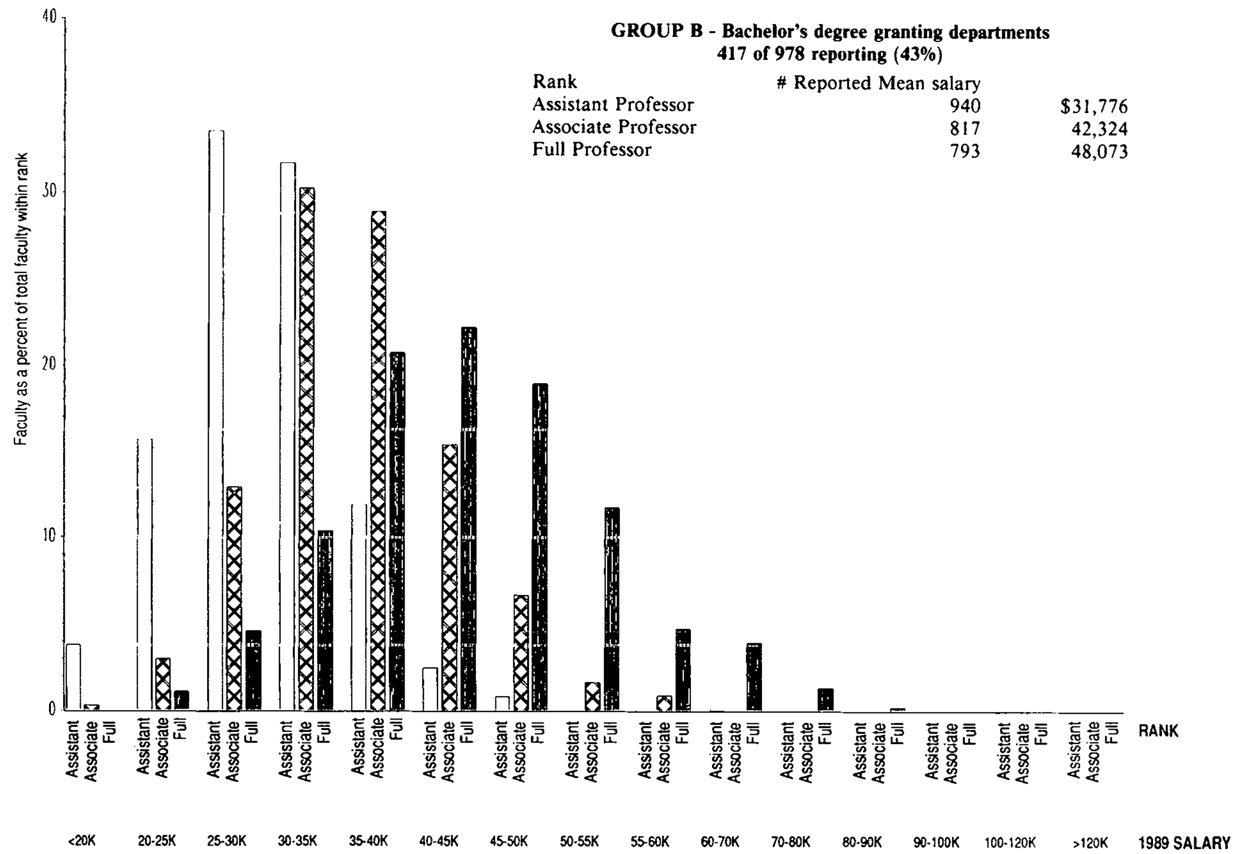
GROUP M - Master's degree granting departments
151 of 260 reporting (58%)

Rank	# Reported	Mean salary
Assistant Professor	714	$32,200
Associate Professor	791	39,959
Full Professor	928	49,172



GROUP B - Bachelor's degree granting departments
417 of 978 reporting (43%)

Rank	# Reported	Mean salary
Assistant Professor	940	$31,776
Associate Professor	817	42,324
Full Professor	793	48,073



Doctoral Degrees Conferred 1988–1989

The annual list of doctoral degrees in the mathematical sciences and related subjects reports 957 degrees conferred between July 1, 1988, and June 30, 1989 by 219 departments in 151 universities in the United States and Canada. Each entry contains the name of the recipient and the thesis title. The number in parentheses following the name of university is the number of degrees listed for that university.

ALABAMA

University of Alabama, Birmingham (2)

BIOSTATISTICS AND BIOMATHEMATICS

Blackwood, Larry G., *Contributions to the theory and application of the Rasch model.*

Hruska, Susan Irene B., *Investigation of a statistic to test for serial correlation within subject in analysis of variance.*

University of Alabama, Tuscaloosa (8)

MANAGEMENT SCIENCES AND STATISTICS

Chyou, Po-Huang, *A comparison of misclassification probability estimating techniques in discriminant analysis.*

Fink, Ross Lawrence, *A knowledge-based approach to expediting in manufacturing facilities.*

Ford, Donnie R., *An intelligent simulation generator with a natural language interface.*

Park, Young-Hong, *An expert system for statistical analysis in simulation.*

Rao, Pamu Mohan, *A knowledge-based methodology for productivity analysis.*

Shirley, Britt M., *The distribution of the number of vertices contained in randomly generated polyhedra.*

Ward, Phillip John, *Goodness of fit tests for multivariate normality.*

West, Mark Stephen, *A quantile view of bootstrap confidence intervals for the mean.*

ALASKA

University of Alaska (1)

MATHEMATICAL SCIENCES

Huang, Sen-Wei, *A fully two-dimensional flux-corrected transport algorithm for hyperbolic partial differential equations.*

ARIZONA

University of Arizona (6)

APPLIED MATHEMATICS

Adachihara, Hatsuo, *Modulational instability in optical ring cavity.*

Elele, Nwabuisi N. O., *Mathematical modeling of multistep chemical combustion: The hydrogen-oxygen system.*

Rajagopalan, Ramachandran, *Bifurcation analysis of the structure of vortices in an univorm strain field.*

MATHEMATICS

Damianou, Pantelis Andrea, *Nonlinear Poisson brackets.*

Grainger, Gary, *Left modules for left nearrings.*

Griesan, Raymond, *Nabla spaces, the theory of the locally convex topologies (2-norms, etc.) which arise from the mensuration of triangles.*

ARKANSAS

University of Arkansas (3)

MATHEMATICAL SCIENCES

Bello, Mohammed Yahuza, *An introduction to free and semi-free groupoids.*

Breen, Michael Almon, *The semigroup of binary relations.*

Grant, Angela G., *Class groups of Zariski surfaces.*

CALIFORNIA

California Institute of Technology (7)

APPLIED MATHEMATICS

Rom-Kedar, Vered, I. *An analytical study of transport, mixing and chaos in an unsteady vortical flow.* II. *Transport in two dimensional maps.*

Rotenberry, James Michael, *Effect of compliant boundaries on weakly nonlinear shear waves in channel flow.*

Soibelman, Israel, *A study of finite amplitude bifurcations in plane Poiseuille flow.*

MATHEMATICS

Feres, Renato, *Geodesic flows on manifolds of negative curvature with smooth horospheric foliations.*

Hasselblatt, Boris, *Regularity of the Anosov splitting and a new description of the Margulis measure.*

Hauser, Kai, *Independence results for indescribable cardinals.*

Verona, Maria Elena, *Generic differentiability of convex functions and monotone operators.*

Stanford University (13)

ENGINEERING-ECONOMIC SYSTEMS

Bell, Hanan S., *A new approach to incentives for information creation and distribution.*

Braden, David Jean, *Nonlinear pricing to reduce demand uncertainty.*

El-Masri, Joseph Elias, *Risk allocation and contract design in banking.*

Fung, Robert, *Structure composing for situation assessment.*

Lyon, Thomas Peyton, *Supply contracts, regulatory lag, and cost disallowance in the natural gas industry.*

Nease, Robert Frank, *Increasing the transparency of medical decision making.*

MATHEMATICS

Chua, Kok-Seng, *Absolute gradient bound for surface of constant mean curvature.*

Eloranta, Kari Väinö, *α-congruence for billiards and Markov processes.*

Greenhalgh, Andrew Simon, *Random walks on groups with subgroup invariance properties.*

Lawlor, Gary Reid, *A sufficient criterion for a cone to be area-minimizing.*

Leung, Ming-Ying, *Probabilistic models and computational algorithms for some problems from molecular sequence analysis.*

Papanicolaou, Vassilis G., *The probabilistic solution of the third boundary value problem for the Schrödinger equation and its path integral representation.*

Puente, Maria Jesus, *Riemann surfaces of a ring and compactifications of semi-algebraic varieties.*

University of California, Berkeley (57)

BIOSTATISTICS

Lindahl, Kenneth Q., Jr., *Biostatistical methods for estimating bark beetle (Coleoptera: Scolytidae) populations and tree mortality.*

INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH

Cosares, Steven Thomas, *On the complexity of some primal-dual linear programming pairs.*

Doucet, Joseph Ambroise, *Differential pricing of electricity through interruption insurance.*

Goldschmidt, Olivier Pol, *Deterministic and probabilistic aspects of the k-cut problem.*

Kim, Soo-Young, *Resource-constrained production scheduling in project-oriented production systems.*

Kim, Sung Chul, *Bayesian calibration experimental designs based on linear models.*

Monteiro, Renato Duarte Carneiro, *Interior path following primal-dual algorithms.*

Resende, Lucia Ignez Polverelli, *Computing network reliability using exact and Monte Carlo methods.*

Wee, Nam-Sook, *A Bayesian model for determining optimal testing intervals for computer software.*

Wood, David Joseph, *A study of multiplicative-strategy equilibria in second-price multi-component auctions.*

Yoon, Bok Sik, *Approximation for the transient behavior of stochastic processes: Discretization and uniformization.*

MATHEMATICS

Arsenovic, Milos, *A C^*-algebra of singular integral operations on the Poincaré plane.*

Balaban, David John, *A geometric perspective of experimental design and parameter identification.*

Bell, George Irving, *A model of vortex induced radiation in the beta plane.*

Berarducci, Alessandro, *The interpretability logic of Peano arithmetic.*

Cai, Maohua, *Boolean logic in artificial intelligence and Turing degrees of Boolean-valued sets.*

Cawley, Elise Ellen, *Smooth Markov partitions and toral automorphisms.*

Dinh, Hung The, *Discrete product systems and their C^*-algebras.*

Grundman, Helen Giessler, *The arithmetic genus of Hilbert modular threefolds.*

Izzo, Alexander John, *Uniform algebras generated by holomorphic and harmonic functions of one and several complex variables.*

Jagy, William Charles, *Minimal submanifolds foliated by spheres.*

Jones, Theodore Warren, *Topological rigidity of horocycle flows.*

Kadison, Lars David, *Cyclic homology of extension algebras with application to matrix algebras, algebraic K-theory, and nest algebras of operators.*

Laroco, Leonard Adlao, Jr., *Stable rank and approximation theorems in H^∞.*

Latham, Geoffrey Arthur, *Solutions of the Kadomtsev-Petviashvili equation associated to higher rank commuting ordinary differential operators.*

LeBlanc, Emile Alvin Pete, *A probabilistic zero set condition for Bergman spaces.*

Li, Jing, *An algorithm for computing the matrix exponential.*

Li, Kin Yin, *Applications of de Branges' theory of contractively contained spaces.*

McCarthy, John Edward, *Analytic structures for subnormal operators.*

Mess, Geoffrey, *The Torelli groups for genus 2 and 3 surfaces.*

Mrowka, Tomasz Stanislaw, *A local Mayer-Vietoris principle for Yang-Mills moduli.*

Nordmark, Henrik Olov, *Higher order vortex methods with rezoning.*

O'Cairbre, Fiacre Ailbhe, *Ergodic actions of $SU(2) \times T$ on operator algebras.*

Pavone, Marco, *Boundaries of discrete groups, Toeplitz operators, and extensions of the reduced C^*-algebra.*

Rainsberger, Robert Bell, *On L^2 boundedness of psuedo-differential operators.*

Strain, John Andrew, *Numerical study of dendritic solidification.*

Torre, Nicholas Goodrich, *Minimal hypersurfaces in compact symmetric spaces.*

Totaro, Burt James, *K-theory and algebraic cycles.*

Walker, Kevin Michael, *An extension of Casson's invariant to rational homology spheres.*

Weinstein, Barry Jay, *On embeddings of the 1-3-1 into the recursively enumerable degrees.*

White, Samuel Pollard, *Two applications of galois theory: A group theory problem of Harvey Friedman and Hodge rings on CM Abelian varieties.*

Zeeman, Mary Lou, *Hopf bifurcations in the competitive three-dimensional Lotka-Volterra systems.*

Zubelli, Jorge Passamani, *Differential equations in the special parameter for matrix differential operations of AKNS type.*

STATISTICS

Chiang, Yann-Tong (Tom), *Tests for exponentiality with censored data.*

Cutler, Adele, *Optimization methods in statistics.*

Cutler, David Richard, *Efficient block designs for comparing test treatments to a control in the presence of correlated errors.*

Eudey, Lynn, *Selection effects on regression models for clustered data.*

Fan, Jianqing, *Contributions to the estimation of nonregular functionals.*

Khoshnevisan, Davar, *Level crossings of the uniform empirical process.*

Kimanani, Ebi Kalahi, *Statistical modelling in pest management: Formulation of a mosquito control model.*

Koo, Ja-Yong, *Tensor product splines in the estimation of regression functions, exponential response functions and multivariate densities.*

Lee, Keewon, *Bootstrap methods in generalized linear models.*

Mo, Moxiu, *Robust additive regression.*

Mykland, Per, *Bootstrap and edgeworth methods for dependent variables.*

Rotnitzky, Andrea, *Analysis of generalized linear models for cluster correlated data.*

Schader, Carl, *The second moment inequality and Gaussian extremes.*

So, Beong Soo, *Asymptotically optimal estimation in the semiparametric heteroscedastic linear model.*

University of California, Davis (8)

MATHEMATICS

Cheung, Samson Hok-Chi, *Convergence acceleration of hypersonic flow calculations.*

Gomulkiewicz, Richard Stephen, *Analytic investigations of diploid models of evolution by female choice sexual selection.*

Goulart, Jose Antonio, *Fisheries models of pelagic species.*

Lucchetti, Roberto Edoardo, *Set converges with application to optimization and probability.*

Riskin, Adrian, *Polyhedral maps on the pinched torus.*

Saleem, Mohammad, *Spectrum analysis and convergence acceleration techniques applied to implicit finite difference approximations for Euler and Navier-Stokes equations.*

Shao, Sai-Lai Sally, *Asymptotic behavior of solutions of model problems for a coupled system.*

Yang, Wei-Chi, *The multidimensional variational integral and its extensions.*

University of California, Irvine (2)

MATHEMATICS

Ford, Richard Loren, *The use of δ-functions in scattering past an obstacle.*

Masters, Wen Chen, *Regularity properties and spectral properties of relativistic Schrödinger operators.*

University of California, Los Angeles (15)

BIOSTATISTICS

Ayala, Rafael Flores, *Regression prediction of body fat in Guatemalan agricultural workers.*

Gjertson, David William, *Incorporation of continuous measurement error into pedigree probabilities.*

Lee, Jiun-Kae, *Estimation of the location parameter for censored paired data.*

Lewis, Steven, *A simple measure of relative quality of fit in stepwise regression.*

Park, Jong-Soon Paik, *A two-stage classification procedure for tree classification.*

Vollset, Stein Emil, *Exact and asymptotic inference in a stratified one parameter conditional logistic model.*

MATHEMATICS

Andretta, Alessandro M., *Iteration trees.*

Bertram, Aaron James, *A compactification of the complement of a secant variety.*

Christ, Carol Shubin, *Singularly perturbed integral equations.*

Grafakos, Loukas Georgios, *Endpoint estimates for singular convolution operators.*

Horn, Werner, *Semi-classical approximations for tunneling near the top of a potential barrier and its application to solid state physics.*

Kawahigashi, Yasuyuki, *One-parameter automorphism groups of the injective finite factor of type* II.

Kim, Sung-Ock, *Noether-Lefschetz locus for surfaces.*

Tan, Ser Peow, *Representations of surface groups into* $\mathrm{PSL}(2,\mathbf{R})$ *and geometric structures.*

Wang, Shicheng, *Several results on* 2- *and* 3-*manifolds.*

University of California, Riverside (3)

MATHEMATICS AND COMPUTER SCIENCE

Bourezgue, Tarik, *Completely nonboundary normal operators in finitely connected domains.*

Michaelis, Rebecca Noelle, *Straight sublattices of Euclidean space.*

STATISTICS

Namini-Asl, Hamid, *On robustness of designs, invariance properties of arrays, and influential observations.*

University of California, San Diego (12)

MATHEMATICS

Allen, Jeffery Crawford, *Nonlinear analysis and approximation theory: Five applications to Haar manifolds.*

Bai, Chongen, *Asymptotic properties of some sample reuse methods for prediction and classification.*

Barcelo, Hélène (Marie-Louise), *On the action of the symmetric group of the free Lie algebra and on the homology and cohomology of the partition lattice.*

Carter, Ithiel, *Circle packing and conformal mapping.*

Gao, Zhicheng, *The number of triangulations of a surface.*

Gove, David B., *Modular forms of weight one-half over class number one imaginary quadratic number fields.*

He, Zheng-Xu, *An estimate for hexagonal circle packings.*

Lin, Tzuemn Renn, *The Hermitian-Yang-Mills metrics and stability for holomorphic vector bundles over compact Kaehler manifolds.*

Luo, Feng, *Triangulations in conformally flat geometry.*

Merino, Orlando, *Optimization over spaces of analytic functions.*

Schwartz, Anne, *Modular forms of weight* 1/2 *on products of p-adic upper half planes.*

Zack, Maria Russell, *Convergence to uniform on the finite Heisenberg group and applications to random number generators.*

University of California, Santa Barbara (4)

MATHEMATICS

BonDurant, William Richard, *Spinor norms of integral quadratic forms.*

Person, Laura Jean, *A piece-wise linear proof that the singular norm is the Thurston norm.*

Yurekli, Osman, *Identities, inequalities and Parseval type relations on integral transforms and fractional integrals.*

STATISTICS AND APPLIED PROBABILITY

Zhou, Xian, *Goodness of fit tests based on spacings, interpoint distances and nearest neighbors.*

University of California, Santa Cruz (2)

MATHEMATICS

Melko, Michael, *On the focal variety of real Stiefel manifolds.*

Rumbos, Adolfo J., *Applications of the Leray-Schauder topological degree to boundary value problems for semilinear differential equations.*

University of Southern California (2)

MATHEMATICS

Engel, Joachim, *Density estimation with Haar series.*

Haghoo, Majid, *Analysis of parallel efficiency of a domain decomposition technique.*

COLORADO

Colorado State University (9)

MATHEMATICS

Alvarez, Eileen E., *Rational elliptic surfaces with infinite cyclic Mordell-Weil groups*

Lundberg, Bruce, *Multistep predictors in continuation methods and equality constrained optimization.*

Refai, Mashhoor, *Group action on finite CW-complexes.*

Rhayyel, Ahmad, *Elliptic surfaces over an elliptic curve and over a hyperelliptic curve.*

STATISTICS

Ahlbrandt, Robert A., *Some methods for selection of predictors.*

Arora, Sanjay, *Contributions to search designs.*

Kinoshita, Keizo, *Multivariate records and scaled limits of random samples.*

Sen, Bhabesh, *Confidence intervals on ratios of variance components in the three stage nested unbalanced model.*

Vecchia, Dominic F., *Permutation tests for equality of linear models.*

University of Colorado, Boulder (2)

MATHEMATICS

Ash, Leslie E., *Counting the number of solutions in reactive flow problems.*

Pierce, Donald C., Jr., *The global structure of positive linear maps between C^*-algebras.*

University of Northern Colorado (6)

MATHEMATICS AND APPLIED STATISTICS

Culverhouse, John, *Predicting error prone cases in a welfare program using the dollar error prone index method.*

Fenn, Ethel Ruth Kloos, *An exploratory data analysis of preschool handicapped children's educational progress during intervention.*

Kopriva, Rebecca, *Effect of reliablity and N size on stat hypotheses.*

Liao, Tien-Fu, *Relationships between family environment variables, children's political efficacy, and participation attitudes using data from Taiwan, Republic of China.*

Malmanger, Curtis, *A statistical word study of the book of Hebrews as to its Pauline authorship.*

May, Douglas, *Robustness considerations of an* M/M/I *queueing model on a local area network.*

CONNECTICUT

University of Connecticut (8)

MATHEMATICS

Hong, Seong-Kowan, *The generalized Gauss maps of a maximal surface in Lorentzian space.*

Ye, Hong, *Some properties of recursively enumerable sets uniform for equivalence relations.*

Yu, Wenhuan, *Inverse problems in partial differential equations.*

STATISTICS

Carlin, Bradley Paige, *Approaches for empirical Bayes confidence intervals with applications.*

Judge, John Joseph, *Multistage sampling techniques for selecting the best treatment.*

Miller, Daniel Stephen, *Sequential procedures based on likelihoods for selecting the best exponential population.*

Moreno, Mabel Haydee, *Multistage and sequential minimum risk point estimation procedures for the means of U-statistics.*

Schumacher, Phyllis Pella, *Analysis of the length of success runs in a two state market chain.*

Wesleyan University (4)

MATHEMATICS

Hidalgo, Melissa, *Periodic points and topological entropy of transitive maps of the circle.*

Landry, Stephen G., *Generalized marginal problems.*

Macula, Anthony J., Jr., *Archimedean vector lattices versus topological spaces with filters.*

Miller, Cheryl Chute, *Automorphism groups of $\aleph_0$-categorical structures with equal numbers of orbits on k and $k+1$ sets.*

Yale University (7)

MATHEMATICS

Bremner, Murray Ronald, *On tensor products of modules over the Virasoro algebra.*

Goldberg-Rugalev, Maxim Jonathan, *Analytic dependence and functional calculi.*

Jing, Naihuan, *Vertex operators, symmetric functions and their q-deformations.*

Pritt, Mark Davenport, *Homotopy theory of minimal simplicial spaces.*

Tan, Eng-Chye, *On some geometrical properties of K-types of principal series representations.*

Tsai, Tian-Yue, *Nonlinear evolutions of the Schrödinger operator in R^2.*

Xue, Xiao-xi, *On the first Betti numbers of hyperbolic surfaces.*

DELAWARE

University of Delaware (8)

MATHEMATICAL SCIENCES

Altekar, Maneesha, *Shift detection on two-way arrays.*

Bodt, Barry Alan, *Extreme quantile estimation on sensitivity analysis.*

Fast, Stephen A., *An optimization method for solving a radiation direction problem.*

Gatica-Perez, Gabriel N., *On the coupling of boundary integral and finite element methods for nonlinear boundary value problems.*

Grynovicki, Jock O., *Variance component estimation diagnostics and associated distribution theory for all random and mixed designs application to repeated measures.*

Krishnamurti, Malini, *Uncertainty and duality in economic models and effects of policy on the West German dairy industry.*

Shi, Sheg Lan (Peter), *Application of variational inequalities to anesotropic Hele-Shaw flows.*

Tung, Sarah Tze-Ming Young, *An expert system for* ANOVA *based on the study of statistical consulting process.*

DISTRICT OF COLUMBIA

American University (6)

MATHEMATICS, STATISTICS AND COMPUTER SCIENCE

Akbari-Zarin, Mansour, *Computer assisted instruction and critical thinking: Developmental model.*

Brown, Martha A., *The relationships between levels of mathematics anxiety in elementary classroom teachers, selected teacher variables, and student achievement in grades two through six.*

Hayden, Linda Bailey, *The impact of an intervention program for high ability minority students on rates of high school graduation, college enrollment and selection of a quantitative major.*

Jacob, Thomas A., *The two-treatment crossover experiment for clinical trials.*

Langdon, Joan M., *The effects of the use of software on students' understanding of selected statistical concepts.*

Taylor, Ann Dismuke, *A study of factors influencing student performance in mathematics on the Florida college-level academic skills test (CLAST).*

George Washington University (3)

MATHEMATICS

Dajani, Karma, *Simultaneous recurrence of weighted cocycles.*

STATISTICS/COMPUTER AND INFORMATION SYSTEMS

Hamdy, Mohammed Ismail, *Approximating the mean of the non-central hypergeometric distribution and an alternative approach to pairwise multiple comparisons.*

Hammick, Patricia, *Estimation of the prevalence of a rare disease using grouped data to preserve anonymity.*

Howard University (4)

MATHEMATICS

Issa, Abdulcadir S., *Spaces of functions L^p-differentiable in the local sense up to a variable order and their stability under pseudodifferential operators.*

Lisan, Amha Tume, *The ideal structure of the space of ultrafilters on a discrete semigroup and related Ramsey theorems.*

Steadman, Vernise, *A theory of operators on Banach spaces.*

Woodson, Leon, *Infinite matrices, C_n-functions and umbral calculus.*

FLORIDA

Florida State University (4)

MATHEMATICS

Ernst, Claus, *On knots and tangles.*

Williams, Roselyn Elaine, *Finite dimensional Hopf algebras.*

STATISTICS

Chiang, Yuang-Chin, *A comparison of two methods of bootstrapping in a reliability model.*

Clair, James, *Simultaneous quantile testing.*

University of Florida (5)

INDUSTRIAL AND SYSTEMS ENGINEERING

Rhee, Hahn-Kyou, *Analysis of a controllable* M/M/2 *queueing system operating under the triadic* (O, K, N, M) *policy.*

Wang, Kuo-Hsiung, *Analysis and diffusion approximation of the* G/G/R *machine repair problem with warm standby spares.*

MATHEMATICS

Bartolomeo, Jerry, *Uniform stabilization of the Euler-Bernoulli equation with active Dirichlet and non-active Neumann boundary feedback controls.*

Neal, David Kenneth, *Optional stochastic integration in Hilbert space with applicatiohns to nuclear spaces*

STATISTICS

Lee, Li-Chu, *Empirical Bayes estimation of the response function and multivariate regression model.*

University of South Florida (1)

MATHEMATICS

Lo, Chi-Chang, *Weak convergence in $d \times d$ bistochastic matricers and other semigroups.*

GEORGIA

Emory University (1)

MATHEMATICS AND COMPUTER SCIENCE

Lindquester, Terri, *The effects of distance and adjacency conditions on Hamiltonian properties in graphs.*

Georgia Institute of Technology (4)

MATHEMATICS

Abell, Martha Louise, *Symmetry reduction of Reynolds equation and applications to film lubrication.*

Khadivi, Mohammed Reza, *Operator theory and infinite networks.*

Lewellen, Gary Boyd, *Topological investigations of self-similarity.*

Patterson, Wanda McNair, *Problems in classical Banach spaces.*

University of Georgia (2)

MATHEMATICS

Wu, De Ting, *A numerical study of second order Ito equations and of their additive functionals.*

STATISTICS

Stewart, Frances P., *Multidimensional blocking in experimental designs.*

HAWAII

University of Hawaii (5)

MATHEMATICS

Agliano, Paolo, *Algebras whose congruence lattices are semimodular.*

Allen, William Clay, III, *Divide and conquer as a foundation for arithmetic.*

Lewis, Keith, *Functional calculi, M-spectral sets and invariant subspaces.*

Sollervall, Hakan L., *Distribution of zeros and polynomials and real analytic functions.*

PUBLIC HEALTH SCIENCES

Yang, Hui-ying, *Segregation analysis of cleft lip and palate under the mixed model: Tests of hypotheses with real and simulated data.*

IDAHO

Idaho State University (1)

MATHEMATICS

Teets, Donald Alan, *Convergence regions for sequences of complex interpolating functions.*

University of Idaho (4)

MATHEMATICS AND APPLIED STATISTICS

Azram, Mohammad, *Graph theoretic versions of Reidemeister moves.*

Do, Tae, *Dean cores for reaction-diffusion-convection problems.*

Lee, Young, *Some singular perturbation problems in Hilbert space.*

Steenberg, Craig, *On the octahedral group.*

ILLINOIS

Illinois Institute of Technology (1)

MATHEMATICS

Ghebremeskel, Kuflu, *Some results in iteration theory.*

Illinois State University (1)

MATHEMATICS

KonKar, Haifa Nassar, *Graph theory as an introduction to methods of proof and problem-solving.*

Northern Illinois University (1)

MATHEMATICAL SCIENCES

Gruenwald, Mark Edward, *Strictly equicontinuous subsets of the space of Bochner integrable functions.*

Northwestern University (14)

ENGINEERING SCIENCE AND APPLIED MATHEMATICS

Braza, Peter Anthony, *Singular Hopf bifurcations in the laser with injected signal and the transition between bounded and unbounded phase solutions.*

Hobbs, Ann Kahlow, *Mathematical modelling of the properties of optical fibers: Bending loss, birefringence, and fiber drawing.*

Swietlik, Craig Edward, *Rational least maximum approximation by weighted least squares.*

MATHEMATICS

Chen, Pengyuan, *On the efficiency and complexity of computational and economic processes.*

Closky, David, *Infinitely many sinks for a singular map.*

Dula, Giora, *The conic structure of Thom spaces.*

Huang, Yenkun, *Random sets for the pointwise ergodic theorem.*

Hughes, Harry, *Hitting time and place to small geodesic spheres of Riemannian manifolds.*

Oakley, Patricia, *Low frequency atmospheric acoustic propagation.*

Pant, Himanshu, *Uncountably many strictly ergodic models which are metrically isomorphic but not almost topologically conjugate.*

Schochat, Rainer, *Two problems in scattering theory.*

Stafford, Matthew, *Markov partitions for the doubling map.*

Van Newenhizen, Jill, *The geometric investigation of voting techniques: A comparison of approval voting, positional voting techniques and the Borda count.*

Xia, Zhihong, *The existence of the noncollision singularities in Newtonian system.*

Southern Illinois University, Carbondale (4)

MATHEMATICS

Boukas, Andreas, *Quantum stochastic analysis: A non-Brownian case.*

Hering, Roger H., *Boundedness and stability in functional differential equations.*

Keller, Timothy Paul, *Witt groups of elementary type.*

Tankou, Victoire, *Use of auxiliary information in sampling theory.*

University of Chicago (11)

MATHEMATICS

Bifet, Emili, *On complete symmetric varieties.*

Bradlow, Steven Benjamin, *Vortices on Kähler manifolds.*

Dix, Daniel Beach, *Decay of solutions to the Benjamin-Ono-Burgers equation.*

Keel, Sean, *Techniques for calculating Chow rings.*

Lewis, James Welsh, *Infinitesimal rigidity for the action of $SL(nz)$ on T^N.*

Napier, Terrence John, *Convexity properties of coverings of smooth projective varieties.*

Pinney, Karen R., *Complexity results for domains in smooth projective varieties.*

Stuck, Garrett, *On the cocycles of characteristic classes associated to certain ergodic group actions.*

STATISTICS

Johnson, Valen Earl, *On statistical image reconstruction.*

Thomas, Neal, Jr., *Designing an observational study using estimated propensity scores.*

Xu, Daming, *Some divergence measures for time series models and their applications.*

University of Illinois, Chicago (9)

MATHEMATICS, STATISTICS AND COMPUTER SCIENCE

Abughalous, Mansour M., *Ranking and selection procedures for non-symmetric models.*

Ganesan, Kothandaraman, *Serre-Tate theory of ordinary K_3 surfaces.*

Itai, Masanori, *On the Strong Martin conjecture.*

Job, Vanessa, *On polyadic codes.*

Johnson, Peter Malcolm, *Gamma spaces and loops of nilpotence class two.*

Phanord, Dieudonne, *Multiple scattering of elastic waves by a distribution of identical spheres.*

Seeley, Craig Derrol, *Nilpotent Lie algebras of dimension 7 over complex numbers.*

Seif, Steven, *Varieties and quasivarieties of rings.*

Srinivasan, Murali, *Optimization problems on posets and graphs.*

University of Illinois, Urbana-Champaign (9)

MATHEMATICS

Benson, Steven Rex, *Canonical invariants for corresponding residue systems in p-adic fields.*

Gurevic, Reuven Henry, *Detecting algebraic (in)dependence of explicitly presented functions.*

Hopkins, Kevin Walter, *Efficient quotient representations of meromorphic functions.*

Lee, Chongsung, *Lattice properties and interpolation theory of the spaces $\Lambda_{\Psi,q}$ and M_Ψ.*

Pollack, David H., *Nonlinear, conditionally stable, singularly perturbed boundary-relation problems.*

Smith, Cameron Cotter, *Dinatural transformations and polymorphic operators.*

Steinbart, Enid Marguerite, *On the location of zeros of solutions to $w'' + Aw = 0$ for certain entire A''.*

Tanner, Franz Xaver, *On the smoothness of the Bellman function.*

Wang, Gang, *Some sharp inequalities for conditionally symmetric martingales.*

INDIANA

Indiana University (3)

MATHEMATICS

Wu, Berlin, *On order statistics in time series analysis.*

Zarnowski, Roger Edward, *A finite-difference scheme for the Navier-Stokes equations of one-dimensional isentropic compressible fluid flow.*

Zasadil, Scott E., *An asymptotic expansion of the Vlasov-Poisson system of equations.*

Purdue University (24)

INDUSTRIAL ENGINEERING

Chou, Yon-Chun, *Automatic design of fixtures for machining processes.*

Gardner, Leah Leslie, *Studies in 3-connect-ed graphs: A decomposition theory and a decomposition-based optimization algorithm.*

Johnson, Mary Agnes, *Phase distributions: Selecting parameters for match moments.*

Kem, Dale, *Optimal distribution network configuration for the single-commodity, single-supplier,* W*-distribution point,* N*-retailer system.*

Lang, George, *Aid for the user of a* CAD *system:* CADCOACH*–the expert tutor.*

Moon, Young Bai, *A framework for failure recovery of automated manufacturing cell components.*

Ouyang, Yew-Shing, *Bimetal forming mechanics with special reference to indentation extrusion and upsetting.*

Song, Whey-Ming (Tina), *Estimators of the variance of the sample mean: Quadratic forms, optimal batch sizes, and linear combinations.*

Upton, David, *The operation of large computer-controlled manufacturing systems.*

Venkatraman, Sekhar, *Modeling multivariate populations with translation systems.*

MATHEMATICS

Bhattacharya, Tilak, *On some nonlinear problems involving the p-Laplacian.*

Ferdinands, Ronald John Dave, *Some complex Grassmanian manifolds that do not fibre nontrivially.*

Haji-Ghassemi, Kamran, *On phase coordinate restrictions in differential games.*

Hung, Yu-Ching, *On the convergence restrictions of divergent power series.*

Johnson, Craig Merle, *Orientation-reversing free actions on closed orientable surfaces by finite groups.*

Kim, Sung Sook, *Characteristic numbers and group actions on homology spheres.*

Notaris, Sotirios, *An algebraic and numerical study of Gauss-Kronrod quadrature formulae.*

Shah, Kishor Mohan, *Coefficient ideals of the Hilbert polynomial and integral closures of parameter ideals.*

Sivaramakrishnan, Narayana, *Quasidiagonality of direct sums of weighted shifts.*

Zhang, Shuang, *On the structure of multiplier algebras.*

STATISTICS

Ananda, Malwane M. A., *Estimating functions of exponential parameters.*

Burt, Jameson, *Towards agreement: Bayesian experimental design.*

Mak, Kok-Sun, *Adaptive tests and classification procedures.*

Nalliah, Manohari, *Estimating certain functions of normal parameters.*

University of Notre Dame (5)

MATHEMATICS

Krueger, Andreas, *Homogeneous Cauchy-Riemann structures.*

Oates, Sarah Elizabeth, *The jump degrees of groups.*

O'Driscoll, Hubert Peter, *Isomorphisms of saturated subgroups of PO_6.*

Razenj, Vladimir, *Low dimensional groups over o-minimal structures.*

Tsapogas, George, *K-Theory of crystallographic groups.*

IOWA

Iowa State University (15)

MATHEMATICS

Martin, Andrew deLong, *Topology posets and an unramified symmetric model for set theory.*

Mehailia, Abdelghani, *Painted network flows with weighted divergence.*

Miliaras, George, *Cardinal invariants and covering properties in topology.*

Mughrabi, Tahsin Ahmad, *Multidimensional Laplace transforms and applications.*

Nimmo, Steven Dale, *Anticommutative derivation alternator rings.*

Park, Sang Ro, *The phenomenon of quenching in the presence of convection.*

STATISTICS

Beam, Craig Allen, *The comparison of diagnostic tests when one is based upon a discrete separator variable and the others are based upon continuous separator variables.*

Carriquiry, Alicia Laura, *Bayesian prediction and its application to the genetic evaluation of livestock.*

Guo, Renkuan, *Bayesian component reliability assessment with system data.*

Hong, Chong Sun, *Granularity and efficiency.*

Jensen, Karen Lorraine, *Optimal adjustment in the presence of process drift and adjustment error.*

Kim, Song-Ho, *Stochastic comparisons of order statistics.*

Mingoti, Sueli Aparecida, *Estimating the total number of distinct species when quadrat sampling by elements is used.*

Nanayakkara, Nuwan, *Heteroskedasticity-robust estimation of means.*

Sung, Nae Kyung, *L_1 Cramer-Rao analogues.*

University of Iowa (4)

MATHEMATICS

Cordero-Brana, Minerva, *P-primitive planes.*

Figueroa, Raul Franciso, *On translation planes admitting a collineation group of order $q^2 - 1$.*

Prado, Humberto Eduardo, *Local representations of symmetric spaces and O-S positivity.*

Vera de Serio, Virginia, *Spherical symmetric rearrangements with respect to a non-homogeneous mass density.*

KANSAS

Kansas State University (2)

MATHEMATICS

Mikhaeel, Nabila Nassief, *λ-quasi partial planes and their logic.*

Zare-Chavoshi, Akbar, *Topics in scattering theory.*

KENTUCKY

University of Kentucky (2)

MATHEMATICS

Wang, Tai-Lin, *Implementation and application of the QR algorithm.*

STATISTICS

Barker, Kerry, *Analyzing repeated measures data with an autocorrelated structure.*

LOUISIANA

Louisiana State University, Baton Rouge (7)

MATHEMATICS

Akkari, Safwan, *On matroid connectivity.*

Carpenter, Jenna Price, *Finiteness theorems for forms over number fields.*

Chon, Inheung, *Lie group and control theory.*

Garcia, Josefa I., *The congruence extension property for algebraic semigroups.*

Phenis, Patrick, *On prime powers and symbolic prime powers.*

Reyes, Edgar Navarro, *Ergodic actions of semi-direct product groups.*

Russell, Robert, *On the relative K_2 of non-commutative rings.*

Tulane University (3)

MATHEMATICS

Joseph, George John, *Stochastic numerical optimization with application to seismic exploration.*

Lee, Sang Bum, *Divisible modules over domains.*

Pickett, Douglas Dean, *Scattering theory for higher order equations.*

University of Southwestern Louisiana (6)

MATHEMATICS

Beslin, Scott Jude, *Number-theoretic equations, rings generated by units, GCD matrices, and topological semigroups.*

STATISTICS

Adams, Benjamin Michael, *Economically optimal on-line quality control procedures.*

Lowry, Cynthia, *Multivariate exponentially weighted moving average control charts.*

Maragah, Hazem Diab, *The effect of autocorrelation on quality control charts.*

Tracy, Nola Diana, *Evolutionarily stable learning rules.*

Vinyard, Bryan, *Some extensions of construction techniques for fractional asymmetrical factorial experiments.*

MARYLAND

Johns Hopkins University (6)

BIOSTATISTICS

Albert, Paul S., *Design and analysis of a panel study for estimating durations and point prevalence in a two-state recurrent illness process.*

MATHEMATICAL SCIENCES

Benjamin, Arthur Todd, *Turnpike structures for optimal maneuvers.*

Mathias, Roy Christopher, *Matrix inequalities.*

MATHEMATICS

Chiang, Yuan-Jen, *Harmonic maps of V-manifolds.*

Goloff, David, *Controlling the dimension of the space of rank-k holomorphic mappings between compact complex manifolds.*

Leu, Ming-Guang, *A class number problem for real quadradic fields of R-D type.*

University of Maryland, Baltimore (1)

MATHEMATICS

Liu, Jinn-Liang, *Numerical methods for parabolic partial differential equation in which the diffusion coefficient changes sign.*

University of Maryland, College Park (13)

MATHEMATICS

Bonnetier, Eric, *Mathematical treatment of the uncertainties appearing in the formulation of some models for plasticity.*

Bryson, Noel, *Multiobjective and large scale linear programming.*

Casey, Stephen D., *The boundary of the universal Teichmüller space and the Bers space of Schwarzians.*

Cox, Stephen E., *Nonlinear stability of traveling waves for a model of viscoelastic materials with memory.*

Farsi, Carla, *Index theory and positive scalar curvature for orbifolds.*

Foster, Dean P., *Conditional least squares for semi-Martingales.*

Myers, Margaret Elaine, *Robustness of design in misspecified logistic regression.*

Noon, Patrick James, *The single layer heat potential and Galerkin boundary element for the heat equation.*

Papadakis, Panagiotis, *Computational aspects of the determination of the stress intensity factors in 2-dimensional elasticity.*

Plaut, Conrad P., *Riemannian geometry on non-Riemannian spaces.*

Shen, Yuan-Yuan, *Units of real cyclic octic fields.*

Stephenson, Lawrence, *Representation theory of nilpotent groups over local fields of characteristic zero.*

Walnut, David, *Weyl-Heisenberg wavelet expansions: Existence and stability in weighted spaces.*

MASSACHUSETTS

Boston University (8)

MATHEMATICS

Atela, Pau, *Studies in dynamical systems: Collisions and codings.*

DiFranco, Donna Maria, *Time-ordered binary data with positive dependence.*

Durkin, Marilyn Barbara, *The dynamics of the complex exponential function: A mathematical and computer graphical analysis.*

Gole, Christopher, *Periodic points for monotone symplectomorphism of $T^n \times R^n$.*

Hathaway, Dale, *Techniques for summarizing longitudinal data.*

Laederich, Stephane, *Exponential dichotomies, non-linear partial differential equations, and differential difference equations.*

Sutherland, Scott, *Finding roots of complex polynomials with Newton's method.*

Terrin, Norma, *The weak convergence of quadratic forms with long-range dependence.*

Brandeis University (3)

MATHEMATICS

Maliakas, Mahalis, *On the representation of theory of the symplectic group.*

Mori, Andrea, *Integrality of elliptic modular forms via mass operators.*

Piovan, Luis Amadeo, *Equivalence between integrable systems and Kummer varieties.*

Harvard University (22)

APPLIED SCIENCES

Cebuhar, Wenceslao A., *Smoothing and approximate linearization of discontinuous control systems.*

Heddaya, Abdelsalam, *Managing event-based replication for abstract data types in distributed systems.*

Kearns, Michael J., *The computational complexity of machine learning.*

Krizanc, Daniel D., *Merging and routing on parallel models of computation.*

Rajasekaran, Sanguthevar, *Randomized parallel computation.*

Salzberg, Steven L., *Learning with nested generalized exemplars.*

Walsh, Robert J., SIMD *algorithms for image rendering.*

BIOSTATISTICS

Archer, Linda Elise, *The impact of tumor lethality on statistical tests for carcinogenicity.*

Begg, Melissa, *The effects of model misspecification in regression, with applications to bioassay.*

Lipsitz, Stuart R., *Methods for analyzing repeated categorical outcomes.*

Neuberg, Donna Shapiro, *Enriching the bootstrap, with application to incomplete data.*

Spiegelman, Donna, *The design and analysis of epidemiologic investigations when the exposure variable is mis-measured, with application to the mis-measurement of obesity in models of diabetes, hypertension and colon cancer incidence.*

Spino, Catherine A., *Rerandomization algorithms for robust statistics and regression with an aggregate covariate.*

MATHEMATICS

Kocherlakota, Rama Rao, *Integral homology of real flag manifolds and loop spaces of symmetric spaces.*

Li, Jun, *The construction of stable vector bundle on surface with low second Chern class.*

Morelli, Robert, *Hilbert's third problem and the K theory of toric varieties.*

Prasad, Dipendra, *Trilinear forms for* GL(2) *of a local field and ϵ-factors.*

Roberts, David P., *Shimura curves analogous to* $X_0(N)$.

Rockmore, Daniel, *Fast Fourier analysis for finite groups.*

Vakili, Pirooz, *Three topics on perturbation analysis of discrete event dynamic systems.*

Zheng, Fanyang, *Semipositive threefolds and threefolds with universal covering* $\mathbb{C}^3$.

STATISTICS

Thoma, Hans Mathis, *Factorization of belief funtions.*

Massachusetts Institute of Technology (34)

MATHEMATICS

Bequillard, Alfredo, *Estimates up to the boundary for certain subellliptic operators.*

Bertsimas, Dimitris, *Probabilistic combinatorial optimization problems.*

Bressler, Paul, *Schubert calculus in complex cobordism.*

Durso, Catherine, *On the inverse spectral problem for polygonal domains.*

Edelman, Alan, *Eigenvalues and condition numbers of random matrices.*

Edward, Julian, *Spectral invariants of the Neumann operator on planar domains.*

Fine, Dana, *Quantum Yang-Mills on the two-sphere.*

Fortnow, Lance, *Complexity-theoretic aspects of interactive proof systems.*

Friedlander, Leonid, *Determinants of elliptic operators.*

Gath, Eugene, *Exact results in quantum field theory: The spinor Lehmann representation in anti-de Sitter space and the superconformal Thirring ghosts.*

Gerdes, Wolfram, *Grassmannian homology, algebraic K-theory and higher Chow groups for an infinite field.*

Harmse, Jorgen, *On Lebesgue space estimates for the wave equation.*

Hess, Kathryn, *A proof of Ganea's conjecture for rational spaces.*

Hovey, Mark, *A new definition of cocategory.*

Huang, Jing-song, *The unitary dual of the universal covering group of* $GL(n, R)$.

Kilian, Joseph, *Uses of randomness in algorithms and protocols.*

Kim, Yeon Mi, *Unique continuation theorems for the Dirac operator and the Laplace operator.*

Koch, Richard, *An analysis of the performance of interconnection networks for multiprocessor systems.*

Lauer, Michael, *Supersymmetric conformal field theory and superstrings.*

Lerman, Eugene, *Symplectic fibrations and weight multiplicities of compact groups.*

Lu, Ya Yan, *Bifurcation to mean flows in convection.*

Malitz, Seth, *Optimal and near-optimal results on book embeddings.*

Messaoudone, Mohamed, *The unit mass ball of three-vectors in* R^6.

Meyer, David, *The dimension of causal sets.*

Pemantle, Robin, *Random processes with reinforcement.*

Pranata, Iwan, *Structure of Dixmier algebras.*

Schick, Irvin, *Robust recursive estimation of the state of a discrete-time stochastic linear dynamic system in the presence of heavy-tailed observation noise.*

Smelt, James, *Fixed point sets of nilpotent elements acting on affine flag varieties.*

Smith, Leslie, *An upper bound with correct scaling laws for turbulent shear flows.*

Snyder, Christopher, *On the effects of partial equilibration and cumulus heating on baroclinic instability.*

Yang, Hu, *Numerical simulation of global and antarctic ozone using a 2-D model in isentropic coordinates.*

You, Yuching, *Soliton equations and infinite dimensional Lie algebras.*

Zaslavsky, Alan, *Representing the census undercount: Reweighting and imputation methods.*

Zworski, Maciej, *High frequency scattering by a convex obstacle.*

Northeastern University (3)

MATHEMATICS

Burgos, L. Fernando, *Inference after selection: Unequal variances and other results.*

Klimek, Jacek, *Equations of nilpotent conjugacy classes in classical Lie algebras.*

Zhang, Weijiang, *Center manifolds for singularly perturbed discrete dynamical systems and an application to multiple coupling in chains of oscillators.*

University of Massachusetts, Amherst (8)

MATHEMATICS AND STATISTICS

Acuna, Carmen Olga, *Parameter estimation for stochastic texture models.*

Ding, Yi, *The inverse power method for semilinear elliptic equations in euclidean space.*

Lin, Zongzhu, *The structure of cohomology of line bundles on the flag varieties for some groups of rank 2.*

Nee, Janpou, *The motion of interaction between two pair of vortices.*

Powers, Robert, *Order theoretic classification of percentile cluster methods.*

Rising, Hawley, III, *Applications of chaos and dynamical systems approaches to mixing in fluids.*

Rising, William Randolph, *Exponential chains and generalized inverses: New approaches to the approximate and exact solution of Markov chain problems.*

Yang, Yisong, *Ginzburg-Landau equations: A revisit.*

MICHIGAN

Michigan State University (12)

MATHEMATICS

Ju, Hyeong-Kwan, *Bifurcations of symmetric planar vector fields.*

Kim, Young Ho, *Submanifolds of euclidean spaces with planar or helical geodesics through a point.*

McKenzie, Robert G., *The ring of cyclotomic integers of modulus thirteen is norm-euclidean.*

Shen, Yun-qiu, *Numerical methods of bifurcation problems via singular value decompositions and homotopy methods.*

Wei, Dongming, *Numerical analyses of some nonlinear partial differential equations.*

STATISTICS AND PROBABILITY

Datta, Somnath, *Asymptotically optimal Bayes compound and empirical Bayes estimators in exponential families with compact parameter space.*

Dhar, Sunil, *Minimum distance method of estimation in an additive effects outliers model.*

Gunawardena, Kosgallana Liyana Durage, *Extended rules for the classification of dependent parameters.*

Jung, Inna, *Parametric empirical Bayes problems with cost for component observations.*

Rahbar, Mohammed Hossein, *Sequential estimation of functionals of the survival curve under random censorship.*

Taraporevala, Arnavaz, *Series representation for processes with infinite energy and their predictions.*

Yang, Song, *Minimum Hellinger distance estimation of parameters in the random censorship model.*

University of Michigan, Ann Arbor (28)

BIOSTATISTICS

Landenberger, Bryce David, *Methods of incorporating litter size in the analysis of teratology.*

Lin, Danyu, *Goodness-of-fit tests and robust statistical inference for the Cox proportional hazards model.*

Martin, Cathy Rose, *Discrimination involving the Markovian normal distribution and discrimination with qualitative data.*

INDUSTRIAL AND OPERATIONS ENGINEERING

Bischak, Diane, *Weighted batch means for improved confidence intervals for steady-state processes.*

Kim, Yeong-Dae, *An iterntive approach for system setup problems of flexible manufacturing systems.*

Lee, Hyo-Seong, *Control policies for queueing and production inventory systems.*

Lee, Woo-Jong, *Tolerancing: computation on geometric uncertainties*

Maddox, Marilyn Johnson, *Scheduling a stochastic job shop to minimize tardiness objectives.*

Murray, Joseph, *Stochastic initialization in steady-state simulations.*

Richter, Lori-Ann, *Resource-constrained project scheduling with preemption of jobs.*

Ryan, Sarah, *Degeneracy in infinite horizon optimization.*

MATHEMATICS

Brenner, Susanne C., *Multigrid methods for nonconforming finite elements.*

Calvis, David Timothy, *Domain constants of injectivity.*

Chan, Kit Chak, *Cyclic vectors in spaces of analytic functions.*

Ferlini, Vincent Joseph, *The existence of solutions to certain equations over cyclic groups.*

Jung, Il Bong, *Dual operator algebras and the classes* $\mathbb{A}_{m,n}$.

Keum, Jonghae, *On Kummer surfaces.*

Kim, Myung-Ho, *Toral actions on 4-manifolds and their classification.*

Kornhauser, Daniel Martin, *Bounds for the smallest integer solution of general quadratic.*

Martin, Thomas Harry, *Minimal theta functions.*

Montenegro Escovar, Carlos Hernando, *Combinatorics on large cardinals.*

Shapiro, Michael David, *Growth, almost convexity, and automatic structure in some geometric three-manifold groups.*

Staples, Susan Grace, *Domains with a local to global norm condition.*

Xin, Zhouping, *Nonlinear stability of rarefaction waves for systems of viscous hyperbolic conservation laws.*

STATISTICS

Choi, Ki-Heon, *An adaptive sequential probability ratio test for autoregressive process.*

Fong, Wai Kwan, *A Bayesian approach to successive sampling with partial replacement of units on two occasions.*

Rekab, Kamel, *Asymptotic efficiency in sequential designs for estimation.*

Zoubeidi, Taoufik, *Sequential tests for clinical trials of two treatments with bounded deficiency.*

Wayne State University (1)

MATHEMATICS

Lai, Hong-Jian, *Contractions and Eulerian subgraphs.*

Western Michigan University (5)

MATHEMATICS AND STATISTICS

Beckmann, Charlene E., *The effect of computer graphics use on student understanding of calculus concepts.*

Holbert, Karen S., *Specified subgraphs and subgraph defined parameters in graphs. ;*

Johns, Garry L., *Generalized distance in graphs.*

Malde, Paresh J., *Chromatic partitions.*

Witt, Lee, *Measures of multiple determination based on R-estimates.*

MINNESOTA

University of Minnesota, Minneapolis (15)

MATHEMATICS

Cohen, Robert Adam, *Fractional step methods for liquid crystal problems.*

De Alwis, Tilak Ananda, *Free minimal resolutions and Betti numbers.*

Gao, Wen-Jie, *Boundary value problems on Lipschitz domains for general elliptic systems.*

Guo, Jong-Shenq, *Nonlinear quenching problem and free boundary problem.*

Hofmann, Steven, *Weighted weak-type (i,i) bounds for singular integrals with non-smooth kernel.*

Larson, Dean S., *The integral cohomology rings of split metacyclic groups.*

Li, Yi, *On semilinear elliptic equations in* $\mathbf{R}^n$.

Louisell, James Albert, *Differential-delay systems: A stability analysis for several classes of delay.*

McDoniel, Douglas Kelley, *Siegel-Hilbert cuspforms attached to CM extensions and their application to periods of genus-2 Hecke eigenfunctions.*

Nelson, Gail, *Bounds for the fundamental solutions of degenerate parabolic partial differential equations.*

Peckham, Bruce Bartlett, *The closing of resonance horns for periodically forced oscillators.*

Pohjanpelto, Petri Juha, *Symmetries of Maxwell's equations.*

Rabau, Patrick, *Emmeration on vector spaces over a field extension.*

Sun, Min-Peter, *A streamline-diffusion method for miscible and immiscible flow in porous media.*

Urbina, Wilfredo Oscar, *On singular integrals with respect to the Gaussian measure.*

MISSOURI

University of Missouri, Columbia (2)

MATHEMATICS

Girou, Mike, *Locally H-closed spaces.*

STATISTICS

Pang, Ching-Fai, *On the estimation of bath-tub shaped arrival rate.*

University of Missouri, Rolla (1)

MATHEMATICS AND STATISTICS

Guffey, James Michael, *Some order restricted inferences in nonhomogeneous Poisson processes.*

Washington University (5)

MATHEMATICS

Deiermann, Paul Jeffry, *Some results on univalent functions with quasiconformal extensions.*

Deliu, Anca Liliana, *IFS and functional equations.*

El ghanmi, Abderrahim, *Spacelike surfaces in Lorentizian manifolds.*

Torres, Rodolfo Humberto, *On the boundedness of certain operators with singular kernels on distribution spaces.*

Villamor, Enrique, *On slowly increasing unbounded harmonic funtions.*

MONTANA

Montana State University (3)

MATHEMATICAL SCIENCES

Doyle, Randy R., *Sinc methods for parabolic type problems.*

Jonca, Andrzej Wilhelm, *Confidence intervals for ill-posed problems.*

Kachman, Stephen Daniel, *Inference procedures for fixed effects in multivariate mixed models.*

University of Montana (2)

MATHEMATICAL SCIENCES

Bolano de la Hoz, Alvaro Jose, *Optimal control problems with state and control constraints.*

St. George, Gregory Michael, *Some aspects of multiplicative commutation relations.*

NEBRASKA

University of Nebraska (3)

MATHEMATICS AND STATISTICS

Gallagher, Richard Joseph, *Scalarization of vector optimization problems and properties of the positive cone in normed vector lattices.*

Kulasekera, Karunarathna, *Estimation of change points in failure rate models.*

Weil, Pascal, *Inverse monoids and the dot-depth hierarchy.*

NEW HAMPSHIRE

Dartmouth College (5)

MATHEMATICS AND COMPUTER SCIENCE

Atkinson, Leigh Louis, Jr., *Embedded eigenvalues and resonances.*

Beery, Janet, *Transitive groups of prime degree.*

Bilaniuk, Stefan, *Some results on Souslin trees.*

Bonin, Joseph Edmond, *Structural properties of Dowling geometries and lattices.*

Wittbold, John Todd, *Controlled signalling systems and covert channels.*

University of New Hampshire (1)

MATHEMATICS

Mathes, D. Benjamin, *Invariant ranges of operator algebras.*

NEW JERSEY

Princeton University (8)

MATHEMATICS

Bluher, Gregory, *Trisecants of certain third-order Wirtinger varieties.*

Canary, Richard Douglas, *Hyperbolic structures on 3-manifolds with compressible boundary.*

Fenley, Sergiu, *Depth one foliations in hyberbolic 3-manifolds.*

Guan, Pengfei, *Holder regularity of subelliptic pseudodifferential operators.*

Lee, Chun-nip, *Stable splittings of the dual spectrum of the classifying space of a compact Lie group.*

Minsky, Yair, *Harmonic maps and hyperbolic geometry.*

Saldanha, Nicolau, *Analytic continuation is impractical.*

Solovej, Jan Philip, *Universality in the Thomas-Fermi von Weizacker model of atoms and molecules.*

Rutgers University, New Brunswick (6)

MATHEMATICS

Capparelli, Stefano, *Vertex operator relations for affine algebras and combinatorial identities.*

Kim, Suh-Ryung, *Competition graphs and scientific laws for food webs and other systems.*

Liverani, Carlangelo, *Quantum systems in contact with a thermal environment: Rigorous treatment of a simple model.*

Meziani, Abdelhamid, *On the integrability of singular differential forms in two complex variables.*

Rynes, Jean, *Nonsingular affine K*-surfaces.*

Tsukada, Haruo, *String path integral realization of vertex operator algebras.*

NEW MEXICO

New Mexico State University (3)

MATHEMATICAL SCIENCES

Golik, Wojciech Ludwik, *Convergence of the integral methods and numerical solutions of Fourier problems.*

Ruch, David, *Bideal theory.*

Zhao, Zhi-Yong, *Edge detection with Q-B-spline operator.*

University of New Mexico (3)

MATHEMATICS AND STATISTICS

Knupp, Patrick, *Robust grid generation on curves and surfaces.*

Pletsch, George William, *Combinatorics in scattering theory.*

Thomas, Edward Victor, *Errors-in-variables estimation in multivariate calibration with application to analytical chemistry.*

NEW YORK

Adelphi University (1)

MATHEMATICS AND COMPUTER SCIENCE

Al-Kahby, Hadi, *Reflection and dissipation of vertically propagating acoustic-gravity waves in an isothermal atmosphere.*

CUNY, Graduate Center (1)

MATHEMATICS

Cook, Michael, *Crystallographic space groups and algorithms.*

Clarkson University (2)

MATHEMATICS AND COMPUTER SCIENCE

Al-Humadi, Ala, *Generalized state space control systems.*

Ruzieh, Subhi, *Some applications of matrices related to graphs.*

Columbia University (10)

MATHEMATICS

Anshel, Iris, *A Freiheitssatz for a class of two relator groups.*

Avidon, Michael, *A method for deriving functional equations with applications to the zeta and generalized theta functions.*

Hakim, Jeffrey, *Distinguished nonarchimedean representations for* GL(2).

Lascurain-Orive, Antonio, *Fundamental polygons for the Hecke congruence subgroups.*

Luttinger, Karl, *Deformations and degenerations of Riemannian manifolds of nonpositive curvature.*

Steiner, Michael, *Gluing data and group actions on* R*-trees.*

To, Wing-Keung, *Metric rigidity theorems on locally symmetric Hermitian manifolds and quasi-projective embeddings of non-compact complete Kähler manifolds of positive Ricci curvature.*

Tsai, I-Hsun, *Holomorphic mappings between Hermitian symmetric spaces.*

Yeung, Sai-Kee, *Compactifying Kähler manifolds and integrality of characteristic numbers.*

Zhang, Xingguo, *Fixed points and automorphisms of free groups.*

Cornell University (11)

Applied Mathematics

Gardner, Kenneth R., *Investigation of population inversion in dense recombining plasmas.*

Swindle, Glen H., *A hydrodynamic limit of the contact process with large range.*

Ye, Zhongxing, *On entropy and epsilon-entropy of random fields.*

Biometrics

Morris, Jeffrey David, *Percentile and percentile ranking estimation in single sample and regression settings with special attention to median unbiasedness.*

Mathematics

Barton, Susan Maureen, *The real spectrum of higher level of a commutative ring.*

Bielefeld, Benjamin Martin, *Changing the order of critical points of polynomials using quasiconformal surgery.*

Brady, Thomas Gerald, *The integral cohomology of* $\mathrm{Out}_{+}(F_3)$.

Kiralis, Geoffrey William, *Pseudo-isotopies of irreducible three-manifolds.*

Low, Mark Gordon, *A unified asymptotic minimax theory for nonparametric density estimation and non parametric regression.*

Meyer, Gabriele Elisabeth, *Attracting and repelling point pairs for vector fields on manifolds.*

Xu, Jinchao, *Theory of multilevel methods.*

New York University, Courant Institute (13)

Mathematics

Alama, Stanley, *An eigenvalue problem and the color of crystals.*

Bell, Robert, *Probabilistic number theory for normed free abelian semigroups.*

Bronsard, Lia, *Reaction-diffusion equations and motion by means curvature.*

Jaffe, Steven, *Kauffman networks: Cycle structure of random clocked Boolean networks.*

Knapp, Robert, *Nonlinearity and localization in* 1*-dimensional random media.*

Li, Yanyan, *On second order fully nonlinear elliptic equations.*

Lowengrub, John, *Convergence of the vortex method for vortex sheets.*

Meth, Kalman, *A vortex and finite difference hybrid method to compute the flow of an incompressible viscous fluid past a semi-infinite plate.*

Nachbin, Andre, *Reflection and transmission of water waves in shallow channels with rough bottoms.*

Redondo, Juan Carlos, *Uniform regularity for level sets of penalized solutions of the obstacle problem.*

Smyrlis, Yiorgos, *Existence and stability of stationary profiles of the LW scheme.*

Weinstein, Michael, *An integro-differential equation model of anovulatory states in mammals.*

Zhu, Jingyi, *An adaptive vortex method for two-dimensional viscous and incompressible flows.*

Polytechnic University (1)

Mathematics

Yallaoui, El-Bachir, *Topological measure theory: A study of repleteness and measure repleteness.*

Rensselaer Polytechnic Institute (8)

Mathematical Sciences

Covey, David, *Parallel ellipsoid algorithms in nonlinear programming.*

Cox, Steven, *Extremal eigenvalue problems for composite membranes.*

Hejna, Matthew James, *Curves constructed by geometrically based algorithm.*

Hou, Jiashi, *Formulation of synovial fluid-articular surface interface conditions, and asymptotic and numerical analysis of squeeze film lubrication of diarthrodial joints.*

Leon, Luis Enrique, *The study of the spinodal region via the hodograph method.*

Szanc, Bohdan, *The generalized complementarity problem.*

Turner, Todd, *Non-smooth analysis of infinite dimensional control sytems.*

Wilder, Joseph W., *Analytic solutions for electrochemical mechanisms involving coupled homogeneous and heterogeneous chemistry.*

SUNY at Binghamton (1)

Mathematical Sciences

Norden, Jeffrey S., *Homeomorphisms between Pixley-Roy spaces.*

SUNY at Buffalo (5)

Mathematics

Chen, Pei-li, *Existence and long time behavior of solutions a diffusion model for meylinated axon.*

Huang, Young-Ye, *Topics on invariant means and weakly almost periodic functions on semigroups.*

Shiau, Lie-June, *Degenerate Hopf bifurcation and isolated periodic solutions of the current clamped Hodgkin-Huxley model.*

Yan, Gea-Gue, *Bifurcation in a reaction-diffusion system with reversible flow in the time-independent system.*

Statistics

Weng, Chung-Sing, *On some asymptotic properties of the Bayesian bootstrap.*

SUNY at Stony Brook (11)

Applied Mathematics and Statistics

Araque Gonzalez, Jesus Rafael, *Contributions to the polyhedral approach to vehicle routing.*

Buonincontri, Stephen, *Multidimensional traveling wave solutions to reaction diffusion equations.*

Gonalez, Jaime, *The role of signatures and strong spanning trees.*

He, Mei-Qi, *On estimating the parametric part of the shape invariant model.*

Joh, Tenshang, *The performance of factor analysis on linear recursive path model.*

MATHEMATICS

Dolan, Peter C., *Spanning structures and undecidability in random graphs.*

Horwitz, Alan, *Foliations with Ehresmann connections.*

Hu, Bizhong, *H-Cobordisms over certain non-positively curved spaces.*

Llarull, Marcelo, *Sharp estimate and Dirac operator.*

Park, Efton, *The index theory of Toeplitz operators on the skew quarter plane.*

Santiago, Freddie, *The Willmore problem.*

Syracuse University (6)

INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH

Foroudi, Amir David, *The solution structure of the mixed integer network flow problem.*

MATHEMATICS

Dezern, David H., *Fourier series on Vilenkin groups.*

Farrell, Ken H., *Solution of a congruence for a pair of polynomials with applications to certain convolutional operators.*

Rajagopalan, Shekhar, *The multicommodity flow problem.*

Rieders, Eric Forrest, *Strong laws of large numbers for certain sequences and arrays of dependent random variables.*

Thongyoo, Sutep, *A study of using microcomputer software to enhance calculus instruction.*

University of Rochester (8)

MATHEMATICS

Conklin, James E., *The discrete Laplacian applications to random walk and inverse problems on weighted graphs.*

Dong, Xiaoying, *Families of functions whose Julia set is* C *and some related results.*

Eron, Mary Bernadette, *Algorithms for finding generators and relations for some cyclic quotient singularities of C^2 and C^3.*

Northshield, Samuel Woodworth, *Schrödinger operators on infinite graphs.*

Stahl, Cynthia Lynne, *Some generalizations of total boundedness and characterizations of compactness in normal spaces.*

Zhou, Xin, *Inverse scattering transform on the line with arbitrary spectral singularities.*

STATISTICS

Heckler, Charles, *Estimators of the variance components and the mean of the three fold nested random effects model.*

McDermott, Michael Paul, *A new approach to statistical analysis subject to order restrictions.*

NORTH CAROLINA

North Carolina State University, Raleigh (16)

MATHEMATICS

Feng, Wei, *Coupled system of reaction-diffusion equations and applications.*

Mattingly, Robert Bruce, *Vector and parallel algorithms for computing the stationary distribution vector of an irreducible Markov chain.*

Ruan, Weihua, *Reaction-diffusion systems with nonlinear boundary conditions.*

Singh, Daya Shankar, *Transitive maps from linearly ordered sets to Dynkin diagrams.*

Yaemsiri, Naulchand, *The structure of solvable K-Lie algebra.*

OPERATIONS RESEARCH

Choi, Munkee, *Multiclass queueing networks with finite buffers.*

Cruz, Jose, *Perturbation analysis and design of networks of queues.*

Ferrell, William Garland, Jr., *System dynamics in quality assurance.*

Jun, Kyung-Pyo, *Approximate analysis of open queueing networks with blocking.*

Shapiro, Gerald, *Flow controls with packet fragmentation.*

STATISTICS

Hernández-Santiago, Jaime Luis, *Testing for genetic disequilibris.*

Kianifard, Farid, *Using recursive residuals, calculated on adaptively ordered observations, to identify outliers in linear regression.*

Liddle, Roger F., *Stochastic approximation for optimization of integrals.*

Marr, Raymond Lloyd, *A normalized uniform test for serial correlation of regression model disturbances.*

Prasetyo, Hardi, *Effects of selection and crossbreeding on growth and fat deposition in mice.*

Schaalje, Gary Bruce, *Models for state structures insect populations affected by pesticides with applications to pesticide efficacy trials.*

University of North Carolina, Chapel Hill (13)

BIOSTATISTICS

Cosmatos, Dennis, *Methods for modeling disease risk using probability of exposure measures.*

Hafner, Kerry B., *Analysis of nonlinear regression models with compound symmetric error covariance structure.*

Origasa, Hideki, *Statistical methods for the analysis of longitudinal data with binary responses.*

Samsa, Gregory Paul, *Regression to the mean with applications to the design and analysis of epidemiologic studies.*

Trost, Donald Craig, *Comparison of the probabilities of misclassification for the estimated linear, quadratic and unbiased-density discriminant functions using asymptotic expansions.*

Williams, Rick L., *Large sample theory for U-statistics in unequal probability samples.*

MATHEMATICS

Calvetti, Daniela, *A stochastic roundoff error analysis of the fast Fourier transform.*

Sutton, Michael, *Equivalence of particle Lagrangians under contact transformations.*

OPERATIONS RESEARCH AND SYSTEMS ANALYSIS

Bartroli, Marcelo, *On the structure of optimal control policies for networks of queues.*

Ware, Keith Alan, *Some polytopes related to the Steiner tree problem.*

STATISTICS

Chao, I-Feng, *Capacity of Gaussian channels with jamming.*

Selukar, Rajesh, *On estimation of Hilbert space valued parameters.*

Sengupta, Debapriya, *Improved estimation in some nonregular situations.*

OHIO

Bowling Green State University (1)

MATHEMATICS AND STATISTICS

Ofori-Nyarko, Samuel, *Improved estimation of the covariance matrix, the precision matrix and the generalized variance.*

Case Western Reserve University (8)

OPERATIONS RESEARCH

Bakshi, Sudhansu Kumar, *Portfolio management and resource allocation in a venture capital company.*

Cherikh, Moula, *Optimal decision and detection in the decentralized case.*

Herzberg, Meir, *Replacement of equipment in public telephone networks due to impact on digital technology–process and optimization.*

Kim, Tai Pyung, *A static design for input selection in a shared resource facility.*

Leach, Cynthia Diane, *Design of a multi-product, multi-period, distribution network with fixed costs, for refined petroleum products.*

Li, Gang, *An interactive Delphi-goal programming procedure for countertrade negotiation decision systems.*

Park, Kil ju, *A systematic approach to countertrade decision making analysis.*

Wu, Yea-win (Peter), *A graph theory approach to process planning for balanced machine loading.*

Kent State University (2)

MATHEMATICAL SCIENCES

Lennard, Christopher J., *Operators and geometry of Banach spaces.*

Selvaraj, Suguna, *Matrix summability of classes of geometric sequences.*

Ohio State University (16)

MATHEMATICS

Anghel, Nicolae, *L^2-index theorems for perturbed Dirac operators.*

Fiedler, Joseph Robert, *On cubic graphs that are edge-critical for the torus.*

Jha, Shingwhu, *Asymptotics for the solutions of systems of smooth recurrence equations and their applications to the orthogonal polynomials.*

Moussong, Gabor, *Hyperbolic coxeter groups.*

Munemasa, Akihiro, *Nonsymmetric P- and Q-polynomial association schemes and associated orthogonal polynomials.*

Ramasinghege, Wimelaratna, *Multi-dimensional geometric moduli and exterior algebra of a Banach space.*

Rzedowski-Calderon, Martha, *Galois module structure of rings of integers and automorphism groups of congruent function fields.*

Villa-Salvador, Gabriel, *Zp-extensions of global fields and semisimple differentials.*

STATISTICS

Chan, Shih-Huang, *Polynomial spline regression with unknown knots and* AR(1) *errors.*

Chen, Yun-Shiow, *The changepoint problem in a multinomial sequence and its application.*

Chi, Yunchan, *Comparisons of several goodness-of-fit tests for proportional hazard models.*

Lin, Meily, *Construction of designs in the presence of polynomial trends for varietal or factorial experiments.*

Lordo, Robert Anthony, *On the use of Friedman-type statistics in a randomly incomplete two-way design.*

Palettas, Panickos, *Stochastic modelling and predictions for fatigue crack propagation.*

Rashid, Md Mushfiqur, *Statistical inference based on ranks for some repeated measurement designs with exchangeable errors within blocks.*

Zubovic, Yvonne M., *Algorithms and bounds for rank estimators for several samples.*

Ohio University (2)

MATHEMATICS

Huang, Yong Kang, *Functional differential equations with piecewise constant argument.*

Wang, You-Qiang, *The P-parts of Brauer character degrees in P-solvable groups.*

University of Cincinnati (6)

EPIDEMIOLOGY AND BIOSTATISTICS

Bregman, Dennis J., *The normal epidemic curve.*

Chen, Rongdean, *Estimation of screening biases and survival benefits of x-ray screened population in the early lung cancer* (ELC) *study.*

MATHEMATICAL SCIENCES

Alfaro, Ricardo, *State spaces and skew group rings.*

Nassar, Manal, *Characterization of mixtures of exponential and geometric probability distributions.*

Yang, Ting, *On the parametric estimations with local bandwidth selections.*

QUANTITATIVE ANALYSIS AND INFORMATION SYSTEMS

Lee, Wonboo, *Consideration of a query methodology to identify natural language texts that correspond to specified topics.*

University of Toledo (1)

MATHEMATICS

Murthy, Nistala V., *Essentially algebraic categories of partial algebras.*

OKLAHOMA

Oklahoma State University (3)

STATISTICS

Chae, Seong-San, *A comparative study to predict the numbers of clusters in cluster analysis.*

Mauromoustakos, Andronikos (Andy), *Models for proportions in a two-way cross classification without interaction.*

Nagadeolekar, Madhuri, *Fixed sample selection procedures and approximate Kieffer-Weiss solution for negative binomial populations.*

OREGON

Oregon State University (4)

MATHEMATICS

Park, Tae-Soon, *Nonlinear free boundary problems arising from melting processes.*

STATISTICS

Abdelhafez, Mohamed, *Bootstrap prediction and tolerance intervals for the Weibull regression model with censored data.*

Halawa, Adel, *Testing for location after transformation to normality.*

Hussien, Osama, *Robust estimation for the mean of skewed distributions.*

University of Oregon (6)

MATHEMATICS

Beale, Stephen Alan, *Rudiments of an arithmetic for profinite groups.*

Hendrick, Daniel Allen, *Common recurrent points for noncommuting transformation.*

Legorreta, Leonardo, *Diagonalization of quadratic forms.*

Meyer, Michael Josef, *Submultiplicative norms on Banach algebras.*

Saxe, Karen, *Fredholm theory with applications to regular operators.*

Simmons, Richard Duane, *Order of uniform approximation to analytic functions by rational trigonometric and weighted rational functions.*

PENNSYLVANIA

Carnegie-Mellon University (13)

MATHEMATICS

Carducci, Olivia Marie, *On balanced and perfect matrices.*

Du, Qiang, *Analysis of a model of incompressible viscous flow and its finite element approximation.*

Meade, Douglas Bradley, *Interface problems in elastodynamics.*

Milić, Nataša, *On non-equilibrium phase transitions in mixtures with interfacial structure.*

Ritchey, Nathan Paul, *Semi-linear programming and the unidimensional simiiliarities problem.*

Tarabek, Michael Anthony, *On one-dimensional nonlinear thermoelasticity with second sound: existence of globally smooth solutions.*

Ziemer, William Karl, *An eigenvalue problem for the mean curvature operator in non-radial domains.*

STATISTICS

Crawford, Sybil Louise, *An approximate Bayesian analysis of finite mixture distributions.*

Goodman, Jay Howard, *Existence of compromises in simple group decisions.*

Lam, Ching Yee Teresa, *Stochastic modeling and analysis of loosely coupled parallel systems.*

Santi, Mary, *A generalization of the Rasch model for items with a cross-classified structure.*

Steffey, Duane Leon, *Hierarchical modeling of binomial data.*

Wilkinson, Robert George, *Bayesian analysis using autoregressive models.*

Lehigh University (5)

MATHEMATICS

Badr, Abdullah, *Gauss-Jacobi quadrature with approximate nodes of unrestricted multiplicity.*

Lienhard, Clarence W., *Randomly stopped binomial tests.*

Monks, Kenneth G., *Nilpotence and torsion in the Steenrod algebra and its cohomology.*

Xiong, Zhongcheng Bonnie, *A new class of almost complex structures.*

Yousef, Hassan, *The spherical spectrum of a graded ring.*

Pennsylvania State University (10)

MATHEMATICS

Coleman, Matthew, *Approximating the vibration frequencies of a homogeneous, isotroric retragular thin plate, using a Legendre spectral method.*

Feng, Qi, *A hierarchy of Ramsey cardinals.*

Ferreira, Fernando, *Polynomial time computable arithmetic and conservative extensions.*

Hatzikiriakou, Kostas, *Commutative algebra in subsytems of second order arithmetic.*

Hirst, Holly, *N-step quadratic convergence in the conjugate gradiant method.*

Rupert, Carl, *Certain rational sets informal language theory.*

Saito, Mutsumi, *A localization theorem for D-modules.*

Stefansson, Gunnar, *Pettis integrability of vector valued functions.*

Suchower, Stephan, *Subfield permutation polynomials in finite fields and combinatorial applications.*

Zhang, Shangyou, *Multi-level iterative techniques.*

Temple University (6)

MATHEMATICS

Xu, Yuan, *Weighted mean convergence of some interpolating processes.*

Zhang, He, *Solving linear systems using parallel and distributing computing.*

STATISTICS

Gillespie, Brenda W., *Topics in Kaplan-Meier estimation.*

Ratnasabapathi, Doraisamy, *Polynomial hazard models in survival analysis.*

Rom, Dror, *Further contributions to the theory of association models in the analysis of contingency tables.*

Shahmaei, Ardeshir, *Stock price behavior and the arc-sine law.*

University of Pennsylvania (4)

MATHEMATICS

Chang, Pei-Kun, *Estimates on harmonic maps.*

Costa, Antone Robert, *The modularity of certain class number congruences.*

Schmidt, Thomas A., *Quaternion L-value congruences.*

STATISTICS

Dating, Corazon, *Missing data in AR processes: Fisher's information in an order determination criterion.*

University of Pittsburgh (7)

BIOSTATISTICS

Patwardhan, Rita Nalavade, *Inferential procedures for multistage models for carcinogenic risk assessment with applications.*

MATHEMATICS AND STATISTICS

Chen, Yong Zhuo, *Functions of bounded upper means and some new classes of Hardy spaces.*

Costigan, Timothy, *Product-type probability bounds.*

Dai, Ruixiu, *Characterization and computation of foldsets for parameter-dependent equations.*

Metry, Magdy, *Positive dependence concepts for empirical rank distributions.*

Sambamoorthi, Nethrasigamani, *Information theoretic criterion approach to dimensionality reduction in multinomial logistic regression models.*

Zeng, Wei-bin, *On a convolution equation and characterization of probability distributions.*

RHODE ISLAND

Brown University (15)

APPLIED MATHEMATICS

Almeida, Murilo Pereira De, *Statistical inference for* MRF *with unbounded continuous spins and applications to texture representation.*

Barat, Christopher Eugene, *A quasi-Gaussian model for real textures.*

Cao, Yulin, *Small solutions and slowly oscillating periodic solutions for scalar differential delay equations.*

Don, Wai Sun, *Theory and application of spectral methods for the unsteady compressible wake flow past a two-dimensional circular cylinder.*

Kirby, Michael Joseph, *Application of the Karhunen-Loève expansion to the analysis of coherent structures.*

Lyberopoulos, Athanasios N., *Asymptotic oscillations of solutions of scalar conservation laws with or without convexity under the action of a linear excitation.*

Rebnord, David Allan, *Parameter estimation for two-dimensional grid structures.*

Regala, Benjamin, *Periodic solutions and stable manifolds of generic delay differential equations.*

Tarman, Isik Hakan, *An analysis of turbulent thermal convection.*

Vazquez-Abad, Felisa Josefina, *Stochastic recursive algorithms for optimal routing in queueing networks.*

MATHEMATICS

Friesen, Christian, *Continued fractions and real quadratic function fields.*

Kuwata, Masato, *Mordell-Weil groups and elliptic K_3 surfaces.*

Loe, Brian J., *Scattering by potentials of unbounded support.*

McLaughlin, Dennis, *Sring structures on loop space.*

Zamboni, Luca, *A Chern character in cyclic homology.*

University of Rhode Island (2)

MATHEMATICS

Farrell, Kevin John, *Neutral delay differential equations with positive and negative coefficients.*

Mayfield, Marie Elizabeth, *Non-reflective boundary conditions for Schroedinger's equation.*

SOUTH CAROLINA

Clemson University (6)

MATHEMATICAL SCIENCES

Domke, Gayla Sue, *Variations of coloring, coverings, and packings of graphs.*

Fields, Mary A., *Analysis of a model of oxygen storage.*

Nylen, Peter MacDougall, *Submultiplicativity and matrix product.*

Rice, Virginia A., *Cohesion properties and graphs.*

Schwartz, Kenneth Eugene, *Group testing with dependence among items.*

Thornton, John Richard, *Two problems concerning robot arms: Product automaton based control and recursive optimization on a hypercube computer.*

Medical University of South Carolina (2)

BIOMETRY

Berrier, Deborah Lane, *A simulation study of variable selecting techniques in linear regression for predictors.*

Craig, Jean Buckner, *Sample size determination in clinical trials considering non-uniform patient entry, loss to follow-up, non-compliance and cost optimization.*

University of South Carolina (3)

MATHEMATICS

Erdelyi, Tamas, *Inequalities for generalized polynomials and their applications.*

Reese, Margaret Linley, *An example related to the atomic space problem.*

Shim, Yong-Sun, *Maximal function techniques in elliptic linear* PDE.

TENNESSEE

Memphis State University (1)

MATHEMATICAL SCIENCES

Hornor, William Edward, *Limiting equations and invariance principles for nonautonomous functional differential equations.*

University of Tennessee (3)

MATHEMATICS

Cohen, Elizabeth Bruce, *Analysis of a class of two step implicit Runge-Kutta schemes for second order systems for ordinary differential equations.*

Guilbault, Craig R., *Some results in the study of non compact 4-manifolds.*

Retnam, P. Xavier Raja, *On a multiple stochastic integral with respect to a strictly semi stable random measure.*

Vanderbilt University (2)

MATHEMATICS

Rayburn, Paula Nell Kimmins, *Local refinements of connectivity.*

Snodgrass, James Tutt, III, *Completely normal lattices.*

TEXAS

Rice University (6)

MATHEMATICAL SCIENCES

Chiang, Jershan, *Convergence rates for the variable, the multiplier, and the pair in SQP methods.*

Lewis, Robert Michael, *Source-velocity identification for a layered model of reflection seismology.*

Li, Shou Bai, *Global convergence of trust region methods for minimizing a nondifferentiable function.*

Percell, Cheryl Bosman, *The effect of caustics in acoustic inverse scattering experiments.*

Torczon, Virginia Joanne, *Multi-directional search: A direct search algorithm for parallel machines.*

MATHEMATICS

Mealy, Jack G., *Calibrations on semi-Riemannian manifolds.*

Southern Methodist University (6)

MATHEMATICS

Bourland, Freddie Jerald, II, *Modulations of the phase shift for nonlinear oscillators and dispersive waves and connections across a separatrix.*

Li, Yong, *The rate of convergence of the $J(q,l)$ Block-Jacobi method.*

Roller, Towanna A., *Recursive processes in linear and nonlinear compartmental analysis.*

Sheng, Liahua, *Numerical solution of nonlinear least squares problems by a class of Broyden-like methods.*

OPERATIONS RESEARCH AND ENGINEERING MANAGEMENT

Amini, Mohammad Mehdi, *Network reoptimization: A computational comparison of algorithmic alternatives.*

STATISTICAL SCIENCE

Li, Huaixiang, *On the* UMVU *estimators after using a normalizing transformation.*

Texas A & M University (8)

MATHEMATICS

Diener, Dwight Allen, *On the stability of the dimension of spaces of bivariate splines.*

STATISTICS

Al-Khalidi, Hussein Rashid, *Aspects of quantitative cancer dose-response modeling and the role of the lognormal distribution.*

Alexander, William Pyle, *Boundary kernel estimation of the two sample comparison density function.*

Ebaseh-Onofa, Benjamin Ovesuo, *Mixture models of stochastic compartmental systems.*

Grimshaw, Scott D., *A unified approach to estimating tail behavior.*

King, Dennis Wayne, *Nonparametric process control procedures.*

King, Eileen Catherine, *A test for the equality of two regression curves based on kernel smoothers.*

Onate, Julia Mercedes, *Distribution of residence times of some stochastic compartmental models.*

Texas Tech University (2)

MATHEMATICS

Balakumar, Sivanandan, *Detection and estimation of a changepoint using nonparametric procedures.*

Koti, Kallappa M., *Optimum stratified sampling using prior information.*

University of Houston (4)

MATHEMATICS

Krupa, Martin, *Bifurcations of critical group orbits.*

Nicolas-Carrizosa, Alfredo, *Numerical aspects of some time dependent partial differential equation problems.*

Waggoner, Sheila, *Global existence for solutions of semilinear and quasilinear parabolic systems of partial differential equations.*

Waller, William Alfred, Jr., *Average distance in graph with prescribed order and independence number.*

University of Texas, Arlington (8)

MATHEMATICS

Alidaee, Bahram, *Solution concepts in cooperative game theory.*

Fritsche, Yaowaluk, *A protocol analysis of a frame-based mathematical problem-solving.*

Golec, Janusz, *Approximation of solutions of stochastic differential equations.*

Ha, Sung Nam, *Experimental numerical studies on a supercomputer of natural convection in an enclosure with localized heating.*

Liu, Xinzhi, *Stability analysis of nonlinear systems in terms of two measures.*

Moadab, Mohammad, *Discrete dynamical systems and applications.*

Pirapakaran, Ratmam, *Some problems in impulsive differential equations.*

Prueitt, Paul Stephen, *Some techniques in mathematical modeling of complex biological systems exhibiting learning.*

University of Texas, Austin (9)

MATHEMATICS

Babich, Amy Juliet, *Vorticist denizens of R^3 are tame.*

Blanchet, Altha Elizabeth, *Function fields of generalized Brauer-Severi varieties.*

Chun, Jang-Ho, *Isomorphic ore extensions of automorphism type.*

Finley, Davis Wallace, *A new proof that 1-ULC implies tameness.*

Knaust, Helmut, *On uniform structures in infinite dimensional Banach spaces.*

Parker, Mary Ruth, *Multiparameter estimation in normal distributions: The slightly unequal variance case.*

Pearson, John Michael, *Sobolev inequalities for ultraspherical polynomials.*

Wang, Suojin, *Saddlepoint approximations in statistics, including resampling.*

Xu, Xiangsheng, *The continuous dependence of solutions to the Cauchy problem $\frac{d}{dt}A(u) + B(u) \ni f$ on A and B and applications to partial differential equations.*

University of Texas, Dallas (3)

MATHEMATICAL SCIENCES

Brock, Kerry Gail, *Topics on invertibility of linear operators.*

Goldthwait, Richard G., Jr., *Approximation of nonlinear control systems by pure feedback systems.*

Wilson, Edward P., *Some lifting of Cauchy-Riemann geometry to Minkowski space.*

UTAH

University of Utah (6)

MATHEMATICS

Austin, David Michael, *$SO(3)$-instantons on $L(p,g) \times \mathbf{R}$*

Bozicevic, Mladen, *A geometric construction of resolutions of fundamental series representations.*

Nordhaus, Thomas Herbert, *Echo-cycles in coupled Fitzhugh-Nagumo equations.*

Phelps, Frederick Martin IV, *The substitutional genetic load and the neutral theory of milecular evolution.*

Stromberg, Marc R., *Solution of shock problems by methods using Sinc functions.*

Zabcic, Miljenko, *Geometry of discrete series.*

Utah State University (1)

MATHEMATICS

Scully, Daniel Joseph, *Maximal rank-one spaces of matrices over chain semirings.*

VIRGINIA

University of Virginia (7)

APPLIED MATHEMATICS

Vaughan, Courtenay Thomas, *The SSOR preconditioned conjugate gradient method on parallel computers.*

MATHEMATICS

Cheng, Raymond, *Strong mixing in stationary fields.*

D'Amour, Alain, *Jordan triple systems of Hermitian type.*

Dritschel, Michael Anthony, *Extension theorems for operators on Krein spaces.*

Johnston, William Wilbur, *Spectral theory for perturbed Toeplitz operators.*

Munoz-Maya, Ismael, *Asymptotic expansion of certain Markov process expectations for large time.*

Peterson, Chariyapoan, *The completion of small categories.*

Virginia Polytechnic Institute and State University (13)

INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH

Magalhaes, Marcos, *Queues with a Markov renewal service process.*

Patuwo, Butje Eddy, *The effect of the dependency in the Markov renewal arrival process on the various performance measures of an exponential server queue.*

Ulular, Osman, *A primal-dual conjugate subgradient algorithm for large scale/specially structured linear programming problems.*

Wortman, Martin A., *Vacation queues with Markov schedules.*

MATHEMATICS

Clemence, Dominic, *Half-bound states of a one-dimensional Dirac system: Their effect on the Titchmarsh-Weyl $M(\lambda)$-function and the scattering matrix.*

Fassari, Silvestro, *Spectral properties of relativistic and non-relativistic Kronig-Penney Hamiltonians with a localized impurity.*

Miller, Robert Edwin, *Approximation of the LQR control problem for systems governed by partial functional differential equations.*

Stoytchev, Orlin, *A study of super-KMS functionals.*

STATISTICS

Chengalur-Smith, Indushobha N., *Variable sampling in multiparameter Shewhart charts.*

Hockman, Kimberly Kearns, *A graphical comparison of designs for response optimization based on slope estimation.*

Kim, Sang-Ik, *Contributions to experimental design for quality control.*

Koons, Bruce Karl, *Parameter estimation for rounded time series data.*

Vining, Gordon Geoffrey, *A graphical approach for evaluating the potential impact of bias due to model misspecification in response surface designs.*

WASHINGTON

University of Washington (13)

BIOSTATISTICS

Anderson, Garnet LaRae, *Mismodelling covariates in Cox regression.*

Churchill, Gary, *Stochastic models for DNA sequence data.*

Emerson, Scott, *Parameter estimation following group sequential hypothesis testing.*

Zhao, Lue Ping, *Multivariate analysis of binary data.*

MATHEMATICS

Do, Chi Ngoc, *Second-order nonsmooth analysis and sensitivity in optimization problems involving convex functionals.*

Jenne, Ralph William, *A construction of conformally invariant differential operators.*

Kwon, Youngmee, *The submartingale problem for Brownian motion in a cone with nonconstant oblique reflection.*

Pang, Myung-Yull, *The structure of Legendre foliations.*

STATISTICS

Andersen, Lars Smedegaard, *Classical inference in spatial statistics.*

Bruce, Andrew Gardiner, *Diagnostics for time series analysis.*

Burns, Patrick Joseph, *Aspects of robust analysis in designed experiments.*

Gentleman, Robert Clifford, *Exploratory methods for censored data.*

Millar, Russell Brian, *Estimation of mixing and mixed distribution.*

WISCONSIN

Marquette University (1)

MATHEMATICS, STATISTICS AND COMPUTER SCIENCE

Huang, Xun-Cheng, *A mathematical analysis of population models.*

University of Wisconsin, Madison (23)

MATHEMATICS

Bak, Jong-Guk, *Restrictions of Fourier transforms to flat curves and surfaces.*

Chisholm, John A., *Effective model theory vs. recursive model theory.*

Choe, Boo Rim, *Composition with bounded holomorphic functions on the ball.*

Cho, Han Hyuk, *Semigroups on Boolean matrices.*

Fisch, Robert Dave, *One-dimensional cyclic cellular automata.*

Goggin, Eimear Mary, *Weak convergence of conditional probabilities.*

Goldsmith, Judith Anne, *Polynomial isomorphisms and near-testable sets.*

Hansen, Scott Walter, *Frequency-proportional damping models for the Euler-Bernoulli beam.*

Jafari, Farhad, *Composition operators in polydiscs.*

Jeske, Clement Thomas, *Groups with character degrees dividing P^2.*

McMichael, John David, *A covering lemma for surfaces of infinite type.*

Newcomb, Richard T., II, *Existence and correspondence of value functions and viscosity solutions of Hamilton-Jacobi equations.*

Silva, Elves Alves de Barros e, *Critical point theorems and applications to differential equations.*

Tang, Dalin, *Peristaltic transport of a heat-conducting fluid, existence, uniqueness, stability, asymptotic expansion and numerical results.*

Theron, D. Peter, *An extension of the concept of graphically regular representations.*

Yoo, Yoon Jae, *On singular area integrals.*

STATISTICS

Chi, Eric Mao-Sung, *Analysis of longitudinal date with random effects and autocorrelated errors.*

Kang, Gunseog, *Topics in multiresponse regression analysis.*

Leu, Ching Ho, *Discriminant and categorical data analysis and variance estimation in complex sample surveys.*

Lin, Kon-Jin Dennis, *Small response surface designs.*

Lu, Jye-Chyi, *Bivariate Weibull models and inferences based on life test of system and components.*

Taam, Winson, *A semi-parametric approach to spatially correlated data.*

Wong, Wing-Keung, *New time series applications in business and finance.*

University of Wisconsin, Milwaukee (2)

MATHEMATICAL SCIENCES

Kreczner, Robert J., *Generalized cardinal series.*

Yang, Shaochen, *Quasi-injective hulls of delta-modules and their semicritical socle series.*

WYOMING

University of Wyoming (6)

MATHEMATICS

Koebbe, Joseph Vincent, II, *Numerical schemes for the immiscible displacement equations using a general polynomial framework for the saturation equation and mixed finite element methods for the pressure/velocity.*

Smylie, Donald Lowell, *A near optimal order approximation to a class of two-sided non-linear degenerate parabolic partial differential equations.*

STATISTICS

Fox, David, *Calibration models: Theory and applications.*

Mortazaviizadi, Mira, *Stochastic goal programming.*

Muttlak, Hassen, *Some aspects of ranked set sampling with size biased probability of selection.*

Ziemer, Terry L., *Construction and testing of an expert system for implementation of exponential smoothing forecasting models.*

CANADA

Dalhousie University (1)

MATHEMATICS, STATISTICS AND COMPUTING SCIENCE

Zhuang, Deming, *Regularity and minimality properties of set-valued structures in optimization.*

McGill University (2)

MATHEMATICS AND STATISTICS

Lamarche, François, *Modelling polymorphism with categories.*

Morin-Wahaab, Danielle, *On some functions of quadratic forms and related topics.*

Queen's University (1)

MATHEMATICS AND STATISTICS

Moisiadis, Alexandros, *K-saturated graphs with minimum number of edges.*

Ottawa-Carleton Institute (6)

MATHEMATICS AND STATISTICS

Bannani, Faiz, *Bounds on classical Ramsey numbers.*

Bickis, Mikelis Guntars, *On the computation of size and power for toxicological bioassays.*

Huse-Eastwood, Vera Regine, *On some nonparametric methods for changepoint problems.*

Mampitiya, M. A. Upali, *Spectral asymptotics for left-definite vector Sturm-Liouville problems.*

Srinivasan, Rengarajan, *Topics in state independent queues and queueing networks.*

Wong, Kieh Yun, *The minimal number of generators of a group.*

Simon Fraser University (2)

MATHEMATICS AND STATISTICS

Biech, Ted, *On exact Shearing solutions of the nonstatic spherically symmetric Einstein field equations.*

Samaratunga, R. T., *A study of subspaces of bounded sequences, sequential completeness and methods of almost convergence.*

Université de Sherbrooke (2)

MATHEMATICS/INFORMATION

Lessard, Francois, *Une méthode générale de compactification d'un ensemble et applications aux opérateurs induits par des transformations ponctuelles continues.*

M'Khalfi, Abdessalam, *Autres approches de l'intégrale généralisée de Riemann.*

Université Laval (5)

MATHÉMATIQUES, STATISTIQUES ET ACTUARIAT

Abdous, Belkacem, *Etude d'une classe d'estimateurs à noyau de la densité d'une loi de probabilité.*

Baribeau, Line, *Quelques problèmes sur les multifonctions analytiques.*

Derhem, Aïssa, *Capitulation dans les extensions quadratiques non ramifiées de corps de nombres cubiques cycliques.*

Fortier, Claude, *Critères de persistance des diagrammes de bifurcation en présence de symétrie.*

Roy, Damien, *Sous-groupes minimaux et questions arithmétiques.*

University of Alberta (2)

MATHEMATICS

Jiang, Hong, *Numerical techniques for large scale computer simulations.*

Kumar, Ravinder, *Analysis of differential equation models of mutualism with a food chain.*

University of Manitoba (3)

STATISTICS

Awuku-Darkoh, Emmanuel, *On the admissibility of the* MLE *of a matrix of Poisson means under a multiplicative model for complete and incomplete data problems.*

Schwarz, Carl, *Post-release stratification and migration models in band-recovery and capture-recapture model.*

Spiring, Frederick A., *Statistical process control methodologies for quality improvement.*

University of New Brunswick (1)

MATHEMATICS AND STATISTICS

Armenakis, Antonis, *Structural approach to slippage problems.*

University of Regina (2)

MATHEMATICS AND STATISTICS

Li, Zhi-Feng, *Contributions to the limit theory of extreme order statistics.*

Xing, Anqing, *Mathematical programming and optimal control theory.*

University of Saskatchewan (1)

MATHEMATICS

Altas, Irfan, *Adaptive mesh generation.*

University of Toronto (4)

MATHEMATICS

Bradley, Robert Emmett, *Induced operators and alternating sequences.*

Goyo, John Octavius, *The Sullivan model of the homotopy-fixed-point set.*

Kalajdzievski, Saso, *Centralizers of finite subgroups of the automorphism groups of a free group.*

MacDonald, Gordon Wilson, *Invariant subspaces for weighted translation operators.*

University of Waterloo (15)

APPLIED MATHEMATICS

Carillo, Sandra, *Invariance properties and symmetry structure of integrable systems.*

Czapor, Stephen Richard, *Grobner basis methods for solving algebraic equations.*

Drennan, William Melville, *Accurate calculations of the Stokes water wave.*

Hughes, William Patrick, *Entropy and inequalities.*

Parris, Ralph, *Asymptotic methods in the numerical solution of stiff ordinary differential equations.*

COMBINATORICS AND OPTIMIZATION

Calkin, Neil James, *Sum-free sets and measure spaces.*

Goddyn, Luis Armando, *Cycle covers of graphs.*

Liu, Weiguo, *Extended formulations and polyhedral projection.*

McCuaig, William Dodd, *Edge reductions in cyclicially k-connected cubic bars.*

McGuinness, Sean, *Random walks on graphs and digraphs.*

PURE MATHEMATICS

Willard, Ross David, *Varieties having Boolean factor congruences.*

STATISTICS AND ACTUARIAL SCIENCE

Chamberlin, Stephen Raymond, *Logical foundation and application of inferential estimation.*

Dean, Charmaine B., *Mixed Poisson models and regression methods for count data.*

Mantel, Harold John, *Conditional inference in a stratified model with nuisance parameters.*

Munholland, Patricia Lynn, *Statistical aspects of field studies on insect populations.*

University of Western Ontario (5)

APPLIED MATHEMATICS

Culumovic, Louis B., *Operator regularization and renormalization theory.*

Kember, Guy C., *Transient heat conduction: Circular pipe in a half-space.*

Steele, Thomas G., QCD *condensates, the* OPE *and the dynamical quark mass.*

Yip, Handson, *Predicting concentration values in environmental flows.*

Young, Peter Joseph, *Steady asymmetric flow of a viscous fluid past a cylinder.*

University of Windsor (1)

MATHEMATICS AND STATISTICS

Naeem, Rana Khalid, *Computation of transonic flows using a streamfunction coordinate system.*

Doctoral Degrees Conferred 1987–1988

Supplementary List

The following list supplements the list of thesis titles published in the November 1988 *Notices*, pages 1314–1331, and the April 1989 *Notices*, pages 383–384.

FLORIDA

University of South Florida (1)

MATHEMATICS

Levinson, Deborah Penick, *Minimizing noise in trimmed resistors.*

MASSACHUSETTS

Tufts University (1)

MATHEMATICS

Couch, Alva Lind, *Graphical representations of program performance on message-passing multiprocessors.*

MISSOURI

St. Louis University (1)

MATHEMATICS AND COMPUTER SCIENCE

Hasting, Martha Emilie, *Foliations with Morse singularities and the theory of levels.*

NEBRASKA

University of Nebraska (2)

MATHEMATICS AND STATISTICS

Saleh, Os, *A characterization of proper minimal points as solutions of sublinear optimization problems.*

Stephen, Joseph B., *Applications of automata theory to presentations of monoids and inverse monoids.*

A Differing View on Mathematics Education Reform

Here We Go Again... Are We Directing Our Efforts and Money at the Correct Problems?

Eleanor G. Palais

Eleanor G. Palais has a bachelor's degree in physics from Radcliffe College, a master's degree in mathematics from Harvard University, and a master's degree in public administration from the Kennedy School of Government at Harvard. She presently teaches mathematics at Belmont High School in Belmont, Massachusetts, and at the Radcliffe Seminars Business Management Program.

I have an uneasy feeling of *déja vu* as once again there is talk of what's wrong with our math curriculum and why aren't our students doing better in their scores and in their general math achievement and understanding. I was in the middle of this controversy in the sixties when my adolescent children proudly came home from middle school (then junior high school) and announced that I didn't know how to do long division any more. They pulled out their workbooks and did what looked totally different from what years earlier I had learned. We both agreed on the final outcome, but their way seemed strange and awkward to me. Thank heavens we now divide in the "old" way ... or is it the "new" way again?

Textbooks in the late sixties and seventies were overly precise with set notation and theory and symbols. This had been ordained by groups of academic educators mostly funded by government grants. Their mission was to make our young students more proficient and more competent to lead the world in math and science. Textbook companies and publishers of education journals buzzed with the excitement of the "New Math." Economically, it was a boon for them and for many others. Teachers were advised by their school administrators that the old curricula were obsolete. There were flurries of workshops, articles, and curriculum revisions.

It's old news now that the New Math was far from totally successful. It had many strengths, but it went too far with formalization and rigor. New Math made reading the text nearly impossible for many students and took the ease out of learning the subject matter and obscured its beauty in the process. The experts had been well-intentioned, but they finally admitted that the New Math had to be modified so our young people could learn and understand. Many years and many dollars were again spent revising texts and curricula.

And so a whole new set of materials was prepared for our schools. The texts were simple, colorful, and clearly directed at the various ability levels—usually four or so ability tracks. Special care was taken to remove stereotypes in texts and to represent minorities in everyday as well as in unusual professional roles. The books for the most part became more readable for student and teacher alike. Theory was clear and not cumbersome. Teachers' department meetings and professional days were spent writing a new curriculum and, happily for me, one could divide again as I had been taught! As technology advanced, the computer's role in educating our students was acknowledged. We taught estimation; the use of calculators in some classes was common (though many of us as teachers were concerned that our students might forget how to multiply or divide without one!). Pascal and Basic programming courses were developed ... and we felt that all was well in our mathematics world.

But during the past few years, and especially during this last year, we again are being deluged with statistics showing poor performance by our students in mathematics. Committees have met, new Standards and Guidelines have been established and we are told that we should stop doing "this" and do more of "that." Software and more audio-visual aids should be used routinely in the classroom. Calculus in high school should be replaced, or at least we should have a parallel track that emphasizes discrete math. And anyway, the place for calculus, we are told, is *really* in college. We also must rethink the calculus curriculum. Why teach students how to integrate and differentiate when soon they can all buy calculators that will do it for them? Why should pencils be used to sketch curves? Many educators feel that students can do much better with interactive learning using a computer.

And so we are setting to work again. But this time the academic community has learned a lesson as planning groups are meeting, organized by colleges and universities, to find out why math scores are so low. Millions of dollars of grant money is being made available to them by the National Science Foundation with the following caveat: the school teachers must be included in this phase of rewriting our math curriculum. Colleges have promised teacher training and professional developement to help teachers learn the new skills they may need in the classroom. Ways are being devised to make math more interesting, more exciting, and more meaningful, such as teaching about the new chaos theory, so students can learn about subjects on the "cutting edge" of mathematical research. The educators, publishers, software companies, computer corporations and curriculum developers are all abuzz once again. This time they will teach our schools how to do it right! This time for sure they know what's wrong with our schools. Now they know why "Janie can't add, or do fractions, or percents, or by gosh, just learn math!"

Well, here's one experienced teacher who's very uneasy about what's going on. For one thing, I worry about—that's right—throwing the baby out with the bathwater. Why must we always start over with a totally new approach? Why don't educators look at what's good about how we are teaching and make changes thoughtfully and cautiously, rather than with full-blown hysteria about teaching and curricula being completely wrong?

Another concern is that the professors who are involved in the grant writing and the proposals are often, as they were before, unfamiliar with the "playing field." Over ten years ago I attended a National Science Board meeting in Washington, representing the Association for Women in Mathematics. About forty of us were there to discuss the "Mathematics Curriculum for the Eighties." Most of the distinguished members there were excellent mathematicians from top universities and colleges. Only a very few of this powerful planning group who were to compile this impressive report were high school teachers, and most of the academics had never been in a public school classroom except as students.

And so it is with today's academic planners. Many have never observed public school classes, or when they have they neglect to account for the effect of their one-time presence. The only high school graduates they do see later are the top students they meet in their own colleges. There is little conception of the actual spread of abilities of the elementary and secondary school students (in our school we have four algebra tracks, for example). Perhaps college and university faculty should actually teach in our classrooms, or at least do some prolonged observation, before they advise and before they spend millions of tax dollars to find out what's wrong and how to change it.

Professors who teach our graduates must be aware that there is *always* a "downward blame" effect. High school teachers may ask: "Why don't fractions get taught properly in the middle schools? It must be the fault of the teacher *down there*. Why, our students in high school can't even add simple fractions!" Of course when we meet with our colleagues at the middle school we find they *have* taught the subject each year. The question must be rephrased as: "Why don't the students learn what is being taught?" This same dialogue gets repeated when college teachers ask why students still can not "do" fractions after six years of high school. The implication is always there: What is wrong with the high school teachers? It's no surprise then to us that we also are gently (sometimes not so gently) advised not to teach calculus to our brighter students. High school is not the place for calculus we are told. For if students "taste" and "learn" calculus once, they will think they know it all and will not learn and be excited when they do it again in college. Once again we get blamed for the fact that in college, the students are not doing well in calculus courses (perhaps this is the start of an "upward blame" effect!).

I firmly believe that calculus, if it is well taught to an appropriately selected group of students, is one subject that has its proper place in high school. The subject is certainly broad and deep enough to be seen more than once, and it finally gives students a most beautiful application of some of the more complicated algebra, curve sketching, and function theory they have worked with for many years. I personally resent the idea that this subject, which flows so naturally from much of the math my students have learned, should somehow be kept sacred and secret until college.

Once again the question surfaces as to why students are not doing well. Don't get me wrong. I agree that the learning ability of our student body is often quite dismal. Students are not motivated and want only easy ways to get good grades without lifting a pencil. One has simply to walk into a public school math class and observe students with bored looks, slouched in chairs with arms folded. Often homework has not been done and the class must be invited to take notes, or even to open their books or to get a pencil. Why hasn't the focus of "Why are the students' scores so poor?" been more on the students themselves, rather than on the schools, the teachers, and the curriculum? I believe our young people today are doing poorly in their school work because they have been brought up as passive listeners in a TV generation. When I am teaching, my students are often glassy-eyed and watching what is happening as if I were a TV performer. *The students do not receive what is being said!* I even write boldly on the board:

Mathematics is not a spectator sport!

to try to get an active response. Students must be taught about active listening and know how to distinguish it from passive listening. This is where our major efforts must be placed if we are really going to improve our students' ability to learn. This is where our creative education efforts and monies should go. We in science and education are faced with a new experience. For the first time in history, we are teaching a generation of students who for the most part have been brought up to tune out whatever noise is going on around them—even if it's teaching. Have you ever seen a student who *must* be surrounded by noise so he or she can tune out and concentrate?

For the first time, also, we have a generation in school who has not *had* to learn to survive. Many of our students don't have the competitive worries people their age used to have. They know they will be able to make it because they come from well-off families, while on the sadder side, others feel that the world has become so upscale that they have little chance of making it no matter how hard they work. In short, many feel that education is no longer the guarantor of making it in the world.

Not only should we look to our students themselves as a possible source of their low achievement, but also, in making broad, sweeping revisions of styles and methods of teaching math, we should be more cautious with our directions. For example, I enthusiastically endorse the computer and software in the classroom as useful tools. But although there is greater interaction with the computer than with a TV, I feel we are encouraging the passive act of watching a screen. Once again, this is learning "TV style." Please, educators, keep the pencil, the paper, and the mind still active. Mathematics is learned by doing, not by watching!

Technology in the classroom, a computer at every desk, or at least a computerized classroom, will also be a tremendous economic burden for the schools. Already schools are mourning tight budgets and the loss of local aid. What should be the priority for our schools? Higher pay for teachers and scholarship incentives to encourage talented young people to choose teaching as a career must be a top economic priority in education. We have an aging faculty in the schools, and unless society dignifies our profession on a par with medicine and law we will very soon face a serious teacher shortage. Shouldn't teaching our youth be considered one of the most important professions, one into which we want to direct our best college graduates?

A high tech direction for our schools means an ever-increasing cost commitment, keeping machines and software current and in good repair. My reasonably affluent school in suburban Boston has just this year been able to afford its second Macintosh for the whole department to share. The first machine has already been dubbed by many as too slow because it has no hard disk. Once the computer companies have this captive market they will be developing "new and better" machines and software continuously. Is all of this technology in the schools really necessary, or is it just a nice alternative to board teaching? Isn't it simply another tool in the teaching of mathematics? Granted, it's a new and exciting tool, one with different strengths than chalk, pencil, and board work. But shouldn't we proceed more cautiously before committing ourselves to sweeping and costly major changes?

I have an uneasy premonition as I look into the future. After all the hard work, the curriculum writing, and the purchase of new equipment, will our students' achievement really improve? Are we looking at the right targets now for our changes? Will educators in the twenty-first century again want a revision in the way we teach our students? The new math of the new century, will that be the phrase? Will we then throw out all our artificial learning aids, and remove all the machines?

Perhaps then we will give students a sharpened pencil, a notebook, and a printed set of words to learn from and to understand. Hands-on knowledge will be the hallmark of this new math. Let them do it themselves with only their expert teacher there to guide, influence, and excite them. Turn off their TVs. Teach them to listen and to hear, to question and to probe. Let them know that an answer is expected. This, I know, will be called the NEW Math, and we will be using a lot of the same methods we used before, when we divided like I still do.

There are a lot of caring, talented, enthusiastic, and knowledgeable teachers in the classroom. We are trained as teachers. We are not all stars but most of us teach well. Now students must listen, they must listen to learn. Our country has shown its concern over our students' poor achievement. It must now show it supports excellence in education by giving academic achievement the top priority in family life, and the education of our young the top priority on local, state, and federal agendas.

Survey of American Research Journals

In November of 1982 the Board of Trustees of the AMS decided that a cost comparison study of mathematical research journals would benefit the entire mathematical community, in particular department chairmen and librarians. A year later the *Notices* of the American Mathematical Society published its first survey of American research journals. We have brought that information up to date in this third survey, expanded to include comparisons between subscription years 1984, 1986, and 1988. A companion to this survey, a study by the European Mathematics Council of prices of European journals, is in preparation.

Selection and classification of journals. As before, the list of journals surveyed consists of those published in the United States and reviewed in their entirety in *Mathematical Reviews*, with the exception of some of the translation journals, which may have been reviewed only in part or in the original. Journals are listed in three classes: primary typeset journals, primary journals published from author-prepared copy, and translation journals. Production costs vary considerably for these classes of journals, with the subscription prices varying accordingly.

Counting methods. First the number of pages published for each subscription year was determined, excluding front and end matter. Extrapolation was required for some of the translation journals, since their nominal volumes were incomplete at the time of the sampling.

The next problem was to determine the amount of material on a page, a difficult task when dealing with mathematics journals. For this reason, readers are encouraged to examine actual copies of these journals when considering these figures. Variations in the amount of displayed material, additional spacing around displays and enunciations, and the typesetting specifications of the particular journal all affect the amount of material per page. Also, character counts in journals printed from author-prepared copy vary considerably from article to article. Therefore, readers should keep in mind that the methods given below for estimating characters per page do not provide absolute figures, but rather suggest a systematic basis for comparison among journals.

At least two samples were taken for each journal. In the first sample ten pages were selected, spaced evenly throughout the journal; these pages were chosen so as to contain no figures, diagrams, or blocks of text set at a type size nonstandard for that particular journal. The lines of text and display per page were counted. A characters-per-line figure was determined by averaging the character count for the first and last full lines of text on the first three pages of our sample. (Spaces between words were counted as one character; spaces in mathematical expressions were not counted.) Averages for the two figures were multiplied to obtain a figure for the characters per page.

A second sample was then taken of another ten pages, spaced midway between the pages chosen for the first sample. The cost calculation is based on the mean of these two samples. For several 1984 journals in which the variation between the first and second samples was greater than 15 percent, a third sample of twenty pages was taken; for these journals, the results of the three samples for that year are reported separately. When the third sample fell between the first two, the mean of the first and second samples has been reported in the table.

Questionnaire information. A questionnaire was sent to each publisher, asking for verification of our observed page counts and subscription prices for each year, as well as our calculated lines per page and characters per line. In addition, we solicited the following information: 1984, 1986, and 1988 circulation figures; the availability of back volumes; the journal's policies regarding page charges, offprints, and discounts; and information about any sources of support that the journal might have in addition to circulation revenues. Much of that information is reported in the following sets of tables, in order that readers might draw their own conclusions regarding the effect of any of these factors on production costs or subscription prices. Blanks in the tables indicate that questionnaires were not returned by the publishers.

Primary Typeset Journals

Journal	Publisher	List Price $US			Pages			Cents/1000 Char		
		1984	1986	1988	1984	1986	1988	1984	1986	1988
Advances in Applied Mathematics	Academic Press	78	92	105	504	502	500	7.1	7.8	9.4
Advances in Mathematics	Academic Press	340	400	528	1279	1285	1605	11.3	14.1	14.9
American Journal of Mathematics	Johns Hopkins University Press	95	122	136	1512	1506	1188	3.1	4.1	5.5
AMS Bulletin, New Series	American Mathematical Society	50	148	161	783	589	829	2.1	8.9	6.4
Annals of Mathematics, Ser. 2	Princeton University Press	140	140	140	1223	1239	1301	4.4	4.5	4.2
Annals of Probability	Institute of Math. Statistics	62	80	100	1227	1431	1859	2.1	2.2	2.3
Annals of Statistics	Institute of Math. Statistics	66	85	96	1596	1641	1741	1.5	1.8	1.9
Applied Math. and Computation	Elsevier	206	354	560	756	1138	1412	12.2	13.8	18.6
Applied Math. and Optimization	Springer-Verlag	70	85	205*	558	276	549	5.6	8.7	12.0
Comms. in Pure and Applied Math.	Wiley & Sons	144	176	256	848	1181	1088	7.4	5.6	10.4
Complex Variables: Theory & Applic.	Gordon & Breach, Science Publ.	201	266	428	372	384	379	28.6	34.5	52.0
Computers and Math. w/ Application	Permagon Press	200	500	840	477	2528	2128	T	4.4	9.8
Duke Mathematical Journal	Duke University Press	110	120	240	1020	1130	1616	4.4	4.5	6.0
Ergodic Theory and Dynamical Sys.	Cambridge University Press	180	190	245	646	644	1059	8.9	9.5	7.7
Houston Journal of Mathematics	University of Houston	70	70	85	599	599	600	5.0	4.7	5.7
Illinois Journal of Mathematics	University of Illinois Press	50	50	70	702	695	715	3.1	3.1	4.5
Indiana University Math. Journal	Indiana University	80	95	95	926	928	934	3.6	4.2	4.4
Information and Control	Academic Press	300	340	384	919	1021	1146	13.0	13.2	13.8
Information Sciences	Elsevier	222	255	322	756	906	1078	11.3	11.7	12.1
Journal of Algebra	Academic Press	525	700	816	3401	3938	4203	6.2	7.3	8.2
Journal of Algorithms	Academic Press	96	105	118	613	604	602	5.8	6.6	7.7
J. of American Statistical Assoc.	American Statistical Assoc.	55	70	85	965	1141	1243	1.0	1.0	1.2
Journal of Approximation Theory	Academic Press	258	300	380	1193	1179	1445	10.6	12.1	12.3
J. of Assoc. for Computing Mach.	Assoc. for Computing Machinery	60	75	75	906	829	1000	2.0	2.5	2.2
J. of Combinatorial Theory, A	Academic Press	174	258	303	754	966	965	9.7	11.2	12.8
J. of Combinatorial Theory, B	Academic Press	174	204	240	612	758	757	11.9	11.5	12.4
J. of Computer and System Sciences	Academic Press	208	246	288	913	910	910	7.5	8.4	10.3
J. of Differential Equations	Academic Press	420	490	588	2197	2203	2404	9.0	9.8	10.6
J. of Differential Geometry	Lehigh University	160	190	190	1105	764	1107	5.9	9.1	6.5
Journal of Functional Analysis	Academic Press	410	485	630	2111	2102	2722	9.0	10.3	10.8
Journal of Graph Theory	Wiley & Sons	88	108	125	532	557	595	6.4	7.2	8.5
Journal of Integral Equations	Elsevier	148	**	**	556	**	**	12.9	**	**
Journal of Logic Programming	Elsevier	85	95	115	356	360	344	7.4	8.2	10.1
J. of Math. Analysis and Applic.	Academic Press	693	912	1064	4205	4797	4808	T	10.0	10.3
J. of Multivariate Analysis	Academic Press	150	224	336	804	997	1419	9.2	9.9	10.4
Journal of Number Theory	Academic Press	180	273	318	850	1130	1130	9.8	11.0	12.6
Journal of Symbolic Logic	Assoc. for Symbolic Logic	65	85	105	1485	1145	1344	1.4	2.2	2.5
Journal of the AMS	American Mathematical Society	**	**	100	**	**	697	**	**	5.4
Libertas Mathematica	Amer. Romanian Acad. of Arts, Sci.	40	40	45	196	200	190	9.5	9.4	10.5
Linear Algebra and its Application	Elsevier	480	792	1134	2343	3481	3662	10.9T	10.3	16.9
Linear and Multilinear Algebra	Gordon & Breach, Science Publ.	252	302	540	345	405	303	35.1	36.4	71.9
Mathematics of Computation	American Mathematical Society	100	164	181	1349	1674	1542	2.7	3.1	3.8
Math. of Operations Research	Inst. of Management Sciences	44	50	60	634	729	724	2.3	2.2	2.1
Mathematical Systems Theory	Springer-Verlag	94	108	109*	356	354	254	9.9T	8.5	14.4
Michigan Mathematical Journal	University of Michigan	30	30	40	379	443	480	2.8	2.3	3.0
Notre Dame J. of Formal Logic	University of Notre Dame	35	40	40	393	605	581	2.8	2.0	2.1
Pacific Journal of Mathematics	Pacific Journal of Mathematics	132	190	190	2970	2475	1498	2.0	3.4	5.7
Proceedings of the AMS	American Mathematical Society	250	369	401	1934	2176	2426	4.4	5.6	5.3
Quarterly of Applied Mathematics	Brown University	40	45	50	512	799	792	2.7	1.9	2.1
Rocky Mountain Journal of Math.	Rocky Mt. Math. Consortium	95	115	145	995	857	864	3.6	5.2	8.9
SIAM J. on Algeb. & Discrete Methods	Soc. for Indust. & Appl. Math.	43	60	**	632	644	**	1.9	2.6	**
SIAM Journal on Applied Math.	Soc. for Indust. & Appl. Math.	95	130	150	1258	1149	1901	2.6	3.8	2.2
SIAM Journal on Computing	Soc. for Indust. & Appl. Math.	68	98	140	889	1194	1282	2.1	2.1	2.8
SIAM J. on Control & Optimization	Soc. for Indust. & Appl. Math.	95	130	172	978	1334	1503	3.1	3.0	3.4
SIAM J. on Discrete Mathematics	Soc. for Indust. & Appl. Math.	**	**	140	**	**	559	**	**	5.9
SIAM Journal on Math. Analysis	Soc. for Indust. & Appl. Math.	102	156	225	1237	1524	1493	3.0	3.2	4.7
SIAM J. on Matrix Analysis & Applic.	Soc. for Indust. & Appl. Math.	**	**	88	**	**	592	**	**	3.5
SIAM J. on Numerical Analysis	Soc. for Indust. & Appl. Math.	95	136	160	1207	1302	1500	2.5	3.5	3.4
SIAM J. on Science & Stat. Comp.	Soc. for Indust. & Appl. Math.	48	78	140	997	1417	1132	1.3	1.6	3.4
Studies in Applied Mathematics	Elsevier	106	126	154	524	542	552	8.5	8.9	10.9
Technometrics	Am. Soc. Qual. Cntl./Am. Stat. Assoc.	23	23	23	419	418	470	1.1	1.1	NA
Transactions of the AMS	American Mathematical Society	445	598	675	4984	4987	5142	3.0	4.2	4.3

* actual prices are 205.50; 109.50
** not applicable; not in publication
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NA not available

Primary Author-Prepared Journals

Journal	Publisher	List Price $US 1984	1986	1988	Pages 1984	1986	1988	Cents/1000 Char 1984	1986	1988
Algebras, Groups & Geometries	Hadronic Press	150	150	150	509	503	500	20.2	19.4	16.2
Applicable Analysis	Gordon & Breach, Science Publ.	252	334	540	283	295	328	56.0	68.6	93.5
Comms. in Algebra	Marcel Dekker	425	475	685	3110	2042	2683	9.8T	16.3	16.3
Comms. in Partial Diff. Equations	Marcel Dekker	255	350	395	1494	1736	1621	12.6	16.3	15.2
Comms. in Stat.: Theory & Methods	Marcel Dekker	490w	550	675	4104	3805	4460	6.3	9.1	8.0
Comms. in Stat.: Simul. & Comput.	Marcel Dekker	490w	185	245	4104	1255	1558	6.3	7.9	8.9
Intl. J. of Math. & Math. Sci.	Univ. Central FL/Calcutta Math. Society	40	60	60	825	832	832	1.8	2.8	2.6
Memoirs of the AMS	American Mathematical Society	148	214	239	2722	2165	1917	2.9	4.7	6.5
Numerical Funct. Anal. & Optim.	Marcel Dekker	57	86	250	378	643	248	9.4	8.4	52.5
Semigroup Forum	Springer-Verlag	216v	172v	96v	1131	831	373	10.6	10.1	13.2
Stochastic Analysis Application	Marcel Dekker	75	125	195	470	497	477	11.2	14.5	25.4

v priced by vol. (1984 contained 3 vols., 1986 contained 2, and 1988 contained 1)
w subscribers received both parts for the stated 1984 price; pages reflect parts A and B
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Translation Journals

Journal	Publisher	List Price $US 1984	1986	1988	Pages 1984	1986	1988	Cents/1000 Char 1984	1986	1988
Algebra & Logic	Plenum Publishing	360	445	495	481	468	482	24.3	30.2	33.8
Differential Equations	Plenum Publishing	505	645	795	1525	1498	1475	9.5	12.9	14.3
Fluid Dynamics	Plenum Publishing	500	640	795	1030	998	990	13.0	15.6	18.5
Fluid Mechanics - Sov. Research	Scripta Publishing Company	319	410	455	863	864	865	11.0	19.0	19.7
Functional Analysis Application	Plenum Publishing	410	495	595	349	338	340	28.8	35.0	37.3
Journal of Soviet Mathematics	Plenum Publishing	1035	1345	1595	3315	2882	2473	9.2	13.6	16.1
Lithuanian Math. Journal	Plenum Publishing	255	325	395	399	393	400	20.1	23.6	24.7
Magnetohydrodynamics	Plenum Publishing	415	495	595	440	456	527	24.8	24.6	26.1
Math. Notes of Acad. of Sci., USSR	Plenum Publishing	520	645	795	965	944	950	14.4	17.3	19.0
Mathematics USSR - Izvestiya	American Mathematical Society	330	426	483	1244	1236	1320	8.4	10.8	10.9
Mathematics USSR - Sbornik	American Mathematical Society	450	596	670	1738	1710	1688	8.5	11.6	12.0
Moscow Univ. Math. Bulletin	Allerton Press	260	385	500	503	486	486	21.0	32.5	37.5
Proceedings, Steklov Inst. of Math.	American Mathematical Society	226	350	393	1096	1099	1023	6.9	11.0	11.6
Selecta Mathematica Sovietica	Birkhäuser Boston	98x	198x	244x	408	421	414	9.8	17.9	20.4
Siberian Mathematics Journal	Plenum Publishing	625	795	955	985	961	950	16.9T	19.8	22.8
Soviet J., Automation & Info. Sci.	Scripta Publishing Company	185	225	235	552	559	579	T	9.7	11.6
Soviet J. of Contemp. Math. Anal.	Allerton Press	260	375	485	500	605	600	25.7	24.8	29.2
Soviet Mathematics - Doklady	American Mathematical Society	350	465	530	1555	874	1459	9.8	15.2	10.7
Soviet Mathematics (Iz. Vuz.)	Allerton Press	335	475	595	1316	1389	1350	10.0	12.2	15.6
Theoretical & Math. Physics	Plenum Publishing	500	625	775	1269	1258	1002	9.6	10.1	18.9
Theory of Probab. & Application	Soc. for Indust. & Appl. Math.	160	216	250	860	740	758	6.0	8.5	8.8
Theory Probab. & Math. Statistics	American Mathematical Society	194	225	245	322	284	301	27.5T	33.9	32.3
Trans. of Moscow Math. Society	American Mathematical Society	150	150	167	558	276	261	10.5	16.8	20.8
Ukrainian Mathematical Journal	Plenum Publishing	500	625	745	618	683	660	24.6	25.6	25.8
Vestnik Leningrad Univ. Math.	Allerton Press (as of 1985)	80	275	385	270	347	330	12.5	30.7	45.4

x prices based on Swiss franc; previously published by Birkhäuser Boston, now handled by Birkhäuser Verlag and considered a European journal
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Primary Typeset Journals

Journal	Publisher	Char/Page			Circulation			Current:				
		1984	1986	1988	1984	1986	1988	Page Chgs ($US)	Back Vols +	Free Off-prints	Outside Support Y/N ++	Inst. Disc. Y/N
Advances in Applied Mathematics	Academic Press	2190	2340	2240	NG	NG	NG	0	P	50	N	N
Advances in Mathematics	Academic Press	2350	2210	2210	NG	NG	NG	0	P	50	N	N
American Journal of Mathematics	Johns Hopkins University Press	2010	1970	2070	1473	1467	1509	0	P,M	75	N	Y
AMS Bulletin, New Series	American Mathematical Society	3090	2810	3030	19465	20189	21194	0	P,M	50	N	Yj
Annals of Mathematics, Ser. 2	Princeton University Press	2580	2520	2550	1777	1748	1695	0	P,M	100	NG	N
Annals of Probability	Institute of Math. Statistics	2460	2570	2340	3334	3238	3235	45	P,M	50	Y	Ygh
Annals of Statistics	Institute of Math. Statistics	2760	2850	2890	4664	4723	4771	45	P,M	50	Y	Ygh
Applied Math. and Computation	Elsevier	2230	2250	2130	392	404	415	0	P,M	0	N	N
Applied Math. and Optimization	Springer-Verlag	2230	3560	3120	700	700	700	0	P,M	25	N	Y
Comms. on Pure and Applied Math.	Wiley & Sons	2290	2650	2260	1336	1284	1309	0	P,M	75	N	Yf
Complex Variables: Theory & Applic.	Gordon & Breach, Science Publ.	1890	2010	2170	NA	NA	NA	0	P,M	0b	N	Y
Computers and Math. w/ Application	Permagon Press	T	4510	4030	NG	NG	NG	0	P,M	25	N	Yi
Duke Mathematical Journal	Duke University Press	2470	2360	2460	1255	1212	1177	0	P,M	100	Yu	N
Ergodic Theory and Dynamical Sys.	Cambridge University Press	3120	3120	3000	389	445	499	0	P,M	100	N	Y
Houston Journal of Mathematics	University of Houston	2320	2510	2490	450	465	475	50	P	50c	N	N
Illinois Journal of Mathematics	University of Illinois Press	2320	2290	2200	1137	1086	1043	40	P	100	Yu	N
Indiana University Math. Journal	Indiana University	2390	2440	2290	NG	NG	NG	40	P	100	NG	N
Information and Control	Academic Press	2530	2520	2420	NG	NG	NG	0	P	50	N	Y
Information Sciences	Elsevier	2590	2410	2460	607	620	600	0	P,M	0	N	N
Journal of Algebra	Academic Press	2490	2450	2380	NG	NG	NG	0	P	50	N	N
Journal of Algorithms	Academic Press	2700	2630	2560	NG	NG	NG	0	P	50	N	N
J. of American Statistical Assoc.	American Statistical Association	5600	6020	5540	18500	18500	18500	65	P	0c	Ym	N
Journal of Approximation Theory	Academic Press	2050	2100	2130	NG	NG	NG	0	P	50	N	N
J. of Assoc. for Computing Mach.	Assoc. for Computing Machinery	3390	3560	3400	15000	15300	14000	60	P,M	50	N	Y
J. of Combinatorial Theory, A	Academic Press	2400	2380	2450	NG	NG	NG	0	P	50	N	N
J. of Combinatorial Theory, B	Academic Press	2400	2350	2550	NG	NG	NG	0	P	50	N	N
J. of Computer & System Sciences	Academic Press	3060	3200	3080	NG	NG	NG	0	P	50	N	N
J. of Differential Equations	Academic Press	2120	2280	2300	NG	NG	NG	0	P	50	N	N
J. of Differential Geometry	Lehigh University	2460	2740	2630	849	821	874	30	P	100a	N	N
Journal of Functional Analysis	Academic Press	2170	2240	2140	NG	NG	NG	0	P	50	N	N
Journal of Graph Theory	Wiley & Sons	2570	2700	2480	706	700	694	NG	P,M	NG	NG	N
Journal of Integral Equations	Elsevier	2070	**	**	260	**	**	0	P,M	0	N	N
Journal of Logic Programming	Elsevier	3210	3200	3320	434	873	1028	0	P	0	N	N
J. of Math. Analysis and Applic.	Academic Press	T	1900	2140	NG	NG	NG	0	P	50	N	N
J. of Multivariate Analysis	Academic Press	2040	2280	2280	NG	NG	NG	0	P	50	N	N
Journal of Number Theory	Academic Press	2170	2200	2240	NG	NG	NG	0	P	50	N	N
Journal of Symbolic Logic	Assoc. for Symbolic Logic	3180	3310	3080	2600	2680	2740	30	P,M	50	Y	Y
Journal of the AMS	American Mathematical Society	**	**	2660	**	**	507	0	P,M	50	N	Yj
Libertas Mathematica	Amer.Romanian Acad.of Arts, Sci.	2150	2120	2250	200	175	175	0	P	25	N	Y
Linear Algebra & its Application	Elsevier	1960	2200	1830	725	734	709	0	P,M	0	N	N
Linear and Multilinear Algebra	Gordon & Breach, Science Publ.	2080	2050	2480	NA	NA	NA	0	P,M	0b	N	Y
Mathematics of Computation	American Mathematical Society	2700	3200	3080	1964	1725	1708	0	P,M	50	N	Yj
Math. of Operations Research	Inst. of Management Sciences	3040	3120	3950	3300	3000	2900	0	NG	0	NG	N
Mathematical Systems Theory	Springer-Verlag	2680	3590	3000	800	800	800	0	P,M	50	N	Y
Michigan Mathematical Journal	University of Michigan	2860	2890	2810	NG	NG	820	25	P	0	N	N
Notre Dame J. of Formal Logic	University of Notre Dame	3160	3270	3260	822	772	812	0	P	50	N	N
Pacific Journal of Mathematics	Pacific Journal of Mathematics	2230	2310	2225	1425	1425	1425	30	P	75d	Yu	N
Proceedings of the AMS	American Mathematical Society	2930	3040	3120	1409	1188	1312	0	P,M	50	N	Yj
Quarterly of Applied Mathematics	Brown University	2850	3020	2990	1057	1052	1020	30	P	100c	N	N
Rocky Mountain Journal of Math.	Rocky Mt. Math. Consortium	2650	2590	1890	680	689	666	35	P	50	N	N
SIAM J. on Algeb. & Discrete Methods	Soc. for Indust. & Appl. Math.	3570	3600	**	883	994	**	64	P,M	0b	Y	Yj
SIAM Journal on Applied Math.	Soc. for Indust. & Appl. Math.	2950	3000	3570	2718	2670	2641	64	P,M	0b	Y	Yj
SIAM Journal on Computing	Soc. for Indust. & Appl. Math.	3580	3860	3950	1917	1956	2004	64	P,M	0b	Y	Yj
SIAM J. on Control & Optimization	Soc. for Indust. & Appl. Math.	3140	3230	3320	1859	1843	1879	64	P,M	0b	Y	Yj
SIAM J. on Discrete Mathematics	Soc. for Indust. & Appl. Math.	**	**	4250	**	**	941	64	P,M	0b	Y	Yj
SIAM Journal on Math. Analysis	Soc. for Indust. & Appl. Math.	2770	3240	3230	1367	1362	1436	64	P,M	0b	Y	Yj

(table continued)

Primary Typeset Journals

Journal	Publisher	Char/Page 1984	1986	1988	Circulation 1984	1986	1988	Current: Page Chgs ($US)	Back Vols +	Free Off-prints	Outside Support Y/N ++	Inst. Disc. Y/N
SIAM J. on Matrix Analysis & Applic.	Soc. for Indust. & Appl. Math.	**	**	4250	**	**	NG	64	P,M	0b	Y	Yj
SIAM J. on Numerical Analysis	Soc. for Indust. & Appl. Math.	3090	3000	3120	2698	2681	2644	64	P,M	0b	Y	Yj
SIAM J. on Science & Stat. Comp.	Soc. for Indust. & Appl. Math.	3620	3490	3650	1507	1704	1844	64	P,M	0b	Y	Yj
Studies in Applied Mathematics	Elsevier	2370	2610	2570	981	943	919	0	M	0b	N	N
Technometrics	Am. Soc. Qual. Cntl./Am. Stat. Assoc.	4900	5150	NA	5700	5800	6371	0	P	0b	N	N
Transactions of AMS	American Mathematical Society	2990	2880	3040	1228	1184	1190	0	P,M	50	N	Yj

+ P = paper; M = microform
++ m = member dues; s = society/association; u = university
** not applicable; not in publication
T see description of sampling methods and table at end of survey
NA not available
NG not given

a two or more coauthors receive 50 offprints each
b offprints available but not free
c contingent on payment of page charges
d two or more coauthors share 100 offprints

f discounts to Courant Institute members only
g second copies received at same location offered at half price
h subscriptions to more than one journal discounted from total of list prices
i lower rates for multi-year subscriptions
j membership-based discounts

Primary Author-Prepared Journals

Journal	Publisher	Char/Page 1984	1986	1988	Circulation 1984	1986	1988	Current: Page Chgs ($US)	Back Vols +	Free Off-prints	Outside Support Y/N ++	Inst. Disc. Y/N
Algebras, Groups & Geometries	Hadronic Press	1460	1540	1860	NG	NG	NG	0	P	50	N	N
Applicable Analysis	Gordon & Breach, Science Publ.	1590	1650	1760	NA	NA	NA	0	P,M	0b	N	Y
Comms. in Algebra	Marcel Dekker	1390	1430	1570	NG	NG	NG	0	P,M	50	N	N
Comms. in Partial Diff. Equations	Marcel Dekker	1350	1240	1600	NG	NG	NG	0	P,M	50	N	N
Comms. in Stat.: Theory & Methods	Marcel Dekker	1900	1590	1900	NG	NG	NG	0	P,M	20e	N	N
Comms. in Stat.: Simul. & Comput.	Marcel Dekker	1900	1860	1770	NG	NG	NG	0	P,M	20e	N	N
Intl. J. of Math. and Math. Sci.	Univ. Central FL/Calcutta Math. Society	2660	2615	2760	250	275	300	20	P	50	Yu	Y
Memoirs of the AMS	American Mathematical Society	1860	2120	1930	634	623	617	0	P,M	50	N	Yj
Numerical Funct. Anal. & Optim.	Marcel Dekker	1610	1600	1920	NG	NG	NG	0	P,M	50	N	N
Semigroup Forum	Springer-Verlag	1800	2050	1950	500	500	500	0	P,M	50	N	Y
Stochastic Analysis Application	Marcel Dekker	1430	1730	1610								

+ P = paper; M = microform
++ m = member dues; s = society/association; u = university
NG not given
e free with orders of 100
j membership-based discounts

Translation Journals

Journal	Publisher	Char/Page 1984	1986	1988	Circulation 1984	1986	1988	Current: Page Chgs ($US)	Back Vols +	Free Off-prints	Outside Support Y/N ++	Inst. Disc. Y/N
Algebra & Logic	Plenum Publishing	3080	3150	3040								
Differential Equations	Plenum Publishing	3500	3330	3780								
Fluid Dynamics	Plenum Publishing	3740	4120	4300								
Fluid Mechanics - Sov. Research	Scripta Publishing Company	3350	2500	2670	233	207	199	0	P,M	1	N	N

(table continued)

Translation Journals

Journal	Publisher	Char/Page 1984	Char/Page 1986	Char/Page 1988	Circulation 1984	Circulation 1986	Circulation 1988	Current: Page Chgs ($US)	Back Vols +	Free Off-prints	Outside Support Y/N ++	Inst. Disc. Y/N
Functional Analysis Application	Plenum Publishing	4080	4190	4690								
Journal of Soviet Mathematics	Plenum Publishing	3390	3430	4000								
Lithuanian Math. Journal	Plenum Publishing	3180	3510	4000								
Magnetohydrodynamics	Plenum Publishing	3800	4410	4320								
Math. Notes of Acad. of Sci., USSR	Plenum Publishing	3750	3960	4410								
Mathematics USSR - Izvestiya	American Mathematical Society	3170	3200	3360	455	424	426	0	P,M	50	N	Yj
Mathematics USSR - Sbornik	American Mathematical Society	3030	3000	3320	440	420	423	0	P,M	50	N	Yj
Moscow Univ. Math. Bulletin	Allerton Press	2460	2435	2750	NG	NG	NG	0	P	0	N	Yk
Proceedings, Steklov Inst. of Math.	American Mathematical Society	2970	3240	3320	330	328	331	0	P,M	50	N	Yj
Selecta Mathematica Sovietica	Birkhäuser Boston	2450	2630	2890	NG	NG	NG	0	NG	30	N	NG
Siberian Mathematics Journal	Plenum Publishing	3750	4180	4360								
Soviet J., Automation & Info. Sci.	Scripta Publishing Company	3750	4140	3670	141	125	116	0	P,M	NG	N	N
Soviet J. of Contemp. Math. Anal.	Allerton Press	2020	2500	2770	NG	NG	NG	0	P	0	N	Yk
Soviet Mathematics - Doklady	American Mathematical Society	3070	3490	3400	709	680	678	0	P,M	50	N	Yj
Soviet Mathematics (Iz. Vuz.)	Allerton Press	2550	2790	2825	NG	NG	NG	0	P	0	N	Yk
Theoretical & Math. Physics	Plenum Publishing	4120	4920	4090								
Theory of Probab. & Application	Soc. for Indust. & Appl. Math.	3090	3440	3740	1072	1059	1080	64	P,M	0b	Y	Y
Theory Probab. & Math. Statistics	American Mathematical Society	T	2340	2520	197	219	215	0	P,M	50	N	Yj
Trans. of Moscow Math. Society	American Mathematical Society	2560	3240	3080	321	369	383	0	P,M	50	N	Yj
Ukrainian Mathematical Journal	Plenum Publishing	3290	3570	4370								
Vestnik Leningrad Univ. Math.	Allerton Press (as of 1985)	2370	2580	2570	NG	NG	NG	0	P	0	N	Yk

+ P = paper; M = microform
++ m = member dues; s = society/association; u = university
NG not given
T see description of sampling methods and the following table:

1984 Cents per 1000 Characters

	sample 1	sample 2	sample 3
Computers and Math. w/ Application	15.6	13.0	13.0
J. of Math. Analysis and Application	8.4	6.8	9.3
Linear Algebra and its Application	9.8	11.1	10.5
Mathematical Systems Theory	9.1	10.7	9.6
Comms. in Algebra	11.3	8.7	9.9
Siberian Mathematics Journal	15.3	18.8	17.3
Soviet Automatic Control #	7.5	9.4	9.4
Theory Probab. & Math. Statistics	30.5	25.1	28.5

b offprints available but not free
j membership-based discounts
k 35% on back volumes
now entitled "Soviet Journal of Automation and Information Sciences"

Computers and Mathematics

Edited by Jon Barwise

Editorial notes

In a previous column[1], I wrote a short piece describing the differences between TeX, LaTeX, and AMS-TeX. That article inspired a pair of articles on TeX and mathematical typesetting, which appear in this month's column. The first is written by Martin Gilchrist, a mathematics editor for Oxford University Press. The second is written by Michael Doob, a mathematician from the University of Manitoba, and author of "A Gentle Introduction to TeX." These articles should be read by anyone contemplating the use of TeX in writing mathematics.

The column also contains three software reviews: a two part review of *PowerMath II* , by Yvonne Nagel and Phil Miles; a review of *Rubik's Algebra*, by Mark Sand; and a review of *Tarski's World*, by Mark Seligman.

Mark Sand replies to Alex Feldman

In an earlier column[2], in a review of *NetWare by Novelle*, Mark Sand described the computational environment at Augustana College, part of which consisted of a system of networked PCs. In a later column[3], Alex Feldman responded to this by questioning the decision-making that often leads schools to go the PC route. Mark Sand replies:

> While I agree with much of what Alex Feldman said in his recent letter, I'd also like to add a couple of points to the debate.
>
> First, not every math department can make independent decisions about what types of hardware and software they want to use. At many smaller colleges, the administration "studies" the options (often just listening to the salespeople) and then mandates what the entire campus will buy. If a department uses its money or grant money to buy "unauthorized" hardware, the school will not commit any resources to its support.
>
> Second, there are times when quickly obtaining some computing power is better than being promised the perfect system at a later date. While PCs and Macs aren't perfect, they are easily configurable to individual users, and have sufficiently powerful hardware and software that they are very useful right now. Although they need improving, they are at least proven (and affordable).

[1] Vol 36, 3 (March 1989)
[2] Vol 36, 3 (March 1989) 247-251
[3] Vol 36, 6 (July/August 1989) 675-676

TeX and Typsetting – A Publisher's View

*Martin Gilchrist**

Within the mathematical community (and increasingly in other disciplines too), TeX is now the de facto standard text-processing system. Throughout the world, more and more mathematicians are using TeX for writing preprints, papers, review articles, and books. Consequently, publishers are finding that these authors would like to see the electronic fruits of their labour used in the production of journals and books. This article is intended to provide something of an idea as to how mathematical publishers are responding to this challenge.

We need to distinguish between word-processing and text-processing: the former describes the activity of inputting text to a computer and its subsequent editing; the latter describes the manipulation of text

*Martin Gilchrist is a mathematics editor for Oxford University Press.

and its logical structure in order to reproduce it for publication. For some purposes, a wide range of "What you see is what you get" (WYSIWYG) word-processing programs are just as good as TeX at producing readable and tidy copy. Many authors are content to prepare the typescripts of papers and books using straightforward word-processors and to leave it to the publisher to worry about the appearance and typesetting of the final form. On the other hand, publishers have over several years developed ways of using author-supplied discs containing the text of books and prepared them using simple mark-up codes (that is, codes inserted into the text which indicated section headings, new paragraphs, footnotes, etc.). However, mathematics and technical material has always posed very difficult problems in this regard. As authors turn to TeX for the more complex functions of text-processing, publishers in turn have had to come to grips with the new possibilities this opens up to use authors' electronic files. In general, journal publishing faces different demands and pressures from those of book publishing, and the remainder of this article will be devoted to the problems of producing books from TeX.

Suppose that an author is using TeX in the production of a typescript. Three main alternatives are open to the publisher. The publisher may prefer to design and typeset the book once the typescript is delivered because they would like the book to have a particular appearance. For example, frequently undergraduate textbooks will be produced using a designer employed by the publisher to prepare the page design and format. In this case, the author's use of TeX to prepare the typescript is helpful (since it will produce neat and unambiguous copy for the typesetter) but it is not critical. A second option is that the author provides a laser-printed typescript from TeX. This will provide perfectly adequate camera-ready copy which can be made up into printing plates by a simple photographic process. For some purposes, such as conference proceedings, this is quite suitable since in this case the main priority will be to produce such a volume rapidly and cheaply. The third option will be to use the electronic files created by the author to "drive" a phototypesetting machine.

Perhaps a remark here about typesetting is in order. In days gone by, books were typeset by laying out in racks the metal type that on inking and pressing to paper gave the printed page. With the advent of lithographic offset-printing, the metal type was used only to create a first image which was then photographically transferred on to plates and the page sheets would then be printed from these plates. This technique in turn has been supplanted by the use of phototypesetters: the original image is created not by metal type, but by scanning high-quality photographic paper with a laser which, by switching on and off very rapidly, creates the image of each letter and symbol as it scans down pages of photographic paper. These first "bromides" are then cut and pasted to make the pages and then photographed to make the printing plates. This is the technology known as phototypesetting which is used to typeset almost all modern books. Critical to this process is the computer program which is driving the laser phototypesetter and which contains all the information concerning the layout of the page, the shape of each letter and symbol, the distance between letters, and between one line and the next. Publishers may not necessarily own a phototypesetter or for that matter use one they own to exclusively set their books. Normally, an academic publisher will buy typesetting from around the world depending on the price, availability and the nature of the task of typesetting for a particular job.

The main output file that the TeX program generates is known as the dvi (device independent) file. This contains the precise details of the layout of each page and therefore many publishers are able to use it for phototypesetting. Indeed, an author's laser-printer is in some respects simply a low-resolution phototypesetter (typically with a resolution of 300 dots per inch (dpi) as opposed to a commercial phototypesetting machine which may have a resolution of 2400 dpi or even higher). The advantages of using a phototypesetter rather than a laser-printer will principally be one of quality in the print of the final book. It is usually possible to tell by close examination whether laser-printed camera-ready copy or phototypesetting has been used to create the image used to produce the printed page.

All publishers, authors, and readers of books will care about how the printed page looks - how pleasing it is to the eye, how easy it is to read, and how free from errors and misprints it is. How a book looks can markedly affect how well it sells and how happy people will be to buy, recommend, and read it. A publisher will want to take care that any book they publish reflects their standards of design and editorial quality. They will also want to ensure that a book looks right for its intended audience. Consequently, if an author is proposing to use TeX, their publisher will want them to follow certain ideas of layout and design. For example, the publisher will have accumulated experience about the right relationship between the width of a line of text on a page, the type size, and the space (the leading) between lines. They will have developed a variety of designs for chapter headings, section headings, running heads, the width and depth of text on a page, etc. Similarly, they will have styles for numbering equations and providing references; these all form part of the publisher's "house style." Different sorts of books will probably have different styles to suit their respective audiences. To ensure that these qualities are preserved it will be important for author and editor to discuss in some detail what is involved at an early stage in the preparation of the typescript. On the other hand, authors themselves may have strong views about how their book should look and will want to influence the final outcome too!

In TEX, the page layout of a document is usually determined by a set of macros. These are sets of instructions which the TEX program can interpret and which, if incorporated in the author's source file (the file of ordinary ASCII characters which is the input to the TEX program), will reproduce certain features such as running heads or section headings or page dimensions in a particular style. Typically, these macros will be held together in a "style file", which is called up by the appropriate TEX command. In common with some other publishers, Oxford University Press can now provide its authors with such style files in order to produce one of a variety of "looks." These files are usually provided on a disc or can even be transmitted by electronic mail.

It is important that the author and publisher discuss what can be done using TEX. It will be useful to check at an early stage that the final electronic form of the dvi file which the author generates can be used by one of the publisher's typesetters. This process will involve ensuring that the typesetter can cope with the range of fonts and symbols that the author will be using (or if not, what substitutes will do). Very often a sample electronic dvi file of a chapter or so is sufficient to check that no problems will arise. If no suitable typesetter can be found, then other arrangements will probably need to be made (for example, by using the author's TEX source file in another system). Some publishers are working towards providing authors with sets of fonts and font metrics which are suitable for a predetermined typesetter though this brings with it additional problems of compatibility at the stage when the author is producing drafts on his/her own printer or screen. Author and editor will also need to discuss issues such as the production of figures, illustrations, tables, etc.

A publisher will still want to ensure that the final dvi file is as error-free as possible. Oxford University Press proceeds as follows. When the author has completed his/her book, he/she first sends in a complete typescript of the book run out on his/her laser-printer or whatever. The hard copy is then read through thoroughly by a professional copy-editor. This will involve the copy-editor checking the entire typescript for consistency of spelling and grammar, that the equation numbering is correct and consistent, that names, dates, and other information are consistent in the text and with the list of references, that the layout conforms to the guidelines given, and many other aspects that contribute to the accuracy of the typescript. The copy-editor will also be looking for stylistic points which they will suggest to the author for improving the clarity of the work. The copy-edited typescript is then returned to the author who is usually responsible for incorporating the suggested changes and corrections into the electronic files. It is almost certainly more efficient to have the author make these changes: they will know their way around the electronic files better than anyone, they can check what affect changes will have (such as line and page breaks), and they are not left with the uncertainty of not knowing what changes are being made. Once the author has made all the corrections, he/she runs the source files one last time through TEX to generate perfect (in principle) dvi files. These are then sent to Oxford for typesetting.

A natural question to ask is: Why use the dvi file rather than the source file created by the author? Several academic publishers, including Oxford University Press, have some in-house capabilities for using and editing TEX files. However, mathematicians will know that there are many variations of TEX available each with subtle variations concerning the range of macros, fonts, and symbols that they will recognize. A source file which produces a particular piece of mathematics in one form of TEX, may produce a subtly different looking version in another (if indeed both versions can accept the same set of macros and fonts used). For a publisher to agree to use source files they would have to be sure that they could match this bewildering array with the same proliferation of machines and TEX variations. On the other hand, the dvi file is by definition independent of machine and should be faithfully produced by any typesetting machine that can interpret it. Often too, authors will have expectations about how a particular piece of material will look, which may not be faithfully reproduced by another version of TEX. Using the dvi file ensures that the author has had complete control over the niceties of layout such as particular page breaks or equation breaks that are important to them. This said, with appropriate planning it is of course feasible and may sometimes be desirable to work with the author's source file.

What benefits will using TEX bring authors and publishers? The obvious advantage that typesetting from TEX has is that the stage of manually rekeying the work by a typesetter is avoided. Thus, there is no danger of new errors creeping in (as otherwise they would inevitably do). In turn, this saves the author from having to read one or more sets of proofs, and results too in some savings in money for the publisher (though I shall return to this point later on). Book production can also be speeded up by the three to four months that typesetting and proof-reading typically take. Inevitably it will involve the author in more work earlier on because TEX requires more effort to input and is more fiddly to change. It is our experience too that whereas authors would often let small mistakes in a typescript go (or handwrite corrections in) and pick them up at proof-stage, with TEX, authors can devote hours to the exact layout of a table or equation because it is possible to do it!

What savings in cost will using TEX bring a publisher? In the normal course of events, an author will usually be expected to bear the cost of preparing a conventional typescript. However, when they have used TEX, an author will occasionally ask for some fee to cover the additional costs (if any) which they have incurred in preparing the typescript. Different publishers will have very different policies regarding any such payment (though a rate calculated per page of output is often agreed). It is much better to arrange a straight fee rather than try to increase a royalty rate. This is because the publisher will want to regard any such payment as part of their production costs for the book and often the author needs to pay a typing bill immediately rather than defer payment until a royalty cheque arrives! When a typesetter can use a TEX dvi file to drive a phototypesetting machine then they usually charge considerably less per page of output than for books which they have manually rekeyed. There is still some charge since labour, machines, and materials are all being used.

What affect then will setting from TEX files have on the price of books? It is certain that TEX will reduce publishers' typesetting bills. However, the costs of typesetting a book comprise only a (surprisingly small) proportion of the cover price of a book. Further, the cost of "keyboarding" (which is essentially what the author is providing) is only a part of the cost of the entire typesetting operation. Larger proportions of the cover price may be taken up by the costs of marketing, promoting, and distributing the book, not to mention the direct costs of paper, ink, printing, and binding. On the other hand, every publisher will be concerned to charge what is a reasonable going rate for their books no matter what the production costs are, and to derive a respectable rate of return. Largely, the impact of TEX on the price of books will depend on each publisher's policy for pricing and printing books and this already varies wildly from one publisher to another!

TEX is making every academic publisher sit up and take notice. The issues raised by TEX and other desktop publishing systems are having a fundamental affect on the publishing industry. Increasingly, a publisher's expertise will reside in their editorial and marketing skills rather than production. The impact of better and better commercially available laser-printers for departments and offices will enable authors to generate high-quality copy themselves. How will this affect the role of publishers? What will be the long term effects on the range of mathematical publications and on their print runs and sales? What affect will email have on the communication of mathematical ideas and the use of books? If one mathematician can electronically transmit, say, a TEX source file to another for processing at the recipient's department what impact will this have? How will journals cope with the different electronic forms of source or dvi files? TEX is also making its presence felt in other academic disciplines too, and so it is not just the main publishers of mathematics books who will have to come to terms with TEX. At the same time, typesetters (particularly those who derive a large amount of their business from mathematical and technical setting) are beginning to realise the implications of these changes and the need to respond either by installing TEX themselves or by ensuring that their machinery can be made compatible. It also means that for typesetters the traditional skill requirements of fast and accurate keying are being supplanted (or at least supplemented) by an ability to edit and reformat electronic files to certain specifications. This in turn will have an affect on the demands for computer literacy in the labour force. Will the imminent availability of WYSIWYG front ends to TEX increase the spread of TEX or simply the ease of use in its present user community? So far, it is clear that TEX is having an enormous impact on mathematical publishing and will continue to do so for the foreseeable future.

TEX and Typsetting – An Author's View

*Michael Doob**

The juxtaposition of this article with the previous one might cause one to believe that the publisher and author have conflicting methods and goals that must somehow be resolved. This, of course, is not the case: both the author and the publisher want to create an accurate, informative, and attractive volume. The perspectives of the two are rather different, and this is reflected in the possible use of TEX.

The highest priority of the author is to present all of his or her results accurately and clearly. There are several options open to do so. One is to prepare a manuscript, either by a typewriter or by a fancier word processor, and then let the publisher typeset the pages in the traditional way. A second option is for the author to do all the preparation on his or her own as camera-ready copy. On the face of it, this is possible using a cleanly typed manuscript, but anyone who has tried to read an entire book done this way soon realizes that it is much harder to digest than is a book typeset in the normal manner. This is not altogether surprising, for there are several hundred years of typesetting experience behind the books we read; the absorption of information is aided by the sometimes subtle cues in the typesetting and in the spacing of words.

Some improvement over the typewritten copy occurs when an author works with a WYSIWYG (what you see is what you get) system, for a variety of typographic tools becomes available. The author has, however, been turned into a graphic designer. Now I have never heard of an expert in the graphic arts say, "I think I'll write a few mathematical papers; after all, my intuition with numbers is really quite good." But, in effect, mathematicians are saying exactly the same thing when they use WYSIWYG systems. It seems that the lure of all those extra fonts is irresistible. Of course it is possible for the mathematician to study some of the classic books on typesetting styles; but it is much more likely that, if the problem of typesetting is considered at all, the author will look at a few books and imitate what is there, thus producing, at best, a work which is an amalgam of different styles. To produce a first rate result, the help of the publisher is certainly necessary.

*Michael Doob is a mathematician from the University of Manitoba.

These two options are the extremes that result in minimal author-publisher cooperation in the typesetting process; either the publisher or the author does everything. One of the great assets of TEX, as we shall see, is that it makes possible a greater level of cooperation.

An appealing aspect of using a WYSIWYG system is the combination of the ease with which changes can be made and the immediate feedback after making these corrections. It is usually possible to pick up objects and move them around the screen using a mouse or some keyboard sequences. But, in this case, the judgement of where to place objects is affected by the resolution of the screen. Either there must be a magnification to see the object in all its detail or there must be a loss of resolution compared to a laser printer or other printing device. This makes precise work difficult. Further, for the publisher to use the author's computer file, the software and hardware must be identical. A WYSIWYG system, at least at the present time, by its definition is highly machine dependent.

Now, this is meant to be in contrast to TEX, of course. TEX is a markup language, that is, instructions are encoded that, for example, set the layout of a page, and the text is then typeset according to those instructions. The disadvantage is obvious compared to WYSIWYG: you don't see the final result as you enter the text. To see the final result it is necessary to create (type in) a source file, to run that file through the TEX program to produce a `dvi` file (which is not human-readable), and then to take that file and use another program to produce legible output. That's a lot of work when compared to WYSIWYG.

What does the author get for this extra work? First of all, there is a much more accurate placement of characters. The internal computations within TEX are carried out to within a few Ångstrom units. Printing devices don't work to that accuracy, of course, but the full capabilities of, say, a 2400 dots per inch phototypesetter are used. A monitor screen has a resolution of about 100 dots per inch, so WYSIWYG is rather limited by comparison. Also, the author gets a large and standard set of fonts. The repertoire of mathematical symbols, in particular, is much greater with TEX than with WYSIWYG systems.

But much more importantly, the universality of TEX allows the author to prepare his or her source file on one machine and the publisher to use that file on a different machine; the use of the intermediate `dvi` file lets both the author and publisher work with printed copy that is identical up to the physical limits of each output device. The WYSIWYG route forces the publisher and author to use identical hardware and software. So, either the publisher must have a myriad of computers with different versions of software and operating systems, or the author is forced to get something that matches what the publisher already has.

But since TEX has been implemented on all major computers, this problem does not arise. This means, at least in principle, that the page layout can be done primarily by the publisher, and the writing can be done primarily by the author, but each can make significant contributions to the other at whatever level is mutually desirable.

The importance of the separation of the page layout from the writing of the mathematical text by TEX is crucial. If the text, for example, is supposed to be 6.5 inches wide, the particular coding in TEX would be `\hsize = 6.5 in`. Once this instruction is given at the beginning of the file, this value will be used for typesetting the width of all of the lines and will also be used for other calculations such as centering lines; it will be in effect for all lines typeset until the end of the document or until the parameter `\hsize` is changed. There are many such parameters like `\hsize`, all of which have default values. The point here is that these values can be changed easily; if, for example, the text should be 16 centimeters wide instead, all one must do is put `\hsize = 16 cm` at the beginning of the document instead. There is no need to go through the document reformatting page after page. The graphics designer can set these parameters while the author can enter the text. In fact this has become standard with TEX and specialized "style" files have become available from particular publishers and even particular journals.

There is another indirect but important advantage for the author using TEX. Since the TEX source file uses only normal characters and no special control characters, the usual array of tools for creating indexes, tables of contents, tagging references, and spelling checking are available. But even more importantly, the source file may be sent by electronic mail, and this makes the communication between the publisher and author much easier. It may be that the planning between author and publisher is perfect when the author starts to write; but it is more likely that there will be some evolution as the project moves along. This is especially true if there is more than one author. It is certainly possible and in fact practical for authors to write separately and then meld the results using electronic mail. The ease of glueing the contributions of the authors and the publisher is a real advantage of using TEX.

The availability of electronic mail transfer has a further implication for the distribution of the author's final result. The distribution of books on magnetic rather than paper media is possible and, in fact, is being done with Mathematical Reviews already. The distribution via electronic mail would be easy. Perhaps in the near future we will be ordering a book by electronic mail and receiving the electronic file by automatic reply the next day. The smallest and most remote colleges will have the same access to new books as the largest and most prestigious urban universities.

Finally, we should note that TEX has some built-in protection against becoming outmoded by technological change. The source code is in the public domain, and can be tested against any new machine or compiler that appears. Also, the use of the `dvi` file makes the use of new printing devices relatively easy, and is independent of the TEX program itself. If, in the future, all libraries have 5000 dots per inch printing devices available like photocopy machines are today, then the TEX file made today will be reproduced in full glory!

Reviews of Mathematical Software

PowerMath II

*Yvonne Nagel**

This is a review of *PowerMath II*, a computer algebra system for the Macintosh. I reviewed Version 2.5 of this program. It was originally developed by Industrial Computations, Inc. for the 128 K Mac and Lisa in 1985. Further enhancements were made in 1986 and 1987. The current version was made in 1987. It is available from Central Products Corporation, 2211 Norfolk, Suite 518, Houston, TX 77098 (phone: 713-529-1080).

The *PowerMath II* manual describes it as the *first* symbolic problem solving program for the Macintosh. I was eager to try it since I had already tried *Derive*

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on an IBM-PC compatible computer. Also, since I had agreed to work in a summer program for high school minority students at the University of Wisconsin, I thought I could test it on them to see their reaction to the program.

The level of mathematical problems which *PowerMath II* is capable of solving is very much below that of *Derive*, *Maple*, *Mathematica* or *Macsyma*, which are other symbolic manipulation languages. In compensation, though, it has a user interface which is more appealing and easier to understand for high school-aged or beginning college students. The four minority students whom I worked with had never used a Macintosh or IBM PC before this summer. One of them had extensive programming experience on a VAX. Two of them had taken an introductory basic course using Apple IIs. The fourth student had no prior computer experience. Moreover, none of them had used symbolic manipulation programs before. They tried some simple problems on the IBM PC using *Matlab* and *Derive*. Then they tried some exercises on the Macintosh using *PowerMath II*. They all agreed that they liked *PowerMath II* best. However, the student with the most computer experience also remarked that perhaps *PowerMath II* might be more limited than the other programs. After working with *PowerMath II* for several days, I tend to agree with him.

The user Interface

I would like to begin by describing the most appealing part of *PowerMath II*, namely the user interface. It is easy to work with and obviously easy to understand for unsophisticated computer users. This might make *PowerMath II* useful in a high school algebra or pre-calculus course.

When the user opens *PowerMath II*, he is presented with four "slates" – actually four rectangles on the left of the screen – which are labelled **Data Sets, Problems, Answers,** and **Functions**. A window titled **Problem Slate** occupies most of the screen. This is a "clean slate" on which the user is to enter his problems.

Following the manual, one can enter a problem such as:

```
? (2x+y)(x-3y)
```

The user then highlights this line using the standard Macintosh click and drag technique and selects **Evaluate Selection** from the Control menu at the top of the screen (or presses the cloverleaf and 'e' keys simultaneously). A window titled **Answer Slate** immediately appears with the answer:

```
2*x^2+(-5*y)x-3*y^2
```

After some practice, the user recognizes this as $2x^2 + (-5y)x - 3y^2$ One can also solve simultaneous equations such as:

```
x+y=4-A^3
y+6=x-4
Solve(x;y)
```

Highlighting this set of commands and choosing **Evaluate Selection** as described above produces the correct answer in terms of the symbolic constant A. Actually, the user has the option of selecting or deselecting a "learning mode". If you choose **Show Work** from the Preferences menu you will see the following display on your answer slate:

```
x+y=4-A^3
y+6=x-4
Solve(x;y)
x+y=-A^3+4
Becomes : A^3+x+y-4=0
y+6=x-4
Becomes : -x+y+10=0
A^3+x+y-4=0
Becomes : x=-A^3-y+4
-x+y+10=0
Becomes : A^3+2*y+6=0
A^3+2*y+6=0
Becomes : y=(-A^3-6)/2
Solution :
x = (-A^3+14)/2
y = (-A^3-6)/2
```

If you do not choose to **Show Work** you will just get the answer:

```
x = (-A^3+14)/2
y = (-A^3-6)/2
```

This is, of course, the kind of technique used in a precalculus course. The method of solution can be immediately comprehended by students in such a course. However, there are other methods of solving such a problem - even in a pre-calculus course and an instructor who uses *PowerMath II* must take care that students do not start solving such problems in a stereotyped way.

The Data and Function slates can be used to define and store data and functions used in several problems. Data can include such things as the values of variables and even matrices. Predefined functions include the standard trigonometric functions such as sin, cos, etc., log with different bases, integration and differentiation, roots, Taylor series, absolute value and powers. The user is encouraged to define his own functions and store them on the **Function** slate for later use. There is also a **Plot** command which allows you to view plots of one or two variable equations. The user must set the range of the independent variable and avoid curves with discontinuities. It is capable of doing multiple plots. Thus one can see a graphical representation of the solutions of a set of simultaneous equations. Apparently, *PowerMath II* is not capable of doing three-dimensional plots. There is also a warning that the speed of plotting is slow.

The Documentation

The manual was well written with clear examples. The examples were easy to follow and the descriptions of the user's actions were clear. However, I found myself wishing for an index and, perhaps, an appendix with a brief summary of *PowerMath II* commands. Like many computer users, I was eager to try out the software and did not want to read the book completely before I could do so. An entire chapter is dedicated to the mechanics of the program. This is probably useful to beginning Macintosh users - as the minority students were, but could probably be skipped by an experienced Macintosh user. The chapters on Problem Definition, Matrices, and Functions were devoted to the mathematics which the program is capable of handling.

The Mathematics

Although *PowerMath II* has an appealing user interface, I feel that much work needs to be done to extend its mathematical capabilities. For example, although *PowerMath II* easily expands an implied multiplication such as

```
?(2x-y)(x-3y)(4x+2y)(3x-7y)
```

It does not seem to be capable of factoring a simple quadratic. Since much time is spent in factoring quadratics in a pre-calculus course, this is a definite drawback.

PowerMath II is capable of differentiating and/or integrating *expressions*. It is also able to give the first n terms of the Taylor expansion of an *expression* about a point. Unfortunately, the manual informs us that *expression* must be a polynomial. I suppose that this is the reason that the program was named *PowerMath II* – i.e. it only handles polynomials well. Of course, the user can create a function definition which tells *PowerMath II* how to differentiate, say, sin or cos. He can then use this definition to illustrate the chain rule by differentiating, e.g. $\sin(x^2 - 2x)$. This might be useful for a precalculus student who is also a computer sophisticate, but would probably be beyond most students in a precalculus course.

Summary

In summary, *PowerMath II* has the potential of developing into a useful tool for precalculus and, perhaps, beginning calculus courses. The user interface is appealing and simple enough for unsophisticated users. However, the mathematical capabilities must be extended before it would be worthwhile in a classroom setting. Also, the retail price of $149.00 is high. Right now, perhaps, *Matlab* or *Derive* on an IBM PC offers better value for the money.

More on PowerMath II

*Phil Miles**

PowerMath as student

PowerMath, in its "symbolic constant" mode, solves problems in a fashion emulating what we conventionally expect in student solutions. Arithmetic of rational numbers is done in terms of rationals, not their decimal approximations. Solutions to quadratics are given in terms of square roots, not decimal approximations. It cheerfully solves $1/r = 1/r1 + 1/r2$ for $r1$ in terms of r and $r2$ [recognizing r, $r1$ and $r2$ as three different variables]. *PowerMath* looks like a student when solving problems.

I had *PowerMath II* take the lower end of our placement test, with myself acting as amanuensis. It got 33 out of 75 questions correct, which places it into our intermediate algebra course. Had it appealed this decision, we would have let it try college algebra

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(which, with trig, immediately precedes calculus). It wouldn't pass college algebra in its present form. I guess that it could be enhanced to a point where it could place directly into calculus, and that the amount of work to accomplish this would be no greater than its creators have put into getting it this far. *PowerMath II* is excellent on algebra problems of the genus "simplify", and good [though slightly quirky] on equations of linear or quadratic type. It is simply not there as regards geometry or most of trig.

Does it learn like a student? The relevant context for this question is elementary calculus. *PowerMath II* comes already able to find derivatives of rational functions and indefinite integrals of polynomials. The user can readily program in rules for derivatives or integrals of other functions - say the basic trig functions, log, exponential and roots. Once this is done, *PowerMath II* can use the chain rule to produce the derivative of any elementary function. If "learning" means what can be readily demonstrated to occur in the majority of students ["assessment learning"], then *PowerMath II* learns the chain rule like a student in a routine business calculus course. I was unable to teach it implicit differentiation or integration by substitution.

I concur with Yvonne Nagel's remarks on the friendliness of the interface. I started with no experience of either the Mac or *PowerMath II* and spent less than three hours of unsupervised exploration of the combination before doing the placement test; most of that time could have been saved had I read the manual more thoroughly.

There were eight problems on the placement test where a different kind of user would, with *PowerMath II*, have gotten the answer. These were "word problems", and the kind of user in question is one who can write down equations from a word problem but can't deal with the equations thereafter. This kind of user is very rare in pre-calculus courses on my campus but, by my guess, constitutes about 10% of the overall undergraduate body.

PowerMath as learning tool

PM's strong point is in getting the answers. In the context of conventional instruction, this ability is otiose. No computer, no matter how cheap - no environment, no matter how friendly, will obtain answers as readily as looking them up in the back of the text. The goal in conventional instruction is not getting the answer but doing the problem. The central failing of conventional instruction in recent years has been in convincing students of the validity of this goal.

PM, in its "show work" mode, does display its steps on the way to the answer. The result is, from a pedagogic viewpoint, a bad implementation of a dull idea. Any device [including text or lecturer] which simply scrolls through the lines of a solution is of little help in teaching algebraic manipulation. And the actual sequence of steps followed by *PowerMath II* is frequently far from the one which a student should follow. In short, *PowerMath II* is more interesting as a student than as a tool for learning.

[These strictures concern PM's relevance to ordinary students; the student who investigates why *PowerMath II* follows the steps it does will presumably learn a lot]

PowerMath and future math education

The wise have, I think, been silent on the future of mathematics education. I will do the best I can and be terse.

Math education, as generally discussed, means roughly math for non-mathematicians. For the education of this group, the fundamental question (I claim) is finding the right role of "getting the answers" - fundamental for both choice of content and for pedagogy. Under at least some answers to this question, future students will be not people but person-machine teams. I doubt that *PowerMath* in its present form is what one would wish as the machine half of such a team. But *PowerMath* does demonstrate an approach which deserves careful consideration when thinking about the possible composition of such teams.

Rubik Algebra

*Mark Sand**

Integrating computers into mathematics classes is easier in some areas than in others, with Abstract Algebra being one of the most difficult. One program which can help is *Rubik Algebra* by Charles G. Flemming and Judy D. Halchin of Eastern Illinois University.

It is commonly known that the turns of the faces of a Rubik's cube can be identified as permutations on the "cubies" that comprise the cube. An introduction to the study of the operations that can be done on a cube was given in Douglas R. Hofstadter's "Metamagical Themas" column in the March 1981 issue of Scientific American Magazine. Using the same ideas and similar notation, *Rubik Algebra* enables the user to perform

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face rotations, either by typing them in or recalling them from a saved list, and analyze them as a product of disjoint cycles.

Initially, the cube is shown on the screen with a menu of choices. Of these, the choice I use most often is "Perform face rotations." After entering the desired sequence of turns and the number of times the sequence should be repeated, the cube is erased and re-drawn in its new state. It would be fun to see the faces turn in animation, but I can think of at least two reasons why that isn't done. First, it would be too slow, since repeating a move a few hundred times (a reasonable thing to do, actually) can last nearly a minute even without animation. Second, *Rubik Algebra* is designed to be a small and simple program that doesn't require an extensive amount of memory.

Rubik Algebra is a lot of fun to use, however, for fans of Rubik's cube or elementary group theory. The menu choices are extensive enough to allow any move to be accomplished, and the program will do some of the work. Other choices that are available for manipulating the cube cause it to be turned, or scrambled, or unscrambled. Another menu line allows the user to step forward or backward through the moves that have been previously entered. This is a good way to set up a sequence of moves that show the cube being gradually scrambled and unscrambled.

Mathematically, the most important menu choice is "Cycle decomposition." This writes the most recent operation on the cube as a product of disjoint cycles, some of them cycles of corner cubies and the rest being cycles of edge cubies. This is more complicated than it sounds, since a cubie has both a position on the cube and an orientation of its colors. There is a help screen that can be called up at this point to summarize what the cycle notation means. It is not extensive, but is adequate to remind the user of what the cycle notation is representing.

Through this process, the user can experiment with orders of elements, conjugates, and commutators, and not worry about the algebraic expressions becoming too long or unwieldy. For example, letting the computer scramble the cube results in a randomly-chosen move of about 60 to 70 face turns (90 degrees each). The cycle decomposition of the move will show cycles of various lengths, with the least common multiple of the lengths being anywhere from a few dozen to many hundreds. Then repeating the move the proper number of times will return the cube to its unscrambled state. If the move is repeated a number of times that is only a proper factor of this least common multiple, interesting patterns can result.

Although I have had a lot of fun and learned a lot from using *Rubik Algebra*, I think I would not use it for an extended time as a teaching tool in a classroom situation. Instead, it is ideally suited to individual investigation. Since it is very easy to use, a student (or teacher, of course) could spend just a short while with the program and gain significant understanding of some of the ideas of group theory. This would spur short classroom demonstrations and discussion without using class time to learn the program.

One word of caution for users of *Rubik Algebra*. Since the main menu choices can be performed by typing the first letter of the line, typing 'u' will execute the operation "Unscramble the cube." However, 'u' also represents a clockwise turn of the "up" face of the cube, and is often typed after selecting the "Perform face rotations" line. When typing quickly, I frequently hit 'u' before selecting the correct line, which unscrambled the cube instead of proceeding with the next move. This cannot be undone, so the previous work is lost.

Rubik Algebra is written for IBM-compatible microcomputers with CGA (or better) graphics. It is distributed as shareware, with a price of $10, and can be obtained by writing to the authors at Department of Mathematics, Eastern Illinois University, Charleston, IL 61920.

Tarski's World

*Mark Seligman**

Tarski's World is a software tutorial written to introduce first-order predicate logic. The program provides an interactive setting in which first-order sentences may be composed, checked for syntactic correctness and verified in a model constructed by the user. Tarski's World runs on Apple Computer's Macintosh machines.

The Product

Tarski's World presents three main windows on the Macintosh screen. The "sentence window" displays formulas of first-order logic which the user wishes to test. The "keyboard window" provides a version of the keyboard in menu form; from it the user may compose

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sentences in the sentence window. The "world window" displays the model in which sentences are to be interpreted. The model, or "world" as the documentation terms it, is a collection of three-dimensional shapes lying on a ruled plane. The sentences being analyzed, then, are to be thought of as statements about the shapes in the world window.

Worlds are built from objects, which can be cubes, dodecahedrons, or tetrahedrons; objects are selected from icons and "dragged" onto the plane in the display. Objects may also be labeled with a constant, much as a constant may be bound to its semantic interpretation. Worlds may be edited using mouse and menu commands to move, remove and size objects. Worlds may be saved in files for later use. An option is given to allow worlds to be viewed two-dimensionally from above, useful when an object obscures the view.

A user composes sentences using either the keyboard or the menu in the keyboard window. Available are the usual symbols of a first-order language, including the existential and universal quantifiers, negation, equality, conjunction, disjunction and implication. Six unary predicates, three relating to shape and three relating to size, and seven binary predicates, relating to relative positions, of objects are provided. There are also supplied six constant and six variable symbols and parentheses. As the sentence is built, it appears in the sentence window. Lists of sentences may be built. Like worlds, sentences may be edited and saved in files.

A menu within the sentence window selects tests which may be made on any displayed sentence. A sentence may at any time be checked syntactically for either of two criteria: Is it a well-formed-formula? Is it a sentence? The user may assert either the truth or the falseness of these criteria; the program will check the assertion. A third test, intended for sentences about a model displayed in the world window, verifies the sentence's interpretation in the model. This test, referred to as "the game", is the heart of the program.

The game is a type of interactive theorem checker. It not only checks the truth of an assertion about the model, but, in the case of false assertions, helps the user identify flaws of reasoning. It does this by deft use of counterexample, prompting the user for claims about the validity of subformulas it has chosen from the sentence, then challenging the user to find an object witnessing a false claim.

On the program disk are included files, most bearing the name of famous logicians, which contain example worlds and sentence lists to be used as exercises. With the program comes a document of about one hundred pages. The document explains how to use the program, introduces concepts in logic and develops exercises for use with the sample files. Some of the exercises can be written and then graded.

Review

The program ran well with exercises taken from the documentation. Even long and complex sentences ran reasonably quickly; I did not attempt to find one long enough to make the program fail, however. There was no problem either reading or writing my own files, although the documentation cautions that additional disks will be needed to hold more than about twenty-five new files.

Those not used to working on the Macintosh may feel cramped by its small screen. At times I was frustrated by having to hide windows or resize then when my sentences grew large or numerous. It would be nice if *Tarski's World* were available for machines with larger screens.

I had some difficulty learning the meaning of the spatial relation predicates used by language of Tarski's World. For instance, "between" always confused me. Checking the documentation, though, one finds exercises prescribed very early for mastering the interpretation of this and other predicates.

There is perhaps one criticism of the game. If a sentence is true, the game will confirm it to be true—period. As the game is intended to be a teaching tool, the user might expect to be able to step back through the verification, to affirm that various pieces of the sentence are valid for the reasons she or he thinks they are. It is not hard to conceive of a student choosing a valid sentence on a hunch, with little confidence in the reasoning leading to the sentence. The only option appears to be to deliberately make a false claim and step through its contradiction.

The documentation is nearly an introductory text on first-order logic. After a brief introduction to the mechanics of building worlds, composing formulas and using files (with references to Appendix 2 for those needing to learn more about Apple utilities), the first chapter concentrates on teaching logic. The meanings of the logical symbols are discussed, then the notions of free and bound variable, well-formed-formula and sentence. Footnotes point to deeper explanations in Appendix 1.

Chapters 2 and 3 explore propositional and predicate logic, respectively. Exercises advise playing the game on various sample sentences in sample worlds and then on alterations on them. A common theme in these exercises is the examination of the expressive power of a formal language versus that of a natural language; often the user is asked to translate English sentences. Many exercises are directed to the illustration of specific concepts in logic, such as a sentence's being vacuously true or being the consequence of, or independent of, other sentences. Oddly, though, the notion of proof, although well motivated at this point, is not covered.

Chapter 4 explores further topics, including consistency, persistence through expansion or contraction of the model and elementary equivalence. Some of the exercises require proofs; one of them requests a proof by induction on the length of a formula. Much emphasis is made here, too, on semantics in the formal language—even the software's constraint on the permitted number of variables and constants is critically examined.

Despite the large number of topics discussed in the documentation, proofs are not given. In that sense at least, the documentation is not a self-contained text, but rather, as it claims, a supplementary text. It is certainly more than just a manual. A curiosity, though, is the authors' commitment to the word "world". They introduce may of the terms used by logicians, but seem to shy away from "model".

Conclusion

Because of the didactic process of verification which the game offers, the user has a tool to help work through mistakes. This might mean less time spent by an instructor on concepts more easily practiced by a student with a machine. *Tarski's World* certainly presents the student with more than just a work book.

Judging by the quality of the software and the coverage of the accompanying text and considering the usual cost of textbooks or classroom time, I'd say that at fifteen dollars *Tarski's World* is a steal.

Tarski's World is currently available from the Kinko's Academic Courseware Exchange, P.O. Box 8022, Ventura, CA 93002-8022 (phone 800-235-6919, from California: 800-292-6640 and from outside the US at 805-652-4158. A new version of the program is expected to be released by CSLI, Ventura Hall, Stanford, CA 94305 by January 1990.

Mathematical Freeware and Shareware

Freeware and Shareware

An enhanced version of CC

A new version of *CC*, the Calculus Calculator (reviewed Vol 36, 7 (Sept 1989)) is now available. Enhancements include symbolic derivatives, complex functions, 3-D graphs of surfaces, vector operations, statistical functions, solutions to non-linear systems of equations, binary and hexidecimal arithmetic, and full programmability. *CC* is shareware and may be obtained by writing:

David Meredith
Department of Mathematics
San Francisco State University
1600 Holloway Ave.
San Francisco, CA 94132

Requests should include two blank IBM-PC disks and a postage paid return envelope.

Science Policy Committee Looks at Accreditation and Travel Grants

The AMS Committee on Science Policy is a standing committee of 14 members. The Committee meets twice yearly to discuss matters of science policy affecting the mathematical sciences community. In addition, it makes recommendations to the AMS Council and other Society committees for actions and projects pertaining to science policy issues.

Discussion of science policy typically goes two ways: either the issues are so lofty that they inspire nothing but platitudes, or they strike sufficiently close to home to bring out some lively debate. The latest meeting of the AMS Committee on Science Policy, held in September in Washington, DC, had its share of platitudes, but for the most part consisted of intense discussion of some of the major issues facing the mathematical community today.

The Committee's agenda covers a daunting breadth of topics, from getting President Bush's Science Adviser to speak at the Society's winter meeting to considering whether the AMS should sponsor a lecture series for high school students. Nonetheless, the Committee has found a fairly clear sense of purpose and is emerging as a powerful and articulate body having an influence on a wide variety of Society affairs. Indeed, the meeting opened with a description of a number of projects—such as awards for public service in mathematics (see *Notices*, October 1989, page 1103) and an opinion column in *Notices*—that the Society is pursuing on the advice of this Committee.

Accreditation of Departments

One topic that drew some spirited discussion was a report by a committee of the Mathematical Association of America that has been examining the possibility of accreditation of mathematics departments. Accreditation can have various meanings, depending on the discipline and the kind of institution. The report, intended as a discussion document, focused on accreditation as a way of setting standards for mathematics departments and for how they fit into their institutions. In other fields, such as engineering, accreditation is fairly common. In fact, the report was put together by "translating" accreditation standards for other fields into standards that might be met by mathematics departments.

As provost at Lehigh University, Committee member David Sanchez has had experience with accreditation boards in many academic disciplines. He strongly criticized the report, saying that 80% of mathematics departments could not meet the standards it set forth. For example, the report said the majority of faculty in any mathematics department should have doctoral degrees, a standard Sanchez called "wonderland" for institutions with only BA programs in mathematics. He felt the report's recommendations about computing equipment were unrealistic, given today's tight budgets, and he questioned the blanket recommendation that mathematics majors comprise 1 1/2% of all baccalaureate recipients at a given institution. He was especially concerned that the report did not clearly differentiate between two different roles of accreditation, as a means of evaluation and as a means of advocating increased resources. He conceded that the report contained some ideas that could serve as useful guidelines, but as a formal accreditation program, he stated emphatically, "I would not support this document *at all*."

David Vogan of the Massachusetts Institute of Technology added that the problems in providing a useful undergraduate experience in mathematics were not addressed in the report. "It's fine to give recommendations," he said, "but many of the best departments would not want to deal with this particular program." Hyman Bass of Columbia University was surprised that the report read less like a set of educational principles than like a set of fair labor and consumer advocacy laws, designed to insure that mathematics faculty have good working conditions and that students are not shortchanged. He also noted that, while the document itself was not adversarial, attempts to meet the standards articulated in the report could set departments in an adversarial relationship with their administrations.

Accreditation programs can help a department argue for increased resources from its administration, but some felt accreditation could end up working against mathematics departments if the standards are too high. For example, if the accreditation standards said that mathematics classes should have fewer than 35 students, university administrations might conclude that all mathematics faculty should teach twice as many classes. In addition, Sanchez, noting that some accreditation boards "develop a life of their own," cited an influential engineering accreditation board which has become so institutionalized that it actually inhibits curricular innovation. Large engineering schools can thumb their noses at the board, but small schools don't have the clout to stand up to it. As an alternative, he suggested a program whereby a mathematics department can request that a team of evaluators be sent out to assess the department's strengths and to offer suggestions for improvement.

Despite the strong criticism, the Committee generally favored the idea of having some sort of standards or guidelines for departments and felt the report made many useful recommendations. The issue of standards also surfaced later on, during their discussion of a report on preparation for college teaching. The Committee decided to recommend that the AMS appoint a committee to give advice on what action the Society should take to establish guidelines for mathematics departments.

Small Travel Grants

The idea of small travel grants for mathematicians has been circulating in mathematical policy circles for some time now, but it has never materialized. The Advisory Committee for the Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) recently endorsed a recommendation for a travel grants program of 200 grants of $2000 each. However, it is politically difficult for the DMS to justify such a program within the NSF. Foundation officials often perceive this kind of program as making "second class" grants to "second class" researchers, or as a way to "spread the wealth," rather than to focus on supporting the highest quality science. In addition, the administrative costs could prove unwieldy.

At the Science Policy Committee meeting, AMS executive director William H. Jaco opened the discussion by saying that an AMS member had suggested the Society formulate a program to administer the travel grants and submit a proposal to the NSF for funding. The AMS would choose the awardees (possibly through panel review) and make the grants directly to individuals, thereby avoiding the overhead costs that educational institutions charge on regular NSF grants. It's not clear the NSF would fund it, but simply submitting the proposal would force the NSF to take some action on an idea that would likely enjoy considerable grassroots support.

Bernard McDonald, deputy director of the DMS, raised a number of questions, such as what the return on the investment would be and how the success of the program would be evaluated. He also said that the AMS could receive 1000-2000 applications for perhaps 100 grants. "If you turn down 900 out of 1000 applicants, will that just create more problems?" he asked. Jaco conceded that, when the DMS rejection rate for regular grant proposals is around 50%, the smaller grants should not have a higher rejection rate.

In addition, the ballpark figure for the program seemed to hover between $500,000 and $1 million, and no new NSF funds would be likely to be available for it. This means that investigators near the "cutoff level" for NSF grants may have to settle for a travel grant rather than a grant with salary support. In recent years, Foundation officials have emphasized increasing the size of grants over increasing the number of grantees, so it may be difficult to sell a program like this one, which spreads limited DMS resources more thinly over a larger pool of researchers.

John Polking of Rice University said that one objection to such a program is that other disciplines will assume that, if mathematicians can get by on small travel grants, then they don't need summer salary support for research. Such perceptions can be important in the political maneuvering for research funding, but Jaco pointed out that they might be less of a problem if the AMS administered the program than if NSF did.

The travel grants could also be leveraged by departments. Frank Gilfeather of the University of New Mexico pointed out that, as a department chair, he would find it relatively easy to kick in $500 for travel to a person who already has received a $500 travel grant. But would deans and other administrators begin to ask for their "share" in the form of indirect costs? Some thought this might be a problem, but others said that, because the grants would carry no salary support, indirect costs would not be an issue.

A few Committee members were adamantly opposed to the idea. Ronald Lipsman of the University of Maryland said the plan sounded like "welfare," and James Glimm of the State University of New York at Stony Brook said such a program would create a class of "double losers," those who were turned down for regular NSF grants and for the travel grants. Glimm said the idea has never been implemented partly because it "devalues" the structure of the mathematics research enterprise.

Some Committee members privately noted that most of the members of the Committee are senior researchers supported on regular NSF grants, so their misgivings about the idea may not reflect the views of the broader mathematical community; after all, only about 1500 investigators are supported by the NSF, compared to the AMS membership of over 20,000. Nonetheless, on the whole, the Committee did support the idea and voted to recommend that the AMS put together a draft proposal in time for the next Committee meeting.

Among the other topics discussed was the update of the David Report, now in preparation by the Board on Mathematical Sciences. The new report will address such topics as the target funding levels for mathematics set forth in the original report, ways to insure adequate numbers of trained mathematicians, and current areas of intense research activity. Lawrence H. Cox, executive director of the Board, was on hand to get the Committee's input on various aspects of the report. The Committee also considered several ways in which it could assist in the widespread dissemination and use of the report, to insure that mathematics departments across the country can use the report effectively in arguing for increased resources from their administrations.

Allyn Jackson
Staff Writer

Washington Outlook

This month's column is written by Hans J. Oser, who is a consultant to the Office of Governmental and Public Affairs of the Joint Policy Board for Mathematics in Washington, D.C.

NSF Budget for FY 1990

As this column is being written, the Senate Appropriations Committee has just voted out an appropriations bill for the HUD-Independent Agencies that differs from the House bill passed last summer. The final word will come from a Senate-House conference expected to take place later this month. This is where things stand right now for NSF:

	NSF Request	House	Senate
		(in million dollars)	
Research	1,803	1,715	1,685
U.S. Antarctic Pgm.	156	74	156
Facility Upgrade	0	0	20
Science Education	190	210	200
Total	2,149	1,999	2,061

The facility upgrade is a disputed item between Congress and the NSF, which did not ask for the money in its 1990 budget request. NSF's priority was for supporting people before buildings, a strategy favored by most scientists. The House agreed with the NSF but the Senate bowed to pressure from some universities and put in $20 million to upgrade research facilities. The way things stand right now, the Senate-House conference will not take place until the second week in October. If the past is any guidance, the conference committee will most likely discover again the arithmetic mean as the appropriate formula to arrive at a compromise figure for the NSF budget. This would work out to an overall increase of 9% in 1990 (6% for the research part, 17% for science education). The administration had proposed a 14% increase to implement the five-year budget doubling plan for NSF. Congress has now rejected this request for the third year in a row. Sympathy for NSF is high in the authorizing committees of both houses, but they don't control the money. Senator Barbara Mikulski (D-MD), chair of the subcommittee responsible for the appropriations of HUD and the Independent Agencies, was able to come up with $200 million more than NASA had requested for the Space Station, but had only regrets for not being able to get NSF a bit more. As it happens, the Goddard Space Flight Center is located in Maryland.

Another big-ticket item is also on the way to congressional approval. The superconducting supercollider (SSC) came out of the Senate-House conference committee with $225 million, just $25 million less than what the administration had asked for. $90 million is intended for continued research and development, the remainder will be used for final studies on the Waxahachie site in Texas and the procurement of "long-lead" items such as tooling and power transformers.

Senator Mark Hatfield (R-OR) recently spoke at a retreat of senior staff of the National Research Council. With a few bold strokes he characterized the budget climate by comparing the changes over a ten-year period from 1980 to 1990. Entitlement programs, now at $550 billion, grew 80% in constant dollars; Defense, now $300 billion, grew by 69%; interest payments on the national debt have risen 189% to $180 billion, while everything else in the budget declined by 33% to $180 billion. Since the science budget is in that "all others" category, it is heartening to note that NSF was able to grow from $912 million to approximately $2 billion, or roughly 39% in constant dollars. But these figures illustrate that science has to fight for a share of the most embattled part, that 15% slice of the federal budget pie that suffered the most precipitous decline in the last ten years. That fact must be kept in mind when discussing federal science policy (or the lack thereof). We could have done a lot worse if science had not had its stout defenders in the federal appropriations process.

High-Performance Computing

A rare concurrence has developed between the Congress and those technical agencies of the executive branch that are covered by the FCCSET umbrella. That acronym stands for Federal Coordinating Council for Science, Engineering and Technology. These agencies have been working hard for the past 18 months to develop a program plan for cooperative research and development in the area of high-performance computing.

In one of his first public acts as the new Science and Technology Adviser to the President, D. Allan Bromley released on 8 September a report entitled "Federal High Performance Computing Program". This report is the culmination of an 18-month effort by the FCCSET Committee on Computer Research and Applications. It sets out a five-year program plan to make supercomputers available to a broad community of users in academia, industry and government. INTERNET, which is managed by NSF, is a vast collection of smaller networks. It currently lacks both the necessary bandwidth and the capacity to grow. Based on an earlier FCCSET report of November 1987, the new program plan recommends that in order to maintain and extend U.S. leadership in high-performance computing, and to maintain U.S. sources of production as well as to support U.S. competitiveness, a multidisciplinary effort should be undertaken in these four areas: (1) High performance computing systems, (2) Advanced software technology and algorithms, (3) A National Research and Education Network, (4) Basic research and human resources.

The program should be based on close cooperation between industry, government, and academia, the report states. FCCSET recommends that the present level of federal support, now about $500 million, should approximately double within the next five years.

Agreeing with FCCSET that the U.S. must maintain its leadership in high performance computing, the authorizing committees in the House and Senate that deal with science and technology introduced legislation in the 101st Congress under the title "High Performance Computer Technology Act of 1989". Doug Walgren (D-PA), chair of the House Subcommittee on Science, Research and Technology, held hearings in June that produced a phalanx of supportive witnesses for this legislation.

On September 15, his counterpart in the Senate, Albert Gore (D-TN), who chairs the Subcommittee on Science, Technology and Space, held hearings on S1067 and again assembled a very impressive list of witnesses who testified in favor of creating a high-performance network linking the nation's supercomputers to assure access for large numbers of users in academia, industry and government. This broadband network would be called the National Research and Education Network (NREN). Both the FCCSET plan and the congressional bill call for adequate support to drive software and algorithmic developments together with adequate standards and protocols to ensure the broadest access with a minimum of inconvenience. Senator Larry Pressler (R-SD), whose state holds NASA's magnetic tape library, said at the hearing that 95% of all the Landsat images have never been seen by a human eye ("never fired a neuron", as Senator Gore put it), but he believes that a broadband network capable of transmitting these pictures to the laboratories of research scientists would go a long way to reap some of the benefits that should be expected from having invested over 40 billion dollars in our satellite programs over the past 20 years.

The House Subcommittee on Science, Research, and Technology held further hearings on high-performance computing on 3 October. D. Allan Bromley, the President's Science and Technology Adviser, testified for the first time since his Senate confirmation hearings in July. With his strong statements he convinced the committee that he would be a very effective spokesman in defending the FCCSET plan within the administration. (It's a pleasure not to have another cheerleader for SDI, the chairman said). Bromley refused to give any dollar amounts until the President submits his 1991 budget to Congress in January.

Appointments in the Department of Education

Things are finally moving at the Department of Education, maybe even a little too fast. Secretary Lauro Cavazos has nominated Leonard L. Haynes, III, to be assistant secretary for post-secondary education. Haynes is the first black to be appointed to a high post in the Education Department. Haynes comes from Louisiana where he was assistant superintendent for academic programs in the state's department of education. It is expected that Leonard Childers will be deputy assistant secretary to Haynes.

The President also sent to the Senate the nomination of Christopher T. Cross for the position of assistant secretary of education for educational research and improvement. Cross is a former Republican staff director of the House Committee on Education and Labor. In his new role he will be supervising the department's Office of Educational Research and Improvement.

Newsweek magazine reports on 2 October that Secretary Cavazos may be out of office before the end of the year. Cavazos is considered by many a do-nothing education secretary. "Imagine what Bennett would have done with this [Charlottesville] summit?", the magazine asks. Well, they did not ask Bennett, but he had a succinct comment anyway: "Pap". The White House was not amused, and Marlin Fitzwater reprimanded him publicly. As for Cavazos' successor, two names are being mentioned: Tom Kean, outgoing governor of New Jersey, and former Tennessee governor Lamar Alexander. Also mentioned: the current undersecretary for education, John Theodore Sanders.

News and Announcements

Sunley Receives Presidential Rank Award

Judith S. Sunley, Director of the Division of Mathematical Sciences (DMS) at the National Science Foundation (NSF), has received the Presidential Rank Award, one of the highest awards at the Senior Executive Service level of government. Sunley's rank of Meritorious Executive, which carries a stipend of $10,000, recognizes sustained accomplishment during her executive career. Awards are made to executives throughout the government, but this is the first time such an award has been conferred on a member of DMS staff.

Judith S. Sunley

Sunley has made many contributions to the management of NSF and has shown outstanding leadership of the DMS both in her current position as Director, which she has held since 1987, as well as in her previous position as Deputy Director. In 1986, she received the first NSF Director's Award for Equal Opportunity Achievement.

According to an internal NSF document on Sunley's nomination for the award, her leadership has been characterized by a flexible approach to dealing with infrastructure concerns within the mathematical community, uniformly excellent management of the Division, exceptional success in recruiting and training high-quality program staff, and a strong commitment to equal opportunity. The document ends by stating, "Her understanding of the mathematical sciences community, her commitment to the goals of the NSF, and her ability to meld these into a forceful plan for action make her an outstanding asset to the Foundation."

Sunley originally came to the Foundation in 1980 as a Program Director in Algebra and Number Theory. She received her Ph.D. from the University of Maryland and was on the mathematics faculty of American University for 10 years.

Luce Fund for Women Scientists

The Henry Luce Foundation has announced the establishment of the Clare Boothe Luce Fund, a $70 million endowment that will provide professorships, fellowships, and scholarships to women scientists in higher education. The fund is intended to respond to the historic underrepresentation of women in the physical sciences, engineering, and mathematics.

The fund sets aside $3 million for each of 14 educational institutions designated by the late Clare Boothe Luce, whose bequest created the fund to encourage women in fields where there have traditionally been obstacles to their advancement. The awards range from $225,000 to $430,000 over a five-year period.

One of the program's professorship awards went to Vanessa Job, who has been named Clare Boothe Luce Professor of Mathematics and Computer Science at Marymount University in Virginia. Job has done research in the area of polyadic codes and is especially interested in coding theory, combinatorics, supercomputing, and complexity theory. She will be the first female appointment to Marymount's computer science department.

Each institution receiving an award will use the income on the funds to support the advancement of women in science and engineering. The designated institutions are: Georgetown University, University of Notre Dame, Boston University, Colby College, Creighton University, Fordham University, Marymount University (VA), Mount Holyoke College, Mundelein College, Santa Clara University, St. John's University, Seton Hall University, Trinity College (DC), and Villanova School. In addition to the professorships, the Clare Boothe Luce Fund has made possible fellowships in research at the Institute for Advanced Study in Princeton.

The remainder of the income from the fund will be distributed in specific grants for professorships, fellowships, and scholarships for women in science and engineering at other institutions. Under the terms of Luce's will, the selection of recipients of awards is made through a six-member selection committee, three members of which are named by the Henry Luce Foundation and three by the Heritage Foundation. Only institutions, not individuals, will be invited by the Luce Foundation to submit applications for these awards.

Nominations for the Alice T. Schafer Mathematics Prize

In January 1989 the Association for Women in Mathematics established the Alice T. Schafer Mathematics Prize of $1000 to be awarded annually, beginning in 1990, to an undergraduate woman for excellence in mathematics. All members of the mathematical community are invited to submit nominations for the Prize, to be awarded in April 1990. The nominee may be at any level in her undergrduate career. The letter of nomination should include, but not be limited to, an evaluation of the nominee on the following criteria: quality of performance in mathematics, exhibition of real interest in mathematics, ability for independent work, performance in mathematical competitions at the local or national level if any. Supporting materials should be enclosed with the nominations. Nominations must be postmarked no later than March 1, 1990 and sent to Patricia Cross, Executive Director, AWM, Box 178 Wellesley College, Wellesley, MA 02181.

Regional Meetings Focus on Minorities

The Mathematical Sciences Education Board of the National Research Council will sponsor a series of six regional workshops this fall and a national convocation in the spring as part of its Making Mathematics Work for Minorities project. Funded by the Exxon Educational Foundation, the project is intended to help reverse long-standing patterns of underachievement and underrepresentation of minorities in the mathematical sciences.

The workshops will seek to raise awareness of the problems, reach consensus on the directions of change in the teaching of mathematics, and point toward solutions that national, state, and local leaders can pursue. The first workshop was held in Atlanta in October. The remaining workshops will be held in Chicago, November 3–5; Seattle, November 9-10; Princeton, November 17-18; San Antonio, November 30–December 2; and Irvine, January 5-6, 1990.

The national convocation will be held May 4-5, 1990 at the National Academy of Sciences in Washington, DC. The purpose of the convocation will be to bring national attention to exemplary programs for minorities, highlight relevant research findings, define national needs, produce a national plan of action, and focus the imagination and commitment of leaders in American education.

For more information, contact Beverly Anderson, Project Director, Making Mathematics Work for Minorities, Mathematical Sciences Education Board, 818 Connecticut Ave, NW, Suite 500, Washington, DC 20006.

Call for Topics Section A (Mathematics) of the AAAS

The American Association for the Advancement of Science (AAAS) is a broadly based organization devoted to promoting research and education in all areas of science. Recently the Society has begun efforts to strengthen its ties with AAAS.

The 1990 Annual Meeting of the AAAS will be held February 15–20, 1990, in New Orleans. Section A of AAAS, which is concerned with mathematics, is sponsoring several outstanding expository talks by prominent mathematicians.

Details about sessions on mathematics at the 1990 AAAS meeting can be found in the section on *Meetings and Conferences of the AMS* in this issue of *Notices*.

Section A knows that the increasing representation and participation of mathematicians at AAAS Annual Meetings are an important means for deepening public awareness and appreciation of the manifold ways that mathematics contributes to science and society. The Section A Committee needs and welcomes suggestions for symposia topics and individuals who might be able to organize them. Please send, and encourage your colleagues to send symposia proposals for 1991 and future AAAS meetings to Warren Page, Secretary of Section A, New York City Technical College, CUNY, 300 Jay Street, Brooklyn, NY 11201.

The Section A Committee will meet in New Orleans from 4:00 p.m. to 6:00 p.m. on February 15, in Marlborough B Room of the New Orleans Hilton. The committee meeting is open to all who are interested in activities of the mathematical sciences within the AAAS.

Magazine for Math and Science Students

With funding from the National Science Foundation (NSF), the National Science Teachers Association will soon publish *Quantum*, a magazine for high school mathematics and science students.

Quantum will be patterned after the successful Soviet magazine *Kvant*, which contains physics and mathematics articles and numerous problem-solving activities. Articles from *Kvant* will be translated for use in *Quantum*.

Two editors-in-chief, one for mathematics and one for physics, together with an advisory board of science and mathematics teachers and professors, will determine the content of *Quantum*, review all articles, and solicit articles from U.S. scientists and mathematicians to supplement the articles from *Kvant*. William P. Thurston of Princeton University has accepted the position as mathematics editor.

Two premiere issues will be published in the coming year, one this month and another in April 1990. Sales of subscriptions and advertising space, as well as corporate donations, will help support the cost of producing *Quantum*. The NSF is contributing $366,000, and non-NSF funding totals $508,500.

News from the Mathematical Sciences Institute
Cornell University

The Mathematical Sciences Institute (MSI) is hosting a major conference on the state of mathematics in the modern world. Titled "Modern Perspectives of Mathematics: Mathematics as a Consumer Good, Mathematics in Academia," the conference will bring together influential mathematics consumers, educators, and researchers for a 3-day examination of the nation's use and development of mathematics resources. (Note: the conference has been previously announced under the title "Mathematics as Art, Mathematics as a Consumer Good.")

Planned for March 29–31, 1990, at Cornell University, Ithaca, NY, the conference will feature 11 lectures by leaders in business and industry, government, and academia. Malvin H. Kalos, Director of the Cornell University Center for Theory and Simulation in Science and Engineering will deliver the keynote address, *Impact of Computers on Mathematics*.

Other invited speakers and their topics in order of their expected appearance at the conference include: Edward E. David, Jr., EED, Inc., *Mathematics in a World of Mega Projects; Can it Survive?*; Peter D. Lax, Courant Institute of Mathematical Sciences, *Today's World and Mathematics*; Jacques-Louis Lions, Centre National d'Etudes Spatiales College de France, *Pure and Applied Mathematics: Examples*; Ivars Peterson, Science News, *The Mathematical Tourist*; Shmuel Winograd, IBM, *Mathematics and Computers*; Roger W. Brockett, Harvard University, *Mathematics and Intelligent Systems*; Mary F. Wheeler, Rice University, *Relationships between Industry and Academics*; Walter W. Hollis, Deputy Undersecretary of the Army for Operations Research, *Mathematics in National Security*; Michael E. Fisher, University of Maryland, *Mathematical Rigor in Physics: To What End?*

John J. Hopfield, California Institute of Technology, will deliver a university-wide lecture on Friday evening, March 30, on *Mathematics in Neural Sciences*.

The conference will conclude with a panel discussion designed to provide commentary on and to summarize the previous presentations. Chaired by Werner C. Rheinboldt, University of Pittsburgh, the panel also will include George Metakides, President, European Strategic Program for Research and Development in Information Technology; Cathleen S. Morawetz, Courant Institute of Mathematical Sciences; Richard S. Stepleman, Exxon Research and Engineering Company; Rose Teukolsky, Ithaca High School; and Daniel Willard, Office of the Deputy Undersecretary of the Army for Operations Research.

Within the context of their individual topics, invited speakers and panelists are expected to address how to develop mathematics education and research in ways that will encourage the interplay of mathematics and its applications in business, industry, and government. The conference is open to all who are interested in these issues.

The conference has been planned by an organizing committee headed by Yervant Terzian, Chairman, Department of Astronomy, Cornell University. Other members of the organizing committee include: Wilson V. Kone, Associate Director for Administration, Mathematical Sciences Institute, Cornell University; Simon A. Levin, Director, Center for Environmental Research, Cornell University; Anil Nerode, Director, Mathematical Sciences Institute, Cornell University; Lars B. Wahlbin, Associate Director for Research, Mathematical Sciences Institute, Cornell University; and Daniel Willard, Office of the Deputy Undersecretary of the Army for Operations Reseach.

The symposium will be held at the Statler Hotel on the Cornell University campus. For a registration packet and general information about the conference, contact conference secretary Diana Drake at the Mathematical Sciences Institute, Cornell University, Ithaca, NY 14853-2602, 607-255-7740.

News from the Center for Discrete Mathematics and Theoretical Computer Science
Rutgers University

As part of its program, the Center for Discrete Mathematics and Theoretical Computer Science (DIMACS) will sponsor a variety of activities each year which revolve around a special theme. The special theme for the academic year 1989-1990 is discrete and computational geometry. A year-long series of research programs devoted to this theme has been organized. These programs are concerned with such topics as geometric computation, geometric complexity, probabilistic methods in discrete and computational geometry, arrangements and their realizations, and polytopes and convex sets.

As part of the special year, the following workshops have been scheduled. More information about these workshops can be obtained from the organizer whose name appears or from the DIMACS office.

Special Year Workshops:

Oct. 16–20: Geometric Complexity, Organizer: Subhash Suri 201-829-4042, email: suri@bellcore.com;
Nov. 11–27, Dec. 1: Probabilistic Methods in Discrete and Computational Geometry, Organizer: Peter Shor 201-582-4435, email: shor@research.att.com;
Jan. 8–12: Polytopes and Convex Sets, Organizer: Jacob E. Goodman 219-690-6737, email: jegcc@cunyvm.cuny.edu;
Mar. 19–23: Arrangements and their Realizations, Organizer: William Steiger 201-932-2083, email: steiger@aramis.rutgers.edu;
Apr. 16–20: Practical Issues in Geometric Computation, Organizer: pending;
May 21–25: Algebraic Issues in Geometric Computation, Organizer: pending.

In addition to the workshops, several weekly seminars on discrete and computational geometry are being run.

During the special year, we will have five visitors for the academic year September to June. They are:

Jacob E. Goodman, The City University of New York; Carl Lee, University of Kentucky; Janos Pach, Courant Institute of the Mathematical Sciences; Micha Perles, The Hebrew University of Jerusalem; Ricky Pollack, Courant Institute of the Mathematical Sciences.

There are also several postdoctoral fellows who have research interests in this area. Furthermore, there will be a very large number of visitors, from periods of a week to several months, who will be participating in the activities of the special year.

Further information about the events of the special year in discrete and computational geometry can be obtained from the organizer, Bernard Chazelle, 609-258-5030; email: chazelle@princeton.edu or from the DIMACS office 201-932-5928.

A New Center for Communications Research

The Institute for Defense Analyses (IDA) and the National Security Agency (NSA) have announced the establishment of a new Center for Communications Research at La Jolla, California modeled after the Communications Research Division of IDA in Princeton, New Jersey. The new center will seek to foster stronger technical interactions with the West Coast academic and industrial research community. By locating the new Center in La Jolla, NSA and IDA hope to take advantage of the emergence of the city of San Diego as a major mathematical sciences community centered around the University of California at San Diego (UCSD).

The Communications Research Division will change its name to Center for Communications Research - Princeton effective January 1, 1990. Both centers will be operated by the Institute for Defense Analyses in support of the mission of NSA. The Center for Communications Research - La Jolla will eventually grow to approximately 25 mathetmatical scientists; Melvin Sweet is the Acting Director.

The Institute for Defense Analyses' establishment of the Center for Communications Research - La Jolla represents another facet of NSA's efforts to stimulate mathematical research and to increase its interaction with the mathematical and scientific communities. Vice Admiral William Studeman, the Director of NSA, has repeatedly stressed his concerns about the health and vitality of mathematics in the United States. In January he addressed the Joint Mathematics Meetings in Phoenix on this subject (see *Notices*, March 1989, pages 237–240). Since assuming his duties, he has increased the Agency's grants program in support of academic research and has urged Agency mathematicians to play a more active role in the national efforts to improve mathematics education.

Funding Information for the Mathematical Sciences

Call for Proposals for Calculus Renewal

The National Science Foundation has for the past two years sponsored a program to support projects aimed at revamping the college calculus curriculum. Designed to stimulate the development of high-quality calculus curricula, the program is managed by the Division of Undergraduate Science, Engineering, and Mathematics Education with the cooperation of the Division of Mathematical Sciences.

Computer technology, more realistic applications, development of mathematical intuition, laboratory experiences, increased student involvement in the learning process, and concepts rather than manipulation of formulas have been some of the emphases of the projects funded in the first two years of the program (see *Notices*, September 1989, page 854, and November 1988, page 1361). The calculus program sponsored several workshops and also provided start-up funding for the *UME TRENDS* newsletter on undergraduate mathematics education reform, a joint project of the AMS, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics. In addition, the last round of awards included a project to disseminate descriptions and summaries of a host of calculus reform projects.

For the next round of awards, the NSF will also consider funding pilot projects in the areas of differential equations and linear algebra, as they pertain to the first two years of college calculus. The deadline for proposals is **February 2, 1990**.

The program announcement and more information are available from John S. Bradley, USEME Room 639, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; telephone 202-357-7051; electronic mail jbradley@note.nsf.gov (Internet) or jbradley@nsf (Bitnet).

NRC-Ford Foundation Postdocs for Minorities

The National Research Council (NRC) plans to award approximately 25 Ford Foundation Postdoctoral Fellowships for Minorities. This program supports individuals showing great promise of future achievement in academic research and scholarship in higher education. The one-year fellowships are available in mathematics, as well as a variety of scientific, engineering, and humanities fields.

The program is open to Native American Indians and Alaskan Natives (Eskimo or Aleut), Black Americans, Mexican Americans/Chicanos, Native Pacific Islanders (Micronesian and Polynesian), and Puerto Ricans. Applicants must be U.S. citizens, hold the Ph.D. or Sc.D. degree, and be preparing for or engaged in college or university teaching.

Tenure of a fellowship provides for postdoctoral research experience at a not-for-profit institution of higher education or research of the fellow's choice. The deadline for submission of applications is **January 12, 1990**.

For more information and a program announcement, contact: Fellowship Office, GR420A, National Research Council, 2101 Constitution Avenue, NW, Washington, DC 20418.

Grants for Women Mathematicians

The National Science Foundation (NSF) sponsors a number of activities to provide support for women researchers in all science and engineering disciplines. As a participant in these efforts, the NSF's Division of Mathematical Sciences (DMS) encourages women mathematicians to apply to the Research Opportunites for Women (ROW) program.

Three kinds of awards are available through ROW. *Research Planning Grants* are for women who have not previously served as principal or co-principal investigators on individual federal research awards or whose research career has been interrupted for at least two of the last five years. These grants provide limited support to facilitate preliminary studies and other activities related to a research project. *Career Advancement Awards* assist in developing the careers of women researchers. These awards are intended for women who have an established research career in their current field or in a new one. Women who have had previous research support are eligible for the program, but this is not required. The deadline for proposals for these two grants is **January 15, 1990**.

Research Initiation Awards are one-time grants designed to provide opportunities to women mathematicians to become actively engaged in research as independent investigators. Like the planning grants, these awards are open to those women mathematicians who have not been principal or co-principal investigators on research grants before. The procedure for applying for the Research Initiation Award is the same as for a regular research grant; checking a box on the proposal cover sheet indicates that the proposal should be considered for funding under the ROW program. As with all research proposals submitted to the DMS, there is no deadline, but it's best to get them in soon after the start of the fiscal year, that is, after October 1.

The Research Planning Grants and the Career Advancement Awards have limits on both the size of the grant and on the amount of overhead that the applicant's institution can charge. At the time of this writing, some of the program guidelines were being changed, so more precise information was not available. However, a new program announcement should be available by the time this issue of *Notices* reaches its readers.

In addition, proposals for the Research Planning Grants and the Career Advancement Awards are handled differently from regular research grants, as they are reviewed by a panel, rather than through mail review. The panel assessment assures that these proposals compete only among themselves. The format for proposals also differs considerably from that for regular research grants, so it may be wise to consult with DMS staff before applying. Funds are limited, but the DMS would nonetheless like to encourage more women who are qualified to apply.

Peter W. Arzberger, the DMS program officer in charge of the ROW program, would be happy to provide program announcements and more information. He can be reached at: Division of Mathematical Sciences, Room 339, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; telephone 202-357-3693; email parzberger@note.nsf.gov on Internet (or use @nsf.arpa for CSNET and @nsf for Bitnet).

New Initiative at the Navy

The Mathematical Sciences Division of the Office of Naval Research has announced a new Accelerated Research Initiative on Random Fields for Oceanographic Modeling.

The goal of this initiative is to develop techniques for probabilistic modeling and statistical inference for acausal random functions of space which are also causally time-varying. Of particular interest is the study of the partial differential equations of physical oceanography, in continuous or discretized form, in the presence of stochastic excitation, stochastic boundary conditions, and/or observation noise. The issue of sparse and irregularly observed data sets is especially relevant for the ocean modeling and prediction problem. New mathematical approaches are currently being sought for the initiative.

Proposals for the period beginning October 1, 1990 are due on or before **April 1, 1990**. Proposals should be sent to: Julia Abrahams, Code 1111, Room 607, Mathematical Sciences Division, Office of Naval Research, 800 North Quincy Street, Arlington, VA 22217-5000.

Postdoctoral Fellowships in Spain

The Council for International Exchange of Scholars (CIES) has announced the opening of its competition for Quincentenary Postodoctoral Fellowships in Spain for U.S researchers. Six to eight grants will be available for individual research in Spain during the 1990-1991 academic year.

Applications are encouraged in several areas, including basic sciences, logic, and mathematics. Preferred projects are those that promote greater knowledge of the development of the U.S. and Spain during the last five centuries.

The basic eligibility requirements for these awards are U.S. citizenship, the doctorate or its equivalent, and sufficient competence in oral and written Spanish for the proposed research. Candidates will be selected on the basis of their aptitute for and experience in carrying through a major project of research and must show strong evidence of the need to be in Spain.

Award periods are from two to ten months during the period August 1, 1990 through July 31, 1991. Benefits include a monthly maintenance allowance of approximately $1800 to $2550, depending on the number of accompanying dependents, as well as funds for travel, insurance, and other miscellaneous items.

The application deadline is **January 2, 1990**. For information and applications, contact: Program Officer, Spain Quincentenary Fellowships, CIES, 3400 International Drive, NW, Washington, DC 20008-3097; telephone 202-686-6243. Requests for applications must be received by December 15, 1989.

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Los Angeles, California
University of California, Los Angeles
November 18–19

Program

The eight-hundred-and-fifty-third meeting of the American Mathematical Society will be held at the University of California, Los Angeles on Saturday, November 18, and Sunday, November 19, 1989. This meeting will be held in conjunction with a meeting of the Southern California Section of the Mathematical Association of America.

Invited Addresses

By invitation of the Far Western Section Program Committee, there will be four invited one-hour addresses. The speakers, their affiliations, the titles of their talks, and scheduled times of presentation are:

BURTON I. FEIN, Oregon State University, *Galois groups and rational division algebras*, 10:00 a.m. Sunday.

STEPHEN M. GERSTEN, University of Utah, Salt Lake City, *Automatic and hyperbolic groups*, 10:00 a.m. Saturday.

NICOLAS SPALTENSTEIN, University of Oregon, Eugene, *Nilpotent orbits and the Weyl group*, 2:00 p.m. Sunday.

THOMAS H. WOLFF, California Institute of Technology, *Recent work in potential theory*, 3:00 p.m. Saturday.

Special Sessions

By invitation of the same committee, there will be four special sessions of selected twenty-minute papers. The topics, the names and affiliations of the organizers, and the list of speakers, are as follows:

Geometric methods in combinatorial group theory, ROGER C. ALPERIN, San Jose State University, and KAREN VOGTMANN, Cornell University. Juan M. Alonso, Martin R. Bridson, Robert Brooks, M. M. Cohen, Daryl Cooper, Mark Feighn, Benjamin Fine, Ross Geoghegan, Robert H. Gilman, Renfang Jiang, Frank Rimlinger, Paul E. Schupp, M. Shapiro, John R. Stallings, and Kay Tatsuoka.

Algebraic topology, JAMES P. LIN, University of California, San Diego. James P. Lin, John McCleary, C. A. McGibbon, Mamoru Mimura, James E. Searl, Michael Slack, and Frank Williams.

Quadratic forms and simple algebras, DAVID J. SALTMAN, University of Texas, Austin, and MURRAY M. SCHACHER, University of California, Los Angeles. Frank Demeyer, Richard Elman, Timothy J. Ford, Mike Fried, Darrell Haile, Bill Jacob, T.-Y. Lam, David B. Leep, Victoria Powers, David Saltman, and A. R. Wadsworth.

Harmonic analysis, THOMAS H. WOLFF. Josefina Alvarez, Christopher Bishop, Stewart Gleason, Peter Holden, Robert Kaufman, Margaret A. M. Murray, Donald Sarason, and J. Michael Wilson.

Contributed Papers

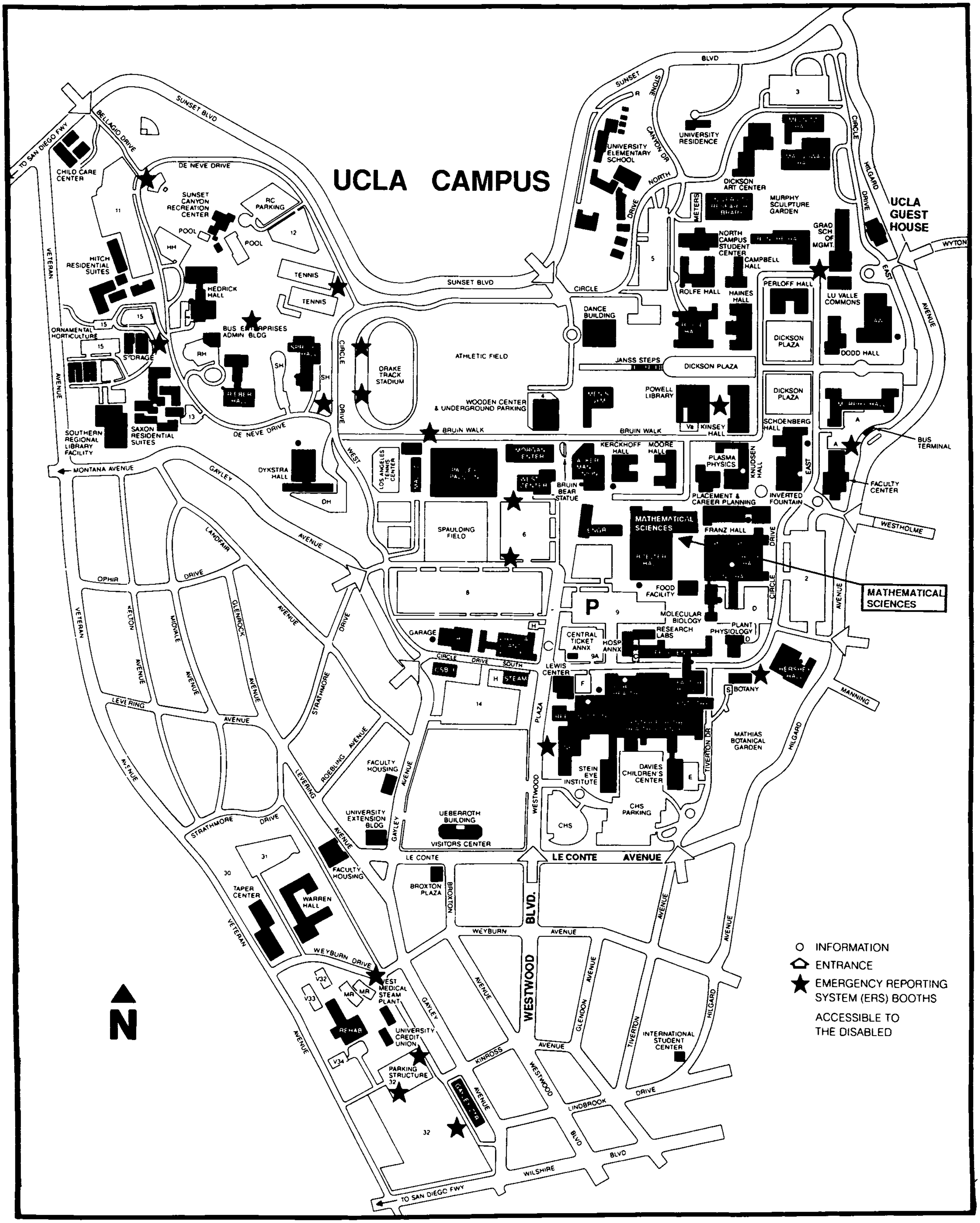
There will also be sessions for contributed ten-minute papers.

MAA Program

The Southern California Section of MAA will meet on Saturday, November 18. The MAA Business Meeting will begin at 8:00 a.m. MAA invited speakers are THOMAS M. LIGGETT, University of California, Los Angeles, *Interacting particle systems: Equilibria and rates of convergence*, 11:00 a.m.; and GUNNAR E. CARLSSON, Princeton University and MSRI, *The topology of some spaces of functions*, 4:00 p.m. The noon luncheon speaker is URI TREISMANN, Director, Charles A. Dana Center for Mathematics and Science, University of California, Berkeley, *Changing demographics and the future of our profession.*

A workshop on *Calculus and the computer* will be presented at 8:30 a.m. by WILLIAM A. HARRIS, JR., University of Southern California; RONALD J. MIECH, University of California, Los Angeles; and AL SHENK, University of California, San Diego.

There will be a special session titled *Equity issues and minority access to mathematics* from 1:30 p.m. to 2:50 p.m. The moderator is PHILIP DARO, Executive Director, California Mathematics Project and American Mathematics Project, and the discussant is URI TREISMANN.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The speakers are RICHARD CERCI, Morningside High School; PHILIP C. CURTIS, University of California, Los Angeles; DAVID MORIN, East Los Angeles Community College; and RAY C. SCHIFLETT, California State University, Pomona.

Registration

The meeting registration desk will be located in the Faculty Lounge in the Mathematical Sciences Building. The desk will be open from 8:00 a.m. until 4:00 p.m. on Saturday, and from 8:30 a.m. to noon on Sunday. The registration fees are $30 for members of the AMS, $45 for nonmembers, and $10 for students and unemployed mathematicians. There is a special one-day fee of $15 for MAA members on Saturday only.

Petition Table

A petition table will be set up in the registration area. Additional information about petition tables can be found in a box in the Louisville meeting announcement in the October issue of *Notices*.

Accommodations

Blocks of rooms were held until **until October 17** at the following locations. Participants should make their own arrangements directly with the hotel of their choice and be sure to mention the meetings at UCLA. Note that the rates do not include applicable taxes. The Claremont and Royal Palace hotels are located in Westwood Village within walking distance, adjacent to the south side of campus. The UCLA Guest House is on the campus. Participants **must refer to the AMS-MAA meetings** when making reservations at the following hotels to obtain the rates that are listed.

Claremont Hotel
1044 Tiverton Avenue, Westwood 90024
Telephone: 213-208-5957

Single $35.50 Double $37.50
Twins $41.50

Royal Palace Westwood
1052 Tiverton Avenue, Westwood 90024
Telephone: 213-208-6677 or 800-248-6955 (California) or 800-631-0100 (Outside California)

Single $67 Double $73
All rooms have kitchenettes.

Participants **must refer to Reference #2905** when making reservations at the following hotel to obtain the rates listed.

UCLA Guest House
(on UCLA campus)
Telephone: 213-825-2923

Queen bed $71
Two twin beds $71
Parlor room (sofa sleeper and kitchenette) $66
Two room suite (kitchenette, queen and sofa sleeper) $99

Food Service

Information will be provided at the meeting registration desk regarding availability of food service within walking distance.

Travel

The UCLA campus is located approximately 12 miles north of Los Angeles International Airport (LAX), which is served by all of the major airlines. The taxi fare from the airport to the UCLA campus is approximately $20 plus tip. There is no extra charge for additional passengers going to the same destination. The Super Shuttle, which provides door-to-door service, can be summoned by dialing number 35 from the courtesy phones in the baggage claim area. The bus should arrive within 15 minutes; the fare is $12 for one passenger plus tip. For information or advance reservations call 213-777-8000. From courtesy phones dial number 35.

The most economical transportation is via public bus from the LAX Transit Center at 96th Street and Vicksburg Avenue (1/4 mile northeast of the main airport exit). To reach the Transit Center from the terminal, wait next to the lower level roadway under a SHUTTLE BUS sign, which lists buses as A, B, C, etc. Board the free C or Lot C bus and exit the airport, getting off at its first stop outside of the airport just after it enters Parking Lot C. Walk 100 yards east to the LAX Transit Center. The fastest and most frequent service to UCLA is by the RTD #560 bus, which takes approximately 30 minutes to reach the campus and costs $1.20. (NOTE: Exact change in **coins** is required; no bills accepted!) Direct service to UCLA is also available Monday through Friday on the Culver City #6 bus, which takes approximately 50 minutes; the fare is 50 cents. All buses approach the campus from the south, up Westwood Boulevard, turning right (east) at LeConte Avenue. Exit the bus at the corner and walk north up Westwood to the Mathematical Sciences Building (Boelter Hall, approximately 3/4 mile on the right, beyond parking structure #9.) Participants planning to stay at the UCLA Guest House should stay on the bus to the end of the line.

Parking

Permits costing $4 per day are required (including weekends) for any cars parking on campus between the hours of 7:00 a.m. and 9:00 p.m. daily and may be obtained at any of the several parking kiosks around the campus. Visitors with permits from other University of California campuses may use these to park at UCLA, but must check in at a kiosk. The parking area closest to the Mathematical Sciences Building is Structure #9 on Westwood Boulevard; its kiosk is in the center of the Boulevard.

Program of the Sessions

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

Abstracts of papers presented in the sessions at this meeting will be found in the November 1989 issue of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings below.

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, November 18

MAA Business Meeting

8:00 a.m.–8:30 a.m. Room 3400, Boelter Hall

AMS Special Session on Algebraic Topology, I

8:30 a.m.–9:50 a.m. Room 5128, Mathematical Sciences Building

8:30 a.m. *Two-torsion and homotopy-associative H-spaces.*
(1) **James P. Lin**, University of California at San Diego, La Jolla, and **Frank Williams***, New Mexico State University, Las Cruces (853-55-13)

9:00 a.m. *Generalized Whitehead spaces with few cells.*
(2) **Norio Iwase** and **Mamoru Mimura***, Okayama University, Japan (853-55-23) (Sponsored by James P. Lin)

9:30 a.m. *Loop spaces with the same n-type for all n.*
(3) Preliminary report.
C. A. McGibbon*, Wayne State University, and **Jesper Møller**, University of Copenhagen, Denmark (853-55-08)

MAA Workshop

8:30 a.m.–9:30 a.m. Room 4000, Mathematical Sciences Building

Calculus and the computer.

AMS Special Session on Geometric Methods in Combinatorial Group Theory, I

9:00 a.m.–9:55 a.m. Room 5118, Mathematical Sciences Building

9:00 a.m. *Subgroups of proper free factors of free groups.*
(4) **John R. Stallings**, University of California, Berkeley (853-20-30)

9:30 a.m. *Automatic structure and graphs of groups.*
(5) **M. Shapiro**, Mathematical Sciences Research Institute, Berkeley and Ohio State University, Columbus (853-20-15)

AMS Special Session on Quadratic Forms and Simple Algebras, I

9:00 a.m.–9:50 a.m. Room 5117, Mathematical Sciences Building

9:00 a.m. *Rational singularities and the Brauer group.*
(6) Preliminary report.
Frank Demeyer*, Colorado State University, **Tim Ford**, Florida Atlantic University, and **Rick Miranda**, Colorado State University (853-13-12)

9:30 a.m. *On the Brauer group of a localization.*
(7) **Timothy J. Ford**, Florida Atlantic University (853-13-10)

AMS Special Session on Harmonic Analysis, I

9:00 a.m.–9:50 a.m. Room 5137, Mathematical Sciences Building

9:00 a.m. *Representation theoretic rigidity in* PSL(2, *R*).
(8) **Christopher Bishop***, University of California, Los Angeles, and **Tim Steger**, University of Chicago (853-22-47)

9:30 a.m. *Extension theorem for VMO.*
(9) **Peter Holden**, Florida International University (853-42-16)

AMS Invited Address

10:00 a.m.–10:50 a.m. Room 4000, Mathematical Sciences Building

(10) *Automatic and hyperbolic groups.*
S. M. Gersten, University of Utah (853-20-28)

Saturday, November 18 (cont'd)

MAA Invited Address

11:00 a.m.–11:50 a.m. Room 3400, Boelter Hall

(11) *Interacting particle systems: Equilibria and rates of convergence.*
Thomas M. Liggett, University of California, Los Angeles

AMS Special Session on Geometric Methods in Combinatorial Group Theory, II

11:00 a.m.–11:55 a.m. Room 5118, Mathematical Sciences Building

11:00 a.m. (12) *Computation in virtually free groups.*
Robert H. Gilman, Stevens Institute of Technology (853-20-14)

11:30 a.m. (13) *Constructing negatively curved groups.* Preliminary report.
Mark Feighn*, Rutgers University, Newark, and **Mladen Bestvina**, University of California, Los Angeles (853-57-33)

AMS Special Session on Algebraic Topology, II

11:00 a.m.–11:50 a.m. Room 5128, Mathematical Sciences Building

11:00 a.m. (14) *A generalization of the torus theorem.* Preliminary report.
Michael Slack, University of California at San Diego, La Jolla (853-55-06)

11:30 a.m. (15) *Rational homotopy theory: The general nilpotent case.*
James E. Searl, New York Institute of Technology (853-55-04)

AMS Special Session on Quadratic Forms and Simple Algebras, II

11:00 a.m.–11:50 a.m. Room 5117, Mathematical Sciences Building

11:00 a.m. (16) *On the relative Brauer group of the funtion field of a plan cubic curve over a number field.* Preliminary report.
Darrell Haile, Indiana University, Bloomington (853-16-29)

11:30 a.m. (17) *Quadratic forms, biquaternion algebras, and function fields.* Preliminary report.
David B. Leep, University of Kentucky (853-12-17)

AMS Special Session on Harmonic Analysis, II

11:00 a.m.–11:50 a.m. Room 5137, Mathematical Sciences Building

11:00 a.m. (18) *Multipliers of some Hilbert spaces of holomorphic functions.* Preliminary report.
Benjamin A. Lotto, Michigan State University, and **Donald Sarason***, University of California, Berkeley (853-30-36)

11:30 a.m. (19) *Regularity properties of commutators and layer potentials associated to the heat equation.*
John L. Lewis, University of Kentucky, and **Margaret A. M. Murray***, Virginia Polytechnic Institute and State University (853-42-03)

MAA Luncheon Speaker

noon–1:20 p.m. Student Union

(20) *Changing demographics and the future of our profession.*
Uri Treisman, University of California, Berkeley

AMS Session on Algebra

1:15 p.m.–2:55 p.m. Room 5138, Mathematical Sciences Building

1:15 p.m. (21) *Combinatorial interpretations of the q-analogues of L_{2n+1}.* Preliminary report.
A. K. Agarwal, Pennsylvania State University, Mont Alto Campus (853-11-53)

1:30 p.m. (22) *The heredity measure of an algebra.*
Vlastimil H. Dlab, Carleton University (853-16-07)

1:50 p.m. (23) *Decompositions of modules over Hensel rings.* Preliminary report.
Michael F. Siddoway, Colorado College (853-16-18) (Sponsored by David W. Roeder)

2:10 p.m. (24) *Neat algebras.*
I. Agoston*, **V. Dlab**, Carleton University, and **T. Wakamatsu**, Jobu University, Japan (853-16-32)

2:30 p.m. (25) *Finitistic dimensions of Noetherian rings.*
Ellen Kirkman*, **James Kuzmanovich**, Wake Forest University, and **Lance Small**, University of California at San Diego, La Jolla (853-16-40)

2:45 p.m. (26) *Ends and cohomology of amalgamated products and HNN-extensions.* Preliminary report.
Michael L. Mihalik* and **Steven Tschantz**, Vanderbilt University (853-20-21)

AMS Special Session on Algebraic Topology, III

1:30 p.m.–2:20 p.m. Room 5128, Mathematical Sciences Building

1:30 p.m. (27) *Homology operations and invariant theory.*
H. E. A. Campbell, Queen's University, and **John McCleary***, Vassar College (853-55-48)

2:00 p.m. (28) *On the homotopy commutativity of the three connective cover of S^3.*
James P. Lin*, University of California at San Diego, La Jolla, and **Frank Williams**, New Mexico State University, Las Cruces (853-55-22)

MAA Session

1:30 p.m.–2:50 p.m. Room 3400, Boelter Hall

Equity issues and minority access to mathematics.

AMS Invited Address

3:00 p.m.–3:50 p.m. Room 4000, Mathematical Sciences Building

(29) *Recent work in potential theory.*
Thomas H. Wolff, California Institute of Technology (853-42-35)

MAA Invited Address

4:00 p.m.–4:50 p.m. Room 3400, Boelter Hall

(30) *The topology of some spaces of functions.*
Gunnar Erik Carlsson, Princeton University and Mathematical Sciences Research Institute, Berkeley

AMS Special Session on Geometric Methods in Combinatorial Group Theory, III

4:00 p.m.–5:55 p.m. Room 5118, Mathematical Sciences Building

4:00 p.m. (31) *Limits of free G-actions on R-trees and reducible automorphisms.*
M. M. Cohen*, Cornell University, and **M. Lustig**, Ruhr Universität, Federal Republic of Germany (853-20-37)

4:30 p.m. (32) *Commuting elements in free actions on R-trees.* Preliminary report.
Frank Rimlinger, Columbia University (853-20-11)

5:00 p.m. (33) *Number of equivalence classes of vertices on R-trees.*
Renfang Jiang, Mathematical Sciences Research Institute, Berkeley (853-20-52)

5:30 p.m. (34) *Semistability of finitely presented groups.*
Ross Geoghegan, State University of New York, Binghamton (853-20-31)

AMS Special Session on Quadratic Forms and Simple Algebras, III

4:00 p.m.–5:20 p.m. Room 5117, Mathematical Sciences Building

4:00 p.m. (35) *Indecomposible division algebras of prime exponent.*
Bill Jacob, University of California, Santa Barbara (853-16-26)

4:30 p.m. (36) *Nilpotence in the Witt ring.* Preliminary report.
Jon Arason, University of Iceland, Iceland, and **Richard Elman***, University of California, Los Angeles (853-11-25)

5:00 p.m. (37) *Serre's problem on lifting A_n covers to unramified $\widetilde{A}_n$-covers.*
Mike Fried, University of California, Irvine (853-12-02)

AMS Special Session on Harmonic Analysis, III

4:00 p.m.–5:20 p.m. Room 5137, Mathematical Sciences Building

4:00 p.m. (38) *Estimates for the kernel and continuity properties of pseudo-differential operators.*
Josefina Alvarez*, Florida Atlantic University, and **J. Hounie**, Universidade Federal, Brazil (853-35-41)

4:30 p.m. (39) *Hessian determinants of harmonic functions.* Preliminary report.
Stewart Gleason, Courant Institute of Mathematical Sciences, New York University (853-31-34)

5:00 p.m. (40) *Cauchy integrals on terrible curves.*
J. Michael Wilson, University of Vermont (853-47-54) (Sponsored by Thomas H. Wolff)

Sunday, November 19

AMS Special Session on Geometric Methods in Combinatorial Group Theory, IV

9:00 a.m.–9:55 a.m. Room 5118, Mathematical Sciences Building

9:00 a.m. (41) *λ_1, diameter, and injectivity radius of manifolds and of graphs.* Preliminary report.
Robert Brooks, University of Southern California (853-58-05)

9:30 a.m. (42) *Non-positive curvature in piecewise Euclidean complexes.*
Martin R. Bridson, Cornell University (853-20-51)

AMS Special Session on Quadratic Forms and Simple Algebras, IV

9:00 a.m.–9:50 a.m. Room 5117, Mathematical Sciences Building

9:00 a.m. (43) *Brauer Hilbertian fields.*
Burton Fein, Oregon State University, **David Saltman***, University of Texas, Austin, and **Murray Schacher**, University of California, Los Angeles (853-12-09)

9:30 a.m. (44) *Higher level orders and holomorphy rings in skew fields.*
Victoria Powers, Emory University (853-12-49)

AMS Session I

9:00 a.m.–9:50 a.m. Room 5138, Mathematical Sciences Building

9:00 a.m. (45) *Boundary localization of the normal family of holomorphic mappings.*
E. B. Lin, University of Toledo (853-32-55)

9:20 a.m. (46) *On orthogonality of Legendre's polynomials via its generating function.* Preliminary report.
Sadanand Verma, University of Nevada (853-33-56) (Sponsored by L. J. Simonoff)

9:40 a.m. (47) *Success runs in Markov chains.* Preliminary report.
Anant P. Godbole, Michigan Technological University (853-60-19)

AMS Invited Address

10:00 a.m.–10:50 a.m. Room 4000, Mathematical Sciences Building

(48) *Galois groups and rational division algebras.*
Burton I. Fein, Oregon State University (853-12-20)

AMS Special Session on Geometric Methods in Combinatorial Group Theory, V

11:00 a.m.–11:55 a.m. Room 5118, Mathematical Sciences Building

11:00 a.m. (49) *Combings of groups.*
Juan M. Alonso, Cornell University (853-20-44)

11:30 a.m. (50) *The domino problem, hyperbolic geometry and the logic of Fuchsian groups.*
Paul E. Schupp, University of Illinois, Urbana-Champaign (853-30-42)

AMS Session II

11:00 a.m.–12:40 p.m. Room 5138, Mathematical Sciences Building

11:00 a.m. (51) *A local direct theorem for a Bernstein-type approximation process.* Preliminary report.
Yegnaseshan Sitaraman, Kentucky Wesleyan College (853-41-39)

11:20 a.m. (52) *Heron's problem in the Minkowski plane.* Preliminary report.
Mostafa Ghandehari, Naval Postgraduate School (853-52-01)

11:40 a.m. (53) *Transforms of support functions.* Preliminary report.
Mostafa Ghandehari and **Christopher P. Sagovac***, Naval Postgraduate School (853-52-46)

noon (54) *Global convolution operations in binary algebras.*
C. R. Giardina, City College, City University of New York (853-93-45)

12:20 p.m. (55) *On the equivalence of laws in trigonometry.* Preliminary report.
Tony S. Verma* and **Tonia S. Verma**, Clark High School and University of Nevada (853-98-57) (Sponsored by L. J. Simonoff)

AMS Invited Address

2:00 p.m.–2:50 p.m. Room 4000, Mathematical Sciences Building

(56) *Nilpotent orbits and the Weyl group.*
Nicolas Spaltenstein, University of Oregon (853-22-58)

AMS Special Session on Geometric Methods in Combinatorial Group Theory, VI

3:00 p.m.–4:25 p.m. Room 5118, Mathematical Sciences Building

3:00 p.m. (57) *Negatively curved groups.* Preliminary report.
Daryl Cooper, University of California, Santa Barbara (853-20-24)

3:30 p.m. (58) *Homology of certain Artin groups.*
Kay Tatsuoka, Rutgers University, Newark (853-57-43) (Sponsored by Mark E. Feighn)

4:00 p.m. (59) *Algebraic analysis of groups F-type.*
Benjamin Fine*, Fairfield University, and **Gerhard Rosenberger**, Universität Dortmund, Federal Republic of Germany (853-20-27)

AMS Special Session on Quadratic Forms and Simple Algebras, V

3:00 p.m.–4:20 p.m. Room 5117, Mathematical Sciences Building

3:00 p.m. (60) *Some recent developments in the theory of function fields of quadratic forms.* Preliminary report.
T.-Y. Lam, University of California, Berkeley (853-12-50)

4:00 p.m. (61) *u-invariants in characteristic* 2. Preliminary report.
P. Mammone, Université de Mons, Belgium, **R. Moresi**, CERFIM, Switzerland, **J.- P. Tignol**, Université Catholique de Louvain, Belgium, and **A. R. Wadsworth***, University of California at San Diego, La Jolla (853-12-38)

Lance W. Small
AMS Associate Secretary
La Jolla, California

Presenters of Papers

Numbers following the names indicate the speakers' positions on the program.
• AMS Invited Lecturer
∘ MAA Invited Lecturer
* AMS Special Session Speaker

Louisville Meetings
January 17 – 20, 1990

Supplement to Announcement in October Notices

Please refer to the Preliminary Announcement for this meeting which appears on pages 1039 – 1082 of the October 1989 issue of *Notices*. The Table of Contents and Important Deadlines from the preliminary announcement are reproduced below for convenience. The forms for Preregistration/Housing, MAA Minicourses, and the Mathematical Sciences Employment Register are located at the back of this issue.

AMS Invited Addresses

The title of the invited address by SUN-YUNG ALICE CHANG is *Analysis of spectral invariants.*

Other AMS-MAA Sessions

The undergraduate linear algebra curriculum: This topic was the partial focus of an NSF funded conference *Matrix theory for applications* during the summer of 1989. The main speaker at the conference was Charles R. Johnson of The College of William and Mary. This session will deal with reports made by subgroups of participants regarding the position of linear algebra in the undergraduate curriculum. A panel discussion will follow. Panelists will be named later and will include mathematicians not at the conference. The session will be moderated by A. DUANE PORTER of the University of Wyoming and will be held on Thursday, January 18, at 8:30 p.m.

AMS Prize Session

The Council and the Board of Trustees of the Society have established an Award for Distinguished Public Service that will be made for the first time at its Business Meeting in Louisville. This award will be presented every two years to a research mathematician who has made a distinguished contribution to the mathematical profession through public service during the preceeding five years. The Council and Board of Trustees of the Society have also established a Citation for Public Service, one to three of which will be presented annually for notable contributions to the mathematical profession through public service. These citations will be presented for the first time at the Business Meeting in Louisville.

IMPORTANT DEADLINES	
AMS Abstracts	
For Consideration for Special Sessions	Expired
Of Contributed Papers	October 11
MAA Abstracts	
Of Contributed Papers	Expired
For Special Computer Session	October 20
Employment Register	
(Applicants & Employers)	November 17
EARLY Preregistration and Housing	October 31
ORDINARY Preregistration and Housing	November 17
MAA Minicourse Preregistration	November 17
FINAL Preregistration	December 18
Motions for AMS Business Meeting	December 18
Preregistration Cancellations (50% refund)	January 3
Housing Changes/Cancellations with Housing Bureau	December 15
AMS Banquet (50% refund)	January 3
NAM Banquet (50% refund)	January 3

MAA Special Report

A special report on *Developing the teacher's ability to encourage creativity in students II* will be given by ARNOLD E. ROSS, Ohio State University. This report will be given at 1:00 p.m. on Saturday, January 20.

Activities of Other Organizations

The **Association for Women in Mathematics** (AWM) Emmy Noether Lecture will be given by BHAMA SRINIVASAN, University of Illinois at Chicago on *The invasion of geometry into finite group theory.*

The speakers who will participate in the AWM panel discussion on affirmative action are BEVERLY ANDERSON, University of the District of Columbia and the Mathematical Sciences Education Board; LIDA K. BARRETT, Mississippi State University; MARY W. GRAY, American University; JILL P. MESIROV, Thinking Machines, Corporation (moderator); MELVYN B. NATHANSON, Herbert H. Lehman College, CUNY; and MICHAEL C. REED, Duke University.

The AWM Business Meeting will now begin at 4:35 p.m. following the panel discussion.

American Mathematical Society Short Course Series

Introductory Survey Lectures on *Mathematical Questions in Robotics*

Louisville, Kentucky, January 16-17, 1990

The following synopses and reading lists supplement those presented in the first announcement of the Short Course to be held at the Hyatt Regency, Louisville; see the October 1989 issue of Notices, pages 1080–1082 for program and registration information. Speakers/topics are: ROGER W. BROCKETT, Harvard University, *Introduction* and *Symbolic Description of Movement*; MADHUSUDAN RAGHAVAN, General Motors Research Laboratories, *Kinematics of Manipulators*; JOHN B. BAILLIEUL, Boston University, *Resolution of Kinematic Redundancy*; SHANKAR SASTRY, University of California, Berkeley, *Control and Programming of Multifingered Robot Hands*; and BRUCE R. DONALD, Cornell University, *Planning and Executing Robot Assembly Strategies in the Presence of Uncertainty.*

Synopses and Reading Lists

Planning and Executing Robot Assembly Strategies in the Presence of Uncertainty (Bruce R. Donald). Research in robot programming attempts to build robot planning systems that can function at the task-level. A task-level specification of a robot plan might have the form, *Put together this disk rotor assembly.* The planner is given geometric models of the parts, and geometric or analytic models of the robot dynamics. Beyond this, the specification, or input to the planner does not mention the specific kinematic and dynamic constraints that the robot must obey; these are determined by the planner using geometrical computation. The goal of a task-level planner is to take a task-level specification and to produce a runnable robot program—one which is fully specified in terms of force-control, kinematics, and dynamics—that can accomplish the task.

Major advances in task-level planning can enable robotics to achieve its full potential in the assembly domain. Today, even existing robots cannot be exploited to their full capacity. For example, assembly tasks require compliant motion; however, compliance requires force-control, and such force-control motion strategies are quite difficult for humans to specify. Furthermore, robot assembly programs are very sensitive to the details of geometry. Finally, reprogramming a general purpose robot for a new assembly task can take time on the order of man-months. For these reasons, we have been working on the automatic synthesis of motion strategies for robots.

Research in task-level planning is often characterized as *theoretical robotics.* There are several reasons for this; the first is that much of the work has been concerned with constructing a *theory* of planning. In other words, the computational problem "task-level planning" is not well-specified. Much of our work lies in specifying the computation precisely. Second, given some sort of decomposition of task-level planning into "planning problems", one is immediately driven to ask, *What are the algorithms for these problems? Can plans, in general, be computed? How efficiently can planning algorithms run?* Historically, the nature of these questions has led researchers to apply tools from theoretical computer science, computational geometry, and algebra.

Recently, a great deal of attention has been focused on a particular robotics problem, called the find-path, or generalized movers' problem. In this problem, we ask the purely kinematic question, can a robot system be moved from one configuration to another, without colliding with obstacles? This is a nicely-defined mathematical problem, and, after much research, at this point its computational complexity is precisely known.

In fact, the neatness of this problem is deceptive, so much so that this formal problem has even been called "the" motion planning problem. From a task-level viewpoint, there is much hidden in the statement "Can the robot system be moved...?" Specifically, the find-path problem assumes that the robot has a perfect control system that can exactly execute the plan, and that the geometric and analytic models of the robot and obstacles are exact.

In reality, of course, robot control systems are subject to significant uncertainty and error. Typical robots are also equipped with sensors—force sensors, kinesthetic position sensors, tactile sensors, vision, and so forth.

However, these sensors are also subject to significant uncertainty. Finally, the geometrical models of the robot and the environment (parts, obstacles, etc.) cannot be exact—they are accurate only to manufacturing tolerances, or to the accuracy of the sensors used to acquire the models. Uncertainty is not a mere engineering detail; in particular, it is characteristically impossible to "patch" these perfect plans in such a way that they will function once uncertainty comes into play. Uncertainty is an absolutely fundamental problem in robotics, and plans produced under the assumption of no uncertainty are meaningless. What is needed is a principled theory of planning in the presence of uncertainty. Such a theory must not only be computational, but must also take uncertainty into account *a priori*. The overlap with exact motion planning algorithms can be stated roughly as follows: exact kinematic planning algorithms provide a computational-geometric theory of holonomic constraints. In motion planning with uncertainty, we exploit compliant motion—sliding on surfaces—in order to effect a "structural" reduction in uncertainty. Such compliant motion plans can be synthesized from a computational analysis of the geometry of the holonomic constraints.

We will present a precise framework for motion planning with uncertainty. In particular, given geometric bounds on the uncertainty in sensing and control, we develop algorithms for generating and verifying compliant motion strategies that are guaranteed to succeed as long as the sensing and control uncertainties lie within the specified bounds.

1. B. R. Donald, *Error Detection and Recovery in Robotics*, Springer-Verlag, Lecture Notes in Computer Science, (1989).

Control and Programming of Multifingered Robot Hands (Shankar Sastry). In this talk, I will discuss the dynamics, control, planning of motions and design of multifingered hands. The talk will be in two parts with extensive videotape footage (to be shown after the talk) illustrating both animated simulations and experiments. The talk is a blend of recent advances in our understanding of classical mechanics, computer graphics as well as some neurophysiology.

In the first part I will discuss the modelling of the low-level control problem for a multifingered hand manipulating an object under a variety of contact types: fixed, sliding, rolling and soft fingered or rhealogical. The nonholonomies associated with rolling make it particularly interesting. We discuss the use of control laws for explicit linearization of these control systems under state feedback. We show simulations and discuss implementation considerations.

I will discuss in the second part of the talk how results from the (differential) geometric control theory literature can be brought to bear on the problem of changing grasps on an object. Some connections with Berry's phase formula will also be given. Finally, I will discuss a neurophysiologically motivated environment which we are developing for the specification, control and programming of multifingered hands.

The talk is based on collaborative work with my students: Li Zexiang (NYU), Ping Hsu (University of Illinois), Arlene Cole (AT&T Bell Labs), John Hauser (USC), Richard Murray, Curt Deno and Kris Pister.

1. Z. Li and S. S. Sastry, *Task Oriented Optimal Grasping by Multifingered Robot Hands*, IEEE Journal of Robotics and Automation, Vol. 4, No. 1, 1988, pp. 32-44.

2. D. J. Montana, *Tactile Sensing and the Kinematics of Contact*, Ph.D. dissertation, Div. of App. Sciences, Harvard Univ., Cambridge, Mass., 1986.

3. A. B. A. Cole and J. E. Hauser, *Kinematics and Control of Multifingered Hands with Rolling Contact*, IEEE Transactions on Automatic Control, Vol. 34, No. 4, 1989, pp. 398-404.

4. Z. Li, P. Hsu and S. S. Sastry, *Grasping and Coordinated Manipulation by a Multifingered Robot Hand*, International Journal of Robotics Research, Vol. 8, No. 4, August 1989, pp. 33-50.

Invited Speakers and Special Sessions

Invited Speakers at AMS Meetings

The individuals listed below have accepted invitations to address the Society at the times and places indicated. For some meetings, the list of speakers is incomplete.

Louisville, KY, January 1990

Jon Barwise (AMS-MAA)
Sun-Yung Alice Chang
Charles W. Curtis (AMS-MAA)
George B. Dantzig (Gibbs Lecture)
Israel C. Gohberg
Mike Hopkins
Henryk Iwaniec
Janos Kollar
Israel M. Sigal
Barry Simon (AMS-MAA)
Shlomo Sternberg (Colloquium Lectures)
Nolan R. Wallach (AMS-MAA)

Fayetteville, AK, March 1990

Marcel F. Neuts
Vladimer I. Oliker
Mark A. Stern
Jonathan M. Wahl

Manhattan, KS, March 1990

J. Brian Conrey
Stewart B. Priddy
Jean-Pierre Rosay
Jang-Mei Wu

University Park, PA, April 1990

Robert T. Glassey
Carsten Grove
Lowell Jones
Gang Tian

Columbus, OH, August 1990

Michael G. Crandall (Progress in Mathematics Lecture)
John Morgan (Progress in Mathematics Lecture)
Michael E. Taylor

Denton, TX, November 1990

Avner D. Ash

Organizers and Topics of Special Sessions

The list below contains all the information about Special Sessions at meetings of the Society available at the time this issue of *Notices* went to the printer. The section below entitled **Information for Organizers** describes the timetable for announcing the existence of Special Sessions.

January 1990 Meeting in Louisville, Kentucky
Associate Secretary: Joseph A. Cima
Deadline for organizers: Expired
Deadline for consideration: Expired

Joseph A. Ball and Israel C. Gohberg, *Linear operators, matrix functions and control*
Joseph G. Conlon, *The Schrödinger equation*
Raúl E. Curto and Paul S. Muhly, *Multivariable operator theory*
Ethan S. Devinatz and Mike Hopkins, *Homotopy theory*
Robert S. Doran, *Group representations and operator algebras*
Bruce R. Ebanks, *Functional equations and their applications*
Florence D. Fasanelli and Victor J. Katz, *History of mathematics*
Robert E. Fennell and Suzanne Marie Lenhart, *Control of infinite dimensional systems*
Carl H. FitzGerald and Ted J. Suffridge, *Geometric function theory in one and several complex variables*
Gary D. Jones, *Oscillation theory in ordinary differential equations*
Janos Kollar, *Algebraic geometry*
Efim D. Khalimsky, Yung Kong and Ralph D. Kopperman, *Topology in computer graphics and image processing*
Inessa Levi and W. Wiley Williams, *Semigroup theory*
Peter A. McCoy, *Function theoretic methods in differential equations*
Lynn McLinden and Jay S. Treiman, *Optimization and nonlinear analysis*
Hugh L. Montgomery, *Analytic number theory*
Peter A. Perry, *Geometric spectral and inverse spectral problems*

Philip E. Protter, *Markov processes and stochastic analysis*

March 1990 Meeting in Fayetteville, Arkansas
Southeast Section
Associate Secretary: Joseph A. Cima
Deadline for organizers: Expired
Deadline for consideration: November 21, 1989

Geraldo Soares De Souza and Gary Sampson, *Singular integral operators and related areas*
J. Duncan and A. L. T. Patterson, *Banach algebras*
Colm A. O'Cinneide and Itrel E. Monroe, *Probability distributions of phase-type and applications*
Karl H. Hofmann and Jimmie D. Lawson, *Semi-groups in geometry and analysis*
Dima Khavinson, *On complex function theory of one and several complex variables*
David R. Morrison and Jonathan M. Wahl, *Algebraic geometry*
Vladimir I. Oliker and Andrejs E. Treibergs, *Geometry, physics and nonlinear PDE's*
James G. Oxley, *Combinatorics*
William L. Pardon and Mark A. Stern, *Differential geometry*

March 1990 Meeting in Manhattan, Kansas
Central Section
Associate Secretary: Andy Roy Magid
Deadline for organizers: Expired
Deadline for consideration: November 21, 1989

Andrew G. Bennett, *Harmonic analysis and probability theory*
David J. Foulis and Richard J. Greechie, *Orthostructures*
Kadosa M. Halasi and Qisu Zou, *Numerical analysis*
David H. Hamilton and John F. Rossi, *Geometric function theory*
Lige Li, *Partial differential equations*
Satyagopol Mandal, *Commutative algebra*
Alexander G. Ramm, *Inverse problems and scattering theory*
Joseph M. Rosenblatt, *Ergodic theory*
Richard H. Schelp, *Graph theory*
Ernest E. Shult, *Groups and geometries*
George E. Strecker, *Applications of category theory*

April 1990 Meeting in University Park, Pennsylvania
Eastern Section
Associate Secretary: W. Wistar Comfort
Deadline for organizers: Expired
Deadline for consideration: January 4, 1990

Donald M. Davis, *Algebraic topology*

April 1990 Meeting in Albuquerque, New Mexico
Far Western Section
Associate Secretary: Lance W. Small
Deadline for organizers: Expired
Deadline for consideration: January 4, 1990

August 1990 Meeting in Columbus, Ohio
Associate Secretary: W. Wistar Comfort
Deadline for organizers: November 15, 1989
Deadline for consideration: April 27, 1990

Eiichi Bannai, Thomas A. Dowling, Dijen Ray-Chaudhuri and Neil Robertson, *Combinatorics*
Zita M. Divis and David Terman, *Dynamics of biological systems*
John S. Hsia and Warren M. Sinnott, *Number theory*
S. P. Jain and T. Rizvi, *Ring theory*
Surinder K. Sehgal and Ronald Solomon, *Group theory*

November 1990 Meeting in Denton, Texas
Central Section
Associate Secretary: Andy Roy Magid
Deadline for organizers: February 15, 1990
Deadline for consideration: July 16, 1990

Information for Organizers

Special Sessions at Annual and Summer Meetings are held under the supervision of the Program Committee for National Meetings (PCNM). They are administered by the Associate Secretary in charge of that meeting with staff assistance from the Meetings and Editorial Departments in the Society office in Providence.

According to the "Rules for Special Sessions" of the Society, Special Sessions are selected by the PCNM from a list of proposed Special Sessions in essentially the same manner as Invited Speakers are selected. The number of Special Sessions at a Summer or Annual Meeting is limited. The algorithm that determines the number of Special Sessions allowed at a given meeting, while simple, is not repeated here, but can be found in "Rules for Special Sessions" on page 614 in the April 1988 issue of *Notices*.

Each Invited Speaker is invited to generate a Special Session, either by personally organizing one or by having a Special Session organized by others. Proposals to organize a Special Session are sometimes requested either by the PCNM or by the Associate Secretary. Other proposals to organize a Special Session may be submitted to the Associate Secretary in charge of that meeting (who is an *ex-officio* member of the committee and whose address may be found below). These proposals must be in the hands of the PCNM well in advance of the meeting and, in any case, at least nine (9) months prior to the meeting at which the Special Session is to be held in order that the committee may consider all the proposals for Special Sessions simultaneously. Proposals that are sent to the Providence office of the Society, to *Notices*, or directed to anyone other than the Associate Secretary will have to be forwarded and may not be received in time to be considered for acceptance.

It should be noted that Special Sessions must be announced in *Notices* in such a timely fashion that any member of the Society who so wishes may submit an abstract for consideration for presentation in the Special Session before the deadline for such consideration. This deadline is usually three (3) weeks before the Deadline for Abstracts for the meeting in question.

Special Sessions are very effective at Sectional Meetings and can usually be accommodated. They are selected by the Section Program Committee. The processing of proposals for Special Sessions for Sectional Meetings is handled by the Associate Secretary for the Section, who then forwards the proposals to the Section Program Committee, which makes the final selection of the proposals. Each Invited Speaker at a Sectional Meeting is invited to organize a Special Session. Just as for national meetings, no Special Session at a Sectional Meeting may be approved so late that its announcement appears past the deadline after which members can no longer send abstracts for consideration for presentation in that Special Session.

The Society reserves the right of first refusal for the publication of proceedings of any Special Session. These proceedings appear in the book series Contemporary Mathematics.

More precise details concerning proposals for and organizing of Special Sessions may be found in the "Rules for Special Sessions" or may be obtained from any Associate Secretary.

Send Proposals for Special Sessions to the Associate Secretaries

The programs of sectional meetings are arranged by the Associate Secretary for the section in question:

Far Western Section (Pacific and Mountain)

Lance W. Small, Associate Secretary
Department of Mathematics
University of California, San Diego
La Jolla, CA 92093
e-mail: g_small@math.ams.com
(Telephone 619-534-3590)

Central Section

Andy Roy Magid, Associate Secretary
Department of Mathematics
University of Oklahoma
601 Elm PHSC 423
Norman, OK 73019
e-mail: g_magid@math.ams.com
(Telephone 405-325-2052)

Eastern Section

W. Wistar Comfort, Associate Secretary
Department of Mathematics
Wesleyan University
Middletown, CT 06457
e-mail: g_comfort@math.ams.com
(Telephone 203-347-9411)

Southeastern Section

Joseph A. Cima, Associate Secretary
Department of Mathematics
University of North Carolina, Chapel Hill
Chapel Hill, NC 27599-3902
e-mail: g_cima@math.ams.com
(Telephone 919-962-1050)

As a general rule, members who anticipate organizing Special Sessions at AMS meetings are advised to seek approval at least nine months prior to the scheduled date of the meeting. No Special Sessions can be approved too late to provide adequate advance notice to members who wish to participate.

Information for Speakers

A great many of the papers presented in Special Sessions at meetings of the Society are invited papers, but any member of the Society who wishes to do so may submit an abstract for consideration for presentation in a Special Session, provided it is received in Providence prior to the special early deadline announced above and in the announcements of the meeting at which the Special Session has been scheduled. Contributors should know that there is a limitation in size of a single special session, so that it is sometimes true that all places are filled by invitation. Papers not accepted for a Special Session are considered as ten-minute contributed papers.

Abstracts of papers submitted for consideration for presentation at a Special Session must be received by the Providence office (Editorial Department, American Mathematical Society, P. O. Box 6248, Providence, RI 02940) by the special deadline for Special Sessions, which is usually three weeks earlier than the deadline for contributed papers for the same meeting. The Council has decreed that no paper, whether invited or contributed, may be listed in the program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.

Electronic submission of abstracts is now available to those who use the TeX typesetting system. Requests to obtain the package of files may be sent electronically via the Internet to **abs-request@math.ams.com.** Requesting the files electronically will likely be the fastest and most convenient way, but users may also obtain the package on IBM or Macintosh diskettes, available free of charge by writing to: Rosanne Granatiero, American Mathematical Society, Publications Division, P.O. Box 6248, Providence, RI 02940, USA. When requesting the Abstracts package, users should be sure to specify whether they want the plain TeX, AMS-TeX, or the LaTeX package.

Number of Papers Presented
Joint Authorship

Although an individual may present only one ten-minute contributed paper at a meeting, any combination of joint authorship may be accepted, provided no individual speaks more than once. An author can speak by invitation in more than one Special Session at the same meeting.

An individual may contribute only one abstract by title in any one issue of *Abstracts*, but joint authors are treated as a separate category. Thus, in addition to abstracts from two individual authors, one joint abstract by them may also be accepted for an issue.

Joint Summer Research Conferences in the Mathematical Sciences

University of Massachusetts at Amherst, MA, June 7 to July 4, 1990

The 1990 Joint Summer Research Conferences in the Mathematical Sciences will be held at the University of Massachusetts at Amherst from June 7 to July 4. It is anticipated that the conferences will be supported by grants from the National Science Foundation and other agencies.

There will be six conferences in six different areas of mathematics. The topics and organizers for the conferences were selected by the AMS-IMS-SIAM Committee on Joint Summer Research Conferences in the Mathematical Sciences. The selections were based on suggestions made by the members of the committee and individuals submitting proposals. The committee considered it important that the conferences represent diverse areas of mathematical activity, with emphasis on areas currently especially active and paid careful attention to subjects in which there is important interdisciplinary activity at present.

The conferences are similiar in scientific structure to those held throughout the year at Oberwolfach. These conferences are intended to complement the Society's program of annual Summer Institutes and Summer Seminars, which have a larger attendance and are substantially broader in scope. The conferences are research conferences and are not intended to provide an entree to a field in which a participant has not already worked.

It is expected that funding will be available for a limited number of participants in each conference. Others, in addition to those funded, will be welcome, within the limitations of the facilities of the campus. In the spring a brochure will be mailed to all who are invited to attend the conferences. The brochure will include information on room and board rates, the residence and dining hall facilities, travel and local information and a housing form to use to request on-campus accommodations. Information on off-campus housing will also be included in the brochure. Participants should make their own housing and travel arrangements. Each participant will be required to pay nominal registration and social fees.

Those interested in attending one of the conferences should send the following information to the Summer Research Conference Coordinator, Meetings Department, American Mathematical Society, Post Office Box 6248, Providence, RI 02940 or by E-Mail: CAK@MATH.AMS.COM on the Internet.

Please type or print the following:

1. Title and dates of conference desired
2. Full name
3. Mailing address
4. Telephone number and area code for office and home
5. Member of AMS, IMS, or SIAM? If AMS, please give member code
6. Your scientific background relevant to the topic of the conference
7. Financial assistance requested; please estimate cost of travel
8. Indicate if interested in attending if support is not offered. Indicate if support is not required.

The deadline for receipt of applications is February 23, 1990. Requests for invitations will be forwarded to the Organizing Committee for each conference for consideration after February 23. Applicants selected will receive formal invitations and notification of financial assistance from the AMS. **Requests received past the deadline will be returned.** Funds available for these conferences are limited and individuals who can obtain support from other sources should do so. Women and members of minority groups are encouraged to apply and participate in these conferences.

Any questions concerning the scientific portion of the conference should be directed to the chair or any member of the Organizing Committee.

The Joint Summer Research Conferences in the Mathematical Sciences are under the direction of the AMS-IMS-SIAM Committee on Joint Summer Research Conferences in the Mathematical Sciences. The following committee members chose the topics for the 1990 conferences: William B. Arveson, John A. Burns, Martin Golubitsky, Daniel J. Kleitman, Anthony W. Knapp, Ingram Olkin, Mary Ellen Rudin, Stephen Simpson and Gregg J. Zuckerman.

Descriptions of the subject matter of each of the 1990 conferences appeared in the October *Notices*, pages 1087 - 1089; they were accompanied by lists of members of the respective Organizing Committees.

Thursday, June 7 to Wednesday, June 13

Probability models and statistical analysis for ranking data

MICHAEL A. FLIGNER (The Ohio State University), Co-Chair,

JOSEPH S. VERDUCCI (The Ohio State University), Co-Chair

Thursday, June 7 to Wednesday, June 13

Inverse scattering on the line

DAVID SATTINGER (University of Minnesota, Minneapolis), Chair

The following description did not appear in the announcement in the October issue.

There has been much progress recently on inverse scattering theory in one and two dimensions. This conference will cover recent developments in the field, including inverse scattering theory on the line, Riemann-Hilbert problems, and inverse monodromy problems. Multidimensional problems will be covered, using the so called $\bar{\partial}$ methods. Applications to the Davey-Stewartson II and KP II equations will be treated. One day will be devoted to higher dimensional problems, and one day to applications of inverse scattering theory and inverse monodromy theory to problems in statistical mechanics.

Members of the Organizing Committee: Ronald R. Coifman (Yale University), Craig A. Tracy (University of California, Davis) and Stephanos Venakides (Duke University).

Thursday, June 14 to Wednesday, June 20

Deformation theory of algebras and quantization with applications to physics

MURRAY H. GERSTENHABER (University of Pennsylvania), Co-Chair

JAMES D. STASHEFF (University of North Carolina), Co-Chair

Thursday, June 21 to Wednesday, June 27

Strategies for sequential search and selection in real time

THOMAS S. FERGUSON (University of California, Los Angeles), Co-Chair

STEPHEN M. SAMUELS (Purdue University), Co-Chair

Thursday, June 21 to Wednesday, June 27

Schottky Problems

LEON EHRENPREIS (Temple University), Co-Chair

ROBERT C. GUNNING (Princeton University), Co-Chair

Thursday, June 28 to Wednesday, July 4

Logic, local fields, and subanalytic sets

LOU VAN DEN DRIES (University of Illinois at Urbana-Champaign), Chair

Mathematics Sessions at the AAAS Annual Meeting

New Orleans, Louisiana, February 15–20, 1990

The 1990 Annual Meeting of the AAAS, February 15–20 in New Orleans, will feature many outstanding expository talks by prominent mathematicians. These include the following symposia (three-hour sessions) and invited talks cosponsored by Section A (Mathematics) of the AAAS and the Society. The names and affiliations of the organizers follow (speakers are given in parentheses):

- *Radon and Penrose transforms: Medical imaging to supersymmetry*, organized by JAMES V. PETERS, Long Island University, C.W. Post Center, and TODD QUINTO, Tufts University. (Allan Cormack, Gabor Herman, Larry Shepp, Ron O. Wells.)
- *New directions in the philosophy of mathematics*, organized by REUBEN HERSH, University of New Mexico. (Gian-Carlo Rota, Thomas Tymoczko, Nicholas Goodman, Hao Wang, Martin Krieger, Michael Resnik.)
- *Computational and mathematical modeling: A study of oil production and water resources*, organized by JAMES G. GLIMM, New York University. (James Glimm, Richard Ewing, Brent Lindquist, Larry Lake, David Wilkinson.)
- *Geometry today*, organized by ERWIN LUTWAK, Polytechnic University of New York, and RALPH ALEXANDER, University of Illinois at Urbana. (George Francis, Vladimir Oliker, Herman Gluck, Gian-Carlo Rota.)
- *Zero knowledge proofs and their applications*, organized by SILVIO MICALI, Massachusetts Institute of Technology. (Shafi Goldwasser, Manuel Blum, Silvio Micali).
- Frontiers of physical sciences: A mathematics lecture by FRANK MORGAN, Williams College.
- One day short course on *Chaotic dynamical systems* by ROBERT L. DEVANEY, Boston University.

Section A of the AAAS is also cosponsoring various symposia that will be of interest to mathematicians and mathematics educators. These include:

- *Chaos in the balance of nature*
- *Symmetry: Its theory and application through science*
- *Mathematical models in the social sciences*
- *The contributions of R.A. Fisher to science* (symposium commemorating the centennial of R.A. Fisher's birthday)
- *Revitalizing science and mathematics education through the use of technology*
- *Project approaches in developing new introductory physics, chemistry, and mathematics curricula*
- *The development of pre-adult attitudes toward science and mathematics in Japan and the United States.*

A meeting of the Section A Committee will take place from 4:00 p.m. to 6:00 p.m. on February 15 in Marlborough B Room of the New Orleans Hilton. The committee meeting is open to all who wish to stimulate interest and activities of the mathematical sciences within the AAAS.

For details see the November 10, 1989, issue of *Science*. Additional information on Section A activities can be found in the *News and Announcements* section of this issue of *Notices*.

Mathematical Sciences Meetings and Conferences

THIS SECTION contains announcements of meetings and conferences of interest to some segment of the mathematical public, including *ad hoc*, local, or regional meetings, and meetings or symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. (Information on meetings of the Society, and on meetings sponsored by the Society, will be found inside the front cover.)

AN ANNOUNCEMENT will be published in *Notices* if it contains a call for papers, and specifies the place, date, subject (when applicable), and the 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 month, year, and page of the issue in which the complete information appeared. Asterisks (*) mark those announcements containing new or revised information.

IN GENERAL, announcements of meetings and conferences held in North America carry only date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. In any case, if there is any application deadline with respect to participation in the meeting, this fact should be noted. All communications on meetings and conferences in the mathematical sciences should be sent to the Editor of *Notices*, care of the American Mathematical Society in Providence.

DEADLINES for entries in this section are listed on the inside front cover of each issue. In order to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of *Notices* prior to the meeting in question. To achieve this, listings should be received in Providence SIX MONTHS prior to the scheduled date of the meeting.

1988-1989. **Academic Year Devoted to Operator Algebras**, Mittag-Leffler Institute, Djursholm, Sweden. (Feb. 1988, p. 307)

1989. **40th Anniversary of Kansas Gamma of Pi Mu Epsilon**, Wichita State University, Wichita, KS. (Jan. 1989, p. 63)

1989. **Concentration Year on Fluid Dynamical Aspects of Combustion Theory**, Instituto Per Le Applicazioni Del Calcolo, Rome, Italy. (Jan. 1989, p. 63)

1989–1990. **Academic Year Devoted to Hyperbolic Geometry and Quasiconformal Mappings**, Mittag-Leffler Institute, Djursholm, Sweden. (Dec. 1988, p. 1584)

* 1989–1990. **Special Year in Geometry**, University of Maryland, College Park, MD.

SPONSORS: The University of Maryland and the National Science Foundation.

CONFERENCE THEMES AND INFORMATION: Activities besides the "Foliations conference in memory of Bruce Reinhart" (Jul./Aug. 1989, p. 762) and the annual "Geometry Festival" will include workshops on the topics: "Spaces of Riemannian manifolds" - contact K. Grove, 301-454-7075; "Moduli spaces" - contact B. Goldman, 301-454-2929; "Cyclic Homology" - contact J. Schafer, 301-454-3535.

January 1–December 23, 1989. **Mathematisches Forschungsinstitut Oberwolfach** (Weekly Conferences), Federal Republic of Germany. (Apr. 1988, p. 629 and Nov. 1988, p. 1381)

November 1989

* 11. **New York Graph Theory Day Eighteen**, Pace University, New York, NY.

SPONSOR: Mathematics Section, New York Academy of Sciences.

INVITED SPEAKERS: N. J. A. Sloane (AT&T Bell Lab.), W.T. Tutte (University of Waterloo).

ORGANIZING COMMITTEE: W. J. Adams, M. L. Gargano, J. E. Houle, J. W. Kennedy, S. M. Merritt, L. V. Quintas, C. Wolf.

INFORMATION: GTD XVIII, Mathematics Department, Pace Univ., New York, NY 10038; Telephone: 212-346-1280 (Mathematics); 212-346-1336 (Computer Science); nfw2@pace (Bitnet).

15–17. **Geometry of Manifolds**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 764)

17–20. **Workshop on Classical and Quantum Transport in Hamiltonian Systems**, Mathematical Sciences Institute, Cornell University, Ithaca, NY. (May/Jun. 1989, p. 600)

18–19. **Far Western Section Meeting of the AMS**, University of California, Los Angeles, CA.

INFORMATION: W. Drady, AMS, P.O. Box 6248, Providence, RI 02940.

19–25. **Random Partial Differential Equations**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 764)

20–24. **Seminaire Sud-Rhodanien de Geometrie Differentielle**, Marseille, France. (Jul./Aug. 1989, p. 764)

26–December 2. **Methoden und Verfahren der Mathematischen Physik**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 764)

27–29. **Computer Algebra and Its Application to Investigations for Mathematics**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 764)

27–29. **The Recent Developments of High Technology and Mathematical Science (II)**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 765)

*27–December 1. **Workshop on Probabilistic Methods in Discrete and Computational Geometry and Tutorial on Random Sampling and its Applications**, Rutgers University, Piscataway, NJ.

SPONSOR: DIMACS.
INFORMATION: DIMACS, Hill Center, Busch Campus, Rutgers University, P.O. Box 1179, Piscataway, NJ 08855; 201-932-5928.

29–December 1. **Numerical Analysis and Scientific Computing**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 765)

December 1989

*2–4. **DIMACS Workshop on Reliability of Computer and Communication Networks**, New Brunswick, NJ.

PROGRAM: Reliability problems arise with increasing frequency as our modern systems of telecommunications, information transmission, transportation, and distribution become more and more complex. This workshop is designed to analyze the discrete mathematical methods which are relevant to these problems, identify the latest trends and important open problems, and survey potential practical applications, with an emphasis on computer and communication networks.
ORGANIZERS: F. Hwang, AT&T Bell Labs.; C. Monma, Bell Communications Research; F. Roberts, Rutgers Univ.
INVITED SPEAKERS: D.P. Agrawal, North Carolina State Univ.; G. Ash, AT&T Bell Labs.; F. Barlow, Univ. of California, Berkeley; J-C. Bermond, Univ. of Paris-Sud; D. Bienstock, Bell Comm. Res.; D. Blair, Rutgers Univ.; F. Boesch, Stevens Institute of Technology; P. Boland, Univ. College, Dublin; R. Cardwell, Bell Comm. Res.; Y. Cheng, AT&T Bell Labs.; J. Cohen, Rockefeller Univ.; C. Colbourn, Univ. of Waterloo; N. Crystal, Bell Comm. Res.; W. Cunningham, Carleton Univ.; R. Evans, Durham, NC; A.G. Fraser, AT&T Bell Labs.; M. Grotschel, Univ. of Augsburg; F. Hwang, AT&T Bell Labs.; P. Kubat, GTE Lab.; M. Lepp, Bolt, Beranek, and Newman; N.F. Maxemchuk, AT&T Bell Labs.; D.K. Pradhan, Univ. of Massachusetts; A. Prekopa, Rutgers Univ.; S. Provan, Univ. of North Carolina; C.S. Raghavendra, Univ. of Southern California; D. Shier, College of William and Mary.
INFORMATION: DIMACS, Hill Center, Busch Campus, Rutgers Univ., P.O. Box 1179, Piscataway, NJ 08855; 201-932-5928; dimacs@math.rutgers.edu.

3–9. **Wiener-Hopf-Probleme, Topelitz-Operatoren und Anwendungen**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 765)

4–6. **1989 Winter Simulation Conference**, Washington, DC. (May/Jun. 1989, p. 600)

4–6. **Studies on Decision Theory and Their Related Topics**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 765)

4–6. **First International Conference on Deductive and Object-Oriented Databases**, Kyoto, Japan. (Oct. 1989, p. 1093)

4–7. **Research on Complex Analytic Geometry and Related Topics**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 765)

4–8. **Fifth Aerospace Computer Security Applications Conference**, Tucson, AZ. (May/Jun. 1989, p. 600)

6–9. **Algebraic Number Theory**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 765)

9. **Boston Celebration of the ASA150 Sesquicentennial**, Boston, MA. (Sep. 1989, p. 914)

10–16. **Asymptotic Methods for Computer-Intensive Procedures in Statistics**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

11–13. **Fourth SIAM Conference on Parallel Processing for Scientific Computing**, Chicago, IL. (Mar. 1989, p. 314)

11–14. **Number Theory - Studies Related to Automorphic Forms**, Research Institute for Mathematical Sciences, Kyoto University, Japan. (Jul./Aug. 1989, p. 765)

12–14. **Second Australian Supercomputer Conference**, University of Wollongong, NSW, Australia. (Sep. 1989, p. 914)

13–15. **Twenty-eighth IEEE Conference on Decision and Control**, Tampa, FL. (Oct. 1989, p. 1093)

17–23. **Theory and Numerical Methods for Initial-Boundary Value Problems**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

*18–20. **Waves and Turbulence in Stably Statified Flows**, Leeds, England.

INFORMATION: Y. May, Conference Officer, The Institute of Mathematics and its Applications, Maitland House, Warrior Square, Southend-on-Sea, Essex SS1 2JY, England.

*18–20. **Cryptography and Coding**, Circencester, England.

INFORMATION: Y. May, Conference Officer, The Institute of Mathematics and its Applications, Maitland House, Warrior Square, Southend-on-Sea, Essex SS1 2JY, England.

27–31. **Holiday Symposium on Braids and Knots**, New Mexico State University, Las Cruces, NM. (Sep. 1989, p. 914)

1990. **IMACS International Workshop on Massively Parallel Methods in Computational Physics**, Boulder, Colorado. (Sep. 1989, p. 914)

1990. **IMACS Conference on Computer Aided Design**, Yugoslavia. (Sep. 1989, p. 914)

January 1990

1–6. **Zeitreihenanalyse**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

3–5. **International Symposium on Artificial Intelligence and Mathematics**, Fort Lauderdale, FL. (Oct. 1989, p. 1093)

7–13. **Mathematische Optimierung**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

*8–12. **Workshop on Applications of Algebraic Geometry**, University of Puerto Rico, Rio Piedras, Puerto Rico.

PROGRAM: The workshop will feature expository lectures on exponential sums in one and several variables, and also current work on the Soviet Union on applications of algebraic geometry to coding theory. Particular attention will be focused on exploring

and discovering new possible interactions between algebraic geometry and different applied areas.
INVITED SPEAKERS: From the U.S.: N. Katz, H. Lenstra, H.P. Mattson, A.M. Odlyzco, N.J.A. Sloanne,W. Schmidt, S. Sperber, V. Pless; From the Soviet Union: S. Litsyn, A.N. Skorobogatov, M.A. Tsfasman, S.A. Stepanov, S.G. Vladut; From Norway: T. Helleseth.
CALL FOR PAPERS: One page abstract should be received by December 20, 1989; include address and email if possible.
INFORMATION: O. Moreno, Department of Mathematics, University of Puerto Rico, Rio Piedras, Puerto Rico, 809-765-5170, 809-765-3263; email: o_moreno@uprenet.bitnet and Carlos Moreno (mjc@cunyvms1.bitnet).

*8–12. **DIMACS Workshop: Polytopes and Convex Sets**, Center for Discrete Mathematics and Theoretical Computer Science, New Brunswick, NJ.

PROGRAM: This is the third workshop in the DIMACS Special Year on Discrete and Computational Geometry. The plan is to have a small number of invited and contributed talks, in order to encourage more direct interaction among the participants.
ORGANIZERS: L. Billera and J. E. Goodman.
INVITED SPEAKERS: G. Kalai, Hebrew Univ.; V. Klee, Univ. of Washington; C. Lee, Univ. of Kentucky; P. Mani-Levitska, Univ. of Bern; M. Perles, Hebrew Univ.; R. Seidel, Univ. of California, Berkeley; R. Wenger, DIMACS.
INFORMATION: DIMACS, Hill Center, Busch Campus, Rutgers University, P.O. Box 1179, Piscataway, NJ 08855; 201-932-5928; dimacs@math.rutgers.edu.

8–13. **Workshop on Variational Methods in Hamiltonian Systems and Elliptic Equations**, L'Aquila, Italy. (Oct. 1989, p. 1093)

9–13. **Stable Processes and Related Topics Workshop**, Ithaca, NY. (Oct. 1989, p. 1093)

10–13. **International Conference on Differential Equations and Applications to Biology and Population Dynamics**, Harvey Mudd College, Claremont, CA. (Sep. 1989, p. 914)

*13–16. **The 1989-1990 Annual Association for Symbolic Logic Meeting**, University of California at Berkeley, CA.

ORGANIZING COMMITTEE: K. Fine, L. Harrington, A.S. Kechris (Chair), A. Scedrov.
INVITED SPEAKERS: G. Cherlin, M. Magidor, W. Just, L. Blum, C. Jockusch, P. Scowcroft, P. Scott, M. Fitting, N. Belnap, G. Boolos, E. Hrushovski.
INFORMATION: C. Ward Henson, Secretary-Treasurer, Department of Mathematics, University of Illinois, 1409 West Green St., Urbana, IL 61801.

14–20. **Nonlinear Evolution Equations, Solitons and the Inverse Scattering Transform**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

15–26. **Workshop on Composite Media and Homogenization Theory**, International Centre for Theoretical Physics, Trieste, Italy. (May/Jun. 1989, p. 600)

16–17. **AMS Short Course on Mathematical Questions in Robotics**, Louisville, KY.

INFORMATION: M. Foulkes, AMS, P.O. Box 6248, Providence, RI 02940.

17–20. **Joint Mathematics Meetings**, Louisville, KY. (Including the annual meetings of the AMS, AWM, MAA and NAM).

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

21–27. **Modelltheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

22–24. **ACM/SIAM Symposium on Discrete Algorithms**, San Francisco, CA. (Sep. 1989, p. 915)

22–26. **Workshop on Applications of Algebraic Topology to Geometry and Analysis**, Mathematical Sciences Research Institute, Berkeley, CA. (May/Jun. 1989, p. 600)

*24–28. **Mathematical Approaches to DNA (Knot Theory, Topology, Geometry, Probability, Statistics)**, Santa Fe, New Mexico.

ORGANIZING COMMITTEE: N.R. Cozzarelli, E. Lander, S.J. Spengler, D. Sumners, J.C. Wang, M.S. Waterman, J.H. White.
CONFERENCE TOPICS: DNA polymorphism; helical repeat; DNA supercoiling, structure and function; higher-order DNA organization; invariants; DNA geometry and flexibilty; graphics; recombination and transposition; sequencing, matching and mapping.
CALL FOR PAPERS: Abstract deadline is December 1, 1989.
INFORMATION: S.J. Spengler, Program in Mathematics and Molecular Biology, 214A Stanley Hall, Univ. of California, Berkeley, CA 94720; Fax (415)643-9290; voice (415)643-7799; email: sylviaj@violet.berkeley.edu or sylviaj@ucbviole.bitnet.

28–February 3. **Regelungstheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

29–February 16. **Second College on Variational Problems in Analysis**, International Centre for Theoretical Physics, Trieste, Italy. (May/Jun. 1989, p. 600)

February 1990

*1–4. **Topological and Measurable Dynamics**, Minneapolis, MN.

ORGANIZERS: R. Ellis, H. Keynes, S.-N. Chow, M. Golubitsky, G.R. Sell.
INFORMATION: Institute for Mathematics and Its Applications, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, Minnesota 55455; Phone: 612-624-6066.

3. **Eighty-seventh Ontario Mathematics Meeting**, Ottawa, Ontario, Canada. (Oct. 1989, p. 1094)

4–10. **Funktiontheoretische Methoden Bei Partiellen Differential Und Integralgleichungen**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

4–10. **Nukleare Frechet-Räume**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 314)

5–10. **Eighth International Seminar on Model Optimization in Exploration Geophysics, with a Workshop on Geophysical Data Inversion in Environmental Research and Planning**, Berlin-West, Free University of Berlin, Federal Republic of Germany. (Jul./Aug. 1989, p. 765)

11–15. **The Twenty-sixth Australian Applied Mathematics Conference**, Coolangatta, Queensland, Australia. (Sep. 1989, p. 915)

11–17. **Funktiontheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

15–20. **American Association for the Advancement of Science Annual Meeting**, New Orleans, LA. (Please note changes from Sep. 1989, p. 915)

INFORMATION: AAAS, 1333 H St., N.W., Washington, DC 20005; 202-326-6640.For information about Section A (Mathematics) Activities, contact Warren Page by calling 914-476-6446.

* 17–19. **Algebraic Geometry and Group Theory Conference/Inaugural Meeting of the Ulam Quarterly**, West Palm Beach, Florida.

SPONSORS: Palm Beach Atlantic College and Ulam Quarterly.
CALL FOR PAPERS: Deadline for Paper Proposals: January 5, 1990.
INFORMATION: P. Blass, Palm Beach Atlantic College, Department of Mathematics, P.O. Box 3353, West Palm Beach, FL 33402-3353; phone: 407-835-4353.

18–24. **Mathematische Modelle in Der Biologie**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

20–22. **Association for Computing Machinery 1990 Computer Science Conference**, Washington, D.C. (May/Jun. 1989, p. 601)

22–23. **Twenty-first SIGCSE Technical Symposium**, Washington, D.C. (May/Jun. 1989, p. 601)

25–March 3. **Eigenwertaufgaben In Natur Und Ingenieurwissensachaften Und Ihre Numerische Behandlung**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

26–March 2. **IEEE Computer Society COMPCON Spring '90**, San Francisco, CA. (Sep. 1989, p. 915)

March 1990

* 1–4. **Mathematicians and Education Reform Network**, Ohio State University, Columbus, Ohio.

PROGRAM: The workshop features presentations by mathematicians who have developed "exemplary projects", especially at the elementary and high school level, and discussions of related issues and programs that effect mathematicians working in educational reform.
INVITED SPEAKERS: K. Hoffman, MSEB; A. Ross, Ohio State Univ.; P. Wagreich, Univ. of Illinois at Chicago; H. Keynes, Univ. of Minnesota; F. Demana, Ohio State Univ.; U. Treisman, Univ. of California at Berkeley; C. Mahoney, Denison Univ.; T. Berger, NSF; E. Fennema, Univ. of Wisconsin-Madison.
INFORMATION: N. Fisher, Associate Director, MER Network, University of Illinois at Chicago, Office of Mathematics and Computer Education (M/C 249), Box 4348, Chicago, IL 60680; telephone: 312-996-2439, bitnet U37158@UICVM.

4–10. **Interval Methods for Numerical Computation**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

5–7. **SIAM Conference on Applied Probability in Science and Engineering**, New Orleans, LA. (Nov. 1988, p. 1389)

5–7. **Symposium on Symbolic Computation (on the occasion of the sixtieth birthday of Erwin Engeler)**, Zürich, Switzerland. (Sep. 1989, p. 915)

11–17. **Mathematische Stochastik**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

* 12–16. **Twist Mappings and Their Applications**, Minneapolis, MN.

ORGANIZERS: L.P. Kadanoff, K. Meyer, J. Moser, C. Robinson, E. Zehnder, S.-N. Chow, M. Golubitsky, R. McGehee, G.R. Sell.
INFORMATION: Institute for Mathematics and Its Applications, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, Minnesota 55455; Phone: 612-624-6066.

13–16. **Twenty-first Annual Iranian Mathematics Conference**, University of Isfahan, Iran. (Jul./Aug. 1989, p. 766)

14–19. **East European Category Seminar**, Predela, Bulgaria. (May/Jun. 1989, p. 601)

15–21. **International Conference on Differential Equations and Mathematical Physics**, University of Alabama at Birmingham, Alabama. (Oct. 1989, p. 1094)

16–17. **Central Section Meeting of the AMS**, Kansas State University, Manhattan, KS.

INFORMATION: W. Drady, AMS, P.O. Box 6248, Providence, RI 02940.

18–24. **Masstheorie**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

18–24. **Third Centenary Celebration of the Mathematische Gesellschaft in Hamburg**, Bundesstraße, Hamburg. (Oct. 1989, p. 1094)

19–22. **Eleventh Annual National Graphics Association Conference and Exposition**, Anaheim, CA. (Jul./Aug. 1989, p. 766)

19–24. **US-USSR Approximation Theory Conference**, University of South Florida, Tampa, FL. (Jul./Aug. 1989, p. 766)

* 19–April 13. **Mathematical Physiology and Differential-Delay Equations**, Minneapolis, MN.

ORGANIZERS: S.-N. Chow, M. Golubitsky, J. Hale, N. Kopell, M. Mackey, J. Mallet-Paret, R. McGehee, G.R. Sell.
INFORMATION: Institute for Mathematics and Its Applications, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, Minnesota 55455; Phone: 612-624-6066.

20–23. **Directions in Matrix Theory**, Auburn, AL. (May/Jun. 1989, p. 601)

23–24. **Southeastern Section Meeting of the AMS**, University of Arkansas, Fayetteville, AR.

INFORMATION: W. Drady, AMS, P.O. Box 6248, Providence, RI 0240.

23–24. **University of Arkansas' Fourteenth Annual Lecture Series in Mathematical Sciences**, Univ. of Arkansas, Fayetteville, Arkansas. (Oct. 1989, p. 1095)

25–31. **Kontinuumsmechanik der Festen Körper**, Oberwolfach, Federal Republic of Germany. (Mar. 1989, p. 315)

26–29. **Workshop on Number Theory and Algorithms**, Berkeley, CA. (Sep. 1989, p. 916)

26–April 6. **Workshop on Group Theory from a Geometrical Viewpoint**, International Centre for Theoretical Physics, Trieste, Italy. (May/Jun. 1989, p. 601)

* 28–29. **Chaos in Praxis: The Application of Nonlinear Dynamics in Social Realms**, Battelle Conference Center, Seattle, WA.

SPONSORS: Battelle Research Institute (with the Department of Energy), Seattle and Antioch University, Seattle.
PURPOSE: This conference will provide an overview of the concepts of nonlinear science, and show how those concepts are being applied to a wide variety of current problems in the social sciences. In addition, techniques for modeling the dynamics of social systems will be demonstrated.
CONFERENCE TOPICS: Nonlinear mathematical models, self-organizing systems, fractal models of social behavior, modeling the dynamics of organizations, chaos and creativity, psychology of decision making, new directions in global economic models, future trends in modeling social phenomena.
INVITED SPEAKERS: R. Abraham, Univ. of California, Santa Cruz; J. Casti, Technical Univ. of Vienna; R. Devaney, Boston Univ.; W. Freeman, Univ. of California, Berkeley; P. Rapp, Medical College of Pennsylvania; J. Sterman, Massachusetts Institute of Technology.
CALL FOR PAPERS: Deadline is January 31, 1990.
INFORMATION: T. Masters, Orion/Wellspring, 900 Queen Anne Ave. N. 308, P.O. Box 9080, Seattle, WA 98109; phone: 206-283-8959.

29–31. **Modern Perspectives of Mathematics: Mathematics in Academia, Mathematics as a Consumer Good**, Cornell University, Ithaca, NY. (Please note changes in name and content from Jul./Aug. 1989, p. 766)

PURPOSE: Designed to examine the nation's use and development of mathematics resources, leaders from business and industry, government, and academia will address how to develop mathematics education and research in ways that will encourage the interplay of mathematics and its applications in business, industry and government.
ORGANIZING COMMITTEE: Y. Terzian (Chair), W.V. Kone, S.A. Levin, A. Nerode, L.B. Wahlbin, D. Willard.
INVITED SPEAKERS: M. H. Kalos, E.E. David, P.D. Lax, J.-L. Lions, I. Peterson, S. Winograd, M.F. Wheeler, J.J. Hopfield, W.W. Hollis, M.E. Fisher.

April 1990

1–4. **ENAR Spring Meeting**, Baltimore, MD. (Jul./Aug. 1989, p. 766)

1–7. **Design and Codes**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

1–14. **NATO Advanced Study Institute on "Generators and Relations in Groups and Geometries"**, Castelvecchio Pascoli (Lucca), Italy. (Sep. 1989, p. 916)

4–7. **Symposium on Distributions with Given Marginals (In Memory of Giuseppe Pompilj)**, Rome, Italy. (Oct. 1989, p. 1095)

* 5–7. **Twenty-fourth Annual Spring Topology Conference**, Southwest Texas State Univ., San Marcos, TX.

PROGRAM: All areas of topology will be covered. Some areas of special interest are general, point-set, and geometric topology, continua theory, and dynamical systems.
ORGANIZING COMMITTEE: S. Singh, T. Thickstun, S. Wayment.
INVITED SPEAKERS: J. W. Cannon, W. G. Fleissner, C. Gordon, S. Newhouse, C. Pugh, A. Dranishnikov, D. Fried, L. Oversteegen, J. T. Rogers.
CALL FOR PAPERS: Fifteen-minute talks in all branches of topology are solicited. Send a type-written (camera-ready) abstract, consisting of two hundred words or less, of your talk to the address below. Abstracts should be received by March 1, 1990.
INFORMATION: S. Singh, Department of Mathematics, Southwest Texas State University, San Marcos, TX 78666; phone: 512-245-3421; email ma_singh@swtexas.bitnet.

7–8. **Eastern Section Meeting of the AMS**, Pennsylvania State University, University Park, PA. (Note change in date from Oct. 1989, p. 1095)

INFORMATION: W. Drady, AMS, P.O. Box 6248, Providence, RI 02940.

* 7–8. **1990 Association for Symbolic Logic Spring Meeting (in conjunction with a Spring meeting of the AMS and a MAMLS meeting)**, Pennsylvania State University, University Park, PA.

PROGRAM COMMITTEE: L. van den Dries, S.G. Simpson (Chair), L. Stanley.
CALL FOR PAPERS: ASL members should submit abstracts of contributed papers by February 2, 1990 to S.G. Simpson at the address below. Abstracts should be no longer than one page (300 words) and should be suitable for eventual publication in the Journal of Symbolic Logic as part of the meeting report.
INFORMATION: S.G. Simpson, Math. Dept., Penn State University, McAllister Building, University Park, PA 16802.

8–14. **Arbeitsgemeinschaft Mit Aktuellem Thema (wird in den Mitteilungen der DMV Heft 1/1990 bekanntgegeben)**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

* 9–13. **Fifth Workshop on Mathematical Aspects of Computer Science**, Mägdesprung, German Democratic Republic.

INFORMATION: J. Dassow, Mägdeburg University of Technology, Department of Mathematics, PSF 124 Mägdeburg, DDR-3010, German Democratic Republic.

15–21. **Mathematical Concepts of Dependable Systems**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

18–21. **Sixty-eighth Annual Meeting of the National Council of Teachers of Mathematics**, Salt Lake City, UT. (Jul./Aug. 1989, p. 766)

* 19–21. **Fourth National Conference on Undergraduate Research**, Union College, Schenectady, NY.

PROGRAM: The conference is expected to attract about 1500 undergraduate students and faculty members to discuss their scholarly and creative activities in a range of disciplines. Research papers, exhibitions, and poster sessions will be presented in the arts, engineering, the humanities, mathematics and computer science, management and business, the natural sciences, and the social sciences.
INVITED SPEAKERS: Joyce Carol Oates, Helen Caldicott, and Richard Voss.
CALL FOR PAPERS: Deadline for submission of abstracts is February 13, 1990.

INFORMATION: NCUR-90, Wells House, 1 Union Ave., Schenectady, NY 12308; phone 518-370-6649.

19–22. **1990 Far Western Section**, University of New Mexico, Albuquerque, New Mexico.

INFORMATION: W. Drady, AMS, P.O. Box 6248, Providence, RI 02940.

22–27. **Tenth Conference on Analytic Functions**, Kozubnik, Poland. (Oct. 1989, p. 1095)

22–28. **Einhollende Algebren und Ringe Von Differentialoperatoren**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

*28–29. **Symposium on Value Distribution Theory in Several Complex Variables**, Univ. of Notre Dame, Notre Dame, Indiana.

SPONSOR: University of Notre Dame.
PURPOSE: The symposium shall portray value distribution theorem in several complex variables, its development, its connection to other fields, and its hope for the future. The University of Notre Dame Press will publish the proceedings.
INVITED SPEAKERS: S.-S. Chern (Invited Participant), D. Drasin, G. Henkin, S. Lang, B. Shiffman, Y.-T. Siu, W. Stoll, P.-M. Wong, L. Yang.
INFORMATION: W. Stoll, Department of Mathematics, University of Notre Dame, P.O. Box 398, Notre Dame, IN 46556.

29–May 5. **Gruppentheorie (Pro-Endliche Gruppen)**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

May 1990

3–4. **Twenty-first Annual Pittsburgh Conference on Modeling and Simulation**, University of Pittsburgh, Pittsburgh, PA. (Sep. 1989, p. 916)

6–12. **Geschichte der Mathematik**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

7–9. **1990 IEEE Symposium on Research in Security and Privacy**, Oakland, CA. (Oct. 1989, p. 1095)

7–10. **SIAM Conference on Applications of Dynamical Systems**, Orlando, FL. (Sep. 1989, p. 916)

7–June 1. **College on Recent Developments and Applications in Mathematics and Computer Science**, International Centre for Theoretical Physics, Trieste, Italy. (May/Jun. 1989, p. 601)

13–19. **Abstrakte Konvexe Analysis**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 766)

14–18. **Conference on Nonlinear Analysis and Partial Differential Equations**, Rutgers University, New Brunswick, NJ. (Jul./Aug. 1989, p. 767)

17–19. **Interface '90 (formerly Computer Science and Statistics: Symposium on Interface)**, East Lansing, MI. (Sep. 1989, p. 916)

20–26. **The Schrödinger Equation and Its Classical Counterparts**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

21–24. **The Simulation of Random Processes and Fields – Mathematics and Applications**, Portofino, Italy. (Sep. 1989, p. 916)

21–25. **Eleventh United States National Congress of Applied Mechanics**, Tucson, AZ. (Nov. 1988, p. 1389)

23–25. **1990 International Symposium on Multiple-Valued Logic**, Charlotte, NC. (Apr. 1989, p. 496)

*24–25. **Twelfth Symposium on Mathematical Programming with Data Perturbations**, George Washington Univ., Washington, DC.

PURPOSE: The symposium is designed to bring together practitioners who use mathematical programming optimization models and deal with questions of sensitivity analysis, with researchers who are developing techniques applicable to these problems.
CALL FOR PAPERS: Contributed papers in mathematical programming are solicited in the following areas: sensitivity and stability analysis results and their applications, solution methods for problems involving implicitly defined problem functions, solution methods for problems involving deterministic or stochastic parameter changes, solution approximation techniques and error analysis. "Clinical" presentations that describe problems in sensitivity or stability analysis encountered in applications are also invited. Abstracts of papers intended for presentation at the symposium should be sent in triplicate to A.V. Fiacco. Abstracts should provide a good technical summary of key results, avoid the use of mathematical symbols and references, not exceed 500 words, and include a title and the name and full mailing address of each author. The deadline for submission is March 9, 1990.
INFORMATION: A.V. Fiacco, Organizer, The George Washington University, Washington, DC 20052; phone: 202-994-7511.

25–31. **Tenth International Conference on Pattern Recognition**, Resorts Hotel, Atlantic City, NJ. (Mar. 1988, p. 466)

27–June 2. **Lyapunov-Exponents**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

*28–June 2. **Geometry of Complex Projective Varieties**, Cetraro, Italy.

ORGANIZING COMMITTEE: F. Catanese, A. Conte, T. Fujita, J. Guenot, A. Lanteri, M. Palleschi, A.J. Sommese, D.C. Struppa.
INVITED SPEAKERS: L. Badescu (Bucharest), F. Catanese (Pisa), C. Ciliberto (Roma), A. Conte (Torino), I. Doglachev (Ann Arbor), T. Fujita (Tokyo), L. Gottsche (Bonn), C. Hulek (Bayreuth), P. Ionescu (Bucharest), V. Iskovskih (Moscow), C. Peskine (Paris), K. Ranestad (Oslo), I. Reider (Norman), F. Sakai (Urawa), M. Schneider (Bayreuth), F. Serrano (Barcelona), A.J. Sommese (Notre Dame), F. Zak (Moscow).

*29–30. **Algebraic Logic Conference in Honour of Professor Don Monk**, Boulder, Colorado.

INFORMATION: W. Taylor, Department of Mathematics, Campus Box 426, Boulder, Colorado 80309-0426.

29–June 1. **Eleventh Annual Conference of the Canadian Applied Mathematics Society**, Halifax, Nova Scotia. (Oct. 1989, p. 1096)

*29–June 2. **Dynamical Theories of Turbulence in Fluid Flows**, Minneapolis, MN.

ORGANIZERS: S.-N. Chow, C. Foias, M. Golubitsky, R. McGehee, R. Temam.
INFORMATION: Institute for Mathematics and Its Applications, 514 Vincent Hall, 206 Church Street S.E.,

Minneapolis, Minnesota 55455; Phone: 612-624-6066.

* 29–June 2. **Workshop on Dynamical Systems in Fluid Mechanics**, Minneapolis, MN.

INFORMATION: W. Miller, Institute for Mathematics and its Applications, University of Minnesota, 514 Vincent Hall, 206 Church St. S.E., Minneapolis, Minnesota 55455.

June 1990

June 1990. **AMS-SIAM Summer Seminar on Vortex Dynamics and Vortex Methods**, Location on the west coast to be announced.

INFORMATION: B. Verducci, AMS, P.O. Box 6248, Providence, RI 02940.

June/July 1990. **International IMACS Conference on Mathematical Modelling and Applied Mathematics**, Vilnius, USSR. (Sep. 1989, p. 917)

1–8. **Third International Symposium on Orthogonal Polynomials and Their Applications**, Erice-Trapani (Sicily), Italy. (Please note change in name from Sep. 1989, p. 917)

1–10. **Fourth Annual Meeting of the International Workshop in Analysis and its Applications**, Dubrovnik-Kupari, Yugoslavia. (Oct. 1989, p. 1096)

3–6. **1990 Annual Meeting of the Statistical Society of Canada**, St. John's, Newfoundland, Canada. (Sep. 1989, p. 917)

3–9. **Graphentheorie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

4–7. **Fifth Annual IEEE Symposium on Logic in Computer Science**, Philadelphia, PA. (Sep. 1989, p. 917)

4–8. **Workshop on Model Theory**, Berkeley, CA. (Sep. 1989, p. 917)

* 4–8. **Nonlinear Phenomena in Atmospheric and Oceanic Sciences**, Minneapolis, MN.

ORGANIZERS: G.F. Carnevale, S.-N. Chow, C. Foias, M. Golubitsky, R. McGehee, R. Pierrehumbert, G.R. Sell, D. Yen.
INFORMATION: Institute for Mathematics and Its Applications, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, Minnesota 55455; Phone: 612-624-6066.

6–9. **Fifth Annual Conference of the European Consortium for Mathematics in Industry**, Lahti, Finland. (Apr. 1989, p. 496)

6–12. **1990 Barcelona Conference on Algebraic Topology**, Centre de Recerca Matematica, Barcelona, Spain. (Sept. 1988, p. 1060)

6–15. **Third Logical Biennial (in honour of S.C. Kleene)**, Chaika (near Varna), Bulgaria. (Oct. 1989, p. 1096)

7–July 4. **1990 Joint Summer Research Conferences in the Mathematical Sciences**, University of Massachusetts at Amherst, MA.

INFORMATION: C. Kohanski, AMS, P.O. Box 6248, Providence, RI 02940.

10–16. **Reelle Algebraische Geometrie**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

* 10–16. **Fourth Czechoslovak Symposium on Combinatorics**, Prachtice, Czechoslovakia.

INFORMATION: P. Liebel, MÚ CSAV, 115 67 Praha 1, Czechoslovakia.

11–14. **Fourteenth Rolf Nevanlinna Colloquium**, University of Helsinki, Helsinki, Finland. (Jul./Aug. 1989, p. 767)

11–14. **World Organization of Systems and Cybernetics Eighth International Congress**, New York, NY. (Mar. 1989, p. 315)

11–14. **Fifth SIAM Conference on Discrete Mathematics**, Atlanta, GA. (Sep. 1989, p. 917)

* 11–15. **Chaotic Processes in the Geological Sciences**, Minneapolis, MN.

ORGANIZERS: G.F. Carnevale, S.-N. Chow, M. Golubitsky, R. McGehee, R. Pierrehumbert, G.R. Sell.
INFORMATION: Institute for Mathematics and Its Applications, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, Minnesota 55455; Phone: 612-624-6066.

11–15. **Third International Conference on Hyperbolic Problems**, Uppsala, Sweden. (Jul./Aug. 1989, p. 767)

11–15. **Rigorous Results in Quantum Dynamics**, Liblice Castle, Czechoslovakia. (May/Jun. 1989, p. 602)

* 11–15. **NSF/CBMS Conference on Wavelets**, University of Lowell, Lowell, MA.

INVITED SPEAKERS: I. Daubechies (Principle Lecturer), AT&T Bell Labs.; R. Coifman, Yale; S. Mallat, Courant.
INFORMATION: CBMS Wavelet Conference, Department of Mathematics, University of Lowell, Lowell, MA 01854; phone: 508-934-2410; email: wavelet@elm.ulowell.edu.

13–15. **Seventh Annual Quality and Productivity Research Conference**, Madison, WI. (Mar. 1989, p. 315)

13–22. **Free Boundary Problems: Theory and Applications**, Centre de Recherches Mathématiques, Université de Montréal, Canada. (Jul./Aug. 1989, p. 767)

* 14–16. **Fifth Southeast Asian Conference on Mathematical Education (SEACME 5)**, Gadong, Brunei Darussalam.

INFORMATION: D. Daniels, SEACME 5 Secretary, University of Brunei Darussalam, Gadong, Brunei Darussalam (SE Asia).

17–23. **Partial Differential Equations in Complex Analysis**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

18–20. **Joint WNAR-IMS Regional Meeting**, Montana State University, Bozeman, MT. (Mar. 1989, p. 315)

18–22. **Fourteenth Mathematical Sciences Lecture Series on Partially Ordered Sets**, Johns Hopkins University, Baltimore, Maryland. (Oct. 1989, p. 1096)

* 18–29. **Radar/Sonar**, Minneapolis, MN.

ORGANIZERS: M. Bern4feld, R.E. Blahut, A. Grunbaum, R. Tolimieri.
INFORMATION: Institute for Mathematics and Its Applications, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, Minnesota 55455; Phone: 612-624-6066.

24–30. **Mathematische Probleme in der Nichtlinearen Elastizität**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 767)

25–29. **International Symposium on Fuzzy Approach to Reasoning and Decision**
Making, Bochyne, Czechoslovakia. (Oct. 1989, p. 1096)

27–30. **Fourth International Congress on Algebraic Hyperstructures and Ap-**

plications, Xanthi, Greece. (Apr. 1989, p. 496)

July 1990

July 1990. **AMS Summer Research Institute on Differential Geometry**, University of California, Los Angeles, CA.

INFORMATION: W. Drady, AMS, P.O. Box 6248, Providence, RI 02940.

1–7. **Modulfunktionen In Mehreren Variablen**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

1–15. **International Symposium on Algebraic Topology - Adams Memorial Symposium**, University of Manchester, England. (Sep. 1989, p. 918)

1–18. **Twentieth Summer Session on Probability Theory**, Saint-Flour (Cantal), France. (Mar. 1989, p. 315)

2–6. **Tenth Australian Statistical Conference/Second Pacific Statistical Congress**, Sydney, Australia. (Jul./Aug. 1989, p. 768)

2–6. **The Jónsson Symposium**, Laugarvatn, Iceland. (Sep. 1989, p. 918)

2–6. **Thirty-fourth Annual Meeting of the Australian Mathematical Society**, Townsville, Queensland, Australia. (Oct. 1989, p. 1097)

*2–31. **Time Series**, Minneapolis, MN.

ORGANIZERS: D. Brillinger, J. Geweke, R. Gnanadesikan, E. Parzen, M. Rosenblatt, M. Taqqu.
INFORMATION: Institute for Mathematics and Its Applications, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, Minnesota 55455; Phone: 612-624-6066.

3–6. **Eleventh Dundee Conference on Ordinary and Partial Differential Equations**, Dundee, Scotland. (Sep. 1989, p. 918)

*6–7. **International Colloquium on Applications of Mathematics (on the occasion of the 80th birthday of Lothar Collatz)**, Hamburg, West Germany.

INVITED SPEAKERS: Ph. Ciarlet (Paris), D. Gaier (Giessen), R. Guenther (Corvallis), W.C. Rheinboldt (Pittsburgh).
INFORMATION: G. Opfer, University of Hamburg, Institute of Applied Mathematics, Bundesstrabe 55, D-2000 Hamburg 13, West Germany.

8–14. **Variationsrechnung**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

9–11. **"Universita'di Genova - The Ohio State University Joint Conference" on New Trends in Systems Theory**, Genoa, Italy. (Jul./Aug. 1989, p. 768)

9–20. **Geometry and Topology of Four-Manifolds**, McMaster University, Hamilton, Ontario, Canada. (May/Jun. 1989, p. 602)

15–21. **Stochastic Image Models and Algorithms**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

*15–22. **1990 European Summer Meeting (Logic Colloquium '90)**, University of Helsinki, Finland.

ORGANIZING COMMITTE: J. Väänänen (Chair), I. Niiniluoto, A. Halko, H. Heikkilä, L. Hella, T. Huuskonen, T. Hyttinen, K. Luosto, J. Oikkonen, H. Tuuri.
INFORMATION: Logic Colloquium c/o J. Väänänen, Department of Mathematics, University of Helsinki, Hallituskatu 15, Finland.

15–23. **Colloquium in Honor of Roland Fraisse**, Centre International de Recontres Mathématiques, Luminy, France. (May/Jun. 1989, p. 602)

16–20. **SIAM Annual Meeting**, Chicago, IL. (Nov. 1988, p. 1389)

22–28. **Konvexgeometrie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

26–29. **International Conference on New Trends in Geometric Function Theory and Applications**, University of Madras, Madras, India. (Sep. 1989, p. 918)

29–August 4. **Mechanik Und Algebraische Geometrie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

*30–August 4. **The Fourth International Conference on Fibonacci Numbers and their Applications**, Wake Forest University, Winston Salem, NC.

SPONSORS: Fibonacci Association and Wake Forest University.
CALL FOR PAPERS: Papers on all branches of mathematics and science related to the Fibonacci numbers and generalized Fibonacci numbers as well as papers related to recurrences and their generalizations are welcome. Abstracts are to be submitted by March 15, 1990, while manuscripts are due by May 1, 1990. Abstracts and manuscripts should be sent in duplicate following the guidelines for submission of articles found on the inside front cover of any recent issue of *The Fibonacci Quarterly* to the address below.
INFORMATION: G.E. Bergum, Department of Computer Science, South Dakota State Univ., P.O.Box 2201, Brookings, SD 57007-0194.

*31–August 2. **Dynamics of Numerics and the Numerics of Dynamics**, Bristol, England.

INFORMATION: Y. May, Conference Officer, The Institute of Mathematics and its Applications, Maitland House, Warrior Square, Southend-on-Sea, Essex SS1 2JY, England.

August 1990

5–11. **Mathematical Methods in Tomography**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

5–11. **International Conference on Approximation Theory**, Hungary. (Oct. 1989, p. 1097)

6–9. **1990 Joint Statistical Meetings**, Anaheim, CA. (Mar. 1988, p. 466)

8–11. **Joint Mathematics Meetings**, Ohio State University, Columbus, OH. (including the summer meetings of the AMS, AWM, MAA and PME). This is the 75th Anniversary of the MAA.

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

12–18. **Algebraische Zahlentheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

12–18. **Pre-Congress Topology Conference**, University of Hawaii, Honolulu, HI. (Feb. 1989, p. 183)

13–16. **Alaska Conference, Quo Vadis, Graph Theory?**, University of Alaska, Fairbanks, AK. (Oct. 1989, p. 1097)

13–17. **Fifth International Conference on Hadronic Mechanics and Nonpotential Interactions**, University of Northern Iowa, Cedar Falls, Iowa. (Jul./Aug. 1989, p. 768)

13–17. **Eleventh IFAC World Congress**, Tallin, USSR. (Sep. 1989, p. 918)

13–17. **Algebraic Geometry and Analytic Geometry**, Tokyo, Japan. (Sep. 1989, p. 919)

13–18. **Institute of Mathematical Statistics Fifty-third Annual Meeting(jointly with the Second World Congress of the Bernoulli Society)**, Uppsala, Sweden. (Sep. 1989, p. 919)

* 13–18. **Tsukuba International Conference on Representations of Algebras and Related Topics**, University of Tsukuba, Japan.

 CONFERENCE TOPICS: Finite dimensional algebras over fields of Artinian rings, representations of finite groups, representations of orders and their related fields.
 INVITED SPEAKERS: M. Auslander, G. Azumaya, S. Brenner, V. Dlab, G. Michler, C.M. Ringel, A.V. Roiter.
 CALL FOR PAPERS: Anyone wishing to talk at the conference should send a one-page abstract to the address below.
 INFORMATION: H. Tachikawa (Organizer), Institute of Mathematics, University of Tsukuba, Tsukuba, Ibaraki 305, Japan.

14–18. **The Asian Mathematical Conference 1990**, Hong Kong, China. (Sep. 1989, p. 919)

15–19. **International Conference on Knot Theory and Related Topics**, International House, Osaka, Japan. (Apr. 1989, p. 497)

* 15–20. **Conference on Gaussian Random Fields (The Third Nagoya Lévy Seminar)**, Nagoya University, Nagoya, Japan.

 PROGRAM: On the occasion of the forty-fifth anniversary of Lévy's Brownian motion with multi-dimensional parameter, the conference will be held and devoted to the theory of Gaussian random fields and its applications; white noise approach and related topics.
 INVITED SPEAKERS: D.A. Dawson, L. Gross, I.A. Ibragimov, G. Kallianpur, H.-H. Kuo, Y.A. Rozanov, B.L. Rozovskii, L. Streit.
 INFORMATION: T. Hida, Department of Mathematics, Nagoya University, Chikusa-ku, Nagoya (464), Japan.

16–18. **SIGAL International Symposium on Algorithms**, Tokyo, Japan. (Oct. 1989, p. 1097)

19–25. **Mathematische Methoden Des VLSI-Entwurfs Und Des Distributed Computings**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

21–29. **The International Congress of Mathematicians 1990**, Kyoto, Japan. (Nov. 1988, p. 1389)

26–September 1. **Komplexe Analysis**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

28–30. **IMACS European Simulation Meeting on Problem Solving by Simulation**, Esztergom, Hungary. (Mar. 1989, p. 316)

28–31. **Operations Research 1990, International Conference Operations Research**, Vienna, Austria. (Jul./Aug. 1989, p. 768)

30–September 4. **International Conference on Potential Theory**, Nagoya, Japan. (May/Jun. 1989, p. 602)

September 1990

September/October 1990. **IMACS-GAMM Conference on Computer Arithmetic, Scientific Computation and Mathematical Modelling**, Bulgaria. (Sep. 1989, p. 919)

IMACS Symposium on Modelling and Simulation of Electrical Machines, ENSEM - Nancy, France. (May/Jun. 1989, p. 602)

2–7. **Twelfth International Conference on Nonlinear Oscillations**, Cracow, Poland. (Sep. 1989, p. 919)

* 2–7. **International Conference on Integral Equations and Boundary Value Problems**, Yantai University, Shandong, People's Republic of China.

 ORGANIZERS: W. Guo-chun (Peking Univ., Yantai Univ.), Z. Zhen (Beijing Normal Univ.), H. Zong-yi (Fudan Univ.), L. Wei (Zhongshan Univ.), L. Jian-ke (Wuhan Univ.).
 INFORMATION: W. Guo-chun, Department of Mathematics, Peking University, Beijing, People's Republic of China 100871.

2–8. **Topologie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 497)

3–6. **Fourth Asian Logic Conference**, Tokyo, Japan. (Mar. 1989, p. 316)

3–7. **IMACS Symposium on Intelligent Models in Systems Simulation**, Brussels, Belgium. (Mar. 1989, p. 316)

3–7. **Representation des Groupes et Analyse Complexe**, Marseille, France. (Jul./Aug. 1989, p. 768)

8–12. **Neuronet-90: IMACS International Symposium on Neural Nets and Neural Computers**, Prague, Czechoslovakia. (Please note change from May/Jun. 1989, p. 602)

9–15. **Surgery and L-Theory**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

10–October 5. **School on Qualitative Aspects and Applications of Nonlinear Evolution Equations**, International Centre for Theoretical Physics, Trieste, Italy. (May/Jun. 1989, p. 602)

10–14. **Mathematiker-Kongress**, Dresden, German Democratic Republic. (Jul./Aug. 1989, p. 769)

16–22. **Risikotheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

17–22. **DMV-Jahrestagung 1990**, Bremen, Federal Republic of Germany. (Jul./Aug. 1989, p. 769)

23–29. **Random Graphs and Combinatorical Structures**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

24–28. **International Symposium on Mathematical Theories**, San Sebastián, Spain. (Jul./Aug. 1989, p. 769)

30–October 6. **Diophantische Approximationen**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

October 1990

7–13. **Arbeitsgemeinschaft Mit Aktuellem Thema**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

14–20. **Geometrie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

21–27. **Mathematische Methoden In Der Robotik**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

21–27. **Arithmetik der Körper**, Oberwolfach, Federal Republic of Germany. (Oct. 1989, p. 1098)

21–27. **International Functional Analysis Meeting on the Occasion of the Sixtieth Birthday of Professor M. Valdivia**, Peñiscola, Spain. (Oct. 1989, p. 1098)

28–November 3. **Mathematical Economics**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

November 1990

2–3. **Central Section Meeting of the AMS**, University of North Texas, Denton, TX.

INFORMATION: W. Drady, AMS, P.O. Box 6248, Providence, RI 02940.

4–10. **Wahrscheinlichkeitsmaße auf Gruppen**, Oberwolfach, Federal Republic of Germany. (Oct. 1989, p. 1098)

5–7. **Second SIAM Confernce on Linear Algebra in Signals, Systems & Controls**, San Francisco, CA. (Sep. 1989, p. 920)

12–16. **Supercomputing '90**, New York, NY. (Sep. 1989, p. 920)

18–24. **Komplexitätstheorie**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

25–December 1. **Stochastische Approximation Und Optimierungsprobleme In Der Statistik**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

25–December 1. **Lineare Modelle und Multivariate Statistische Verfahren**, Oberwolfach, Federal Republic of Germany. (Jul./Aug. 1989, p. 769)

December 1990

2–8. **Multigrid Methods**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

3–5. **First International Symposium on Uncertainty and Analysis: Fuzzy Reasoning, Probabilistic Methods and Risk Management**, College Park, Maryland. (Oct. 1989, p. 1098)

3–7. **1990 Australasian Conference on Combinatorial Mathematics and Computing**, Palmerston North, New Zealand. (Feb. 1989, p. 183)

9–15. **Allgemeine Ungleichungen**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

16–22. **Mathematische Logik**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

25–January 1. **Lineare Modelle Und Multivariate Statistische Verfahren**, Oberwolfach, Federal Republic of Germany. (Apr. 1989, p. 498)

January 1991

16–19. **Joint Mathematics Meetings**, San Francisco, CA. (including the annual meetings of the AMS, AWM, MAA, and NAM)

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

June 1991

*10–14. **Bernoulli Society Twentieth Conference on Stochastic Processes and their Applications**, Nahariya, Israel.

INFORMATION: R. Adler, Industrial Engineering & Management, Technion, Haifa, 32000 Israel; Tel: 972-4-294503; email: ierra02@technion.bitnet.

*17–21. **1991 International Symposium on the Mathematical Theory of Networks and Systems (MTNS-91)**, International Conference Center Kobe, Kobe, Japan.

CONFERENCE TOPICS: Mathematics for Control, System and Circuit Theory; System Theory-Modelling, Realization and System Identification; Control of Linear/Nonlinear System; Specific Applications.
INFORMATION: H. Kimura, Department of Mechanical Engineering for Computer-Controlled Machinery, Faculty of Engineering, Osaka University, Yamada-oka, Suita, Osaka 565, Japan.

July 1991

8–12. **Second International Conference on Industrial and Applied Mathematics**, Washington, DC. (Nov. 1988, p. 1389)

*22–26. **Thirteenth IMACS World Congress on Computation and Applied Mathematics**, Trinity College, Dublin University, Dublin, Ireland. (Please note changes from Mar. 1989, p. 316)

CHAIRMAN: J.H. Miller, Trinity College, University of Dublin.
PROGRAM: The last IMACS World Congress, (the 12th, held in Paris in 1988), featured about 800 technical papers on a wide variety of subjects, and was attended by 1100 participants coming from 52 countries. The 13th IMACS World Congress is expected to follow a similar format.
CALL FOR PAPERS: Under the general theme of computation and applied mathematics, preliminary manuscripts (original contributions or survey papers) and proposals for the organization of sessions are solicited in the following areas: theory, applications, new tools in computation, contributions to scientific computing coming from nonnumerical disciplines, and history of computing and applied mathematics.

August 1991

8–11. **Joint Mathematics Meetings**, University of Maine, Orono, ME. (including the summer meetings of the AMS, AWM, MAA, and PME)

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

19–22. **1991 Joint Statistical Meetings**, Atlanta, GA. (Mar. 1988, p. 466)

January 1992

8–11. **Joint Mathematics Meetings**, Baltimore, MD. (including the annual meetings of the AMS, AWM, MAA and NAM)

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

June 1992

29–July 1. **Joint Meeting with the London Mathematical Society**, Cambridge, England.

INFORMATION: H. Daly, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940.

January 1993

13–16. **Joint Mathematics Meetings**, San Antonio, TX. (including the annual meetings of the AMS, AWM, MAA, and NAM)

INFORMATION: H. Daly, AMS, P.O. Box 6248, Providence, RI 02940.

New AMS Publications

THE CONNECTION BETWEEN INFINITE DIMENSIONAL AND FINITE DIMENSIONAL DYNAMICAL SYSTEMS

Basil Nicolaenko, Ciprian Foias and Roger Temam, Editors

(Contemporary Mathematics, Volume 99)

The last few years have seen a number of major developments demonstrating that the long-term behavior of solutions of a very large class of partial differential equations possesses a striking resemblance to the behavior of solutions of finite dimensional dynamical systems, or ordinary differential equations. The first of these advances was the discovery that a dissipative PDE has a compact, global attractor with finite Hausdorff and fractal dimensions. More recently, it was shown that some of these PDEs possess a finite dimensional inertial manifold–that is, an invariant manifold containing the attractor and exponentially attractive trajectories.

With the improved understanding of the exact connection between finite dimensional dynamical systems and various classes of dissipative PDEs, it is now realistic to hope that the wealth of studies of such topics as bifurcations of finite vector fields and "strange" fractal attractors can be brought to bear on various mathematical models, including continuum flows. Surprisingly, a number of distributed systems from continuum mechanics have been found to exhibit the same nontrivial dynamic behavior as observed in low-dimensional dynamical systems. As a natural consequence of these observations, a new direction of research has arisen: detection and analysis of finite dimensional dynamical characteristics of infinite-dimensional systems.

This book represents the proceedings of an AMS-IMS-SIAM Summer Research Conference, held in July, 1987 at the University of Colorado at Boulder. Bringing together mathematicians and physicists, the conference provided a forum for presentations on the latest developments in the field and fostered lively interactions on open questions and future directions. With contributions from some of the top experts, these proceedings will provide readers with an overview of this vital area of research.

Contents

1980 *Mathematics Subject Classifications*: 34C, 35K, 70K, 76
ISBN 0-8218-5105-5, LC 89-15158
ISSN 0271-4132
376 pages (softcover), November 1989

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SOME MATHEMATICAL QUESTIONS IN BIOLOGY: THE DYNAMICS OF EXCITABLE MEDIA

Hans G. Othmer, Editor

(Lectures on Mathematics in the Life Sciences, Volume 21)

This volume contains the proceedings of the 22nd annual Symposium on Some Mathematical Questions in Biology, held in May, 1988 in Las Vegas. The diversity of current research in the dynamics of excitable media is reflected in the six papers in this volume. The topics covered include a mathematical treatment of phase-locking, numerical results for models of synchronization in the mammalian sinoatrial node, simulations of a model of the hippocampus, and wave propagation in excitable media. Both experimental and theoretical aspects are treated. Aimed at mathematicians, physiologists, and cardiologists, the book requires only background in differential equations. Readers will gain a broad perspective on current research activity in the modeling, analysis, and simulation of systems with excitable media.

Contents

1980 *Mathematics Subject Classifications*: 92A07, 92A09
ISBN 0-8218-1171-1, LC 89-17794
ISSN 0075-8523
192 pages (softcover), November 1989
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TOPOLOGIES ON PSEUDO-TREES AND APPLICATIONS

Jacek Nikiel

(Memoirs of the AMS, Number 416)

The main purpose of this monograph is to build a theory of natural topologies of psuedo-trees. Pseudo-trees are partially ordered sets fulfilling the acyclicity condition that for each point, the set of all predecessors of that point is linearly ordered. The theory appears to be a natural extension of the theories of linearly ordered topological spaces and GO-spaces. The author applies the theory to solve some problems in general topology and the theory of uniquely arcwise connected continua.

Contents

1980 *Mathematics Subject Classifications*: 54F05, 54F20; 54A10, 54H12, 06F30
ISBN 0-8218-2479-1, LC 89-17764
ISSN 0065-9266
124 pages (softcover), November 1989
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COMPLETING THE RIESZ-DUNFORD FUNCTIONAL CALCULUS

John B. Conway, Domingo A. Herrero and Bernard B. Morrel

(Memoirs of the AMS, Number 417)

In the classical context, the Riesz-Dunford functional calculus analyzes the functions of a given, fixed operator. In this work, the authors take a different tack, by treating the case in which the function f is fixed and the operator T is allowed to vary over all operators for which it makes sense to define $f(T)$. More precisely, the authors take f analytic in some neighborhood of a fixed, nonempty subset E of the plane and analyze the topological properties of the set of all operators of the form $f(T)$. In this case, T runs over all (bounded linear) operators acting on a complex, separable, infinite-dimensional Hilbert space such that the spectrum of T is contained in the original set E. One of the book's main results is a characterization of the closure and interior of the set of all such $f(T)$ in terms of spectral and function-theoretic properties alone. The results and proofs provide an interesting interplay between operator theory and function theory, and several key examples illustrate the possible pathologies.

Contents

1980 *Mathematics Subject Classifications*: 47A60, 47A05, 47A10
ISBN 0-8218-2480-5, LC 89-17740
ISSN 0065-9266
124 pages (softcover), November 1989
Individual member $10, List price $17,
Institutional member $14
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THE BASIS PROBLEM FOR MODULAR FORMS ON $\Gamma_0(N)$
Hiroaki Hijikata, Arnold K. Pizer and Thomas R. Shemanske

(Memoirs of the AMS, Number 418)

Requiring a basic knowledge of number theory and modular forms, this work will provide readers with an understanding of the explicit connections between the arithmetic of quaternion algebras and the theory of modular forms on $\Gamma_0(N)$. The book explores the "basis problem" for modular forms. Simply posed, the problem is to construct a basis for all spaces $S_k(N,\chi)$ of cuspforms of integer weight $k \geq 2$ and character χ on $\Gamma_0(N)$ whose elements are "arithmetically distinguished" in that the coefficients in their Fourier expansions are explicitly computable. The authors consider two kinds of spaces (certain spaces of explicitly computable theta series and spaces of cuspforms called primitive neben spaces) which provide a complete solution to the basis problem, in the sense of providing an explicit decomposition of any space of newforms $S_k^{\text{new}}(N,\chi)$ into a direct sum of character twists of these two types of spaces. The book concludes with many numerical examples illustrating various aspects of the theory of Brandt matrices, theta series, twists of newforms, and the basis problem.

Contents

1980 *Mathematics Subject Classifications*: 11F11; 11E45, 11R52, 11S45, 16A18
ISBN 0-8218-2481-3, LC 89-17739
ISSN 0065-9266
168 pages (softcover), November 1989
Individual member $12, List price $20,
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The following videotape is now available through the AMS.

THE BEAUTY AND COMPLEXITY OF THE MANDELBROT SET
John Hubbard

A Science Television Production

Providing an accessible introduction to the basics of fractals, this videotape presents an appealing balance of the theoretical and aesthetic aspects of the Mandelbrot set. Viewers will appreciate the clarity of exposition as John Hubbard uses a combination of lecture, boardwork, Macintosh computer demonstrations, and colorful computer-generated films and pictures to bring the concepts to life. Part I focuses on iteration and Julia sets, while Part II addresses Mandelbrot sets. Part III examines a way of using the concept of electric field lines to understand these fractal sets. The concluding remarks round out the lecture by pointing to a philosophical framework that relate these sets to phenomena occurring in the natural world. Requiring only a background in calculus, this videotape will prove a useful tool in classrooms and would be an excellent addition to a videotape library.

1980 *Mathematics Subject Classification*: 58
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EIGHT PAPERS TRANSLATED FROM THE RUSSIAN

S. G. Dalalyan, I. I. Danilyuk, A. T. Fomenko, S. G. Gindikin, M. L. Gorbachuk, V. I. Gorbachuk, M. G. Krein, V. P. Palamodov, I. V. Skrypnik, Dao Chong Tkhi

(American Mathematical Society Translations, Series 2, Volume 145)

The papers in this collection range over topics in such areas as algebraic geometry, partial differential equations, Fourier analysis, functional analysis, operator theory, differential geometry, and global analysis.

Contents

1980 *Mathematics Subject Classifications*: 14H45, 34B45, 35G30, 35J05, 35K05, 35S10, 42A99, 46F15, 47A55, 53C65, 58E15, 58F05, 82A25; 31B15, 33A70, 47B10, 47B47
ISBN 0-8218-3129-1, LC 89-17983
ISSN 0065-9290
128 pages (hardcover), November 1989
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This publication is an indispensible source of information for students seeking support for graduate study in the mathematical sciences. Because it provides data from a broad range of academic institutions, it is also a valuable resource for mathematical sciences departments and faculty.

Assistantships and Graduate Fellowships brings together a wealth of information about resources available for graduate study in mathematical sciences departments in the United States and Canada. For each department listed, it provides the number of faculty, graduate students, and degrees awarded (BAs, MAs, and PhDs). Stipend amounts and the number of awards available are given, as well as information about foreign language requirements for the mathematics PhD and whether or not the department accepts critical, expository, or historical theses. Numerous display advertisements from mathematical sciences departments throughout the country provide additional information.

Also listed are sources of support for graduate study and travel, summer internships, and graduate study in the U.S. for foreign nationals. Finally, a list of reference publications for fellowship information makes *Assistantships and Graduate Fellowships* a centralized and comprehensive resource.

1980 *Mathematics Subject Classification*: 00
ISBN 0-8218-0141-4
ISSN 1040-7650
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SOCIÉTÉ MATHÉMATIQUE DE FRANCE, ASTÉRISQUE

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ORBITES UNIPOTENTES ET REPRÉSENTATIONS. VOL. I GROUPS FINIS ET ALGÈBRES DE HECKE

(Astérisque, Number 168)

This volume is the first of a series of three which contain the proceedings of the "Période spéciale: Orbites unipotentes, représentations des groupes finis, réels et p-adiques et représentations des algèbres de Hecke" held in Paris, Orsay and Marseille-Luminy in June–July 1987. They include synthetic presentations and research articles. The general theme of this series is that some common ideas in geometry play a role in all the parts of representation theory of reductive groups (finite groups, real or p-adic groups, adelic groups, primitive ideals). Volume I is devoted more particularly to finite groups. (Volume II is AST/171-172.)

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1980 *Mathematics Subject Classification*: 20
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LOCAL MODULI FOR MEROMORPHIC DIFFERENTIAL EQUATIONS

D. G. Babbitt and V. S. Varadarajan

(Astérisque, Number 169–170)

This paper is concerned with the local study of linear differential equations with meromorphic coefficients at an irregular singularity. One of the most important ways in which this theory differs from the theory at a regular singularity is that formal solutions are not generally convergent, and one has to work with analytic solutions that are only asymptotic to the formal solutions in sufficiently small sectors. The asymptotic solutions are not unique and change abruptly when the sectors on which they are defined rotate; this is the **Stokes Phenomenon** for these equations. The main content of this paper is a systematic study of the Stokes phenomenon and the question of how it is affected when the differential equations vary analytically but with their formal structures fixed.

Contents

1980 *Mathematics Subject Classification*: 34
ISSN 0303-1179
220 pages (softcover), 1989
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ORBITES UNIPOTENTES ET REPRÉSENTATIONS, VOLUME II: GROUPES *P*-ADIQUES ET RÉELS

(Astérisque, Number 171–172)

The volume is the second of a series of three which contain the proceedings of the "Période spéciale: Orbites unipotentes, représentations des groupes finis, réels et *p*-adiques et représentations des algèbres de Hecke," held in Paris, Orsay and Marseille-Luminy in June–July 1987. They include synthetic presentations and research articles. The general theme of this series is that some common ideas in geometry play a role in all the parts of representation theory of reductive groups (finite groups, real or *p*-adic groups, adelic groups, primitive ideals). Volume II is devoted more particularly to *p*-adic and real groups. (Volume I is AST/168.)

Contents

1980 *Mathematics Subject Classifications*: 11, 14, 22
ISSN 0303-1179
338 pages (softcover), 1989
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The following publication is being reprinted with a corrected book description and Table of Contents.

ACTIONS OF LINEARLY REDUCTIVE GROUPS ON AFFINE PI-ALGEBRAS

Nikolaus Vonessen

(Memoirs of the AMS, Number 414)

Aimed at researchers and advanced graduate students interested in ring theory and invariant theory, this book introduces readers to a new and quite beautiful area of noncommutative invariant theory.

The author examines this subject in the setting of affine PI-algebras, extending both the theory of actions of finite groups on noncommutative rings and commutative invariant theory. The work focuses on the action of a linearly reductive group G on a finitely generated PI-algebra R. One of the book's major results is that the fixed ring R^G is finitely generated, provided that R is Noetherian. Other topics explored here include localization, the behavior of prime ideals in the ring extension $R^G \subset R$, and actions by inner automorphisms. The author also shows that many of the results obtained actually characterize linearly reductive groups and are, in particular, false in prime characteristic if the acting group is reductive rather than linearly reductive. This situation contrasts with commutative invariant theory, where, in prime characteristic, most results can also be proven for reductive groups.

Contents

1980 *Mathematics Subject Classifications*: 16; 20
ISBN 0-8218-2477-5, LC 89-15148
ISSN 0065-9266
106 pages (softcover), September 1989
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EVERY PLANAR MAP IS FOUR COLORABLE

K. Appel and W. Haken

(Contemporary Mathematics, Volume 98)

In this volume, the authors present their 1972 proof of the celebrated Four Color Theorem in a detailed but self-contained exposition accessible to a general mathematical audience. An emended version of the authors' proof of the theorem, the book contains the full text of the supplements and checklists, which originally appeared on microfiche. The thiry-page introduction, intended for nonspecialists, provides some historical background of the theorem and details of the authors' proof. In addition, the authors have added an appendix which treats in much greater detail the argument for situations in which reducible configurations are immersed rather than embedded in triangulations. This result leads to a proof that four coloring can be accomplished in polynomial time.

1980 *Mathematics Subject Classification*: 05C15
ISBN 0-8218-5103-9, LC 89-15011
ISSN 0271-4132
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Bylaws of the American Mathematical Society

Article I
Officers

Section 1. There shall be a president, a president-elect (during the even-numbered years only), an ex-president (during the odd-numbered years only), three vice-presidents, a secretary, four associate secretaries, a treasurer, and an associate treasurer.

Section 2. It shall be a duty of the president to deliver an address before the Society at the close of the term of office or within one year thereafter.

Article II
Board of Trustees

Section 1. There shall be a Board of Trustees consisting of eight trustees, five trustees elected by the Society in accordance with Article VII, together with the president, the treasurer, and the associate treasurer of the Society *ex officio*. The Board of Trustees shall designate its own presiding officer and secretary.

Section 2. The function of the Board of Trustees shall be to receive and administer the funds of the Society, to have full legal control of its investments and properties, to make contracts, and, in general, to conduct all business affairs of the Society.

Section 3. The Board of Trustees shall have the power to appoint such assistants and agents as may be necessary or convenient to facilitate the conduct of the affairs of the Society, and to fix the terms and conditions of their employment. The Board may delegate to the officers of the Society duties and powers normally inhering in their respective corporative offices, subject to supervision by the Board. The Board of Trustees may appoint committees to facilitate the conduct of the financial business of the Society and delegate to such committees such powers as may be necessary or convenient for the proper exercise of those powers. Agents appointed, or members of committees designated, by the Board of Trustees need not be members of the Board.

Nothing herein contained shall be construed to empower the Board of Trustees to divest itself of responsibility for, or legal control of, the investments, properties, and contracts of the Society.

Article III
Committees

Section 1. There shall be nine editorial committees as follows: committees for the *Bulletin*, for the *Proceedings*, for the *Colloquium Publications*, for the *Journal*, for *Mathematical Surveys and Monographs*, for *Mathematical Reviews*; a joint committee for the *Transactions* and the *Memoirs*; a committee consisting of the representatives of the Society on the Board of Editors of the *American Journal of Mathematics*; and a committee for *Mathematics of Computation.*

Section 2. There shall be a Science Policy Committee.

Section 3. There shall be a communications committee called the Committee to Monitor Problems in Communication.

Section 4. The size of each committee shall be determined by the Council.

Article IV
Council

Section 1. The Council shall consist of fifteen members-at-large and the following *ex officio* members: the officers of the Society specified in Article I, except that it shall include only one associate secretary, the chairman of each of the editorial committees and of the communications committee and of the Science Policy Committee, any former secretary for a period of two years following the terms of office, and members of the Executive Committee (Article V) who remain on the Council by the operation of Article VII, Section 4.

The chairman of any committee designated as a Council member may name a deputy from the committee as substitute. The associate secretary shall be the one charged with the scientific program of the meeting at which the Council meets except that at a meeting associated with no scientific meeting of the Society the secretary may designate the associate secretary.

There is one exception. Council members by virtue of membership on an editorial committee or as associate secretary on January 1, 1986 shall remain members of the Council through their elected terms. This paragraph is no longer effective after December 31, 1989 and shall then be deleted.

Section 2. The Council shall formulate and administer the scientific policies of the Society and shall act in an advisory capacity to the Board of Trustees.

Section 3. In the absence of the secretary from any meeting of the Council, a member may be designated as acting secretary for the meeting, either by written authorization of the secretary, or, failing that, by the presiding officer.

Section 4. All members of the Council shall be voting members. Each member, including deputies and the designated associate secretary, shall have one vote. The method for settling matters before the Council at any meeting shall be by majority vote of the members present. If the result of a vote is challenged, it shall be the duty of the presiding officer to determine the true vote by a roll call. In a roll call vote, each Council member shall vote only once (although possibly a member of the Council in several capacities).

Section 5. Any five members of the Council shall constitute a quorum for the transaction of business at any meeting of the Council.

Section 6. Between meetings of the Council, business may be transacted by a mail vote. Votes shall be counted as specified in Section 4 of this Article, "members present" being replaced by "members voting." An affirmative vote by mail on any proposal shall be declared if, and only if, (a) more than half of the total number of possible votes is received by the time announced for the closing of the polls, and (b) at least three-quarters of the votes received by then are affirmative. If five or more members request postponement at the time of voting, action on the matter at issue shall be postponed until the next meeting of the Council, unless either (1) at the discretion of the secretary, the question is made the subject of a second vote by mail, in connection with which brief statements of reason, for and against, are circulated; or (2) the Council places the matter at issue before the Executive Committee for action.

Section 7. The Council may delegate to the Executive Committee certain of its duties and powers. Between meetings of the Council, the Executive Committee shall act for the Council on such matters and in such ways as the Council may specify. Nothing herein contained shall be construed as empowering the Council to divest itself of responsibility for formulating and administering the scientific policies of the Society.

Section 8. The Council shall also have power to speak in the name of the Society with respect to matters affecting the status of mathematics or mathematicians, such as proposed or enacted federal or state legislation; conditions of employment in universities, colleges, or business, research or industrial organizations; regulations, policies, or acts of governmental agencies or instrumentalities; and other items which tend to affect the dignity and effective position of mathematics.

With the exception noted in the next paragraph, a favorable vote of two-thirds of the entire membership of the Council shall be necessary to authorize any statement in the name of the Society with respect to such matters. With the exception noted in the next paragraph, such a vote may be taken only if written notice shall have been given to the secretary by the proposer of any such resolution not later than one month prior to the Council meeting at which the matter is to be presented; and the vote shall be taken not earlier than one month after the resolution has been discussed by the Council.

If, at a meeting of the Council, there are present twelve members, then the prior notification to the secretary may be waived by unanimous consent. In such a case, a unanimous favorable vote by those present shall empower the Council to speak in the name of the Society.

The Council may also refer the matter to a referendum by mail of the entire membership of the Society, and shall make such reference if a referendum is requested, prior to final action by the Council, by two hundred or more members. The taking of a referendum shall act as a stay upon Council action until the votes have been canvassed, and thereafter no action may be taken by the Council except in accordance with a plurality of the votes cast in the referendum.

Article V
Executive Committee

Section 1. There shall be an Executive Committee of the Council, consisting of four elected members and the following *ex officio* members: the president, the secretary, the president-elect (during even-numbered years), and the ex-president (during odd-numbered years).

Section 2. The Executive Committee of the Council shall be empowered to act for the Council on matters which have been delegated to the Executive Committee by the Council. If three members of the Executive Committee request that any matter be referred to the Council, the matter shall be so referred. The Executive Committee shall be responsible to the Council and shall report its actions to the Council. It may consider the agenda for meetings of the Council and may make recommendations to the Council.

Section 3. Each member of the Executive Committee shall have one vote. An affirmative vote on any proposal before the Executive Committee shall be declared if, and only if, at least four affirmative votes are cast for the proposal. A vote on any proposal may be determined at a meeting of the Executive Committee, but it shall not be necessary to hold a meeting to determine a vote.

Article VI
Executive Director

Section 1. There shall be an Executive Director who shall be a paid employee of the Society. The Executive Director shall have charge of the central office of the Society, and shall be responsible for the general administration of the affairs of the Society in accordance with the policies that are set by the Board of Trustees and by the Council.

Section 2. The Executive Director shall be appointed by the Board of Trustees with the consent of the Council. The terms and conditions of employment shall be fixed by the Board of Trustees.

Section 3. The Executive Director shall work under the immediate direction of a committee consisting of the president, the secretary, and the treasurer, of which the president shall be chairman *ex officio*. The Executive Director shall attend meetings of the Board of Trustees, the Council, and the Executive Committee, but shall not be a member of any of these bodies. The Executive Director shall be a voting member of the Committee to Monitor Problems in Communication but shall not be its chairman.

Article VII
Election of Officers and Terms of Office

Section 1. The term of office shall be one year in the case of the president-elect and the ex-president; five years in the case of the trustees; two years in the case of the president, the vice-presidents, the secretary, the associate secretaries, the treasurer, and the associate treasurer. The term of office in the case of members of the editorial committees and appointed members of the communications committees shall be four years for the *Proceedings* and the *Transactions* and *Memoirs* committees and three years for the remaining committees, except that when the size of an editorial or communications committee is changed, the Council may authorize the appointment of a member for a shorter term. The term of office for members-at-large of the Council shall be three years, five of the members-at-large retiring annually. The term of office for elected members of the Executive Committee shall be four years, one of the elected members retiring annually. All terms of office shall begin on January 1 and terminate on December 31 with the exception that the officials specified in Articles I, II, III, IV, and V (excepting the president-elect and ex-president) shall continue to serve until their successors have been duly elected or appointed and qualified.

Section 2. The president-elect, the vice-presidents, the secretary, the associate secretaries, the treasurer, the associate treasurer, the trustees, and the members-at-large of the Council shall be elected by written ballot. An official ballot shall be sent to each member of the Society by the secretary on or before October 10, and such ballots, if returned to the secretary in envelopes bearing the name of the voter and received within thirty days, shall be counted. Each ballot shall contain one or more names proposed by the Council for each office to be filled, with blank spaces in which the voter may substitute other names. A plurality of all votes cast shall be necessary for election. In case of failure to secure a plurality for any office, the Council shall choose by written ballot among the members having the highest number of votes. **Each committee named in Article III, Section 1 or 3, shall be appointed by the Council in a manner designated by the Council. Each such committee shall elect one of its members as chairman in a manner designated by the Council.**

Section 3. The president becomes ex-president at the end of the term of office and the president-elect becomes president.

Section 4. On or before January 15, the secretary shall send to all members of the Council for a mail vote a ballot containing two names for each place to be filled on the Executive Committee. The nominees shall be chosen by a committee appointed by the president. Members of the Council may vote for persons not nominated. Any member of the Council who is not an *ex officio* member of the Executive Committee (see Article V, Section 1) shall be eligible for election to the Executive Committee. In case a member is elected to the Executive Committee for a term extending beyond the regular term on the Council, that person shall automatically continue as a member of the Council during the remainder of that term on the Executive Committee.

Section 5. The president and vice-presidents shall not be eligible for immediate re-election to their respective offices. A member-at-large or an *ex officio* member of the Council shall not be eligible for immediate election (or re-election) as a member-at-large of the Council.

Section 6. If the president of the Society should die or resign while a president-elect is in office, the president-elect shall serve as president for the remainder of the year and thereafter shall serve the regular two-year term. If the president of the Society should die or resign when no president-elect is in office, the Council, with the approval of the Board of Trustees, shall designate one of the vice-presidents to serve as president for the balance of the regular presidential term. If the president-elect of the Society should die or resign before becoming president, the office shall remain vacant until the next regular election of a president-elect, and the Society shall, at the next annual meeting, elect a president for a two-year term. If the ex-president should die or resign before expiration of the term of office, the Council, with the approval of the Board of Trustees, shall designate a former president of the Society to serve as ex-president during the remainder of the regular term of the ex-presidency. Such vacancies as may occur at any time in the group consisting of the vice-presidents, the secretary, the associate secretaries, the treasurer, and the associate treasurer shall be filled by the Council with the approval of the Board of Trustees. If a member of an editorial or communications committee should take temporary leave from duties, the Council shall then appoint a substitute. The Council shall fill from its own membership any vacancy in the elected membership of the Executive Committee.

Section 7. If any elected trustee should die while in office or resign, the vacancy thus created shall be filled for the unexpired term by the Board of Trustees.

Section 8. If any member-at-large of the Council should die or resign more than one year before the expiration of the term, the vacancy for the unexpired term shall be filled by the Society at the next annual meeting.

Section 9. In case any officer should die or decline to serve between the time of election and the time to assume office, the vacancy shall be filled in the same manner as if that officer had served one day of the term.

Article VIII
Members and Their Election

Section 1. Election of members shall be by vote of the Council or of its Executive Committee.

Section 2. There shall be four classes of members, namely ordinary, contributing, corporate, and institutional.

Section 3. Application for admission to ordinary membership shall be made by the applicant on a blank provided by the secretary. Such applications shall not be acted upon until at least thirty days after their presentation to the Council (at a meeting or by mail), except in the case of members of other societies entering under special action of the Council approved by the Board of Trustees.

Section 4. An ordinary member may become a contributing member by paying the dues for such membership. (See Article IX, Section 3.)

Section 5. A university or college, or a firm, corporation, or association interested in the support of mathematics may be elected a corporate or an institutional member.

Article IX
Dues and Privileges of Members

Section 1. Any applicant shall be admitted to ordinary membership immediately upon election by the Council (Article VIII) and the discharge within sixty days of election of the first annual dues. Dues may be discharged by payment or by remission when the provision of Section 7 of this Article is applicable. The first annual dues shall apply to the year of election, except that any applicant elected after August 15 of any year may elect to have the first annual dues apply to the following year.

Section 2. The annual dues of an ordinary member of the Society shall be established by the Council with the approval of the Trustees. The Council, with the approval of the Trustees, may establish special rates in exceptional cases and for members of an organization with which the Society has a reciprocity agreement.

Section 3. The minimum dues for a contributing member shall be three-halves of the dues of an ordinary member per year. Members may, upon their own initiative, pay larger dues.

Section 4. The minimum dues of an institutional member shall depend on the scholarly activity of that member. The formula for computing these dues shall be established from time to time by the Council, subject to approval by the Board of Trustees. Institutions may pay larger dues than the computed minimum.

Section 5. The privileges of an institutional member shall depend on its dues in a manner to be determined by the Council, subject to approval by the Board of Trustees. These privileges shall be in terms of Society publications to be received by the institution and of the number of persons it may nominate for ordinary membership in the Society.

Section 6. Dues and privileges of corporate members of the Society shall be established by the Council subject to approval by the Board of Trustees.

Section 7. The dues of an ordinary member of the Society shall be remitted for any years during which that member is the nominee of an institutional member.

Section 8. After retirement from active service on account of age or on account of long term disability, any ordinary or contributing member who is not in arrears of dues and with membership extending over at least twenty years may, by giving proper notification to the secretary, have dues remitted, on the understanding that the member will thereafter receive the *Notices* but not the *Bulletin*.

Section 9. An ordinary or contributing member shall receive the *Notices* and *Bulletin* as privileges of membership during each year for which dues have been discharged.

Section 10. The annual dues of ordinary, contributing, and corporate members shall be due by January 1 of the year to which they apply. The Society shall submit bills for dues. If the annual dues of any member remain undischarged beyond what the Board of Trustees deems to be a reasonable time, the name of that member shall be removed from the list of members after due notice. A member wishing to discontinue membership at any time shall submit a resignation in writing to the Society.

Section 11. Any person who has attained the age of 62 and has been a member for at least twenty years may become a life member by making a single payment equal to five times the dues of an ordinary member for the coming year. Insofar as there is more than one level of dues for ordinary membership, it is the highest such dues that shall be used in the calculation, with the exception for members by reciprocity noted in the following paragraph. A life member is subsequently relieved of the obligation of paying dues. The status and privileges are those of ordinary members. (This section does not affect those persons who became life members before October 25, 1941. They remain life members with the status and privileges of ordinary members. When the class of them is empty, this parenthetical remark is to be removed.)

A member of the Society by reciprocity who has reached the age of 62, has been a member for at least 20 years, has been a member by reciprocity for at least 15 of those 20 years and asserts the intention of continuing to be a member by reciprocity may purchase a life membership by a one-time payment of a special rate established by the Council, with the approval of the Trustees.

Article X
Meetings

Section 1. The annual meeting of the Society shall be held between the fifteenth of December and the tenth of February next following. Notice of the time and place of this meeting shall be mailed by the secretary or an associate secretary to the last known post office address of each member of the Society. The times and places of the annual and other meetings of the Society shall be designated by the Council. There shall be a business meeting of the Society at the annual meeting and at the summer meeting. A business meeting of the Society shall take final action only on business accepted by unanimous consent, or business notified to the full membership of the Society in the call for the meeting, except that the business meetings held at either the annual meeting or the summer meeting may take final action on business which has been recommended for consideration by the Council and has been accepted by the vote of four-fifths of the Society present and voting at such a meeting. Such notification shall be made only when so directed by a previous business meeting of the Society or by the Council.

Section 2. Meetings of the Executive Committee may be called by the president. The president shall call a meeting at any time upon the written request of two of its members.

Section 3. The Council shall meet at the annual meeting of the Society. Special meetings of the Council may be called by the president. The president shall call a special meeting at any time upon the written request of five of its members. No special meeting of the Council shall be held unless written notice of it shall have been sent to all members of the Council at least ten days before the day set for the meeting.

Section 4. The Board of Trustees shall hold at least one meeting in each calendar year. Meetings of the Board of Trustees may be called by the president, the treasurer, or the secretary of the Society upon three-days' notice of such meetings mailed to the last known post office address of each trustee. The secretary of the Society shall call a meeting upon the receipt of a written request of two of the trustees. Meetings may also be held by common consent of all the trustees.

Section 5. Papers intended for presentation at any meeting of the Society shall be passed upon in advance by a program committee appointed by or under the authority of the Council; and only such papers shall be presented as shall have been approved by such committee. Papers in form unsuitable for publication, if accepted for presentation, shall be referred to on the program as preliminary communications or reports.

Article XI
Publications

Section 1. The Society shall publish an official organ called the *Bulletin of the American Mathematical Society*. It shall publish four journals, known as the *Journal of the American Mathematical Society*, the *Transactions of the American Mathematical Society*, the *Proceedings of the American Mathematical Society*, and *Mathematics of Computation*. It shall publish a series of mathematical papers known as the *Memoirs of the American Mathematical Society*. The object of the *Journal*, *Transactions*, *Proceedings*, *Memoirs*, and *Mathematics of Computation* is to make known important mathematical researches. It shall publish a periodical called *Mathematical Reviews*, containing abstracts or reviews of current mathematical literature. It shall publish a series of volumes called *Colloquium Publications* which shall embody in book form new mathematical developments. It shall publish a series of monographs called *Mathematical Surveys and Monographs* which shall furnish expositions of the principal methods and results of particular fields of mathematical research. It shall also cooperate in the conduct of the *American Journal of Mathematics*. It shall publish a news periodical known as the *Notices of the American Mathematical Society*, containing programs of meetings, items of news of particular interest to mathematicians, and such other materials as the Council may direct.

Section 2. The editorial management of the publications of the Society listed in Section 1 of this article, with the exception of the *Notices*, and the participation of the Society in the editorial management of the *American Journal of Mathematics* shall be in the charge of the respective editorial committees as provided in Article III, Section 1. The editorial management of the *Notices* shall be in the hands of a committee chosen in a manner established by the Council.

Article XII
Communications

The Committee to Monitor Problems in Communication shall perform such tasks in the field of communication of mathematics as are assigned to it by the Council.

Article XIII
Indemnification

Any person who at any time serves or has served as a trustee or officer of the Society, or as a member of the Council, or, at the request of the Society, as a director or officer of another corporation, whether for profit or not for profit, shall be indemnified by the Society and be reimbursed against and for expenses actually and necessarily incurred in connection with the defense or reasonable settlement of any action, suit, legal or administrative proceeding, whether civil, criminal, administrative or investigative, threatened, pending or completed, to which that person is made a party by reason of being or having been such trustee, officer or director or Council member, except in relation to matters as to which the person shall be adjudged in such action, suit or proceeding to be liable for negligence or misconduct in the performance of official duties. Such right of indemnification and reimbursement shall also extend to the personal representatives of any such person, and shall be in addition to and not in substitution for any other rights to which such person or personal representatives may now or hereafter be entitled by virtue of the provisions of applicable law or of any other agreement or vote of the Board of Trustees, or otherwise.

Article XIV
Amendments

These bylaws may be amended or suspended on recommendation of the Council and with the approval of the membership of the Society, the approval consisting of an affirmative vote by two-thirds of the members present at a business meeting or of two-thirds of the members voting in a mail ballot in which at least ten percent of the members vote, whichever alternative shall have been designated by the Council, and provided notice of the proposed action and of its general nature shall have been given in the call for the meeting or accompanies the ballot in full.

As amended December 1988

AMS Funds, Prizes, Officers and Lecturers

Endowment Fund

In 1923 an Endowment Fund was collected to meet the greater demands on the publication program of the Society, these demands caused by the ever-increasing number of important mathematical memoirs. Of this fund, which amounted to approximately $94,000 in 1960, a considerable proportion was contributed by members of the Society. In 1961, upon the death of the last legatees under the will of the late Robert Henderson–for many years a Trustee of the Society–the entire principal of the estate was received by the Society, thereby bringing the total of the Endowment Fund to approximately $648,000.

Prize Funds

The Bôcher Memorial Prize

This prize was founded in memory of Professor Maxime Bôcher with an original endowment of $1,450. It is awarded every five years for a notable research memoir in analysis that has appeared during the past five years. Either the recipient is a member of the Society or the Memoir is published in a recognized North American journal; this provision, introduced in 1971, is a liberalization of the terms of the award.

First (preliminary) award, 1923: To G. D. Birkhoff for his memoir, *Dynamical systems with two* *degrees of freedom*. Transactions of the American Mathematical Society, volume 18 (1917), pp. 199-300.

Second award, 1924: To E. T. Bell for his memoir, *Arithmetical paraphrases*. I, II, Transactions of the American Mathematical Society, volume 22 (1921), pp. 1-30, 198-219; and to Solomon Lefschetz for his memoir, *On certain numerical invariants with applications to Abelian varieties*, Transactions of the American Mathematical Society, volume 22 (1921), pp. 407-482.

Third award, 1928: To J. W. Alexander for his memoir, *Combinatorial analysis situs*, Transactions of the American Mathematical Society, volume 28 (1926), pp. 301-329.

Fourth award, 1933: To Marston Morse for his memoir, *The foundations of a theory of the calculus of variations in the large in m-space*, Transactions of the American Mathematical Society, volume 31 (1929), pp. 379-404; and to Norbert Wiener for his memoir, *Tauberian theorems*, Annals of Mathematics, Series 2, volume 33 (1932), pp. 1-100.

Fifth award, 1938: To John von Neumann for his memoir, *Almost periodic functions and groups*. I, II, Transactions of the American Mathematical Society, volume 36 (1934), pp. 445-492, and volume 37 (1935), pp. 21-50.

Sixth award, 1943: To Jesse Douglas for his memoirs, *Green's function and the problem of Plateau*, American Journal of Mathematics, volume 61 (1939), pp. 545-589; *The most general form of the problem of Plateau*, American Journal of Mathematics, volume 61 (1939), pp. 590-608; and *Solution of the inverse problem of the calculus of variations*, Proceedings of the National Academy of Sciences, volume 25 (1939), pp. 631-637.

Seventh award, 1948: To A. C. Schaeffer and D. C. Spencer for their memoir, *Coefficients of schlicht functions*. I, II, III, IV, Duke Mathematical Journal, volume 10 (1943), pp. 611-635, volume 12 (1945), pp. 107-125, and the Proceedings of the National Academy of Sciences, volume 32 (1946), pp. 111-116, volume 35 (1949), pp. 143-150.

Eighth award, 1953: To Norman Levinson for his contributions to the theory of linear, nonlinear, ordinary, and partial differential equations contained in his papers of recent years.

Ninth award, 1959: To Louis Nirenberg for his work in partial differential equations.

Tenth award, 1964: To Paul J. Cohen for his paper, *On a conjecture of Littlewood and idempotent measures*, American Journal of Mathematics, volume 82 (1960), pp. 191-212.

Eleventh award, 1969: To I. M. Singer in recognition of his work on the index problem, especially his share in two joint papers with Michael F. Atiyah, *The index of elliptic operators*. I, III, Annals of Mathematics, Series 2, volume 87 (1968), pp. 484-530, 546-604.

Twelfth award, 1974: To Donald S. Ornstein in recognition of his paper, *Bernoulli shifts with the same entropy are isomorphic*, Advances in Mathematics, volume 4 (1970), pp. 337-352.

Thirteenth award, 1979: To Alberto P. Calderón in recognition of his fundamental work on the theory of singular integrals and partial differential equations, and in particular for his paper *Cauchy integrals on Lipschitz curves and related operators*, Proceedings of the National Academy of Sciences, USA, volume 74 (1977), pp. 1324-1327.

Fourteenth award, 1984: To Luis A. Caffarelli for his deep and fundamental work in nonlinear partial differential equations, in particular his work on free boundary problems, vortex theory and regularity theory.

Fifteenth award, 1984: To Richard B. Melrose for his solution of several outstanding problems in diffraction theory and scattering theory and for developing the analytical tools needed for their resolution.

Sixteenth award, 1989: To Richard M. Schoen for his work on the application of partial differential equations to differential geometry, in particular his completion of the solution to the Yamabe Problem in *Conformal deformation of a Riemannian metric to constant scalar curvature*, Journal of Differential Geometry, volume 20 (1984), pp. 479-495.

The Frank Nelson Cole Prize in Algebra
The Frank Nelson Cole Prize in Number Theory

These prizes were founded in honor of Professor Frank Nelson Cole on the occasion of his retirement as secretary of the American Mathematical Society after twenty-five years of service as editor-in-chief of the *Bulletin*. The original fund was donated by Professor Cole from moneys presented to him on his retirement, was augmented by contributions from members of the Society, and was later doubled by his son, Charles A. Cole. The present endowment is $2,250. The prizes are awarded at five-year intervals for contributions to algebra and the theory of numbers, respectively, under restrictions similar to those for the Bôcher Prize.

First award, 1928: To L. E. Dickson for his book *Algebren und ihre Zahlentheorie*, Orell Füssli, Zürich and Leipzig, 1927.

Second award, 1931: To H. S. Vandiver for his several papers on Fermat's last theorem published in the Transactions of the American Mathematical Society and in the Annals of Mathematics during the preceding five years, with special reference to a paper entitled *On Fermat's* *last theorem*, Transactions of the American Mathematical Society, volume 31 (1929), pp. 613-642.

Third award, 1939: To A. Adrian Albert for his papers on the construction of Riemann matrices published in the Annals of Mathematics, Series 2, volume 35 (1934) and volume 36 (1935).

Fourth award, 1941: To Claude Chevalley for his paper, *La théorie du corps de classes*, Annals of Mathematics, Series 2, volume 41 (1940), pp. 394-418.

Fifth award, 1944: To Oscar Zariski for four papers on algebraic varieties published in the American Journal of Mathematics, volumes 61 (1939) and 62 (1940), and in the Annals of Mathematics, Series 2, volumes 40 (1939) and 41 (1940).

Sixth award, 1946: To H. B. Mann for his paper, *A proof of the fundamental theorem on the density of sums of sets of positive integers*, Annals of Mathematics, Series 2, volume 43 (1942), pp. 523-527.

Seventh award, 1949: To Richard Brauer for his paper, *On Artin's L-series with general group characters*, Annals of Mathematics, Series 2, volume 48 (1947), pp. 502-514.

Eighth award, 1951: To Paul Erdős for his many papers in the theory of numbers, and in particular for his paper, *On a new method in elementary number theory which leads to an elementary proof of the prime number theorem*, Proceedings of the National Academy of Sciences, volume 35 (1949), pp. 374-385.

Ninth award, 1954: To Harish-Chandra for his papers on representations of semisimple Lie algebras and groups, and particularly for his paper, *On some applications of the universal enveloping algebra of a semisimple Lie algebra*, Transactions of the American Mathematical Society, volume 70 (1951), pp. 28-96.

Tenth award, 1956: To John T. Tate for his paper, *The higher dimensional cohomology groups of class field theory*, Annals of Mathematics, Series 2, volume 56 (1952), pp. 294-297.

Eleventh award, 1960: To Serge Lang for his paper, *Unramified class field theory over function fields in several variables*, Annals of Mathematics, Series 2, volume 64 (1956), pp. 285-325; and to Maxwell A. Rosenlicht for his papers, *Generalized Jacobian varieties*, Annals of Mathematics, Series 2, volume 59 (1954), pp. 505-530, and *A universal mapping property of generalized Jacobians*, Annals of Mathematics, Series 2, volume 66 (1957), pp. 80-88.

Twelfth award, 1962: To Kenkichi Iwasawa for his paper, *Gamma extensions of number fields*, Bulletin of the American Mathematical Society, volume 65 (1959), pp. 183-226; and to Bernard M. Dwork for his paper, *On the rationality of the zeta function of an algebraic variety*, American Journal of Mathematics, volume 82 (1960), pp. 631-648.

Thirteenth award, 1965: To Walter Feit and John G. Thompson for their joint paper, *Solvability of groups of odd order*, Pacific Journal of Mathematics, volume 13 (1963), pp. 775-1029.

Fourteenth award, 1967: To James B. Ax and Simon B. Kochen for a series of three joint papers, *Diophantine problems over local fields*. I, II, III, American Journal of Mathematics, volume 87 (1965), pp. 605-630, 631-648, and Annals of Mathematics, Series 2, volume 83 (1966), pp. 437-456.

Fifteenth award, 1970: To John R. Stallings for his paper, *On torsion-free groups with infinitely many ends*, Annals of Mathematics, Series 2, volume 88 (1968), pp. 312-334; and to Richard G. Swan for his paper, *Groups of cohomological dimension one*, Journal of Algebra, volume 12 (1969), pp. 585-610.

Sixteenth award, 1972: To Wolfgang M. Schmidt for the following papers: *On simultaneous approximation of two algebraic numbers by rationals*, Acta Mathematica (Uppsala), volume 119 (1967), pp. 27-50; *T-numbers do exist*, Symposia Mathematica, volume IV, Academic Press, 1970, pp. 1-26; *Simultaneous approximation to algebraic numbers by rationals*, Acta Mathematica (Uppsala), volume 125 (1970), pp. 189-201; *On Mahler's T-numbers*, Proceedings of Symposia in Pure Mathematics, volume 20, American Mathematical Society, 1971, pp. 275-286.

Seventeenth award, 1975: To Hyman Bass for his paper, *Unitary algebraic K-theory*, Springer Lecture Notes in Mathematics, volume 343, 1973; and to Daniel G. Quillen for his paper, *Higher algebraic K-theories*, Springer Lecture Notes in Mathematics, volume 341, 1973.

Eighteenth award, 1977: To Goro Shimura for his two papers, *Class fields over real quadratic fields and Heche operators*, Annals of Mathematics, Series 2, volume 95 (1972), pp. 130-190; and *On modular forms of half integral weight*, Annals of Mathematics, Series 2, volume 97 (1973), pp. 440-481.

Nineteenth award, 1980: To Michael Aschbacher for his paper, *A characterization of Chevalley groups over fields of odd order*, Annals of Mathematics, Series 2, volume 106 (1977), pp. 353-398; and to Melvin Hochster for his paper *Topics in the homological theory of commutative rings*, CBMS Regional Conference Series in Mathematics, Number 24, American Mathematical Society, 1975.

Twentieth award, 1982: To Robert P. Langlands for pioneering work on automorphic forms, Eisenstein series and product formulas, particularly for his paper *Base change for* GL(2), Annals of Mathematics Studies, volume 96, Princeton University Press, 1980; and to Barry Mazur for outstanding work on elliptic curves and Abelian varieties, especially on rational points of finite order, and his paper *Modular curves and the Eisenstein ideal*, Publications Mathématiques de l'Institut des Hautes Études Scientifiques, volume 47 (1977), pp. 33-186.

Twenty-First award, 1985: To George Lusztig for his fundamental work on the representation theory of finite groups of Lie type. In particular for his contributions to the classification of the irreducible representations in characteristic zero of the groups of rational points of reductive groups over finite fields, appearing in *Characters of Reductive Groups Over Finite Fields*, Annals of Mathematics Studies, volume 107, Princeton University Press, 1984.

Twenty-Second award, 1987: To Dorian M. Goldfeld for his paper, *Gauss's class number problem for imaginary quadratic fields*, Bulletin of the American Mathematical Society, volume 13, (1985), pp. 23-37; and to Benedict H. Gross and Don B. Zagier for their paper, *Heegner points and derivatives of L-Series*, Inventiones Mathematicae, volume 84 (1986), pp. 225-320.

The Oswald Veblen Prize in Geometry

This prize was established in 1961 in memory of Professor Oswald Veblen through a fund contributed by former students and colleagues. The fund was later doubled by the widow of Professor Veblen, bringing the fund to $2,000. The first two awards of the prize were made in 1964 and the next in 1966; thereafter, an award will ordinarily be made every five years for research in geometry or topology under conditions similar to those for the Bôcher Prize.

First award, 1964: To C. D. Papakyriakopoulos for his papers, *On solid tori*, Annals of Mathematics, Series 2, volume 66 (1957), pp. 1-26, and *On Dehn's lemma and the asphericity of knots*, Proceedings of the National Academy of Sciences, volume 43 (1957), pp. 169-172.

Second award, 1964: To Raoul Bott for his papers, *The space of loops on a Lie group*, Michigan Mathematical Journal, volume 5 (1958), pp. 35-61, and *The stable homotopy of the classical groups*, Annals of Mathematics, Series 2, volume 70 (1959), pp. 313-337.

Third award, 1966: To Stephen Smale for his contributions to various aspects of differential topology.

Fourth award, 1966: To Morton Brown and Barry Mazur for their work on the generalized Schoenflies theorem.

Fifth award, 1971: To Robion C. Kirby for his paper, *Stable homeomorphisms and the annulus conjecture*, Annals of Mathematics, Series 2, volume 89 (1969), pp. 575-582.

Sixth award, 1971: To Dennis P. Sullivan for his work on the Hauptvermutung summarized in the paper, *On the Hauptvermutung for manifolds*, Bulletin of the American Mathematical Society, volume 73 (1967), pp. 598-600.

Seventh award, 1976: To William P. Thurston for his work on foliations.

Eighth award, 1976: To James Simons for his work on minimal varieties and characteristic forms.

Ninth award, 1981: To Mikhael Gromov for his work relating topological and geometric properties of Riemannian manifolds.

Tenth award, 1981: To Shing-Tung Yau for his work in nonlinear partial differential equations, his contributions to the topology of differentiable manifolds, and for his work on the complex Monge-Ampère equation on compact complex manifolds.

Eleventh award, 1986: To Michael H. Freedman for his work in differential geometry and, in particular, the solution of the four-dimensional Poincaré conjecture.

The George David Birkhoff Prize in Applied Mathematics

This prize was established in 1967 in honor of Professor George David Birkhoff. The initial endowment of $2,066 was contributed by the Birkhoff family and there have been subsequent additions by others. It is normally awarded every five years, beginning in 1968, for an outstanding contribution to "applied mathematics in the highest and broadest sense." The award is made jointly by the American Mathematical Society and the Society for Industrial and Applied Mathematics. The recipient must be a member of one of these societies and a resident of the United States, Canada, or Mexico.

First award, 1968: To Jürgen K. Moser for his contributions to the theory of Hamiltonian dynamical systems, especially his proof of the stability of periodic solutions of Hamiltonian systems having two degrees of freedom and his specific applications of the ideas in connection with this work.

Second award, 1973: To Fritz John for his outstanding work in partial differential equations, in numerical analysis, and, particularly, in nonlinear elasticity theory; the latter work has led to his study of quasi-isometric mappings as well as functions of bounded mean oscillation, which have had impact in other areas of analysis.

Third award, 1973: To James B. Serrin for his fundamental contributions to the theory of nonlinear partial differential equations, especially his work on existence and regularity theory for nonlinear elliptic equations, and applications of his work to the theory of minimal surfaces in higher dimensions.

Fourth award, 1978: To Garrett Birkhoff for bringing the methods of algebra and the highest standards of mathematics to scientific applications.

Fifth award, 1978: To Mark Kac for his important contributions to statistical mechanics and to probability theory and its applications.

Sixth award, 1978: To Clifford A. Truesdell for his outstanding contributions to our understanding of the subjects of rational mechanics and nonlinear materials, for his efforts to give precise mathematical formulation to these classical subjects, for his many contributions to applied mathematics in the fields of acoustic theory, kinetic theory, and nonlinear elastic theory, and the thermodynamics of mixtures, and for his major work in the history of mechanics.

Seventh award, 1983: To Paul R. Garabedian for his important contributions to partial differential equations, to the mathematical analysis of problems of transonic flow and airfoil design by the method of complexification, and to the development and application of scientific computing to problems of fluid dynamics and plasma physics.

Eighth award, 1988: To Elliott H. Lieb for his profound analysis of problems arising in mathematical physics.

The Norbert Wiener Prize in Applied Mathematics

This prize was established in 1967 in honor of Professor Norbert Wiener and was endowed by a fund amounting to $2,000 from the Department of Mathematics of the Massachusetts Institute of Technology. The prize is normally awarded every five years, beginning in 1970, for an outstanding contribution to "applied mathematics in the highest and broadest sense." The award is made jointly by the American Mathematical Society and the Society for Industrial and Applied Mathematics. The recipient must be a member of one of these societies and a resident of the United States, Canada, or Mexico.

First award, 1970: To Richard E. Bellman for his pioneering work in the area of dynamic programming, and for his related work on control, stability, and differential-delay equations.

Second award, 1975: To Peter D. Lax for his broad contributions to applied mathematics, in particular, for his work on numerical and theoretical aspects of partial differential equations and on scattering theory.

Third award, 1980: To Tosio Kato for his distinguished work in the perturbation theory of quantum mechanics.

Fourth award, 1980: To Gerald B. Whitham for his broad contributions to the understanding of fluid dynamical phenomena and his innovative contributions to the methodology through which that understanding can be constructed.

Fifth award, 1985: To Clifford S. Gardner for his contributions to applied mathematics in the areas of supersonic aerodynamics, plasma physics and hydromagnetics, and especially for his contributions to the truly remarkable development of inverse scattering theory for the solution of nonlinear partial differential equations.

The Leroy P. Steele Prizes

These prizes were established in 1970 in honor of George David Birkhoff, William Fogg Osgood, and William Caspar Graustein, and are endowed under the terms of a bequest amounting to $145,000 from Leroy P. Steele. From 1970 to 1976 one or more prizes were awarded each year for outstanding published mathematical research; most favorable consideration was given to papers distinguished for their exposition and covering broad areas of mathematics. In 1977 the Council of the AMS modified the terms under which the prizes are awarded. Since then, up to three prizes have been awarded each year in the following categories: (1) for the cumulative influence of the total mathematical work of the recipient, high level of research over a period of time, particular influence on the development of a field, and influence on mathematics through Ph.D. students; (2) for a book or substantial survey or expository-research paper; (3) for a paper, whether recent or not, that has proved to be of fundamental or lasting importance in its field, or a model of important research.

August 1970: To Solomon Lefschetz for his paper, *A page of mathematical autobiography*, Bulletin of the American Mathematical Society, volume 74 (1968), pp. 854-879.

August 1971: To James B. Carrell for his paper, written jointly with Jean A. Dieudonné, *Invariant theory, old and new*, Advances in Mathematics, volume 4 (1970), pp. 1-80.

August 1971: To Jean A. Dieudonné for his paper, *Algebraic geometry*, Advances in Mathematics, volume 3 (1969), pp. 223-321, and for his paper, written jointly with James B. Carrell, *Invariant theory, old and new*, Advances in Mathematics, volume 4 (1970), pp. 1-80.

August 1971: To Phillip A. Griffiths for his paper, *Periods of integrals on algebraic manifolds*, Bulletin of the American Mathematical Society, volume 76 (1970), pp. 228-296.

August 1972: To Edward B. Curtis for his paper, *Simplicial homotopy theory*, Advances in Mathematics, volume 6 (1971), pp. 107-209.

August 1972: To William J. Ellison for his paper, *Waring's problem*, American Mathematical Monthly, volume 78 (1971), pp. 10-36.

August 1972: To Lawrence F. Payne for his paper, *Isoperimetric inequalities and their applications*, SIAM Review, volume 9 (1967), pp. 453-488.

August 1972: To Dana S. Scott for his paper, *A proof of the independence of the continuum hypothesis*, Mathematical Systems Theory, volume 1 (1967), pp. 89-111.

January 1975: To Lipman Bers for his paper, *Uniformization, moduli, and Kleinian groups*, Bulletin of the London Mathematical Society, volume 4 (1972), pp. 257-300.

January 1975: To Martin D. Davis for his paper, *Hilbert's tenth problem is unsolvable*, American Mathematical Monthly, volume 80 (1973), pp. 233-269.

January 1975: To Joseph L. Taylor for his paper, *Measure algebras*, CBMS Regional Conference Series in Mathematics, Number 16, American Mathematical Society, 1972.

August 1975: To George W. Mackey for his paper, *Ergodic theory and its significance for statistical mechanics and probability theory*, Advances in Mathematics, volume 12 (1974), pp. 178-286.

August 1975: To H. Blaine Lawson for his paper, *Foliations*, Bulletin of the American Mathematical Society, volume 80 (1974), pp. 369-418.

1976, 1977, 1978: No awards were made.

January 1979: To Salomon Bochner for his cumulative influence on the fields of probability theory, Fourier analysis, several complex variables, and differential geometry.

January 1979: To Hans Levy for three fundamental papers: *On the local character of the solutions of an atypical linear differential equation in three variables and a related theorem for regular functions of two complex variables*, Annals of Mathematics, Series 2, volume 64 (1956), pp. 514-522; *An example of a smooth linear partial differential equation without solution*, Annals of Mathematics, Series 2, volume 66 (1957), pp. 155-158; *On hulls of holomorphy*, Communications in Pure and Applied Mathematics, volume 13 (1960), pp. 587-591.

August 1979: To Antoni Zygmund for his cumulative influence on the theory of Fourier series, real variables, and related areas of analysis.

August 1979: To Robin Hartshorne for his expository research article *Equivalence relations on algebraic cycles and subvarieties of small codimension*, Proceedings of Symposia in Pure Mathematics, volume 29, American Mathematical Society, 1975, pp. 129-164; and his book *Algebraic geometry*, Springer-Verlag, Berlin and New York, 1977.

August 1979: To Joseph J. Kohn for his fundamental paper: *Harmonic integrals on strongly convex domains*. I, II, Annals of Mathematics, Series 2, volume 78 (1963), pp. 112-248 and volume 79 (1964), pp. 450-472.

August 1980: To André Weil for the total effect of his work on the general course of twentieth century mathematics, especially in the many areas in which he has made fundamental contributions.

August 1980: To Harold M. Edwards for mathematical exposition in his books *Riemann's zeta function*, Pure and Applied Mathematics, number 58, Academic Press, New York and London, 1974; and *Fermat's last theorem*, Graduate Texts in Mathematics, number 50, Springer-Verlag, New York and Berlin, 1977.

August 1980: To Gerhard P. Hochschild for his significant work in homological algebra and its applications.

August 1981: To Oscar Zariski for his work in algebraic geometry, especially his fundamental contributions to the algebraic foundations of this subject.

August 1981: To Eberhard Hopf for three papers of fundamental and lasting importance: *Abzweigung einer periodischen Lösung von einer stationären Lösung eines Differentialsystems*, Berichte über die Verhandlungen der Sächsischen Akademie der Wissenschaften zu Leipzig. Mathematisch-Naturwissenschaftliche Klasse, volume 95 (1943), pp. 3-22; *A mathematical example displaying features of turbulence*, Communications on Applied Mathematics, volume 1 (1948), pp. 303-322; and *The partial differential equation* $u_t + uu_x = \mu u_{xx}$, Communications on Pure and Applied Mathematics, volume 3 (1950), pp. 201-230.

August 1981: To Nelson Dunford and Jacob T. Schwartz for their expository book, *Linear operators*, Part I, *General theory*, 1958; Part II, *Spectral theory*, 1963; Part III, *Spectral operators*, 1971, Interscience Publishers, New York.

August 1982: To Lars V. Ahlfors for his expository work in *Complex analysis* (McGraw-Hill Book Company, New York, 1953), and in *Lectures on quasiconformal mappings* (D. Van Nostrand Co., Inc., New York, 1966) and *Conformal invariants* (McGraw-Hill Book Company, New York, 1973).

August 1982: To Tsit-Yuen Lam for his expository work in his book *Algebraic theory of quadratic forms* (1973), and four of his papers: *K_0 and K_1—an introduction to algebraic K-theory* (1975), *Ten lectures on quadratic forms over fields* (1977), *Serre's conjecture* (1978), and *The theory of ordered fields* (1980).

August 1982: To John W. Milnor for a paper of fundamental and lasting importance, *On manifolds homeomorphic to the 7-sphere*, Annals of Mathematics (2) 64 (1956), pp. 399-405.

August 1982: To Fritz John for the cumulative influence of his total mathematical work, high level of research over a period of time, particular influence on the development of a field, and influence on mathematics through Ph.D. students.

August 1983: To Paul R. Halmos for his many graduate texts in mathematics and for his articles on how to write, talk and publish mathematics.

August 1983: To Steven C. Kleene for three important papers which formed the basis for later developments in generalized recursion theory and descriptive set theory: *Arithmetical predicates and function quantifiers*, Transactions of the American Mathematical Society 79 (1955), pp. 312-340; *On the forms of the predicates in the theory of constructive ordinals (second paper)*, American Journal of Mathematics 77 (1955), pp. 405-428; and *Hierarchies of number-theoretic predicates*, Bulletin of the American Mathematical Society 61 (1955), pp. 193-213.

August 1983: To Shiing-Shen Chern for the cumulative influence of his total mathematical work, high level of research over a period of time, particular influence on the development of the field of differential geometry, and influence on mathematics through Ph.D. students.

August 1984: To Elias M. Stein for his book, *Singular integrals and the differentiability properties of functions*, Princeton University Press (1970).

August 1984: To Lennart Carleson for his papers: *An interpolation problem for bounded analytic functions*, American Journal of Mathematics, volume 80 (1958), pp. 921-930; *Interpolation by bounded analytic functions and the Corona problem*, Annals of Mathematics (2), volume 76 (1962), pp. 547-559; and *On convergence and growth of partial sums of Fourier series*, Acta Mathematica volume 116 (1966), pp. 135-157.

August 1984: To Joseph L. Doob for his fundamental work in establishing probability as a branch of mathematics and for his continuing profound influence on its development.

August 1985: To Michael Spivak for his five-volume set, *A Comprehensive Introduction to Differential Geometry* (second edition, Publish or Perish, 1979).

August 1985: To Robert Steinberg for three papers on various aspects of the theory of algebraic groups: *Representations of algebraic groups*, Nagoya Mathematical Journal, volume 22 (1963), pp. 33-56; *Regular elements of semisimple algebraic groups*, Institut des Hautes Études Scientifiques, Publications Mathématiques, volume 25 (1965), pp. 49-80; and *Endomorphisms of linear algebraic groups*, Memoirs of the American Mathematical Society, volume 80 (1968).

August 1985: To Hassler Whitney for his fundamental work on geometric problems, particularly in the general theory of manifolds, in the study of differentiable functions on closed sets, in geometric integration theory, and in the geometry of the tangents to a singular analytic space.

January 1986: To Donald E. Knuth for his expository work, *The Art of Computer Programming*, 3 Volumes (1st Edition 1968, 2nd Edition 1973).

January 1986: To Rudolf E. Kalman for his two fundamental papers: *A new approach to linear filtering and prediction problems*, Journal of Basic Engineering, volume 82, (1960), pp. 35-45; and *Mathematical description of linear dynamical systems*, SIAM Journal on Control and Optimization, volume 1 (1963), pp. 152-192; and for his contribution to a third paper, (with R. S. Bucy) *New results in linear filtering and prediction theory*, Journal of Basic Engineering, volume 83D (1961), pp. 95-108.

January 1986: To Saunders Mac Lane for his many contributions to algebra and algebraic topology, and in particular for his pioneering work in homological and categorical algebra.

August 1987: To Martin Gardner for his many books and articles on mathematics and particularly for his column "Mathematical Games" in *Scientific American.*

August 1987: To Herbert Federer and Wendell Fleming for their pioneering paper, *Normal and integral currents*, Annals of Mathematics, volume 72 (1960), pp. 458-520.

August 1987: To Samuel Eilenberg for his fundamental contributions to topology and algebra, in particular for his classic papers on singular homology and his work on axiomatic homology theory which had a profound influence on the development of algebraic topology.

August 1988: To Sigurdur Helgason for his books *Differential Geometry and Symmetric Spaces* (Academic Press, 1962), *Differential Geometry, Lie Groups, and Symmetric Spaces* (Academic Press, 1978); and *Groups and Geometric Analysis* (Academic Press, 1984).

August 1988: To Gian-Carlo Rota for his paper *On the foundations of combinatorial theory, I. Theory of Möbius functions*, Zeitschrift für Wahrscheinlichkeitstheorie und Verwandte Gebiete, volume 2 (1964), pp. 340-368.

August 1988: To Deane Montgomery for his lasting impact on mathematics, particularly mathematics in America. He is one of the founders of the modern theory of transformation groups and is particularly known for his contributions to the solution of Hilbert's fifth problem.

August 1989: To Daniel Gorenstein for his book *Finite Simple Groups, An Introduction to their Classification* (Plenum Press, 1982); and his two survey articles *The Classification of Finite Simple Groups* and *Classifying the Finite Simple Groups*, Bulletin of the American Mathematical Society, volume 1 (1979) pp. 43-199, and volume 14 (1986) pp. 1-98, respectively.

August 1989: To Alberto P. Calderón for his paper *Uniqueness in the Cauchy Problem for Partial Differential Equations*, American Journal of Mathematics, volume 80 (1958), pp. 16-36.

August 1989: To Irving Kaplansky for his lasting impact on mathematics, particularly mathematics in America. By his energetic example, his enthusiastic exposition, and his overall generosity, he has made striking changes in mathematics and has inspired generations of younger mathematicians.

The Delbert Ray Fulkerson Prize

Gifts of friends of the late Professor Fulkerson have provided a fund in excess of $7,000. Part or all of the proceeds is to be used jointly by the Mathematical Programming Society and the American Mathematical Society for the award of one or more prizes in discrete mathematics at regular intervals.

First award, 1979: To Richard M. Karp, for *On the computational complexity of combinatorial problems*, Networks, volume 5 (1975), pp. 45-68; to Kenneth Appel and Wolfgang Haken, for *Every planar map is four colorable*, Part I: *Discharging*, Illinois Journal of Mathematics, volume 21 (1977), pp. 429-490; and to Paul D. Seymour, for *The matroids with the max-flow min-cut property*, Journal of Combinatorial Theory, Series B, volume 23 (1977), pp. 189-222.

Second award, 1982: To D. B. Judin and A. S. Nemirovskiĭ, for *Informational complexity and effective methods of solution for convex extremal problems*, Ekonomika i Matematicheskie Metody 12 (1976), 357-369, and to L. G. Khachiyan for *A polynomial algorithm in linear programming*, Akademiia Nauk SSSR. Doklady 244 (1979), 1093-1096; to G. P. Egorychev, for *The solution of van der Waerden's problem for permanents*, Akademiia Nauk SSSR. Doklady 258 (1981), 1041-1044, and D. I. Falikman, for *A proof of the van der Waerden conjecture on the permanent of a doubly stochastic matrix*, Matematicheskie Zametki 29 (1981), 931-938; and to M. Grötschel, L. Lovász and A. Schrijver, for *The ellipsoid method and its consequences in combinatorial optimization*, Combinatorica 1 (1981), 169-197.

Third award, 1985: To József Beck, for *Roth's estimate of the discrepancy of integer sequences is nearly sharp*, Combinatorica 1 (4), 319-325, (1981); and H. W. Lenstra, Jr., for *Integer programming with a fixed number of variables*, Mathematics of Operations Research 8 (4), 538-548, (1983); and Eugene M. Luks for *Isomorphism of graphs of bounded valence can be tested in polynomial time*, Journal of Computer and System Sciences 25 (1), 42-65, (1982).

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Fourth award, 1988: To Éva Tardos for *A strongly polynomial minimum cost circulation algorithm*, Combinatorica, volume 5 (1985), pp. 247-256; and to Narendra Karmarkar for *A new polynomial-time algorithm for linear programming*, Combinatorica, volume 4 (1984), pp. 373-395.

Special Funds

AMS Centennial Fellowship Fund

This fund was established by the Society in 1973 and provides one-year Research Fellowships awarded each year in March. The number of fellowships granted each year depends on the contributions the Society receives, matched by a contribution from the Society of between $9,000 and $20,000. Through the academic year 1983-84, this was a postdoctoral fellowship, restricted to persons only a few years past the Ph.D. In the competition of January 1984, it was changed to an early mid-career fellowship, for persons five to ten years past the Ph.D. At the same time, the stipend was substantially increased. For the 1988 award, the name of the fellowship was changed from AMS Research Fellowship to AMS Centennial Fellowship in honor of the Society's Centennial.

First Award, 1974-1975: Fred G. Abramson and James Li-Ming Wang.

Second award, 1975-1976: Terence J. Gaffney, Paul Nèvai, and George M. Reed.

Third award, 1976-1977: Fredric D. Ancel and Joseph A. Sgro.

Fourth award, 1977-1978: Steven Kalikow, Charles Patton, Duong-Hong Phong, and David Vogan.

Fifth award, 1978-1979: Alan Dankner, David Harbater, Howard Hiller, Steven P. Kerckhoff, and Robert C. McOwen.

Sixth award, 1979-1980: Scott W. Brown, Jeffrey E. Hoffstein, Jeffry N. Kahn, James E. McClure, Rick L. Smith, and Mark Steinberger.

Seventh award, 1980-1981: Robert K. Lazarsfeld, Thomas H. Parker, and Robert Sachs.

Eighth award, 1981-1982: Lawrence Man-Hou Ein and Mark Williams.

Ninth award, 1982-1983: Nicholas J. Kuhn.

Tenth award, 1983-1984: Russell David Lyons.

Eleventh award, 1984-1985: Richard Timothy Durrett.

Twelfth award, 1985-1986: R. Michael Beals.

Thirteenth award, 1986-1987: Dinakar Ramakrishnan

Fourteenth award, 1987-1988: Richard Hain and Bill Jacob

Fifteenth award, 1988-1989: Stephen R. Bell, Don M. Blasius, and David Gabai

Sixteenth award, 1989-1990: Isaac Y. Efrat, John M. Lee, and Ralf J. Spatzier

The Levi L. Conant Fund

Levi L. Conant bequeathed a sum of $9,500 which the Trustees incorporated with the permanent endowments for prize funds.

The Karl Menger Fund

The family of the late Karl Menger were the major contributors to a fund established at Duke University totalling $40,000. The majority of the income from this fund is to be used by the Society for annual awards at the International Science and Engineering Fair.

The Eliakim Hastings Moore Fund

This fund was donated in 1922 in honor of Professor Eliakim Hastings Moore on the occasion of the twenty-fifth anniversary of the Chicago (Western) section of the Society. The fund is $2,575 and the income from the fund is to be used at the discretion of the Council for the publication of important mathematical books and memoirs and for the award of prizes.

The Joseph Fels Ritt Memorial Fund

From the estate of Estelle F. Ritt, the income from a fund of $22,500 is available for the publication of works in the field of mathematics as shall be determined by the governing bodies of the Society.

The Waldemar J. Trjitzinsky Fund

A bequest of $189,000 was received in 1988 from the estate of Barbara G. Trjitzinsky to establish a fund in memory of her husband, Waldemar J. Trjitzinsky. The income from this fund is to be used for needy students studying in the field of mathematics.

Friends of Mathematics Fund

A Friends of Mathematics Fund has been created to incorporate monetary gifts to the Society of a general nature. The principle of this fund is now $123,572. The proceeds of the fund are a part of the invested assets of the Society. The following gifts are components of this fund: $1,000 from the estate of Professor Ernest William Brown; $1,000 from the estage of Genevra B. Hutchinson; $3,000 from Solomon A. Joffe; $650 from the estate of Professor Helen A. Merrill; $23,600 from the estate of Dean Marion Reilly; $1,000 from the estate of James K. Whittemore; and $2,700 from an anonymous donor.

Miscellaneous

Personal Items

George D. Byrne, Research Associate with Exxon Research and Engineering Company, was elected a Fellow in The Institute of Mathematics and its Applications.

Gary A. Lorden, of the California Institute of Technology, has been appointed the Institute's Vice-President for Student Affairs.

Michael C. Mackey, of McGill University, has been appointed Director of the Centre for Nonlinear Dynamics in Physiology and Medicine.

Leopoldo Nachbin, George Eastman Professor, University of Rochester, was given the title of Honorary Professor by the State University of Campinas, Sao Paulo, Brazil.

Daniel H. Wagner, of the Naval Postgraduate School, has accepted a visiting research professorship at the U.S. Naval Academy.

Deaths

William P. Hanf, Professor Emeritus of the University of Hawaii, died on August 15, 1989, at the age of 55. He was a member of the Society for 24 years.

Truman L. Koehler, Professor Emeritus of Muhlenberg College, died on July 17, 1989, at the age of 86. He was a member of the Society for 61 years.

Russell J. Michel, Professor Emeritus of Southeast Missouri State University, died on September 7, 1989, at the age of 82. He was a member of the Society for 53 years.

Allen E. Murray, of Rochester, New York, died on June 12, 1989, at the age of 77. He was a member of the Society for 32 years.

Sallie E. Pence, of Lexington, Kentucky, died on July 26, 1989, at the age of 95. She was a member of the Society for 56 years .

J. Barkley Rosser, Professor Emeritus of the University of Wisconsin, died on September 5, 1989, at the age of 81. He was a member of the Society for 56 years.

Robert B. Warfield, University of Washington, died on September 20, 1989, at the age of 49. He was a member of the Society for 23 years.

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(2) Two or three Research Assistant Professorships in Computational and Applied Mathematics. Applicants must show very strong promise in research and teaching. Salary $37,000. Three year appointment. Teaching load: four quarter courses per year, which may include one advanced course in the candidate's field. Preference will be given to applications completed by January 1, 1990.

(3) One or two Assistant Professorships in the Program in Computing (PIC). Applicants must show very strong promise in teaching and research, preferably in the general area of Logic, Language and Computation. Teaching load: four quarter programming courses and an advanced quarter course of the candidate's choice per year. Two year appointment, possibly renewable once or twice. Salary range: $37,000–$44,000. Preference will be given to applications completed by January 1, 1990.

(4) One or two Lectureships in the Program in Computing (PIC). Applicants must show very strong promise in the teaching of programming. Teaching load: five quarter programming courses per year. One year appointment, possibly renewable up to four times. Salary depends on experience, begins at $31,200.

(5) Subject to administrative approval, a few adjunct assistant professorships. Two year appointments. Strong research and teaching background required. Salary $32,400–$36,500 per year. Teaching load: five quarter courses per year.

(6) Several positions for visitors and lecturers.

To apply, write to Alfred W. Hales, Chair, Department of Mathematics, University of California, Los Angeles, CA 90024-1555. Attn: Staff Search.

UCLA is an equal opportunity/affirmative action employer.

POSITIONS AVAILABLE

WAKE FOREST UNIVERSITY
The Z. Smith Reynolds Professorship in Mathematics

Wake Forest University announces the establishment of a distinguished professorship made possible by the Z. Smith Reynolds Foundation. The scholar selected to fill this position must have an established record of recognized scholarship and a commitment to teaching and research in a university setting. Duties include teaching, continuing a program of research, contributing to the intellectual life of the Department of Mathematics and Computer Science, and fostering the mathematical growth of gifted undergraduates. The position, which carries both tenure and the rank of professor, could be filled as early as the fall semester of 1990.

Wake Forest University is a comprehensive university with 5000 students, 3500 of whom are in the undergraduate college. The Department of Mathematics and Computer Science has 17 permanent positions, 13 of which are in mathematics, and offers majors in mathematics and computer science and an MA in mathematics.

Inquiries, nominations, and applications should be directed to:

Professor Richard Carmichael, Chair
Department of Mathematics and Computer Science
P.O. Box 7311
Wake Forest University
Winston-Salem, NC 27109 USA

Evaluation of applicants will begin in late winter and will continue until the position is filled. AA/EO employer.

SUNY PLATTSBURGH CHAIRPERSON DEPARTMENT OF MATHEMATICS

SUNY Plattsburgh invites applications for Department Chairperson in the Mathematics Department. Opportunity to provide leadership in undergraduate curriculum development (both for mathematics majors and in service courses) and to help establish a supportive environment for teaching and scholarship.

Qualifications: Ph.D. in Mathematics or Statistics plus five years of college mathematics teaching, administrative experience at the departmental level, and continued involvement in mathematics research required. Experience as Chair or Vice-Chair of a Department of Mathematics preferred. Rank will be Associate or full Professor, depending upon experience.

INDIVIDUALS WITH AN UNDERSTANDING OF AND SENSITIVITY TO MINORITY AND GENDER CONCERNS ARE ENCOURAGED TO APPLY.

SUNY Plattsburgh is primarily an undergraduate college with approximately 5,500 students. At present, there are over 100 math majors. Plattsburgh is located in Northeastern New York State on Lake Champlain, near the Adirondack Mountains and approximately sixty miles from Montreal.

Deadline is December 15, 1989, however applications will be accepted until the position is filled.

Send nominations and applications with a list of references to:

Chair, Search Committee
c/o Office of Personnel/Affirmative Action
SUNY Plattsburgh
Box **1639-401**
Plattsburgh, New York 12901

SUNY PLATTSBURGH IS AN EQUAL OPPORTUNITY EMPLOYER.

UNIVERSITY OF CALIFORNIA SANTA BARBARA DEPARTMENT OF MATHEMATICS

Applications are invited for the KY FAN ASSISTANT PROFESSORSHIP. The Ky Fan assistant professorship is a special two-year non-renewable position which carries a research stipend. Appointment is effective July 1, 1990. Candidates must possess a Ph.D. by September 1990. Selection will be based primarily on demonstrated research achievement. Teaching experience is desirable. Teaching load will consist of four quarter courses per year. To apply send vita and publication list, and arrange to have 3 letters of recommendation sent to: Ky Fan Faculty Search Committee, Department of Mathematics, University of California, Santa Barbara, CA 93106. All applications received by January 10, 1990 will be given thorough consideration. UCSB is an Equal Opportunity/Affirmative Action employer. Proof of U.S. citizenship or eligibility for U.S. employment will be required prior to employment (Immigration Reform and Control Act of 1986).

FLORIDA STATE UNIVERSITY

Applications are invited for an assistant professorship with research specialization in computational and applied mathematics, geometry (especially differential geometry), or topology. The application deadline is January 16, 1990, and appointment would begin August 1990. The candidate should have potential for excellence in research and teaching. Please send resume, and arrange for three letters of recommendation to be sent to Ralph McWilliams, Chair, Department of Mathematics, Florida State University, Tallahassee, Florida 32306. Florida State University is an EEO/AA employer.

POSITIONS AVAILABLE

DARTMOUTH COLLEGE

Senior Position in Mathematics. Associate or Full Professor position available beginning in 1990–91. Candidates should have established and recognized research program, proven ability to attract external research support, and interest in building and leading a strong research group. Appointee will participate in the recruitment for several junior positions. Proven record of excellence in teaching at both the undergraduate and graduate levels and commitment to professional interaction with faculty and Ph.D. students required. Applications are welcome in all fields of mathematics. Department has special interests in algebra, combinatorics, geometry/topology, and probability/statistics. Dartmouth provides grants to new faculty members for research-related expenses, a generous sabbatical program, and moderate teaching loads. The review of applications will begin on January 1, 1990. Send a letter of application, a curriculum vitae, the names of four people who have agreed to write letters of recommendation, and a description of research interests to: Mathematics Senior Search Committee Chair, Department of Mathematics and Computer Science, Bradley Hall, Dartmouth College, Hanover, NH 03755. Dartmouth is firmly committed to Affirmative Action and strongly encourages applications from minorities and women.

DUKE UNIVERSITY
Department of Mathematics

Applications are invited for two or more tenure track positions in Mathematics, rank and salary open, all fields. Please send curriculum vitae, a research plan, and arrange for three letters of recommendation to be sent. Address correspondence to: Faculty Search Committee, Department of Mathematics, Duke University, Durham, NC 27706. Duke University is an affirmative action/equal opportunity employer.

CENTER FOR DISCRETE MATHEMATICS AND THEORETICAL COMPUTER SCIENCE
Visiting and Post-Doctoral Positions

Applications are invited for visiting and post-doctoral positions in the Center for Discrete Mathematics and Theoretical Computer Science (DIMACS). This Center is supported through the NSF Science and Technology Centers Research Program. The participating institutions are Rutgers University, Princeton University, AT&T Bell Laboratories and Bell Communications Research. Research facilities are located at the Rutgers and Princeton campuses.

Applicants are sought in all areas of discrete mathematics and theoretical computer science, including (but not limited to) analysis of algorithms, combinatorics, complexity, computational algebra, discrete and computational geometry, discrete optimization and graph theory. The Center will be able to offer a few long-term positions (one to two years) and a number of short-term positions (up to a few months).

A primary activity of the Center is to sponsor year-long research programs on specific topics of current interest. The topic for 1990-91 is Complexity Theory of Interactive Computation. People with research interest in such fields as cryptography, communication complexity, computational learning, computational number theory, and circuit complexity, are particularly encouraged to apply. DIMACS will also sponsor short-term research workshops in these and other areas to which a large number of participants will be invited. In addition, the Center is planning a number of educational activities, including a summer workshop for high school mathematics teachers and a summer workshop for high school students.

Postdoctoral fellows and long-term/short-term visitors will pursue an active research program and participate in the activities of the Center. A few positions will be reserved for faculty members from non-research institutions who might wish to spend all or part of their sabbatical year at DIMACS. Applications from researchers in industry are especially encouraged and will be given special consideration. All applications are due February 1.

Direct inquiries to:

Professor Daniel Gorenstein,
Director
DIMACS
Hill Center for the Mathematical
Sciences
Rutgers University
P.O. Box 1179
Piscataway, NJ 08855-1179
dimacs@math.rutgers.edu

All participating institutions are equal opportunity/affirmative action employers.

DUKE UNIVERSITY
Department of Mathematics

One postdoctoral position in the Duke Center for Non-linear Studies, working with David Schaeffer and a group of scientists and engineers who will be modelling experiments, with emphasis on scientific computations in granular flow. This is a two-year position and carries a teaching load of one course per term. A SUN workstation will be provided.

All candidates should send curriculum vitae, a research plan, and arrange for three letters of recommendation to be sent. Address correspondence to: Faculty Search Committee, Department of Mathematics, Duke University, Durham, NC 27706. Duke University is an affirmative action/equal opportunity employer.

ITHACA COLLEGE

The Department of Mathematics and Computer Science at Ithaca College has at least three tenure eligible positions in mathematics at the Assistant Professor level available for the 1990-91 academic year. All successful candidates will be expected to teach a wide variety of mathematics courses at the undergraduate level. A Ph.D. is required. For one of these positions, specialization in statistics is preferred. Screening begins December 15, 1989. Send vitae to: Dr. Eric Robinson, Chair, Department of Mathematics and Computer Sciences, Ithaca College, Ithaca, New York 14850. An Affirmative Action/Equal Opportunity Employer.

POSITIONS AVAILABLE

POMONA COLLEGE
CLAREMONT, CA 91711

Pomona College invites applications for a tenure track Assistant Professorship in the mathematical sciences beginning in the fall of 1990. The Ph.D. and demonstrated excellence in teaching and research are required. Must have a strong commitment to high quality teaching in a variety of undergraduate courses and contributing to the mathematical life of our department. Preference will be given to strong candidates in statistics and applied mathematics. Pomona College, the founding member of The Claremont Colleges, offers the opportunity to teach intellectually gifted undergraduates in a small liberal arts college while participating in a mathematically active intercollegiate community of over 30 mathematicians, with clinics in applied mathematics and statistics. Submit applications, including resume, transcripts and letters evaluating teaching and research capabilities by January 31, 1990, to The Search Committee, Department of Mathematics, Millikan Laboratory, Pomona College, Claremont, CA 91711-6348. Applicants who will attend the AMS January Meeting in Louisville should so indicate in their application letter prior to January 3. Pomona College is an affirmative action/equal opportunity employer and encourages applications from minority candidates and women.

DAEMEN COLLEGE
Buffalo, New York

The Department of Mathematics invites applications for a tenure-track position in mathematics at the assistant professor level beginning September, 1990. Candidates must have a Ph.D. in mathematics and a strong commitment to teaching. Applications will be accepted until February 15, 1990 or until the position is filled. Spanish speaking desirable. Send a curriculum vitae, three letters of recommendation, and transcripts to: Chairperson, Math. Department, Daemen College, 4380 Main Street, Amherst, NY 14226. Daemen College is an E/O, A/A employer.

RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY
Department of Mathematics
New Brunswick, NJ

anticipates the following open positions beginning September, 1990.

(1) TENURE-TRACK AND TENURE POSITIONS. The Department anticipates several openings. Depending on the qualifications of the applicants, appointments may be as tenure-track assistant professorships or as tenured associate, full, or special professorships. Candidates must have Ph.D., outstanding research ability in pure or applied mathematics and concern for teaching. Normal course load now averages 5 hours. Preference given to applicants working in differential geometry, Lie theory, logic, nonlinear analysis, topology, and ring theory (ideally interacting with algebraic geometry). However, exceptionally strong candidates in all fields are encouraged to apply and will be given careful consideration.

(2) HILL ASSISTANT PROFESSORSHIP. This is a three-year non-renewable position. Candidates should have recently received the Ph.D., show outstanding promise in research ability in pure or applied mathematics, and have concern for teaching. Normal course load approx. 6 hours but one course teaching reduction provided in two of the three years.

(3) LECTURESHIPS. (Assistant Professor level and above). Normal course load approx. 6 hours. Candidates must have Ph.D., show outstanding promise in research ability in pure or applied mathematics and have concern for teaching. These are one or two year non-tenure-track positions.

(4) INSTRUCTORSHIPS. Responsible for teaching mainly at the level of precalculus and below. Normal course load 12 hours. Candidates must have masters degree or equivalent related experience and provide evidence of teaching ability. These are one or two year non-tenure-track positions.

(5) VISITING POSITIONS; part-time and full-time. Normal full-time course load approx. 6 hours. These positions are intended to permit individuals with regular appointments elsewhere to visit Rutgers for the purpose of engaging in joint research with members of the faculty. Candidates must have Ph.D., proven record of outstanding research accomplishments in pure or applied mathematics, and concern for teaching. These are one or two year non-renewable positions.

(6) PART-TIME POSITIONS (all levels). These may be used both for candidates with primary responsibility for teaching and for candidates of outstanding promise for research activity.

Send resume and at least three letters of recommendation to SEARCH COMMITTEE, Department of Mathematics, Rutgers University, New Brunswick, NJ 08903 as soon as possible. Indicate position desired and give # of your area of specialty according to AMS Mathematics Subject Classification. RUTGERS UNIVERSITY IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

UNIVERSITY OF CALIFORNIA
AT RIVERSIDE
Faculty Position in Mathematics

Applications and nominations are invited for a tenured or tenure track position in Analysis beginning July 1, 1990 or later. The position is open as to rank; candidates at all levels and in all areas of analysis will be considered. Demonstrated excellence in research and teaching is required. The eligibility pool for this position will consist of those candidates for whom we receive a vita, a list of publications and three letters of recommendation by January 22, 1990. Established criteria of the University of California determine salary and rank. Candidates should send a curriculum vita, a list of publications and the names of at least three references to

Professor M. M. Rao, Chair
Analysis Hiring Committee
Department of Mathematics and
Computer Science
University of California
Riverside, California 92521

University of California is an Affirmative Action/Equal Opportunity Employer.

POSITIONS AVAILABLE

UNIVERSITY OF CALIFORNIA AT RIVERSIDE
Faculty Position in Mathematics

Applications and nominations are invited for a tenured or tenure track position in Geometric Analysis beginning July 1, 1990 or later. The position is open as to rank; candidates at all levels and in all areas of geometric analysis will be considered. Demonstrated excellence in research and teachng is required. The eligibility pool for this position will consist of those candidates for whom we receive a vita, a list of publications and three letters of recommendation by January 22, 1990. Established criteria of the University of California determine salary and rank. Candidates shouuld send a curriculum vita, a list of publications and the names of at least three references to

Professor Bun Wong, Chair
Geometric Analysis Hiring Committee
Department of Mathematics and Computer Science
University of California
Riverside, California 92521

University of California is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF SOUTH FLORIDA
Department of Mathematics

At least one tenure-track position is available beginning August 1990. Applicants must possess a Ph.D. degree. Applicants specializing in analysis (numerical analysis, approximation theory, special functions); differential equations; probability/mathematical statistics; theory of computation (algebra, combinatorics logic) are preferred but other outstanding candidates will be considered. Rank and salary will depend on credentials. To apply, send curriculum vitae and have three letters of recommendation sent to Kenneth L. Pothoven, Chairman, University of South Florida, Department of Mathematics, Tampa, Florida 33620-5700. Application deadline: February 12, 1990. The University of South Florida is an equal opportunity employer.

UNIVERSITY OF SOUTHERN CALIFORNIA LOS ANGELES, CALIFORNIA 90089-1113

The Division of Natural Sciences and Mathematics at USC has begun a five-year, $50 million Science Initiative. Several tenure-track Assistant Professorships and possible tenured positions at Associate Professor and Professor are anticipated for 1990-91 in Mathematics. Visiting positions (at all levels) and postdoctoral appointments will also be available.

Any research area in pure or applied mathematics or statistics will be considered, including but not restricted to: Algebraic Geometry, Biomathematics, Control Theory, Differential Geometry, Dynamical Systems, Functional Analysis, Group Theory, Number Theory, Numerical Analysis, Ordinary or Partial Differential Equations, Probability, Ring Theory, Statistics, and Topology.

Assistant Professors teach two courses per semester, must show strong research promise, and preferably should work in one of the above areas. Applicants for senior positions must have an outstanding record of research and scholastic achievement. Address inquiries to: Chair of Appointments Committee/Department of Mathematics-DRB 306/Los Angeles, CA 90089-1113. EOE/AA.

UNIVERSITY OF MARYLAND UNIVERSITY COLLEGE TEACH IN ASIA OR EUROPE

The University of Maryland University College seeks excellent teachers for openings on U.S. military bases overseas. Appointments begin August, 1990. Requirements include M.A. or Ph.D., recent college teaching experience, and U.S. citizenship. Competence to teach in another discipline desirable. Benefits include transportation and military base privileges (PX, commissary, etc.). Frequent travel and the cost of schooling make these positions difficult for those with children. Send resume to Dr. Ralph E. Millis, Assistant to the President, Overseas Programs, The University of Maryland University College, College Park, MD 20742-1642. AA/EEO.

UNIVERSITY OF CALIFORNIA MATHEMATICS DEPARTMENT SANTA CRUZ, CA 95064

The Mathematics Department at the University of California, Santa Cruz expects to have several visiting positions available during the academic year 1989-90 and invites applications from qualified mathematicians in all fields. Appointments will be made as Visiting Assistant, Associate or Full Professor, as appropriate. Visitors will be expected to teach, pursue their research, and perform some department or university service. Such positions are available for periods ranging from one quarter to the full academic year, with a possible extension to a second year. There is also a possibility that visitors will be able to stay on to do summer school teaching following the academic year. Preference will be given to those who can teach for the entire academic year. Applicants must hold the Ph.D. in Mathematics. University teaching experience desired. Applicants should send vitae, three letters of reference speaking of the applicant's teaching and research experience to: Recruiting Committee, Mathematics Department, University of California, Santa Cruz, CA 95064. Closing Date: February 1, 1990. Please refer to #T89-14 in your reply. UCSC is a SAA/EOP/IRCA/EOE/AA employer.

THE OHIO STATE UNIVERSITY
Department of Mathematics
Research Instructorships in Mathematics

Applications are invited for the position of research instructor in mathematics for the academic year 1990–91. Candidates should hold a Ph.D. (or equivalent) in mathematics and show strong research promise.

Please send credentials and have letters of recommendation sent to Professor Joseph Ferrar, Department of Mathematics, The Ohio State University, 231 W. 18th Avenue, Columbus, Ohio 43210. The Ohio State University is an Equal Opportunity/Affirmative Action Employer.

POSITIONS AVAILABLE

UNIVERSITY OF SOUTHERN CALIFORNIA
Department of Mathematics
Chairperson

The University of Southern California invites applications and recommendations for the faculty position of Chairperson of the Department of Mathematics (at the rank of Professor). The Department has a faculty of about 45 members, representing many areas in pure and applied mathematics. The Division of Natural Sciences and Mathematics has begun a $50 million Science Initiative, which is expected to increment the Division's annual budget by about $15 million after five years. The opportunities for growth and enhancement of the Department are substantial.

The Department offers PhD and master's degrees in both pure and applied mathematics, and a master's degree in statistics (with a PhD program planned). A new Center for Applied Mathematical Sciences, under the direction of H. T. Banks, has been established, and offers an extensive program of visitors and seminars. The Department also has a large computer-assisted learning center for undergraduates and a statistics laboratory.

Candidates for the position must have an outstanding record of research and scholarship and must be ready to assume the academic leadership and administrative direction of a broadly-based university department which is in the process of expanding. If interested, send a vita and names of references to:

Chair Search Committee
Department of Mathematics
University of Southern California
Los Angeles, CA 90089-1113

USC is an Equal Opportunity/Affirmative Action employer.

WESTERN WASHINGTON UNIVERSITY

Applications are invited for tenure-track and visiting positions to begin Fall 1990. Successful candidates will be expected to be active in research, to interact at the research level with current department members, and to be good teachers. A Ph.D. in Mathematics is required.

Candidates are especially sought in the following two areas, although outstanding candidates with other specialties will be considered: (1) Applied mathematics. (2) Mathematics Education.

Rank and salary are open, but a substantial research record will be required for appointment above the Assistant Professor level. The normal teaching load for research faculty is two courses per quarter.

Western Washington University is located on Bellingham Bay in an area of outstanding natural beauty within an hour's drive of the Seattle and Vancouver, B.C. metropolitan areas and the Cascade Mountains. The department has a strong undergraduate program with a somewhat applied flavor and a flourishing Master's program with more than twenty students.

Applications should be sent to Professor Thomas T. Read, Chairman, Department of Mathematics, Western Washington University, Bellingham, WA 98225.

Interested candidates should submit a letter of application, complete transcripts, a vita, and three letters of recommendation. Deadline for applications is February 1, 1990; later applications will be considered if positions remain available. Positions are subject to the continuing availability of funds. The University is an EO/AA employer.

THE UNIVERSITY OF FLORIDA
Department of Mathematics

In each of the next several years, the Department of Mathematics intends to fill a substantial number of tenure-track faculty positions with mathematicians of exceptional caliber. Outstanding candidates from all academic ranks and all areas of pure and applied mathematics are invited to apply for these positions. Applications from junior candidates with post-doctoral experience are especially welcome.

First preference will be given to candidates who will facilitate Department goals of establishing strong working groups in partial differential equations, algebraic geometry and number theory. Secondary preference will be given to candidates who will fit well into currently functioning groups. In particular, it is likely that one position will be filled this year by an algebraist.

Senior candidates should have distinguished research records, and junior candidates are expected to have made significant research contributions. Every candidate is expected to possess a strong commitment to teaching. Candidates should forward a resume (including a list of publications) and should arrange for at least four letters of recommendation to be sent to:

David A. Drake, Chair
Department of Mathematics
University of Florida
201 Walker Hall
Gainesville, Florida 32611

All applications for the academic year 1990–1991 should be complete by December 31, 1989. The University of Florida is an equal opportunity employer and energetically solicits applications from women and minority candidates.

POSITIONS AVAILABLE

SOUTHERN METHODIST UNIVERSITY
Department of Mathematics
Junior Tenure-Track Positions

The Department of Mathematics at Southern Methodist University seeks applications for junior tenure-track positions with employment beginning Fall 1990. An outstanding candidate may be considered for a more senior position. Candidates should be active researchers in applied or numerical mathematics and should have a strong commitment to teaching. The department has an active doctoral program. Applicants must be able to teach graduate level courses in applied mathematics, numerical analysis or scientific computation. The teaching load for each position is two courses (six hours) per semester. There may also be visiting positions available in academic year 1990-91.

Southern Methodist University has about 8000 students. The Department of Mathematics has a strong and ongoing commitment to the development of classical and modern applied mathematics. Thirteen of the sixteen full-time faculty are applied or numerical mathematicians. Current areas of research include mathematical modeling of physical and biological phenomena, nonlinear waves, perturbation methods, fluid dyamics, numerical bifurcation, mathematical software, numerical solution of differential equations, and parallel computation. Candidates should be active in one of these areas or a related one. Senior faculty and their interests include D. H. Anderson (mathematical biology), W. E. Ferguson (numerical partial differential equations), I. Gladwell (mathematical software), R. Haberman (nonlinear waves), G. W. Reddien (bifurcation theory), D. A. Reinelt (fluid dynamics) and L. F. Shampine (numerical ordinary differential equations). Among its computers, the university has a Sequent Symmetry for research use.

Applications must be received by January 10, 1990. Please send a vita and three letters of recommendation to: Professor I. Gladwell, Chair, Department of Mathematics, Southern Methodist University, Dallas, Texas 75275 (Tel: (214) 692-2506, FAX: (214) 692-4099) who may also be contacted with any questions concerning the positions.

I. Gladwell's email addresses are:
na.gladwell@na-net.stanford.edu
h5nr1001@smuvm1 (on bitnet)

SMU is an equal opportunity/affirmative action/Title IX employer.

INDIANA STATE UNIVERSITY
CHAIRPERSON
DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

The Department of Mathematics and Computer Science, Indiana State University, invites applications for the position of Chairperson. Applicants should have a doctorate in Mathematics or Computer Science, a record of successful teaching and research, and a commitment to promoting research, teaching, and other scholarly activities. In addition applicants should have a potential for administering a department with both Mathematics and Computer Science degree programs. The Computer Science area is undergoing active development, so familiarity with Computer Science curricular issues is desirable.

The Department offers BS and BA degrees in Mathematics and Computer Science. It also offers MS and MA degrees in Mathematics and it is developing an MS degree in Computer Science. There are 25 faculty positions. The Department has an 8 processor Sequent and a VAX minicomputer and a microcomputer laboratory.

Salary and rank are commensurate with qualifications and experience. Please send a letter of application, vita and three letters of recommendation to:

Dr. David Hutchison, Chairperson
Search Committee
Department of Mathematics and Computer Science
Indiana State University
Terre Haute, IN 47809

Applications received after February 1, 1990 cannot be guaranteed consideration. Proof of U.S. citizenship or eligibility for U.S. employment will be required prior to employment (Immigration Reform and Control Act of 1986). Indiana State University is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF UTAH
Department of Mathematics
invites applications for the following positions:

1. At least four full time tenure track appointments on any of the professorial levels. The Department is particularly interested in applicants who work in the areas of geometry, algebra, topology, group representation theory, applied mathematics, and scientific computing. Selection will be based on research expertise and teaching ability. Applications will be accepted until January 31, 1990 or until the positions are filled.

2. Two or more nonrenewable three-year Instructorships. Persons of any age receiving Ph.D. degrees in 1989 or 1990 are eligible. Applicants will be selected on the basis of ability and potential in teaching and research. Starting salary this academic year is $29,500; cost of living increases are contingent on action by the State Legislature. Duties consist of teaching five courses during the three quarter academic year. Applications will be accepted until December 31, 1989 or until the positions are filled.

3. One or more visiting positions of one year or less. Selection criteria are teaching ability and potential contribution to our research environment. Applications will be accepted until January 31, 1990 or until the positions are filled.

Applications must include curriculum vitae, bibliography and three letters of reference. (Instructorship applications must also include an abstract of the thesis and either a list of graduate courses completed or a transcript of graduate work.)

Please send your application to:

COMMITTEE ON STAFFING
DEPARTMENT OF MATHEMATICS
UNIVERSITY OF UTAH
233 JWB
SALT LAKE CITY, UTAH 84112

The University of Utah is an equal opportunity-affirmative action employer.

POSITIONS AVAILABLE

UNIVERSITY OF CALIFORNIA DAVIS FACULTY POSITION IN STATISTICS

The Division of Statistics and the Department of Mathematics, University of California, Davis, invite applications and nominations for a position beginning Fall 1990. Appointment to be made at rank and salary commensurate with qualifications. Duties include teaching at all levels and research. Applicants should have a distinguished research record in probability theory/applied probability/stochastic processes, strong interest in mathematical statistics, and a record of excellence in teaching.

The Division of Statistics functions as a department with additional intercollege status and scope. The Graduate Group in Statistics brings together the faculty of the Division and faculty from other disciplines who have a strong interest in statistical applications. The Statistical Laboratory, also a component of the Division, provides campus-wide consultation and affords an opportunity for graduate students to gain practical experience. The Department of Mathematics includes faculty in both pure and applied mathematics engaged in numerous areas of interdisciplinary research activity. In addition to the departmental graduate program, the Graduate Group in Applied Mathematics is also housed in the department. This graduate group brings together faculty in Mathematics and faculty from other disciplines who have strong interests in all areas of applied Mathematics. Mathematics and Statistics offer full academic programs leading to the BA, BS, MS, and Ph.D. degrees.

The city of Davis is an energy-conscious and progressive city located in Northern California's Central Valley. It lies within twenty minutes of the state capital, Sacramento, and within ninety minutes of the San Francisco Bay Area. Davis residents are ideally located for participating in the recreational opportunities of Lake Tahoe, the Napa Valley, and the coastline of Northern California.

The postmarked deadline for applications is January 11, 1990. An application consists of a vitae and three letters of recommendation to be sent to:

Joint Search Committee
Division of Statistics
University of California
Davis, CA 95616

The University of California, in compliance with the Civil Rights Acts of 1964, Title IX of the Education Amendments of 1972 (45 CFR 86), the Rehabilitation Act of 1973, and the Age Discrimination in Employment Act of 1967, does not discriminate on the basis of age, race, color, national origins, religion, sex, or handicap in any of its policies, procedures, or practices; nor does the University discriminate against any employees or applicants for employment because they are disabled veterans or veterans of the Vietnam era. This anti-discrimination policy covers admission and access to, and the treatment and employment in University programs and activities. Inquiries regarding the University's equal opportunity policies may be directed to Vice Chancellor-Academic Affairs, U.C. Davis.

EASTERN ILLINOIS UNIVERSITY Chairperson

EASTERN ILLINOIS UNIVERSITY invites applications for Chairperson of the Department of Mathematics. Requirements include a doctorate in a mathematical science and experience in teaching and research; administrative experience is preferred. EIU is a residential university of 10,000 students located in east central Illinois. The Department of Mathematics, with 28 regular faculty members, offers Bachelors and Masters degrees in Mathematics and Mathematics Education, and Bachelors degrees in applied Computer Science.

Send applications with transcripts, vita, three letters of reference, and a brief statement of educational and administrative philosophy to Jon Laible, Dean, College of Liberal Arts and Sciences, Eastern Illinois University, Charleston, IL 61920. The closing date is January 1, 1990 or when the position is filled. EIU is an affirmative action, equal opportunity employer.

UNIVERSITY OF WISCONSIN-MADISON Department of Mathematics Employment Opportunities

The Department of Mathematics at the University of Wisconsin-Madison solicits applications for the following positions to begin fall 1990.

Tenure and Tenure Track Positions. Appointments will be made at the Assistant Professor level unless qualifications and experience require appointment at higher rank. Deadline for applications is November 30, 1989.

Van Vleck Assistant Professorships. Appointments are for a specified term of three years at an academic year salary of at least $31,500. The usual teaching load is two courses per semester. Ordinarily only those applicants who have received their doctorate since 1987 and prior to September 1990 will be considered. Preference will be given to candidates who are likely to interact well with other members of the Department. Deadline for applications is December 31, 1989.

Candidates should provide clear evidence of teaching ability and excellence in mathematical research. Supporting materials should include a vita, and three or four recommendation letters, at least one of which discusses, in detail, the candidate's teaching qualification. Van Vleck applicants are also required to submit a one to three page abstract of their dissertation.

Application forms are available from the Hiring Committee, Department of Mathematics, 223 Van Vleck Hall, 480 Lincoln Drive, Madison, WI, 53706. Applications will be accepted for all positions until they are filled; however, in order to ensure full consideration, the application and all supporting materials should be received by the above deadlines. The University of Wisconsin is an AA/EOE employer.

The Immigration Reform and Control Act of 1986 requires the University to verify the identity and work authorization of the successful applicant. Offer of employment is contingent upon verification.

POSITIONS AVAILABLE

UNIVERSITY OF IOWA

The Mathematics Department of the University of Iowa invites applications for the following positions:

1. Three tenure-track appointments at the Assistant or beginning Associate Professor level beginning in the 1990-91 academic year. One of these is to be in numerical analysis and two are to be filled by specialists in harmonic analysis, probability theory, or topology of manifolds. Selection will be based on evidence of outstanding research accomplishments or potential, and teaching ability. A Ph.D. or equivalent training is required.

2. One senior faculty position beginning in 1990-91 academic year or later. Only applicants of extraordinary stature will be considered. A strong record of leadership in teaching and research in one of the department's current or developing areas of strength is required.

3. Pending availability of funds, one or more visiting positions for all or part of the 1990-91 academic year. Selection will be based on research expertise and teaching ability. Preference will be given to applicants whose scholarly activity is of particular interest to members of the current faculty.

Women and minority candidates are especially urged to apply for any of the above positions. The University of Iowa welcomes the employment of highly qualified professional couples on its faculty and staff, permits the appointment of faculty couples within the same department, and permits the sharing of a single appointment by a faculty couple.

Applications will be received until January 31, 1990, or until the positions are filled. To apply send a complete vita and have three letters of recommendation sent to:

Professor W. A. Kirk, Chair
Department of Mathematics
University of Iowa
Iowa City, Iowa 52242

The University of Iowa is an Equal Opportunity/Affirmative Action Employer.

KENT STATE UNIVERSITY
Department of Mathematical Sciences
Senior Position in Applied Mathematics/Scientific Computation

Applications are invited for a faculty position at the associate or full professor level beginning Fall Semester 1990. The ideal candidate would have a strong training in classical applied mathematics and some experience with large-scale scientific computation. He or she would be expected to have a solid record of research, publication, and external funding, as well as a commitment to quality teaching. The appointed faculty member would be expected to enhance the Department's outreach and interdisciplinary research efforts, supervise graduate students, and contribute to curricular planning and development. A competitive salary is available.

The Department of Mathematical Science at Kent State University comprises pure and applied mathematics, statistics, computer science, and the Institute for Computational Mathematics. This new position is intended to complement existing strengths in applied analysis (especially numerical analysis and approximation theory) and computer science (especially symbolic computation, expert systems, and parallel computing).

The infrastructure of the Department is very good: the equipment inventory includes 2 VAX mini-computers plus Encore, Sequent, Staran, and Warp parallel-processing computers and a variety of work-stations and peripherals. The University also maintains an IBM 3090 mainframe and a high-performance (interactive) link to the Cray Y-MP/864 at the Ohio Supercomputer Center in Columbus, on which computing time is readily available.

Kent State University is attractively set in the rolling hills of northeast Ohio 40 minutes southeast of Cleveland and 20 minutes east of Akron. Some of the main research centers in the area include the University's internationally known Glenn H. Brown Liquid Crystal Institute, NASA Lewis Reseach Center in Cleveland, and Loral Systems (formerly Goodyear Aerospace) in Akron.

Application deadline is February 24, 1990. If qualified individuals do not apply by February 24, 1990, the deadline will be extended until the position is filled or until August 18, 1990, whichever occurs first. Applicants should submit a resume and arrange to have three letters of recommendation sent to Chuck Gartland, Chair of the Applied Mathematics Search Committee, Department of Mathematical Sciences, Kent State University, Kent, OH 44242. Kent State University is an Affirmative Action/Equal Opportunity Employer.

NORTHERN ARIZONA UNIVERSITY
Flagstaff, Arizona

The Department of Mathematics announces tenure-track openings in mathematics for Fall 1990.

The first is an Associate Professorship in dynamical systems, in particular, qualitative theory of differential equations. A sustained, high quality research program is required. Assistant professor appointments in the area are also anticipated as we develop an existing strength into a clear focus. Related research of the department concentrates mainly but not exclusively on planar systems with polynomial right-hand sides.

Also open is an assistant professorship in algebra or combinatorics, especially combinatorial areas of algebra or geometry.

Each requires a PhD, demonstrated potential for a productive, quality research program, and substantial evidence of quality teaching.

Flagstaff is located in the cool pine forests of Northern Arizona, near high mountains, the Grand Canyon and numerous other natural attractions. NAU has an on-campus enrollement of approximately 14,000. The Department of 34 faculty offers bachelor's and master's degree programs.

Send vita and direct three letters of reference to: Screening Committee, Department of Mathematics, PO Box 5717, Northern Arizona University, Flagstaff, AZ 86011. The searches will remain open until the positions are filled; however, the Screening Committee will begin reviewing applications on December 1, 1989. Northern Arizona University is an Equal Opportunity/Affirmative Action Institution. Women and minorities are encouraged to apply.

POSITIONS AVAILABLE

CARNEGIE MELLON UNIVERSITY
A Zeev Nehari Assistant Professorship in Mathematics

The Zeev Nehari Assistant Professorships have been instituted in the Department of Mathematics of Carnegie Mellon University to honor the memory of Professor Zeev Nehari, a member of the Department from 1954 to his death in 1978. The position available is for an initial period of one or two academic years, beginning in September 1990, and extendable for one additional year when mutually agreeable. It carries a reduced academic year teaching load of six hours per week during one semester and three hours per week during the other. Applicants are expected to show exceptional research promise, as well as clear evidence of achievement and should have research interests which intersect those of current faculty of the Department. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have at least three letters of recommendation sent to the committee. Applications also should include at most three two-digit mathematics subject classification numbers (as displayed in *Mathematical Reviews*) corresponding to the primary area(s) of research of the applicant. All communications should be addressed to: Zeev Nehari Assistant Professorship Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon University is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF COLORADO AT BOULDER
FACULTY APPOINTMENTS
PROGRAM IN APPLIED MATHEMATICS

The University of Colorado at Boulder has made a substantial commitment to building a preeminent program in applied mathematics. The program fosters interdisciplinary activities and exciting opportunities exist for interaction with various centers and institutes in the area.

A number of faculty appointments are anticipated over the next few years. Preference will be given to candidates at the Assistant Professor level with a research emphasis in the area of computational mathematics. Exceptionally strong candidates at other levels will be considered. Other areas of foci in the program are nonlinear phenomena and physical applied mathematics, especially fluids and plasmas.

Applicants are invited for tenure track positions with appointments beginning fall, 1990.

The University of Colorado has a strong institutional commitment to the principle of diversity in all areas. In that spirit we are particularly interested in receiving applications from a broad spectrum of scholars including women, members of ethnic minorities and disabled individuals.

Applicants should send a current curriculum vitae and selected reprints to Professor Mark J. Ablowitz, Director, Program in Applied Mathematics, Campus Box 426, University of Colorado, Boulder, CO 80309-0426. Applications are due by February 1, 1990. Late applications will be considered for any positions remaining unfilled on April 15, 1990. EOE/AA.

UNIVERSITY OF COLORADO AT BOULDER
INSTRUCTORS-VISITING ASSISTANT PROFESSORS
PROGRAM IN APPLIED MATHEMATICS

The University of Colorado at Boulder has made a substantial commitment to building a preeminent program in applied mathematics. The program fosters interdisciplinary activities and exciting opportunities exist for interaction with various centers.

Applications are invited for instructors or visiting assistant professor positions beginning in the fall of 1990. Preference will be given to candidates with a research emphasis in any of the following three areas: computational mathematics, physical applied mathematics, especially fluids and plasmas, or nonlinear phenomena.

The Program, an interdisciplinary effort, includes faculty in computer science, engineering, mathematics, astrophysical sciences as well as other departments, institutes and centers.

The University of Colorado has a strong institutional commitment to the principle of diversity in all areas. In that spirit we are particularly interested in receiving applications from a broad spectrum of scholars including women, members of ethnic minorities and disabled individuals.

Applicants should send a current curriculum vitae, reprints, and three letters of recommendation to Professor Mark J. Ablowitz, Director, Program in Applied Mathematics, Campus Box 426, University of Colorado, Boulder, CO 80309-0426. Applications are due February 1, 1990. Applications for positions remaining unfilled will be considered until April 15, 1990. EOE/AA.

POSITIONS AVAILABLE

UNIVERSITY OF SOUTH ALABAMA DEPARTMENT OF MATHEMATICS AND STATISTICS

Two tenure-track positions starting September 1, 1990. Appointment will be made at the Assistant Professor or possibly Associate Professor level. Applicants must have a Ph.D. in Mathematics (earned or anticipated by 9/1/90). Strong research potential and a commitment to excellence in teaching are required. The successful candidate for appointment as Associate Professor must also demonstrate significant research accomplishments. Preference will be given to areas complementing existing research specialities. Salaries will be competitive. Applications will be accepted until positions are filled, but should be completed by 1/31/90 to ensure consideration. Please send detailed resume and arrange to have three letters of recommendation sent to Dr. Suzanne McGill, Chair; Department of Mathematics/Stat; University of South Alabama; Mobile, AL 36688. An Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF NORTH CAROLINA AT CHARLOTTE DEPARTMENT OF MATHEMATICS, CHARLOTTE, NC 28223

Two tenure-track and one or more Visiting positions at Asst/Assoc/Full Prof. level in Mathematics and Statistics, and one senior Assoc/Full Prof. level in Math Education. Rank and salary depend on qualifications. A PH.D and a serious commitment to teaching and research are required. Preferred specialties are: Algebra, Analysis, Applied Mathematics, Math Education, Statistics, but strong candidates in all areas are encouraged to apply. Also possible are lecturer positions (one or two year renewable; MA/MS required). Send vitae, list of four references, and abstracts of current research to Prof. Hae-Soo Oh at the above address. Closing date: Feb. 2, 1990, but applications will be considered until the positions are filled.

UNCC IS AN AFFIRMATIVE ACTION/ EQUAL OPPORTUNITY EMPLOYER

OKLAHOMA STATE UNIVERSITY DEPARTENT OF MATHEMATICS

Several tenured, tenure-track and visiting positions at all professorial ranks are anticipated for Fall, 1990. All areas are under consideration, but we especially encourage applications in Differential Geometry, Partial Differential Equations, Probability, Algebraic Geometry, Topology, Several Complex Variables, Harmonic Analysis, and Applied Math. Normal duties include research and at most six hours teaching per semester. Minimum qualifications are a Ph.D. in Mathematics or a related field, evidence of research achievement or potential, and a commitment to teaching. Postdoctoral experience is desirable, but not essential. For full consideration, send a resume and arrange to have three confidential letters of reference sent by January 15, 1990 to J. Cogdell, Appointments Committee Chairman, Department of Mathematics, Oklahoma State University, Stillwater, OK 74078-0613. O.S.U. is an equal opportunity/affirmative action employer. Women and minorities are especially encouraged to apply.

PORTLAND STATE UNIVERSITY

The Department of Mathematical Sciences invites applications for one or more tenure track positions at the assistant professor rank beginning Fall 1990. Applicants should hold a PhD degree (or equivalent) in mathematics or statistics and have demonstrated both a strong research potential and a strong commitment to teaching. Send a vita and have at least three letters of recommendation sent to:

Bruce A. Jensen
Department of Mathematical Sciences
Portland State University
PO Box 751
Portland, OR 97207

Screening of applications will begin on February 1, but applications will be accepted until the positions are filled. Portland State University is an equal opportunity/affirmative action employer. Minorities, women and other protected groups are encouraged to apply.

SOUTHEASTERN MASSACHUSETTS UNIVERSITY VACANCY

Two Full-time faculty positions in the Department of Mathematics beginning September, 1990

Earned doctorate and excellence in teaching required. Research potential/ experience is expected. The selected candidate will join an established program with traditional and computer-oriented degrees and will have the opportunity to participate in the development of mathematics courses for growing undergraduate and graduate programs in the Department of Mathematics and in the Department of Computer and Information Sciences.

Application deadline: **January 15, 1990.** Applications, including resume, transcript, and **three letters of reference** should be sent to:

Rufus A. Winsor, Chairperson
Department of Mathematics
Southeastern Massachusetts University
North Dartmouth, MA 02747

SMU IS AN EO/AA EMPLOYER.

BRADLEY UNIVERSITY
Department of Mathematics

Applications are invited for an entry level tenure-track position at the rank of Assistant Professor beginning August, 1990. Candidates should have a strong commitment to undergraduate teaching. The Ph.D. is required, and continuing professional growth (publication) is necessary for tenure and advancement. Applicants from all areas are invited. Special consideration will be given to those in the fields of statistics, mathematical modeling, discrete mathematics, and geometry. Salary is competitive. The closing date is January 12, 1990, or until the position is filled. Other positions may become available at a later date. Send letter of application, vita, and three or more letters of recommendation to: Dr. T. V. Sastry, Search Committee, Department of Mathematics, Bradley University, Peoria, IL 61625. Bradley University is an AA/EO employer. Women and minorities are encouraged to apply.

POSITIONS AVAILABLE

CARNEGIE MELLON UNIVERSITY
Richard J. Duffin
Assistant Professorship in Mathematics

On the occasion of his 80th birthday, the Department of Mathematics at Carnegie Mellon University is pleased to announce the inauguration of the

RICHARD J DUFFIN
ASSISTANT PROFESSORSHIP

The position is available for an initial period of one or two academic years, and is extendable for one additional year when mutually agreeable. The first appointment is available in September 1990. It carries a reduced academic year teaching load of six hours per week during one semester and three hours per week during the other. Applicants are expected to show exceptional research promise, as well as clear evidence of achievement and should have research interests which intersect those of current faculty of the Department. Applicants should send a vita, list of publications, and a statement describing current and planned research, and arrange to have at least three letters of recommendation sent to the committee. Applications should also include at most three two-digit mathematics subject classification numbers (as displayed in *Mathematical Reviews*) corresponding to the primary area(s) of research of the applicant. All communications should be addressed to: Richard J. Duffin Assistant Professorship Committee, Department of Mathematics, Carnegie Mellon University, Pittsburgh, PA 15213. Carnegie Mellon is an Affirmative Action/Equal Opportunity Employer.

SOUTHERN COLLEGE OF TECHNOLOGY

MATHEMATICS–The Mathematics Department of the Southern College of Technology seeks applicants for one or more tenure-track positions at the rank of Assistant or Associate Professor. The Department desires faculty who can contribute to upper division programs in Mathematics. Ph.D. in mathematics or mathematical statistics required. Research potential is desirable but is neither required nor heavily weighed.

The ideal candidate will show a strong mastery of the discipline, a commitment to professional growth and development, an ability for and commitment to excellence in teaching, and the potential and desire to enhance the college's intellectual community.

The Mathematics Department has fourteen tenure-track positions. There is a minor in mathematics as well as a substantial load of service courses. The college is located in Marietta, Ga.

A complete application consists of a letter of application, a curriculum vitae, transcripts of all college work, and a minimum of two lettrs of reference. The search will continue until the position is filled, but applications received by February 1 will be considered first.

Applications and inquiries should be addressed to:

Dr. James C. Kropa
Mathematics Department
Southern College of Technology
Marietta, Georgia 30060-2896

Southern College of Technology is an equal opportunity/affirmative action employer.

OAKLAND UNIVERSITY
Department of Mathematical Sciences
Applied Statistics Position

The Department of Mathematical Sciences at Oakland University seeks applications for a tenure-track position at the Assistant or Associate Professor level in applied statistics commencing August 15, 1990.

The position involves teaching, research and consulting in a program that interacts heavily with the auto-industry in the Detroit area. Through programs with Ford Motor Company and General Motors courses are taught at industrial sites. The position requires participation in these programs. Preference will be given to those applicants whose research interests overlap with quality and productivity issues in the auto-industry. Strengths especially important are reliability methods, warranty forecasting, time series methodology, robust procedures and design of experiments.

Minimal qualifications are a Ph.D. in Statistics, evidence of research achievement or research potential and a commitment to effective teaching. Successful applicants at the associate professor level must demonstrate maturity as a research scholar, a record of versatile and effective teaching and experience and commitment to statistical consulting.

For full consideration, send a resume and arrange to have three confidential letters of reference sent by January 15, 1990 to

Alphonse Baartmans, Chair
Department of Mathematical Sciences
Oakland University
Rochester, MI 48309-4401

Oakland University is an equal opportunity/affirmative action employer. Women and minorities are especially encouraged to apply.

POSITIONS AVAILABLE

HEAD, DEPARTMENT OF MATHEMATICS THE UNIVERSITY OF TENNESSEE-KNOXVILLE

Nominations and applications are invited for the position of department head in Mathematics. Candidates must possess an earned doctorate, a substantial record of research achievement, a commitment to excellence in research and teaching, a demonstrated capacity for leadership and administration, and an understanding of and commitment to equal employment opportunity and affirmative action.

The University of Tennessee at Knoxville, with an enrollment of 25,000, is the primary campus of the state university and a land grant institution. The department, with 46 full time faculty and 65 graduate students, offers advanced degrees in many areas of pure and applied mathematics. Its research activities are supported by an active visitors program, center-of-excellence funds from the state of Tennessee, and interactions with Oak Ridge National Laboratory.

Applications will be reviewed beginning Jan. 1, 1990; the desired starting date is August, 1990. Salary will be commensurate with qualifications. Candidates should provide a vita and four letters of recommendation. Inquiries, applications, and letters of recommendation should be sent to Professor Kenneth Stephenson, Secretary, Mathematics Search Committee, 121 Ayres Hall, The University of Tennessee, Knoxville, TN, 37996-1300 (615) 974-4261.

UTK is an EEO/AA/Title IX/Section 504 Employer.

UNIVERSITY OF CALIFORNIA LOS ANGELES Department of Mathematics

REGULAR POSITIONS IN PURE AND APPLIED MATHEMATICS

Four to six regular positions in pure and applied mathematics. Areas of specific interest include logic; algebra, algebraic geometry, number theory and combinatorics; geometry and topology; analysis, functional analysis, mathematical physics and dynamical systems; probability, statistics and game theory; linear and non-linear differential equations; applied mathematics, numerical analysis and mathematical computer science. Very strong promise in research and teaching required. Positions initially budgeted at the assistant professor level. Sufficiently outstanding candidates at higher levels will also be considered. Teaching load: Averaging 1.5 courses per Quarter, or 4.5 Quarter courses per year.

To apply, write to Alfred W. Hales, Chair, Department of Mathematics, University of California, Los Angeles, CA 90024-1555. Attn: Staff Search.

UCLA is an equal opportunity/ affirmative action employer.

COLLEGE OF STATEN ISLAND (CUNY) Department of Mathematics

A tenure-track position in mathematics is available for Fall 1990. Requirements: Ph.D., strong commitment to teaching; published research beyond the Ph.D. All mathematics research areas will be considered with special preference given to probability and statistics. Rank and salary commensurate with qualifications. The College of Staten Island is a senior college in CUNY. Send resume and three letters of reference to: Dr. Jane Coffee, Mathematics Department, College of Staten Island, 130 Stuyvesant Place, Staten Island, N.Y. 10301 by January 31, 1990. AA/EOE Employer.

QUEEN'S UNIVERSITY AT KINGSTON DEPARTMENT OF MATHEMATICS AND STATISTICS

Applications are invited for a renewable (tenure track) position at the assistant professor level beginning July 1990. Candidates are sought with demonstrated potential in research and undergraduate teaching.

The Department is especially interested in candidates whose area of research is in statistics, or applied numerical analysis or other applied mathematics. Candidates with research interests in other areas, which would make interaction with current members of the Department likely, may also be considered.

A substantial portion of the Department's undergraduate teaching is to engineering students. Candidates are requested to provide evidence in their applications which indicates their potential or proven ability for effective teaching in this area.

Salary is negotiable-the present assistant professor base salary is $32,375 per annum.

Those interested are requested to send their curriculum vitae and arrange for letters of recommendation from three or more referees to be sent to the address below by January 31, 1990. At least one letter should comment on the candidate's teaching ability.

Professor Joan M. Geramita
Chair, Appointments Committee
Mathematics & Statistics Department
Queen's University
Kingston, Ontario K7L 3N6

In accordance with Canadian Immigration requirements, this advertisement is directed to Canadian citizens and permanent residents. Candidates of either sex are equally encouraged to apply. Queen's University is willing to help the spouse of a new appointee to seek suitable employment.

POSITIONS AVAILABLE

OAKLAND UNIVERSITY
Department of Mathematical Sciences
Continuous Applied Mathematics Position

The Department of Mathematical Sciences at Oakland University seeks applications for a tenure-track position at the Assistant or Associate Professor level in applied mathematics commencing August 15, 1990.

All fields of applied mathematics will be considered, but preference will be given to candidates in P.D.E., control theory, optimization, numerical analysis, and mathematical modeling.

Minimal qualifications are a Ph.D. in Mathematics, evidence of research achievement or research potential and a commitment to effective teaching. Appointments at the Associate level require a proven record of research achievements, and a record of versatile and effective teaching.

For full consideration, send a resume and arrange to have three confidential letters of reference sent by January 15, 1990 to

Alphonse Baartmans, Chair
Department of Mathematical Sciences
Oakland University
Rochester, MI 48309-4401

Oakland University is an equal opportunity/affirmative action employer. Women and minorities are especially encouraged to apply.

OAKLAND UNIVERSITY
Department of Mathematical Sciences
Applied Discrete Mathematics Position

The Department of Mathematical Sciences at Oakland University seeks applications for a tenure-track position at the Assistant or Associate Professor level in applied discrete mathematics commencing August 15, 1990.

All fields of discrete mathematics will be considered. Preference will be given to candidates who have interest and/or experience in directing students to solve industrial problems through mathematical modeling with applied discrete mathematics.

Minimal qualifications are a Ph.D. in Mathematics, evidence of research achievement or research potential and a commitment to effective teaching. Appointments at the Associate Professor level require a proven record of research achievements, and a record of versatile and effective teaching.

For full consideration, send a resume and arrange to have three confidential letters of reference sent by January 15, 1990 to

Alphonse Baartmans, Chair
Department of Mathematical Sciences
Oakland University
Rochester, MI 48309-4401

Oakland University is an equal opportunity/affirmative action employer. Women and minorities are especially encouraged to apply.

DARTMOUTH COLLEGE
John Wesley Young Research Instructorship

The John Wesley Young Research Instructorship is a two year post-doctoral appointment for promising new or recent PhD's whose research interests overlap a department member's. Current departmental interests include areas in algebra, analysis, algebraic geometry, combinatorics, computer science, differential geometry, logic and set theory, number theory, probability and topology. Teaching duties of four ten-week courses spread over two or three quarters typically include at least one course in the instructor's specialty and include elementary, advanced and (at instructor's opinion) graduate courses. Nine-month salary of $31,000 supplemented by summer (resident) research stipend of $6,889 (two-ninths). Send letter of application, resume, graduate transcript, thesis abstract, description of other research activities and interests if appropriate, and 3 or preferably 4 letters of recommendation (at least one should discuss teaching) to Richard E. Williamson (Recruiting), Department of Math and CS, Bradley Hall, Hanover, NH, 03755. Applications received by Jan. 15 receive first consideration; applications will be accepted until position is filled. Dartmouth College is committed to affirmative action and strongly encourages applications from minorities and women. EOE/AA.

NORTH CAROLINA STATE UNIVERSITY
Department of Mathematics

A junior-level tenure-track position in probability and stochastic processes will become available July 1, 1990. Requirements include records in or strong potential for research and instruction. To apply, send resume, any reprints or preprints, and thesis abstract, and arrange to have three letters of reference sent to: J. W. Bishir, Department of Mathematics, Box 8205, North Carolina State University, Raleigh, NC 27695-8205. AA/EOE. Applications from women and minorities are especially encouraged.

UNIVERSITY OF ARIZONA
DEPARTMENT OF MATHEMATICS
TUCSON, ARIZONA 85721

The Mathematics Department at the University of Arizona will have several visiting positions for next year. Applications received by February 1, 1990 will be considered first, if suitable candidates are not found then late applications will be reviewed. Send applications (please include Social Security number if possible) to Department Head, Department of Mathematics. The University of Arizona is an Equal Opportunity/Affirmative Action Employer.

GEORGIA INSTITUTE OF TECHNOLOGY

The School of Mathematics expects to have some visiting and tenure-track positions at various levels beginning in Fall 1990. Candidates with strong research and teaching records or potential should send a resume, at least three letters of reference, and a summary of future research plans to The Hiring Committee, School of Mathematics, Georgia Institute of Technology, Atlanta, Georgia 30332-0160. Georgia Tech, a member of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

POSITIONS AVAILABLE

HOBART AND WILLIAM SMITH COLLEGES
Department of Mathematics and Computer Science

Assistant Professor, tenure track position starting in September *1990*. Salary is competitive. Applicants should have a Ph.D. in computer science or a Ph.D. in mathematics and experience in computer science. Duties include teaching undergraduate computer science, teaching some mathematics (depending on interests and qualifications), and participating in the Colleges' Interdisciplinary General Curriculum. A strong commitment to teaching and promise of continued scholarly activity required. Teaching load: two courses per trimester. Hobart and William Smith are coordinate, four year, liberal arts colleges, committed to teaching and interdisciplinary study with a combined enrollment of 1900 students. Within an hour's drive are three major universities: Cornell, Rochester, and Syracuse.

Send detailed resume, three letters of recommendation (at least one including comments on teaching), and undergraduate and graduate transcripts (photocopies acceptable) to: Prof. David Eck, Department of Mathematics and Computer Science, Hobart and William Smith Colleges, Geneva, NY 14456. Evaluation of applications will begin January 15, 1990 and will continue until the position is filled. Women and minorities are encouraged to apply. An Equal Opportunity/Affirmative Action Employer.

BOSTON UNIVERSITY DEPARTMENT OF MATHEMATICS

The Department anticipates two positions in pure mathematics for Fall 1990. One at the Full or Associate Professor level. The other level depending on candidates. Record of distinguished achievements in research and commitment to excellence in teaching required. Preference will be given to candidates in Number Theory and/or Algebraic Geometry. Send applications to: Search Committee, Department of Mathematics, 111 Cummington St., Boston, MA 02215. AA/EOE.

TRINITY UNIVERSITY
Position Announcement

Trinity University invites applications and nominations for a tenure-track position in mathematics, appointment beginning August, 1990. The appointment will be made at the rank of Assistant Professor. Responsibilities include teaching nine credit hours per semester, continuing scholarly activity, assisting in curriculum development, advising, and committee service. Minimum qualifications are the Ph.D. in Mathematics with excellence in and strong commitment to teaching.

Founded in 1869, Trinity University occupies a modern campus overlooking the San Antonio skyline. Purposely small and selective, with about 2500 students, Trinity stresses a high quality, undergraduate liberal arts and science program; in particular, the Mathematics Department does not offer graduate courses. San Antonio is a city of approximately 850,000 people situated in a metropolitan area of 1.2 million.

Closing date for applications is December 29, 1989. Send vita, graduate transcripts and three letters of reference to:

Professor William F. Trench
Department of Mathematics
Trinity University
715 Stadium Drive
San Antonio, Texas 78212

Trinity University is an equal opportunity affirmative action employer.

UNIVERSITY OF GEORGIA
Department of Mathematics
Athens, GA 30602

The department may have some tenure track positions available for the 1990–91 academic year at the assistant and associate professor levels. The rank and salary will be commensurate with the applicant's abilities and experience. The principle requirement is excellence in teaching and research. Some preference will be given to areas in which the department is already well represented. Send curriculum vitae and four letters of recommendation to Richard A. Bouldin Head (address above) by January 15, 1990. UGA is an Equal Opportunity/Affirmative Action Employer.

GMI ENGINEERING & MANAGEMENT INSTITUTE FACULTY POSITION IN MATHEMATICS

The Science and Mathematics Department of GMI Engineering & Management Institute is seeking to fill a tenure-track position in mathematics at the level of Assistant Professor. Outstanding candidates may be considered for appointment at the rank of Associate Professor or the rank of tenured, Full Professor.

GMI is a highly competitive private college whose academic year starts July 1. The Mathematics faculty consists of 14 full-time members, who offer a wide range of undergraduate courses. The feasibility of initiating a degree program in mathematics or computer science is currently under investigation.

The minimum requirements for this position include an earned Ph.D. in mathematics or a related field and evidence of strong research and undergraduate teaching abilities. Areas of expertise of special interest include mathematics applied to engineering disciplines, mathematics education, actuarial mathematics, and computer applications.

Please send resume, statement concerning current research interests, and three letters of reference to: Dr. J. J. Salacuse, Search Committee Chair, Science and Mathematics Department, GMI Engineering & Management Institute, 1700 West Third Avenue, Flint, Michigan 48504-4898. Applications will be accepted until February 1, 1990 or until the position has been filled.

GMI is an Affirmative Action/Equal Opportunity Employer.

THE JOHNS HOPKINS UNIVERSITY

Applications are invited for a junior position in statistics, to begin in Fall 1990. Selection is based on demonstration and promise of excellence in research, teaching, and innovative application. AA/EOE. Applicants are asked to furnish a vita, transcripts, a letter describing professional interests and aspirations, and arrange for three letters of recommendation to be sent to Prof. John C. Wierman, Chairman, Mathematical Sciences Department, The Johns Hopkins University, Baltimore, MD 21218.

POSITIONS AVAILABLE

CALIFORNIA STATE UNIVERSITY, NORTHRIDGE

Applications are invited for four tenure track positions for the Fall of 1990. Three positions at the assistant professor level in areas of interest to the faculty and possibly one at the associate professor level, will be available. A Ph.D. by the Fall of 1990 is required. Candidates in Mathematics Education and Applied mathematics (especially with experience in industry) are encouraged to apply, but candidates in all areas of mathematics with a commitment to both teaching and research will be considered. Responsibilities include teaching 9-12 hours, depending on research and/or other contributions. Send vita and three letters of recommendation to Jerry Rosen, Hiring Committee Chair, Dept. of Mathematics, California State University, Northridge, CA 91330 by Feb. 15 for full consideration. Women and minorities are especially encouraged to apply. CSUN is located in a Northwestern suburb of Los Angeles and is in close proximity to Cal. Tech., U.S.C., and U.C.L.A. (15 mins. away).

AFFIRMATIVE ACTION/EQUAL OPPORTUNITY EMPLOYER

UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL
Dept. of Mathematics
Chapel Hill, N.C. 27599-3250

Tenure-track and visiting faculty positions anticipated, pending Dean's approval, effective Fall 1990. Rank and salary dependent on qualifications and budget considerations. Ph.D., exceptionally strong research program and commitment to excellent teaching required. Send 4 letters of recommendation, vitae, and abstract of current research program to: Search Committee Chairman, Mathematics Dept., UNC at Chapel Hill, CB #3250 Phillips Hall, Chapel Hill, N.C. 27599-3250. Equal Opportunity/Affirmative Action Employer. Women and minorities are encouraged to identify themselves voluntarily. Completed applications received by January 10, 1990 are assured of full consideration.

MILLS COLLEGE
Oakland, California

The Department of Mathematics and Computer Science invites applications for a tenure track position as an Assistant Professor of Mathematics, to commence in the fall of 1990 (subject to final budgetary approval). Applicants must have a Ph.D. in mathematics and should submit evidence of exceptional teaching ability and strong research potential. Mills is a small liberal arts college for women, located in the San Francisco Bay Area, and is known for its innovative mathematics and computer science programs. Applications should include a vita and three letters of reference (addressing both teaching ability and research potential). Please have all materials sent to:

Head of the Mathematics Search Committee
Department of Mathematics and Computer Science
Mills College
5000 MacArthur Blvd.
Oakland, California 94613

The deadline for completed applications is January 20, 1990. Mills College is an affirmative action/equal opportunity employer.

MACALESTER COLLEGE
Mathematics/Computer Science
1600 Grand Ave.
St. Paul, MN 55105

Applications are invited for two approved tenure-track positions in Mathematics, and one position, subject to administrative approval, in Computer Science, beginning in September, 1990. Candidates should have a Ph.D. and an interest in a career of teaching and research in a four-year liberal arts college. Teaching load is 6-9 hours a week. Competitive salary scale, good benefits, pleasant urban residential location. Applicants should supply resume and three references to Professor Wayne Roberts, address above. Applications received until positions filled. Macalester is an equal opportunity, affirmative action employer. Women and minorities are especially encouraged to apply.

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN DEPARTMENT OF MATHEMATICS

Applications are invited for one or more permanent faculty positions, rank open (subject to administrative approval). Some visiting appointments are also anticipated. Appointments are to commence August 1990. Competitive salary and teaching load. Candidates must have completed Ph.D. by time appointment begins. Candidates should send letter of application, vita and publication list and arrange to have three letters of reference sent directly to

C. Ward Henson, Chair
Department of Mathematics
University of Illinois at Urbana-Champaign
1409 W. Green St.
Urbana, IL 61801
tel. (217)333-3352

In order to ensure full consideration, application materials should be received by December 1, 1989. Interviews may be conducted prior to December 1, but all applications received by that date will receive full consideration. Candidates are expected to present evidence of excellence, or potential for excellence, in research and teaching. Applications from women and minority candidates are especially encouraged. The University of Illinois is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF TOLEDO
Department of Mathematics

Applications are invited for anticipated tenure track positions beginning in September 1990. Applicants should have a Ph.D. by September 1990 and be committed to teaching and research. While we are particularly interested in algebraic topology, combinatorics, probability, algebraic geometry and dynamical systems, applicants in all areas will be considered. Rank open (subject to funding). Applicants should send a vita and arrange for three letters of reference to be sent to Harvey Wolff, Chairman, Department of Mathematics, University of Toledo, Toledo, Ohio 43606. The University of Toledo is an equal opportunity, affirmative action employer.

POSITIONS AVAILABLE

CASE WESTERN RESERVE UNIVERSITY DEPARTMENT OF MATHEMATICS AND STATISTICS

Tenure-track, possibly senior, positions anticipated to beging August 15, 1990. Outstanding research record and/or proven research potential and teaching excellence required. Preferred areas: Statistics and Probability. The recently established CWRU Center for Stochastic and Chaotic Processes in Science and Technology will provide an especially friendly environment for probabilists doing theoretical research motivated by serious applications. Interacting particle systems, stochastic control, population genetics, random media and infinite dimensional stochastic processes (Malliavin calculus and stochastic P.D.E.) are good examples here. The statisticians are expected to work within an autonomous Applied Statistics unit. Women and minority groups candidates are especially encouraged to apply. Visiting positions also possible. Send vita plus three letters of recommendation to Professor W. A. Woyczynski, Chairman, Department of Mathematics' and Statistics. Case Western Reserve University, Cleveland, OH 44106.

An affirmative action equal opportunity employers.

TEMPLE UNIVERSITY Department of Mathematics

The Department of Mathematics expects to have at least two tenure track positions at the junior level for Fall, 1990. Preferred specialties: Applied Math., Dynamical Systems, Geometry, Probability. Outstanding research potential and serious commitment to teaching required. At least two years experience preferred. Vita and three letters of reference should be sent by **December 31, 1989** to *D. Reich, Head, Search Committee, Box Q, Department of Mathematics, Temple University, Philadelphia, PA 19122.*

Women and minorities are especially encouraged to apply. Temple University is an Affirmative Action and Equal Opportunity employer.

BARNARD COLLEGE of Columbia University Department of Mathematics

Senior position in Mathematics. Barnard College of Columbia University invites applications for a tenure or tenure-track position in its Department of Mathematics. Applicants must have research accomplishments appropriate to a permanent appointment at a major research-oriented university, and in addition be interested in an ready to assume a leadership role in Barnard's undergraduate mathematics program. The ideal applicant will be ready for immediate tenure, although tenure-track candidates will also be considered by the search committee. The successful applicant will be welcome to participate in all aspects of the Columbia University graduate program. Normal teaching duties will be two courses/semester.

Qualified candidates are invited to send a letter of application and a Curriculum Vita, and to arrange for three letters of recommendation. Application materials should be sent to:

Professor Joan Birman,
Chairperson
Department of Mathematics
Barnard College
3009 Broadway
New York, New York 10027

EOE/AA.

OHIO UNIVERSITY Department of Mathematics

The Department of Mathematics anticipates the appointment of one tenure-track assistant professor in the area of algebra or analysis beginning September 1, 1990. Salary will be competitive. Duties include research and teaching at the undergraduate and graduate level. Applicants must have a Ph.D. in Mathematics and have research interests compatible with the current faculty in algebra or analysis. Send resume and have three letters of recommendation sent to Shih-liang Wen, Chairman, Department of Mathematics, Ohio University, Athens, Ohio 45701. The deadline for applications is January 1, 1990.

Ohio University is an Equal Opportunity and Affirmative Action Employer.

UNIVERSITY OF CENTRAL FLORIDA Department of Mathematics

Applications are invited for at least two tenured track and visiting positions at Associate, Assistant Professor or instructor level beginning in August 1990. Ph.D. degree with strong research potential or experience and dedication to teaching required for appointment at Associate or Assistant Professor level. Candidate with substantial completion of Ph.D. requirements will be considered for the instructor level. The positions are unrestricted as to area of specialization within mathematical sciences. For one of the tenured track positions preference will be given to those with research interests in numerical analysis, computational mathematics or related applied fields. Candidate should send a detailed resume and arrange to have at least three letters of recommendation and a transcript sent to: Dr. Lokenath Debnath, Department of Mathematics, University of Central Florida, Orlando, Florida 32816, postmarked by February 2, 1990. Some Search Committee members will be available at the Louisville meeting in January 1990 for an interview. The University is an equal opportunity affirmative action employer. As an agency of the State of Florida, UCF makes all application materials and selection procedures available for public review.

SAINT LOUIS UNIVERSITY Department of Mathematics and Computer Science Saint Louis, MO 63103

A tenure track position is available at the Assistant Professor level beginning fall 1990. The department offers the B.A., M.A., and Ph.D in Mathematics and the B.A. in Computer Science. Persons holding a Ph.D. in Mathematics who are committed to teaching and research are invited to apply. Preferred specialties include geometric topology, differential geometry, Lie groups and functional analysis, group theory and representation theory. Have a vita and three letters of recommendation sent to Professor Charles Ford at the above address. An AA/EOE.

POSITIONS AVAILABLE

UNIVERSITY OF CALIFORNIA AT RIVERSIDE
Faculty Position in Mathematics

Applications and nominations are invited for a tenured or tenure track position in Algebraic Geometry or Commutative Algebra beginning July 1, 1990 or later. The position is open as to rank; candidates at all levels and in all areas of algebraic geometry and commutative algebra will be considered. Demonstrated excellence in research and teaching is required. The eligibility pool for this position will consist of those candidates for whom we receive a vita, a list of publications and three letters of recommendation by January 22, 1990. Established criteria of the University of California determine salary and rank. Candidates should send a curriculum vita, a list of publications and the names of at least three references to

Professor Richard Block, Chair
Algebraic Geometry/Commutative Algebra
Hiring Committee
Department of Mathematics and Computer Science
University of California
Riverside, California 92521

University of California is an Affirmative Action/Equal Opportunity Employer.

STETSON UNIVERSITY
Department of Mathematics and Computer Science

Applications are invited for a tenure track position in mathematics at the Assistant Professor level beginning Fall, 1990. A Ph.D. in mathematics is required. Applicants should have a strong commitment to undergraduate teaching in a liberal arts environment. Teaching load: 9-10 hrs/wk. Responsibilities include teaching mathematics courses at all levels of the undergraduate curriculum, and continuing scholarly activity. The department currently has 10 full-time faculty members. Stetson University, located in Central Florida, is a small, private, comprehensive university of 2500 students. Its three schools-the College of Arts and Sciences, the School of Business, and the School of Music-are dedicated to excellence in teaching and are united by a commitment to the liberal arts. Send vitae and three letters of recommendation to: Professor Dennis Kletzing, Department of Mathematics and Computer Science, Stetson University, DeLand, Florida 32720. Deadline for applications is January 31, 1990, or until position is filled. Stetson University is an equal opportunity employer and enthusiastically solicits applications from women and minorities candidates.

QUEEN'S UNIVERSITY AT KINGSTON DEPARTMENT OF MATHEMATICS AND STATISTICS

Applications are invited for a renewable (tenure track) position at the rank of assistant professor in arithmetic algebraic geometry to begin July 1991. The successful applicant will have an excellent research record and be able to interact with the members of the Department working in this area.

Salary will be negoitiable-the current assistant professor floor is $32,375.00

Those interested are requested to send their curriculum vitae and arrange for letters of recommendation from three or more referees to be sent to the address below by November 1, 1989. At least one letter should comment on the candidate's teaching ability.

Professor Joan M. Geramita
Chair, Appointments Committee
Mathematics & Statistics Department
Queen's University
Kingston, Ontario K7L 3N6

In accordance with Canadian Immigration requirements, this advertisement is directed to Canadian citizens and permanent residents. Candidates of either sex are equally encouraged to apply. Queen's University is willing to help the spouse of a new appointee to seek suitable employment.

SUNY-COLLEGE AT NEW PALTZ

A tenure track Assistant Professorship is available for a mathematician doing research in some branch of analysis or probability theory. Department offers bachelor's and master's in mathematics, mathematics education and computer science. The College is located in the Hudson Valley/Catskill region of New York, known for its natural beauty and easy access to NYC. Send application and 3 recommendations attesting to teaching excellence and scholarly potential to D. Clark, Chairman, Dept. of Mathematics & Computer Science, Box 10, SUNY, College at New Paltz 12561. Review of applications will begin 12/1/89, pending funding approval. An AA-EOE. Women and minorities are urged to apply.

TEXAS TECH UNIVERSITY

Texas Tech University seeks applications for a position in the Department of Mathematics opening in the Fall of 1990. To qualify applicants must 1) have a Ph.D. from a recognized university, 2) have a strong dedication to both teaching and research, 3) exhibit research interests that are compatible with ongoing programs in the department and 4) be willing and able to work with students at both the undergraduate and graduate level. To apply send resume and have three letters of recommendation sent to Harold Bennett, Chairman of Hiring Committee, Department of Mathematics, Texas Tech University, Lubbock, Texas 79409. Applications are to be received no later than December 15, 1989. Texas Tech University is an equal opportunity employer. EOE/AA.

THE CITY UNIVERSITY OF NEW YORK
John Jay College of Criminal Justice
Department of Mathematics

Assistant Professor, tenure-track position, January 1990. Requirements: Ph.D.; demonstrated potential for research; strong commitment to teaching. Computer science, numerical analysis or operations research background preferred. John Jay College of Criminal Justice, located in Manhattan, is a senior college in CUNY. Send resume, graduate transcript, relevant reprints, dissertation abstract and three letters of reference to Samuel Graff, Chairperson, Department of Mathematics, John Jay College of Criminal Justice, 445 West 59 Street, New York, NY 10019 by December 1, 1989. Minorities and women are encouraged to apply. AA/EOE Employer.

POSITIONS AVAILABLE

WESTERN KENTUCKY UNIVERSITY
Headship, Department of Mathematics

Applications are invited for the Headship of the Department of Mathematics with appointment date as early as July 1, 1990. WKU has an enrollment of more than 14,500 students and is located in Bowling Green, KY (population approximately 56,000), two hours south of Louisville and one hour north of Nashville, TN. The department consists of 28 full-time faculty and offers masters and baccalaureate degree programs with undergraduate enrollment of approximately 170 majors and 100 minors. Applicants must hold a doctorate in mathematics and have at least five years of college mathematics teaching experience. Applications should provide evidence of administrative leadership, effective teaching, public service and research/scholarly activities. To insure consideration, respond by January 15, 1990. The position will remain open until filled. Send letter of application, vita and names of at least three references to Office of Academic Affairs, Mathematics Headship Search, Western Kentucky University, Bowling Green, KY 42101. Women and minorities are encouraged to apply. An Affirmative Action, Equal Opportunity Employer.

UNIVERSITY OF ARIZONA
DEPARTMENT OF MATHEMATICS
TUCSON, ARIZONA 85721

The Mathematics Department of the University of Arizona is happy to announce several postdoctoral fellowships (Research Associate) which will be available beginning August '90. Applicants with science and nonlinear optics may qualify for special Center of Excellence Awards. Only candidates with outstanding research records or potential should apply. Applications received by February 1, 1990 will be considered first, if suitable candidates are not found then late applications will be reviewed. Send applications (please include Social Security number if possible) to Department Head, Department of Mathematics. The University of Arizona is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF ARIZONA
DEPARTMENT OF MATHEMATICS
TUCSON, ARIZONA 85721

MATHEMATICS EDUCATION: The University of Arizona Department of Mathematics is seeking nominations and applications for a tenure-track Assistant Professorship in mathematics education. Responsibilities include teaching mathematics and mathematics education courses, developing programs for mathematics teachers, initiating research and development projects, and involvement with state and national projects to improve mathematics education. A candidate should be an excellent teacher and should show promise of making substantial contributions to the improvement of the teaching of mathematics through research or its creative equivalent and through service to the profession. This is a tenure-track position that will begin in the fall of 1990. Closing date for applications is 15 January 1990. Candidates should send a resume and a list of at least three references to Alan Newell, Head, Department of Mathematics, University of Arizona, Tucson, AZ 85721. The University of Arizona is an Equal Opportunity/Affirmative Action Employer.

BOSTON UNIVERSITY
DEPARTMENT OF MATHEMATICS

The Department of Mathematics at Boston University invites applications for two anticipated positions in the area of Dynamical Systems. One position is a permanent position at the Assistant Professor level or higher. The successful applicant should be a recognized scholar in the field of dynamics and should have research interests which complement those of current members of the Dynamics group at Boston University. Salary and academic rank are negotiable. The Department also seeks applications for a two year visiting Assistant Professorship in this field. Applications should be sent to: Search Committee, Department of Mathematics, Boston University, 111 Cummington St., Boston, MA 02215. AA/EOE.

STETSON UNIVERSTIY
Department of Mathematics
and Computer Science

Applications are invited for a non-tenure track position in computer science for 1990-1991, beginning Fall 1990. The position is on a year-to-year basis, renewable for at most three years. The Department has a Micro VAX II running ULTRIX 2.2 and assorted microcomputers. University facilities reside in an Academic Computer Center which has a VAX 6210 running VMS, and numerous microcomputers and graphics peripherals, including IBM PS/2's, model 50, and Mac SE's and Mac II's. Stetson University, located in Central Florida, is a private liberal arts university of 2500 students with a commitment to excellence in undergraduate education. Applicants should have an MS degree in computer science. Send vitae and three letters of recommendation to: Professor Dennis Kletzing, Department of Mathematics and Computer Science, Stetson University, DeLand, Florida 32720. Deadline for applications is January 31, 1990, or until position is filled. Stetson University is an equal opportunity employer and enthusiastically solicits applications from women and minority candidates.

CALIFORNIA STATE UNIVERSITY
LONG BEACH
Department of Mathematics

Two tenure-track positions beginning Fall, 1990: one in statistics and one in Math Education. Both positions require completed Ph.D., evidence of excellent teaching, strong research record or potential. Asst. or Assoc. Prof. preferred; applicants with distinguished records in teaching and research may be considered for Professor. Must be U.S. citizen or permanent resident. Further details of duties, salary range, specialty and degree requirements provided on request. Positions open until filled, but selection begins from applicants with complete files (resume, transcript, 3 reference letters) 12/1/89. Apply to Roberto A. Mena, Chair, Mathematics Department, CSULB, Long Beach, CA 90840. CSULB is an Affirmative Action/Equal Opportunity Employer.

POSITIONS AVAILABLE

UNIVERSITY OF CALIFORNIA SANTA BARBARA
Department of Mathematics

Applications are invited for a ladder-position at the Assistant Professor level in the area of nonlinear partial differential equations, including the numerical and applied aspects thereof. Salary will depend upon qualifications. Appointment will be effective July 1, 1990. Candidates must possess the Ph.D. degree or equivalent. Strong evidence of commitment to teaching and outstanding promise in research is required. To apply send vita and publication list, and arrange to have 3 letters of recommendation sent to: PDE Search Committee, Department of Mathematics, University of California, Santa Barbara, CA 93106. Deadline to apply is January 15, 1990.

UCSB is an Equal Opportunity/Affirmative Action Employer. Proof of U.S. citizenship or eligibility for U.S. employment will be required prior to employment (Immigration Reform and Control Act of 1986).

WESTERN ILLINOIS UNIVERSITY DEPARTMENT OF MATHEMATICS

Applications and nominations for the position of chairperson with associate or full professor faculty rank are invited. The doctorate in mathematics, statistics, or mathematics education is required. Evidence of excellence in undergraduate and graduate teaching, a record of substantial research/scholarly achievement, and the demonstration of appropriate administrative ability is expected. The selection process will begin November 1, 1989 and continue until the position is filled. Send application, vita, photocopies of transcripts, and at least three letters of reference to: Chairperson Search Committee; Department of Mathematics; Macomb, Il 61455. WIU IS AN EQUAL OPPORTUNITY AFFIRMATIVE ACTION EMPLOYER. WOMEN, MINORITIES, AND HANDICAPPED PERSONS ARE ESPECIALLY ENCOURAGED TO APPLY.

WEST VIRGINIA UNIVERSITY
Department of Mathematics

The Department of Mathematics intends to make several faculty appointments that will commence August 1990. Appointments are expected to be made at the Assistant or Associate rank. Candidates are expected to have a PhD in mathematics or equivalent with a strong record or demonstrated potential in both research and teaching. Preference will be given to applicants whose research interests complement those currently in the Department in algebra, analysis, applied or numerical analysis, discrete mathematics. Normal responsibilities include research and a two course teaching assignment per semester at the graduate or undergraduate level. Applications and inquiries should be directed to James Lightbourne, Department of Mathematics, West Virginia University, Morgantown, WV 26506. Applicants should submit a vita and have three letters of reference sent (senior applicants may choose to submit names of references). Applications will be reviewed beginning January 15, 1990. WVU is an affirmative action/equal opportunity employer. Qualified women and minorities are especially encouraged to apply.

UNIVERSITY OF ARIZONA DEPARTMENT OF MATHEMATICS TUCSON, ARIZONA 85721

Tenure track positions. Ph.D., excellent research record or potential, strong commitment to teaching required. Field is less important than ability but should complement existing strengths in algebra, computational science, differential equations, dynamical systems, geometry, mathematical physics, nonlinear analysis, number theory, probability and statistics. Applications received by February 1, 1989 will be considered first, if suitable candidates are not found then late applications will be reviewed. Send applications (please include Social Security number if possible) to Department Head, Department of Mathematics. The University of Arizona is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA AT BERKELEY
Department of Mathematics
Berkeley, CA 94720

TEMPORARY POSTDOCTORAL POSITIONS

Several temporary positions beginning in Fall 1990 are anticipated for new and recent Ph.D.'s of any age, in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology. The terms of these appointments may range from one to three years. Applicants for NSF or other postdoctoral fellowships are encouraged to apply for these positions; combined teaching/research appointments may be made for up to three years. Mathematicians whose research interests are close to those of regular department members will be given some preference. Applicants should send a resume, and reprints, preprints, and/or dissertation abstract, and ask three people to send letters of recommendation to Andrew J. Casson, Vice Chair for Faculty Affairs, at the above address. We should receive this material no later than January 15, 1990. The University of California is an Equal Opportunity, Affirmative Action Employer.

RUTGERS UNIVERSITY-NEWARK
Professor of Mathematics

The Department of Mathematics and Computer Science anticipates an opening at the Rank of Professor I or Professor II beginning Fall 1990. Candidates should exhibit outstanding research accomplishments. Salary and teaching load are negotiable. Applicants from all fields are invited. Areas of research interest in the department include number theory, representation theory and automorphic forms, Lie algebras, transformation groups, low dimensional topology and Teichmuller theory. Nominations and applications should be sent to: Jane Gilman, Chair, Department of Mathematics, Rutgers University, Newark, New Jersey 07102. The closing date for applications is 1/15/90 but applications will be considered until the position is filled. AA/EOE.

POSITIONS AVAILABLE

UNITED STATES NAVAL ACADEMY
Department of Mathematics

The Naval Academy anticipates having one or two tenure-track and several one-year visiting positions available, all at the assistant professor level, commencing in August of 1990. The initial salary will be competitive and commensurate with experience and qualifications. Research opportunities exist for augmenting salary during the summer intersessional period. Specialization in applied mathematics or operations research is of particular interest. Applicants must possess an earned Ph.D. by the date of appointment, have a commitment to excellence in teaching, and be capable of pursuing an independent program of research. Inquiries and applications should be sent to J. M. D'Archangelo, Mathematics Department, U.S. Naval Academy, Annapolis, Maryland 21402-5002. Required of each applicant are a resume, transcripts of academic records, and three letters of recommendation from persons familiar with the applicant's teaching and research. Interviews will be conducted at the annual AMS/MAA meeting in Louisville in January. The Naval Academy is an EO/AA employer.

STANFORD UNIVERSITY
DEPARTMENT OF MATHEMATICS

Assistant Professorships in honor of Gabor Szegö. The department expects to make one or more appointments in 1990-91 for a term of two years, possibly renewable for a third year. Applicants are expected to show outstanding promise in research and clear evidence of achievement. They should have received the Ph.D. prior to the start of the appointment but not before 1988. Stanford is committed to excellence in teaching, and applicants should count this as one of their goals. The teaching load consists of five 3-hour quarterly courses, and may include graduate courses. The nine-month salary for 1990-91 will be at least $32,750. Candidates should send a letter of application with a curriculum vitae, a list of publications and information concerning teaching experience, and should arrange to have three letters of recommendation sent to Prof. Gregory Brumfiel, Acting Chairman, Department of Mathematics, Stanford University, Stanford, CA 94305-2125, by January 1, 1990. Stanford is an Affirmative Action, Equal Opportunity Employer, and welcomes applications from women and minorities.

SOUTHERN ILLINIOS UNIVERSITY
AT CARBONDALE
DEPARMENT OF MATHEMATICS
CARBONDALE, IL 62901

POSITION DESCRIPTION

Applications are invited from qualified candidates for a tenure track position beginning on August 16, 1990. Ph.D. in mathematics with a strong background in pure or applied combinatorics, graph theory or combinatorial designs required. Candidates must have demonstrated excellence in research or potential for such. Evidence of teaching effectiveness is required. Rank will be at the assistant or associate level; substantial record of published research required for appointment at a non-entry level. Send letter of application, resume and three letters of recommendation to:

Combinatorics Position
c/o Ronald B. Kirk, Chair
Department of Mathematics
Southern Illinois University
Carbondale, IL 62901

The closing date is December 15, 1989, or until the position is filled.

SIUC IS AN EQUAL OPPORTUNITY/ AFFIRMATIVE ACTION EMPLOYER. Women and minorities are particularly encouraged to apply.

COLLEGE OF CHARLESTON
DEPARTMENT OF MATHEMATICS

Applications are invited for at least 2 tenure-track positions at the Assistant Professor level beginning August 1990. Candidates must have a Ph.D. in one of the mathematical sciences, a commitment to undergraduate teaching, and potential for continuing research. The normal teaching load is 9 hrs/wk for those engaged in research. The salary is competitive. Applicants should send a vita and have three letters of recommendation sent to William L. Golightly, Chairman, Department of Mathematics, College of Charleston, Charleston, SC 29424. The process of evaluating applications will begin on January 22, 1990, but applications will be considered until the positions are filled. The College of Charleston is an Affirmative Action/Equal Opportunity Employer.

CALIFORNIA STATE UNIVERSITY
SACRAMENTO

Three tenure track positions for Fall 1990, at a step appropriate to the applicant's experience. Must have PhD in Math or Statistics by Sept. 1990. Salary range begins at $31,668. Applicants should be committed to excellence in teaching (12 units/semester). The dept. has a diverse curriculum currently experiencing growth in undergrad. and grad. degree and teacher preparation programs. Send vita, transcripts, and three letters of recommendation (at least one commenting on teaching ability), by 2/1/90, to Hiring Committee, Math and Stat Dept., Sacramento, CA 95819-2694. The dept. is committed to improving the diversity of its faculty and encourages qualified women, underrepresented ethnic minorities, disabled individuals, and Vietnam-era veterans to apply. AA/EOE.

UNIVERSITY OF COLORADO AT
COLORADO SPRINGS
DEPARTMENT OF MATHEMATICS
COLORADO SPRINGS, CO 80933-7150

Applications are invited for 1 or 2 possible tenure track Assistant Professor positions for Fall 1990. Prefer areas consistent w/present research interests: algebra, diff. eq., computer vision, harmonic analysis, probability and math physics. Applicants should have significant research accomplishments or exceptional research promise and evidence of good teaching. Ph.D. is required. The average weekly teaching load is 7 1/2 hours. Generous support for faculty development such as travel, teaching off-loads and summer research. Send resume and 3 letters of reference to James E. Daly, Chairman. Screening will begin on Feb. 1, 1990 and continue until all positions are filled. AA/EEO.

POSITIONS AVAILABLE

THE UNIVERSITY OF ALABAMA MATH FACULTY POSITIONS

The department expects to fill from two to five tenure track positions at the rank of Assistant Professor or possibly at a higher rank beginning August 16, 1990. Areas of special interest are: algebra, analysis, fluid mechanics, computational mathematics, differential equations, differential geometry, optimization, stochastic modeling, and topology. Applicants for Assistant Professor should have or reasonably expect to have by August 16, 1990 a Ph.D. or the equivalent. Excellence in both teaching and research is required. An established record of research and leadership in one of the areas described above is expected of applicants for a senior position. We also invite applications for visiting positions. Women and minorities are particularly encouraged to apply. Send a curriculum vitae, reprints and/or preprints, and at least three letters of recommendation to: Search Committee, Department of Mathematics, The University of Alabama, Box 870350, Tuscaloosa, AL 35487-0350. UA is an AA/EOE.

UNIVERSITY OF SOUTH CAROLINA Department of Mathematics

Applications are invited for anticipated tenure-track faculty positions at all ranks. Applications in all areas of mathematics will be considered. The Department is building on existing research strengths and is increasing the scope of its program in applied and computational mathematics. Faculty research is supported by excellent departmental library and high-performance computing facilities. The Ph.D. degree or its equivalent is required, and all appointments will be consistent with the Department's commitment to excellence in research and teaching at the undergraduate and graduate levels. A resume, containing a summary of research accomplishments and goals, and four letters of recommendation should be sent to:

Dr. Colin Bennett, Chairman
Department of Mathematics
University of South Carolina
Columbia, South Carolina 29208

The closing date for applications is January 31, 1990. The University of South Carolina is an Affirmative Action/Equal Opportunity Employer.

STANFORD UNIVERSITY DEPARTMENT OF MATHEMATICS

The department expects to make one or more tenure-track or tenured appointments beginning September 1990, among the following fields: (1) analysis, (2) geometry or topology, (3) algebra, number theory, or logic, (4) applied mathematics or probability; in the last case there are also possibilities for joint appointments with other departments. At the tenured level, preference will go to individuals in the early years of their ranks, though a more senior appointment may be possible for an extremely well-qualified individual.

Candidates should send a letter of application and a curriculum vitae with a list of publications, and arrange to have three letters of recommendation and some evidence of commitment to excellence in teaching sent to Prof. Gregory Brumfiel, Acting Chairman, Department of Mathematics, Stanford University, Stanford, CA 94305-2125, by January 1, 1990.

Stanford is an Equal Opportunity, Affirmative Action Employer, and welcomes applications from women and minorities.

MICHIGAN TECHNOLOGICAL UNIVERSITY

The Department of Mathematical Sciences is seeking a director for the Fluids Research Oriented Group (F.R.O.G.). F.R.O.G. is an interdisciplinary group, involving Departments of Mathematical Sciences, Mechanical Engineering, and Chemical Engineering, engaged in an active program of research in Fluid Mechanics. This position will carry an appointment as Associate Professor or Professor. Candidates should have an active research record in Fluid Mechanics or Computational Mathematics. A good funding record and experience with Ph.D. students is required. The position starts in September 1990. Send a curriculum vitae and three letters of recommendation to Recruitment Committee, Dept. of Math. Sciences, MTU, Houghton, MI 49931. MTU is an equal opportunity educational institution/equal opportnity employer.

THE UNIVERSITY OF TEXAS AT AUSTIN DEPARTMENT OF MATHEMATICS AUSTIN, TEXAS 78712

A number of openings are expected for Fall 1990 at all levels, including Instructor (customarily appointees are new PhDs), Assistant Professor (customarily appointees have at least two years' experience beyond the PhD), Associate Professor, and Professor. Candidates should have outstanding research ability and concern for teaching. Salaries are competitive. Please send vita, detailed summary of research interests, and three recommendation letters to address above, directed as follows:

Instructor and Assistant Professor: c/o Recruiting Committee

Associate Professor and Professor: c/o John Dollard, Chairman

The University of Texas at Austin is an equal opportunity employer. Minorities and women are encouraged to apply.

MICHIGAN TECHNOLOGICAL UNIVERSITY Department of Mathematical Sciences

Subject to final administrative approval, we expect to fill the following positions. Starting date is Sept. 1990.

1. One tenure-track Assistant Professorship. Strong research and teaching background required. Teaching load: five quarter courses per year.
2. At least two Visiting Assistant Professorships. These are one year positions with a teaching load of six quarter courses per year.
3. One instructorship. An M.S. and strong teaching background is required. Teaching load: nine quarter courses per year.

To apply, submit vitae and three letters of recommendation to Recruitment Committee, Dept. of Math. Sciences, MTU, Houghton, MI 49931. MTU is an equal opportunity educational institution/equal opportunity employer.

POSITIONS AVAILABLE

WEST VIRGINIA UNIVERSITY EBERLY PROFESSORSHIP IN MATHEMATICS

The Department of Mathematics invites applications and nominations for the EBERLY PROFESSORSHIP IN MATHEMATICS. Candidates are sought who have outstanding scholarly accomplishments, research interests which complement current areas of concentration in applied analysis or discrete mathematics, a record of funded research, and a commitment to instruction. The individual selected will be expected to provide academic leadership with continued excellence in these areas. The position will commence August 1990. Applications, nominations and inquiries should be directed to James Lightbourne, Department of Mathematics, West Virginia University, Morgantown WV 26506. Candidates should submit a letter of application, vita, and names and addresses of five references. Applications will be reviewed as received and accepted until the position is filled. WVU is an affirmative action/equal opportunity employer. Qualified women and minorities are especially encouraged to apply.

UNIVERSITY OF KANSAS Department of Mathematics

Applications are invited for tenure-track and temporary positions at all levels, commencing August 16, 1990 or as negotiated. Field is unrestricted but preference will be given to numerical analysis then to probability/statistics, then to areas meshing well with the department's needs. Require Ph.D. or Ph.D. dissertation accepted with only formalities to be completed.

Application, detailed resume with description of research, and three recommendation letters should be sent to C. J. Himmelberg, Chairman, Department of Mathematics, University of Kansas, Lawrence, KS 66045-2142.

Deadlines: December 1, 1989 for first consideration, then monthly until August 1, 1990.

The University of Kansas is an AA/EOE.

SOUTHERN ILLINIOS UNIVERSITY AT CARBONDALE DEPARMENT OF MATHEMATICS CARBONDALE, IL 62901

POSITION DESCRIPTION

Applications are invited from qualified candidates for a tenure track position at the Assistant Professor level beginning on August 16, 1990. Ph.D. in mathematics and a strong background in analysis required. Preference will be given to the areas of complex, functional or stochastic analysis, but other areas of analysis will be considered. Selection will be based on the potential and demonstration of excellence in research and teaching. Applicants are asked to send letter of application, vita, and three letters of recommendation to:

Analysis Position
c/o Ronald B. Kirk, Chair
Department of Mathematics
Southern Illinois University
Carbondale, IL 62901

The closing date for applications is December 15, 1989, or until the position is filled. SIUC IS AN EQUAL OPPORTUNTY/AFFIRMATIVE ACTION EMPLOYER. Women and minorities are particularly encouraged to apply.

UNIVERSITY OF HAWAII DEPARTMENT OF MATHEMATICS

Applications are invited for some anticipated positions beginning Fall 1990, one tenure-track and some temporary (one year). Rank open. Duties include mathematical research and teaching 6 credit hours per semester. Minimum qualifications include a Ph.D., commitment to research and teaching, and achievement appropriate to rank. Research interests complementing those of the Department are desirable. Normal salary range as of 7/90 is from $30,240 (minimum for assistant professor) to $68,928 (maximum for full professor). To apply, write to Professor L. Thomas Ramsey, Chairman, Department of Mathematics, 2565 The Mall, Keller 401A, Honolulu, HI 96822. Have 3 references send confidential letters directly to the chairman. DEADLINE FOR APPLICATION: 1/22/90. The University of Hawaii is an AA/EO employer.

MIAMI UNIVERSITY Middletown, Ohio Department of Mathematics and Statistics

anticipates an assistant professorship (tenure track) or an instructorship beginning August, 1990. Miami University Middletown is a two-year regional campus. Duties include teaching 12 hours per semester, service and scholarship. Applicants for the assistant professorship should have a doctorate in one of the mathematical sciences or in mathematics education by 8/90. Applicants for an instructorship should have a master's degree in one of the mathematical sciences or in mathematics education by 8/90. A strong interest in teaching algebra and pre-calculus is desired. Please send vita, graduate transcript and three reference letters to John Skillings, Middletown Search, Department of Mathematics and Statistics, Miami University, Oxford, Ohio 45056. Review of applications will commence on January 15, 1990. Women and minorities are encouraged to apply. Miami provides equal opportunity in employment and education. EOE/AA.

ILLINOIS WESLEYAN UNIVERSITY DEPARTMENT OF MATHEMATICS BLOOMINGTON, IL 61702

Applications are invited for a tenure track position at the rank of Assistant Professor starting the fall semester 1990. Candidates must possess a Ph.D. in mathematics, a dedication to excellent teaching in an independent, liberal arts university, and active research interests. Preference will be given to individuals with active interests in applied mathematics. The initial closing date for applications is January 10, 1990 (prior to the AMS/MAA Louisville meeting). Thereafter until the position is filled, the closing dates are February 10, March 10, and April 10. Women and minorities are strongly encouraged to apply. Candidates should submit a curriculum vitae and three letters of recommendation to Melvyn W. Jeter, Head, Department of Mathematics, Illinois Wesleyan University, Bloomington, IL 61702. Equal Opportunity Employer.

POSITIONS AVAILABLE

AUBURN UNIVERSITY DEPARTMENT OF ALGEBRA, COMBINATORICS AND ANALYSIS

The department expects to make two tenure-track appointments at the rank of assistant professor beginning September 1990. One position is in any area of probability theory. One position is in combinatorics with preference given to candidates in coding theory or cryptography.

Some temporary one-year appointments at the rank of assistant professor are also expected for September 1990. For these, research interests compatible with current faculty in algebra, analysis, combinatorics, differential equations, linear algebra or probability desired.

Excellence required in both teaching and research for all positions. Send resume and arrange for at least three letters of recommendation to be sent to James Wall, 120 Math Annex, Auburn University, AL 36849-5307. Minorities and women are encouraged to apply. AUBURN UNIVERSITY IS AN EQUAL OPPORTUNITY AFFIRMATIVE ACTION EMPLOYER.

CLARKSON UNIVERSITY

The Department of Mathematics and Computer Science at Clarkson University invites applications for tenure track positions in mathematics. PhD in mathematics or a closely related discipline is required. Rank and salary are negotiable. Strong candidates in all areas are encouraged to apply. We are especially interested in new colleagues with interests in differential and algebraic geometry, probability and statistics, and computational mathematics.

The university is located in upstate New York close to the scenic Adirondack and Thousand Island regions. The concentration of college campuses in the vicinity creates a rich cultural environment with a high quality of life without the problems of major cities.

Applications including vita and names of three references should be submitted to Professor A. Fokas, Department of Mathematics and Computer Science, Clarkson University, Potsdam, NY 13676. Clarkson University is an equal opportunity/affirmative action employer and encourages applications from women and minorities.

PORTLAND STATE UNIVERSITY

The Department of Mathematical Sciences invites applications for one or more tenure track positions at the assistant professor rank beginning Fall 1990. Applicants should hold a PhD degree (or equivalent) in mathematics or mathematics education with a strong mathematics emphasis, have demonstrated a strong commitment to teaching and to working with secondary teachers, and have demonstrated an ability to conduct research. Applicants should send a vita and have at least three letters of recommendation sent to

Bruce A. Jensen
Department of Mathematical Sciences
Portland State University
PO Box 751
Portland, OR 97207

Screening of applications will begin on February 1, but applications will be accepted until the positions are filled. Portland State University is an equal opportunity/affirmative action employer. Minorities, women and other protected groups are encouraged to apply.

UNIVERSITY OF TORONTO
Department of Mathematics

Applications are invited from recent Ph.D.'s for a tenure-stream position at Erindale Campus beginnng July 1, 1990. This position which is subject to final budgetary approval is open to all branches of pure and applied mathematics.

Duties will consist of research and teaching and candidates must demonstrate clear strength in both.

Applicants should send their complete C.V. together with a list of publications and arrange to have at least three letters of reference sent directly to Professor D. Masson, Associate Chairman, Department of Mathematics, University of Toronto, Toronto, Canada, M5S 1A1.

To insure full consideration, this information should be recieved by January 15, 1990.

The University of Toronto encourages both women and men to apply.

GOUCHER COLLEGE MATHEMATICS AND COMPUTER SCIENCE DEPARTMENT

Applications are invited for two tenure track positions at the Assistant Professor level beginning August, 1990. Qualifications include a Ph.D. in mathematics or computer science and a strong commitment to and demonstrated excellence in undergraduate teaching. Responsibilities include a teaching load of 9-10 hrs/wk and continuing scholarly activity. Goucher is a select, private, coeducational, liberal arts college located eight miles north of Baltimore and is convenient to Washington, D.C. The selection process will begin Jan., 1990. Goucher is an EOE. Send vita and three letters of recommendation to:

Dr. Joan S. Morrison
Chair of the Mathematics and Computer Science Department
Goucher College
Towson, MD 21204

THE UNIVERSITY OF MISSISSIPPI
Professor and Chair of Mathematics

The Department of Mathematics seeks applications and nominations for the position of Professor and Chair of the Department of Mathematics. The department consists of 16 full-time faculty, and offers the Ph.D. degree. Applicants must possess a Ph.D. in Mathematics or a Mathematical Science, a research record appropriate for leadership in a research institution, evidence of administrative ability, and a commitment to quality teaching. Salary is open. Initial applicant screening will begin December 8, 1989 with applications accepted until the position is filled. Desired appointment date is July 1, 1990. Send application, curriculum vitae, and three letters of recommendation to: Dr. Eldon Miller, Department of Mathematics, University of Mississippi, University, MS 38677. The University of Mississippi is an Affirmative Action/Equal Opportunity Employer.

POSITIONS AVAILABLE

SOUTHERN ILLINIOS UNIVERSITY AT CARBONDALE DEPARMENT OF MATHEMATICS CARBONDALE, IL 62901

POSITION DESCRIPTION

Applications are invited from qualified candidates for a tenure track position at the Assistant Professor level beginning on August 16, 1990. Ph.D. in mathematics and a strong background in algebra or topology required. Selection will be based on the potential and demonstration of excellence in research and teaching. Applicants are asked to send letter of application, vita, and three letters of recommendation to:

Algebra Position
c/o Ronald B. Kirk, Chair
Department of Mathematics
Southern Illinois University
Carbondale, IL 62901

The closing date for applications is December 15, 1989, or until the position is filled. SIUC IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER. Women and minorities are particularly encouraged to apply.

UNIVERSITY OF LOUISVILLE DEPARTMENT OF MATHEMATICS

The Department of Mathematics in the College of Arts and Sciences at the University of Louisville, is seeking 2 Assistant Professors for tenure-track positions. Candidates must have active research program in applicable mathematics, probability or statistics. Primary teaching responsibilities will include courses in applicable mathematics or probability/statistics as well as introductory undergraduate courses. A Doctorate in the Mathematical Sciences is required, as is evidence of scholarly achievement. Teaching experience is desirable. Interested candidates should send a letter of application, curriculum vitae and at least 3 letters of recommendation by January 29, 1990 to:

Dr. Robert B. McFadden
Chair, Department of Mathematics
College of Arts and Sciences
UNIVERSITY OF LOUISVILLE
Louisville, Ky 40292

The University of Louisville is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF PITTSBURGH Department of Mathematics and Statistics

The following positions are expected, subject to funding approval:

1. Specialist in applied mathematics with emphasis on scientific computing.

2. A position in pure mathematics. We are interested particularly in algebraic topology, algebra, and analysis, but outstanding applicants in any field will be considered.

The rank is open on each position. Requirements include outstanding research accomplishment or potential. Excellence in teaching is also essential.

Junior applicants should send a resume and arrange to have at least three letters of recommendation sent to: Stuart Hastings, Department of Mathematics and Statistics, University of Pittsburgh, Pittsburgh, PA 15260. Senior applicants should write directly to the same address.

The University of Pittsburgh is an equal opportunity/affirmative action employer. Women and minorities are especially encouraged to apply.

UNIVERSITY OF CALIFORNIA AT BERKELEY Department of Mathematics Berkeley, CA 94720

ASSISTANT PROFESSORSHIPS

We invite applications for one or more positions effective July 1, 1990, at the tenure-track Assistant Professor level, subject to budgetary approval, in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology. Applicants are expected to have demonstrated outstanding research potential, normally including major contributions beyond the doctoral dissertation. Applicants should send a resume, and reprints, preprints, and/or dissertation abstract, and ask three people to send letters of recommendation to Andrew J. Casson, Vice Chair for Faculty Affairs, at the above address. We should receive this material no later than January 15, 1990. The University of California is an Equal Opportunity, Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA AT BERKELEY Department of Mathematics Berkeley, CA 94720

TENURED POSITION

We invite applications for one or more positions effective July 1, 1990, at tenure level (Associate or full Professor), subject to budgetary approval, in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology. Demonstrated leadership in research is expected of applicants. Applicants should send a curriculum vitae, list of publications, a few selected reprints or preprints, and the names of three references to Andrew J. Casson, Vice Chair for Faculty Affairs at the above address. We should receive this material no later than January 15, 1990. (Applications received for our earlier October 1, 1989 deadline will automatically be considered for this deadline also.) The University of California is an Equal Opportunity, Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA IRVINE DEPARTMENT OF MATHEMATICS IRVINE, CALIFORNIA 92717

Applications for an Assistant Professorship opening in the academic year 1990-91 are invited:

Candidates for the position must have a Ph.D. and a research record in either Mathematical Physics or Differential Geometry. Duties include research, undergraduate and graduate teaching. Send applications, curriculum vitae, work in print or in preparation, and three letters of recommendation to: Professor Abel Klein, Chairman of the Recruitment Committee, Department of Mathematics, University of California, Irvine, CA 92717.

Appointment begins on July 1, 1990. UC Irvine is an Affirmative Action/Equal Opportunity Employer.

If no qualified candidates apply, there is a possibility that the position may be upgraded.

POSITIONS AVAILABLE

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY DEPARTMENT OF MATHEMATICS

We anticipate making several tenure-track appointments at the assistant professor level or above beginning with the academic year 1990-1991. Very strong research potential is required for junior-level appointments and a demonstrated outstanding record for senior-level appointments. A Ph.D. is required. Primary areas of interest are algebraic and differential geometry, discrete mathematics, dynamical systems, and computationally oriented mathematics. Exceptional candidates in other areas will be considered. Applications will be accepted until March 15, 1990, or until the positions are filled. Applicants should send vita and three letters of reference to: Chairman, Search Committee, Department of Mathematics, Virginia Tech, Blacksburg, VA 24016-0123. Women and minorities are encouraged to apply. Virginia Tech is an Equal Opportunity/Affirmative Action Employer.

DEPARTMENT OF STATISTICS UNIVERSITY OF CALIFORNIA AT BERKELEY

Pending final budgetary approval, we invite applications for a faculty position at any **tenured or tenure-track rank**, to begin July 1, 1990. We will consider strong candidates in any area of theoretical and applied statistics, probability and applied probability theory.

Interdisciplinary interests are encouraged and joint appointments are a possibility. The department is particularly interested in hearing from suitably qualified women or members of minorities currently under-represented in faculty positions. Send inquiries and applications including a resume and three references by November 30, 1989 to:

David R. Brillinger
Personnel Committee
Department of Statistics
University of California
Berkeley, CA. 94720

The University of California is an Equal Opportunity-Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA SANTA CRUZ

The Mathematics Department at the University of California, Santa Cruz is recruiting for a position in algebra or number theory. The teaching load is 4 one-quarter courses per year. Rank: Assistant Professor I-III. Minimum Qualifications: Ph.D. in Mathematics. Demonstrated achievements in, or potential for, research, teaching and professional service, commensurate with experience. Salary: $32,400–$34,900. Effective: July 1, 1990. Applicants should send vitae, information about their research and teaching experience and four letters of recommendation commenting on their teaching and research, to–Recruitment Committee, Mathematics Department, University of California, Santa Cruz, CA 95064. Closing Date: December 31, 1989. Please refer to #190-890 in your reply. UCSC IS AN EEO/AA/IRCA EMPLOYER

SAN JOSE STATE UNIVERSITY
Department of Mathematics and Computer Science
San Jose, California 95192-0103

Four openings for Assistant or Associate Professor (Professor in exceptional case) to start Fall 1990. Ph.D. in any mathematical science, we are especially looking for partial differential equations, numerical analysis, applied mathematics education, or computer science. Must have demonstrated high ability and interest in undergraduate teaching at all levels and be able to take an active role in departmental affairs. Rank and salary commensurate with experience. Significant professional activity required for eventual tenure consideration. Application deadline January 1, 1990. Send vita, three letters of reference, and transcripts to Dr. Veril L. Phillips, Chairman, SJSU is an Equal Opportunity/Affirmative Action Employer.

VANDERBILT UNIVERSITY DEPARTMENT OF MATHEMATICS NASHVILLE, TN 37235

ASSISTANT PROFESSOR (Ph.D. required) two positions with two year appointments beginning Fall, 1990. These are not tenure track appointments but are intended for individuals with demonstrated research potential who would like to spend time in a department with a vigorous research atmosphere. We are especially interested in individuals who work in one of the areas of deparmental strengths which include universal algebra, differential equations, approximation theory, operator theory, applied mathematics, graph theory, and topology. Have vita and four letters of recommendation (including one about teaching) sent to Professor Glenn Webb, Chairman.

VANDERBILT UNIVERSITY IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

UNIVERSITY OF CALIFORNIA AT BERKELEY
Department of Mathematics
Berkeley, CA 94720

CHARLES B. MORREY JR.
ASSISTANT PROFESSORSHIPS

We invite applications for these special two-year (non-tenure-track) positions effective July 1, 1990. Applicants should have a recent Ph.D. in the areas of algebra, analysis, applied mathematics, foundations, or geometry and topology, and should have demonstrated superior research potential. Applicants should send a resume, and reprints, preprints and/or dissertation abstract, and ask three people to send letters of recommendation to Andrew J. Casson, Vice Chair for Faculty Affairs, at the above address. We should receive this material no later than January 15, 1990. The University of California is an Equal Opportunity, Affirmative Action Employer.

POSITIONS AVAILABLE

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY DEPARTMENT OF MATHEMATICS

We are seeking a distinguished scholar as our nominee for the College of Arts and Sciences C. C. Garvin Visiting Endowed Professorship for the 1991-92 academic year. The position will be awarded to one of the three departments in the Mathematical Sciences Division of the college. The Visiting Endowed Professor will be expected to stimulate faculty research and to give one public lecture in the fall semester on a subject of interest to the general university community. Applicants should submit a curriculum vita by February 1, 1990 to: Chairman, Endowed Professorship Search Committee, Department of Mathematics, Virginia Tech, Blacksburg, VA 24061-0123. Women and minorities are encouraged to apply. Virginia Tech is an Equal Opportunity/Affirmative Employer.

MIAMI UNIVERSITY
Oxford, Ohio
Department of Mathematics and Statistics

anticipates a tenure track assistant professorship beginning August, 1990 in the area of mathematics education. Duties include teaching 8-9 hours per semester, continuing scholarship and service. Applicants should have (by 8/90) a doctorate in mathematics education or a doctorate in mathematics with expertise in mathematics education. Please send vita, transcripts and three reference letters to John Skillings, Math Education Search, Department of Mathematics and Statistics, Miami University, Oxford, Ohio 45056. Review of applications will commence on January 15, 1990. Women and minorities are encouraged to apply. Miami provides equal opportunity in employment and education. EOE/AA.

OREGON STATE UNIVERSITY

The Andreotti Assistant Professor position in mathematics will become available September 16, 1990. Salary depends on qualifications. Closing date is December 15, 1989. Write to:

Professor Bent Petersen, Chair
Andreotti Professorship Selection Committee
Department of Mathematics
Oregon State University
Corvallis, Oregon 97331-4605

Oregon State University is an Affirmative Action/Equal Opportunity Employer and complies with Section 504 of the Rehabilitation Act of 1973. OSU has a policy of being responsive to the needs of dual-career couples.

STAFF SELECTION COMMITTEE
B. E. Petersen, Chair
B. I. Fein
R. Higdon
R. M. Schori

UNIVERSITY OF CALIFORNIA DEPARTMENT OF MATHEMATICS DAVIS, CA 95616

Applications are invited for two or more anticipated tenure track positions in the Department of Mathematics, University of California, Davis, effective July 1, 1990. Appointments will be made at rank and salary commensurate with qualifications. Qualifications include a Ph.D. and an outstanding record or great promise in teaching and research. Duties include undergraduate and graduate teaching and mathematical research. We are interested in applicants in one or more of the following areas. Applicants should indicate in which area(s) they are applying: 1) Geometric Partial Differential Equations; 2) Mathematical Biology; 3) Algebra, particularly Algebraic Geometry and Lie Groups/Representation Theory; 4) Applied Analysis. The postmarked deadline for applications is December 18, 1989. An application consists of a curriculum vitae, list of publications, and at least three letters of reference sent to: Chair of Search Committee, Department of Mathematics, University of California, Davis, CA 95616. The University of California is an Equal Opportunity/Affirmative Action Employer.

THE UNIVERSITY OF NEW MEXICO
Albuquerque, New Mexico
Department of Mathematics and Statistics

The Department expects to have four tenure track positions available, beginning in the Fall Semester, 1990. We are particularly interested in candidates at the assistant professor level with postdoctoral experience, but we will consider outstanding applicants at all levels. Candidates must have a strong research record or outstanding potential and a commitment to excellence in teaching.

The Department of Mathematics and Statistics currently has 40 faculty members and an active and expanding graduate program. The Department has close research ties with Los Alamos and Sandia National Laboratories, and access to major computing facilities. Joint appointments with other departments are possible.

Review of applications will begin January 15, 1990, and will continue until the positions are filled. All exceptionally strong candidates, especially women and minority group members, are urged to apply. Please have vitae and three letters of reference sent to:

Professor Robert Cogburn, Chair
Hiring Committee
Dept. of Mathematics & Statistics
The University of New Mexico
Albuquerque, NM 87131

THE UNIVERSITY OF NEW MEXICO IS AN AA/EOE.

POSITIONS AVAILABLE

GEORGIA INSTITUTE OF TECHNOLOGY

The Center for Dynamical Systems and Nonlinear Studies expects to have some long and short-term visiting positions beginning Fall 1990. These positions are in nonlinear differential equations, dynamical systems, computational methods and related areas. In addition to a resume and at least three letters of reference, candidates should send a summary of future research plans to Professor Jack Hale, Director, CDSNS, Georgia Institute of Technology, Atlanta, Georgia 30332. Georgia Tech, a member of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

RUTGERS UNIVERSITY, CAMDEN

The Mathematical Sciences Department seeks highly qualified applicants for an anticipated assistant professorship. Tenure track, very low teaching for the first two years, competitive salary. Strong research credentials a necessity. Send resume, at least three letters of recommendation, and reprints/preprints **as soon as possible** to:

Search Committee
Mathematical Sciences
Department
Rutgers University
Camden, NJ 08102

AA/EOE.

MICHIGAN TECHNOLOGICAL UNIVERSITY
Department of Mathematical Sciences

We invite applications and nominations for the position of Department Head. The department offers B.S. and M.S. degrees and is developing a Ph.D. program. We have a strong commitment to research, especially in Applied Mathematics, and to excellence in undergraduate education. We are seeking a distinguished senior mathematician to further develop and enchance our programs. To apply, send a curriculum vitae and at least three letters of recommendation to Head Search Committee, Dept. of Math. Sciences, MTU, Houghton, MI 49931. MTU is an equal opportunity educational institution/equal opportunity employer.

BELOIT COLLEGE

Tenure track Assistant or Associate Professor beginning 8/90 to teach computer science and mathematics in a liberal arts setting. Qualifications: Ph.D. in a mathematical science, excellence in teaching, potential for growth. Computer Science and/or Statistics must be area(s) of professional interest. Apply by letter and full vita to R. Roy, Acting Chairman, Mathematics & Computer Science, Beloit College, 700 College St., Beloit, WI 53511; arrange for letters of reference and graduate and undergraduate transcripts to be sent. Deadline: 1 Feb 1990. Beloit College is an Affirmative Action/Equal Opportunity Employer.

FAIRFIELD UNIVERSITY
Tenure-track Position in Mathematics

An entry level Assistant Professor is sought to start in September 1990 who must have a Ph.D. in Mathematics and evidence of teaching ability. Normal teaching load is 3 courses per semester plus research. Salary is competitive and full consideration is given to dossiers completed by February 1, 1990. Please send a resume and three letters of reference to Joseph B. Dennin, Chair, Dept. of Math and Computer Science, Fairfield University, Fairfield, CT 06430-7524. Fairfield is a Jesuit University located 60 minutes from New York City. It is an Equal Opportunity/Affirmative Action Employer.

THE PENNSYLVANIA STATE UNIVERSITY
DEPARTMENT OF MATHEMATICS (N)
228 MC ALLISTER BUILDING
UNIVERSITY PARK, PA 16802

Applications are invited for tenure track faculty positions at all levels. Candidates from all areas of mathematics are welcome to apply (Ph.D. required). Inquiries should be accompanied by a vitae, publications record and a list of references to Professor Richard Herman, Chairman at the above address. Applications will be reviewed beginning October 15th, 1989 and continue until positions are filled.

AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER. WOMEN AND MINORITIES ENCOURAGED TO APPLY.

POSITIONS AVAILABLE

RICE UNIVERSITY
Department of Mathematics

Applications are invited for a tenure track assistant professorship. There is a possibility of an upgrade to associate or full professorship for an exceptional senior candidate. Candidates must have an extremely strong research background and good teaching skills. Preference will be given to applicants in low-dimensional topology, although outstanding candidates in analysis, geometry, and topology will also be considered.

Please send a curriculum vitae and at least 3 letters of recommendation to: Appointments Committee, Department of Mathematics, Rice University, P.O. Box 1892, Houston, Texas 77251.

Rice University is an Equal Opportunity/Affirmative Action Employer.

RICE UNIVERSITY

Griffith Conrad Evans Instructorships. Postdoctoral appointments for two to three years for promising research mathematicians with research interests in common with the active research areas at Rice. Applications should be in by 15 January 1990. Rice University is an Equal Opportunity/Affirmative Action Employer. Inquiries and applications should be addressed to Chairman, Evans Committee, Department of Mathematics, Rice University, Box 1892, Houston, Texas 77251.

SAINT OLAF COLLEGE
NORTHFIELD, MINNESOTA 55057

One two-year postdoctoral position, partially funded by the Fund for the Improvement of Post-Secondary Education. This position is half time teaching (three courses/year) and half time research. Unlike most postdoctoral positions, there will be a strong emphasis upon developing the teaching aspect of an academic career through a mentored internship. This position is allotted generous research and professional travel budgets. Salary: $31,500. For new or recent Ph.D.'s only. Write to Professor Paul D. Humke, Mathematics Department, St. Olaf College, Northfield, MN 55057. St. Olaf is an Equal Opportunity Affirmative Action Employer.

MIAMI UNIVERSITY
Oxford, Ohio
Department of Mathematics and Statistics

anticipates a tenure track assistant professorship beginning August, 1990. Duties include teaching 8-9 hours per semester, continuing scholarship and service. Applicants should have a Ph.D. in pure or applied mathematics by 8/90. Please send vita, graduate transcript and three reference letters to John Skillings, Mathematics Search, Department of Mathematics and Statistics, Miami University, Oxford, Ohio 45056. Review of applications will commence on January 15, 1990. Women and minorities are encouraged to apply. Miami provides equal opportunity in employment and education.

LOYOLA UNIVERSITY OF CHICAGO

The Department of Mathematical Sciences anticipates at least one tenure track position and some visiting positions beginning in August, 1990. Requirements are the Ph.D., an active research program in any area, and a commitment to quality teaching. The department offers courses in mathematics, computer science, and statistics at the undergraduate and masters level. Interviews will begin in January and continue until all positions are filled. Send detailed C.V. and three letters of recommendation to Professor R. J. Lucas, Department of Mathematical Sciences, Loyola University, Chicago, IL 60626. Loyola University of Chicago is an Equal Opportunity/Affirmative Action Employer.

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
DEPARTMENT OF MATHEMATICS

We are seeking applications for one senior visiting appointment (Associate or Full Professor) for the academic year 1990–1991. Duties are expected to include teaching a topics course and interacting with faculty and graduate students. The review of applications will begin on November 15, 1989 and continue until the position is filled. To apply submit a curriculum vita to: Chairman, Senior Visitor Search Committee, Department of Mathematics, Virginia Tech, Blacksburg, VA 24061-0123. Women and minorities are encouraged to apply. Virginia Tech is an Equal Opportunity/Affirmative Action Employer.

POSITIONS AVAILABLE

EMBRY-RIDDLE AERONAUTICAL UNIVERSITY DEPARTMENT OF MATHEMATICS & PHYSICAL SCIENCE

Mathematics: Tenure-track entry level positions beginning Spring and Fall 1990. A commitment to teaching excellence and scholarly activities is essential. Ph.D. in Applied Mathematics required. The department offers a B.S. degree in Engineering, Physics and provides support courses for other Programs throughout the campus. We offer a comprehensive compensation/benefits package. Send a letter of interest, resume and three letters of reference to: Chair, MA/PS Department (NOTICES/NOV), c/o Office of Human Resources, Embry-Riddle Aeronautical University, Daytona Beach, FL 32114-3900. EOE

ROSE-HULMAN INSTITUTE OF TECHNOLOGY DEPARTMENT OF MATHEMATICS

A tenure-track assistant or associate professorship will be available September 1, 1990. Applicants should have a Ph.D. in mathematics or statistics and a strong commitment to teaching and scholarship. Ability and interest to teach statistics, operations research and/or applied mathematics is desirable. Send letter of application, resume, three letters of recommendation and graduate transcripts to George Berzsenyi, Chairman, Department of Mathematics, Rose-Hulman Institute of Technology, Terre Haute, IN 47803.

Rose-Hulman Institute of Technology is an equal opportunity employer.

BOSTON UNIVERSITY DEPARTMENT OF MATHEMATICS

The Department of Mathematics at Boston University anticipates an opening for an Assistant Professor in Probability for Fall 1990. Outstanding candidates should be able to teach courses in Operations Research. Preference given to applicants with a strong theoretical background and a commitment to teaching. Send vita and 3 letters of reference to: Murad Taqqu, Department of Mathematics, Boston University, 111 Cummington St., Boston, MA 02215. AA/EOE.

WILLIAMS COLLEGE
Department of Mathematics
Williamstown, Massachusetts 01267

Three anticipated positions, probably at the rank of assistant professor, for Fall 1990. Strong Commitment to both teaching and scholarship is essential.

Please have a vita and three letters of recommendation on teaching and research sent to Frank Morgan, Chair. Evaluation of applications will continue until positions are filled.

AA/EOE

CANISIUS COLLEGE DEPARTMENT OF MATHEMATICS

Applications are invited for a tenure track position in mathematics to begin in late August 1990. Applicants must have the Ph.D. in mathematics and a strong commitment to quality teaching. Salary and fringe benefits are competitive commensurate with credentials and experience. Applicants should send resume, transcripts and three letters of recommendation to Dr. Richard Escobales, Chairman, Department of Mathematics, Canisius College, Buffalo, NY 14208. AA/EOE.

POSITION WANTED

I earned a Ph.D. from Harvard in 1973, an M.D. from the Univ. of Miami in 1978, and have done both number theory and family practice. I am now interested in mathematical biology and modelling in medicine. Will consider both academic and private sector, association with medical school ideal. If interested contact Joseph E. Carroll, 1355 Fickle Hill Road, Arcata, Ca. 95521. 707-822-7371.

FOR SALE

Symbolism: Sculptures and Tapestries, by John Robinson. Catalogue produced for the POP Maths Roadshow, Leeds, Sept., 1989. Colour photographs of 4 tapestries: 14 symbolic and 5 representational sculptures. Beautifully crafted, mainly in bronze. Includes trefoil, (8, 3) and (15, 4) torus knots. Comments by John Robinson and Ronnie Brown. Order from: Mathematics and Knots, University of Wales, Bangor, Gwynedd LL57 1UT, U.K. Fax: (248)361429:email: R.Brown&UK.AC.Bangor.VAXA
(£6 sterling, P/P £1.20 Surface, £2.60 Air: Mastercard/VISA to home address).

American Math Monthly and Bulletin of AMS from 1961. Bound volumes. Am retiring and am willing to negotiate at bargain prices for the entire collection. For details write to Prof. Bert Ross, Math Dept. Univ. of New Haven, West Haven, Conn. 06516

INSTITUTE FOR MATHEMATICS AND ITS APPLCATIONS

ANNOUNCES A NEW PROGRAM

PHASE TRANSITIONS AND FREE BOUNDARIES

ADVISORY COMMITTEE: H. Brezis, L. A. Caffarelli, D. Kinderlehrer, J. Serrin
ORGANIZING COMMITTEE: R. Fosdick, M. E. Gurtin, W.-M. Ni, L. A. Peletier

A one-year program with two components:

September 1990 - January 1991: Phase Transitions

Evolution of Phase Boundaries

Modern Calculus of Variations in Materials Science

Shock Induced Transitions and Phase Structures in General Media

Statistical Thermodynamics and Differential Geometry of Microstructured Material

January - June 1991: Free Boundaries

Degenerate Diffusions

Variational Problems and Applications

Free Boundaries in Viscous Flows

POSTDOCTORAL MEMBERSHIPS

All requirements for a doctorate should be completed by September 15, 1990. Applicants must show evidence of mathematical excellence, but they do not need to be specialists in the field. The following materials must be submitted (all material should arrive by January 15, 1990):

(1) Personal statement of scientific interests, research plans, and reasons for wishing to participate in this program. (This is an essential part of the application.)
(2) Curriculum vitae and a list of publications.
(3) Three letters of recommendation, to be sent directly to the IMA.

SENIOR MEMBERSHIPS

Preference will be given to supplementary support for persons with sabbatical leaves, fellowships, or other stipends.

All correspondence should be sent to

VISITING MEMBERSHIP COMMITTEE
INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS
UNIVERSITY OF MINNESOTA
514 VINCENT HALL
206 CHURCH ST. S.E.
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MAY 14 - JULY 13, 1990

MAY 14 - JUNE 8:

Informal rencontre involving extended, in-depth interaction on partially formulated and unsolved problems.

Partial list of invitees

E. Di Benedetto (Northwestern)
S. Davis (Northwestern)
P. Fife (Utah)
J. Glim (Courant)
J. Keller (Stanford)
L. Caffarelli (IAS, Princeton),
C. Evans (Maryland)
A. Friedman (Minnesota)
S. Howison(Oxford)
P. Ortoleva (Indiana)

Postdoctoral fellows and advanced graduate students are encouraged to apply for financial support.

Organizers: *J. Chadam and H. Rasmussen*

JUNE 13 - JUNE 22:

The fifth of a series of triennial International Colloquia on Free Boundary Problems: Theory and Applications.

Invited participants

H.-W. Alt (Bonn)
E. DiBenedetto (Northwestern)
C.Baiocchi (Pavia)
Ph. Benilan (Besançon)
H. Brézis (Paris VI & Rutgers)
L. Caffarelli (IAS, Princeton)
M. Chipot (Metz)
A. Damlanian (Ecole Poly., France)
S. Davis (Northwestern)
P. Fife (Utah)
A. Friedman (Minnesota)
M. Glicksman (RPI, Troy)
J. Glimm (Courant)
S. Howison (Oxford)
L.S. Jiang (Suzhou)
S. Kamin (Tel Aviv)
J. Keller (Stanford)
D. Kinderlehrer (Minnesota)
P. Knabner (Augsburg)
S. Luckhaus (Heidelberg)
E. Magenes (Pavia)
G. Meyer (Georgia Tech.)
P. Ortoleva (Indiana)
R. Pego (Michigan)
R. Ricci (Firenze)
G. Sivashinsky (Tel Aviv)
I. Stakgold (Newark)

Those interested in applying for the limited number of spaces should contact the organizers a.s.a.p.

Organizers: *J. Chadam and H. Rasmussen*

JUNE 25 - JULY 13:

Séminaire de Mathématiques Supérieures (29th session) on "Shape Optimization and Free Boundary Problems".

This related event is a NATO-ASI organized by the Département de Mathématiques et de Statistique of the Université de Montréal.

Partial list of lecturers

H. Brézis (Paris VI & Rutgers)
J. Chadam (McMaster)
M. Delfour (Montréal)
A. Fasano (Firenze)
M. Fortin (Laval)
O. Pironneau (Paris VI & INRIA)
J. Sokolowski (Warsaw)
I. Stakgold (Newark)
R. Temam (Orsay & Bloomington)
J. Vazquez (Madrid)
J. P. Zolésio (Montpellier)

It is expected that partial financial assistance will be available for a certain number of participants. Priority will be givento graduate students. For information and registration forms, please contact Ms. Ghislaine David (Secrétaire / Séminaire de Mathématiques Supérieures, Université de Montréal, C.P. 6128-A, Montréal, Québec, Canada, H3C 3J7, Tel.:(514) 343-6710).

Organizers: *M. Delfour (Scientific Organizer) and A. Daigneault (Permanent Director)*

To request detailed information about any of the above activities, please contact organizers directly at:

J. Chadam or H. Rasmussen
Department of Mathematic
Mc Master University
Hamilton, Ontario, Canada
L8S 4K1
Tel.: (416) 525-9140
Fax: (416) 528-5030
e-mail:chadam@mcmaster.bitnet

M. Delfour
Dépt. de math. et de Stat.
Université de Montréal
C.P. 6128-A,Montréal (Québec)
Canada, H3C 3J7
Tel.: (514) 343-7265 / 7501
Fax: (514) 343-2254
e-mail: delfour@cc.umontreal.ca

Ms. Sylvie Chênevert or
Ms. Josée Roy
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Assistantships and Graduate Fellowships in the Mathematical Sciences, 1990-1991

Assistantships and Graduate Fellowships in the Mathematical Sciences, 1990-1991, continues to provide vital information about university graduate mathematics programs. In addition, it includes information on thesis and foreign language requirements within each listing.

Up-To-Date

The up-to-date information contained within the pages of *A&GF* is compiled from data supplied by university departments. The list of assistantships and graduate fellowships includes approximately 409 departments of mathematics, applied mathematics, statistics, computer science, and related mathematical disciplines; these represent about 337 colleges and universities. A section on stipends for study and travel and addresses of sources of graduate fellowship information is also included.

Wide Distribution

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30	Functions of a complex variable
31	Potential theory
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45	Integral equations
46	Functional analysis
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*The annual dues for **external members**, those who reside in developing countries which do not have any mathematical society, are $49.*

*Members can purchase a **multi-year membership** by prepaying their current dues rate for either two, three, four or five years. This option is not available to either unemployed or student members.*

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MAA Minicourse Preregistration Form, Louisville, Kentucky

January 17–20, 1990

NOTE: This is NOT an AMS Short Course Form. Please use the Joint Meetings Pregistration/Housing Form to preregister for the AMS Short Course.

To register for MAA Minicourse(s), please complete THIS FORM or a PHOTOCOPY OF THIS FORM and return it with your payment to:

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1529 Eighteenth Street, N.W.
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Telephone: 202-387-5200

____ Telephone: __________________
(Please print) Surname First Middle

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Street address City State Zip

- Deadline for MAA Minicourse preregistration: November 17, 1989 (After this date, potential participants are encouraged to call the MAA headquarters at 800-331-1622.)
- Deadline for cancellation in order to receive a 50% refund: January 3, 1990
- Each participant must fill out a separate Minicourse Preregistration form.
- Enrollment is limited to two Minicourses, subject to availability.
- Please complete the following and send both form and payment to Susan Wilderson at the above address:

  I would like to attend ☐ 1 Minicourse ☐ 2 Minicourses

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  In order of preference, my alternatives are: #___ and #___
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2. Finite-Pak - Software for Linear Programming	Marvin L. Bittinger & J. Conrad Crown	$50
3. Random mappings	Bernard Harris	$30
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Instructions for Applicant's Form on facing page

The form. Applicants' forms submitted for the Employment Register will be photographically reproduced in the December 1989 issue of *Employment Information in the Mathematical Sciences (EIMS).* Résumés of those attending will be posted at the meeting.

The forms **must be** carefully typed using a fresh black ribbon. The best results are obtained with a carbon-coated polyethylene film ribbon, but satisfactory results may be obtained using a ribbon made of nylon or other woven fabric if suitable care is exercised. It is important that the keys be clean and make a sharp, clear impression. Do not erase—it causes smudges which reproduce when photographed. Use a correcting typewriter or correction tape or fluid if necessary. Submit the original typed version only. Copies will not reproduce properly and are not acceptable. **Hand lettered forms will be returned.**

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AL = Algebra	AN = Analysis
BI = Biomathematics	BS = Biostatistics
CB = Combinatorics	CM = Communication
CN = Control	CS = Computer Science
CT = Circuits	DE = Differential Equations
EC = Economics	ED = Mathematical Education
FA = Functional Analysis	FI = Financial Mathematics
FL = Fluid Mechanics	GE = Geometry
HM = History of Math	LO = Logic
MB = Mathematical Biology	ME = Mechanics
MO = Modelling	MP = Mathematical Physics
MS = Management Science	NA = Numerical Analysis
NT = Number Theory	OR = Operations Research
PR = Probability	SA = Systems Analysis
ST = Statistics	TO = Topology

(B) Career Objectives

AR = Academic Research	AT = Academic Teaching
NR = Nonacademic R&D	NC = Nonacad. Consulting
NS = Nonacademic Supervision	

(H) (I) Duties

T = Teaching	U = Undergraduate
G = Graduate	R = Research
C = Consulting	A = Administration
S = Supervision	IND = Industry
GOV = Government	DP = Data Processing

Location

E = East		S = South
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Mailing address (include zip code) ____________________

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Ⓑ Career objectives and accomplishments

ACADEMIC: ☐ Research, ☐ Teaching

NON-ACADEMIC: ☐ Research and Development, ☐ Consulting, ☐ Supervision

Near-term career goals____________________

Significant achievements or projects, including role____________________

Honors and offices____________________

Other (e.g., paper to be presented at THIS meeting)____________________

Selected titles of papers, reports, books, patents____________________

Ⓒ Degree Year Institution

Ⓓ No. of abstracts, internal reports______

Ⓔ No. of papers accepted______

Ⓕ No. of books and patents______

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	Present	Previous	Previous
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Position			
Ⓗ Duties			
Years	to	to	to

DESIRED POSITION:____________________

Ⓘ Duties____________________

Ⓙ Available mo.____ /yr.____ Location____________ Salary______

Ⓚ References (Name and Institution)

Ⓛ Citizenship: (check one) ☐ U.S. Citizen ☐ Non-U.S. Citizen, Permanent Resident

☐ Non-U.S. Citizen, Temporary Resident

Ⓜ AVAILABLE FOR INTERVIEWS:

(Interviews for Session 4 scheduled on the basis of employer's request only.)

Session 1 ☐ **Thurs. AM 9:30-11:45**

Session 2 ☐ **Thurs. PM 1:15-5:00**

Session 3 ☐ **Fri. AM 9:30-11:45**

Session 4 ☐ **Fri. PM 1:15-5:00**

I do not plan to attend the Louisville meetings ☐

EMPLOYER FORM MATHEMATICAL SCIENCES EMPLOYMENT REGISTER LOUISVILLE, KENTUCKY JANUARY 17-19, 1990

INSTRUCTIONS: Please read carefully before completing form 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 at the Register exactly as submitted. The SUMMARY STRIP (be sure to complete) will be used to prepare a computer printed list of summaries for distribution at the Register sessions. Employers are encouraged to provide more than one interviewer when they are able to do so, in order to increase the number of interviews which may be scheduled. Please take care to indicate on the Form the number of interviewers for whom simultaneous interviews may be scheduled. (If all interviewers will be interviewing for the same position, or for the same set of positions, only one form should be submitted and only one employer code number will be assigned; therefore, each interviewer would then receive a separate computer schedule and separate table number.) More than one employer code will be required if some interviewers will not interview for all positions. Thus, if there are two disjoint sets of positions, two forms are required and two employer codes will be assigned. **(Please refer to the section on the Employment Register following the Louisville meeting announcement.)**

EMPLOYER CODE Institution __________ Dept. __________

Name of Interviewer(s) 1. __________ 2. __________

3. __________ 4. __________

City, State, Zip __________

(A) Title(s) of Position(s) __________ (B) Number of Positions _____ Number of People Supervised _____

(C) Starting Date ____ mo. / ____ yr. Salary _____ (D) Term of Appointment _____ yrs. (E) Renewal ( ) Possible ( ) Impossible Tenure Track Position Yes ( ) No ( ) Unknown ( )

Teaching hrs./wk _____ (F) Specialties Sought __________

(G) Degree Preferred _____ (H) Degree Accepted _____ (I) Duties _____ (J) Experience _____ (K) Citizenship Restriction _____

(L) Available for Interviews **Session 1 ( ) Thurs. AM, 9:30-11:45** **Session 2 ( ) Thurs. PM, 1:15-5:00** **Session 3 ( ) Fri. AM, 9:30-11:45** **Session 4 ( )* Fri. PM, 1:15-5:00**

(M) Number of Interviewers ____ **Interviewers** ____ **Interviewers** ____ **Interviewers** ____ **Interviewers**

Institution City State (A) Title of position (B) No. (C) Start mo. / yr.

(D) (E) (F) Specialities sought (G) (H) (I) Duties (J) Experience (K) (L) Sessions

NOTES: (A) Inst, Lect, Asst Prof, Asso Prof, Prof, Dean, Open, MTS (Member Technical Staff), OPAN (Operations Analyst), PREN (Project Engineer), RESC (Research Scientist); (C) Date e.g. 01/90; (E) Possible=P, Impossible=I; (F) Algebra=AL, Analysis=AN, Biomathematics=BI, Biostatistics=BS, Combinatorics=CB, Communication=CM, Control=CN, Computer Science=CS, Circuits=CT, Differential Equations=DE, Economics=EC, Mathematical Education=ED, Functional Analysis=FA, Financial Mathematics=FI, Fluid Mechanics=FL, Geometry=GE, History of Mathematics=HM, Logic=LO, Mathematical Biology=MB, Mechanics=ME, Modeling=MO, Mathematical Physics=MP, Management Science=MS, Numerical Analysis=NA, Number Theory=NT, Operations Research=OR, Probability=PR, Systems Analysis=SA, Statistics=ST, Topology=TO; (G)(H) Bachelor=B, Master=M, Doctor=D; (I) (J) Teaching=T, Undergraduates=U, Graduates=G, Research=R, Consulting=C, Administration=A, Supervision=S, Industry=IND, Government=GOV, Data Processing=DP, no experience required=N; (K) U.S. Citizen=C, U.S. Citizen or permanent resident=CP, No restriction=NR; (L) Periods available for interviews: Check 1, 2, 3, and/or 4, see the FORM above.

* Interviews are scheduled in this session on the basis of employers request only.

Preregistration/Housing Form, Louisville, Kentucky

January 17–20, 1990

Please complete this form and return it with your payment to
Mathematics Meetings Housing Bureau
P.O. Box 6887, Providence, Rhode Island 02940 – Telephone: (401) 272-9500, Ext. 290-Telex: 797192

DEADLINES:

Room Lottery Qualification	October 31, 1989
Preregistration/Employment Register/Hotel Reservations	November 17, 1989
Final Preregistration ONLY	December 18, 1989
Housing Changes/Cancellations	December 15, 1989
50% Refund on Preregistration/Employment Register/Banquets	January 3, 1990 (no refunds after this date)

	REGISTRATION FEES Preregistration by December 18, 1989	At Meeting
JOINT MATHEMATICS MEETINGS	$	$
Member of AMS, CMS, MAA	68	88
Nonmember	105	136
* Student, Unemployed, or Emeritus	21	27
AMS SHORT COURSE		
Member/Nonmember	40	50
* Student or Unemployed	15	20
EMPLOYMENT REGISTER – Employer fee (1st Interviewer)	75	100
– Employer fee (2nd / 3rd Interviewer)	35	50
– Applicant fee	15	20
– Posting fee for job descriptions for noninterviewing employers	10	15

(N.B.: A separate form appears in this issue for preregistration for MAA Minicourses)

* All full-time students currently working toward a degree or diploma qualify for the student registration fees, regardless of income. 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 from their latest position. The emeritus status refers to any person who has been a member of the AMS or MAA for twenty years or more and is retired on account of age or on account of long term disability from his or her latest position.

PREREGISTRATION SECTION: Please check the function(s) for which you are preregistering:

Joint Meetings ☐ AMS Short Course (January 16–17, 1990) ☐ Employer ☐ Co-Interviewer ☐ Applicant ☐ Posting ☐

1) ______________________________ Telephone: ______________
(Please print) Surname First Middle

2) ______________________________
(Mailing address for acknowledgement, badge, and program) **I do not wish my badge and program to be mailed** ☐

3) Badge information: a) Nickname (optional):__________ b) Affiliation __________ c) City&State __________

4) I am a student at __________ 5) Emeritus member ☐ Unemployed ☐ MR Classification # __________ MR Reviewer ☐

6) Accompanied by spouse __________ Number of children __________ (Enumerate only if accompanying to meeting)
(name)

7) Member of AMS ☐ CMS ☐ MAA ☐ Nonmember ☐ Member of other organizations: AWM ☐ NAM ☐

8) Joint Meetings fee $ ______ 9) **AMS** Short Course fee $ ______ 10) Employer fee(s) $ ______ 11) Co-Interviewer fee(s) $ ______

12) Applicant fee $ ______ 13) Posting fee $ ______ 14) Hotel deposit $ ______ **(necessary ONLY if paying deposit by check)**

15) ______ AMS 25-Year Banquet ticket(s) @ $20 each = $ ______ 16) ______ NAM Banquet ticket(s) @ $20 each = $ ______

17) TOTAL AMOUNT ENCLOSED FOR 8 through 16 $__________ NOTE: May be paid by check payable to AMS (Canadian checks must be marked "U.S. Funds") or VISA or MasterCard credit cards.

Credit card type: __________; Card number: ______________________; Expiration date: __________
If this is your credit card, please print your name as it appears on the credit card on the line below as well as sign your name.
If this is not your credit card, please print card holder's name as it appears on the credit card on the line below, and have the card holder sign:

____
(Printed name) (Signature)

Please complete the appropriate sections on the reverse.

For office use only:

Codes:	Options:	Hotel:	Room type:
Dates:	Hotel Deposit	Total Amt. Paid:	
Special Remarks:			

HOUSING SECTION: PREREGISTRATION/HOUSING FORM, Louisville, Kentucky January 17–20, 1990

☐ PLEASE CHECK HERE IF YOU WILL **NOT** REQUIRE A ROOM

☐ PLEASE CHECK HERE IF YOU WILL BE STAYING AT A HOTEL/MOTEL **NOT** LISTED BELOW

EVEN IF HOUSING IS NOT NEEDED, PLEASE GIVE ARRIVAL/DEPARTURE DATES BELOW.

Please rank hotels in order of preference by writing 1, 2, 3, etc. in the spaces at the left on form, and by circling the requested room type and rate. If the rate requested is no longer available, you will be assigned a room at another hotel at the next available rate. **If not all hotels are ranked, and all rooms have been filled at the ranked hotels, the assignment will be made at an unranked hotel with the next available rate.** Rates listed below are subject to 9.2% sales/occupancy tax.

The following hotels have nonsmoking rooms, based on space availability, and are also equipped for the handicapped.

GUARANTEE REQUIREMENTS: $50 by check **OR** a credit card guarantee with VISA, MasterCard, or American Express (for housing only). No other credit cards will be accepted for room guarantees. PLEASE SUPPLY THIS INFORMATION ON THE REVERSE, together with mailing address for confirmation of room reservation.

Order of choice		Single	Double 1 bed	Double 2 beds	Triple 2 beds	Triple 2 beds w/cot	Quad 2 beds	Quad 2 beds w/cot	Suites
		$	$	$	$	$	$	$	$
	Hyatt Regency (Headquarters Hotel)	60	65	65	75	85	85	95	195–325
	Galt House East (All Suites)	59	63	63	63	N/A	68	N/A	400
	The Brown	58	58	58	64	N/A	64	N/A	200–300
	Seelbach	55	60	60	65	80	70	85	225
	Galt House	49	53	53	53	N/A	58	N/A	200

Special housing requests: ______________________________

I will arrive on (date) ____________ at ____________ a.m./p.m., and depart on (date) ____________ at ____________ a.m./p.m.

Please list other room occupants; indicating ages of children.

FULL NAME	ARRIVAL DATE	DEPARTURE DATE

Available from JPBM:

MATHEMATICAL POSTERS AND POSTCARDS

On the occasion of Mathematics Awareness Week, the Joint Policy Board for Mathematics commissioned the printing of the posters and postcards that were designed to acquaint the public with this year's theme, "Mathematics: Discovering Patterns". Copies are still available of these well-designed objects:

A. Five-color poster, size 16x20 inches, suitable for framing and ideal as a gift. The poster shows a photograph of silicon bronze sculpture by Helaman Ferguson, *Umbilic Torus.* **$5**

B. Black and white poster with the Mathematics Awareness Week theme, from *Tilings and Patterns,* by Branko Grünbaum and G. C. Shephard. **$3**

C. Set of 20 color postcards, 10 each of two different bronze works by Helaman Ferguson, *Torus with Cross Cap,* and *Alexander's Horned Wild Sphere, Five Bifurcations.* **$10**

D. Set of 20 color postcards, 5 each of four different fractal images. Limited supply from the 1988 Mathematics Awareness Week. **$10**

Proceeds will be used to start a fund to underwrite the JPBM Communications Award, given the first time in 1988 to James Gleick for his bestseller *CHAOS*. Your purchase of these postcards and the poster will help promote a better public understanding of mathematics.

Please specify your order, indicating the quantity desired, by using the appropriate letter for that item. Send a check, payable to American Mathematical Society, to:

JPBM Visuals
818 Connecticut Ave., NW
Suite 515
Washington, DC 20006

"The importance of the program cannot be overlooked ... it so fundamentally alters the mechanics of mathematics."

New York Times

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William Thurston
Professor of Mathematics,
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William Press
Professor of Astrophysics,
Harvard University

1990 Mathematica Conference
January 11-13, 1990
Redwood City, California

Mathematica®

A System for Doing Mathematics by Computer

Some facts:

Function: Numerical, symbolic, graphical computation, interactive programming. Integrated technical computing environment.

Numerical Computation: Arbitrary precision arithmetic, complex numbers, special functions (hypergeometric, elliptic, etc.), combinatorial and integer functions. Matrix operations, root finding, function fitting, Fourier transforms, numerical integration, minimization, linear programming.

```
In[1]:=
3^70
Out[1]=
2503155504993241601315571986085849
In[2]:=
Hypergeometric2F1[7,5,4.1,3-I]
Out[2]=
-0.00403761 - 0.00295663 I
```

Numerical Computation

Symbolic Computation: Equation solving, symbolic integration, differentiation, power series, limits. Algebraic operations, polynomial expansion, factorization, simplification. Operations on matrices, tensors, lists.

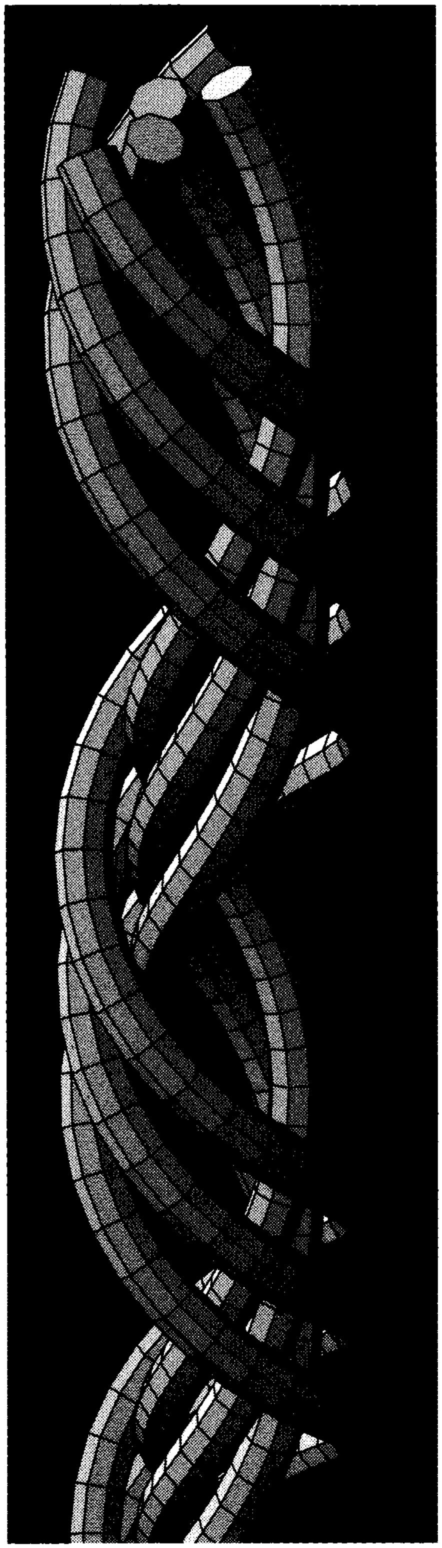
Graphics: 2D, 3D plots of functions, data, geometrical objects. Contour, density plots. 3D rendering with intersecting surfaces, lighting models, symbolic descriptions. Color PostScript output, publication quality graphics, animation (most versions).

```
In[1]:=
Integrate[x/(a + Exp[x]), x]
Out[1]=
  2                 x
 x      x Log[1 + E  ]
---- - -------------
 2a          a
                        x
              PolyLog[2, -(E /a)]
            - -------------------
                       a
```

Symbolic Computation

Programming: High-level, interactive, symbolic system. Full procedural language, functional programming constructs. General transformation rule paradigm based on pattern matching.

External Interface: Input from external files, programs. Output in TeX, C, FORTRAN, PostScript. Interactive external process control (most versions).



Graphics and Visualization

Macintosh User Interface: Notebook interactive documents mixing text, graphics, animations, *Mathematica* input, output. Macintosh front end can be used with kernels on other computers. Macintosh graphics standards used.

Documentation: "*Mathematica*: A System for Doing Mathematics by Computer" by Stephen Wolfram (Addison-Wesley, 1988) available at bookstores. Additional documentation supplied with specific versions. *Mathematica* Journal to be published in 1990.

Versions Now Available: Apple Macintosh: $495 (Plus, SE, etc.); $795 (II, IIx, IIcx, SE/30, etc.) • 386-based MS-DOS systems: $695 (no coprocessor); $995 (287/387); $1295 (Weitek) • Apollo DN 3000, 4000: $2400 • DEC VAX VMS, ULTRIX, DECstation: from $2400 • Hewlett-Packard 9000/300, 800: from $2400 • IBM AIX/RT: $2400 • MIPS: from $2800 • NeXT: bundled as standard system software • Silicon Graphics IRIS-4D: from $2800 • Sony NEWS: from $2400 • Sun 3, 4, 386i: from $2250 • Supercomputer and other versions also available. • Educational, volume, reseller, and other discounts available • Now shipping Version 1.2.

```
log[1] = 0
log[E] = 1
log[x_ y_] := log[x] + log[y]
log[x_^n_] := n log[x]
log'[x_] = 1/x   (* derivative *)
log/: InverseFunction[log] = exp
log/:
Series[log[x_], {x_, 1, n_}] :=
  Sum[-(-1)^k (x-1)^k/k, {k,1,n}] +
                        O[x,1]^(n+1)
```

High-Level Programming

Implementation: 770 pre-defined *Mathematica* functions (C source 180,000 lines). Design, development led by Stephen Wolfram. Version 1.0 released June 1988.

Typical Applications: Research, engineering, education, mathematical modeling, publication graphics, data analysis, visualization, systems analysis, algorithm development.

Awards: Best 10 New Products, *Business Week* 1988 • Editor's Choice Award, *MacUser* 1989 • Award of Distinction, *BYTE* 1988.

Wolfram Research, Inc.

P.O. Box 6059, Champaign, IL 61826-6059, USA.
Information: 217-398-0700. Orders: 800-441-MATH.
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