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Curriculum Recommendations Grades 11–13 The NCTM/MAA Task Force Report

Donovan R. Lichtenberg

In 1986, the National Council of Teachers of Mathematics and the Mathematical Association of America established a joint Task Force on the Mathematics Curriculum for Grades 11–13. A five-person Executive Committee and a 16-member Corresponding Committee comprised this Task Force. Members of the Executive Committee included Joan P. Leitzel (Chair) of Ohio State University, Philip C. Curtis of the University of California at Los Angeles, Charles L. Hamberg of the Illinois Mathematics and Science Academy, Donovan R. Lichtenberg of the University of South Florida, and Ann E. Watkins of Los Angeles Pierce College.

The Task Force was asked to develop a recommended mathematics curriculum for grades 11–13 for high school and college students who intend to pursue careers dependent upon mathematics. The Task Force's report is now available and its primary recommendations are summarized below.

The Task Force studied numerous national reports on the status of mathematics education, the recommendations of many national and state boards, and the reports of several current curriculum projects. These sources clearly indicated that the present situation in mathematics education is very dynamic and that significant changes in the curriculum of grades 11–13 are likely in the next few years. However, these sources also revealed a general consensus within the profession on many issues related to the curriculum in grades 11–13. This consensus prompted the following recommendations by the Task Force.

Four Years of Mathematics Needed College-bound students should take mathematics in all years of secondary school; this mathematics should include the content of geometry and intermediate algebra.

Geometry Geometry in both two and three dimensions, coordinate geometry, and the development of geometric perception are essential parts of college preparatory mathematics.

Programming Courses Should Not Replace Mathematics Although computer programming remains an important tool for all college-bound students, courses in computer programming should not be regarded as substitutes for college preparatory mathematics. *(Recommendations continued on page 5)*

College Mathematics at ICME-6

Paul Zorn

The Sixth International Congress on Mathematical Education (ICME 6), held in Budapest, Hungary was no ordinary mathematical conference. Over 3,000 conferees and guests were there, representing scores of countries, countless professional specialties, and every level of mathematics education, from early childhood to graduate school and beyond. The activities of the Congress were just as varied. There were plenary lectures to audiences of thousands, area keynote addresses to groups of several hundred, all kinds of informal presentations and demonstrations, discussion groups, poster sessions, software demonstrations, a full-day special program on Mathematics and Society, weekend tours, an elegant reception at the Hungarian National Gallery, and a well-provisioned daily "happy hour."

ICME-6 was also unusual in that, although there was plenty of mathematics to be heard, the principal focus was mathematics *education*, in the broadest sense: How do students learn mathematics? What mathematics do they—and don't they—learn? What *should* they learn. How do we teach students and teachers? How should we? How do technology, culture, human psychology, economics, and politics affect all of this?

As at every good conference, some of ICME's most valuable meetings were informal. Former strangers became colleagues in lectures, discussion groups, on streetcars, or waiting in line for morning coffee. Where else could one compare notes on elementary calculus in Ghana, Britain, the Ivory Coast, India, Singapore, Hungary, China, and West Germany?

Fully "covering" college-level mathematics at ICME-6 would be impossible. Sheer size was one problem. In addition, college mathematics, although *officially* the topic of only one smallish subset of the Congress, refused to be confined within rigid programmatic boundaries. Issues of emerging technologies, differing cultural conditions, and new research in cognitive science all touch mathematics at every level. This report only samples—quite randomly—an enormous variety of college mathematics at ICME-6.

(ICME-6 will be continued on page 3.)

MAA Section Awards for Meritorious Service see pages 6–7
FOCUS on Publications: MAA Awards for Expository Writing see pages 8–9

Classroom Computer Gap? Ershov of USSR on Plans and Reform

Jeremy Kilpatrick

Links between *perestroika* and reforms in mathematics education were part of Andrei Ershov's address outlining ambitious plans of the Soviet National Program for Computerization of Schools, which he directs. Ershov, head of Informatics at the computer center in Novosibirsk and professor of computer science at the university there, delivered his remarks in a special invited address at the Sixth International Congress on Mathematical Education, in Budapest in August, 1988.

Ershov expressed confidence that about 3,000 classes in the Soviet Union will be equipped with 12 to 15 computers apiece by the next academic year and that "by 1995 each secondary school will have a computer class," although he expressed some doubt about reaching the numerical goal of 400,000 school computers by the 1990-91 school year. Over the past three years, Ershov and his colleagues have been devising a 70-hour course for grades 9 and 10 entitled "Fundamentals of Informatics and Computer Technology." This course, which will become part of the standard curriculum, eventually moving into grades 7 and 8, was designed to promote computer literacy and to incorporate computers into education. Ultimately, this course will attempt to integrate informatics and computer studies with disciplines such as mathematics and physics. The course has been devised so that it compensates for a likely absence of computers from the classroom by shifting from computer manipulations to concepts from informatics supplemented by a variety of mathematics-oriented problems. The first textbook for the course has already been published in 15 languages, and a new journal, *INFORMATICS AND EDUCATION*, has reached a circulation of 100,000.

"In a sense, this decision [to launch the National Program of Computerization by introducing the course]," said Ershov, "symbolized the beginning of *perestroika*." Mikhail Gorbachev, as Chairman of the Commission on School Reform, submitted the decision to the Politburo in February 1985. On March 11, he was elected Secretary General of the Communist Party and began engineering dramatic changes in Soviet society. The computerization program enjoys his strong support.

Ershov contended that the computerization of schools is both a premise and a component of the more global process of "informatization" in which information become a strategic resource like material or energy resources. In this view, computers and the links among them become the central nervous system for the organism of human society, and informatics emerges as the natural science of that system. Ershov defines informatics as the "science of the rules of purposeful activity" and thereby forms part of a trinity, along with language and mathematics, of "the main manifestations of the human intellect: the ability to communicate, the ability to reason, and the ability to act."

THE KOLMOGOROV REFORMS, A SOVIET "NEW MATH"? As a context for his remarks, Ershov cited the reform movement in the Soviet secondary school mathematics curriculum that began in the mid-1960s and that came to be called the Kolmogorov reform, although it had begun as a governmental decision and was a collective endeavor. Despite the support of papers on methodology, in-service courses for teachers, and new textbooks, the reform movement ran into many problems. The children found the new mathematics more difficult and less interesting than before. "The level (of preparation) of university applicants fell considerably. Teachers found themselves disoriented."

Gradually a counterreformation developed that took a more traditional view of school mathematics. Although this movement was not monolithic and many traces of the Kolmogorov reform can still be found, the new curriculum is generally viewed as conservative. The heated discussions and personal attacks that accompanied the movement took their toll on Kolmogorov, whose final years were saddened by more than just his serious illness.

Ershov saw many positive outcomes of the Kolmogorov reforms, including a new generation of successful mathematicians; a teaching force who, despite many difficulties, was alerted to new ideas; and many publications for students, including the journal *KVANT* and an accompanying library series. In Ershov's view, the fate of the reform cannot be separated from the situation of all of Soviet education in the two decades known as the "stagnation period." During that time, Brezhnev and his minions attempted the transition to a mandatory universal secondary education that preserved all the "rigidity, uniformity, and authoritarian character of the education system," achieved at "zero" expenses, without proper support and resources."

Ershov drew a series of parallels between Kolmogorov and another Russian of the same generation, Boris Pasternak: "the same measure of talent, high professionalism, and ability in ordinary work; the same distance from and incompatibility with many realities of our contemporary life and environment; the same intimate connection with culture and nature; the same deadly jealousy and disquietude from some of their guild brothers; the same high feeling of devotion and uncompromising will in performing a mission."

The story of the Kolmogorov reform, according to Ershov, provides him with both "inspiration and warning in our surgical work on implantation of the computer into school education." He is aiming at the same problems that Kolmogorov tried to solve but this time armed with the support and resources of the central government.

After Ershov's address, a long-time observer of the Soviet scene remarked privately that the bureaucratic forces of the Soviet education establishment were arrayed against the computerization program, and against the implementation of the new course in particular. Ershov apparently faces many of the same obstacles as Gorbachev in getting a bloated, balky system to move.

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Mathematical Modeling Contestants Intercept Drug Runners and Load Flatcar

B. A. Fusaro

The Mathematical Contest in Modeling (MCM) swung into its fourth year with a field of 204 teams, approximately a 30 percent increase over 1987. As in previous years, the MCM advisor opened a Consortium for Mathematics and Its Applications (COMAP) packet with two problems on a Friday in late February. Each team then chose a problem and spent the weekend working on it. Teams were allowed to use computers, books, notes—any inanimate source. On Monday a typed solution paper was mailed to COMAP.

The first problem, "Drug Runner," dealt with a helicopter night search for a small power boat whose position was known at one instant of time. This difficult and very open-ended problem was chosen by 82 teams.

The second problem, "RR Flatcar," dealt with stacking loads on two railroad flatcars. This problem had clear mathematical solutions via integer programming, but required some care in implementing it in a real setting. The RR Flatcar problem was chosen by 122 teams.

The judges selected 15 Meritorious Drug Runner papers and designated two of them as Outstanding. They chose 25 Meritorious RR Flatcar papers and designated four of them as Outstanding. These six teams will have their papers published in a special issue of the UMAP JOURNAL.

The two Drug Runner winners are Drake University and the North Carolina School of Science and Mathematics (a high school sleeper). The four RR Flatcar winners are Harvard University, the United States Military Academy, the University of California at Berkeley, and the University of Toronto.

Some of the six teams received further recognition. Among the judges were two ORSA graders, and they chose an ORSA Drug Runner winner and an ORSA RR Flatcar winner. SIAM also had two judges and chose a SIAM winner from among the six teams.

The ORSA winners are the North Carolina School of Science and Mathematics and the University of Toronto. They were awarded a free trip to the TIMS/ORSA April meeting in Washington, D.C. They gave their papers at a special student session and each team was awarded a \$150 cash prize.

The SIAM winner was Harvard University. The team gave its paper at a mini-symposium at the SIAM July meeting in Minneapolis. The team was part of a special awards presentation and was awarded a \$300 cash prize.

The MCM is administered by the COMAP. Full funding was provided by the United States Department of Education (FIPSE) during 1985–87, and partial funding was supplied in 1988. COMAP supplied most of the funds in 1988 and proposes to support the contest in 1989. Readers wanting information about participation or who are aware of potential donors should call B. A. Fusaro at (301) 543-6470 or 6471, or COMAP Executive Director Sol Garfunkel at (617) 645-2600.

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(ICME-6 continued from page 1)

MAJOR ADDRESSES Although small-group activities were the rule at Budapest, each day also offered several major addresses, with simultaneous English, French, German, Hungarian, Japanese, and Russian translations. Some were plenary sessions, on broad themes; others surveyed concerns of particular working groups at the Conference. Whatever the subject, almost every speaker touched somehow on the content and pedagogy of college mathematics.

Andrei Ershov, scientific director of the Soviet National Program for Computerization of Schools, in a lecture remarkable both for its striking cartoon graphics and for its unsparing frankness, described the infancy and growth of educational computing in the Soviet Union. He began by recalling the so-called Kolmogorov curriculum reforms of the sixties and seventies. These reforms, said Ershov, are now generally (although not universally) thought to have failed. Changes were imposed from above; classroom teachers, who were expected to implement the reforms, were seldom consulted and poorly prepared. Such top-down attitudes, Ershov explained, were common before *glasnost*, but are now *passé*.

Americans in the audience had a field day drawing—or rejecting—parallels with our "new mathematics" of the same period.

Laszlo Lovasz, from Hungary, compared the roles of "algorithmic" and "axiomatic" viewpoints in mathematics, past and future. To illustrate the difference, he compared two descriptions of the set of primes. Axiomatically speaking, a prime number is one with no nontrivial integer divisors. An algorithmic definition, on the other hand, is a concrete *procedure* for deciding whether a given number is prime. Operation-oriented viewpoints are hardly newfangled notions, observed Lovasz: concrete procedures rather than formal axiomatics dominated mathematics until relatively modern times. Lovasz argued that "structural" and "algorithmic" approaches to mathematics enrich and reinforce each other.

Almost every speaker acknowledged a personal debt to Hungarian mathematics and mathematicians. Several talks were unmistakably Hungarian. Paul Erdős posed, for a packed and sweltering audience, a collection of tantalizing but difficult(!) problems in plane geometry and number theory. ("Any fool can *state* number theory problems," said Erdős, "but only a wise man can solve them.") In the Congress closing ceremony, Jean-Pierre Kahane, president of the International Commission on Mathematical Instruction, assessed George Pólya's enormous contributions to mathematics and mathematics education. Pólya, who died in 1985, aged 98, was the patron saint of the Congress; commemorative medals sold briskly in the lobby.

COMPUTING AND MATHEMATICS Mathematical implications of modern technology—economic, pedagogical, psychological, social, and curricular—arose again and again at this Congress. In nearly every Action, Theme, and Topic Group, whether the formal subject was Curriculum: Towards the Year 2000 (Theme Group 7) or Language and Mathematics (Topic Group 8), computing was an *ex officio* member. Here are a few samples of what was said and done.

Computers and the teaching of mathematics at all educational levels was the subject of Theme Group 2. In her opening address, chief organizer Rosemary Fraser, from the UK, observed that computers, unlike chalk and blackboards, permit *dynamic*, not merely *static*, representations of mathematical phenomena. In another session, David Tall, also from the UK, made a similar point, stressing the role of visualization in the process of mastering mathematical concepts. Computers, of course, produce formerly undreamed-of visuals. Researchers from the CABRI-Geometrie project at the University of Grenoble I described graphics software that can vary geometric constructions continuously, in real time. A student might observe concretely, for instance, how a property of a triangle (e.g., the crossing point of the medians) varies continuously (or remains fixed!) as the triangle itself varies.

Working Group 2.5, a subgroup of Theme Group 2, considered the effects of technology and computer science on a mathematics curriculum for the future. As Anthony Ralston, from the USA, observed, technology is now *the* force for curriculum change; technology poses most of the important questions for new research in mathematics education. Among the questions participants posed and debated:

- Must students learn techniques that computers can do more quickly and accurately?
- How are technical skills and mathematical understanding related? Can either exist without the other? Can the computer foster both?
- When is a student "ready" to learn a given piece of mathematics? Can computing advance that time?
- In an age of technology, what mathematics must *everyone* learn?

- What will mathematics curricula contain far—say 10 years—in the future? Audun Holme, from Norway, recommended this longer view. Don't, said Holme, base the mathematical curricula of tomorrow on the advanced computer science of yesterday.

Action Group 5.3 focused specifically on mathematical computing at the postsecondary level. Participants represented at least 20 countries, from Czechoslovakia to Singapore. The group's four morning sessions centered on three different, although overlapping, themes: computing tools (software, mainly); uses of computing in specific college courses; and philosophy and pedagogy of mathematical computing.

Many tools for instructional computing were described and, in some cases, demonstrated. They ranged from powerful graphics and symbol-manipulating calculators, to special purpose microcomputer packages (e.g., for calculus or linear algebra), to sophisticated mathematical toolkits (popularly, though inaccurately, known as "computer algebra systems") such as Macsyma and Maple. Although participants agreed that modern computing offers impressive mathematical power and that mathematical instruction should, and will, reflect that fact, elements of healthy skepticism and prudent caution emerged as well. Some argued, for example, that sophisticated computing requires more, not less, mathematical sophistication from students who use it. Others warned against allowing computing to divert time and attention from our main business—mathematics. As members from developing countries pointed out, choices among computing tools are still, practically speaking, available mainly in Western Europe and North America. It follows, some said, that we who enjoy the luxury of choice should also accept the burden of work that choice entails: to develop and critically assess new uses of mathematical computing.

Participants described using computers in courses spanning the undergraduate curriculum: calculus, linear algebra, discrete mathematics, statistics, and beyond. Elementary calculus received the most attention. (Interestingly, the calculus reform movement we know so well seems to be mainly a North American phenomenon. One reason may be that students in other countries begin their mathematical specialization earlier, and so study calculus in high school.) Speakers described calculus projects using almost all imaginable forms and levels of computing, from handheld calculators to computer algebra systems. Many speakers cited their concern to minimize the "overhead" computing imposes. Thus, the typical calculus project avoids full-scale programming; students invoke, or at most modify, existing programs. Still, few principles are absolute, and this one is no exception. Several speakers argued convincingly for the pedagogical value *to the student* of "teaching" the computer, by programming. Agreement did emerge on one point: Whatever the pros and cons of instructional computing a crucial goal should be to emphasize more clearly the concepts, rather than the routine manipulations, of the calculus.

Computing is starting to appear in advanced mathematics courses, some of them in the mainstream of classical mathematics. By handling routine, and even non-routine computations, computers can help students discover patterns and understand principles. Peter Giblin, from the UK, described a number theory course in which students used computing to study such topics as greatest common divisors, primes and primality testing, sieves, and continued fractions. Andreas Hinz, from West Germany, told of using a computer to estimate certain norms in operator theory. Hervé Lehning, from France, showed how he uses computer graphics to discover and motivate solutions to differential equations.

As always, computing raised all sorts of pedagogical and philosophical questions. For example:

- Computers can support an "experimental," inductive, example-driven approach to mathematical learning. But is mathematics truly an experimental science? If so, how can we communicate this to students who were raised on, and confidently expect, routine manipulations? If not, can computing still help students master concepts?
- How much computing power is appropriate for a given instructional purpose? Some speakers argued that students should use state-of-the-art tools, the same ones actually used in applications. Other speakers warned against thoughtless, "oracular" uses of the machine.
- Is computing right for every student? Research on how students learn with—or despite—computers must be done and disseminated. (Some has been done. In another session, Elmar Cohors-Fresenborg, from West Germany, cited research in his country indicating that some mathematics students enjoy and benefit from computing; others don't.) Can computing accommodate students' different learning styles?

TEACHING AND LEARNING COLLEGE MATHEMATICS Mathematical pedagogy in all its aspects—psychology, didactics, learning theory, cognitive science, etc.—was an important theme at the Congress. (This doubtless naive—and certainly ignorant—writer found both the number of papers and the scholarly level of discussion on mathematical pedagogy impressive. A lode of knowledge on teaching and learning, from Europe, Canada, the US, and elsewhere, lies unmined [by the writer, at any rate.] Making such discoveries is a principal benefit of attending ICME, *especially* for mathematicians who lack such expertise.) Action Group 5.4, for example, spent four morning sessions surveying research on teaching and learning at the postsecondary level. Topic Area 7: Proofs, Justification, and Conviction affords another example, one especially apt in the country of Lakatos and Pólya. In one of its sessions, participants debated theories and research results on how students learn, or don't learn, how to understand and construct mathematical proofs. Even to a neophyte, to whom the professional language (e.g., the "implicit contract" between speaker and hearer embodied by mathematical proof) was unfamiliar, the arguments were sharp and the issues were clear. Gila Hanna, from Canada, for example, argued against stressing rigorous proof in secondary education. Rigorous proof, she asserted, is neither the most significant aspect of mathematical practice, nor even grounded upon generally accepted criteria for validity. Lively discussion followed, leading this writer to one clear verdict: seeing and reading proofs is no guarantee of understanding or belief. The road to conviction is often circuitous, passing through manipulations, examples, trials and errors.

MATHEMATICS AND SOCIETY A "fifth-day special" program at ICME-6 was devoted to the triple theme of Mathematics, Education, and Society. Our discipline is practiced in various social, economic, political, and cultural milieus, each of which affects what is taught and how it is learned. A new specialization, "ethnomathematics," has arisen to describe and study connections between society and mathematics.

On the provocative topic *Are girls underprivileged around the world?*, Erika Kuendiger and Gila Hanna, from Canada, summarized results from the 1982 Second International Mathematics Study, comparing mathematical performance and attitudes of boys and girls in twenty countries. The study finds differences between countries to be far greater than those between boys and girls. In France, for example, boys performed better than girls in all five areas of comparison. In nearby Belgium, the situation was precisely reversed. Such results suggest, at the least, that biological differences can't explain major performance differences.

Speaking on *The cultural role of mathematics education in the future*, Philip Davis, from the USA, described the growing "mathematization" of modern economic and, more frighteningly, military life. Did some mathematical calculation, he wondered, done under combat conditions, lead to the recent disastrous downing of an Iranian airliner? More and more, said Davis, important decisions—on "acceptable" risk, for instance—are reduced, perhaps thoughtlessly, to mathematical form. Who decides such questions, and how? As mathematicians, we must either oppose or "validate" such mathematization of public life. As teachers, we must prepare students, particularly nonspecialists, for intelligent citizenship in mathematized societies.

ICME-6 was a vast and varied conference. To reflect its subject, it had to be.

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(Recommendations continued from page 1)

Full Preparation Is Needed for Calculus Students should learn the content of a full four years of college preparatory mathematics before taking a calculus course. Moreover, students directed toward twelfth grade calculus need enriched programs as early as grades 7 and 8.

Full Programs for All High Schools A full program of college preparatory mathematics should be provided in every secondary school.

Calculus in High School Calculus, if taught in the schools, should be equivalent to college-level calculus. The NCTM and the MAA have made a joint recommendation to the schools that students should expect to write proficiency examinations (either Advanced Placement or university credit exams) to establish that they have learned beginning calculus, and to obtain college credit for high school calculus courses. Watered-down calculus courses in the secondary schools that stress manipulations but slight subtle processes do not help students. Introducing polynomial calculus in pre-calculus courses uses time better spent on other topics.

Continuity Needed in Training If mathematics is required in a student's college program, the student should enroll in mathematics courses as a college freshman. There should not be a gap of a year or more during which a student takes no mathematics.

Use of Calculators and Computers Students should expect to make use of calculators and computers in their mathematics courses in grades 11–13. Calculators and computers should be used as tools to enhance and expand the learning of mathematics in these grades.

Computation, A Key Tool for Discovery The availability of technology should permit computational approaches to college preparatory mathematics that result in the mathematics being accessible to more students. Further, the availability of technology should permit students in these grades to investigate problem situations that are not approachable without computational tools and to be introduced to different mathematics than was possible without calculators and computers.

Real World Applications Mathematics in grades 11–13 needs to have a clear connection to real world problems, and students should be expected to acquire a growing ability to use mathematics to model real situations. Students should become aware of new applications of mathematics as these applications develop. In addition, students should understand that mathematics itself is a developing discipline, and, where possible, students should come to appreciate new developments in mathematics.

Statistics and Probability The curriculum in grades 11–13 should contain units in statistics, probability, and fundamental topics in discrete mathematics for all college-bound students.

Computation and Reasoning Mathematics in grades 11–13 should have goals beyond the acquisition of computational techniques. Mathematical understanding and analytical reasoning are basic goals for mathematics at this level. Problem solving strategies should be stressed, and manipulative and computational techniques, although important, should not predominate.

Reading, Writing, and Learning Teachers of mathematics in grades 11–13 should employ strategies that encourage student reading, writing, and reflection. Assignments and examinations should be designed to help students become more independent learners of mathematics and to increase their abilities to discuss both orally and in writing the mathematical ideas they are learning. Courses should not cover an excessive number of topics at the expense of reflection and independent learning on the part of

students. Teachers should take advantage of mathematics competitions and science fairs to encourage independent learning in students.

Review While there is need for meaningful review within new mathematics, the amount of time spent on review at the beginning of a course in grades 11-13 should not be excessive. Typically, review should be integrated into the learning of new mathematics.

Homework and Examinations Expectations of students with regard to homework, examinations, and knowledge of previous courses need to be raised in many grade 11-13 programs. These expectations should include daily homework, cumulative examinations, and examination questions that require problem-solving skills.

Women and Minorities To overcome the effects of socialization that discourage girls and U.S. minorities from studying mathematics, these groups of students should be especially encouraged in the study of mathematics in grades 11-13, and efforts should be made to identify applications of mathematics that hold particular interest for under-represented groups. Furthermore, the perceived preponderance of negative attitudes toward mathematics in this country should be studied to determine what aspects of curriculum and what features of culture contribute most heavily to these attitudes.

School and College Teachers as Colleagues Opportunities need to be created for secondary, two-year, and four-year college teachers to work together on curricular projects.

The Task Force also identified many issues where there is a lack of consensus and where more study and discussion will be needed. Examples of such issues include the following:

- Should the very best students be accelerated or should their programs instead be enriched with topics they may otherwise miss?
- To what extent should the curriculum be integrated or unified?
- What is the appropriate course in grade 12 for college-bound students?
- What is the appropriate calculus course for college freshmen who studied calculus in high school but who did not receive college credit?
- What is the proper use of standardized test scores?
- What form should the study of geometry take?

The portion of the report that deals with the issues on which there is a lack of consensus provides a discussion of arguments on both sides of these issues.

A considerable amount of time was spent by the Task Force in discussing the kinds of efforts that will be needed to effect change in United States education. Reports on the success of mathematics students in other countries, particularly those from Japan, have emphasized the importance of collaboration between school and family. In order to effect change in this country, there will have to be extensive collaborative efforts involving school leadership, pupil guidance personnel, parents, teachers, and, of course, students. The Task Force recommends that the NCTM and the MAA prepare information brochures targeted specifically at these various groups.

The above issues are treated fully in the complete report. Copies available for \$2 duplicating and shipping cost from the MAA, 1529 Eighteenth Street, N.W., Washington, D.C. 20036. Readers of FOCUS are urged to write for the report, study it, and make their views known on the issues, particularly those on which there is currently no consensus.

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		26,000
11. SIGNATURE AND TITLE OF EDITOR, PUBLISHER, BUSINESS MANAGER, OR OWNER I certify that the statements made by me above are correct and complete		
Signature: <i>Jeffrey A. Hill</i> Executive Director, MAA		

MAA Awards for Meritorious Service

Each year six MAA Sections put forth nominees for these awards. The brief descriptions that follow give a good idea of the many contributions for which these members received their awards at the MAA business meeting in Providence this August.

At this meeting a special certificate for meritorious service was given to Walter Mientka for his contributions to the school contest program. His citation will be in the next issue of FOCUS, along with a main article on the contest program.



MISSOURI SECTION

Troy L. Hicks
University of Missouri,
Rolla, Missouri

Professor Hicks has been an MAA member since 1962 and has been an enthusiastic leader in the Missouri Section for over twenty years, serving terms as Vice President, Secretary-Treasurer, and Sectional Governor.

Troy L. Hicks is an outstanding teacher and has worked steadily to improve the quality of mathematics education. He has been a

primary source of guidance for students, encouraging them to attend and present papers in mathematics meetings and he is an active lecturer in the Missouri High School Lecture Program. Professor Hicks has taught four National Science Foundation Institutes for secondary school teachers of science and mathematics and has directed eight Ph.D. dissertations. Three of his Ph.D. students have held major offices in the Missouri Section.



KENTUCKY SECTION

Aughtum S. Howard
Eastern Kentucky University,
Richmond, Kentucky

Professor Howard has been an MAA member since 1944, and her dedicated service and leadership has sustained and helped the Kentucky Section develop into one of the most active

in the Association. She has served as Governor (1951–1954), Chair (1944–1946), and Secretary (1949–1951) of the Section.

Professor Howard is an outstanding teacher and always considered teaching her primary goal. She was one of the founders of the Society of the Sigma Xi Chapter at Eastern Kentucky University, and later served as Chapter Secretary-Treasurer (1967) and President (1970–1971). Through the efforts of her students, Professor Howard was commissioned a Kentucky Colonel in 1964.

Of her MAA award, Professor Howard said, "After being a retired teacher for 15 years, I'm elated that my dedicated services to education and to the Kentucky Section during my teaching years are now being honored." Aughtum S. Howard is retired from her position as Professor of Mathematics at Eastern Kentucky University.



ILLINOIS SECTION

John A. Schumaker
Rockford College,
Rockford, Illinois

Professor Schumaker, an MAA member since 1949, has served as Vice-Chair, Chair, and Past Chair (1970–1973) of the Illinois Section and represented the Illinois Section on the MAA

Board of Governors from 1974–1977. In 1984, Professor Schumaker was presented with the Illinois Section's own Distinguished Service Award.

On hearing of his selection Professor Schumaker said, "I feel greatly honored to be the first person recommended for the Certificate of Meritorious Service by the Illinois Section. I consider myself to be just the representative of a great group of dedicated persons who have enabled the Section to accomplish so much over the years and thus have made those of us holding positions of responsibility look good."

Professor Schumaker is a charter member of the Illinois Council of Teachers of Mathematics and in 1984 he was recipient of the Distinguished Life Member Award from ICTM.



NORTHERN CALIFORNIA SECTION

Harold M. Bacon
Stanford University,
Stanford, California

Professor Bacon is one of 12 MAA members who organized the Northern California Section on January 28, 1939. He exemplifies the steady leadership that has helped the Northern

California Section become one of the largest and most active sections in the Association. In addition to serving as Secretary (1939–1945) and Chair (1950) of the Section, Professor Bacon has served two terms on the MAA Board of Governors and has been a member, and many times chair, of many national and sectional committees.

Professor Bacon has been tireless in his dedication to mathematics education. His contributions to college and high school education have been many. He directed four academic year and several summer National Science Foundation Institutes for secondary school teachers and he has actively lectured on mathematical topics at high schools and served as consultant to many high school mathematics programs.



SEAWAY SECTION

Erik Hemmingsen
Syracuse University,
Syracuse, New York

An MAA member since 1963, Professor Hemmingsen's service includes terms as President and Vice-President of the Seaway Section. In addition, he served a term as Seaway Sectional

Governor on the MAA Board of Governors and for many years was a lecturer in the Syracuse University mathematics lecture program for upstate colleges. From 1971–1979, Professor Hemmingsen served as Chair of the Department of Mathematics at Syracuse University, where he is now Emeritus Professor of Mathematics.



WISCONSIN SECTION

Paul J. Campbell
Beloit College,
Beloit, Wisconsin

Professor Campbell joined the MAA in 1965, since then he has been a tireless member of the Wisconsin Section serving as Secretary-Treasurer (1978–1982), Public Information Officer (1983), and Sectional Governor on the MAA Board of Governors (1984–1987).

Since 1980, he has served as Coordinator of the Wisconsin Mathematics League.

Professor Campbell is an Associate and Reviews Editor for MATHEMATICS MAGAZINE and Editor of The UMAP JOURNAL. He is currently serving on several national MAA committees including the Committee on the Participation of Women and the Mertens Hasse Prize Committee for Expository Writing.

FOCUS on MAA Publications

The 1988 Ford, Allendoerfer, and Pólya Awards

Six Articles and Seven Writers That You Should Read

The MAA's journals are its publishing crown and glory. They cover the full range of collegiate mathematical interests: exposition on all topics, articles on the teaching of mathematics, debates on the nature and meaning of mathematics and on pedagogical issues, book reviews, historical articles, and so on. Each year the committees on the MAA's awards select the strongest articles from each journal for consideration for the Lester R. Ford Award (for papers in the MONTHLY), the Carl B. Allendoerfer Award (for papers in MATHEMATICS MAGAZINE), and the George Pólya Award (for papers in The COLLEGE MATHEMATICS JOURNAL). This year's awards all went to authors of articles in contrast to last year when book reviews figured in the awards as well. The list of articles below should not only inspire your reading but, we hope, it will inspire at least some you to write as well.

It is worth noting that this year's authors were set on the paths to writing these articles by such ordinary motivations as a question by a fellow faculty member, reading a column by Martin Gardner, or simple curiosity. Award winners in 1988 received checks for \$500 in addition to a certificate and the considerable honor and recognition these awards bring. Read and enjoy their work and join in the effort to improve mathematical teaching and exposition. Better exposition is possible, as these authors show, and it is needed and rewarded.

LESTER R. FORD AWARDS

These went to James Epperson and Stan Wagon in 1988. **James Epperson**, Assistant Professor of Mathematics at the University of Alabama, Huntsville, was honored for his paper "On the Runge Example," which appeared in the April 1987 issue of The MONTHLY. The citation for the Ford Award describes Epperson's article as "a fine example of a rather technical paper written in a light and understandable manner." Professor Epperson described how he came to write this article: "An algebraist colleague was teaching numerical analysis and didn't understand the Runge example. The text was no help; nor were any elementary references. He came to me for help and I couldn't explain it to his satisfaction. In an effort to help him out, I did all

the research and then decided, on a whim, to write it up and send it out. Obviously, I'm glad I did!" Here are lessons for us all: Clear and beautiful explanations set down for one's colleagues *are* rewarded.

Stan Wagon, Associate Professor of Mathematics at Smith College, Northampton, Massachusetts, was honored for his "Fourteen Proofs of a Result About Tiling a Rectangle," which appeared in the August–September 1987 issue of The MONTHLY.

The committee on the Ford Award described Wagon's paper as follows: "Whenever a rectangle is tiled by rectangles each of which has at least one integer side, then the tiled rectangle has at least one integer side. Double integration, Sperner's Lemma, Bipartite Graphs all play roles in the varied proofs of this result. Wagon's *tour de force* is a refreshing antidote to the increasing fragmentation of modern mathematics."

Concerning the award, Professor Wagon said, "I have devoted much effort to expository writing in recent years, and was immensely pleased to receive some official recognition." Wagon's strong interest in exposition is evident in his publications which include THE BANACH-TARSKI PARADOX (1985) and a series of articles on numerical evidence for various conjectures in THE MATHEMATICAL INTELLIGENCER. He and Victor Klee are working on several projects slated for publication in the MAA's Dolciani Mathematical Exposition series and to appear in about a year.

CARL B. ALLENDOERFER AWARDS

These awards were presented to Bart Braden and Steven Galovich at the MAA's Business Meeting in Providence in August, 1988. **Bart Braden**, Professor of Mathematics at Northern Kentucky University, in Highland Heights, received his award for "Pólya's Geometric Picture of Complex Integrals," which appeared in the December 1987 issue of MATHEMATICS MAGAZINE.

Describing how he came to write his article, Braden said, "I've been using computer-drawn vector field pictures since 1980 in my classes, and I had spoken at meetings on their uses in teaching complex analysis. But only when I discovered how they classify the

fundamental 'triangle inequality for complex integrals,' in 1985, did I have all the ingredients for the paper."

The Allendoerfer Award Committee said of this paper: "Braden has taken an elegant idea of Pólya's which deserves to be more widely known, and presented it clearly with well chosen examples and transparent proofs."

Professor Braden was trained as an algebraist. His doctoral training and early research was in abstract algebra but over the years his interests have shifted toward classical applied mathematics and mathematical physics, and to the use of computer graphics to clarify mathematical problems.

Steven Galovich is Professor of Mathematics at Carleton College, Northfield, Minnesota. He was honored for "Products of Sines and Cosines," which appeared in the April 1987 issue of MATHEMATICS MAGAZINE.

The Committee for the Allendoerfer Award describes Galovich's article as presenting "some elegant mathematics (cyclotomic fields) at a relatively elementary level. It provides an excellent example of how a broader perspective can provide unity and insight, building nicely from the introductory 'intriguing identities' through roots of unity and a little number theory to the cyclotomic integers. Numerous classroom problems at several levels can be harvested from this material. There are useful references, and the application to chords of regular n -gons is an extra bonus."

Professor Galovich is a popular lecturer and invited speaker and is the author of many published articles. He is presently working on a textbook titled INTRODUCTION TO MATHEMATICAL STRUCTURES with support from the Vaughn Foundation Fund.

GEORGE PÓLYA AWARDS

The Pólya Awards in 1988 went to Dennis M. Luciano and Gordon Prichett, jointly, and to V. Frederick Rickey.

Dennis M. Luciano, Chair and Associate Professor of Mathematics at Western New England College, Springfield, Massachusetts, and **Gordon D. Prichett**, Professor of Mathematics at Babson College, Babson Park, Massachusetts, jointly received one of the George Pólya awards given in 1988. They were honored for "Cryptology: From Caesar Ciphers to Public-key Cryptosystems," which appeared in the January 1987 issue of The COLLEGE MATHEMATICS JOURNAL.

The Pólya Award Committee described this paper thus: "'Cryptology: Caesar Ciphers to public-key Cryptosystems' surveys the science of composing secret messages from Julius Caesar's use, in 50 B.C., of a simple

modular arithmetic transformation cipher to attempts, in the mid-1980s, to devise a secure public-key 'knapsack' cipher."

Professor Prichett said that he became intrigued with the topic after reading "A New Kind of Cipher That Would Take Millions of Years to Break" by Martin Gardner. "Dennis and I experienced tremendous excitement merging mathematical discoveries of the 1st century B.C. with 17th, 18th, and 20th century mathematical discoveries and applications. The evolution and application of mathematical ideas give them new life and luster," Prichett said.

In discussing this topic, Professor Luciano said, "Cryptology has a long, rich history, one that has always used mathematics, and most recently depended on results of computer science. . . Its history, current significance, dependence on a beautiful, pure area of mathematics, and relationship to the mathematics undergraduate curriculum were the motivating factors for writing on this topic." Professor Luciano's mathematical interests include number theory, graph theory, and applications of mathematics at the undergraduate level.

Professor Prichett has published a variety of papers on number theory and computer applications and his current interests include curriculum development and alternative approaches to instruction. He is coauthor of a self-paced introductory calculus text, and is Vice President for Academic Affairs and Dean of the Faculty at Babson College.

V. Frederick Rickey, Professor of Mathematics and Statistics at Bowling Green State University, Bowling Green, Ohio, received his award for "Issac Newton: Man, Myth, Mathematics," which appeared in the November 1987 issue of *The COLLEGE MATHEMATICS JOURNAL*.

In the words of the Pólya Committee his article is "... an engaging account of the life and mathematical work of Issac Newton, with considerable attention paid to his intellectual forebears—especially Descartes—and the debunking of certain myths current in the mathematical community about Newton's mathematical achievements." Continuing, the committee notes that, "By humanizing the development of Newton's thought, Rickey has made Newton a more accessible, and much more interesting figure in the history of mathematics."

Professor Rickey's current primary research interests are in the history of mathematics, particularly the history of calculus. He is Chair of the Americas Section of the International Study Group for History and Pedagogy of Mathematics (HPM), a group which encourages mathematics teachers at all levels to use the history of mathematics as a motivational tool in their teaching.

FOCUS EMPLOYMENT ADVERTISEMENTS

FOCUS advertisements reach the MAA's 28,000 members, most of whom are college and university mathematicians. FOCUS now offers a new line of advertisement formats; for these new formats we have adjusted our rates per inch accordingly. A FOCUS ad now costs approximately 60 cents per word for solid text; such text will yield roughly sixty-six words for each eight lines and slightly more than eight lines per inch.

Rates for FOCUS Employment Ads are:

- 50 words or less: \$37.50
- More than 50 words: \$40.00 per column inch

There is a 15% discount for the same ad in more than two consecutive issues (with contract in advance). An insertion order on institutional letterhead will be considered a contract. Charges will be billed after the first occurrence specified in the contract.

Anyone wishing to place an employment advertisement in FOCUS should write to: Siobhán B. Chamberlin, FOCUS Employment Advertisements, The Mathematical Association of America, 1529 Eighteenth Street, N.W., Washington, D.C. 20036. For more information, call the MAA Washington office at (202) 387-5200.

The deadline for submission in the March-April issue is January 15, 1989.

ENDOWED POSITION IN APPLIED MATHEMATICS

Nominations and applications are sought for an endowed position in applied mathematics. The position (yet unnamed) is permanently funded by an endowment and is expected to lead to tenure. Other attractive features of the position include a reduced course load and the possibility of budget supplements for travel and secretarial support. A specific responsibility of the holder of this position will be the establishment and supervision of a **Center for Applied Mathematics** within the Department of Mathematics, focused on the preparation of undergraduates for work in applied mathematics, including opportunities for undergraduate research and for collaboration with the region's profit and non-profit institutions on specific problems.

The successful applicant for this position will hold a Ph.D. in mathematics or applied mathematics, have a recognized program of research in one or more areas of applied mathematics, demonstrate good organizational and interpersonal skills, and share a commitment to quality teaching in a liberal arts environment. The salary and rank of appointment will be appropriate for the candidate selected.

The College of St. Thomas, the largest private college in Minnesota, is located one block from the Mississippi River in the heart of the attractive and dynamic Twin Cities metropolitan area. For over a century the college has provided a strong program of liberal arts education in the Catholic tradition of service to the greater community. The Department of Mathematics has a current faculty of 12, representing a variety of mathematical interests.

Application materials, including a letter of interest, curriculum vita, and three letters of recommendation (including comments on the applicant's experience and promise in the areas of teaching, research, and leadership) will be accepted until December 31, 1988 and, thereafter, until the position

is filled. Applications, nominations, and inquiries should be sent to John T. Kemper, Chair, Department of Mathematics, College of St. Thomas, St. Paul, MN 55105. Individuals from both academic and industrial backgrounds whose interests and credentials are compatible with the requirements of the position are encouraged to apply. The College of St. Thomas is an equal opportunity/affirmative action employer.

TRINITY UNIVERSITY San Antonio, Texas Assistant/Associate Professor of Mathematics

Trinity University invites applications and nominations for a tenure-track position in mathematics, appointment beginning August 1989. The appointment will be made at the rank of Assistant Professor or Associate Professor, depending on qualifications. Responsibilities include teaching nine credit hours per semester, continuing scholarly activity, assisting in curriculum development as appropriate to the needs of the department and the university, advising, and committee service.

Minimum qualifications are the Ph.D. in Mathematics or Applied Mathematics with excellence in and strong commitment to teaching. Preference given to candidates with teaching and research interests in one or more of the following areas: applied mathematics, numerical analysis, classical analysis, differential equations.

Founded in 1869, Trinity University occupies a modern campus overlooking the San Antonio skyline. Purposely small and selective, with about 2700 students, Trinity stresses a high quality, undergraduate liberal arts and sciences program. San Antonio is a city of approximately 850,000 people situated in a metropolitan area of 1.2 million.

Closing date for application is January 27, 1989. Send vita, transcripts, and three letters of reference to:

Dr. Donald F. Bailey, Chairman
Department of Mathematics
Trinity University
715 Stadium Drive
San Antonio, Texas 78284

Trinity University is an equal opportunity affirmative action employer.

CANISIUS COLLEGE Department of Mathematics

A tenure-track position as Assistant Professor in mathematics is available beginning in late August 1989. Applicants must have a Ph.D. in mathematics and a strong commitment to quality teaching. The teaching load is twelve hours per semester. Salary and fringe benefits are competitive, commensurate with credentials and experience.

Applicants should send resume, transcripts, and three letters of recommendation to Dr. Richard H. Escobales, Chairman, Department of Mathematics, Canisius College, Buffalo, New York 14208. AA/EOE.

CANISIUS COLLEGE**Department of Mathematics**

A second tenure-track position (Assistant Professor) in mathematics is available in late August 1989. Applicants should have a Ph.D. in mathematics and a strong commitment to quality teaching. Salary and fringe benefits are competitive and commensurate with credentials and experience.

Applicants should send resume, transcripts, and three letters of recommendation to Dr. Richard Escobales, Chairman, Department of Mathematics, Canisius, Buffalo, NY 14208.

The Department is looking to expand its offerings and options while at the same time maintaining its sound preparation for students with mathematical potential. AA/EOE.

SOUTHWESTERN UNIVERSITY**Georgetown, Texas 78626**

Applications are being invited for a tenure-track position in Mathematics at the Assistant Professor level beginning Fall semester 1989. Ph.D. required. Southwestern is a selective liberal arts undergraduate college with 1100 students. Faculty are expected to have a strong commitment to excellence in undergraduate teaching, to maintain an active interest in scholarly pursuits, and to possess an appreciation of liberal arts education. Please send a letter of application, vita, and three current letters of reference to Theodore D. Lucas, Associate Provost. Southwestern University in an EOE/AA employer.

UNIVERSITY OF WYOMING**Department of Mathematics**

Invites applications for the following positions:

One or more tenure-track positions at the assistant/associate professor level in the areas of applied mathematics, algebraic/computational combinatorics, functional analysis, numerical linear algebra.

One or more visiting positions at levels appropriate for the applicant.

Send resume and direct three letters of recommendation to:

Professor W. Bridges, Chairman
Mathematics Department
P.O. Box 3036 University Station
University of Wyoming
Laramie, WY 82071-3036
(307) 766-4222

Applications completed by January 31, 1989 will be given first consideration. The University of Wyoming is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF WYOMING**Department of Mathematics**

Invites applications for the following positions:

A senior-level position in the area of computational mathematics. Candidates should have an outstanding record of accomplishment in an area of computational applied mathematics that makes significant use of high speed computers. The appointee will be expected to interact with our Center for Computational Mathematics and Mechanics and to provide leadership in the developing field of scientific computation.

Send resume and direct three letters of recommendation to:

Professor W. Bridges, Chairman
Mathematics Department
P.O. Box 3036 University Station
University of Wyoming
Laramie, WY 82071-3036
(307) 766-4222

Applications completed by January 31, 1989 will be given first consideration. The University of Wyoming is an Equal Opportunity/Affirmative Action Employer.

THE UNIVERSITY OF AKRON

The Department of Mathematical Sciences invites applications for tenure-track, faculty positions in mathematics, available January 1, 1989 or August 28, 1989. Ph.D. in Mathematics required. Candidates in all areas of pure and applied mathematics are urged to apply. Applicants with earned doctorates will be judged on the basis of effective teaching and success or potential of scholarly productivity and active participation in expanding funded research. Salaries are competitive, fringe benefits are excellent. The University of Akron is the third largest state-assisted university in Ohio with an enrollment of 27,000 day and evening students. Department offers B.S. and M.S. degrees in Mathematics/Applied Mathematics and Statistics, and B.S. degree in Computer Science, and is in the process of developing a Ph.D. program in Applied Mathematics. All materials (application letter, vita, three reference letters, transcripts) will be considered at the first of each month, starting November 1, 1988 and continuing until all positions are filled or until final cutoff on August 1, 1988. Forward materials to Dr. William H. Beyer, Head, Department of Mathematical Sciences, Attention: Faculty Search, The University of Akron, Akron, OH 44325. Women and minorities are encouraged to apply. The University of Akron is an Equal Education and Employment Institution.

AUBURN UNIVERSITY**Division of Mathematics
Department of Foundations
Analysis, and Topology**

One instructor position is expected for Fall, '89 for the 9 mo. academic year; renewable appointment not to exceed 7 years. Duties include 15 hrs/wk teaching (3 courses). Anticipated salary is \$15,000-\$18,000. Master of Science degree in mathematics and record of teaching effectiveness required.

Send vita and have three letters of recommendation sent by February 15, 1989 to George Kozlowski, Head, Department of Foundations, Analysis, and Topology, Auburn University, AL 36849. Minorities and women are encouraged to apply.

AUBURN UNIVERSITY IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

GREENSBORO COLLEGE

Position open August, 1989 for a math generalist with potential to teach computer science to undergraduates. Ph.D. in Mathematics with dedication to teaching undergraduates in a small college setting required. Rank and salary commensurate with credentials and experience. Send letter of application, resume, transcripts, and three letters of recommendation by December 16, 1988 to Professor Elizabeth Calog, Chair, Mathematics Search Committee, Greensboro College, 815 W. Market Street, Greensboro, NC 27401-1875.

MATHEMATICS EDUCATION**Wright State University
Department of Mathematics and Statistics
Dayton, Ohio 45435**

Tenure-track position in mathematics education anticipated for Fall 1989. Preference will be given to applicants who qualify for appointment at the rank of full professor but all qualified applicants will receive consideration. Excellent research record or potential and commitment to quality teaching required. Applicants should expect to complete all requirements for the Ph.D. or Ed.D. by September 15, 1989. Competitive salary and excellent fringe benefits. Two-course teaching load. Department has 30 Ph.D. faculty and offers a masters degree. Please send vita, graduate transcript(s) and three letters of reference to: Faculty Search Committee. Closing date: February 1, 1989, then every two weeks until selection or July 1, 1989. WSU is an AA/EOE.

AGNES SCOTT COLLEGE**Department of Mathematics
Decatur, Georgia 30030**

Metro-Atlanta area liberal arts college with a strong four-year program in mathematics has a tenure-track position starting Fall 1989. With a firm and historical commitment to women's education, Agnes Scott has been successfully educating women for leadership roles for 100 years. The position requires a Ph.D. in mathematics or computer science, a strong commitment to teaching in an undergraduate setting, and a definite interest in participating in a growing program in computer science integrated within the mathematics curriculum. Salary and rank commensurate with qualifications. Professional activity is strongly encouraged. College support is available. Send resume, transcripts, and 3 letters of recommendation to Robert Leslie, Chair. Complete files will formally be considered beginning January 23, 1989 and continue until the position is filled.

**DEPARTMENT OF MATHEMATICS
AND PHYSICAL SCIENCE****Embry-Riddle Aeronautical University
Daytona Beach, Florida 32014**

Applications are invited for a tenure-track entry level position in Mathematics beginning January 1989. 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. A letter of application and a resume with the names of three references should be sent to:

Chair, MA/PS Dept.
c/o Office of Human Resources
Embry-Riddle Aeronautical University
Daytona, Beach, FL 32014
Equal Opportunity Employer

MATHEMATICS DEPARTMENT**Kennesaw State College
P.O. Box 444, Marietta, GA 30061**

Two tenure-track positions in mathematics at the level of Assistant Professor or above beginning in September 1989. A Ph.D. is required with a strong commitment to undergraduate teaching as well as an interest in scholarly activities. Salary and rank are competitive and commensurate with credentials and experience. The College is located in Northwest Metro Atlanta, and enrolls approximately 8500 day and evening students in undergraduate and graduate programs. The Department of Mathe-

atics has 15 full-time faculty and shares 6 others with the Department of Computer Science. Send resume and a list of three references to Dr. Thomas R. Thomson, Chair, Search Committee. Application deadline is March 15, 1989 or until filled.

Kennesaw State College is an affirmative action/equal opportunity employer.

**POTSDAM COLLEGE of the
STATE UNIVERSITY OF NEW YORK**
Department of Mathematics

One tenure-track position in Mathematics. Rank and salary open. Teach up to 12 hrs undergraduate and beginning graduate Mathematics. Ph.D. in any area of Mathematics, (near completion ABD will be considered). To start Sept. 1, 1989. Send letter of application, resume, graduate transcripts, and 3 letters of reference to: Dr. A.E. Spencer, Search Committee Chair, Mathematics Dept., SUNY Potsdam, Potsdam, NY 13676. Applicant review will begin Feb. 1, 1989 and continue until position is filled. Potsdam is committed to providing opportunities for women and minorities and actively seeks these candidates.

**CALIFORNIA STATE UNIVERSITY,
HAYWARD**
Department of Mathematics
and Computer Science

The department is now seeking applicants for an entry level tenure-track Assistant Professor position in mathematics beginning Fall 1989.

Applicants should hold the Ph.D. degree in mathematics. Candidates should be committed to excellence in teaching, be willing and able to participate in curriculum development, and should exhibit the competence and potential to engage in significant professional activities, including research and publication. All areas of specialization will be considered, including mathematics education. The interests of the presnet faculty include a wide range of fields in mathematics and in computer science.

Interested applicants should send a resume and three references to:

Mathematics Faculty Search Committee
Department of Mathematics
and Computer Science
California State University, Hayward
Hayward, CA 94543-3092

Applications received by January 1, 1989 will be assured full consideration. Applications will be accepted as long as positions remain available.

California State University, Hayward, an Equal Opportunity, Affirmative Action Employer, seeks to create a stimulating atmosphere for its ethnically diverse student body and encourages applications from women and men of all ethnic backgrounds and physical abilities.

FACULTY POSITIONS
Mathematics

Frostburg State University seeks applicants for two, tenure-track Instructor or Assistant Professor positions beginning Fall 1989. Salary range \$20,000-\$39,000. Rank and salary commensurate with qualifications. Master's degree in Mathematics or related field required, along with strong commitment of undergraduate teaching. Teaching experience and quality of teaching will be of prime concern in reviewing candidates. Doctorate in Mathematics or Mathematics Education preferred and background involving experience with applications of Mathematics welcome. Send letter of application, resume,

transcripts, and three letters of recommendation, not later than February 3, 1989, to: Mr. C. Douglas Schmidt, Director of Personnel Services, Frostburg State University, Frostburg, MD 21532. Women and minorities are encouraged to apply. AA/EEOE.

THE UNIVERSITY OF TOLEDO

Applications are invited for one or more tenure-track positions to be available beginning in September 1989. Applicants should have a Ph.D., or have completed the Ph.D. by September 1989, and be committed to both teaching and research. In addition, the department will have several visiting positions. Please send a resume and three letters of reference to Harvey Wolff, Chairman, Department of Mathematics, Toledo, Ohio 43606. The selection process will begin in early January, but applications will be accepted until the positions are filled. The University of Toledo is an equal opportunity, affirmative action employer.

**CALIFORNIA STATE UNIVERSITY
LONG BEACH**

Department of Mathematics

Seven tenure-track positions beginning Fall 1989. Algebra or Analysis (3 positions); Applied Math, with Numerical Analysis, applied PDE or applied Probability preferred (2 positions); Statistics with Actuarial Math (1 position); Math Education (1 position). All 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 prior to offer of appointment. 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) 12-01-88. Apply to C.W. Austin, chair, Mathematics Department, CSU, Long Beach, CA 90840. CSULB is an Affirmative Action/Equal Opportunity Employer.

MATHEMATICS

Tenure-track position available for Fall 1989. Duties include teaching freshman and sophomore math courses. Minimum qualifications include a Master's degree in mathematics and a strong commitment to teaching. Preferred qualifications: a Ph.D. in mathematics or an Ed.D. in math education. Salary and rank commensurate with qualifications and experience. Send vita, transcripts, and 3 letters of recommendation by January 23, 1989, to: Dr. Bob Nebrun, Chairman of Science, Mathematics, and Engineering, University of South Carolina at Sumpter, Sumter, SC 29150-2498. USC-Sumter is an Affirmative Action/Equal Opportunity Employer.

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 Ph.D.'s whose research interests overlap a department members'. 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 option) graduate courses. Nine-month salary of \$29,500 supplemented by summer (resident) research stipend of \$6555 (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 letter of recommendation (at least one should discuss teaching) to Kenneth P. Bogart, Recruiting Committee Chair, Department of Math and CS, Bradley Hall, Hanover, NH 03755. Applications received by Jan. 10 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.

UNIVERSITY OF SOUTHERN ILLINOIS
Department of Mathematics

Applications are invited for a tenure-track position as Assistant Professor of Mathematics beginning August 1989. Teaching responsibilities include courses in elementary algebra, precalculus, and business calculus. Ph.D. in mathematics or substantial completion of degree required. Candidates with specialization in probability and statistics, computer science, or applied mathematics will receive favorable consideration. Submit letter of application, resume, transcripts, and the names of three professional references by February 15, 1989 to: Dr. Victoria M. Phil, Chair, Department of Mathematics, University of Southern Indiana, 8600 University Boulevard, Evansville, IN 47712. AA/EEOE.

FACULTY POSITION
Clayton State College

Clayton State College in the Atlanta area invites applications for a tenure-track position in mathematics for September, 1989. Rank and salary depend on qualifications. Doctorate in mathematics or mathematics education preferred; Master's degree and teaching experience required. Apply by Feb. 6, 1989, to Catherine Aust, School of Arts and Sciences, Clayton State College, Morrow, GA 30260. AA/EEOI.

HARVEY MUDD COLLEGE
Mathematics Department
Claremont, CA 91711

Harvey Mudd College has one entry level position in mathematics. Strong preference will be given to applicants who have received a Ph.D. degree no earlier than 1985. We are an affirmative action employer.

Excellence in teaching is essential. Any applicant should have a strong background, including evidence of ongoing research, in one of the following: statistics, operations research, theoretical computer science, or some area of discrete mathematics. In addition, applicants must show a breadth of mathematical interests and the ability to work well with others in developing our departmental program. Applicants must be comfortable with the use of computers.

Harvey Mudd College is a small, private, undergraduate college (approx. enrollment 550). Our students major in chemistry, engineering, mathematics or physics. A year course in calculus at the high school level is a prerequisite for admission. Ph.D. degrees have been earned by 40.7% of the college's pre-1980 graduates—the highest percentage in the nation. The college is affiliated with four other undergraduate colleges and a graduate

school in Claremont, an academic community with about 5,000 students.

Applications received by February 3, 1989 will be considered first.

THE AMERICAN UNIVERSITY

Washington, D.C. 20016

Tenure-track position available at the rank of Assistant Professor beginning Fall 1989 in the Department of Mathematics and Statistics. Qualifications: A Ph.D. in Mathematics Education or equivalent; evidence of teaching and scholarship. Responsibilities: Graduate and undergraduate teaching, advising, curriculum and program development, scholarship, and University service. Salary competitive, commensurate with qualifications and experience. Send curriculum vitae and three letters of recommendation to Basil P. Korin, Chair, Department of Mathematics and Statistics, the American University, Washington, D.C. 20016. An EEO/AA University; minority and women candidates encouraged to apply.

LINDENWOOD COLLEGE

Mathematics & Computer Science Position

Applications are invited for a tenure-track position at the rank of assistant professor beginning August 1989. Ph.D. in mathematics required. The position requires the teaching of a wide range of undergraduate courses and a strong commitment to liberal arts education. Ability to teach in the computer science program is desirable. Lindenwood is a small, private liberal arts college located in St. Charles, Missouri. Send applications, resumes, transcripts, and three letters of recommendation by February 1 to Daniel N. Keck, Dean of Faculty, Lindenwood College, St. Charles, MO 63301.

LE MOYNE COLLEGE

Syracuse, New York 13214

The Computer Science Department invites applications for a tenure-track appointment as Assistant Professor, starting Fall 1989. Candidate should hold the doctorate in CS, or in a cognate area with experience in computing (preferably a master's degree in CS).

Le Moyne College is a four-year Jesuit college with approximately 1900 students, located on a suburban 150-acre campus. The CS department, with 5 full-time faculty members, offers two strongly mathematical major programs and a minor. Students use the college's VAX BB10 computer (VMS), which is dedicated to instruction and research, as well as the CS department's MicroVAX II (ULTRIX 32-m) and a microcomputer laboratory with IBM PS/2 (Model 50) equipment.

Duties: Undergraduate teaching; some evidence of successful scholarly initiative also expected. Salary: competitive, depending on qualifications and experience.

Applicants should send resume to: James F. Smith, Chair, Computer Science Department, Le Moyne College, Syracuse, NY 13214. Le Moyne College is an Equal Opportunity/Affirmative Action Employer.

EMPORIA STATE UNIVERSITY

Division of Mathematics

Applications are invited for two or more tenure-track positions starting Fall 1989 at the rank of Assistant Professor. Ph.D. in mathematics is required. Excellence in teaching and commitment to scholarly and creative activities is expected. Screening will begin

March 1, 1989 and continue until positions are filled. Send resume and three letters of reference to: Jim Calvert, Interim Chair, Division of Mathematical and Physical Sciences, Emporia State University, Emporia, KS 66801. AA/EOE.

FURMAN UNIVERSITY

Greenville, South Carolina 29613

One tenure-track position in mathematics beginning September 1989. A Ph.D. in mathematical sciences is required. Excellence in teaching and continued scholarly activity are expected. Rank and salary will be based on qualifications. All areas of specialization are acceptable. Vita, graduate and undergraduate transcripts, and three letters of recommendation should be sent to Dr. Robert Fray, Department of Mathematics. Application deadline: February 1, 1989. EOE/AEE.

KENYON COLLEGE

Mathematics Department
Gambier, Oh 43022

Two tenure-track positions starting 89-90. One Asst. Prof. or beginning Assoc. Prof., other Asst. Prof. Ph.D. required for Assoc., highly desirable Asst. Must have broad background in math. For one position, preference for candidates in stats or prob. Strong commitment to undergraduate teaching and scholarship is required. Teach 3 courses per sem. For full information, contact Stephen Slack at the above address or call (614) 427-5267. First screening of dossiers December 15, 1988; applications accepted until positions are filled. Kenyon is an EOE and encourages applications from minorities and women.

BRADLEY UNIVERSITY

One, perhaps two, entry-level, tenure-track positions in mathematics beginning August 12, 1989 at the rank of Assistant Professor available. Ph.D. to be completed by August 12, 1989 required. Preference to candidates who will complement current research activities in the department (AL, FA, MO, TO). Salary competitive. Normal teaching load 12 hours per semester, reduced load for research possible. Continuing scholarly activity necessary for tenure. Closing date: January 13, 1989, or until the position is filled. Send letter of application, vita, and three letters of recommendation to: Jerome E. Hahn, Chairman, Department of Mathematics, Bradley University, Peoria, IL 61625. AA/EOE.

WILKES COLLEGE

Department of Mathematics
and Computer Science

Two tenure-track positions are available beginning September 1989. A Ph.D. in Mathematics or Computer Science is required. Rank and salary are open, depending on experience and qualifications. Wilkes is a liberal arts college with a strong commitment to quality teaching. Located in the Pocono-Northeast of Pennsylvania, Wilkes enrolls about 1750 undergraduate students. The department has 13 full-time members, about 100 majors, and offers degrees in mathematics and computer science. Send resume, graduate transcripts, and 3 recommendation letters to Professor Samuel Merrill, Chair, Department of Mathematics and Computer Science, Wilkes College, Wilkes-Barre, PA 18766. AA/EOE.

MIAMI UNIVERSITY

Oxford, Ohio

Department of Mathematics and Statistics

anticipates a tenure-track assistant professorship beginning August, 1989. Duties include teaching 8-9 hours per semester, continuing scholarship, and service. Applicants should have a Ph.D. in pure or applied mathematics by 8/89. Please send vita, graduate transcript, and three reference letters to John Skillings, Department of Mathematics and Statistics, Miami University, Oxford, Ohio 45056 by February 1, 1989. Women and minorities are encouraged to apply. Miami provides equal opportunity in employment and education.

SAINT MICHAEL'S COLLEGE

Department of Mathematics
Winooski, Vermont

Applications are invited for a tenure-track position at the Assistant Professor level to begin September 1, 1989. Candidates should have the Ph.D. in Mathematics (by Fall 1989), and a strong commitment to undergraduate teaching as well as to scholarly activity. To assure full consideration, applications should be received by January 15, 1989. Please send resume, transcript, and three letters of recommendation to Personnel Office, Saint Michael's College, Winooski, VT 05404. Saint Michael's College is an Affirmative Action/Equal Opportunity Employer.

SAN FRANCISCO STATE UNIVERSITY

Department of Mathematics
San Francisco, CA 94132

Applications are invited for one tenure-track position in Mathematical Statistics at the Assistant Professor level for Fall 1989. Ph.D. and demonstrated competence in teaching and research required. Must be U.S. citizen or Permanent Resident. Teaching load equivalent to twelve hours per week. Current salary range from \$27,600 to \$38,100. Closing date: January 15, 1989. Please send vita, graduate transcripts, and three letters of recommendation to Newman Fisher, Chair, San Francisco State University is an Equal Opportunity/Affirmative Action/Handicapped/Title IX/Vietnam Era Vet Employer.

CARLETON COLLEGE

Department of Mathematics
and Computer Science
Northfield, MN 55057

One (perhaps two) tenure-track faculty position(s) beginning 1989-90. Ph.D. required. Teach six courses per year in mathematics, computer science, and/or statistics. Preference given to individuals with ability in two of these areas. Excellent teaching skills essential; research encouraged. Interviewing at MAA/AMS meeting in January. Deadline January 20; applications accepted until position(s) filled. Affirmative Action/Equal Opportunity Employer; applications specifically invited from women and minorities. Send letter of application, resume, and three recent letters of reference to David Appleyard, Chair.

Carleton College is a small highly selective, liberal arts college 35 miles south of Minneapolis/St. Paul. College owns a variety of VAXes running VMS. Department has SUN 3/50 and 386i workstations, DEC MicroVAX running Ultrix, RAster Tech 3/85 high resolution graphics workstation, AT&T UNIX PC's, FiveStar 80386 Micro, Apple Macintosh SE, Apple II GS's, Macintoshes, IBM PC/XT and compatible microcomputers.

CHAIRPERSON**Department of Mathematics**

SUNY COLLEGE AT 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, and continued involvement in mathematics research required. Rank will be Associate of 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 about 5,500 students. At present, there are over 100 mathematics majors. Plattsburgh is located in Northeastern New York State on Lake Champlain, near the Adirondack Mountains, approximately sixty miles from Montreal.

Deadline is December 15, 1988; however, applications will be accepted until 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 1568-1529
Plattsburgh, New York 12901

SUNY PLATTSBURGH IS AN EQUAL OPPORTUNITY EMPLOYER

**SOUTHERN ILLINOIS UNIVERSITY
AT CARBONDALE****Department of Mathematics
Carbondale, IL 62901**

Applications are invited from qualified candidates for a tenure-track position at the Assistant Professor level beginning on August 16, 1989. Ph.D. in mathematics and a strong background in probability or stochastic processes 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: Probability Position, c/o Ronald Kirk, Chairman, Department of Mathematics, Southern Illinois University, Carbondale, IL 62901. The closing date for applications is January 10, 1989 or until the position is filled SIUC IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER. Women and minorities are particularly encouraged to apply.

**SOUTHERN ILLINOIS UNIVERSITY
AT CARBONDALE****Department of Mathematics
Carbondale, IL 62901**

Applications are invited from qualified candidates for a tenure-track position at the Assistant Professor level beginning on August 16, 1989. Ph.D. in mathematics required. Preference will be given to applicants with strong backgrounds in analysis, but other areas 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 Kirk, Chairman, Department of Mathematics, Southern Illinois University, Carbondale, IL 62901. The closing date for applications is January 10, 1989 or until the position is filled SIUC IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER. Women and minorities are particularly encouraged to apply.

MATH FACULTY

SUNY Plattsburgh invites applications for a tenure-track position in the Department of Mathematics beginning Fall, 1989. Appointment possible at all levels.

Duties: Primary responsibilities are undergraduate teaching, research, and service to the College.

Qualifications: Ph.D. in Mathematics or Statistics required.

INDIVIDUALS WITH AN UNDERSTANDING OF AND SENSITIVITY TO MINORITY AND GENDER CONCERNS ARE ENCOURAGED TO APPLY.

SUNY Plattsburgh, a four-yr college with approximately 5,500 undergraduates and over 100 math majors, is located in the northeast corner of New York State, on the western shore of Lake Champlain, near the Adirondack Mountains and approximately sixty miles from Montreal.

Closing is January 20, 1989; however, applications will be accepted until the position is filled.

Send letter of application, current resume, and three current letters of recommendations to:

Chair, Search Committee
c/o Office of Personnel/Affirmative Action
SUNY Plattsburgh
Box 1567-1529
Plattsburgh, New York 12901

SUNY PLATTSBURGH IS AN EQUAL OPPORTUNITY EMPLOYER

Oxford College, a two-year undergraduate division of Emory University, located 35 miles east of Atlanta, seeks to fill a full-time, tenure-track mathematics position beginning Fall Semester, 1989. Applicants are expected to present evidence of a strong commitment to teaching in a small, residential, liberal arts college and of excellence in teaching undergraduate mathematics. A master's degree in mathematics is required; a Ph.D. is highly desired. Send letters of application including curriculum vitae and the names, addresses, and telephone numbers of at least three references by January 15, 1989, to Dr. William E. Baird, Chairman, Division of Natural Science and Mathematics, Oxford College of Emory University, Oxford, GA 30267. Emory University is an Equal Opportunity/Affirmative Action Employer.

TRINITY COLLEGE OF VERMONT**Mathematics Faculty Position**

Trinity College invites applications for a ranked faculty position in Mathematics, August 1989. Trinity College uses a system of multiple-year contracts as an alternative to tenure. Ph.D. in math required; emphasis on demonstrated teaching ability. Duties: 24 credit hours of instruction per year in a variety of undergraduate level courses, student advising, committee work. Research: opportunities limited but encouraged. Rank and salary depend on qualifications and experience. Application: letter, vita, graduate transcript, one letter of reference addressing teaching skills, names/addresses/phone

numbers of 2-3 additional references. Submit to: Dr. John F. Heinbokel, Chair, Natural Sciences and Mathematics, Trinity College, Burlington, VT 05401, by 1 December 1988. Applications from women and minorities are encouraged. AA/EOE.

Five tenure-track positions at the assistant professor level. One position requires a doctorate (or near doctorate) in mathematics education, K-12 teaching experience preferred. One position requires a Ph.D. in mathematics with research interests in Combinatorics or Approximation Theory preferred. One position requires a Ph.D. in statistics. The remaining two positions will be filled from the three areas above according to the qualifications of candidates. Priority will be given to those who can supplement existing research areas within the department. Candidates positions should show promise of excellence in teaching and research. Salaries are competitive and benefits include university paid TIAA, medical, dental, group life. Send resume, transcripts, and three letter of recommendation to R. Fleming, Department of Mathematics, Central Michigan University, Mt. Pleasant, MI 48859 by Jan. 20, 1989. Late applications will be received until the positions are filled. CMU is an Affirmative Action/Equal Opportunity Institution.

ITHACA COLLEGE**Department of Mathematics
and Computer Science**

The Department of Mathematics and Computer Science has several tenure eligible positions in Mathematics for Fall 1989. A Ph.D. in Mathematics or Statistics is required. For one of these positions preference will be given to a person with the ability to teach statistics courses at several levels. Send vita to Dr. Diane Schwartz, Chair, Department of Mathematics and Computer Science, Ithaca College, Ithaca, New York 14850. An EO/AA employer.

EAST TEXAS STATE UNIVERSITY**at Texarkana
Position in Mathematics**

The Department of Arts and Sciences has an opening, beginning either Summer or Fall 1989, for a Ph.D. in Mathematics. The position is full-time, tenure-track. Rank and salary are open, commensurate with qualifications. Duties include teaching 12 hours per semester of upper level and graduate mathematics courses for mathematics and education students. Summer teaching is expected. A minimum of three years university level mathematics teaching with demonstrated excellence is required. Previous experience dealing with preservice and inservice teachers is strongly preferred. Send vita, transcripts, and three letters of recommendation prior to January 10, 1989 to: Dr. A.H. Simonson, Chair of Search Committee, ETSU-T, P.O. Box 5518, Texarkana, TX 75505. ETSU-T is an AA/EOE employer.

UNITED STATES NAVAL ACADEMY**Department of Mathematics**

Applications are invited for one or two tenure-track and several one-year visiting appointments, all at the assistant professor level, commencing in August of 1989. 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

posses 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, transcript 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 Phoenix in January. The Naval Academy is an EO/AA employer.

Assistant Professor (outstanding senior considered); academic year, tenure track, one-half time Math Department, one-half time Statistics Program. Duties include teaching, research and some consulting. Ph.D. in statistics or related field required. Area of specialization open, preference given to interests in statistical computing, response surface design, quality control or area of engineering application. Vita and 3 letters of reference sent to Professor Michael Jacroux, Chair, Statistics Search Committee, Department of Math, Washington State University, Pullman, WA 99164-2930. Closing date: January 15, 1989. WSU is an EO/AA education and employer. Protected group members are encouraged to apply.

Alcorn State University seeks applicants for several position in mathematical sciences. Full time positions are available in the spring and fall semesters of 1989. All areas of mathematics or computer science will be considered. Rank and salary will depend upon degrees and experience. Each position requires a minimum of a Master's degree with 18 graduate hours in mathematical sciences and requires a commitment to excellence in teaching undergraduate mathematical sciences. Apply to Faculty Search Committee, Department of Mathematical Sciences, Alcorn State University, Lorman, MS 39096

BETHEL COLLEGE

**Math & Computer Science Dept.
3900 Bethel Drive, St. Paul, MN 55112**

Bethel College has a full-time tenure-track position in the seven-member Department of Math and Computer Science for a Ph.D. in Mathematics Education. Candidates must be strongly committed to the education mission and evangelical Christian orientation of the college. Write to: Dr. H. David Brandt, Provost.

THE KING'S COLLEGE

Briarcliff Manor, NY 10510

The King's College, an independent, conservative evangelical Christian liberal arts college has a tenure track teaching position in the Department of Mathematical Sciences and Physics at the Assistant or Associate professor level, teaching computer science courses. Applicants must have a master's degree in computer science and adhere to the college standards of conduct and belief. The College is located approximately 30 miles north of New York city in Westchester county, overlooking the Hudson river. Send letter of application and resume to: Dr. Rex M. Rogers, Vice President for Academic Affairs. The King's College is an Equal Opportunity Employer.

BEMIDJI STATE UNIVERSITY

Mathematics and Computer Science

Applications are invited for a tenure-track position in mathematics beginning August 30, 1989. A Doctorate with emphasis in any area of pure or applied mathematics or doctoral candidate in pure or applied mathematics with degree expected by September 1, 1989, is required. Commitment to quality teaching will be expected of all candidates. Candidates for this position will be expected to teach a wide variety of mathematics courses ranging from precalculus level courses to upper level courses in pure and/or applied mathematics. In addition to teaching, the person who fills this position will be required to work with other faculty members and students in curriculum development, student placement, and student advising. All applicants must be able to lawfully accept employment in the United States at the time of an offer of employment.

Appointments generally will be at the assistant professor level although in exceptional cases a more senior appointment is possible. Starting salary range is \$24,000 to \$33,000. For further information about the position contact Dr. Tom Richard, Department of Mathematics and Computer Science, Bemidji State University, Bemidji, MN 56601.

Submit letter of application, resume, official transcripts from all degree granting institutions, and three current letters of reference submitted directly be referrers to: Dr. Frank Saccoman, Dean of Science and Mathematics, Bemidji State University, Bemidji, MN 56601. The postmarked deadline is January 3, 1989, or until the position is filled. Bemidji State University is an equal opportunity educator and employer.

LOYOLA UNIVERSITY

New Orleans, Louisiana

The Department of Mathematical Sciences invites applications for two tenure-track positions (one Associate/Assistant and one Full/Associate). Candidates in all areas of pure and applied Mathematics will be considered. The position will begin August, 1989, pending availability of funds.

Candidates are expected to have a commitment to excellence in teaching, a significant research record or potential and should possess a Ph.D. in Mathematics, Applied Mathematics or Statistics.

Please send (1) a curriculum vitae, (2) three letters of recommendation, and (3) an official transcript to:

Dr. Janet Melacon
Chair, Department of Mathematical Sciences
Box 104
Loyola University
6363 St. Charles Avenue
New Orleans, Louisiana 70118

Applications must be received by January 30, 1989.

Loyola University is an Equal Opportunity/ Affirmative Action Employer.

MATHEMATICS EDUCATION

**Ball State University
Muncie, Indiana**

Ball State University seeks applications for a tenure-track position in mathematics education to begin August 1989. Appointment will be at the assistant or associate professor level dependent upon qualifications. Salary is negotiable. Responsibilities: Teach undergraduate and graduate courses in mathematics education and undergraduate courses in mathematics; engage in scholarly activity appropriate for mathematics education; advise undergraduate and

graduate students in mathematics education; participate in outreach activities with Indiana schools and teachers, K-12, including service in state and regional professional organizations. Minimum Qualifications: Ph.D. or Ed.D. in mathematics education by time of appointment; strong background in mathematics, including graduate coursework; precollege teaching. Preferred Qualifications: Evidence of scholarly productivity; successful college teaching experience. For consideration above the assistant professor level, a record of scholarly productivity in mathematics education is required. Review of applications begins immediately and continues until the position is filled. Send current vita and three letters of recommendation to: Dr. Bernadette H. Perham, Chairperson, Mathematics Education Search Committee, Department of Mathematical Sciences, Ball State University, Muncie, IN 47306.

Ball State University Practices Equal Opportunity in Education and Employment.

The Calvin College Department of Mathematics and Computer Science will have one tenure-track opening for the 1989-90 academic year. Applicants in Mathematics Education, Computer Science, and Mathematical Statistics will be considered. The department currently has eighteen full-time faculty positions and nearly one-hundred majors at the junior-senior level. Calvin College is a Christian liberal arts college, and each faculty member is expected to demonstrate a Reformed and Christian perspective in her or his teaching and other professional activities. To apply, contact Professor S. Leestma, Chairman, Dept. of Mathematics and Computer Science, Calvin College, Grand Rapids, MI 49506. Calvin College is an equal opportunity, affirmative action employer.

UNIVERSITY OF ILLINOIS AT CHICAGO

Mathematics and Computer Education

The Department of Mathematics, Statistics, and Computer Science invites applications for tenure-track or tenured positions in Mathematics and Computer Science Education.

The Department offers the stimulating environment of a highly rated mathematics department coupled with a strong commitment to the improvement of pre-college education. Current programs in mathematics education include: two major N.S.F. grants for elementary school math and science curriculum development and implementation; private and state grants to support primary and secondary teacher enhancement programs; undergraduate and graduate programs for the certification of elementary and secondary teachers; M.S.T. and D.A. degree programs; and an extensive program of continuing education for teachers. The state has provided funding to expand and improve these activities and to support research in the teaching and learning of mathematics.

Applicants must have a Ph.D. or a D.A. in Mathematics, Mathematics Education, Computer Science, or related field; an outstanding research and publication record; experience in undergraduate and graduate teaching; and previous involvement with teacher education programs. Candidates with experience and interest in working directly with teachers and schools will be given preference.

Applications are also invited for visiting positions for 1 or more quarters. Send vita and direct 3 letters of reference to Chairman, Search Committee, Dept. of Mathematics, Statistics, and Computer Science, Univ. of Illinois at Chicago, Box 4348, Chicago, IL 60680. UIC is an affirmative action/equal opportunity employer.

BARD COLLEGE

Tenure Track Position in Mathematics

Applications are invited for a tenure-track position in Mathematics at Bard College for the Fall of 1989. Bard is a liberal arts college with a young and expanding Mathematics Department. We are seeking someone with a strong interest in building an innovative mathematics program in a liberal arts context. Candidates must have a Ph.D. by the Fall of 1989, and a commitment to teaching and continued mathematical activity. Salary and rank depending on experience. To apply, submit a resume, a statement of teaching and research interests, and 3 letters of recommendation (at least one concerning teaching to Prof. Ethan Bloch, c/o Dean's Office, Bard College, Annandale-on-Hudson, NY 12504. Deadline for applications is 1/1/89; late applications will be considered until the position is filled. For more information, call 914-758-6822, exts. 266, 267. Bard will have representatives at the AMS Employment Register at the Jan. 1989 meeting in Phoenix. Bard College is an AA/EEO.

RADFORD UNIVERSITY

The Department of Mathematics and Statistics is accepting applications for teaching positions to start in the fall of 1989. Ph.D. in mathematics, statistics, or related areas required. Specialization and rank open. Submit letter of application, current vita, copies of undergraduate and graduate transcripts, and three recent confidential letters of reference to:

Dr. David L. Albig, Chairman
Department of Mathematics and Statistics
Radford University
Radford, VA 24142

Review of applications to begin on January 1; applications will be accepted until the position is filled. Minorities and women are encouraged to apply. EO/AA Employer.

MIAMI UNIVERSITY

Middletown, Ohio

Department of Mathematics and Statistics

anticipates authorization of an assistant professor (tenure-track) position beginning in August 1989. Miami University Middletown is a two-year regional campus. Duties include teaching 12 hours per semester, service, and scholarship. Applicants should have a Ph.D. in one of the mathematical sciences by August 1989 and a strong interest in teaching. Send a vita, graduate transcript, and three reference letters to Middletown Search Committee, Department of Mathematics and Statistics, Miami University, Oxford, Ohio 45056 by February 1, 1989. Late applications may be considered. Women and minorities are encouraged to apply. Miami University provides equal opportunity in employment and education.

MICHIGAN BUSINESS SCHOOL

University of MI, Ann Arbor

Faculty position(s) Fall 1989; ranks open; assistant tenure-track professor, associate or full professor. Ph.D. in statistics or closely related field; sound theoretical preparation in statistics and mathematics required. Candidates should have an interest in business applications and promise of excellence in teaching and research. The positions involve teaching service courses, electives, and doctoral students. Opportunities for summer research funded by the Michigan Business School are available. Competitive salary/fringe benefits. Women

and minorities are strongly encouraged to apply. Contact Professor Roger L. Wright, Chairman, Department of Statistics and Management Science, Michigan Business School, University of Michigan, Ann Arbor, MI 48109.

MANKATO STATE UNIVERSITY

Department of Mathematics,
Astronomy, and Statistics
Mankato, MN 56001

Tenure-track faculty positions anticipated. Rank and salary dependent upon qualifications. Ph.D. required. Applications particularly encouraged from persons with specialties complementing current faculty areas of applied mathematics, mathematics education, numerical analysis, and statistics. Possibility exists for joint appointment with Computer Science. Applicants must have strong interest in teaching at freshman through graduate levels and show evidence of successful teaching at postsecondary level. Teaching load at most 36 quarter hours per 9 month academic year. Successful candidate will teach courses in mathematics/statistics and assist with student advising, serve on various departmental committees, and conduct appropriate research. Application deadline is February 1 or until filled. Send application letter, vita, research and teaching interests, and three (3) letters of reference to F.T. Hannick, Chairperson. AA/EEO.

MANKATO STATE UNIVERSITY

Department of Mathematics,
Astronomy, and Statistics
Mankato, MN 56001

Fixed-term faculty positions anticipated. Rank and salary dependent upon qualifications. Masters degree required. This position involves coordinating and teaching developmental mathematics. Applicants must have strong interest in teaching at freshman level and show evidence of successful teaching at postsecondary level. Teaching load at most 36 quarter hours per 9 month academic year. Successful candidate will teach courses in mathematics, assist with student advising, and serve on various departmental committees. Application deadline is February 1 or until filled. Send application letter, vita, teaching and research interests, and three (3) letters of reference to F.T. Hannick, Chairperson. AA/EEO.

GRAND VALLEY STATE UNIVERSITY

Allendale, Michigan

Tenure-track positions in Mathematics and Computer Science:

MATHEMATICS: Assistant—must have a Ph.D. with an emphasis in statistics, discrete mathematics, or mathematics education. Preference given to candidates with strong teaching recommendations.

COMPUTER SCIENCE: Assistant or Associate Professor—must have a Ph.D. in CS or Information Systems. Preference given to candidates qualified to assist in a C.I.S. graduate program.

For each position, duties include teaching, curriculum development, student advising, and professional development. GVSU is located just west of Grand Rapids, the second largest metropolitan area in Michigan and offers numerous cultural and recreational opportunities. Cost of living is moderate and quality of life is high. Salary: commensurate

with experience; good fringe benefits. Send resume to: Faculty Search Committee, Math & CS Dept., GVSU, Allendale, MI 49401. An EO/AA Institution.

WESTERN NEW ENGLAND COLLEGE

Department of Mathematics
and Computer Science

Assistant or Associate Professor of Mathematics tenure-track position(s) beginning September 1989. Candidate will instruct 12 credit hours per semester. Applicants must have a Ph.D. in Mathematics or Mathematical Sciences with excellence in and a strong commitment to teaching. Scholarly activity is expected and supported through released time, summer research grants, and professional travel funds. There are no restrictions as to area of specialization. Salary is competitive and commensurate with credentials and experience. Western New England College is an independent, non-denominational, coeducational institution with Schools of Arts and Sciences, Business, Engineering, and Law with a total day-evening enrollment of over 5000 students. The department has 11 full-time faculty members and over 80 undergraduate majors. Send cover letter (indicate if you plan to attend AMS/MAA annual meeting in Phoenix), curriculum vitae, and three letters of recommendation to Dennis M. Luciano, Chairman, Department of Mathematics and Computer Science, Western New England College, Springfield, Massachusetts 01119. Applications will be screened on a rolling basis until the positions are filled. Western New England College is an Equal Opportunity/Affirmative Action Employer and encourages applications from women and minority candidates.

Math Education

EAST CAROLINA UNIVERSITY'S Mathematics Department is currently accepting applications for tenure-track Assistant/Associate Professors in Mathematics Education beginning August 21, 1989. **REQUIRED:** PHD or EDD in mathematics education or related area, and evidence of ability to engage in research/creative activities. **PREFERRED:** Some elementary/secondary teaching experience, and an interest in the areas of special education, middle grades or elementary school education.

ECU is a growth-oriented institution with a current enrollment of 15,600 and offers both undergraduate and graduate degrees in mathematics. The Mathematics Department consists of 47 faculty members in the Mathematics, Mathematics Education, Computer Science, and Statistics areas. The University is located in Greenville, NC, a city with a population of approximately 40,000. Competitive salaries, commensurate with qualifications. Candidates should submit resume, official transcripts and three letters of reference to **Dr. Robert L. Bernhardt, Mathematics Department, EAST CAROLINA UNIVERSITY, Greenville, NC 27858-4353.** Screening will begin on January 15, 1989, and will continue until the positions are filled. As an AA/EEO employer, ECU especially encourages applications from minority Americans and women. Federal law requires proper documentation of identity and employability at the time of employment.



Calendar

National MAA Meetings

January 11–14, 1989 72nd Annual Meeting, Phoenix, Arizona
(Board of Governors, January 10, 1989)

January 17–20, 1990 73rd Annual Meeting, Louisville, Kentucky

Sectional MAA Meetings

Allegheny Mountain Robert Morris College, Pittsburgh, Pennsylvania, March 31–April 1, 1989

Eastern Pennsylvania and Delaware University of Pennsylvania, Philadelphia, Pennsylvania, April 8, 1989

Florida University of Florida, Gainesville, Florida, March 3–4, 1989

Illinois Western Illinois University, Macomb, Illinois, April 28–29, 1989

Indiana Indiana University, Bloomington, Indiana, Spring, 1989

Intermountain Brigham Young University, Provo, Utah, April, 1989

Iowa Coe College, Cedar Rapids, Iowa April 7–8, 1989

Kansas Hutchinson Community College, Hutchinson, Kansas, April 21–22, 1989

Kentucky Pennyryle Forest State Park, Dawson Springs, Kentucky, April 7–8, 1989

Louisiana–Mississippi Mississippi State University, Biloxi, Mississippi, February 24–25, 1989

Metropolitan New York SUNY at Farmingdale, Farmingdale, New York, May 6, 1989

Michigan Hope College, Holland, Michigan, May 12–13, 1989

Missouri University of Missouri–Columbia, Missouri, April 7–8, 1989

Nebraska Doane College, Crete, Nebraska, April 14–15, 1989

New Jersey St. Peter's College, Jersey City, New Jersey, April 22, 1989

North Central Mankato State University, Mankato, Minnesota, April 1989

Northeastern Keene State College, Keene, New Hampshire, June 2–3, 1989; College of the Holy Cross, Worcester, Massachusetts, November 17–18, 1989

Northern California Sonoma State University, Rohnert Park, California, March 4, 1989

Ohio Ohio State University, Columbus, Ohio, Spring, 1989

Oklahoma–Arkansas Central State University, Edmond, Oklahoma, March 31–April 1, 1989

Pacific Northwest Gonzaga University, Spokane, Washington, June 15–17, 1989

Rocky Mountain Fort Lewis College, Durango, Colorado, 1989

Seaway Union College, Schenectady, New York, April 28–29, 1989; Utica College, Utica, New York, Fall, 1989; Colgate University, Hamilton, New York, Spring, 1990

Southeastern University of Tennessee, Knoxville, Tennessee, April 7–8, 1989

Southwestern New Mexico Western University, Silver City, New Mexico, Spring, 1989

Texas Texas Lutheran College, Seguin, Texas, April 6–8, 1989

Wisconsin University of Wisconsin–Parkside, Kenosha, Wisconsin, April 21–22, 1989

Other Meetings

March 30–April 1 The Department of Mathematical Sciences and the Institute for Computational Mathematics at Kent State University will host a conference on Approximation Theory and Numerical Linear Algebra at Kent State University, Kent, Ohio. The Conference will consist of 15 invited 1-hour addresses, 6 solicited 20-minute talks, and 8 contributed 15-minute papers. The Conference is international in nature, with 9 of the 21 participants coming from outside of the continental United States; it bears the endorsement of the International Mathematical Union. The conference proceedings will be published in *Numerische Mathematik*. For further information contact Professor E.C. Gartland, Jr., Department of Mathematical Sciences, Kent State University, Kent, Ohio 44242, USA; gartland@kent.edu or egartlan@kentvm.bitnet.

March 31–April 1 Spring Conference on the First Two Years: Teaching the Mathematical Core, University of Hartford. Topics: discrete mathematics, calculus revision, and curriculum development. Featured speakers include: Ron Douglas, Jan DeLange, John Kenelly, and Fred Roberts. Persons interested in giving a short talk or demonstration on classroom experience with calculus revision, innovative teaching techniques, modeling in freshman and sophomore classes, or development of courses in discrete mathematics should submit an abstract to: Conference Committee, Math/Physics/Computer Science Department, University of Hartford, 200 Bloomfield Avenue, West Hartford, Connecticut 06117. This conference is funded by the Exxon Education Foundation.

April 9–11 Twelfth Annual Symposium on Developmental and Remedial Education, sponsored by the New York College Learning Skills Association, Albany, New York. Dr. Judith Langer of SUNY Albany will give the keynote address. Other speakers include Dr. Robert Hackworth on mathematics. For information, contact: David Martin, Director, Learning Skills Center, Cayuga Community College, Auburn, New York 13021; (315) 255-1743, ext. 304.

April 12–15 67th Annual Meeting of the National Council of Teachers of Mathematics, Orlando, Florida. For information, contact Betty C. Richardson, Director of Convention Services, NCTM, 1906 Association Drive, Reston, Virginia 22091; (703) 620-9840.

April 14–16 Annual New York State Mathematics Association of Two-Year Colleges Conference, Albany Hilton, Albany, New York. For information, contact Ernest Danforth, Mathematics Department, Corning, New York 14830; (607)962-9243.

July 3–7 1989 IFIP Conference on Modeling and Optimization, Leipzig University of Technology, GDR. Abstracts on papers and software developments of at most 2 single-spaced typewritten pages should be sent by 12/15/88 to Secretariat, Dr. K. Tammer, Leipzig University of Technology, Mathematics, and Informatics, PF66, Leipzig 7030, GDR.
