# FOCUS

THE NEWSLETTER OF THE MATHEMATICAL ASSOCIATION OF AMERICA

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## In this Issue



## Survey of Minority Graduate Students in U.S. Mathematical Sciences Departments

"I received a phone call from—, professor and graduate advisor from—, who stated that if I were to attend the university, I would 'flunk out' of the program within the first year. He went on to 'warn' me that if I should attend the university, '...it would be difficult.' The conversation was nothing but a repeat of 'warnings' and at no time was there any mention of mentors, tutors, or program assistance...no encouragement! The professor went on to say that he knew I was a Native American and that there was an underrepresentation of mathematicians in my ethnic group, '...but let's be realistic.' The conversation, in my opinion, was unprofessional and very discouraging."

—Native American male, Master's level

This report details results of a survey of mathematics graduate students from underrepresented groups: African Americans, American Indians/Alaskan Natives, Native Hawaiians/Other Pacific Islanders, and Hispanics. The survey was conducted in fall 1995 and spring 1996 by the MAA and its Strengthening Underrepresented Minority Mathematics Achievement (SUMMA) Program, in collaboration with the National Association of Mathematicians (NAM), as the first phase of a proposed Graduate Student Mentoring Network. Funding was provided by the Alfred P. Sloan Foundation. The AMS provided technical assistance. Professors Gloria Hewitt (Uni-

See *Survey* on page 13

## How Much Calculus is Needed for Probability and Statistics Courses?

*Norean Radke Sharpe, Homer T. Hayslett, and R. A. Roberts*

### Introduction

The past decade has witnessed an intense reexamination of the way we teach college students calculus. The sweeping changes in calculus—better known as calculus reform—have been exposed to widespread attention and public scrutiny, both in the professional journals and in the popular press. Many of the frontier calculus reform projects were described in the 1990 *MAA Notes* volume titled *Priming the Calculus Pump: Innovations and Resources.*[1] Although these pioneering efforts have been revamped, improved, and sometimes refocused, the common threads among modern calculus reform projects remain (1) increased use of technology in the classroom and/or lab; (2) increased emphasis on the process of problem

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# Editorial

*The editorial in this issue of* FOCUS *is written by former* FOCUS *editor Peter Renz. As always, the views expressed in the* FOCUS *editorial are those of the author, and should not be taken as representative of the official views of the MAA.*

— Keith Devlin, Editor

## An Excess of Jargon and a Poor Aim?

When my February FOCUS arrived, I dove into the article on the front page, "Enthusiasm for Research in Mathematics Education Grows," by John and Annie Selden. I found it frustrating and revealing. It left out or left unresolved the most important things. The jargon of the field and the failure to relate the material to common teaching concerns points up the gulf between the average classroom teacher and the typical participant at this conference. The thrust of this article seemed to be that if only the ordinary teachers would come over to the educational researchers' side, everything would be OK. Problem solved.

This will simply not happen unless the educational researchers can show that doing so will make people's lives easier, more productive, and more rewarding. I don't see much sign of this in the present report. This is probably because not much of general use was said at this meeting. The conference may still be quite productive, in its own terms. If it were a high-level conference on algebraic geometry, it would be a sure thing that nothing much of general use would be said, the subject being highly specialized.

But there were some missed opportunities in the article, failures to reach closure, and failures to provide pointers. For example:

1. What did Hyman Bass say about the linguistic compression afforded by mathematical symbolism? What do we gain from it in ability to manipulate and calculate and what do we lose in associations to the non mathematical world? This is a meaty issue and Bass is articulate, thoughtful, and deeply involved. At least we should have a pointer to where his talk is available, as I suspect it is.
2. Let's have some closure on Shea and the idea that 6 is both odd and even. Shea deserves to be heard and understood, but if he leaves the class without a clear understanding that, for nonnegative integers, "odd" by definition means "not even," he has been ill served—no matter how good it might be for his ego to have people discuss his ideas. It *is* interesting to wonder what his thought processes were, but in class one must move on, and one must understand that 6 is even, not odd.
3. Dubinsky says it all: "...a teacher might ask, 'Did the student learn the math?'" The teacher *will* ask this, and until the researcher can answer this question in a direct and positive way, teachers will not pay attention.
4. Anna Sierpinska on the linear algebra course: Here is a burning question about a pivotal course. The approaches are familiar. Here the speaker could have reached out and engaged almost every reader of FOCUS, but I challenge you to get anything useful out of this paragraph, and it is not the reportage that is at fault, I suspect. This seems to be a problem of jargon, of avoidance of the concrete, of failure to come to grips with the teaching problem.
5. The summary of M. Kathleen Heid's talk is informative in that it gives a list of topics being looked at and issues being addressed, but it says nothing about what has been discovered and what the implications of this work are for teaching. This creates the impression that the field is without substance and of no use.

### Where and When Might it Work?

Where and when might the new ideas work? I think about this as someone who has taught at Reed, Wellesley, and Bard and served on the MAA Board of Governors and as associate director of the MAA and editor of FOCUS. During more than ten years as editor at W. H. Freeman and Company, I spoke to many teachers from diverse schools with different and interesting approaches to the material and to pedagogy. My interests in educational research are those of a teacher and of an editor. I must ask not just "Does it work?" or "Could it work for my students?" but "Where might it work?" Educational experiments vary from routine trying of a new text to wholesale change as Michigan's calculus reforms. But our power to generalize from them is limited, and it is here that mathematical education research might make a huge contribution. In doing so, the field may help us understand what it means for an educational program to "work" and what is the defining core of various approaches.

Our society is confronted with serious questions and problems concerning education. It is commonplace that education is the key to national and individual success in the new post-industrial age, the information age. You see this sort of thing, for example, in Timothy S. Norfolk's article "A Mathematician's Apology? It's Time to Stop" in the same issue of FOCUS. I quote: "...to stay competitive in the global economy, the *average* American worker is going to need improved skills in data analysis and mathematics." This statement suggests that Norfolk has never conducted a survey or attempted to extract useful information from data. If he had he would know better. These are costly and specialized jobs. The gathering of data bearing on serious questions (say, whether women in their forties should routinely have mammograms) is expensive (often in blood as well as treasure) and its analysis is not to be undertaken lightly. The first effect of better training in mathematics for the general population (and even for those in the field) would be that such overblown claims would vanish.

Should we lay the success of state lotteries to innumeracy? And can we call the adverse odds to the player ruinous (Norfolk, again), when the state is the winner? I am not so sure. People gamble in part out of amusement and in part out of desperation. If they have problems, these are psychological and economic, not mathematical. To attribute their behavior to a lack of mathematical training is as foolish as to attribute smoking or drinking to a lack of biological training. (Are doctors immune to substance abuse?) Mathematics does not and should not *determine* human behavior, and it is unseemly for us to say it should. Let us hope, rather, that our subject will inform the lives of some to their benefit. Let's have more modesty, please.

## What Do People Need to Know?

What do people really *need* to know? Here we come to the idea of standards. Some suggest that what we need to do is to set standards and hold schools and students accountable for meeting them. This misunderstands the problem, for the great unknown is what will prove most essential, enriching, and useful. We have many competing ideas about what one should learn, as well. Surely the greatest error is to think that everybody must or should learn the same things. Either because of this objection or despite it, the exercise of preparing a minimal list of things one should know is worthwhile—and we should expect to find we have some holes in our own backgrounds, opportunities to pursue life-long learning even in our own field, let alone out of our areas of specialization.

Here is a first cut at things students should know.

- Students need to understand how to use what they already know to solve problems that fall into standard patterns. For example, how to use rates or unit prices to help make buying decisions. Mundane, yes, and denigrated as mechanical, but so important, the government insists that such information be provided in convenient form.
- Students need to know how to find solutions to problems by asking others (e.g., asking directions when lost) or by looking things up (dictionaries, maps, even user's manuals *can* be helpful).
- Students need to know how to write things down, draw pictures and diagrams to help them solve problems. So they need basic ideas of counting, diagrams, and geometry, but here we are getting into deep waters. They also need to know something of calculation, units, the general sizes of things, and how things work.
- To a lesser extent, they need expressive power in speaking, writing, and drawing, so they can present their ideas to others. For some this will be extremely important.
- They need an appreciation of how difficult it is to discover solutions to problems and of the fact that in practice, problems often have either multiple solutions or no solutions.

The interesting thing about practical problems is that they can be recast in different forms. For example, if you are wondering how you might come up with $180,000 to a buy house, this problem can be transformed into one of paying the interest on, say, $150,000, if you can scrape up a $30,000 down payment. This is a conceptual transformation; making it work depends on an elaborate system of social and financial arrangements. This is not a solution to the original problem, but a way of changing one problem for another, perhaps one you will deal with on a monthly basis for years to come.

- Students need to understand that most human and practical problems do not have definitive solutions like those for mathematical exercises. (For example, what might be the "solution" to the questions raised by financial projections concerning Social Security and Medicare?)

We need some students to know more, to become specialists, and we need the voting public to understand something of the power and limitations of mathematics, science, medicine, and economics and finance, not to mention politics.

I hope the specialists will be doing that data analysis Norfolk refers to, and the rest of us will watch the work with interest where the analysis bears on us, cheer the analysts on, and perhaps help keep them honest.

## Solving Educational Problems

At this stage of our knowledge we want solutions that work, not theories that don't. Jenner introduced vaccination against smallpox to the West by use of cowpox crusts, a practice used over centuries in the Middle East. This worked, despite the fact that no one knew how immunity was created or what caused smallpox.

Mathematics teachers must begin by finding out what works for their students. This assumes we and our students understand what a good outcome is. This is debatable, but it seems to boil down to the student's learning the math and having the inclination and ability to use it.

One cannot address these problems of outcome without understanding, oneself, what the mathematics is and what it is for. Here we come to "teacher subject matter knowledge," as M. Kathleen Heid delicately puts it. To understand this, look at something like the first edition of Thompson's *Calculus Made Easy* or *Concrete Mathematics* by Graham, Knuth, and Patashnik, or at, say, the treatment of determinants in Peter Lax's new linear algebra book. These authors show us what certain ideas and techniques are really for and how those who use them think of them. These teacher/practitioners have lessons to teach that would have changed my mathematical life, made it better. Indeed I wish I could spend a few years working through them even now. Deathbed repentance? Perhaps.

### The Call to Action

Let me finish with the words of Roger Godement, in the preface to his book *Algebra* (English translation, Houghton–Mifflin, Boston, 1968).

> "[I disagree] with the large number of public personalities at the present time who demand of scientists in general, and mathematicians in particular, that they should devote their energies to producing the legions of technologists whose existence, it appears, is urgently indispensable for our survival. Things being as they are, it seems to us that in the scientifically and technologically overdeveloped "great" nations in which we live, the first duty of a mathematician—and of many others—is to produce what is *not* demanded of him, namely men who are capable of thinking for themselves, of unmasking false arguments and ambiguous phrases, and to whom the dissemination of truth is infinitely more important than, for example, world-wide three-dimensional T.V.: free men, and not robots ruled by technocrats. It is sad but true that the best way of producing such men does not consist in teaching them mathematics and physical science; for these are the branches of knowledge which ignore the very existence of human problems, and it is a disturbing thought that our most civilized societies award them the first place. But even in the teaching of mathematics it is possible to attempt to impart a taste for freedom and reason, and to accustom the young to being treated as human beings endowed with the faculty of reason."

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*Peter Renz is an editorial consultant. He has taught at several colleges, served on the MAA Board of Governors and as an associate director of the MAA, and is a past editor of* FOCUS. *His e-mail address is plrenz@aol.com.*

# Letter to the Editor

Dear Editor,

In the February 1997 FOCUS, Annie and John Selden tell about Richard Noss's three dilemmas. All three dilemmas had to do with two things (as a good dilemma should), each of which is necessary to obtain the other: understanding and use, definitions and properties, concrete and abstract.

I think the apparent paradox comes from looking at mathematical learning as if it had the same structure as mathematics itself. Clearly, it does not. The structure of mathematics is a tree. Each new theorem follows from the axioms, definitions, and theorems that have gone before. It is essential to maintain the treelike structure to avoid circular reasoning.

But learning mathematics is, should be, must be circular. We learn a little, we practice what we've learned, probably doing very badly at first, then we review what we learned, and practice a little more. We memorize the definitions, derive the properties, and then switch back and forth between the two, so that we can look at each problem in at least two different ways. And we understand the abstract by looking at examples, and then understand the examples better by abstracting what they have in common.

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# Call for Papers

## Sixth Annual MAA Student Chapters Special Paper Session

### Baltimore, MD, January 7-10, 1998

The MAA Student Chapters Session serves as a forum for the exchange of ideas among advisors to individual chapters and section coordinators. Each fifteen-minute talk will focus on one or several activities implemented by a campus chapter or by a section or on activities supported by the Exxon grants.

If you are interested in presenting a paper on your student chapter activities, please submit the title and an abstract of the proposed talk to Karen Schroeder, Mathematical Sciences Department, Bentley College, 175 Forest Street, Waltham, MA 02154-4705; (617) 891-2267; Fax: (617) 891-2457; e-mail: kschroed@bentley.edu. Include your name, affiliation, address, telephone number, e-mail address, and whether you are a chapter advisor or a section coordinator. Deadline is September 12, 1997.

# Courses on Hand-Held Technology

The Ohio State University College Short Course Program is offering nearly fifty short courses on enhancing the teaching and learning of collegiate mathematics with hand-held technology at many colleges this summer. For information on site locations, contact Ed Laughbaum at (614) 292-7223; e-mail: elaughba@math.ohio-state.edu; WWW: http://www.math.ohio-state.edu/Entities/Organizations/TCSC/index.html.

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solving; (3) increased exposure to *applications* of mathematics; and (4) increased use of writing to learn and express mathematical concepts.

The January 1996 issue of *UME Trends* featured the first decade of calculus reform, retracing the progress of the movement from its birth in 1986 to the present. Just a few of the recurring themes in the article by Alan Schoenfeld[2] in this issue were "understanding," "concepts," "discovery," "hands-on," and "projects"—all consistent with the focus of calculus reform, all laudable ideas, and all time consuming endeavors in the classroom. Partly as a result of the increased attention given to pedagogy and conceptual understanding, and partly as a result of the focus on the real-world uses of mathematics, the *content* of calculus courses has also changed. Material that had been standard for decades in the calculus curriculum has been omitted and material which may have been offered in a variety of alternative mathematics courses has been inserted. Most of us would agree that the benefits are a "leaner and livelier" calculus course which motivates and engages the students. At the same time, those of us who teach students in upper-level mathematics courses need to be involved in examining the costs of omitting previously covered material.

Recent trends in education and the computer revolution have also had pedagogical and curricular impact on statistics courses. The report of the joint ASA–MAA statistics curriculum focus group[3] offered three recommendations for the teaching of statistics:

I. Emphasize Statistical Thinking
II. More Data and Concepts
III. Foster Active Learning

These recommendations are similar in both spirit and intent to the recurring themes of calculus reform mentioned above. Most instructors of statistics now agree that exposure to *real data* is a necessary part of an undergraduate curriculum. (See, for example, 4, 5, and 6.) However, if a mathematics department offers a "data driven" course for its mathematics majors, it is typically offered *in addition* to the required year (or semester) of probability and mathematical statistics.[7] Thus while the offering of applied statistics courses has increased, the amount of calculus used in the traditional probability and statistics sequence for majors has not necessarily *de*creased. The focus of our efforts here is to initiate a discussion on the topics of calculus that we consider essential for the probability and statistics courses offered by mathematics departments for their majors.

## Calculus Used in Probability and Mathematical Statistics Courses

*Fundamentals* First, there is a set of basic skills that instructors of probability and statistics assume their students will have acquired from repetitive exposure throughout their secondary and/or collegiate coursework. Some of these skills are central to the current calculus reform movement, such as those required for solving *word problems, designing informative and accurate graphs, interpreting and constructing tables, and expressing oneself clearly and concisely in written form.*[8,9] In addition to these skills, teachers also expect their students to be able *to use standard notation (such as summation and product notation), have strong algebraic skills, and to be able to follow and write elementary proofs.* Of course, faculty teaching many other upper-level mathematics courses would expect their students to have this preparation. However, we have observed a wide range of aptitudes in these skills among our students. For example, in recent years we have noticed a wide range in *algebraic and graphing skills*, and note that these skills may depend on the technology used in the students' prior courses.

*Elementary Concepts and Techniques* Beyond these basic skills, there are elementary calculus concepts and techniques that are used in most probability and mathematical statistics courses. The lists we present below (in all sections) were generated in a "brainstorming session" with fellow instructors of statistics. These topics are intended to represent a minimal level of exposure rather than a comprehensive list of prior experiences.

The following is a list of elementary topics which teachers of probability and mathematical statistics use in their courses.

- elementary set theory
- limits and continuity
- functions (piecewise, inverse, power, exponential, and logarithmic)
- differentiation techniques (especially chain rule)
- integration techniques (by substitution and by parts)
- improper integrals

Elementary set theory is needed throughout probability and statistics for basic probability concepts (if they are taught), as is the concept of continuity (e.g., continuous sample spaces.) Limits are used in general when evaluating improper integrals, and specifically, in the proof of the central limit theorem. Elementary functions are used to define commonly occurring probability distributions and students should be able to work with the functions (determine inverses, derivatives, and integrals). In particular, the exponential function is used in the normal and exponential distributions, as well as in the proof of the central limit theorem. The ability to differentiate functions is needed primarily for finding the probability density function (pdf) from the cumulative distribution function (cdf) and for finding maximum likelihood estimators—which often requires differentiating logarithmic functions. Students need to be able to evaluate definite integrals in order to find probabilities associated with commonly occurring distributions (such as the uniform, exponential, gamma, beta, and Weibull), and to find their means, variances, and moment generating functions. Knowledge of change of variables techniques and the evaluation of improper integrals is especially valuable here. Integration techniques also are needed for finding the cdf from the pdf.

*Advanced Concepts and Techniques* Many probability and statistics courses for mathematics majors present an in-depth survey of probability and cover more advanced statistical methods than those mentioned above, particularly if a full semester of each subject is required. In addition to the elementary concepts already noted, the following more advanced calculus concepts and techniques are often used in mathematical statistics courses.

- infinite series (especially geometric series)
- Taylor and Maclaurin series (especially

for $e^x$)
- double integration
- partial differentiation

Like the elementary concepts, this list represents the *minimum* set of required concepts and techniques we expect students to have mastered in their calculus courses prior to taking a mathematical probability or statistics course. Infinite series are used when finding probabilities, moments, and moment generating functions associated with discrete random variables. Taylor series are needed to discuss moment generating functions and to prove the central limit theorem. Double integrals are used for probabilities involving two continuous random variables, and partial differentiation is needed both to find the maximum likelihood estimates of two or more parameters and to derive the least squares estimates for regression. The basic and advanced concepts and techniques listed above, along with their applications in probability and statistics, are summarized in Table 1.

Although we, as statistics instructors, would be content if students had a solid preparation in the aforementioned topics, those of us involved in the "brainstorming sessions" thought of additional topics that we, as individuals, may use in either of these foundation courses, or in upper-level courses. Thus we came up with a "wish list" of topics which we felt would enhance the student's preparation for the probability and statistics sequence, in general:

- matrix algebra
- Lagrange multipliers
- root finding techniques

Matrix algebra can be used throughout probability and statistics, since many topics can be conveniently represented in matrix form, particularly regression. Matrices and determinants are also needed to find the probability distribution of a function of continuous random variables. Lagrange multipliers are used in constrained maximum likelihood estimation and root finding techniques are used for solving for maximum likelihood estimates numerically. Of course, not all mathematical statistics courses use the above concepts, but some do—and those that do may assume that a student who has taken the foundation courses for a mathematics major has been exposed to these topics.

## Conclusion

With the recent trends in making probability and statistics courses more applied and introducing real data at an earlier stage in the education process, departments have observed an increase in the number of data analysis and/or applied regression courses offered to their students. While these types of courses are *essential* to the reform that has been taking place in statistics education, and are popular with a wide variety of students, we believe that the need for educating our students in many calculus topics still exists for the probability and mathematical statistics courses offered by most departments.

At the same time, we realize that the statistics curriculum and the level of calculus preparation of students varies from institution to institution. The breadth and depth of the statistics courses may even vary from instructor to instructor. Instructors of statistics now have a wide variety of textbooks to choose from[10] and with all the new pedagogical approaches—from using the World Wide Web to using case studies to collaborative learning to computer labs— we don't seem to have the time to cover all the topics that we want to. We understand that any individual statistics instructor may not use *each* of the topics listed above *each and every* semester. We would, however, like to initiate a discussion between those who teach mathematical statistics for majors and those who teach calculus.

## References


[1]Tucker, T. W., ed. 1990. *Priming the Calculus Pump: Innovations and Resources.* MAA Notes 17. Washington, DC: MAA.

[2]Schoenfeld, A. H. "A Brief Biography of Calculus Reform." *UME Trends*, vol. 6, no. 6 (1995) : 3.

[3]Cobb, G. 1992. "Teaching Statistics." *Heeding the Call for Change: Suggestions for Curricular Action.* MAA Notes 22. Washington, DC: MAA.

[4]Moore, T. and Roberts, R. A. "Statistics at Liberal Arts Colleges." *The American Statistician*, vol. 43 (1989): 80.

[5]Singer, J. D. and Willett, J. B. "Improving the Teaching of Applied Statistics: Putting the Data Back into Data Analysis." *The American Statistician*, vol. 44, no. 3 (1990): 223.

[6]Willett, J. B. and Singer, J. D. "Providing a Statistical 'Model': Teaching Applied Statistics Using Real World Data." *Statistics for the Twenty-first Century.* MAA Notes 26. Washington, DC: MAA.

[7]Moore, T. and Witmer, J. "Statistics Within Departments of Mathematics at Liberal Arts Colleges." *The American*


| TECHNIQUE/CONCEPT | PRIMARY AREA OF APPLICATION |
|---|---|
| Elementary Set Theory | Understanding basic probability concepts |
| Limits and Continuity | Defining cdf*s*, evaluating improper integrals, and proving central limit theorem |
| Functions (especially exponential/logarithmic) | Defining commonly occurring probability distributions and finding probabilities associated with discrete random variables |
| Differentiation Techniques | Finding pdf*s* from cdf*s* and maximum likelihood estimators |
| Integration Techniques and Improper Integrals | Finding probabilities, moments, and moment generating functions for continuous random variables |
| Infinite Series | Finding probabilities, moments, and moment generating functions for discrete random variables |
| Taylor Series | Understanding moment generating functions |
| Double Integration | Finding probabilities for functions of two continuous random variables |
| Partial Differentiation | Finding maximum likelihood estimates in the multiparameter case and deriving the least squares estimates for regression |

***Table 1.** Techniques and Concepts Required for Probability and Mathematical Statistics*

*Mathematical Monthly*, vol. 98, no. 5 (1991): 431.

[8]Iversen, G. 1991. "Writing Papers in a Statistics Course." SLAW Technical Report no. 91-007. (Department of Mathematics) Pomona College, Pomona, CA.

[9]Radke Sharpe, N. "Writing as a Component of Statistics Education." *The American Statistician*, vol. 45, no. 4 (1991): 292.

[10]Cobb. G. W. "Introductory Textbooks: A Framework for Evaluation." *Journal of the American Statistical Association*, vol. 82 (1987): 321.

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## Who Chairs That Committee?

Remember you can find a complete listing of the chairs of MAA committees in *MAA Online*. Any member of the Association who is interested in serving on an MAA committee should contact Secretary Martha Siegel at siegel@towson.edu.

# ASA Response to MAA Guidelines

In January 1993, the Board of Governors of the MAA approved the adoption of the *Guidelines for Programs and Departments in Undergraduate Mathematical Sciences*. As stated in these guidelines, "The document includes statements on planning and periodic review, faculty and staffing, curriculum and teaching, institutional and departmental resources, physical facilities, libraries, and student issues." Following the adoption, the Board of Governors contacted other professional organizations, including the American Statistical Association, for a vote of "endorsement in principle" in the hope of being able "to submit to the community a document that reflects a consensus statement of the professional leadership."

In August of that year, the Board of Directors of the ASA, while endorsing the general spirit of the document, felt it could not endorse the document itself because it needed to reflect the concerns and needs of all the mathematical sciences. The MAA replied that it "considers the Guidelines to be a 'living document' and one that should reflect current thinking and policies of the profession."

In response to the need for interpretation of the document in the particular area of statistics, the ASA–MAA Committee on Undergraduate Statistics created the document *A Review of and Response to Guidelines for Programs and Departments in Undergraduate Mathematical Sciences*. This document was unanimously endorsed by the ASA Board of Directors at its December 1996 meeting with the following resolution:

"The ASA Board of Directors endorses the *Review and Response to Guidelines for Programs and Departments in Undergraduate Mathematical Sciences* and urges the MAA to seriously consider these comments in revising and implementing the Guidelines."

A copy of the document and resolution was sent from Lynne Billard, president of the ASA, to Kenneth Ross, president of the MAA, subsequent to the December meeting. This document is available on the MAA website http://www.maa.org, and the ASA–MAA Committee on Undergraduate Statistics urges all undergraduate mathematical science departments to consult the document for guidance in evaluating programs and faculty in statistics.

Don Kreider comments for the MAA's Council on Education:

The MAA's Guidelines for Programs and Departments in Undergraduate Mathematical Sciences were developed by a special committee during the period 1990 to 1993 and were approved by the MAA Board of Governors in 1993. They were widely disseminated during the ensuing years, and responsibility for periodic review and updating was assigned to the Council on Education.

The Council on Education has recommended to President Jerry Alexanderson that a new Guidelines Review Taskforce be established at this time to review and update the MAA guidelines. The paragraphs concerning statistics, in particular, need clarification and updating, as do other parts of the guidelines that deal with the status of the profession.

*Both of the documents referred to above may be found on* MAA Online. *Comments or suggestions concerning the review of the MAA Guidelines can be sent to the chair of the Council on Education, Don Kreider, Dartmouth College, 6211 Sudikoff Lab, Hanover, NH 03755-3510; e-mail: don.kreider@dartmouth.edu. Comments will be forwarded to the chair of the new Guidelines Review Committee as soon as it is established.*

# Mathematics and the FY 1998 Federal Budget Request

*The following is a brief extract from a much longer report by Lisa Thompson of the Joint Policy Board for Mathematics. The full report is available on* MAA Online.

President Clinton's budget plan is intended to lead to a balanced federal budget in FY 2002. Consequently it is basically a hold-the-line R&D budget: overall R&D would grow by $1.648 billion in FY 1998, an increase of 2%, to a total of $75.469 billion.

Priority areas have been identified and would receive better-than-average, and in some cases significant, increases. These include an emphasis on ensuring public benefits of information technology and educational technology.

## National Science Foundation Budget Request

The first page of the NSF budget summary notes that key economic areas have deep roots in NSF support for research and education and cites as an example of public benefit the quicker and lower-than-usual cost of development of the Boeing 777, which can be traced to "years of sustained public investments in such diverse topics as scientific visualization, fundamental mathematics, rapid prototyping, and other areas."

NSF's priority areas include an ambitious and far-ranging initiative in Knowledge and Distributed Intelligence (KDI). It has two components and three identified subcomponents: a) Next Generation Internet and b) Multidisciplinary Approaches in 1) knowledge networking, 2) learning and intelligent systems, and 3) new approaches to computational tools. While Division of Mathematical Sciences Director Donald Lewis is heading up the internal working group for the third subcomponent, the mathematical sciences have a fundamental role in all three of the components.

| | FY97 | FY98 | change |
|---|---|---|---|
| Computer & Information Sciences & Eng | $273.4 | $294.2 | 7.6% |
| Mathematical Sciences | $93.2 | $97.0 | 4.1% |

### Division of Mathematical Sciences

The Division of Mathematical Sciences' budget would continue to increase at a rate greater than the average for NSF research—4.1% versus 3.4% in FY 1998. Its estimated growth of 6.3% from FY 1996 to FY 1997 will outpace the average of 4.5%. The FY 1998 increment of $3.78 million for DMS would be apportioned as follows (figures in millions):

| | FY97 | FY98 | change |
|---|---|---|---|
| Research project support | $72.9 | $74.0 | 1.5% |
| Infrastructure support | $20.3 | $23.0 | 13.3% |

### Division of Education and Human Resources

EHR plans some greater-than-usual funding redistribution among its divisions (as well as within its divisions) in FY 1998. Broken down by educational level, EHR support is projected to be as follows (figures in millions):

| | FY97 | FY98 | change |
|---|---|---|---|
| PreK–12 Education | $377.2 | $375.5 | –0.5% |
| Undergraduate Education | $109.5 | $114.7 | 4.7% |
| Graduate Education | $74.7 | $77.7 | 4.0% |
| Public Understanding of Science | $9.1 | $10.5 | 14.7% |

# Task Force Studying NCTM Standards

The National Council of Teachers of Mathematics has asked several mathematics organizations, including the MAA, to create Association Review Groups (ARGs) to serve as advisory groups to the NCTM Commission on the Future of the Standards, which currently is reexamining the NCTM Standards. The MAA created the President's Task Force on the NCTM Standards to serve as its ARG. This is an ongoing effort that is expected to take three years. The first set of responses, to questions involving the content of the Standards submitted by the NCTM Commission, were submitted by this task force in late January.

You are encouraged to visit the task force's website (http://www.maa.org/past/maa_nctm.html) where you will find the following: background information about the MAA and the NCTM Standards; membership of the task force; the questions submitted by the NCTM Commission; the task force's response on January 27; and a response from Mary Lindquist, chair of the NCTM Commission. Questions may be addressed to the chair of the task force, Ken Ross at ross@math.uoregon.edu.

# Art and Mathematics Conference

## SUNY, Albany, NY, June 21–25

AM97 will consist of three days for slide–video talks (June 21–23) and two days for teacher workshops (June 24 & 25). The schedule is the same as AM96, which provides more time for people to share ideas. There will be group-interest meetings covering topics such as sculpture, two-dimensional art, computer graphics, polyhedra structures, and interdisciplinary curricula. The teacher workshops will be concerned with classroom projects relating art and mathematics. For further information, see *MAA Online* or contact the conference organizer, Nathaniel Friedman; home: (518) 456-4390; office: (518) 442-4621; fax: (518) 442-4731; e-mail: artmath@math.albany.edu.

# MAA Contributed Papers in Baltimore

The MAA and the AMS will hold their annual joint meetings Wednesday, January 7, 1998 through Saturday, January 10, 1998 in Baltimore, Maryland. The complete meetings program will appear in the October 1997 issues of FOCUS and the AMS *Notices*. This preliminary announcement is designed to alert participants about the MAA's contributed papers sessions and their deadlines.

Note that the days scheduled for these sessions remain tentative. The organizers listed below solicit contributed papers pertinent to their sessions; proposals should be directed to the organizer whose name is followed by an asterisk (*). For additional instructions, see the Submission Procedures box on page 11.

Sessions generally must limit presentations to ten minutes, but selected participants may extend their contributions up to twenty minutes. Each session room contains an overhead projector and screen; blackboards will not be available. You may request one additional overhead projector, a 35mm slide projector, or a 1/2- or 3/4-inch VHS VCR with one color monitor. Persons needing additional equipment should contact, as soon as possible but prior to October 2, 1997, Donovan H. Van Osdol, Dept. of Math, University of New Hampshire, Durham, NH 03824; dvanosdo@math.maa.org.

Applied Calculus and Mathematics for Advanced Technical Careers
*Thursday & Friday mornings*

Janet P. Ray*, Seattle Central Community College, BE5104, 1701 Broadway, Seattle, WA 98122; (206) 587-4080; fax: (206) 344-4390; janray@seaccc.sccd.ctc.edu

Brian Smith, McGill University; Yajun Yang, SUNY Farmingdale

In recent years, there has been increasing recognition of the need for a highly trained and competent technical workforce. We invite papers dealing with mathematics courses for advanced technology programs (e.g., electronics, robotics, biotechnology, and manufacturing). Content could include calculus, statistics, or other college level mathematical material. Papers on innovative approaches to other applied courses, such as business calculus, are also welcome. E-mail submissions are preferred. This session is sponsored by the MAA Committee on Two-Year Colleges.

Chaotic Dynamics and Fractal Geometry
*Wednesday and Friday mornings*

Jon Scott*, Montgomery College, Dept. of Math, Takoma Park, MD 20912-4199; (301) 650-1443; fax: (301) 650-1346; jscott@umd5.umd.edu

Denny Gulick, University of Maryland

This session invites papers in the general areas of chaotic dynamics and fractal geometry. The papers, which should have an expository flavor, might include new developments in either chaos or fractals, interesting or novel applications, undergraduate research experiences, or innovative approaches for exploring these topics in undergraduate mathematics.

Mathematics and Sports
*Saturday afternoon*

Robert Edward Lewand*, Goucher College, Dept. of Math and Computer Science, Baltimore, MD 21204-2794; (410) 337-6239; fax: (410) 337-6408; blewand@.goucher.edu

Mathematics has been used routinely for statistical analyses of athletic contests. Increasingly, however, mathematics is being employed in devising training strategies and competitive tactics for both individuals and teams. This session invites papers on any aspect of mathematics (especially statistics, operations research, and discrete mathematics) that pertains to sports.

Teaching the Practice of Statistics at All Levels
*Thursday and Saturday afternoons*

Anne D. Sevin*, Framingham State College, Dept. of Math, Framingham, MA 01701-9101; (508) 626-4777; fax: (508) 626-4003; asevin@frc.mass.edu

K. L. D. Gunawardena, University of Wisconsin Oshkosh

This session will present papers related to teaching the practice of statistics at all levels, especially in courses beyond the introductory applied course. For this session, organizers invite papers which focus on teaching statistics to mathematics majors, use of technology in statistics courses, innovative teaching techniques, and teaching statistics to prospective teachers. Submission of proposals by e-mail is preferred.

Rethinking Upper Level Core Mathematics Courses
*Wednesday and Thursday afternoons*

Alan C. Tucker*, SUNY Stony Brook, Applied Math Dept., Stony Brook, NY 11974-3600; (516) 632-8365; atucker@ccmail.sunysb.edu

Upper level core mathematics courses should today be addressing the needs of a diverse array of students beyond just those planning graduate study in mathematics: future statisticians, industrial mathematicians, secondary school teachers, and more. This session invites papers about innovative curriculum and pedagogy in abstract algebra, analysis, and other upper level mathematics courses which try to serve this broad audience.

Innovations in Teaching Linear Algebra
*Wednesday morning and Friday afternoon*

David C. Lay*, University of Maryland, Dept. of Math, College Park, MD 20742; (301) 405-5473; fax: (301) 314-0827; lay@math.umd.edu

Steven J. Leon, University of Massachusetts at Dartmouth

This session will focus on successful methods for teaching students to conceptualize topics in linear algebra and to communicate mathematical ideas in written or verbal form. Sample topics: carefully designed lesson plans, homework assignments, or lab projects that require students to communicate mathematical concepts orally or in writing; using technology (such as *ATLAST* programs, interactive texts, *Mathematica* notebooks) to stimulate good mathematical writing; collecting student work via a network; and evaluating student writing.

Using Real World Data in the Teaching and Learning of Mathematics
*Wednesday morning and Friday afternoon*

Florence S. Gordon*, New York Institute

of Technology, Dept. of Math, Old Westbury, NY 11568; fgordon@faculty.nyit.edu

Sheldon P. Gordon, Suffolk Community College, Iris B. Fetta, Clemson University

The use of real world data to motivate the teaching and learning of mathematics is one of the strong threads that runs through much of the mathematics reform movement, but has received relatively little attention compared to themes such as the use of technology or new learning paradigms. This session invites papers describing experiences using real world data that simultaneously motivate both the mathematical development and students' appreciation for the value of mathematics at any level of the curriculum, from introductory algebra through precalculus and on to calculus and differential equations, as well as in service courses such as business math, finite mathematics, quantitative reasoning, and so forth.

The Uses of History in the Teaching of Mathematics

*Friday and Saturday mornings*

Florence Fasanelli*, MAA, 1529 18th St. NW, Washington, DC 20036-1385; (800) 741-9415; fax: (202) 265-2384; ffasanel@maa.org

V. Frederick Rickey, Bowling Green State University, Victor J. Katz, University of the District of Columbia

An NSF-supported MAA Institute on the History of Mathematics and its Use in Teaching has dealt, for three summers, with the history of mathematics, how it can be used in the classroom, and how to teach history of mathematics courses. To continue, this session invites contributions from individuals who have taught history of mathematics in innovative ways or who have used history in their classes to support current changes in curricula, pedagogy, and the mathematical preparation of teachers.

Developmental Programs that Work

*Saturday afternoon*

Catherine M. Murphy*, Purdue University Calumet, Dept. of Math, Comp Sci. & Stat., Hammond, IN 46323; (219) 989-2273; fax: (219) 989-2750; murphycm@calumet.purdue.edu

Eileen Poiani, St. Peters College

We invite the submission of papers which develop one of the following topics: research that focuses on how underprepared students learn mathematics; preparation of faculty to teach developmental mathematics courses; successful courses, programs, or approaches for students in developmental mathematics courses.

Mathematics Across the Disciplines

*Friday afternoon and Saturday morning*

Brian J. Winkel*, United States Military Academy, Dept. of Math Sciences, West Point, NY 10996-9902; (914) 938-3200; fax: (914) 938-2409; ab3646@usma2.usma.edu

There is interest in efforts to move mathematics across the curriculum. This session invites papers which describe interdisciplinary activities which integrate mathematics with one or more partner disciplines. Examples may include one activity, one class, one project, one section, one course, or an entire curriculum. It is desirable to offer illustrations of specific activities which are transportable. We welcome participation of colleagues from partner disciplines. This session is part of the activities of the CUPM subcommittee to promote and disseminate efforts on moving "Mathematics Across the Disciplines."

The World Wide Web in Mathematical Instruction

*Thursday morning and Friday afternoon*

Earl Fife*, Calvin College, Dept. of Math, Grand Rapids, MI 49546-4388; (616) 957-6403; fife@calvin.edu

Eugene Klotz, Swarthmore College, Laurence Husch, University of Tennessee–Knoxville

The World Wide Web is being used increasingly for presenting mathematical instructional materials to students. This session invites presentations of such materials. The form of materials will range from web pages with interactive gif images, or java applets, to special browser plug-ins which allow increasing interactivity. By the time of the meeting, a wide variety of methods of presentation should be beyond experimental use. The organizers hope for a wide range of modes of presentation represented in the session. Submission by e-mail is encouraged.

Research in Undergraduate Mathematics Education

*Wednesday and Thursday afternoons*

Michael A. McDonald*, Occidental College, Dept. of Math; Los Angeles, CA 90041; (213) 259-2504; fax: (213) 259-2958; mickey@oxy.edu

Karen J. Graham, University of New Hampshire

Research papers which address issues in the teaching and learning of mathematics at the undergraduate level are welcome. Investigations may be theoretical or empirical, and may utilize either qualitative or quantitative methodologies. To the greatest extent possible, reports should be situated in and advance understandings about the teaching and/or learning of undergraduate mathematics. The work should be set within appropriate theoretical frameworks. This session is sponsored by the AMS–MAA Committee on Research in Undergraduate Mathematics Education (CRUME).

Mathematics For Preservice Elementary Teachers

*Wednesday and Friday mornings*

Albert D. Otto*, Illinois State University, Dept. of Math, Normal, IL 61790-4520; (309) 438-5767; fax: (309) 438-5866; otto@math.ilstu.edu

C. Patrick Collier, University of Wisconsin at Oshkosh, Judith L. Covington, Lousiana State University at Shreveport, William Haver, Virginia Commonwealth University

We invite proposals that describe both the mathematical topics and experiences in courses taken by preservice elementary teachers, along with the rationale for their inclusion. Proposals can be devoted to the description of an individual course or can be focused on the entire mathematics portion of the preservice program, including methods and mathematics courses. This session is cosponsored by the MAA Committee on Mathematical Education of Teachers (COMET) and the Virginia Urban Corridor Teacher Preparation Collaborative (NSF CETP Program).

Establishing and Maintaining Undergraduate Research Programs in Mathematics
*Thursday and Saturday afternoons*

Emelie Kenney*, Siena College, Dept. of Math, Loudonville, NY 12211-1462; (518) 783-2913; emelie@ares.cs.sienna.edu

Joseph Gallian, University of Minnesota at Duluth

We are interested in descriptions of all types of efforts to promote, encourage, or support undergraduate research in mathematics. Examples are administrative support; research results; and funding, symposia, conferences, prizes, and other forms of recognition for student research. Undergraduate and graduate student perspectives are welcome.

## Submission Procedures for Contributed Paper Proposals

After you have selected a session to which you wish to contribute a paper, forward the following directly to the organizer (indicated with an asterisk (*)):

- the name(s) and address(es) of the author(s) and
- a one-page summary of your paper.

The summary should enable the organizer to evaluate the appropriateness of your paper for the selected session. Consequently you should include as much detailed information as possible within the one-page limitation. **Your summary must reach the designated organizer by Friday, September 5, 1997.** The organizer will acknowledge receipt of all paper summaries. If the organizer accepts your paper, you will receive instructions about preparing an abstract. Please submit the completed abstract to the AMS by Thursday, October 2, 1997. Abstracts received after the deadline will not be published in the booklet of abstracts that will be available in the meetings registration area during the conference in Baltimore.

# Hilbert & Erdös Awards Presented

At the International Congress on Mathematics Education held in Seville, Spain, the World Federation of National Mathematics Competitions presented the David Hilbert International and Paul Erdös National Awards.

The Hilbert Award recognizes mathematicians whose contributions have played a significant role in the development of mathematical challenges at the international level and who have been the stimulus for enrichment of mathematics learning. The 1996 award was made to Andrew Chiang-fung Liu, a professor of mathematics at the University of Alberta. Andy was a member of the USA Mathematical Olympiad Committee (1980–87), deputy leader and assistant coach of the U.S. team at the IMO (1981–84), and vice president of the International Mathematics Tournament of the Towns (1992–present). He is a winner of the Faculty of Science Award for Excellence in Teaching and the A. C. Rutherford Award for Excellence in Undergraduate Teaching at the University of Alberta. In 1995 he won a teaching award at the University of Agiven, given by the faculty of Engineering to professors not in their faculty but teaching courses their students take.

*R to L: Andrew Chiang-fung Liu, George Berzsenyi, Anthony Gardiner, and Derek Holton.*

The Erdös Award recognizes mathematicians whose contributions have played a significant role in the development of mathematical challenges at the national level and who have been the stimulus for enrichment of mathematics learning. The Erdös Awards for 1994–95 were made to George Berzsenyi of the USA and Tony Gardiner of Great Britain.

George Berzsenyi is a native of Hungary. Following his emigration in 1956, he completed his education in the U.S., where he is presently a professor of mathematics at the Rose-Hulman Institute of Technology. He served on the committee in charge of the USAMO (1976–87).

Anthony Gardiner's 250 publications run the gamut from how young children learn about infinity to esoteric theorems of locally finite groups. His influence on mathematics education has been felt nationally and internationally for many years. Tony teaches mathematics at the University of Birmingham.

The Erdös Award for 1995–96 went to Derek Holton of the University of Otago, New Zealand. Derek's work has included the setting up of formal infrastructure and providing challenge to New Zealand students from a mathematical point of view. His two problem solving books *Let's Solve Some Math Problems* and *Let's Solve Some More Math Problems* have become standard training texts for Olympiad participants.

# New Books from the MAA

## Power Play

Series: Spectrum

*Ed Barbeau*

*A country walk through the magical world of numbers*

Powers of numbers exhibit fascinating patterns, some of which indicate a deep and complex structure. This book collects many of them. It can be enjoyed by anyone, regardless of technical backround. The chapters are supplemented by notes, exercises and solutions directed to those who have some background in mathematics.

Strict amatuers who ignore the exercises and notes will find that a background in high school algebra will carry them through. Many of the exercises can be done by high school students. Teachers at all levels will find resource material for both mainstream and enrichment mathematics. Mathematicians will find a handy compilation of results and references to the literature for material strewn over many books and journals of the last fifty years.

While this book could be read as one listens to a symphony, there are exercises (with solutions) and references to the literature for those who would like to probe deeper. There is a great deal of enrichment material here, as well as exercises on basic mathematics that are more interesting than standard textbook fare.

212 pp., 1997, Paperbound, ISBN 0-88385-523-0

List: $29.00 MAA Member: $22.95

Catalog Code: POPL/FOC97

## Interdisciplinary Lively Application Projects (ILAPs)

Series: Classroom Resource Materials

*David C. Arney*

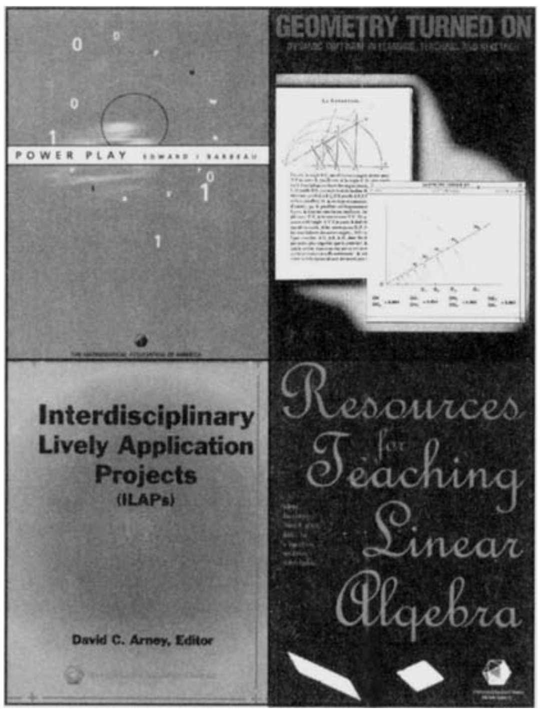
Interdisciplinary Lively Application Projects (ILAPs) are small group projects developed through the cooperation of faculty from mathematics and partner disciplines. These projects will provide teachers with material that can help their students understand mathematical concepts, develop strong mathematical skills and motivate them towards an interest in future subjects accessible through the study of mathematics. It is an important step towards helping students acquire a broad, interdisciplinary outlook towards problem solving.

The ILAPs provide supplemental classroom resource materials in the form of eight project handouts that you can use as student homework assignments. They require students to use scientific and quantitative reasoning, mathematical modeling, symbolic manipulation skills, and computational tools to solve and analyze scenarios, issues, and questions involving one or more disciplines. Sample solutions to the problems, background material, notes to the instructor and a student writing guide are also included.

206 pp., Paperbound, 1997, ISBN 0-88385-706-5

List: $27.50 MAA Member: $ 22.00

Catalog Code: ILAP/FOC97




## Geometry Turned On

### Dynamic Software in Learning, Teaching and Research

Series: MAA Notes

*James King and Doris Schattschneider, Editors*

This volume is a collection of articles about dynamic geometry. Dynamic geometry is active, exploratory geometry carried out with interactive computer software. This software has had a profound effect on classroom teaching wherever it has been introduced. Although not originally intended by its developers, it has also become an indispensable research tool for mathematicians and scientists. Our authors give many examples of the ways in which the software can be used, and some of the effects it can have. Authors also make clear that the software raises questions on the design of the software itself. They address the basic question, "What is dynamic geometry software good for?" as they discuss and illustrate all these answers: accuracy of construction, visualization, exploration and discovery, motivating proof, transformations, tracing loci, simulation, and creating microworlds.

With the use of interactive computer software, the focus in teaching shifts from students laboriously making constructions by hand to verify a stated fact in a test (for which there seems little reason to produce a proof) to a focus on students carrying out experiments, quickly producing many accurate sketches from which they conjecture properties that seem to be "always true."

275 pp., 1997, Paperbound, ISBN 0-88385-099-0

List: $38.95 MAA Member: $31.00

Catalog Code: NTE-41/FOC97

## Resources for Teaching Linear Algebra

Series: MAA Notes

*David Carlson, Charles R. Johnson, David C. Lay, A. Duane Porter, Ann Watkins, William Watkins, Editors*

This volume grew out of the work of the Linear Algebra Curriculum Study Group (organized by David Carlson, Charles R. Johnson, David C. Lay, and A. Duane Porter), and the 1993 Special Issue on Linear Algebra of the *College Mathematics Journal* (then edited by Ann Watkins and William Watkins.) This book argues that the teaching of elementary linear algebra can be made more effective by emphasizing applications, exposition and pedagogy.

This volume includes the recommendations of the Linear Algebra Curriculum Study Group, with their core syllabus for the first course, and the thoughts of mathematics faculty who have taught linear algebra using these recommendations.

306 pp., Paperbound, 1997, ISBN 0-88385-150-4

List: $34.95 MAA Member: $29.00

Catalog Code: NTE-42/FOC97

**TO ORDER, CALL THE MATHEMATICAL ASSOCIATION OF AMERICA AT 1-800-331-1622**

*Survey* from page 1

versity of Montana) and Bettye Anne Case (Florida State University) acted as survey consultants. Drs. Jack Alexander, president of NAM, and William Hawkins, director of the SUMMA Program, were project codirectors.

The goal of the survey is to enhance the retention and completion rates of minority students in graduate mathematics degree programs by gathering information on their learning environments and disseminating that information throughout the mathematics, higher education, and other communities. No complete national survey had ever before been conducted directly of minority mathematics graduate students. The results of this survey clearly show that a multifaceted mentoring program will help considerably to relieve the isolation which most minority graduate students feel in their programs.

There were responses from 267 of 505 surveyed departments. The total number of students identified was 657, with 492 in doctoral departments and 165 in master's level programs. A total of 233 students responded individually. Almost equal numbers of master's and doctoral students completed questionnaires, with 43% female and 57% male. The approximate ethnic composition of the sample was 58% African Americans, 35% Hispanics, 4% American Indians/Alaskan Natives, 2% Native Hawaiians/Other Pacific Islanders, and 2% of unknown ethnicity. (These percentages are similar to those reported for the larger pool of 657 students and thus may approximate the actual population of minority graduate students in terms of ethnicity. Unfortunately, no gender data was collected for these 657 students.)

Almost all of the 233 respondents were full-time students with the vast majority receiving teaching assistantships or fellowships. Viewing graduation in 1996 as taking one year to complete the degree, we find an average of just under 3.3 years remaining to completion for the doctoral students and just over 1.6 years for Master's students.

### Some Major Findings

45% of the respondent students entered graduate school because of their interest in mathematics or desire to further their education

36% indicated the way family, friends, and professors had helped them the most was by providing encouragement

54% said the person(s) most instrumental in pursuit of their goals had been undergraduate professor(s)

46% gave a negative response or none at all when asked to identify organized, planned helpful activities or programs

18% responded that other minority or female graduate students in the department or same specialization, students from same minority group, or interaction with minority faculty or mathematicians outside academia were missing from their support system, but 15% said their support system was adequate

48% saw themselves eventually as college, university, or research professors

The concerns expressed by these students are well reflected in the elements of the proposed mentoring network. Electronic communication will promote the development of a community of minority graduate students and facilitate continued involvement with undergraduate faculty who have been so influential in their academic lives. The students' intense interest in mathematics will be reinforced by attendance at the national mathematics meetings to interact with the mathematics community and their peers. Departments clearly can use faculty consultants to examine and modify impediments to minority student success.

### Recommendations for Professional Mathematics Organizations

1. Survey minority graduate students annually to monitor retention and degree completion. The current survey provides a benchmark with which to compare future developments.

2. Seek funding for implementation of a Graduate Mentoring Network as discussed.

### Recommendations for Graduate Mathematics Departments Based on Existing Programs

1. Grow your own minority graduate students by cultivating the mathematical interest and involvement of minority undergraduates or terminal master's students in your department. The small numbers of minority students cannot simply be redistributed to other locales.

2. Use departmental minority alumni to familiarize new minority graduate students with the "unwritten rules" of the department. Minority alumni should be invited back occasionally for special departmental events, seminars, and conferences, and special times should be set aside for minority alumni and students to meet and discuss mathematics.

3. Create mechanisms such as bridge programs or summer mathematics institutes for introducing minority students to numerous areas of mathematics which might not have been done as undergraduate work.

4. Assign each first-year graduate student a faculty mentor to assist with academic and other concerns and issues that face the new student. The mentor need not become the student's eventual thesis advisor.

5. Conduct weekly "case studies" seminars for first-year students where faculty present their research. This would be useful in learning what different professors are doing and in finding a thesis advisor.

6. Use willing minority graduate students to recruit more minority students to mathematics. They can return to their baccalaureate institutions and talk with students about the rewards of choosing mathematics as a life's vocation.

7. Inform minority graduate students of on-campus minority organizations and volunteer opportunities within nearby minority communities. This will assist minority students in adjusting to the culture of the institution and their new surroundings.

8. Sponsor departmental parties, picnics, teas, coffee hours, and get-togethers to help minority and non-minority students and faculty get acquainted on other levels than mathematics. This will encourage a welcoming atmosphere within the department.

9. Recruit minority and female faculty for tenure-track positions. Hiring faculty is a powerful indicator of departmental concern with increased minority retention and degree completion.

# DIMACS Workshops

## Network Switching

**Computer Science Department, Princeton University, Princeton, NJ**

July 7–9, 1997

There are many worthwhile and interesting issues about switching networks. This workshop focuses on nonblocking and almost nonblocking switching networks (NANSN), including but not limited to the following varieties (according to various criteria): NONBLOCKINGNESS Strictly nonblocking, wide-sense nonblocking, rearrangeable; NETWORK Multistage, rings, cubes, grids, star, general connectors; COMPONENT Concentrator, superconcentrator, partial concentrator, expander, multiplier, copy network, n-generalizers; TRAFFIC Point-to-point, pertation, broadcast; ENVIRONMENT Circuit-switching, packet switching, ATM switching. For further information, contact Frank Hwang, Department of Applied Math, Chiaotung University, Hsinchu, Taiwan Republic of China; fhwang@math.nctu.edu.tw. For local arrangements, contact Sandy Barbu, Princeton University, Princeton, NJ 08544; (609) 258-4562; barbu@cs.princeton.edu.

## DIMACS Research & Education Institute: DREI '97—Cryptography and Network Security

**DIMACS Center, Rutgers University, Piscataway, NJ**

July 28–August 15, 1997

During the summer of 1997 we will be offering a three-week program of research workshops aimed at scientists from academia and industry, and open to graduate students and postdoctoral fellows, along with an educational program for high school and college teachers, undergraduates and others. For further information, contact Elaine Foley, drei@dimacs.rutgers.edu. For local arrangements, contact Pat Pravato; (908) 445-5929; pravato@dimacs.rutgers.edu; WWW: http://dimacs.rutgers.edu/drei/1997/index.html.

## DIMACS Quantum Computing Tutorial and Workshop

**Computer Science Department, Princeton University, Princeton, NJ**

August 11–15, 1997

DIMACS will be sponsoring a three-day tutorial on quantum computing (August 11–13) directed towards computer scientists, followed by a two-day scientific workshop (August 14–15) on recent results in quantum computing. The speakers and schedule have not yet been determined. As more details are known, they will be made available at the website http://dimacs.rutgers.edu/Workshops/index-general.html. Contact Peter Shor (chair); shor@research.att.com. For local arrangements, contact Sandy Barbu, Princeton University; (609) 258-4562; barbu@cs.princeton.edu.

## Cryptographic Protocol Design and Verification

**DIMACS Center, Rutgers University, Piscataway, NJ**

September 3–5, 1997

The purpose of the workshop is to bring together those who design and implement cryptographic protocols with those who formally analyze them, in order to develop a community that can routinely produce secure protocols for use in protecting organizational data and facilitating commerce. The two groups will have opportunities to share ideas about the current state of the art, directions to pursue, and the motivation for their work. For further information, contact Hilarie Orman, DARPA; (703) 696-2234; fax: (703) 696-6416; orman@darpa.mil. For local arrangements, contact Pat Pravato, DIMACS Center; (908) 445-5929; pravato@dimacs.rutgers.edu; WWW: http://dimacs.rutgers.edu/Workshops/index.html.

# Classifieds

### GEORGIA

**COMPUTER SCIENCE/MATHEMATICS**

Computer Science/Mathematics. The Department of Mathematics and Computer Science at Wesleyan College has an opening for a tenure-track, assistant professorship in computer science/mathematics. Ph.D. and commitment to undergraduate teaching required. The successful candidate will be instrumental in leading the implementation of our new computer science minor. Preference will be given to candidates qualified to teach numerical methods and topics in discrete mathematics. Committed to becoming a preeminent liberal arts college for women, Wesleyan emphasizes critical thinking, collaborative thinking, writing across the disciplines, and student-faculty research. Submit letter of application, vita, transcripts, and three letters of recommendation by May 26 to Priscilla Danheiser, Dean of the College, Wesleyan College, 4760 Forsyth Road, Macon, GA 31210-4462. Women and minority candidates are encouraged to apply. AA/EOE.

### NEW YORK

BRONX COMMUNITY COLLEGE of CUNY

The Department of Mathematics and Computer Science invites applications for anticipated tenure track positions starting in September, 1997. A Ph.D in mathematics or computer science is preferred although enrollment in a doctoral program is desirable in its absence. Candidates must have a record of and commitment to excellence in teaching and continued scholarly activity. The department has 23 full-time and 55 part-time faculty members. Courses offered range from developmental to upper level mathematics and computer science. Bronx Community College encourages applications from women and minority candidates and is an AA/EOE. Send a letter of application, a statement of teaching philosophy, resume, graduate transcript(s), and three recent letters of reference (at least one should address teaching) to:

Prof. Germana Glier
Chair, Mathematics and Computer Science
Bronx Community of CUNY
University Ave. and West 181 St.
Bronx, NY 10453

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Advertisers should contact: Joseph Watson, The Mathematical Association of America, 1529 18th St., NW, Washington, DC 20036; (202) 387-5200; fax: (202) 265-2384; e-mail: jwatson@maa.org

# MEETINGS

**National MAA Meetings**

August 1–4, 1997 MathFest, Atlanta, GA

January 7–10, 1998 Eighty–first Annual Meeting, Baltimore, MD. Board of Governors Meeting January 6, 1998

January 13–16, 1999 Eighty–second Annual Meeting, San Antonio, TX. Board of Governors Meeting, January 12, 1999.

January 19–22, 2000, Eighty–third Annual Meeting, Washington, DC. Board of Governors Meeting, January 18, 2000.

January 10–13, 2001 Eighty–fourth Annual Meeting, New Orleans, LA. Board of Governors Meeting, January 9, 2001

**Section Meetings**

ALLEGHENY MOUNTAIN – April 1998, Clarion University of PA, Clarion, PA

EASTERN PA & DELAWARE – November 1, 1997, University of Pennsylvania, Philadelphia, PA

INDIANA – October 18, 1997, Wabash College, Crawfordsville, IN
– March 20–21, 1998, Ball State University, Muncie, IN

LOUISIANA–MISSISSIPPI – March 6–7, 1998, University of New Orleans, LA

MICHIGAN – May 1–2, 1998, Western Michigan University, Kalamazoo, MI

MISSOURI – Spring 1998, Southwest Missouri State University, Springfield, MO

NORTHEASTERN – Nov 21–22, 1997, Western New England College, Springfield, MA

OKLAHOMA–ARKANSAS – March 27–28, 1998, University of Arkansas–Little Rock, AR
– Spring 1999, Southern Nazarene University, Bethany OK

PACIFIC NORTHWEST – June 19–21, 1997, Western Washington University, Bellingham, WA

SOUTHEASTERN – March 13–14, 1998, College of Charleston, SC

SOUTHERN CALIFORNIA – October 4, 1997, Claremont McKenna College, Claremont, CA

SOUTHWESTERN – Spring 1998, Pima Community College, Tucson, AZ

SEAWAY – November 7–8, 1997, Siena College, Loudonville, NY
– April 1998, York University, No. York, Ontario, Canada

TEXAS – Spring 1998, Southern Methodist University, Dallas, TX
– Spring 1999, Southwest Texas State University, San Marcos, TX

WISCONSIN – April 17–18, 1998, University of Wisconsin–Stevens Point, Stevens Point, WI

# Preppies Take Tops at Collegians' Math Conference

Last winter marked the thirtieth annual meeting for the MAA's Florida Section. As a special event, they held a student conference February 28, organized by Ben Fusaro. Over forty college students participated, including two students from Lake Highland Prep School in Orlando. Nine papers by twelve students were presented at the session and a banquet, with speaker Jack Crow, director of the National Magnetic Field Lab, was held that evening. Three judges chose the top papers based on content, delivery, and abstract. The top two papers were by the prep school students who apparently gave it the old college try.

Pictured here, from left to right, are Jennifer Pelka (ninth grade; first place for "Self-complementary Degree Sequences); Don Hill, president of the Florida Section; Don Albers, associate executive director of the MAA; and Rachel Auerbach (eighth grade; second place for "Fractal Music"). Typically the Florida Section meetings draw a dozen or so college students. This meeting's large attendance demonstrates that interest is directly proportional to the dedication of a program.

# NSF Faculty Advancement in Mathematics Workshops

**Discrete Modeling Workshop**
**United States Military Academy**
**West Point, NY**
**June 8–20, 1997**

The Discrete Mathematics Workshop should be of special interest to faculty teaching mathematics courses for future elementary teachers. This workshop will focus on appropriate mathematics for non-science majors; visits to innovative general education courses developed under an NSF-supported CETP program; and preparation of presentations for undergraduate courses, in-service workshops for teachers, or professional meetings.

**Discrete Mathematics Workshop**
**Virginia Commonwealth University**
**Richmond, VA**
June 16–27, 1997

This workshop will focus on the mathematical preparation of future secondary school teachers. Participants in this workshop will work in small groups to write a curriculum module to be published by COMAP for participants' home use and for the broader mathematics community.

The workshops are sponsored through COMAP. In addition to presenting new and exciting content and applications, both workshops will have a pedagogical component. For either workshop, contact William E. Haver, Dept. of Mathematical Sciences, Virginia Commonwealth University, PO Box 842014, Richmond, VA 23284-2014; (804) 828-1301 X123; e-mail: wehaver@vcu.edu.