FOCUS is published by the Mathematical Association of America in January, February, March, April, May/June, August/September, October, November, and December.

Editor: Fernando Gouvêa, Colby College; fqgouvea@colby.edu

Managing Editor: Carol Baxter, MAA cbaxter@maa.org

Senior Writer: Harry Waldman, MAA hwaldman@maa.org

Please address advertising inquiries to: Kate Debelack, MAA; debelack@maa.org

President: Thomas F. Banchoff, Brown University

First Vice-President: Barbara L. Osofsky, **Second Vice-President:** Frank Morgan, **Secretary:** Martha J. Siegel, **Associate Secretary:** James J. Tattersall, **Treasurer:** Gerald J. Porter

Executive Director: Tina H. Straley

Associate Executive Director and Director of Publications and Electronic Services: Donald J. Albers

FOCUS Editorial Board: Gerald Alexanderson; Donna Beers; J. Kevin Colligan; Ed Dubinsky; Bill Hawkins; Dan Kalman; Maeve McCarthy; Peter Renz; Annie Selden; Jon Scott; Ravi Vakil.

Letters to the editor should be addressed to Fernando Gouvêa, Colby College, Dept. of Mathematics, Waterville, ME 04901.

Subscription and membership questions should be directed to the MAA Customer Service Center, 800-331-1622; e-mail: maahq@maa.org; (301) 617-7800 (outside U.S. and Canada); fax: (301) 206-9789.

Periodicals postage paid at Washington, DC and additional mailing offices. **Postmaster:** Send address changes to FOCUS, Mathematical Association of America, P.O. Box 90973, Washington, DC 20090-0973.

ISSN: 0731-2040; Printed in the United States of America.

FOCUS

February 2001

Volume 21, Number 2

Inside

4 Strength in Numbers
By Deanna Haunsperger and Stephen Kennedy

6 The MASS Program at Penn State
By A. Katok, S. Katok and S. Tabachnikov

7 Math in 2010: A Business View
By Susanna S. Epp

8 Mathematics at Microsoft Research
By Henry Cohn

10 R U Ready 2 Teach Probablity and Stats?
By Peter Renz

12 The History of Mathematics: A New Distance Learning Course
By John Fauvel

14 Short Takes

15 Contributed Papers Sessions at Mathfest 2001

17 Employment Opportunities

On the cover: Deena Schmidt, Emily Gamber and Pam Richardson at the Summer Mathematics Program held at Carleton and St. Olaf Colleges. See page 4.

FOCUS Deadlines

	April	May/June	August/September
Editorial Copy		March 16	July 14
Display Ads	February 22	April 5	July 28
Employment Ads	February 15	March 30	July 20

MAA Prizes and Awards Announced at the January Joint Meetings

The MAA announced several prizes and awards at the Joint Mathematics Meetings, held in New Orleans this January. In addition to the Haimo awards for distinguished teaching, which were already announced in the November issue of FOCUS, the Association awarded five Certificates of Meritorious Service, the Chauvenet prize, and the Gung-Hu Award for distinguished service to mathematics.

The Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics is the most prestigious award made by the Association. This award has been made possible by the late Dr. Hu and his wife, Yueh-Gin Gung. Dr. Hu, who was a professor of geology at the University of Maryland, had such strong feelings about the importance of mathematics in all human endeavors that he felt impelled to contribute generously to our discipline. The award he and his wife funded allows the Association to recognize those who have made truly significant contributions to mathematics and to the MAA.

Manuel P. Berriozábal

This year's Gung-Hu Award for Distinguished Service to Mathematics went to **Manuel P. Berriozábal** of the University of Texas at San Antonio. The citation describes Professor Berriozábal as "a visionary with the unusual talent to turn his visions into reality." An example is his Prefreshman Engineering Program (PREP). He formed PREP at the University of Texas at San Antonio in 1979, with the goal of identifying middle and high school students who are potential engineers or scientists and giving them reinforcement and encouragement. This exemplary program has been honored by the Society of Mexican-American Engineers and Scientists, the U.S. Department of Education, and the U.S. Department of Energy. In 1997, the program received a Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring. The PREP program has been replicated at 25 other college campuses in Texas; as a result, Dr. Berriozábal was made a charter member of the Texas Science Hall of Fame last year.

Professor Berriozábal has also been active in the MAA, focusing in particular on minority issues. He was the first chair (with Sylvia Bozeman) of the Committee on Minority Participation in Mathematics from 1989 to 1995 and served as Member-at-Large Representing Minority Interests on the MAA Board of Governors from 1996 to 1999. An extended appreciation of Professor Berriozábal and his contributions to mathematics appears in the February issue of the *American Mathematical Monthly.*

Carolyn S. Gordon

The Chauvenet Prize for expository writing is given for an outstanding expository article on a mathematical topic by a member of the Association. The prize is named for William Chauvenet, a professor of mathematics at the United States Naval Academy.

This year's prize went to **Carolyn S. Gordon** and **David L. Webb**, both of Dartmouth College, for their article "You can't hear the shape of a drum," published in the January-February 1996 issue of *American Scientist*. The article describes work they carried out jointly with Scott Wolpert in response to a question raised by Mark Kac in a 1966 *Monthly* article entitled "Can one hear the shape of a drum?" which won him the Chauvenet Prize in 1968. Though it does not set out all the technical details of the Gordon-Webb-Wolpert construction, the article gives the reader some insight into how it works. The underlying idea is to use group-theoretic reasoning to construct a pair of isospectral plane polygons that are not congruent. These plane regions can be thought of as two (rather strange) drumheads that have different shapes but the same vibration frequencies. So the answer to Kac's question is that no, one cannot hear the shape of a drum.

David L. Webb

The article is exciting, accessible, and contains a good deal of historical information about results on vibrating systems and their frequencies. It seems fitting that an article explaining the solution to the problem posed in Marc Kac's Chauvenet-winning article should win the same prize 32 years later.

The Deborah and Franklin Tepper Haimo Awards for Distinguished College or University Teaching of Mathematics are awarded each year to teachers who have been widely recognized as extraordinarily successful. As announced in the November issue of FOCUS, this year's winners are Edward B. Burger of Williams College, Evelyn Silvia of the University of California at Davis, and Leonard F. Klosinski of Santa Clara University. The three winners spoke at a special session held on Friday, January 12.

Every year, the MAA presents Certificates of Meritorious Service to members who have been exceptional in their service to a Section of the Association. This year's winners are Carl Leinbach of (Gettysburg College, Bern)–Eastern Pennsylvania and Delware Section, Bernard Sohmer of (City College of CUNY)–Metropolitan New York Section, Ralph W. Carr (St. Cloud State University)–North Central Section; Kenneth A. Ross (University of Oregon)–Pacific Northwest Section, and Joanne Peeples (El Paso Community College)–Southwestern Section. ■

More information about the winners can be found on MAA Online at http://www.maa.org/news/janprizes.html.

Strength in Numbers

By Deanna Haunsperger and Stephen Kennedy

Several years ago, a student of ours came back from the Mills Summer Mathematics Institute for Women bubbling with enthusiasm and ready to begin applying to graduate school in math. She couldn't say enough good things about the wonderfully inspiring, nurturing environment. She confessed to just one regret: she had learned so much about how to prepare for graduate school, and she only had a year left as an undergraduate. She wished that she could have gone when she was younger.

SMP 2000 investigates triangular numbers.

The following year, we enlisted the aid of our colleagues Laura Chihara and Kay Smith from St. Olaf and Gail Nelson from Carleton and started planning a program for female students finishing their first or second year of college. This, we felt, was a crucial time for young women, a time when they are making difficult, perhaps irrevocable, decisions about their futures, often without a lot of accurate information. Every year dozens of young women apply to our program and tell us "I love math, but I really don't want to teach – that's why I'm double-majoring in biology (or chemistry, or business)." We have learned that a word or two of encouragement can make an enormous difference to a first- or second-year student, especially an insecure, unconfident student. Having a critical mass of students together studying math builds an incredibly strong sense of community and creates the desire and self-confidence to continue in math.

What we do

Participants are first-and second-year undergraduates from colleges and universities throughout the country. The "typical" student has had three semesters of calculus, a linear algebra course, and one to three other math courses. She has a G.P.A. of 3.85, she works in the campus tutoring service, and she plays the French horn.

The heart of the program is, of course, the coursework. The women take two classes that meet every day. We have been extremely fortunate in our choice of instructors, each of whom has thrown herself into the program and given of her time and energies in ways that we would never dare ask of anyone. Each has described her time in the Carleton and St. Olaf Colleges' Summer Mathematics Program (SMP) as the most fulfilling and rewarding teaching experience of her life.

Bethany Webb, Mary Ellen Rudin, Kendra Killpatrick and Teena Garrett discuss graduate school at SMP 96.

Topics have included Dynamical Systems, Applied Functional Analysis, Algebraic Coding Theory, Game Theory, Fuzzy Logic, and Knot Theory. The faculty and teaching assistants serve as role models of professionalism and dedication to mathematics. They help the students with mathematical problems, provide a mentoring relationship, dine with the students, cheer up the sad, and build an *esprit de corps* amongst the girls that carries most well beyond the end of the program.

In addition to the coursework there is a twice-weekly colloquium series, recreational problem solving, weekly panel discussions, and mathematical outings and social activities including at least one picnic per week, movie nights, canoe trips, hikes, even the Mall of America. The program closes with a banquet celebrating success and honoring the participants. Farewells are difficult for the women, many of whom have found long-sought-after sisters in mathematics.

The Immediate Outcome

Our 18 young women mathematicians immerse themselves in mathematics, living and working in a supportive community of women scholars (undergraduates, graduates, and faculty) who are passionate about learning and doing mathematics. Our intentions for them are threefold: to excite them about mathematics and mathematical careers, to provide them with some of the tools they will need to succeed in a mathematical career, and to connect them to a network of fellow female mathematicians. The students themselves report that the experience was "the most exciting and fun experience in math I've ever had" and say that "to learn about other women's expe-

riences, to be encouraged, supported, to have so many people believe in me, and to connect with such brilliant and fun women was awesome!"

The students return to their home institutions eager to plunge into their studies. They have a clearer idea of what mathematics is and how to organize their future plans. Their increased awareness of various topics within mathematics have led many to give talks in their home departments on the mathematics that they learned in the summer program. Most have gone on to participate in REUs, the Budapest Semester, or other enrichment programs. All who have done so acknowledge being much better prepared to succeed at, and benefit from, those programs than they otherwise would have been. Perhaps more important than the knowledge and renewed excitement for mathematics, each of the students has gained confidence in her ability to do mathematics. Here's what they say:

It challenged me, but I was able to work through the proof, I really put my heart into it—and I loved it. It was not only good for me alone, but it was so special to have a class full of people who could handle this level of self-motivated, rigorous learning.

But now, given this opportunity, I'm excited for school to start in the fall and I'm excited that I am a smart and intelligent math student. Really I am. And most of all, I don't need to prove it to anyone–just to myself.

People explained things so that others would understand, and people kept telling each other, "Good call," "great idea," or "you're brilliant." You don't hear that studying with guys. It is very reassuring to discover that almost everyone else has the same insecurities and self-doubts and when you realize everyone else's are unfounded, it starts to chip away at your own.

Deena Schmidt, Pam Richardson and Emily Gamber at SMP.

This confidence building is central to the mission of this program. All of these students are intellectually capable of achieving an advanced degree in mathematics. Something other than intellectual capacity prevents many women from pursuing one. Heightened self-confidence and a supportive network of colleagues and mentors are two factors that we hope will prevent young women from dropping out. These students return to their home institutions knowing that women can and should be doing mathematics. They are not only supported by this knowledge, but they also carry the message back with them to influence their peers and their teachers.

The Long-Term Outcome

We attempt to keep track of our alumnae; our data is summarized in the table below. It is clear to us that we have a positive impact on the lives of the young women who come to our program—we see increased confidence, enthusiasm, knowledge, and mathematical sophistication. It is less clear to us how to measure this effect. We can never know how many would have gone on to productive mathematical careers without us—given the talent level, some certainly would. We won't know for some time how long and how far the impetus we give sustains them in the face of adversity. There is evidence, however, that we are making a difference: the women of SMP99 are actively discussing their post-graduation plans on the program's email list-server; Alissa (SMP97) just emailed this morning that she'd passed another qualifying exam in her PhD program; and Suzanne (SMP95) will be our first PhD this spring, with many more coming up behind her. Watch nametags at national math meetings for our SMP alumnae sticker—watch them gain strength in numbers. ■

The authors, together with Jill Dietz and Gail Nelson, are the current directors of the Summer Mathematics Program. They would like to express their appreciation to the National Science Foundation and the National Security Agency for funding.

Please encourage your talented first- and second-year women students to apply to the program. For application materials and more information see http://www.mathcs.carleton.edu/smp.

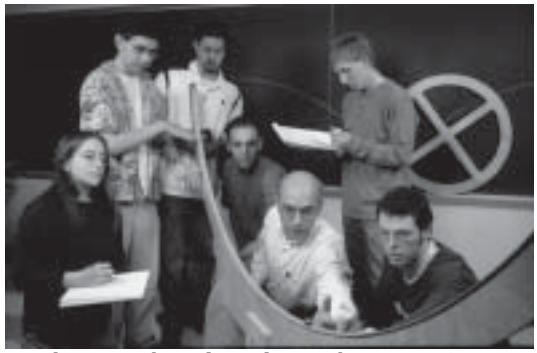
	1995	1996	1997	1998	Total
Graduate school in mathematics or related field	7	12	13	13	45
Career in mathematics-related field	8	2	2	2	14
Non-mathematics-related graduate school or career	3	4	0	1	8
Undecided or unknown	0	0	1	2	3

Post-graduation outcomes/plans for SMP alumnae

The MASS Program at Penn State

By A. Katok, S. Katok and S. Tabachnikov

The MASS program—Mathematics Advanced Study Semesters—at Penn State was founded in 1996 by a group of Penn State faculty which included G. Andrews, A. Katok, S. Katok. Also involved was A. Kouchnirenko from Moscow State University, who served as a director of the program for the first two years. MASS is an innovative, intensive program for select groups of undergraduates from around the country who come to Penn State for the fall semester. It provides a unique and mutually reinforcing blend of learning and research activities for its participants.



Mark Levi with students during the 1999 MASS Program

MASS is unique among mathematics programs for undergraduates in the U.S., quite distinct from honors programs, math clubs, and summer educational or research programs. The principal difference is the comprehensive character of the program: for a whole semester, all the academic activities of the participants are especially designed and coordinated to enhance their learning and introduce them to research in mathematics. A key feature of the MASS experience is the intense and productive interaction that takes place among the students. The environment is designed to encourage such interaction: a classroom is dedicated to MASS and furnished so as to serve as a lounge and a computer lab outside of class times. The students live together in a contiguous block of dorm rooms, they eat together, and they pursue various social activities together. The effect of such conditions is dramatic: the students find themselves members of a cohesive group of like-minded people sharing a special formative experience. They quickly bond, and often remain friends after the program is over. They study together, attack problems together, debug computer programs together, collaborate on research projects and, most importantly, talk about mathematics all the time. This, of course, is exactly how "mature" mathematicians operate in their professional life.

The main components of MASS are courses, individual projects, a seminar, and a Colloquium. There are three core courses designed exclusively for MASS students on topics chosen from the areas of Algebra/Number Theory, Analysis, and Geometry/Topology. Each course features three lectures per week, a weekly meeting conducted by a MASS Teaching Assistant, weekly homework assignments, a written midterm exam, a final project, and an oral final examination/presentation. The individual student research projects range from theoretical mathematics research to computer implementation. Some projects are related to the core courses while others are developed independently according to the interests and abilities of the student. The weekly working seminar is devoted to selected topics in mathematics and helps to unify all other activities. Finally, the MASS Colloquium is a weekly lecture series by distinguished mathematicians. These lectures are instrumental in focusing interest of the MASS participants on various research areas of mathematics.

In the fall of 2000, for example, the core courses were *Finite groups, symmetry, and elements of group representations* (A. Ocneanu), *Projective and non-Euclidean geometry* (V. Nistor), and *Real and p-adic analysis* (S. Katok). The MASS Colloquium included talks on *Knotted flowlines* by R. Ghrist of Georgia Tech, *Euler, Jacobi, Ramanujan: interesting formulae, beautiful results and some recent variations* by I. Kra of SUNY at Stony Brook, *The Future of Mathematics* by D. Zeilberger of Temple University, and many others, ranging from internet search engines to flexible polyhedra and aperiodic tilings.

The MASS Program is funded by Penn State and the National Science Foundation. Penn State provides fellowships for out-of-state students that reduce their tuition to the in-state level. In particular, MASS participants whose tuition in their home institution is lower than Penn State in-state tuition receive grants for the difference.

Some MASS participants have produced significant pieces of mathematical research. James Kelley, a MASS-98 participant, studied the representation of integers by quadratic forms, a classical problem in number theory. His work led to a paper that has been submitted for publication.

Another MASS student, Kevin Weis, worked on a project entitled "On sigma-phi numbers" supervised by R. Vaughan. The project resulted in a joint paper to appear in *Mathematika*.

The best assessment comes from the students themselves. For example, Suzanne Lynch, who participated in MASS '96 and is now a Ph.D. candidate at Cornell, described the MASS program as "the best semester of my life. I was immersed in an environment of bright, motivated students and professors and challenged as never before. I was pushed by instructors, fellow students and something deep inside myself to work and learn about mathematics, and my place in the mathematical world. I loved my time there, and never wanted to leave. I believe the MASS program helped to prepare me for the rigors of graduate school, academically and emotionally. The MASS program has been very instrumental in opening grad school doors to me, and giving me the courage to walk through them." And here is Jared Speck, MASS '99: "My overall impression of MASS was WOW! This has been the best academic program of my life. Thanks to the program, I am now sure that I want to go to grad school in mathematical physics. It was wonderful to be around so many intelligent people who are my age." ■

For more about the program, please visit the MASS web site at http://www.math.psu.edu/mass.

Math in 2010: A Business View

By Susanna S. Epp

At the Los Angeles Mathfest, CUPM sponsored and MAA member Patrick McCray organized a panel on what business looks for in mathematics graduates. The panelists described their mathematical and professional backgrounds, the ways they have used mathematics in their jobs, and the qualities they most value in potential new hires. Considering that about half of all mathematical sciences graduates in the U.S. now go into the business world, the issues raised deserve our attention.

Elizabeth Dill, an actuary with William M. Mercer and Associates, double-majored in mathematics and philosophy. Now she leads a team that examines the impact of various potential pension programs on a company's bottom line. This involves being able to interpret large quantities of statistical data and the broad implications of computer-generated projections.

R. Peter Delong is a systems engineer with the Raytheon Corporation, an aerospace company. He earned a Ph.D. in mathematics, writing a thesis on Killing Tensors and Hamilton-Jacobi Equations. "I have used most of what I learned in graduate school and wish I'd learned more," he said. Much of Delong's work involves communication: writing reports, locating experts and consulting with them, writing specifications, making presentations, and so on. He also creates models (which includes writing software), defines measures of performance, travels to technical working group meetings, and manages others' efforts. The tools he uses include PCs and workstations, pencil and paper, Intranet and Internet for e-mail and Netscape, the C programming language, software for optimizing and visualizing networks, Matlab and Mathematica, books, some journals, and a programmable calculator.

Patrick McCray is systems project leader at Pharmacia Corporation. Shortly after earning his Ph.D. in mathematics, he joined the Searle pharmaceutical company and was quickly put to work programming in COBOL, helping others with their programs, building a database system, and working to untangle the logic of old programs that needed modification. Over the years, he has become heavily involved with statistical computing for very large data sets and has often been able to use his knowledge of numerical analysis to figure out why programs resulted in bizarre output. Computer programs are mostly purchased nowadays, but employees need to know enough programming to trouble-shoot them and modify them.

Albert Aubin is director of the UCLA Career Center. He listed the qualities most sought after by recruiters: excellent communication skills both written and verbal, interpersonal skills with a strong team orientation, personal attributes such as leadership ability, motivation, enthusiasm, and professionalism, computer skills, work experience, especially internships, and a good GPA. In one survey of employers, the top five attributes most valued in potential hires were being a team player, intelligence, a professional demeanor, organizational skills, and friendliness.

Dill said that William Mercer looks to see if job candidates have taken tough courses and been successful. Since most new hires are prospective actuaries, good skills in calculus, statistics, and numerical analysis are all desirable. Mercer values strong general analytical skills, the capacity to see the broad picture, and the ability to take complex technical issues and make them comprehensible to non-technical people. Also important are organizational skills. She added that it's not enough just to have a good idea; one must be able to justify it convincingly. Recruiters for Mercer are impressed by a job candidate who can coherently describe a project they worked on as part of a team, especially if the candidate displays a well-written report to accompany the verbal description.

Several panelists offered recommendations about the mathematics curriculum. Delong suggested organizing courses around unifying principles such as optimization, functions, graphs and matroids, and modeling and simulation, and he advocated cross-departmental team-teaching. His advice to math departments was to experiment with developing new courses, recognizing and accepting the fact that not all experiments will succeed. He urged mathematics faculty to involve other departments in textbook selection and course development, to encourage students to take statistics courses, to institute problem-solving clinics with real problems, to involve local industry in teaching, to teach how to use the Internet to do research, and to stay in touch with alumni.

McCray suggested that abstract algebra and set theory are more important for programmers than calculus. He recommended courses in discrete dynamical systems, modeling, and perhaps number theory. Computer Science students especially benefit from graph theory, combinatorics, and experience with real-world problems, he said. Since teams in business and industry are typically interdisciplinary, with only one team member serving as the mathematical expert, he urged mathematics departments to teach students to recognize the limits of their own knowledge and to learn to use outside sources.

As the session was ending, the panelists were asked to identify the one thing they had learned in their major that had been most important in their careers. Both Delong and McCray responded that it was the ability to read mathematics and figure things out on their own, and Dill and Aubin gave the top mark to the general critical thinking skills they credited their majors with helping them develop.

Susanna Epp is Professor of Mathematical Sciences at DePaul University and a member of the MAA Committee on the Undergraduate Program in Mathematics and the Committee on Calculus Reform and the First Two Years.

Mathematics at Microsoft Research

By Henry Cohn

Fifteen years ago, there was virtually no mathematical research being done in the software industry. Today that has changed, but many pure mathematicians seem not to be aware of this. I am currently a postdoc at Microsoft Research, after studying pure mathematics in graduate school. That hardly qualifies me as an expert on mathematics in industry, but I hope my comments on mathematics at Microsoft will be useful for curious mathematicians.

Building 113 in the Microsoft Campus, one of the two buildings that house Microsoft Research. Photo by Brian Meyers.

Microsoft Research (MSR) is the branch of Microsoft devoted to research, rather than development of products. This research deals with topics deemed relevant to current or future products, but given that, there is surprising support for fundamental research. MSR is primarily located in two buildings on the edge of Microsoft's Redmond, Washington campus (there are also smaller groups in England and China), and currently employs approximately six hundred people. As in most industrial research labs, these researchers are divided into a number of specialized research groups.

The research group at Microsoft that is most similar to an academic mathematics department is the "theory group," in which I am a postdoc. It has seven permanent members, about that many postdocs, and several long-term visitors. Everyone here has at least some interest in theoretical computer science, but other than that the research directions are surprisingly diverse. For example, the managers, Jennifer Chayes and Christian Borgs, are mathematical physicists who work on a statistical physics approach to the theory of computation. Perhaps the most famous members of the theory group are László Lovász, who works on combinatorics and algorithms, and Michael Freedman, who won a Fields medal for his work in four-dimensional topology and is currently working on quantum computation. Other areas of particular interest in the theory group include computational complexity and probability theory. In general, the theory group has no set research agenda or pressure to work on specific topics.

The theory group shows Microsoft's commitment to unfettered research, but it is not at all representative of mathematics at Microsoft Research as a whole. Most mathematics here is done in other groups, in areas such as speech recognition, computer vision, machine learning, data mining, statistics, signal processing, cryptography, natural language processing, computer graphics, and adaptive systems. It is difficult to estimate how many mathematicians work at Microsoft, since the question is not well defined. For example, theoretical computer scientists or statisticians may prove theorems of intrinsic mathematical interest, without calling themselves mathematicians. It's safe to say that most people in the groups mentioned above use substantial mathematics, that many work on developing new mathematical methods or applications of mathematics, and that a few think of themselves primarily as mathematicians or hold degrees in mathematics. Everything that follows is intended to apply to all of these research areas, and not just the theory group.

External constraints

What worried me most when I was applying for jobs in industry was intellectual property. What sort of restrictions would there be on publishing or communication with people outside the company? I was relieved to learn that at Microsoft Research, there is no prepublication review for any group, and there are no questionable limits on communication with the rest of the world. In other words, there are obvious limits to what one can discuss with colleagues from academia (e.g., product plans or trade secrets are out, without a non-disclosure agreement), but I do not know of any case in which these limits seem arbitrary or unreasonable.

Aside from limits on communication, the intellectual property issue most likely to affect mathematicians is patent rights. Microsoft, like all companies that hire mathematicians, would like to patent mathematical algorithms, such as cryptographic methods; signing over your rights to them is a condition for working here. Based on what I've seen, I trust MSR not to apply for ridiculous or offensive patents, but of course I would have no legal recourse if they did.

Another important concern is outside direction of one's research. This really has to be addressed on a case by case basis. Some groups, such as the theory group, have essentially no pressure to work on particular topics. Certain others, such as

the speech technology group, are much more product-oriented. Most are in between: for example, the cryptography group's efforts cover a wide spectrum from concrete implementation details for product groups to theoretical work in number theory and the theory of computation. Different sorts of people prefer different sorts of groups, depending on whether they prefer free inquiry or contributing to products that are used by millions of people.

A final issue is infrastructure. While Microsoft's physical plant and computing resources are comparable or superior to academia, it lacks a serious mathematics library. However, there is an excellent document delivery service, which partially compensates for this lack, and one can use the University of Washington's libraries if necessary.

General atmosphere

The greatest difference I have seen between Microsoft Research and academia, aside from the obvious lack of students at Microsoft, is the sort of communication that takes place. At Microsoft, there is much more "cross-cultural" communication between mathematicians, computer scientists, physicists, electrical engineers, statisticians, computer programmers, etc. (Of course, this takes place in academia as well, but there it is much less common for pure mathematicians.) I enjoy the sort of translation required to work with people from different backgrounds, since it provides a new perspective on mathematics I already understood from one point of view.

Another view of building 113. Photo by Brian Meyers.

Having people around from many different fields can prove quite stimulating mathematically. For example, I have long been interested in saddle point methods for estimating integrals. I was drawn to them because of their applications in number theory and combinatorics, but until I came here I had no idea of their importance in statistics. In general, when enough people come together, they are sure to be surprised by some common interests.

One drawback to working in industry can be a feeling of isolation from pure mathematicians, since many specialties are not represented here at all. Fortunately, the University of Washington is just on the other side of Lake Washington, and it has a large mathematics department. Furthermore, Microsoft brings well over a hundred pure mathematicians to Redmond as visitors each year, which keeps the environment relatively lively. Still, there's a trade-off between being exposed to different fields, and having ready access to many researchers in one's own field.

Overall, I have found Microsoft Research to be an exciting place to be a mathematician. Now that the software industry is starting to mature, there are many important problems in areas outside traditional applied mathematics, as well as within it. Some beautiful mathematics arises both in actual applications and in theoretical work, and MSR provides an environment in which this mathematics flourishes. ■

Henry Cohn (cohn@microsoft.com) *is currently a postdoc at Microsoft Research, and holds a five-year fellowship from the American Institute of Mathematics. He received his Ph.D. in 2000 under the supervision of Noam Elkies. His home page is at* http://www.math.harvard.edu/~cohn.

R U Ready 2 Teach Probability & Stats?

By Peter Renz

I was dragooned into teaching probability and statistics with little background in either. I was confident because I saw statistics as part of mathematics. Applied measure theory, perhaps? To test your readiness, try the question below. As background, you need understand only that the p-values given by standard statistical software are the probabilities of observing a statistic as extreme as that given by your data—assuming that the null hypothesis is true. Usual practice is to reject the null hypothesis if the p-value is small enough, commonly if $p < 0.05$, or less than 1 chance in 20.

Question: you have entered your data and tested the null hypothesis: H_0 (that $c = 0.5$) versus the alternative hypothesis H_a (that $c = 1$). Your software gives $p = 0.000977$. Which of the following gives the probability Q of being correct if you reject the null hypothesis and accept the alternative hypothesis based on this data?

a) Q = 2.355

b) Q = 0.999023

c) Q = 0.000977

d) Q = –0.999023

e) Insufficient information to calculate Q.

The choices are standard: some obviously wrong or linked to common errors, a catchall at the end, and a clear winner. But which is that? Ann Watkins, president of the MAA, said statisticians would get this in an instant. Judging by introductory texts, some authors would pick a loser.

Why the problem? Because the terminology is confusing. A p-value is a probability, but not the one you need to answer this question. A decision maker wants the probability of reaching a correct decision based on the data. She might set her significance level at, say, 0.001, so that she would reject the null hypothesis only if the conditional probability of seeing data as extreme as hers is less than 0.001 under the null hypothesis. So she would have 0.999 chance of being right if she ends up rejecting the null hypothesis based on her data – and b) would be the correct answer to the question above.

Wait. What is the probability space here? Suppose I test the null hypothesis, H_0, that I have a fair coin against the alternative hypothesis, H_a, that I have a two-headed coin and do this by flipping the coin 10 times and observing the outcome. (In our setup c was the probability of heads. For the fair coin, $c = 0.5$; for the two-headed coin, $c = 1$.) The p-value for getting a string of 10 heads in this test is 1/1024, which rounds to $p = 0.000977$. If I get 10 heads, what is the probability that I have a two-headed coin in hand? You can't say. The question makes no sense unless you have a probability model for producing coins, some fair and some two-headed. The answer is e), not b).

David S. Moore suggests: "The root confusion in many texts is mixing the practical approach (p-values) with the accept/reject decision approach. …[I]nductive reasoning from empirical evidence is a difficult subject that many people don't believe has been successfully reduced to a mathematical formulation, even in the rather structured settings of basic stat problems." The accept/reject approach gives a table with an "alpha" for the probability of falsely rejecting the null hypothesis and a "beta" for the probability of clinging to the null hypothesis when it is false. But the probability spaces used to calculate these probabilities do not allow you to even frame the question of whether your decision will be correct, given your data.

Flipping Coins

Draw your null hypotheses at random from a population with a known distribution of true and false hypotheses, and you can figure the probability of falsely rejecting the null hypotheses, given your data. Suppose you select a coin at random from a collection containing a known mix of fair and two headed coins. To make a point and for simplicity, let all the coins in this batch be fair.

Pick a coin at random and flip it ten times. The null hypothesis is that it is fair; the alternative that it is two-headed. You test this at an alpha level of 0.001, so that you will reject the null hypothesis only if you get ten heads ($p = 1/1024 < 0.001$). If you observe ten heads and hence reject the null hypothesis, your probability of being wrong is 1 and this is larger than alpha = $0.001 > p = 1/1024$. If you use a statistical test to search for something that is non-existent, or sufficiently rare, all or most of the "positives" you find will be false, even those with small p values. In the search for ESP effects, observations far from the expected may result from poor randomization, information passed by sensory means, deception, chance variations, or, possibly, paranormal effects. To decide which is most likely, you would have to look carefully at the experiment itself. You can't rely solely on the p value.

Here is how John Haigh puts it for a related question in the preface to his book *Taking Chances* (Oxford University Press, 1999)

"Suppose you are a member of a jury, where a defendant is accused of a serious crime such as rape or murder. The evidence is said to be such that the chance of its arising if the defendant were innocent is one in a million. Some people might believe that this is equivalent to saying that the chance that the defendant is innocent, given the evidence, is one in a million. Nonsense. That piece of logic is akin to equating 'the chance that Jean forgets her coat when it rains is 1%' with 'the chance that it rains when she forgets her coat is 1%.'"

Finding the Right Model?

Monty Hall is famous for a conundrum presented on his show "Let's Make a Deal," a puzzle of finding the right probability model, if such exists. The contestant faced three doors. If he picked the one concealing the car, he won the car; otherwise he lost. On occasion, Hall

would open one of the doors not chosen to reveal an empty space. Hall would tantalize the contestant by offering him the opportunity to switch his choice to the remaining closed door. The puzzle is to work out whether it is best to stick or switch. Or, as Joe Buhler put it, the *mathematical* problem is to come up with a plausible model that allows a solution.

The standard model assumes that the contestant's initial choice and the position of the car are equi-distributed, independent random variables. It assumes that Hall always offers the contestant the opportunity to switch doors and that he does so without giving the contestant information on the position of the car. The contestant wins by sticking if his original choice was correct, probability = 1/3. He wins by switching if his first choice was wrong, probability = 2/3. This solution meets Buhler's challenge.

But what of the quiz show? The contestant is talking to Hall, who knows where the car is. The contestant has more information (or disinformation) than in our model. Moreover, Hall only occasionally allowed contestants a chance to switch. In interviews, Hall indicated that he used this as a trick to prevent contestants from winning. In doing this, he would try to avoid any obvious pattern that would give the game away or spoil the fun for the audience.

We do not know how the position of the car on the show was determined nor how good a poker face Hall maintained. Some contestants might have had a good chance of divining the winning door using clues available to them. Mathematically, some contestants may have made initial guesses that were positively correlated with the car's position. If the correlation were strong enough, switching would be a bad strategy, even ignoring the fact that Hall was sometimes out to deceive the contestant.

The mathematical version of the Monty Hall problem is a fine puzzle for us. For laymen, it is a snare. It drives them nuts because they know that it would be unwise to give Hall control over their decisions. Our "solution" is irrefutable, yet at odds with the realities. It is not clear what sort of model would be appropriate, except for one based on a study of the shows themselves.

The Gleason Flip

In introductory probability classes at Harvard, Andrew Gleason would sometimes flip a coin. Covering the coin with his hand, he might ask how many students would be willing to bet a dollar at even money that it had landed heads up. Most students would go for this bet, showing their understanding of the probabilities. Then Gleason might lift his hand and look at the coin. Covering the coin again, he might ask, "Now how many of you would be willing to bet on heads?" The coin remains the same, the outcome remains the same, but what are the probabilities? What should our model be? We no longer know; the odds are indeterminate. This is the situation when it is you versus Monty Hall on "Let's Make a Deal."

It is the situation when you test a hypothesis using statistical methods in an unexplored area.

Who Knows What Lurks? The Statistician Knows

Statisticians know p-values are simply a measure of the strength of the evidence the data gives against the null hypothesis. They will not be tricked. Professionals working in familiar areas have a sense of the background probabilities and will be able to set their p-levels sensibly, and Bayesians can fall back on their prior probabilities, whether empirical or subjective. But for students, or in a situation where you have no sense of the underlying probabilities, it is easy to end up in a morass.

Since that first course, I have learned much. I owe a huge debt to David Moore, George McCabe, David Freedman and his co-authors, George Cobb, and Bradford Wiley, II. They taught me and/or made me rethink these things. The field is richer than measure theory. That first assignment was the start of an excellent adventure, one I recommend to others. ■

Peter Renz taught probability and statistics at Wellesley and Bard Colleges. He is a consulting editor. This article is based on experience studying introductory texts and reviewer comments and working on manuscripts, a good way to learn of the pitfalls and, perhaps, how to avoid them. He can be reached at plrenz@aol.com.

The History of Mathematics: A New Distance Learning Course

By John Fauvel

The history of mathematics has never been so popular as today. It was over a century ago that a number of US educationists, notably David Eugene Smith and Florian Cajori (both influential in the foundation of the MAA in 1915), began to emphasize the importance of the history of mathematics in teaching, learning and understanding mathematics. Now, evidence of the widespread appeal of history of mathematics is seen in the many college and university mathematics teachers from all over the US who attend the history sessions at the Joint Mathematics Meetings each January. Cynically, one might observe that these sessions are popular because history of mathematics is the one subject, outside their own specialty, that all mathematicians can understand and enjoy without a lot of previous study—but the hunger for more historical information and training also reflects a growing feeling that the history of mathematics is really important, helping students and teachers at every level of the educational process.

A number of recent books have argued the general case for involving history of mathematics in the teaching and learning of mathematics. Some books also contain a range of examples of such practices in mathematical classrooms. The most recent example of the former is *History in Mathematics Education: The ICMI Study*, edited by John Fauvel and Jan van Maanen (Kluwer, 2000), while two books published by the MAA, *Learn From the Masters*! (ed. by Frank Swetz et al, MAA 1995) and *Using History to Teach Mathematics* (ed. by Victor Katz, MAA 2000) are excellent examples of how history can make a vital contribution to mathematics education. An important development in the politics of history, so to speak, has been the growing realization that history projects can teach communication, information research, and other skills of critical interpretation and work presentation which the rest of a student's mathematics classes may not bring out and develop so strongly. These skills are important. History is a crucial complement and enrichment to the rest of a student's mathematical development.

All this activity depends on teachers having good efficient access to the accumulated historical knowledge uncovered by generations of historical scholars. In the old days the solution would have been to sit down with a good book, perhaps

Florian Cajori's *History of Mathematics* (born 1894 and still in print). But as Dirk Struik (born in the same year as Cajori's *History*) said in a 1998 interview, two years before he died, "Florian Cajori is solid but dry as dust. If you have a sleepless night, take Cajori and begin to read. After two pages, you'll fall asleep." The modern way of learning history is more interactive, involving the learner in getting to grips with well-chosen primary sources. This way the learner develops mathematical thinking and understanding, not only the content of mathematical results. A fine text in this new style is Reinhard Laubenbacher and David Pengelley's *Mathematical Expeditions: Chronicles by the Explorers* (Springer, 1998), which covers a small number of major developments in some depth with a rich use of primary sources.

For a more global understanding of how mathematics has developed, two courses are about to become available throughout the US, put on by the United States Open University. For some years now the MAA has been the North American distributor of a large yellow book called *The History of Mathematics: A Reader*, edited by John Fauvel and Jeremy Gray. This book, which has already sold widely in the US, consists of a large number of mathematical texts from ancient sources onwards. It contains the set of sources on which students at the British Open University have been building their understanding of the history of mathematics for some years now. Experience has shown that many students find that this approach makes for one of the most enthralling courses of their student career. This tried-and-tested course will now be offered in the US, split into two for purposes of US credit arrangements (one course dealing with mathematics from ancient times to the scientific revolution, the other from the birth of calculus to the twentieth century). This is a major step forward in making available a history of mathematics course which students can study from home, wherever in the US they live.

The US Open University (USOU) is a new non-profit university offering several courses through a range of programs, all using the medium of distance learning. Most material is available on the web, in individual student accounts, with the major course texts being sent by mail (at least for now). The programs consist of courses that have been written and pioneered in the UK by the British Open University, a distance teaching institution of high repute, so it is known that the courses work, both academically and in terms of delivery systems. The USOU bases its teaching philosophy on Supported Open Learning, whose key principles are student centredness and a focus on learning rather than teaching—thus, the university's whole philosophy is very much in keeping with the new mode of learning history of mathematics described above. Each student is assigned to a member of Associate Faculty, who

will be a US college professor with wide experience in teaching the subject. This teacher provides regular individual support via telephone, e-mail and written communication, helping the student to learn from the course materials as well as commenting on and grading the student's written assignments submitted during the course. The quality of the individual attention offered to each student, and the support structure to respond to individual circumstances during the course, have been major factors in the success of the Open University in the UK, the first and pioneering "open university."

In the forthcoming spring semester, USOU is presenting two history of mathematics courses:

- the 4 credit HIST3401, *History of Mathematics I*, which covers the history of mathematics up to the seventeenth century, the time of Descartes and Newton; and
- the 8-credit HIST3801, *History of Mathematics I and II*, covering the history of mathematics from earliest times up to the twentieth century.

In the fall, *History of Mathematics II* will be offered. This course carries on from *History of Mathematics I* by telling the story of mathematics from the rise of the calculus onwards. Whatever the workpace chosen, students will have an enjoyable and rich learning experience interacting with the great mathematical developments of the past and learning a lot about the historical development of mathematics in the process.

Mathematics has a long history that goes back at least to the Egyptian and Mesopotamian civilizations of the third millennium BC. In classical Greece, around 400 to 300 BC, there were developments in the mathematical objects studied and the notion of rigorous mathematical proof which have marked mathematics ever since. Euclid's *Elements* and the works left by the great geometers Archimedes and Apollonius deeply influenced the mathematics of the Renaissance. The USOU course follows the development of the algebraic approach through Muslim culture and then the rediscovery in Europe of classical Greek texts at the end of the sixteenth century. Work of Napier, Kepler, Galileo, Descartes, and others led to an unprecedented flowering in the seventeenth century that set the scene for the world of modern mathematics.

During the subsequent three centuries this ferment played out in a number of ways. The calculus was invented in the late 17th century by Isaac Newton and Gottfried Wilhelm Leibniz (building on the work of many earlier mathematicians). During the 18th century algebraic concerns reached almost their modern form in the work of Leonhard Euler. When we move on to the 19th century a further set of interesting questions arise. Is Euclid's "parallel postulate" necessarily true, or can other logically consistent geometries be devised? Can a formula be found for solving equations of the fifth degree or, if not, why not? Was the French Revolution a good thing (for the development of geometry)? Were the foundations of the calculus secure? If not, what to do about it? (Or did it matter?) Can calculation be mechanized, and at what cost? These characteristic topics of nineteenth-century mathematics are the basis for many of the concerns and approaches of mathematics in the twentieth century.

Learning the history of mathematics involves both becoming familiar with the story of the development of mathematics in the past, and practicing the historical judgements and methods that enable the story to be told. The courses available through USOU should also deepen the student's understanding of what mathematics is, the role it has played in society and in increasing our knowledge of the world. ■

John Fauvel teaches and researches the history of mathematics at the Open University, UK, and is Instructor of Record for the USOU history of mathematics courses. Besides being a regular attender at the Joint Mathematical Meetings (delivering in 1999 an invited MAA address on "The history of mathematics and its future"), his experience of the US educational system includes some months in 1999 at Colorado College, Colorado Springs, where he was a Fulbright Scholar and Visiting Professor of Mathematics. Further details of USOU are available on http://www.open.edu.

The People Behind the USOU History of Mathematics Course

The Open University's history of mathematics team—which is one of the largest such teams anywhere working together in one institution—comprises four people involved in different ways in constructing and presenting USOU history of mathematics.

June Barrow-Green is responsible for the USOU history of mathematics website and is the author of the widely-acclaimed *Poincaré and the Three Body Problem*. Her *Britmath Database* on 19th and 20th Century British mathematics contains extensive information relating to mathematical activity in Britain between 1860 and 1940. She is currently writing a book on the early history of chaos theory.

John Fauvel, has wide interests largely in the social-institutional history of mathematics. For some years he has especially focused on the relations between mathematics teaching and learning and the history of mathematics, culminating in the recent co-edited *History in Mathematics Education: the ICMI Study*. John is working with Jeremy Gray on a history of mathematics textbook .

Jeremy Gray, in charge of student assessment and support materials for the USOU course, is a historian of geometry and analysis with particular interests in the 19th and 20th centuries. He is on the editorial boards of several journals and is a member of the International Commission on History of Mathematics. Jeremy's latest book is *The Hilbert Challenge* and his forthcoming book on *Bolyai and Geometry* is in press.

Robin Wilson, responsible for briefing the USOU associate faculty, is a graph theorist turned historian of combinatorics. With John Fauvel, and Raymond Flood, Robin recently brought out *Oxford Figures: 800 Years of the Mathematical Sciences*. He and Jeremy Gray recently put together a volume of selected articles from the *Mathematical Intelligencer*.

Short Takes

Pi Mu Epsilon Looking for Student Papers for Mathfest

The Pi Mu Epsilon Council encourages students who are interested in presenting papers at Mathfest 2001 to begin making plans soon. Members of Pi Mu Epsilon representing their chapters at this meeting are eligible for partial travel support. The application deadline is June 29, 2001. More information about Pi Mu Epsilon and application materials can be found at the PME web site, http://www.pme-math.org, or contact jgalovich@csbsju.edu.

Hudson River Undergraduate Mathematics Conference

The eighth annual Hudson River Undergraduate Mathematics Conference will be held on April 28, 2001, at Skidmore College in Saratoga Springs, NY. The conference includes presentations on mathematics by both faculty and students, and both are encouraged to participate. Conference sessions are designed so that some presentations are accessible to undergraduates in their first years of study, and others are accessible to third- or fourth-year undergraduate mathematics majors. The keynote speaker will be Ingrid Daubechies. Those wishing to present at the conference should submit electronically an abstract by March 2, 2001. Abstracts can be submitted via the web. To find out more about HRUMC, visit the conference web site at http://www.skidmore.edu/academics/mcs/hrumc.htm.

Grading the States on Higher Education

The National Center for Public Policy and Higher Education recently issued a report card grading each of the fifty states on how well they deliver higher education. The worst grades were in "affordability," and the best in graduation rates. The study was criticized for, among other things, focusing exclusively on undergraduate education and also for ignoring part-time students in its assessment of graduation rates. The full report can be found at the website at http://measuringup2000.highereducation.org.

TIMSS: the Second Round

TIMSS, the Third International Math and Science Study, was originally done in 1995. TIMSS-Repeat, a second round of testing, was held last year, and did not see much improvement in US mathematics scores. The American fourth-graders who did so well on the test four years ago did not score as well on the eighth-grade test.

TIMSS-R tested 180,000 eighth-graders in 38 nations. Some of the Western European nations that participated in the first round chose not to take part this time; there were also several new participating nations. American eighth-graders performed roughly in the middle of the pack, behind students from Singapore, Taiwan, Russia, Canada, Finland, Hungary, the Netherlands, and Australia. The results can be found online at http://timss.bc.edu/timss1999.html.

It is expected that the release of the TIMSS-R results will inspire many new research projects. In particular, the Department of Education plans to release more detailed data, allowing researchers to analyze the data by state or by school district. DoE is also expected to release reports comparing American classroom practices with those of other countries.

A more extensive report on TIMSS-R and its impact will appear in a forthcoming issue of FOCUS.

NCTM Releases Statement on High-Stakes Testing

In December, the National Council of Teachers of Mathematics (NCTM) released a statement on "high-stakes testing." The statement argues that a single test should not be the sole basis for decisions concerning promotion, graduation or tracking. Rather, school officials should consider scores from a variety of tests. NCTM objects to the fashion for high-stakes testing both on grounds on fairness and equity and also because of the impact such tests have on the curriculum. The statement is online at the NCTM website: http://www.nctm.org/about/position_statements/highstakes.htm.

A Summer Seminar on Proofs and Refutations

"Proofs and Refutations in Mathematics Today" is an NEH Summer Seminar for College and University Teachers, to be held at Case Western Reserve University in Cleveland OH. Aimed at mathematicians, philosophers, historians, and anyone else interested, the seminar will focus on the roles of rigor and intuition in mathematics, drawing on Lakatos's book *Proofs and Refutations* and on the debate in the *Bulletin of the American Mathematical Society* that began with Jaffe and Quinn's 1993 article "Theoretical mathematics: towards a cultural synthesis of mathematics and theoretical physics."

The seminar runs six weeks, from June 25 to August 3, 2001, and participants receive a stipend of $3,700. Applications must be mailed by 1 March 2001.

Further information is available on the web at http://www.cwru.edu/artsci/phil/events/neh.html, or from Colin McLarty, Department of Philosophy, Case Western Reserve University, Cleveland OH 44106 (cxm7@po.cwru.edu).

National High School Calculus Award

The second annual National High School Calculus Award, sponsored by Calculus.org, will award $1000 to the winning student. Teachers may nominate any U.S. junior high or high school student for this award. Nominations are due by February 28, 2001.

Visit http://www.calculus.org, for further information, including a report on last year's winner and the five runners up. ■

Contributed Papers Sessions at Mathfest 2001

The Mathematical Association of America will hold its annual Mathfest from Thursday, August 2, 2001 through Saturday, August 4, 2001 in Madison, Wisconsin. The complete meetings program will appear in the April 2001 issue of FOCUS. This announcement is designed to alert participants about the MAA's contributed paper sessions and their deadlines.

Please 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 (*). Note that there will be a general contributed paper sessions at the Madison Mathfest.

Sessions generally must limit presentations to ten minutes or fifteen minutes. Each session room contains an overhead projector and screen; black/white boards will not be available. Persons needing additional equipment should contact the organizer of their session as soon as possible, but prior to May 1, 2001.

Submission Procedures for Contributed Paper Proposals

Send the name(s) and address(es) of the author(s), and a one-page summary of your paper directly to the organizer (indicated with an (*). In order to enable the organizer(s) to evaluate the appropriateness of your paper, include as much detailed information as possible within the one-page limitation.

Your summary must reach the designated organizer by Friday, May 4, 2001. Early submissions are encouraged. The organizer will acknowledge receipt of all summaries. There will be no published abstracts for this meeting.

Departmental Strategies for Training Faculty to Use Technology

Thursday afternoon

Various types of technology are being used with ever-increasing frequency as a pedagogical tool in mathematics classrooms. This trend raises several issues: How does a department integrate the use of technology when courses are taught by different instructors with varying levels of expertise and possibly conflicting teaching philosophies? What types of strategies are available to train faculty to use technology appropriately? How does a department keep current with new advances? How does a department with limited resources incorporate technology in a meaningful way?

The purpose of this contributed paper session, sponsored by the MAA Committee on the Teaching of Undergraduate Mathematics (CTUM), is to solicit papers that address these or related questions.

Kirk E. Weller (*)
Division of Mathematics
and Computer Science
Bethel College
Mishawaka, IN 46545
Phone: (219) 257-3388
Fax: (219) 257-3326
E-mail: wellerk@bethel-in.edu

Janet Andersen
Hope College

Making General Mathematics and Precalculus Courses of Service to Mathematics

Saturday afternoon

General Mathematics and Precalculus courses, service courses to colleges/universities, can serve mathematics departments by inspiring students and by providing the skills and the mathematical sophistication necessary to enable students to pursue mathematics as a major. Exposure to thought provoking puzzles and proofs, especially proofs without words, and the use of projects, applications to other disciplines, especially those involving real data, and innovative assignments, including those involving creative writing, can help students to view mathematics as real, creative, and enjoyable.

This session invites papers describing efforts to use General Mathematics and Precalculus courses to attract students to study mathematics. Participants are encouraged to discuss course changes made to improve student attitudes and to attract students to study mathematics as well as assignments/projects, demonstrations, and activities used to stimulate interest in mathematics. Of particular interest are professor/student reactions, the ease/difficulty with which changes are made, and the overall effect of course changes.

Sarah L. Mabrouk (*)
Mathematics Department
Framingham State College
100 State Street, PO Box 9101
Framingham, MA 01701-9101
Phone: (508) 626-4785
Fax: (508) 626-4003
E-mail: smabrouk@frc.mass.edu

Creative Use of Technology in Teaching Mathematics

Thursday and Friday afternoons

This session will focus on innovative uses of technology to support and enhance the learning of mathematics in all college courses. In particular we are interested in the use of technology to support conceptual understanding and appreciation of the application of mathematical principles to solving real world problems. The course is sponsored by the MAA Committee on Computers in Mathematics Education (CCIME).

Mary L. Platt (*)
Department of Mathematics
Salem State College
Salem, MA 01970
Phone: (978) 542-6928
Fax: (978) 740-7175
E-mail: mplatt@salemstate.edu

Marcelle Bessman
Jackson University

Technology Based Modeling in Mathematics Courses

Saturday afternoon

This session invites papers from any

Continued on page 16

course where computers, calculators or other forms of technology are used as part of a project involving mathematical modeling. Papers that emphasize student projects are especially welcome.

Possible questions that could be addressed in the paper session are: How do students choose or are assigned modeling projects? What role does technology play in building and analyzing the models? Is technology used in testing the model and interpreting the results? This paper session is sponsored by the Committee on Computers in Mathematics Education.

Rebecca E Hill (*)
Rochester Institute of Technology
85 Lomb Memorial Drive
Rochester, NY 14623
Phone: (716) 475-2498
Fax: (716) 475-5766
E-mail: rehsma@ritvax.isc.rit.edu

Howard Lewis Penn
U.S. Naval Academy

Strategies for Implementing Recommendations in the Mathematical Education of Teachers (MET)Document

Thursday and Friday afternoons

This session will present courses, programs, and faculty development initiatives for implementing the recommendations for the mathematical preparation of future K- 12 teachers. Papers are sought which provide practical information on these mathematics courses and programs and how they are taught. Also welcome are papers that focus on strategies for assisting mathematics faculty in teaching these courses and programs. Papers are also sought which address issues such as identification of undergraduate students interested in teaching, recruitment of good students into teaching, and increasing diversity of the teaching force.

All papers should show a clear connection to the Mathematical Education of Teachers document. The course is sponsored by the MAA Committee on the Mathematical Education of Teachers (COMET).

Judith Covington (*)
Department of Mathematics
Louisiana State University - Shreveport
Phone: (318) 797-5354
fax: (318) 795-4221
e-mail: jcovingt@pilot.isus.edu

Marj Enneking
Portland State University

Smoothing Mathematical Transtions: Articulation Efforts Between Institutions

Friday and Saturday afternoons

This session invites presentations on efforts to smooth the transition in mathematics education between institutions. The transitions include high school to college, two-year college to four-year college, and between colleges.

The impediments to smooth transitions can include variations in curricula and pedagogies, differing levels of use of technology, institutional or system policies, and assessment — including admission, placement, rising, and exit examinations. In addition to how efforts and formal agreements among institutions and systems have smoothed mathematical transitions, presentations can include the negative affects of such efforts. Of particular interest is the effect of articulation agreements on possible curricular innovations.

The course is jointly sponsored by the MAA Task Force on Articulation, CUPM (Committee on the Undergraduate Program in Mathematics), CRAFTY (Calculus Reform and the First Two Years), Committee on Two-Year Colleges, Committee on Service Courses, and Committee on Quantitative Literacy.

Bernard L. Madison (*)
Visiting Mathematician
Mathematical Association of America
1529 Eighteenth Street NW
Washington, DC 20036-1358
Phone: (202) 387-5200
Fax: (202) 265 -2384
E-mail: bmadison@maa.org

Sheldon Gordon
SUNY at Farmingdale

The Use of History in the Teaching of Mathematics

Thursday afternoon

This session invites contributions which describe the use of the history of mathematics in innovative ways to motivate students or to support changes in the mathematics curriculum and pedagogy. Ideas about the use of history to prepare future teachers are especially encouraged. Also invited are submissions which address methodologies and resources for modern historical research relevant to the mathematics classroom experience. Ideas about how to get students actively involved are especially encouraged.

Dick Jardine (*)
Keene State College
Mathematics Department
Keene, New Hampshire 03435-2001
Phone: (603) 358-2873
E-mail: rjardine@keene.edu

Amy Shell
U.S. Military Academy

ARUME: How Mathematics Education Research Can Inform Teaching

Friday and Saturday afternoons

This session will be devoted to expositions of research results and uses of research (RUME) in teaching. Summaries of research results together with implications for the classroom or specific examples describing how research results have informed work in actual college classrooms are especially encouraged.

Julie M. Clark (*)
Department of Mathematics
Emory & Henry College
Emory, VA 24327
Phone: (540) 944-6191
Fax: (540) 944-6223
E-mail: jmclark@ehc.edu

Bernadette Baker
Drake University

Pam Crawford
Jacksonville University

Innovative Programs to Improve the Teaching of Mathematics

Friday afternoon

Have you participated in or developed a program to improve your department's teaching of mathematics? Traditional programs to improve the teaching of mathematics by college and university professors are usually evaluative in nature and have primarily examined student and departmental peer assessment.

This session will examine innovative, locally created programs which help college and university professors improve their teaching skills or help them develop new approaches to teaching traditional mathematics topics. Such programs may include the use of interdisciplinary teaching teams, teaching seminars, or peer mentoring programs.

Aaron K. Trautwein (*)
Department of Mathematics
Carthage College
2001 Alford Park Drive
Kenosha, WI 53140
Phone: (262) 551-5873
Fax: (262) 551-6208
E-mail: akt@carthage.edu

Eric Rawdon
Chatham College

Innovative Methods in Courses Beyond Calculus

Thursday afternoon

Are you doing things a bit differently in an upper division course? And are you having some success doing it? Do your students have a better understanding of the material because of the new methods being used? If so, this session provides you with an opportunity to share your approach with others.

Papers presented at this session should discuss both the innovations that are being used in an upper division course and why these innovations have been judged successful.

Richard J. Maher (*)
Department of Mathematical and Computer Sciences
Loyola University Chicago
6525 N. Sheridan Road
Chicago, Illinois 60626
Phone: (773) 508-3565
Fax: (773) 508-2123
E-mail: rjm@math.luc.edu

General Contributed Paper Session

Wednesday and Thursday afternoons

This session is designed for papers that do not fit into one of the other sessions. Papers may be presented on any mathematics related topic. Papers that fit into one of the other sessions should be sent to that organizer, not to this session. Papers should not be sent to more than one organizer. E-mail submissions are preferred.

Susan E. Kelly (*)
Mathematics Department
University of Wisconsin - La Crosse
La Crosse, WI 54650
Phone: (608) 785-6610
Fax: (608) 785-6602
E-mail: kelly.susa@uwlax.edu

EMPLOYMENT OPPORTUNITIES

CALIFORNIA

CALIFORNIA STATE UNIVERSITY
LOS ANGELES
Department of Mathematics and Computer Science
Applications are invited for a tenure track position in Mathematics Education at the level of assistant/ associate professor, starting June or September 2001. Ph.D. in Mathematics with demonstrated experience in Mathematics Education, or a doctorate in Education with a strong background in Mathematics is required. Successful candidate will teach both mathematics and mathematics education classes. Publications in peer reviewed journals and/or grant activity is required. CSULA is on the quarter system. Considerations will start March 1, 2001. Send a letter of application and vita to Dr. Michael Hoffman, Chair, Department of Mathematics and Computer Science, California State University at Los Angeles, 5151 State University Drive, Los Angeles, CA 90032. An Equal Opportunity, Affirmative Action, Handicapped Title IX Employer.

KANSAS

TABOR COLLEGE
Mathematics/Computer Science
Description: Full-time position in Mathematics and Computer Science, starting Fall 2001. Responsibilities include teaching courses in the Mathematical Sciences' majors, and in the general education courses offered by the department, supervising senior theses, and advising students majoring in the Mathematical Sciences.

Qualifications: Prefer doctorate earned or in progress in Mathematics or Computer Science. Candidates with master's degree in one field with strong background in the other will be considered. Suitable teaching experience required. Candidates must understand and support the mission and goals of Tabor College, as an evangelical Christian college. Must be able to articulate his/her personal Christian commitment and be prepared to be a positive role model for students, in keeping with the lifestyle guidelines included in the college catalog.

Rank: Dependent on experience and qualifications.

Salary: Competitive with Kansas private colleges.

Closing Date: Applications will be accepted until March 1, 2001.

Application Process: Send vita, transcripts, and the names of three references who can be contacted to: Dr. Howard Keim, Dean of the Faculty, Tabor College, 400 South Jefferson Street, Hillsboro, KS 67063-1799. (E-mail: howardk@tabor.edu; FAX 316-947-2607).

Equal Opportunity: Tabor College continues to provide equal opportunity, without regard to race, color, gender, ethnic or national origin, disability, or age. Minorities and women are especially encouraged to apply.

For further information about Tabor College, see the Tabor website: www.tabor.edu.

NEW JERSEY

PRINCETON UNIVERSITY PRESS
Mathematics Editor
Princeton University Press seeks Editor or Senior Editor in pure and applied mathematics and related fields to enhance its prestigious math list. Two years of book acquisitions experience and an appropriate undergraduate or graduate degree are desirable. However, candidates with relevant backgrounds and a strong interest in publishing will be considered. Excellent work environment and benefits. Letter/resume (incl. books acquired) to: Mr. Terry Vaughn, Editor-in-Chief, Princeton University Press, 41 William St., Princeton, NJ 08540 Fax: 609-258-6305 (Only finalists will be contacted.)

NEW YORK

AMMERMAN CAMPUS OF SUFFOLK COUNTY COMMUNITY COLLEGE
Ammerman Campus of Suffolk County Community College, located on Long Island in NY, is accepting applications for a tenure-track position in Mathematics beginning in Fall 2001. Duties include teaching one course and serving as Mathematics Learning Center Coordinator. For further information, select "Employment" from the menu on our webpage: http://www.sunysuffolk.edu.

COLGATE UNIVERSITY
The Mathematics Department of Colgate University is accepting applications for two one-year leave replacement positions beginning August 2001. A Ph.D. is preferred. We invite applications representing all areas of mathematics. Colgate University is a highly selective liberal arts college with 2700 students. Faculty members teach five courses per year and are encouraged to participate in all-university programs. An application, including at least a vita, an unofficial graduate transcript and three letters of recommendation, should be sent to The Search Committee, Department of Mathematics, Colgate University, 13 Oak Drive, Hamilton, NY 13346-1398. Screening of applications will begin January 1, 2001. Colgate is an equal opportunity, affirmative action employer. Applications from women and minorities are encouraged.

ST. JOHN FISHER COLLEGE
Three positions available: Mathematics, Mathematics Education, Computer Science
St. John Fisher College invites applications and nominations for three pending tenure-track positions at the rank of Assistant/Associate Professor beginning August, 2001. Ph.D. in Mathematics, Mathematics Education, or closely related field required for the Mathematics and Mathematics Education positions (earned by August, 2001) and Masters in Computer Science required for the Computer Science position. A strong commitment to and proven effectiveness in undergraduate teaching are essential. The successful candidates should expect to teach three courses per semester and be involved in curriculum development.

Applications, which must include letter of interest, a statement of the applicant's philosophy of teaching, a curriculum vitae, three letters of recommendation describing teaching experience and abilities, and a transcript (a copy is acceptable) should be sent to:

Dr. Carol Freeman
Chair, Mathematics and Computer Science Search Committee
St. John Fisher College
3690 East Avenue
Rochester, New York 14618
E-Mail: freeman@sjfc.edu

We will be interviewing in New Orleans January, 2001 at the Joint Meetings. Review of applications will begin immediately and continue until the positions are filled.

Located in Rochester, New York, St. John Fisher College is a comprehensive College in the Catholic tradition of American higher education. Guided since its inception by the educational philosophy of the Congregation of St. Basil, the College emphasizes liberal learning for students in both traditional academic disciplines and professional fields. In keeping with the openness that is characteristic of its Basilian heritage, Fisher welcomes qualified students, faculty and staff regardless of religious or cultural background.

Rochester is noted for its excellent symphony orchestra, arts and science museums, proximity to the Finger Lakes region and Toronto, a high concentration of major international corporations, and some of the best hospitals and schools in the nation.

St. John Fisher College is an Equal Opportunity/Affirmative Action Institution and is committed to providing equal opportunity through its employment practices. Women and minorities are encouraged to apply. Additional information is available at: http://home.sjfc.edu/~mst/index.htm.

OHIO

OHIO DOMINICAN COLLEGE
Dynamic, private liberal arts college in Columbus, Ohio seeks an energetic, creative individual for a tenure track position beginning Fall 2001. The chosen candidate would teach a wide variety of undergraduate mathematics courses. A strong commitment to quality teaching is expected and an interest in using technology in the classroom is desired. An earned doctorate in mathematics or related fields preferred. Masters degree considered, but Ph.D. required for tenure. Interested applicants should send resume, statement of teaching philosophy, evidence of teaching effectiveness, and three letters of reference by February 1, 2001 to: Charlette Helm, Assistant to the Vice President for Academic Affairs; Ohio Dominican College; 1216 Sunbury Road; Columbus, Ohio 43219-2099.

Ohio Dominican College is an equal opportunity employer.

SHAWNEE STATE UNIVERSITY
Chairperson
Department of Mathematical Sciences
Position #00024
Shawnee State University, an open-admission undergraduate state institution that enrolls 3500 students, is accepting applications for the position of chairperson for the Department of Mathematical Sciences. The department has eleven full-time members.

Qualifications: Doctorate in the mathematical sciences or math education with strong master's degree in mathematics, substantial experience in undergraduate math education, administrative experience (or demonstrated administrative potential), strong commitment to undergraduate education. Seeking individual with experience and interests that include developmental courses, general/liberal education and service courses, and upper division courses for math majors. The department values the use of a variety of approaches to teaching and learning, including appropriate use of technology, use of applications to motivate mathematical ideas, collaborative learning, and development of students' abilities to communicate mathematical ideas.

A complete application file will include a letter of application (reference pos. #00024), vita, and three letters of reference (with phone numbers). Candidates should clearly and specifically address how their qualifications satisfy the requirements for the position and are encouraged to submit supporting information with their applications. Send application materials to: Dr. Jerry Holt, Dean, College of Arts and Sciences, Shawnee State University, 940 2nd St., Portsmouth, OH 45662-4344. Application review will begin immediately and continue until position is filled. Position open at this time.

Information about the University is available on our homepage at http://www.shawnee.edu

SSU seeks staff who share our commitment to students as our first priority. SSU is an AA/EOE

SHAWNEE STATE UNIVERSITY
Senior Instructor of Mathematics
Position #99391
Shawnee State University, an open-admission undergraduate state institution that enrolls 3500 students, is accepting applications for a senior instructor of mathematics. This is a continuing

contract eligible (tenure track) faculty position in the Department of Mathematical Sciences.

Requirements:
- Master's degree in mathematics or math education with at least 18 graduate level semester hours of mathematics;
- Strong commitment to teaching developmental mathematics, service courses, and general/liberal education courses focusing on quantitative literacy.

Qualified candidates will be evaluated on the extent to which their application packets demonstrate successful experience in, or potential for:
- effective teaching of developmental math courses;
- effective teaching in math courses focusing on general/liberal education;
- effective service focusing on increasing student retention and success.

Seeking faculty who are committed to the use of a variety of approaches to teaching and learning, including appropriate use of technology, use of applications to motivate mathematical ideas, collaborative learning, and development of students' abilities to communicate mathematical ideas.

To apply submit a letter of application (reference pos. #99391), a vita, copies of graduate and undergraduate transcripts (unofficial or official), and three letters of reference (with phone numbers) to: Dr. Jerry Holt, Dean, College of Arts and Sciences, Shawnee State University, 940 2nd St., Portsmouth, OH 45662. Electronically submitted or faxed applications will not be considered. Candidate should fully address how their qualifications satisfy the requirements for the position and are encouraged to submit supporting information with their applications. Review of applications will begin immediately and continue until position is filled. Position available at this time.

Information about the university is available on our homepage at http://www.shawnee.edu

SSU seeks staff who share our commitment to students as our first priority. SSU is an AA/EOE

OREGON

CENTRAL OREGON
COMMUNITY COLLEGE
Enjoy a teaching career in Mathematics in Bend, Oregon, an exceptionally attractive location on the eastern slopes of the Cascade Mountains with spectacular views and easy access to mountain lakes, scenic rivers and forested wilderness. Sunny high desert climate is ideal for outdoor activities, including a major ski resort at Mt. Bachelor. The area supports a growing population, with a strong, diversifying economic base, and provides high quality services particularly in health care and education. Seeking two exceptional classroom teachers with promise of excellence based on strong academic preparation. Masters degree in Mathematics Education or Mathematics with strong upper division math coursework required. Application deadline 4/6/01. For complete requirements, required application, and further information, see our website www.cocc.edu/hr or contact the Human Resources Office, CENTRAL OREGON COMMUNITY COLLEGE, 2600 NW College Way, Bend OR 97701 (541) 383-7216 (Voice). If you are hearing/speech impaired, call TDD# (541) 383-7708. EEO/AA.

PENNSYLVANIA

COLLEGE MISERICORDIA
Mathematics - Assistant Professor
College Misericordia invites applications for a tenure track position at the Assistant Professor level beginning August 2001. A Ph.D. in mathematics or closely related field at time of appointment is required. Candidates will possess a strong commitment to quality undergraduate teaching in a liberal arts setting and display continued interest in professional growth. The successful candidate will be required to teach a wide range of courses in the department including general education. The mission of the college is to educate students for lives of thoughtful inquiry, service, leadership and care. College Misericordia is committed to excellence and actively supports cultural diversity. To promote this endeavor, we invite individuals who contribute to such diversity to apply, including minorities and women. For inquiries please contact *Dr. Jerry Bradford, Department Chair of Mathematics, (570) 674-6741 or e-mail: jbradfor@miseri.edu.* We request all interested applicants to indicate if they will be attending the Joint Mathematics Meetings in New Orleans. For confidential consideration, please submit a letter of application, curriculum vitae, statement of teaching philosophy and three letters of recommendation to: *College Misericordia, Attention: Human Resources Department, 301 Lake Street, Dallas, PA., 18612, or e-mail: hr@miseri.edu. College Misericordia is located in the Pocono Northeast Region of Pennsylvania approximately 2 hours from Philadelphia and New York City.*

TEXAS

UNIVERSITY OF ST. THOMAS
Department of Mathematics
The University of St. Thomas invites applications and nominations for a senior level, tenure-track position to be chair of the Mathematics Department beginning in August 2001. The University of St. Thomas is a private university committed to the liberal arts and to the religious, ethical, and intellectual tradition of Catholic higher education. The Department of Mathematics offers a major and a cooperative engineering program in addition to providing important service and support to other programs. The successful candidate will have a Ph.D. in mathematics, and provide evidence of scholarly activity, excellent teaching and leadership experience. Rank will be determined by experience. Duties include providing guidance and leadership in curriculum, teaching 9 hours per semester, course scheduling, reporting, assessment and other administrative duties. Send letter of application, curriculum vitae, statement of teaching philosophy, evaluations of teaching, and names, addresses, telephone numbers and e-mail addresses of three references to Dr. Paul Knopp, Chair, Mathematics Department, University of St. Thomas, 3800 Montrose Blvd, Houston, Texas 77006, email pknopp@stthom.edu. Review of applications will begin immediately and continue until the position is filled. EOE. We encourage women and minorities to apply.

WISCONSIN

MOUNT MARY COLLEGE
Mathematics/ Mathematics Education Instructor
Mount Mary College is seeking an Assistant Professor for a full-time tenure track position in the Mathematics/Computer Science Department beginning August, 2001. ABD or Doctorate in mathematics/mathematics education preferred. Preference given to candidates with proven excellence in college-level teaching experience in mathematics/mathematics education. Additional preferred qualifications: interest in mathematics curriculum reform and innovative format and delivery systems; knowledge of current standards in mathematics education; mathematics teaching experience in K-12; ability to teach mathematics methods course for middle/secondary mathematics education majors; ability to teach statistics courses. Primary responsibilities include teaching a variety of undergraduate mathematics courses (introductory and upper division courses in both day and evening sections), advising students, and general academic duties.

Mount Mary is an equal opportunity employer encouraging minorities, women, veterans and individuals with disabilities to apply. Review of applications will begin February 15, 2001 and continue until position is filled. Send letter of application, vita, transcripts, and three letters of reference to: Sister Joy Marie Parolari, SSND, Chair - Mathematics/Computer Science Department, c/o Human Resources:

Mount Mary College
2900 N. Menomonee River Parkway
Milwaukee, WI. 53222-4597
Email: parolaj@mtmary.edu