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MAA FOCUS

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Inside

On the cover: To escape the hurly-burly of the court in Berlin, Frederick the Great built himself a palace in Potsdam and named it "Sans Souci," meaning "without a care." There, Euler was asked to help create a fountain that would shoot water high up in the air. Unfortunately, the engineers did not heed his advice to test the ability of the tubes to withstand the required water pressure, and the fountain never worked successfully. (Photograph of Sans Souci Palace provided by Jim Smith)

Mathematics at the AAAS, February 2008

By Edward Aboufadel

The 2008 Annual Meeting of the American Association for the Advancement of Science will be February 14–18, in Boston, MA. This year's program features many outstanding expository talks by prominent mathematicians, including a topical lecture by Curtis T. McMullen on "The Geometry of 3-Manifolds," focusing on the Poincaré Conjecture. The overall theme of this year's meeting is "Science and Technology from a Global Perspective"; many of the symposia sponsored by Section A (Mathematics) are interdisciplinary sessions that fit this theme. The Section A symposia are only a few of the nearly 200 AAAS program offerings in the physical, life, social, and biological sciences. For further information, including the schedule of talks, go to http://www.aaasmeeting.org.

AAAS annual meetings are the showcases of American science, and the participation by mathematicians and mathematics educators is encouraged. (AAAS acknowledges the generous contributions of AMS and MAA for travel support and SIAM for support of media awareness.) The AAAS Program Committee is genuinely interested in offering symposia on pure and applied mathematical topics of current interest, and in previous years there have been symposia on subjects such as the changing nature of mathematical proof, mathematical ecology, and recent results in prime number research.

The 2009 meeting will be February 12-16, 2009 in Chicago. The Steering Committee for Section A seeks organizers and speakers who can present substantial new material in an accessible manner to a large scientific audience. All are invited to attend the Section A Committee business meeting in Boston on Friday, February 15, 2008, at 7:45 PM, where we will brainstorm ideas for symposia. In addition, I invite you to send me, and encourage your colleagues to send me, proposals for future AAAS annual meetings.

Edward Aboufadel is the Secretary of Section A of the AAAS. He can be reached at aboufade@gvsu.edu.

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Symposia Sponsored by Section A

Mathematics and the Brain
(organized by Jack Cowan, Chicago)

Design of Mechanical Puzzles
(organized by Peter Winkler, Dartmouth)

Modeling the Dynamics of the Drug-Resistant Killers of the 21st Century
(organized by Sally Blower, UCLA)

Quantum Information Theory
(organized by Mary Beth Ruskai, Tufts)

New Techniques in the Evaluation and Prediction of Baseball Performance
(organized by Edward Aboufadel, Grand Valley State)

Other Symposia of Interest to the Mathematical Community

Biometrics in Border Management: Grand Challenges for Security, Identity, and Privacy

Atomic Detectives: Nuclear Forensics and Combating Illicit Trafficking

Ethical Issues in Scientific Publishing

Enhancing Science Globally Through High-Performance Computing and Simulation

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Collaboratively Developing Student Mathematical Thinking Among APEC Member Economies

Promoting the Success of Minority Graduate Students

Inside the Double Bind: Women of Color in Science, Technology, Engineering, and Mathematics

Looking for *Hard Problems*?

The world premiere of George Csicsery's film *Hard Problems: The Road to the World's Toughest Math Contest* will happen at the Joint Mathematics Meetings in January. See page 31 for more details.

The Dangers of Dual Enrollment

By David M. Bressoud

Dual or concurrent enrollment programs are arrangements between a local college and high school whereby students enrolled in certain classes receive both high school and college credit. For the purposes of this article, the term will be used exclusively for classes that are taken at the high school and receive dual credit.

Though they have existed for a long time, dual enrollment programs have taken off in the past decade as high schools and colleges have come to see them as mutually beneficial. In fact, they seem to be a win for everyone: Colleges like them because, even at reduced tuition, they are a source of additional revenue and a way of increasing enrollment numbers at very low cost. High schools like them because of the prestige of offering college-credit courses. Students like them because they eliminate the need to take a high stakes national test, such as the AP Calculus exam, in order to earn credit, and they look good on a transcript when applying to college. Parents like them because they can shorten the number of years their child will be in college, and thus the number of tuition payments.

I know that college material can be taught in high schools at a level that is comparable to what is taught in college. This is the premise of the College Board's Advanced Placement Program, and it is justified in the high success rates of students who use the college credit they have earned to move directly on to more advanced courses. But not everyone who studies college-level material in high school achieves college-level proficiency, as witnessed by the fact that at most a third of those who study calculus while in high school earn college credit for this course, and many of those who do not earn college-level credit struggle when they take a real college course on this same material. For this reason, a red flag goes up when colleges see students coming to them with credit for courses taken under dual enrollment programs. What has been the level of accountability in these programs? How has the mastery of this material been assessed?

This column looks at data from the CBMS Survey, Fall 2005, references the example of Nassau Community College which has shown what it takes to build a good dual enrollment program (see also the separate article "A Case Study of Concurrent Enrollment Patnerships in Mathematics" in this issue), and describes the Early College High School Initiative, a national dual enrollment program with both promise and danger.

CBMS Survey Data

While a small number of students take statistics under dual enrollment, most of the dual enrollment courses in mathematics are either college algebra/precalculus or calculus. Just offering college algebra/precalculus as a college-credit course taught in a high school can be problematic. Many colleges, Macalester among them, no longer consider these to be college-level courses. Even colleges and universities that do offer college credit for these courses usually treat them as preliminary to the mathematics required for mathematically intensive majors. If these courses really are high school mathematics, what does it mean to offer college credit for them when they are taken in high school?

To get an idea of the annual numbers, the CBMS survey counted the number of students in dual enrollment programs in both spring and fall terms of 2005 [1]. There were 63,986 students studying college algebra/precalculus and 33,436 studying calculus. Both 2-year and 4-year colleges are involved in awarding dual enrollment credit: 22% of the students in college algebra/precalculus and 42% of those in calculus I received their credit from a 4-year college. Occasionally, these courses are taught by college faculty, but that is the exception. Only 4% of the courses affiliated with 4-year colleges and 12% of those affiliated with 2-year colleges are taught by college faculty. Even the label "college faculty" can be problematic because there are cases where high school teachers are designated as faculty of the college.

College departments were asked to self-report on whether they maintained control over four aspects of these programs: selection of textbook, syllabus, final exam, and choice of instructor. The table on page 5 shows the results. I find it very disturbing that the most effective means of ensuring quality control over the final examination and the choice of instructor, are so seldom used.

This lack of accountability can lead to serious problems for both the students and the colleges at which they are accepted. While there are many excellent high school teachers capable of teaching these courses as well as or better than the instruction at college, and while even the term "college-level" is problematic because of the great disparity among colleges in how such courses are taught, the goal of any dual enrollment course is that students who successfully complete it are at least as well prepared for the next course in the sequence as those who have taken it at the college from which credit is given. Without close oversight and supervision, there is danger that credit might be given even when the level of preparation is below that required for the next course.

Maintaining Quality

There are dual enrollment programs that do maintain the control that is needed. Nassau Community College on Long Island, New York, is one that is doing a good job. Further information on their program can be found elsewhere in this issue [2].

There now is an accreditation agency for dual enrollment programs, the National Alliance of Concurrent Enrollment Partnerships (NACEP) [3]. For those readers who know more about this organization, I would be very interested in your assessment of its usefulness. What impresses me most about NACEP is that its accreditation is accompanied by a rating system that describes the degree of control along several different dimensions. It appears that NACEP accreditation may be a useful tool to help colleges decide when dual enrollment credit should be accepted.

Early College High School (ECHS)

In learning about dual enrollment programs, I have also been alerted to a movement that has the potential to greatly impact the educational system as we know it. The Early College High School Initiative is a nation-wide collection of programs that award college credit for courses taken while in high school. It is targeted specifically at "low-income youth, first-generation college goers, English language learners, students of color, and other young people underrepresented in higher education."[4] It is committed to instruction that is "rigorous, relevant, and relationship-based" (its 3R's). Alarmingly, one of its primary goals is to allow these students to earn up to two full years of college credit while still in high school. Spearheaded by the Bill & Melinda Gates Foundation with support from Carnegie Corporation of New York, The Ford Foundation, and The W.K. Kellogg Foundation, it is a serious undertaking that is already operating in 130 schools, involving over 16,000 students. The goal by 2012 is 239 schools and 96,400 students.

College Control Over	4-year colleges			2-year colleges		
	never	sometimes	always	never	sometimes	always
Textbook	41%	15%	44%	14%	12%	74%
Syllabus	2%	6%	92%	4%	7%	89%
Final Exam	40%	30%	30%	36%	28%	37%
Instructor	32%	20%	48%	35%	13%	52%

Level of control by college mathematics departments over dual-enrollment courses.

Unlike the dual enrollment programs described above, most of the college-level classes (58% of all programs) are taught on college campuses, while another 22% are in special facilities devoted to ECHS. For the most part, the courses that carry college credit are taught by college faculty (again, this can be an ambiguous designation), but usually to classes made up entirely of high school students. Of eight ECHS programs that were studied in detail in 2006, five teach at least some of the college-credit courses in classes that enroll both college and ECHS students, but only one of the programs teaches all of its college-credit courses in this manner. [5, p. 33]

This makes a difference. In an independent study of this program undertaken during 2004–05, "interviews revealed that college instructors were more likely to maintain their usual standards if ECHS students were enrolled alongside other college students, rather than comprising the entire class." [5, p. 35] The program is new enough that as yet there are no reliable statistics on its effectiveness at getting at-risk students into and through college.

In an independent evaluation prepared for The Bill & Melinda Gates Foundation, the American Institute for Research noted that college faculty make a very conscious effort to maintain college-level expectations in these courses, but that "rigorous instruction was elusive [in the ECHS high school classes], particularly in mathematics classes." [5, p. 91] Of eight programs offering college credit that were studied in some detail in the spring of 2006, five did teach at least some classes that enrolled both college and high school students, but only one of the colleges did this exclusively.

As I see it, the primary goal of this initiative is to introduce rigorous, college-level material to at-risk students, giving them a sense of what college is like and what it will take to succeed while providing an environment that helps them to succeed. This is a very worthy goal. I do worry about the promise of being able to complete two years of college-level courses while in high school. Students who successfully complete this program and arrive at college with the intention of graduating in only two more years will find themselves shut out of any mathematically intensive major. Few students, even among the most talented and accelerated, arrive at college with the three semesters of calculus and the semester of linear algebra required before taking junior/senior level courses in mathematics, physics, or chemistry.

The independent report does suggest backing off from the promise of two years of college credit earned while in high school as a "core principle" and replacing it with a commitment to compress the time needed to complete a post-secondary degree. [5, p. 93] Even that commitment may make it more difficult for these students to enter mathematically intensive fields.

This initiative is already encountering some problems in maintaining rigor. I am concerned about what will happen to the expectations for achievement levels as this initiative expands and attracts imitators who sell their program as a way of cutting college costs.

Many forces have combined to drive both dual enrollment and the ECHS promise of a high school diploma that comes with an associate's degree attached. High college tuition is one of them. Until now, demand for college degrees has seemed perfectly inelastic; people will pay whatever colleges charge. As everyone knows, that cannot be true. People are not going to stop going to college, but they may well seek perverse and counter-productive routes to its completion. For those of us who worry about the low number of students going into mathematically intensive majors, this should be a matter of concern.

References

[1] CBMS Survey, Fall 2005, tables SP.16 and SP.17, pages 62–63. http://www.ams.org/cbms/report05/

[2] Philip Cheifetz and Ellen Schmierer, A Case Study of Concurrent Enrollment Partnership in Mathematics, see below.

[3] National Alliance of Concurrent Enrollment Partnerships. http://www.nacep.org

[4] The Early College High School Initiative. http://www.earlycolleges.org/

[5] American Institute for Research and SRI International. Evaluation of the Early High School Initiative. Prepared for The Bill & Melinda Gates Foundation. 2007. http://www.earlycolleges.org/publications.html

David M. Bressoud teaches at Macalester College. He will be President-Elect of the MAA beginning in January 2008. A version of this article also appeared as a Launchings column in July, 2007 on MAA Online, at http://www.maa.org/columns/launchings.

A Case Study of Concurrent Enrollment Partnership in Mathematics

By Philip Cheifetz and Ellen Schmierer

A concurrent enrollment partnership (CEP) is an association between a college and one or more high schools that allow qualified high school students to earn college credit by taking college courses taught in their high schools. As reported by David Bressoud elsewhere in this issue [1], enrollment in such programs has grown exponentially in the past few years.

This article reports on the Partnership Program in Mathematics at Nassau Community College (NCC) on Long Island, NY, as an example of what we believe the parameters of a successful CEP with integrity should embody. NCC, the largest single campus community college in New York, serves Nassau County, whose population is over 1.3 million people. The College enrolls over 21,000 students per year. The Partnership Program in Mathematics [2] began as an outreach program to local high schools in 1997 as a result of a bold redesigning of NCC's calculus courses in 1993. At that time, the NCC mathematics department began teaching what was then referred to as "reform calculus." In particular, the department adopted the calculus curriculum and materials developed under a National Science Foundation grant by the consortium based at Harvard University. Since NCC captured approximately 28% of all Nassau County college-bound seniors at that time, we felt in was incumbent upon us to alert the high schools in the county of the dramatic changes their students would face if they enrolled in calculus courses at NCC.

In 1993, a workshop was offered to high school mathematics chairpersons and their department members. The calculus workshop consisted of two eight-hour days in the fall and spring semesters. These four workshops were attended by approximately 25 teachers, many of whom were department chairs. The attendees received hands-on instruction on the new "fewer but deeper" ideas in the NCC curriculum. A second set of four calculus workshops was given the following year to a new set of participants.

With the success of the calculus reform, the Harvard Consortium developed a precalculus curriculum and associated materials. Again, NCC adopted this curriculum and ran four new workshops in precalculus. These workshops were attended by many of the same attendees who had attended the calculus workshops.

During one of the sessions in 1996, one of the high school chairs asked if he could offer precalculus in his high school and have his students receive NCC credit. His reasoning was "you trained us, we will use the same textbook as NCC, we will use your exams, and we will come to NCC once a month to discuss the progress of the partnership." Meetings with the NCC administration and the College union were held at NCC to examine the viability and ramifications of such an arrangement. After a year of meetings, NCC began a pilot partnership program in precalculus in the fall of 1997 with two high schools and 47 students. The model we developed had the key components that follow. The last item was recently added.

- Any high school that wishes to participate in our CEP must send the teachers who would teach the course to a one-week summer workshop at NCC to prepare them to teach the course. Implicit in this preparation is the introduction to the NCC course curriculum and the textbook we use, as well as working out many of the homework exercises.
- These teachers must agree to attend a regularly scheduled users' group at NCC to discuss issues, examinations, upcoming material, etc.
- School districts must agree that the high school class will be visited every second week by an NCC faculty member who will teach the next scheduled lesson to the high school class.
- School districts must agree that the final course grade will be computed using examinations written and graded by faculty at NCC.

- Students will be taught using The Way of Archimedes: formal definitions and procedures evolve from the investigation of practical problems.
- The responsibility for learning will be gently shifted from teacher centered to student centered.
- Faculty will continually encourage students to adapt to ever changing challenges in their academic lives. Furthermore, the techniques for learning to meet these various challenges may have to change.
- Course texts, syllabi and materials will reflect the spirit of the standards established by the National Council of Teachers of Mathematics (NCTM), the American Mathematical Association of Two-Year Colleges (AMATYC), and meet the recommendations of the Mathematical Association of America (MAA).
- Course quality and standards should meet the recommendations published by The National Alliance of Concurrent Enrollment Partnerships [3] and endorsed by the Chancellor of the State University of New York (SUNY).

The first step in the implementation of our CEP is the one-week summer workshop, which is open to all high school teachers in the county whether or not they wish to participate in our CEP. The workshop serves as a brush-up for many participants, as well as an exposure to the rigor and performance we expect.

After the completion of the course, each new participating high school teacher is introduced to his or her NCC partner professor. Telephone numbers and email addresses are exchanged and plans are made for the professor's first visit. It should be noted that the NCC professor has this high school partnership course as part of his or her full-time schedule. At the first visit, the professor outlines the course expectations, hands out the NCC course outline, discusses policy, and informs the class that the NCC course-wide final examination (worth 35% of the final course grade) is given at the College. Three other course examinations (each worth 10% of the final grade) are given at the high school. All these exams are constructed and graded by the NCC professor. The remaining 35% of the final course grade is composed of the average of many quizzes and tests constructed by the high school teacher in collaboration with the NCC professor.

As we pioneered this CEP in 1997, the above four points seemed reasonable to all parties. However, today, ten years later, there is an overwhelming national pressure to pass all students and more likely than not, award every high school and college student a grade of A or B, which, in many CEPs, translates into the use of easier texts than on the college campus and a compromise on rigor and curriculum.

In [1], Bressoud has reported the data that shows how few colleges maintain control over textbook, syllabus, final exam, and instructor, Given this data, it appears that today the NCC program is rather uncommon, since we completely control textbook selection, course syllabus, the final exam, and the NCC instructor. Our model does not deputize the high school teacher to assign the NCC final course grade, nor does the high school teacher have adjunct status in the NCC mathematics department. Rather, the high school teacher has the shared responsibility for imparting instruction and therein produces the partnership. Although the students who have enrolled in finite mathematics, precalculus or calculus are among the more mathematically talented students in their respective high schools, only 88% receive a C or higher.

An unexpected benefit of our regularly scheduled users' group at NCC is the interaction between high school teachers and NCC faculty on topics that are tangentially related to the curriculum. The NCC professors learn about the awarding of significant partial credit, parental pressure, administrative pressure, and statewide mandates, while the high school teachers learn about the lack of student motivation, resistance to the shift from teacher centered to student centered instruction, the multiple representations of concepts, the difference between superficial and deep understanding, and the shift from drill to interpretation and the absence of weeks of review for standardized exams. This interaction provides an appreciation for the issues of each group, and is very useful for establishing a collegial relationship.

In 2006, 11 NCC instructors and 19 high school teachers were responsible for 504 enrollees in seven public high schools. This year, we expect over 600 students to enroll in one of our three mathematics courses. To date, over 3,500 high school students have been through the program. In 2000, the program was recognized by the American Mathematics Association of Two-Year Colleges and was awarded its Annenberg/CPB Foundation's INPUT Award for "innovative curriculum and pedagogy in introductory college courses before calculus."

References

[1] David Bressoud, The Dangers of Dual Enrollment. See page 4.

[2] The NCC Partnership Program in Mathematics. http://www.matcmp.sunynassau.edu/~cheifp/partners.htm

[3] National Alliance of Concurrent Enrollment Partnerships. http://www.nacep.org

Phil Cheifetz has been teaching at Nassau Community College (NCC) for 41 years. He is the co-author of five mathematics texts and numerous articles. Phil was a founder of AMATYC and served as its president in 1978. He is the co-director of the Partnership Program in Mathematics.

Ellen Schmierer has been teaching at NCC for 12 years. She is the co-author of three mathematics texts and has presented many papers at both local and national mathematics meetings. Among her other duties, Ellen is co-director of the Partnership Program in Mathematics and handles the day-to-day operations of the program.

Found Math

"Do you have to pick me up in your Acme uniform? It's, like, soooooo embarrassing."

"I certainly do," I replied, giving her a big smoochy kiss to embarrass her further, something that didn't really work, as the pupils in her math class were all grown up and too obsessed with number sets and parameterized elliptic curves to be bothered by a daughter's embarrassment over her mother.

"They're all a bit slow," she said as we walked to the van. "Some of them can barely count."

"Sweetheart, they are the finest minds in mathematics today; you should be happy that they're coming to you for tutoring. It must have been a bit of a shock to the mathematics fraternity when you revealed that there were sixteen more odd numbers than even ones."

"Seventeen," she corrected me. "I thought of another one on the bus this morning. The odd-even disparity is the easy bit," she explained. "The hard part is trying to explain that there actually is a highest number, a fact that tends to throw all work regarding infinite sets into a flat spin."

Thursday Next in First Among Sequels, by Jasper Fforde, p. 108.

Thanks to Henry Ricardo

1188 Reviews So Far!

So many books... So little cash... It helps to know what others think. *MAA Reviews* is the place to find reviews of mathematics books.

http://mathdl.maa.org/mathDL/19/

Teaching Time Savers: The Exam Practically Wrote Itself!

By Michael E. Orrison

When I first started teaching, creating an exam for my upper division courses was a genuinely exciting process. The material felt fresh and relatively unexplored (at least by me), and I remember often feeling pleasantly overwhelmed with what seemed like a vast supply of intriguing and engrossing exam-ready problems. Crafting the perfect exam, one that was noticeably inviting, exceedingly fair, and unavoidably illuminating, was a real joy.

As the years went by, however, the process of creating an exam began to feel more and more like a chore. What had once seemed like a vast supply of great problems now began to look like a nice, tidy, but ultimately small collection of simple and uninspiring questions. The excitement had worn off, and I was beginning to feel like I was spending too much time crafting or looking for problems. I still wanted to create perfect exams, though, so I decided that I needed to find a new source of inspiration.

So, a few years ago, in anticipation of what seemed like another uneventful exam making session, I decided to get my students involved in the process. A few days before I was to write the exam, I gave each student a sheet of paper that had, printed at the top, the following:

Problem Proposal: Propose a problem for the upcoming exam and explain why it should be on the exam.

I explained to them that (and I really do believe this) one characteristic of a good student is his/her ability to anticipate what an upcoming exam will look like. He/she should have a solid feel for the big ideas in a course, and be able to suggest several questions that could act as vehicles to demonstrate a thorough understanding of those ideas. This exercise would, therefore, give them an opportunity to go through that process.

I made it clear that the exercise was completely optional, and that there would be no "extra credit points" assigned to it. I did, however, tell them that I would carefully read each submission, and that there was a good chance that one or two of their problems would make their way onto the exam, especially if the justification was solid and compelling. I also told them that I thought this was a great way to begin studying for the exam, and that they were free to share their ideas with their classmates.

The response was wonderful. First of all, almost every student submitted a problem together with a solid justification; from their responses, I could quickly get a sense of what they thought were the major themes of the course. Moreover, their justifications were thoughtful and, more often than not, made their point while cleverly connecting together several of those major themes.

From an exam writing perspective, it was impossible for me not to feel as though the exam was essentially writing itself as I read through their responses. The questions were at the right level, used the right notation, and were focused on the right ideas. As you might expect, I found a lot of my old standbys in the mix, but they now seemed refreshed and ready for action. It was like being handed a draft of the exam, and I was the editor. It was the inspirational spark I needed.

I now use the Problem Proposal sheet in all of my classes, and at least 90% of my students submit a problem each time. I have found that in addition to speeding up the process of creating an exam, it gives me an easy way to gauge student understanding at key points throughout the course. Moreover, the resulting exams seem to be ultimately more fair and connected to my classes because, in a very real sense, they are derived (or at least inspired) by the classes themselves. Thanks to my students, crafting the perfect exam is again a real joy.

Time spent: About one minute to read through each submission.

Time saved: About 30 to 90 minutes of creating or searching for exam questions.

Michael Orrison teaches at Harvey Mudd College. He is the editor of the Teaching Time Savers series.

Teaching Time Savers are articles designed to share easy-to-implement activities for streamlining the day-to-day tasks of faculty members everywhere. If you would like to share your favorite time savers with the readers of FOCUS, then send a separate email description of each activity to Michael Orrison at orrison@hmc.edu. Make sure to include a comment on "time spent" and "time saved" for each activity, and to include pictures and/or figures if at all possible.

Have You Moved?

The MAA makes it easy to change your address. Please inform the MAA Service Center about your change of address by using the electronic combined membership list at MAA Online http://www.maa.org) or call (800) 331-1622, fax (301) 206-9789, email: maaservice@maa.org, or mail to the MAA, PO Box 90973, Washington, DC 20090.

The MAA Euler Study Tour

The MAA's Leonhard Euler Study Tour took place from July 1–14, 2007. The group of 26 intrepid travelers assembled initially in the Andersen Hotel in Saint Petersburg, Russia on July 1. Led by Victor and Phyllis Katz, the group then spent six days in the former Russian capital, visiting places where Euler lived and worked, as well as his tomb. We also were privileged to examine some of Euler's notebooks and other original documents in the Archives of the Russian Academy of Sciences. Naturally, we also visited some of the main tourist sites of St. Petersburg, and also learned about mathematics and mathematics education in Russia today.

View of Basel

On July 7, we flew to Basel, Euler's birthplace. There, besides seeing the house where Euler grew up and the gymnasium that he attended, we also visited the houses and graves of several of the members of the Bernoulli family. In addition, we had a great time exploring the mathematics exhibit that had been originally put together for the ICM in Madrid in 2004.

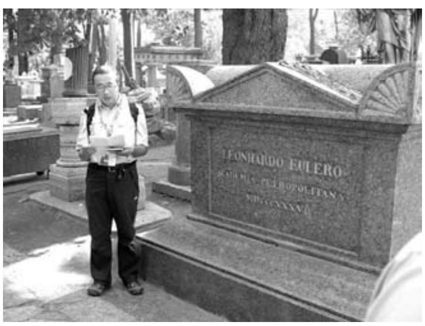
On July 9, we went on to Berlin, the city where Euler spent close to a quarter of a century in the prime of his life in the employ of Frederick II (sometimes known, incorrectly according to one of our guides, as Frederick the Great). There we heard several lectures on Euler's life and work while visiting the Academy of Sciences and the Humboldt University, formerly the University of Berlin. We were treated to another exhibit of Euler's papers, including the maps he worked on as part of his duties in the Academy. At the Technical University, we learned about German graduate mathematical education today and had a tour of their virtual reality exhibit as well as their three-dimensional printing equipment. We concluded our tour with a visit to Frederick's summer palace in Potsdam, where Euler had tried unsuccessfully to persuade Frederick that he needed better materials in the pumping system if he wanted the fountains to work. Victor was responsible for putting together most of the academic portions of the tour, while Phyllis led several discussions on how to use the photographs and other information gleaned on the tour in teaching classes.

Reports and Comments from the Participants

Thoughts on the Euler Tour

Siu Man-Keung

For me the most worthwhile part of this Euler Study Tour was the opportunity to read the many original manuscripts from the pen of Euler now kept in the archives in St. Petersburg and in Berlin. The neat and beautiful handwriting, the meticulous and copious writing and the substantial content enhance my admiration and respect of this great mathematician and personality. While I walked on the spiral stone staircase and the floor of the place that the great man once worked in, the feeling was both strange and uplifting. I regarded it an honour to be able to read a short eulogy before his tomb in the Alexander Nevsky Monastery Cemetery (see page 12).



Man Keung Siu reading his eulogy to Euler.

Thanks to the kind arrangement of a Russian friend of Andrew Potter, a few of us went to visit the Pulkovo Observatory on a free afternoon. The Observatory is situated in a large bushy estate on the outskirts of St. Petersburg. Two things about the visit particularly impressed me. The first is the spirit of enthusiasm and dedication the staff possess despite the not-so-affluent condition (compared with some institutions which however do not accomplish as much). When I saw the old-fashioned observatory towers hidden in the bush I thought at first they were only historical remnants, but after explanation by the staff I realized that those were still working well and had accomplished good work in the past. In one telescope a part is actually a bicycle chain cleverly converted to fit the purpose. It reminds me of the kind of self-reliance practiced by Chinese scientists from the 1950s to the early 1980s to cope with the financially inadequate situation at the time, but in high spirits and with full enthusiasm.

The second impressive thing is a copy of an old book that bears the scar of war in the defense of the motherland during WWII. The bullet went straight through the pages! At the time there was nothing but books to build a blockade for the Observatory under heavy German fire. I have heard and read about the 29-month siege of Leningrad (former name of St. Petersburg from 1924 to 1991), but this time I actually saw the relics of the siege for myself.

As someone interested in history of mathematics, the other (even older) books in the library certainly fascinated me also. Fortunately the staff succeeded in removing those precious old books to a safe place at the time of the siege; otherwise we would not be able to still read them. In particular, it was fascinating to read a copy of *Astronomicum Caesareum* (1540) written by Peter Apianus for Charles V, which is full of illustrations in the form of movable hands-on devices, like those seen in a modern pop-up book for children!

The Euler Adventure
Carole Lacampagne

Carole Lacampagne at the "Farewell to St. Petersburg" dinner with a balalaika player.

The most exciting event of the Euler trip was our visit to the Euler Archives at the Russian Academy of Sciences. We were actually allowed to turn the pages of Euler's notebooks and read his mathematical ideas and formulas written in his own hand or that of his scribe. Other great experiences included hearing talks by Fred and Joel in the Old Aula in Museum lecture hall in Basil, surrounded by busts of Euler, the Bernoulli brothers, Gauss, and other famous mathematicians; and going to the Humboldt University in Berlin to hear lectures by Helmut Koch and Norbert Chapter on various aspects of Euler's work.

Of course the sightseeing was also terrific. St. Petersburg is an absolutely beautiful city, filled with palaces and cathedrals, rivers and bridges. Basel retains its quaint charm with old buildings and the Rhine River running though it. And Berlin, with all its beautiful museums, still has a flavor of the devastation of World War II.

And I did this marvelous trip on what I wore on the plane from Washington, a change of underwear, and a couple of borrowed clothes loaned to me by good friends! My luggage never arrived.

Two Weeks Studying the Life of Euler
John Wilkins

John Wilkins at the Idiot Café in St. Petersburg.

Leonhard Euler was a remarkable mathematician. Although very few mathematicians would disagree with this statement, that is not to say our community appreciates him fully. Participating in the tour was a chance to develop my appreciation of his work. One experience that left a significant impression on me was the day we visited the St. Petersburg Academy. The room that contained Euler's archived notebooks was small, so we had to take turns viewing them. One group toured the surrounding buildings, while the other viewed yet to be published manuscripts. To hold a notebook that Euler wrote over 250 years ago in his own hand was a very exciting moment. Some members of our talented group were able to translate a portion of the pages we were viewing from their original Latin and German. Those translations allow us the opportunity to discuss Euler's thinking about a particular problem in mathematics. You can see photos of this experience at: http://www.maa.org/EulerTour/StP_Academy_Euler_Archives/index.htm.

This experience and many others have supplied me with a great wealth of material that I can use to enrich my History of Mathematics course.

A Non-Mathematical Moment
Madeleine Long

Madeleine Long outside of the Hermitage in St. Petersburg.

The sky kept darkening as the rain interrupted the pace of the visit through the streets of Basel. As we stood in front of one of the many Euler sights, the group of twenty or so, uncomfortable yet intensely interested in the town and its many historical sights, our guide, clad in a bright red jacket that contrasted markedly with the gray black of the day, raised a question. Would it be ok, she asked, if she pointed out something that was totally non-mathematical, even non-scientific?

"Yes," we all said, as if in a chorus. She then spoke of a philosopher she felt might be virtually unknown to most of us but was evidently quite important to her, a man who had lived and worked in Basel longer than in any other place, a philosopher she was extremely eager, yet quite hesitant, to tell us about. Does anyone know who Nietzsche is? The responses that came from our group surprised and pleased our guide, and produced a radiance brighter than any we were to see that entire day. Mathematicians are interested in matters that pass beyond Euler and mathematicians! There is balance in the world after all!

Reflections on the Euler Tour, 2007

Herb Kasube

The 2007 Euler Tour was inspiring as well as breathtaking. To look at Euler's papers in the archive in St. Petersburg was a once in a lifetime opportunity. His notebooks were journals chronicling his life. What better way to look into the soul of an individual?

The charm of the city of Basel, Switzerland radiated from every corner. The view from a 31st floor window was breathtaking. A ground level view of Basel revealed its old charm. I look forward to returning to Basel some day.

Herb Kasube in front of Euler's tomb.

Being in Berlin conjured up memories of families separated by "The Wall" and thoughts about how far this city had come. One day, my morning run took me through the infamous "Checkpoint Charlie" in both directions. Forty years ago that would have been a lot more dangerous. Tears welled up in my eyes.

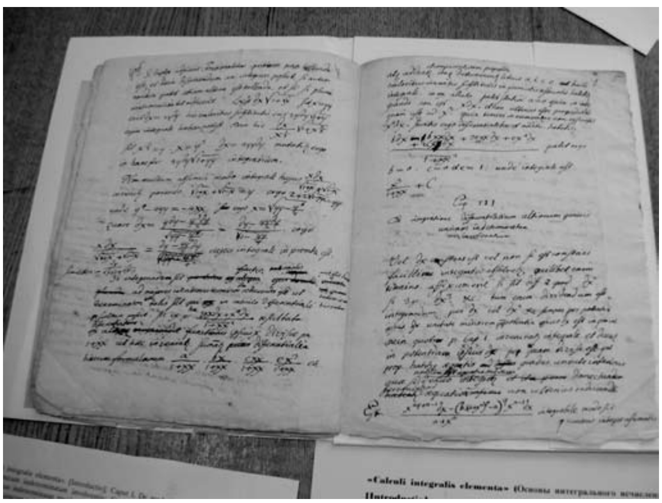
I end these reflections where they began, with the man of the year, Leonhard Euler. Standing next to his tomb In St. Petersburg, I felt his presence.

Eulogy of Leonhard Euler (1707–1783)

By Siu Man Keung

Respectfully read before the tomb of Euler at the Alexander Nevsky Monastery Cemetery in St. Petersburg on July 3, 2007.

To commemorate the three-hundredth anniversary of the great Swiss mathematician Leonhard Euler we would have to transport ourselves to the Europe in the eighteenth century, which can be justly hailed as "the Age of Euler." As the late Clifford Truesdell, himself a renowned mathematician and a life-long admirer of Euler, put it, "To study the work of Euler is to survey all the scientific life, and much of the intellectual life generally, of the central half of the eighteenth century."[1] It was a time when academic activities and scientific progress in Europe took place most prominently in the few royal academies rather than in the many universities. It was also a time when no national distinction nor geographical boundary was recognized in the pursuit of science, so that eminent scholars came from different parts of Europe to study and work side by side at the same academy. Among them was the "incomparable Leonhard Euler" (in the words of Johann Bernoulli).



Euler Notebook 6. Photograph by Herb Kasube.

Euler left his homeland at the age of twenty and spent the next fifty-six incredibly productive years in the Russian Academy in St. Petersburg and the Prussian Academy in Berlin. The French mathematician-physicist François Arago said of him, "Euler calculated without apparent effort, as men breathe, or as eagles sustain themselves in the wind." The French philosopher-mathematician Marquis de Condorcet said in a eulogy of Euler, "He ceased to calculate and to breathe." That happened on the evening of September 18, 1783 when Euler suffered from a stroke at his home in St. Petersburg. Today we come in homage to his burial ground.

Euler is well known for his prolific output of an order of magnitude unparalleled in history, both in quality and quantity. There is this amusing story that the accumulation of the stack of his finished memoirs increased more rapidly than the rate these memoirs went to press, so that very often they were published in the reversed order of completion with the strange consequence that the content of a published memoir was more extended and improved than that of another that appeared later!

Approximately one-third of the research in mathematics, mathematical physics and engineering mechanics published in the last three-quarters of the eighteenth century was authored by Euler. The modern revision of his collected works (Opera Omnia) began in 1911 and is not yet finished, with already near to eighty volumes published by 1994. In 1983 a special issue of *Mathematics Magazine* dedicated to his memory listed forty-four items of mathematical terms or theorems that bear his name. His versatility as an all-round researcher is phenomenal, both in the continuous and in the discrete, so that he was truly an expert in "con-crete" mathematics![2] The influence of Euler goes far beyond the eighteenth century and into the era we live in. Just to cite two examples. His idea on the famous seven bridges of Königsberg led to the Guan-Edmonds algorithm on the Chinese Postman Problem in the early 1960s. It also led to the efficient Christofides algorithm in the mid-1970s that yields a solution to the (Euclidean) Travelling Salesman Problem no worse than three-halves of the optimal solution. The second example is in number theory. Euler calculated the famous infinite sum of the reciprocal of consecutive squares, also known as $\zeta(2)$, to be π squared over six, and treated successfully $\zeta(n)$ for n even. More than 240 years later Roger Apéry proved that $\zeta(3)$ is irrational, but nobody yet knows what $\zeta(3)$ is. In recent years both interest and progress are rekindled in the investigation of (n) for odd n.

As an author and teacher Euler is noted for his clarity in exposition, but more than that he was eager to share with his readers his ideas that led to those

Instruments. Photograph by Phil Scalisi.

discoveries.[3] No wonder Pierre-Simon Laplace said of him, "Read Euler, read Euler. He is the master of us all." His primary interest was in the wonder of discovery and its explication, but cared little whether he or somebody else made the discovery. The late Russain historian of mathematics, Adolf P. Youschkevitch, described Euler as a well disposed man not given to envy, and further borrowed from the famous eulogy by Bernard le Bouyer de Fontenelle on Gottfried Wilhelm Leibniz to highlight this noble trait of Euler, "He was glad to observe the flowering in other gardens of plants whose seeds he provided."[4]

One more thing about the man that earns our admiration is the way he led a fruitful life despite adversity. He was seriously ill at twenty-eight that led to loss of sight in his right eye at thirty-one. He was struck by illness again at fifty-nine that led to partial loss of sight in his left eye, and at sixty-four became totally blind for the last twelve years of his life. At sixty-four he was further hit by misfortune in losing his house and properties in a fire, followed two years later by the death of his first wife. Euler had thirteen children, but eight died in infancy. He took all the misfortune in stride and was so dedicated to his work that nearly half of his research was produced when he was close to sixty.

In the ancient *Chinese Book of Odes* one reads the verses that have come to connote the noble character we admire and the virtuous deed we emulate : "The high mountain I look up at it. The great road I travel on it." Euler was a genius, whose height very few can hope to reach. But we can all learn from his great zest for life, work and study, his insatiable curiosity to know and to probe, his determination to procure deeper and deeper understanding, his industry, his modesty, his generosity, and his toughness in facing adversity with tranquility. These are qualities we strive for.

The inscription on a plaque put up in his memory in his hometown (Riehen near Basel) sums up succinctly the life of this simple yet great man, "Er war ein grosser Gelehrter und ein gütiger Mensch (He was a great scholar and a kind man)."

1. C. Truesdell, *Leonhard Euler, Supreme Geometer, in C. Truesdell, An Idiot's Fugitive Essays on Science*, Springer-Verlag, New York, 1984, 337-379.

2. *Concrete Mathematics* is the title of the book written by R.L. Graham, D.E. Knuth, O. Patashnik, published by Addison-Wesley in 1989. The authors say that they are not bold enough to try "distinuous mathematics!"

3. Many more examples, besides the computation of $\zeta(2)$, can be found in M.K. Siu, Euler and heuristic reasoning; Mathematical thinking and history of mathematics, in *Learn From the Masters!* Proceedings of the Kristiansand Conference on History of Mathematics and its Place in Teaching, August 1988, edited by F. Swetz et al, Mathematical Association of America, Washington D.C., 1995, 256-275; 279-282.

4. A.P. Youschkevitch, Euler, in *Biographical Dictionary of Mathematicians*, Volume 2 (from *Dictionary of Scientific Biography*, Volume 4), edited by C.C. Gillispie, Scriber's, New York, 1970-80, 736-753.

Asking Questions: Improving Prospective Teachers' Knowledge of Mathematics

By Wendy A. Weber

In 1987 Richard J. Crouse and Clifford W. Sloyer published the (now out of print) two-volume book *Mathematical Questions from the Classroom* (Janson Publications, Inc.). Using this book as a guide, I designed a one semester hour course focused on the mathematics needed for teaching middle and high school. This course helps prospective teachers deepen their own understanding of fundamental mathematics, make connections between the courses they have taken as mathematics majors, and learn how to handle questions that arise in the classroom. We explore questions from the middle school level, introductory through advanced algebra, geometry, trigonometry, functions, probability, and calculus (statistics and discrete mathematics are undeveloped areas in the original text).

Course Design

The questions we explore could certainly fill more than one semester hour. We nevertheless chose to make the course only one semester hour, in part because our students already take a full load of courses from our department as well as the education department. We did not want to overburden them with more hours. In addition, because all mathematics faculty already have a full load and we did not want to reduce offerings that all majors could take, we restricted the number of hours faculty would be teaching.

The structure of the course is simple. We meet once a week for fifty minutes. We either start class with a short quiz containing questions similar to ones we discussed in the previous class, or we begin with student presentations of the questions. In these presentations, students are expected to respond as if they were actually asked such a question by a student in one of their classes. Students know ahead of time which questions they will need to prepare, and I encourage them to discuss their answers with me before their presentation.

Most of the class time is spent discussing the questions. Students are asked to read through the questions before coming to class and to think about how to answer them. I intentionally choose questions that are rich and offer extended conversation. We typically spend only 2–3 minutes per question, though some questions (like those included below) are so rich they take up to 10 minutes to cover. As students become more proficient at unpacking their knowledge, many questions that would have taken several minutes at the beginning of the course only take 30 seconds to discuss. In a 50 minute class period we can usually cover 20–25 questions.

After each class students are expected to write solutions to all the questions discussed from the day. I periodically collect the solutions and examine them for accuracy. I make comments and corrections on a separate piece of paper so that students may fix their errors before they turn in all solutions at the end of the semester.

The Questions

We begin with questions from the middle school level; understanding these questions provides a foundation for subsequent questions. Mathematics majors know and can perform fundamental algorithms, but they no longer question why they do what they do. These questions help them unpack their knowledge and rebuild their understanding into a usable form for teaching mathematics.

Examples of questions we explore follow. To illustrate the depth of questions and the type of conversation these questions can generate, I have included in brackets after the original question the warm-up or follow-up questions I might ask.

A student asks you the following question, "When multiplying decimals, why do we count off decimal places from right to left in each factor and then add them in order to find out where to put the decimal point in the answer?" How do you respond?

[What is a factor? What are other representations of decimals? When might one representation of a decimal (or a fraction) be more useful than another? Why do we line up decimal points when adding and subtracting decimals? Why do we move decimal places when performing long division of decimals?]

In response to your question of how to define yk, a student says that y is multiplied by itself k times. How do you reply?

[What does the student mean versus what s/he says? How could you determine if the student has the correct idea and is only explaining it incorrectly? Does the context of the question make a difference as to whether you pick up this thread with the student and correct him/her?]

Tony can't understand why division by zero is undefined. He wants $0 \div 0 = 0$. His explanation is: "If you have nothing in one hand and you divide it by nothing, why don't you still end up with nothing?"

[What is the operation of division? Is "zero" the same as "nothing?" What is $0 \div 0$? How is this problem (or your explanation) the same or different from $1 \div 0$?]

"If it is true that the square root of 25 is ± 5, then why doesn't $\sqrt{25} = \pm 5$?"

[What does the square root symbol mean? What is a function? How do we solve $x^2 = 25$? What are we really doing when we take the square root of both sides of this equation? What is $\sqrt{(x^2)}$?]

The students in your class are asked to solve the following problem. "Find the roots of $x^3 = 2x^2 + 8x$." One student does the following work: $x^3 = 2x^2 + 8x \rightarrow x^2 - 2x - 8 = 0 \rightarrow (x - 4)(x + 2) = 0 \rightarrow x = 4$ or $x = -2$. Is the student correct?

[How many solutions should the equation have? Why can't s/he divide by x?]

A student hands in the following work: $(6t)\sqrt{3} = (6\sqrt{3})(t\sqrt{3})$. How would you help this student?

[What property is s/he attempting to use? How would you help this student see that his/her work is incorrect? How would you help this student see that multiplication distributes over addition and subtraction but not over multiplication?]

How do you know for sure that some irrational number does not have a repeating decimal eventually?

[What is an irrational number? A rational number? What is a series that converges to a rational number? How can we write any repeating decimal as a rational number? Why are we allowed to do these operations? What happens if you assume an irrational number eventually repeats?]

What is the difference between the terms polynomial, polynomial equation and polynomial function?

[How important is the language we use as teachers?]

Does $\lim_{x\to 0} (1/x) = \infty$ or does this limit not exist?

[What does the symbol ∞ mean? Is there a difference between saying a limit equals infinity and it does not exist? Is there always a difference?]

Why is an inverse function a reflection about the line $y = x$?

[Geometrically, what is a reflection? What is an inverse function? If the original point is (x,y) and the reflected point is (y,x), how do we find the line of reflection and what is it?]

You ask your students to find the probability of both children being boys in a two child family. One student says the probability is 1/3; another says it is 1/4. Is either student correct?

[What does a probability of 1/3 (or 1/4) mean in this situation? How can you illustrate the solution?]

A student asks you why $\sin^2(x) + \cos^2(x) = 1$.

[What is the Cartesian equation of the unit circle? What are the functions sine and cosine? This question is not found in Crouse and Sloyer's text, but we believe it is needed.]

The class has been very successful. It helps prospective teachers learn to draw on their considerable mathematical knowledge to accurately answer student questions at the correct level. Students enter their student teaching experience armed with 200 questions that cover nearly all the topics they will teach. More importantly, they enter the teaching profession able to answer their students' questions with much more than a simple "because."

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Calculators at the Smithsonian

On September 25, 2007, in commemoration of the 40th anniversary of its invention of the handheld calculator, Texas Instruments donated one of the original handhelds to the Smithsonian. Speakers at the donation ceremony included Dr. Brent D. Glass, Director of the National Museum of American History, Melendy Lovett, President of Texas Instruments Education Technology Division, and Jerry Merryman, one of the three inventors. The original, along with an array of the calculators that followed, was on display. Photographs and caption courtesy of Robert Vallin.

First Annual TENSOR–SUMMA Grant Program a Success

By Efraim Armendariz and Carole Lacampagne

The first TENSOR-SUMMA grants were awarded in April 2007, thanks to the generous support of the Tensor Foundation. The awards program was designed to provide grants to support college or university faculty conducting programs to encourage the pursuit and enjoyment of mathematics among middle, high school, and beginning college students from groups traditionally under-represented in mathematics. The quality of the proposals submitted was very high and had strong relevance to the goal of the grant program: engaging more minority students in activities that potentially open doors into mathematically based professions. Twelve proposals were recommended for funding.

Two awards were given for Math Circles to serve inner city school students: the DC and the Oakland Math Circles. Project Director Jamylle Carter, of San Francisco State University, reported that the first five weeks of the Oakland Math Circle were spent on plane symmetries and tessellations. A seventh grade boy from the Circle said, "I love everything you're doing because it's stuff I've never seen before. It rocked!" Project Director Dan Ullman of George Washington University is conducting his Math Circle at the Carriage House of the MAA. DC middle school students have a lively time experimenting, conjecturing, finding counterexamples, debating, proving, and generalizing. A grant for another Math Circle went to Joseph Meyinsse from Southern University, an HBCU.

Projects from the University of Texas at San Antonio, the University of Arizona, and North Carolina A&T State University (an HBCU) are concerned with the transition from high school to college. The University of Texas at San Antonio's Number Olympics was held in September. Project director Eduardo Duenez reports that they attracted a diverse pool of almost 50 participants. Duenez recruited UTSA freshmen at orientations days in his "Tensor Hut" with currency in TENSOR bills which came in denominations of 101 and 1010 tensors. Students earned tensors by solving problems and used them to purchase prizes.

The University of Arizona's David Savitt and William Yslas Velez held a one-week, four hour-a-day workshop for entering calculus students. Twenty-one students participated. An added bonus was that many of the participants enjoyed the interaction with the math majors so much that they chose to major in mathematics! North Carolina A&T State University's project director Alexandra Kurepa is also looking to the transition from high school and college. Kurepa has designed a program to provide enrichment activities for high school students enrolled in AP or Honors Calculus and precalculus as well as for students in the Early College program. She says that students from the Early College program find the experience especially helpful with their transition from high school to college.

Wentworth Institute of Technology's Amanda Hattaway directs Students Loving Adventures in Mathematics (SLAM), a yearlong, twice a month Saturday morning program designed to expose high school sophomores to mathematics in fun and innovative ways. As part of the SLAM Math Career Series, three actuaries from the International Society of Black Actuaries, a Boston university bioinformatics professor, and an information technology specialist spoke to the students who will later present a poster session on these topics.

Bemidji State University's Colleen Livingston and Fort Lewis College's Carl Lienert are both holding week-long summer mathematics camps for middle or high school students, many of whom come from near-by Indian reservations.

Fayetteville State University, an HBCU, the University of Minnesota, and Mount Holyoke College received grants to supplement existing successful programs. Fayetteville's Project Director Kimberly Smith Burton is adding a technical literacy component to her Saturday Academy for middle school students. In September their teachers received instruction in using the National Science Digital Library which they will pass on to their students. The University of Minnesota's Project Director Harvey Keynes and Mount Holyoke College's Project Director D. James Morrow are making a concerted effort to attract more young women of color to their summer program programs.

The deadline for receipt of the second annual TENSOR-SUMMA Grant applications is February 15, 2008. All innovative projects are welcomed. See the MAA website for details.

Found Ego-Boost

Today I discovered the *Public Library of Science* journals, free, open-access academic journals in Biology, Medicine, Computational Biology (Sweet!), Pathogens, Neglected Tropical Diseases, and Clinical Trials. For once Google was not my informer, but FOCUS (the MAA newsmagazine).

—Eric "SigmaX" Scott
Thinking Aloud, 11/07/2007.
http://sigmax.no-ip.org/blog/?p=966

TENSOR-MAA Grants for Women and Girls in Mathematics

In April 2007, the TENSOR-MAA program made grants of up to $6,000 to 17 institutions for faculty members to conduct programs to encourage women and girls to continue the study of mathematics. Among these, seven were renewals of previously funded programs.

Renewal Grants

The Joy of Thinking girls' math club program at Texas Tech University is now in its fifth year and can boast a record number of seven schools participating in fall 2007. Five of these schools have student populations almost entirely members of underrepresented groups. Project Director, Jerry Dwyer, wrote of his work in FOCUS, January 2006.

The MPower program at Metropolitan State University (Saint Paul, MN) offered its second annual, five-day summer camp to 21 middle school girls living in Saint Paul. Director Rikki Wagstrom is preparing to reunite these girls for a day of mathematics in November 2007.

The TENSOR-MAA program usually makes one grant for a Math Day. In 2006 and again in 2007, Hood College hosted their Sonya Kovalevsky Day for local high school girls. Betty Mayfield will direct the next day March 10th, 2008. Members of the AWM Student Chapter help with the day of workshops, panels and fun.

This is the second year of the Piney Woods Lecture Series in Mathematics, a program which invites well-known female mathematicians to campus to present talks which are accessible to undergraduates. The women then meet informally with students during a reception, and have dinner with nominated female students. In the past 18 months there were five speakers and four are scheduled for spring 2008. More information is available at http://www.shsu.edu/~mth_jaj/pwls/ or by contacting project director, Jacqueline Jensen.

Another summer program is in its sixth year: The University of St. Thomas in St. Paul, Minnesota, held its annual summer residential camp for sixteen high school girls June 24-29, 2007. Activities under the direction of Lisa Rezac, included math mini-courses, talks on connections in biology and mathematics, symmetry, topology and mathematical sculpture as well as a career panel and a trip to the Science Museum of Minnesota to see the calculus exhibit.

CSU Stanislaus, under the direction of Viji Sundar, conducted a week-long intensive Summer Academy called Preparing Women for Mathematical Modeling-Robotics (PWMMR) which included a one day field trip to The Tech Museum of Innovation in San Jose. There will be a one-day follow-up in March 2008 when the participants will return to campus to participate in a math conference on "Mathematical Moments" based on the AMS series.

The Girls Math & Technology Camp was held July 22-28, 2007, on the University of Nevada, Reno campus for 60 middle school girls of diverse backgrounds from across Northern Nevada. A web site will provide participants and their parents year-round support and encouragement in math and technology from director, Lynda Wiest.

New Grants

The ten grants for new programs were made. These programs range in scope as their directors seek new ways to reach candidates who would have benefit from this work.

Rachelle De Coste (now at Wheaton College), recognized a need for assistance in the transition year from completing the dissertation to gaining employment. With the help of the Military Academy where she was employed she conducted a highly successful program in August 2007 which brought together at West Point ten women participants, five junior faculty "mentors" in addition to senior faculty mentors from West Point for a two day conference. They will reconvene at the Joint Meetings with plans for another CaMeW (Career Mentoring Workshop) for women finishing their PhD's in mathematics.

An entirely different program was held for a group of 50 high school women at Bloomsburg University of Pennsylvania, each of whom was given a scholarship for the First Annual Computer Forensics Summer Experience for Young Women (CFSEYW). In this week-long program directed by Elizabeth Mauch, young women were introduced to the mathematics and computer science necessary for the field of computer forensics by studying numerical analysis, statistics, mathematical modeling, and finite mathematics.

For many years Hampshire College has had a highly successful summer program for pre-college students who love mathematics. In an effort to enroll more women, HCSSiM recruited its female alumnae to mail customized postcards to recruit new girls to apply to HCSSiM 2007. Under the direction of sarah-marie belcastro, they held mathematical and discussion activities with alumnae during the program to enhance the program for girls.

The first day of the USD Math Days for Women program was in October 2007 at the University of South Dakota, Vermillion SD; a second day will be in December and the third in February. The young women participants from the surrounding area high schools worked on origami constructions and *Geometer's Sketchpad* exercises in addition to learning about the usefulness of mathematics in various careers. Communication between the director, Violetta Vasilevska, program leaders, students and their teachers is by email where weekly problems are posed.

At the University of California Santa Barbara, graduate students are making plans to attend the Joint Meetings in San Diego utilizing some of the grant funds. The group, let by Maria Isabel Bueno Cachadina and Birge Huisgen-Zimmermann, organized activities in the fall of

2007 which included a documentary film showing of *The Gender Chip*, five professors talking about their research and, of course, accompanying social activities one of which was with women undergraduates.

Catherine O'Neil directed a new program at Barnard College which funded a day of mathematics and physics in partnership with the nearby Urban Assembly Institute for Math & Science for Young Women. The entire school consisting of 78 sixth grade girls came to Barnard campus for a day and listened to lectures, did puzzles, won prizes, and competed in a group math competition for tickets to Six Flags.

Fifteen Hispanic and economically disadvantaged young girls, Grades five and six, were granted scholarships to participate in a two-week long summer Math Camp at Texas State University San Marcos. The girls were challenged to think and do mathematics on their own, and demonstrated a significant increase in their algebra preparedness under the guidance of project director, Alejandra Sorto.

At the time this report was written the second three-day residential workshop planned by Janet Kaahwa to refresh 20 teachers of mathematics from ten schools in three districts (Masindi, Kibaale, and Hoima) in Uganda was completed. The facilitators were six women mathematicians who acted as role models after participating in the first workshop held at Makerere University, School of Education, Department of Science, and Technical Education.

The Infinite Possibilities Conference (IPC) sponsored by the non-profit Building Diversity in Science, North Carolina State University, and the Statistical and Applied Mathematical Sciences Institute (SAMSI) directed by Kimberly Weems was held at the North Carolina State University, November 2–3, 2007. This conference was designed to foster increased participation of underrepresented minority women in the mathematical sciences. Conference activities included plenary talks by Iris Mack and Freda Porter, research talks, student poster presentations, roundtable discussions, and panels on graduate studies and professional development along with workshops for high school students and the development of mentoring circles at every stage of the educational and professional pipeline.

In Fall 2007, under the leadership of Jacqueline Dewar, Women and Mathematics for Future Teachers collaborated with various programs at Loyola Marymount University (the future K-8 teacher preparation program, Women's Studies, Honors program) to cross-list a team-taught course on women and mathematics in Spring 2008. This course will examine historical and current equity issues in mathematics education and math-related careers through a study of the biographies and mathematical contributions of nine women mathematicians from the 4th through the 20th centuries.

Remember the Alamonoid: The Art of Factorization in Multiplicative Systems in San Antonio

By Scott T. Chapman

In a typical beginning abstract algebra class, students are introduced to non-unique factorizations into products of irreducibles by the example

$$6 = 2 \cdot 3 = \left(1+\sqrt{-5}\right)\left(1-\sqrt{-5}\right)$$

in the ring $D = \mathbf{Z}\left[\sqrt{-5}\right]$. Here the elements 2, 3, $1+\sqrt{-5}$, $1-\sqrt{-5}$ are all irreducible and are pairwise nonassociate, i.e., the two different factorizations are not generated simply by multiplying factors by invertible elements. A careful analysis of this example shows that $\left(1+\sqrt{-5}\right)\left(1-\sqrt{-5}\right)$ and $2 \cdot 3$ are, up to associates, the *only* factorizations of into products of irreducibles in *D*. Moreover, *D* has the following nice property: if *x* is a nonzero nonunit of D and $a_1, a_2, \ldots, a_n, b_1, b_2, \ldots, b_m$ irreducible elements of *D* with $x = a_1 \cdots a_n = b_1 \cdots b_m$, then $n = m$.

It is observations such as these which led mathematicians to become interested in the behavior of non-unique factorizations in other mathematical structures. Problems which involve non-unique factorizations of elements in integral domains and monoids have become frequent topics in undergraduate and graduate mathematics over the past 35 years. Solving such problems requires techniques from multiple areas of algebra and discrete mathematics.

A group of 33 participants gathered for five days from May 20th to May 25th 2007 at Trinity University in San Antonio, Texas for an MAA-PREP Workshop entitled *The Art of Factorization in Multiplicative Structures*. The workshop, unlike a regular research conference, had multiple goals:

• To present in accessible fashion the fundamental results of the theory of non-unique factorizations.

• To demonstrate that such results involve not only commutative algebra, but also rational and additive number theory, combinatorics, discrete structures and the geometry of $\mathbf{N}^k$.

• To provide to college and university level faculty and graduate students a rich source of material which not only can supplement existing courses in algebra, number theory and combinatorics, but also can be taught as a stand-alone advanced undergraduate course or as an introductory graduate level course.

• To demonstrate that while advanced results in this area involve deep mathematics, many problems are suitable for masters level work, summer REUs, or even capstone undergraduate projects.

In keeping with the theme of the workshop, the participants represented a broad mathematical spectrum: about 60% college or university faculty and 40% undergraduate or graduate students. Trinity University's Holt Conference Center offered an intimate setting for the meeting.

Why might this topic be worthy of such a general gathering of interested mathematicians? Since 1988 several hundred papers dedicated to non-unique factorizations in commutative rings or monoid have appeared in refereed mathematical journals or conference proceedings (see the references in [4] for a complete listing). Two major conference proceedings ([1] and [3]) dedicated primarily to factorization problems have been recently published by Marcel Dekker and Chapman & Hall. Additionally, 2006 has seen the publication of a major monograph by Geroldinger and Halter-Koch [4] which details the current state of research in this field.

The workshop began with keynote addresses by the workshop leaders, Scott Chapman of Trinity University and Jim Coykendall of North Dakota State University. The morning sessions consisted of a series of lectures by three leading researchers in this area: David Anderson from the University of Tennessee at Knoxville, Alfred Geroldinger from Karl-Franzens-Universität in Graz, Austria, and Ulrich Krause from Universität Bremen in Bremen, Germany. In combination, the main speakers offered over 80 years of classroom experience, in addition to over 200 refereed publications. The afternoon sessions included seminars by two graduate assistants, Paul Baginski from the University of California at Berkeley and Amanda Matson from North Dakota State University, who provided extensive experience in working with factorization problems at both the undergraduate and graduate level. The afternoons concluded with a series of problem/discussion sessions which not only addressed problems posed by the main speakers, but also how factorization material can best be used in the classroom and in undergraduate research projects.

The three main speakers focused on four different approaches to factorization theory prevalent in the literature today.

Algebraic: How do ring properties influence factorizations? Do polynomial rings, power series rings and other such structures inherit the factorization properties of their base rings?

Combinatorial: An in-depth analysis of the factorization properties of arithmetically motivated monoids (such as submonoids of the natural numbers). A study of the connection of factorization problems to problems involving zero-sum theory in finite abelian groups. This includes a study of the calculation of the elusive Davenport Constant and cross number.

Geometric A study of factorization properties in submonoids of $\mathbf{N}^k$. An exploration of the connection between factorization properties of integral domains and the structure of cones in $\mathbf{N}^k$.

Number Theoretic: How do number theoretic properties influence factorizations? What role do factorization properties play in some classical problems from number theory (e.g. representation of integers by quadratic forms)? How completely are orders in rings of integers determined by only considering factorization properties?

We offer the reader one example of the combinatorial/number theoretic aspects described above. This approach to factorization theory studies combinatorial sets and constants associated to particular multiplicative structures. Suppose M is an monoid in which every element has an irreducible factorization. If $x \in M$ is not a unit, *then the set of lengths of* x is the set of integers n such that x can be factored as a product of n irreducibles. Write these lengths in increasing order: $\{n_1,n_2,\ldots,n_k\}$. We can look at several ways of describing this set. We define $\ell(x) = n_1$ to be the length of the shortest factorization and let $L(x) = n_k$ to be the longest. We define $\Delta(x)$ to be the set of differences $n_i - n_{i-1}$, and $\Delta(M)$ to be the union of all the sets of differences as x ranges through the non-units in M.

The elasticity of an element $x \in M$, denoted $\rho(x)$, is the quotient $L(x)/\ell(x)$. *The elasticity of M* is then defined as $\rho(M) = \sup\{\rho(x) | x \in M \setminus M^{\times}\}$ We say that M has *accepted elasticity* if there exists $x \in M$ such that $\rho(x) = \rho(M)$.

Determining these sets and constants, even for simple monoids, can be tricky, as we demonstrate with the set of integers $S = \{0,2,3,4,5,6,7,\ldots\}$ under *regular addition*. Notice that 2 and 3 are the only irreducible elements of S. Hence, an irreducible factorization of $n \in S$ is of the form $n = x_1 \cdot 2 + n_2 \cdot 3$. Factorizations in S are far from unique; for example,

$$17 = 7 \cdot 2 + 1 \cdot 3 = 4 \cdot 2 + 3 \cdot 3 = 1 \cdot 2 + 5 \cdot 3 .$$

Thus,

$\ell(17) = 6$, $L(17) = 8$. $\Delta(17) = \{1\}$ and $\rho(17) = 8/6 = 4/3$.

Notice that the longest factorization of an element $n \in S$ contains the most possible copies of 2 and the shortest the most possible copies of 3. Hence, modulo 6 the exact values of $\ell(m)$ and $L(m)$ can be computed with elementary number theory as seen in the table below. It turns out (and isn't hard to check) that $\rho(m) \le 3/2$ for all m and $\rho(m) = 3/2$ if $m \equiv 0 \pmod 6$. Thus $\rho(S) = 3/2$ and the elasticity is accepted.

The workshop's website, located at http://www.trinity.edu/schapman/ArtofFactorization.htm, is a multipurpose electronic resource for not only participants, but all those interested in the subject. This site contains almost all of the materials used during the meeting including background material, slides, exercises, and a list of principal open problems. A list of projects appropriate for undergraduate students is under development.

Despite the workshop's full schedule, participants were able to enjoy an afternoon off to explore San Antonio's celebrated Riverwalk and the Alamo. A group of participants even braved the 60 mile trek to Luckenbach, Texas, but (alas) did not catch a glimpse of Willie Nelson.

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$m \pmod 6$	$L(m)$	$\ell(m)$
0	$\frac{m}{2}$	$\frac{m}{3}$
1	$\frac{m-3}{2}+1$	$\frac{m-4}{3}+2$
2	$\frac{m}{2}$	$\frac{m-2}{3}+1$
3	$\frac{m-3}{2}+1$	$\frac{m}{3}$
4	$\frac{m}{2}$	$\frac{m-4}{3}+2$
5	$\frac{m-2}{2}+1$	$\frac{m-2}{3}+1$

Remembering Paul Cohen

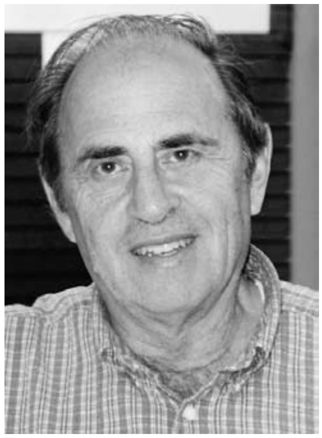
By Peter Sarnak

Paul Joseph Cohen, one of the stars of 20th century mathematics, passed away in March, 2007 at the age of 72. Blessed with a unique mathematical gift for solving difficult and central problems, he made fundamental breakthroughs in a number of fields, the most spectacular being his resolution of Hilbert's first problem — the continuum hypothesis.

Like many of the mathematical giants of the past, Paul did not restrict his attention to any one specialty. To him mathematics was a unified subject which one could master broadly. He had a deep understanding of most areas, and he taught advanced courses in logic, analysis, differential equations, algebra, topology, Lie theory, and number theory on a regular basis. He felt that good mathematics should be easy to understand and that it is always based on simple ideas once you got to the bottom of the issue. This attitude extended to a strong belief that the well recognized unsolved problems in mathematics are, firstly, the heart of the subject and, secondly, that they have clear and transparent solutions once the right new ideas and viewpoints are found. This belief gave him courage to work on notoriously difficult problems throughout his career.

Paul's mathematical life began early. As a child and a teenager in New York City he was recognized as a mathematical prodigy. He excelled in mathematics competitions, impressing everyone around him with his rare talent.

After finishing high school at a young age and spending two years at Brooklyn College he went to graduate school in mathematics at the University of Chicago. He arrived there with a keen interest in number theory, which he had learned by reading some classic texts. There he got his first exposure to modern mathematics and it molded him as a mathematician. He tried working with André Weil in number theory but that didn't pan out. Instead, he studied with Antoni Zygmund, writing a thesis in Fourier Series on the topic of sets of uniqueness.



Paul Cohen. Photograph courtesy of Stanford News Service.

In Chicago he formed many long lasting friendships with some of his fellow students (John Thompson, for example, who remained a lifelong close friend).

The period after he graduated with a PhD was very productive: he enjoyed a series of successes in his research. He solved a problem of Walter Rudin's in Group Algebras and soon after that he obtained his first breakthrough on what was considered to be a very difficult problem — the Littlewood Conjecture. He gave the first nontrivial lower bound for the L1 norm of trigonometric polynomials on the circle whose Fourier coefficients are either 0 or 1. The British number theorist-analyst Harold Davenport wrote to Paul saying that if Paul's proof held up, he would have bettered a generation of British analysts who had worked hard on this problem. Paul's proof did hold up; in fact, Davenport was the first to improve on Paul's result. This was followed by work of a number of people, with the complete solution of the Littlewood Conjecture being achieved separately by Konyagin and Mcgehee-Pigno-Smith in 1981.

In the same paper, Paul also resolved completely the idempotent problem for measures on a locally compact abelian group. Both of the topics from this paper continue to be very actively researched today especially in connection with additive combinatorics.

As an instuctor at MIT, Paul was introduced to the question of uniqueness for the Cauchy problem in linear partial differential equations. Alberto Calderon and others had obtained uniqueness results under some hypotheses, but it was unclear whether the various assumptions were essential. Paul clarified this much studied problem by constructing examples where uniqueness failed in the context of smooth functions, showing in particular that the various assumptions that were being made were in fact necessary. He never published this work (other than putting out an ONR Technical report) but Lars Hörmander incorporated it into his 1963 book on linear partial differential equations, so that it became well known. This was one of many instances in which Paul's impact on mathematics went far beyond his published papers. He continued to have a keen interest in linear PDEs and taught graduate courses and seminars on Fourier Integral Operators during the 70s, 80s, and 90s.

After spending some time in Princeton at the Institute for Advanced Study, Paul moved to Stanford in 1960; there he remained for the rest of his life. He said that getting away from the lively but hectic mathematical atmosphere on the East Coast allowed him to sit back and think freely about other fundamental problems. He has described in a number of places (see, for example [Yandell]) his turning to work on problems in the foundations of mathematics. By 1963 he had produced his proof of the independence of the continuum hypothesis, as well as of the axiom of choice, from the axioms of set theory. His basic technique to do so, that of "forcing," revolutionized set theory as well as related areas. To quote Hugh Woodin in a recent lecture "it will remain with us for as long as humans continue to think about mathematics and truth." A few years later Paul combined his interest in logic and number theory giving a new decision procedure for polynomial equations over the *p*-adics and the reals. His very direct and effective solution of the decision problem has proved to be central in many recent developments in the subject [Macintyre].

After 1970 Paul published little, but he continued to tackle the hardest problems, to learn and to teach mathematics and to inspire many generations of mathematicians. I was a member of the new generation who was lucky enough to be around Paul.

I first heard of Paul when I was still an undergraduate in Johannesburg in the 1970s. I was taken by the works of Gauss, Dirichlet and Riemann, but studying with them was not an option. However Paul, whose work on the continuum problem is recorded in any good introductory text to mathematics, was apparently alive and well and living in California. Moreover his reputation and stories of his genius had reached all corners of the mathematical world. Kathy Driver (then Kathy Owen and today Dean of Science at the University of Cape Town) had just returned from Stanford with the following sort of description of Paul, which she e mailed me recently.

"Paul was an astonishing man. Impatient, restless, competitive, provocative and brilliant. He was a regular at coffee hour for the graduate students and the faculty. He loved the cut-and -thrust of debate and argument on any topic and was relentless if he found a logical weakness in an opposing point of view. There was simply nowhere to hide! He stood out with his razor-sharp intellect, his fascination for the big questions, his strange interest in "perfect pitch" (he brought a tuning fork to coffee hour and tested everyone) and his mild irritation with the few who do have perfect pitch. He was a remarkable man, a dear friend who had a big impact on my life, a light with the full spectrum of colours."

I set my goal to study with Paul in the foundations of mathematics and was lucky enough to get this opportunity. Paul lived up to all that I expected. Soon after I met him he told me that his interests had moved to number theory and in particular the Riemann Hypothesis, and

The Stuyvesant Math Team, Fall 1948. Top row, left to right: Unknown, Unknown, Elias Stein, Harold Widom, Paul Cohen. Bottom row: Unknown, Martin Brilliant, Unknown. Photograph courtesy of Martin Brilliant, from Indicator, *January 1949.*

so in an instant my interests changed and moved in that direction too.

Given his stature and challenging style he was naturally intimidating to students (and faculty!). This bothered some; it is probably the reason he had few graduate students over the years. I have always felt that this was a pity, because one could learn so much from him (as I did) and he was eager to pass on the wealth of understanding that he had acquired. Once one got talking to him he was always very open and welcomed with enthusiasm and appreciation your insights when they were keener than his (which I must confess wasn't that frequent). As a student I could learn from him results in any mathematical area. Even if he didn't know a particular result he would eagerly go read the original paper (or, I should say, he would skim the paper, often creating his own improvised proofs of key lemmas and theorems) and then rush back to explain it.

His ideas on the Riemann Hypothesis (about which I will write elsewhere) led him to study much of the work of Atle Selberg and especially the "trace formula". This became my thesis topic. Paul and I spent one or two years going through this paper of Selberg and providing detailed proofs of the many theorems that were announced there. We wrote these up as lecture notes, which both Paul and I used repeatedly over the years as lecture notes for classes that we taught. Sections of these notes have found their way into print (in some cases with incorrect attribution) but unfortunately we never polished them for publication.

Paul continued to work on the Riemann Hypothesis till the end, not for the glory, but because he believed in the beauty of the problem and expected that a solution would bring a deep new understanding of the integers. As mentioned above, it was his strong belief that such problems have simple solutions once properly understood. This gave him the courage to continue this life long pursuit. When working on such problems one is out there alone, with nothing to fall back on. Most professional mathematicians simply don't take this kind of risk.

At Stanford Paul and his wife Christina hosted many dinners and parties for students (graduate and undergraduate), faculty and visitors to the department. I remember many occasions where Paul would treat a visitor to a personal guided tour of San Francisco and the bay area. This opening of their house and their hospitality is remembered fondly by many mathematicians around the world.

Paul's passing marks the end of an era at Stanford. The world has lost one of its finest mathematicians and for the many of us who learned so much from him and spent quality time with him, it is difficult to come to terms with this loss.

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Statistics: A Key to Student Success in College and Life

By John Loase

A few years ago, Ben Fusaro asked me what I thought was the most important college course for an undergraduate. I replied in an instant: Statistics. Ben agreed. His innovations in mathematical modeling and environmental mathematics appeal to our advanced students. Statistics, on the other hand, could help all undergraduates in both their future personal and professional lives.

In 2005, the Department of Education released a report that revealed mathematics to be the most serious obstacle to college graduation in the United States. The report described mathematics as an "insurmountable barrier" for economically disadvantaged college students. We should be looking to fix this.

We can make a difference in student retention, effect long-term influence toward our students, and share an enjoyable, almost fun, experience. Students in my statistics courses are successful. Concordia College–NY has wonderful students with mean SAT scores in mathematics at approximately the national average, but this approach could be replicated at any college. I came up with many of these strategies during my eighteen years teaching statistics at SUNY–Westchester Community College. The resulting course was enjoyable for the students and for me.

Here is how. I rely on four moves that are the results of two decades of experience.

Shorten the List of Topics

If I did not use a topic from statistics in my first five published interdisciplinary books or my consulting work (both college and legal), then I did not teach that topic. We are still left with seven or eight key topics: probability, small and large sample confidence intervals, sample size, one and two sample hypothesis testing of the difference of means and proportions, correlation, and linear regression. That is plenty. Postpone anova, multiple regression, and nonparametric statistics for a second, optional course.

Some might feel that this amounts to lowering standards. But consider the collateral damage of finishing the book. Do you really reach the students by covering a different topic every day with little time to apply the concept to the student's future personal and professional life? Are we denying students an opportunity to become an English teacher or social worker because he/she cannot understand Chebyshev's Theorem?

I confess to ignorance as to where Iraq is on the modern globe. My high school and college French were not adequate for me to obtain routine directions while in Paris. We believe that students need arithmetic and algebra as life skills. As a consequence, we frequently end up denying them a college degree, which is essential for economic survival. Are we abusing our power by maintaining the status quo without scrutinizing the role mathematics plays in winnowing the preferred jobs?

Rely on the TI-83 Calculator

Many (if not most) of our students cannot read their textbook. Some students will never learn elementary algebra, despite our best efforts. The calculator compensates for their mathematical handicaps. I wrote a 92 page book, *Essentials of Elementary Statistics (TI-83 Based)*, that I give each student for free. For every topic I teach in statistics, my book shows the students the step-by-step key strokes to perform the statistical analysis. This becomes my main text for statistics. Write me and I will send you a copy of my book, that you can duplicate and distribute to your students, until that blessed day when (or if) it is published. I assign Triola's masterful *Elementary Statistics* for additional homework and as an invaluable lifelong reference text.

Have Fun

I assign three interdisciplinary books and require students to write essays and attend book discussions on the readings. If they fail to attend the discussion (with the essay as ticket for admission), they lose a letter grade. My assigned books are *Man's Search for Meaning* (Frankl), *Our Neglect, Denial, and Fear* (Loase), and *The Millionaire Next Door* (Stanley and Danko). The three essays, which go through a revise-rewrite cycle, coupled with a required short research paper, constitute 1/3 of the students' grade. Each student is required to write a two page (400-500) word essay critiquing each book and discussing the statistical issues that I raise from each book.

Man's Search for Meaning is one of the twentieth century's great works. I relate statistics to the book by having each student complete a survey to quantify students' perceptions of their positive influence toward others. We discuss this concept at the book seminars. As a mathematician-psychologist, the books I assign may be different from the ones you assign. Statistics has the potential to prepare students for their future personal and professional life with relevance that few courses can rival, and using it to think about books such as these highlights that potential.

If you find the readings interesting, your students may as well. At worst, they will be amazed by our idiosyncratic tastes. Experiment. Have fun. If you are not having fun, your students are not.

I highly recommend *The Millionaire Next Door*, an outgrowth of extensive data mining and statistical analysis, as one of your required readings. It focuses on money and how to become rich in America — a high interest topic for everyone. I suggest to the students that they advise their "Baby Boomer" parents about retirement, using material from the book. I also caution them that their parents do not expect us to teach their children anything that could help them. Be gentle with parents with weak hearts: the shock of being counseled by their children may be too much to bear.

Allow Students In

If a student places in college arithmetic, which is in fact a euphemism for fourth grade arithmetic, the conditional probability of that student graduating from college within five years is in the same ballpark as one of us becoming a major league athlete. We are no better than the elementary, junior high, and senior high mathematics teachers, who failed to impart the fundamentals of arithmetic, and they had 180 days a year. We have 45–60 class sessions. Yes, some students may earn a C in statistics without having mastered addition of fractions. But that student now has an improved chance of graduating from college, earning a decent living, and hiring an accountant to do his/her taxes.

I consulted at one college that had a failure rate far in excess of 50% among its educationally disadvantaged students. At another college, the Director of Counseling regularly informed me that the high rate of remedial mathematics failure was cutting the graduation rate in half. Effective remedial courses are costly, resource intensive, and only available to a small fraction of the under-prepared mathematics students. Those same students could succeed in a statistics course.

Few professions scrutinize the fairness of their credentialing system, which creates winners and losers. In fact, several professions increase their mathematics requirements whenever supply exceeds demand. Several years ago, I attended an MAA session on "Why is Math so Unpopular?" After an hour of missing the painful truth, I raised my hand and asked whether math was so unpopular because we mathematicians serve as the students' executioners, by whom they are screened out of Engineering, Medicine, and MBAs. Mathematicians have the tools and the intellect to scrutinize our largely unchallenged assumptions about what constitutes essential mathematical knowledge for college graduates. We could lead other professions in a spirit of societal transformation.

We can prepare all our students for their future professional challenges by tapping the vitality of statistics. We need to prune the curriculum, add enrichment activities, empower students with the TI-83 Calculator, and (if remediation does not work) give students a chance to succeed in statistics.

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It is Time to Support Extremes

By Reza Noubary

Traditionally, statistics has focused on the study of values with high frequencies and on averages. This becomes clear when we examine textbooks and course descriptions for introductory statistics courses. In today's world, however, it is not sufficient to focus on averages alone. It has become important and even necessary to study extremes and rare events, since they are usually critical, newsworthy, and are often accompanied by severe consequences.

The celebrated central limit theorem has given statistics its focus on averages — we do what we know how to do. The statistical theories of extremes are less simple, less unified, and more recent. However they are not less important and there is a need for their inclusion in introductory statistics courses.

Why Averages?

Most of the elementary mathematics we teach deals with the "smooth" part of the world. In the same way most classical statistical methods are based on the idea of smoothing the data as a part of their analysis. Specifically, some methods treat the data as a message and seek to decompose it into a systematic (deterministic, trend, signal) part and a random (stochastic, noise) part.

When the form of the systematic part is known, it is easy to separate it from the random part. In the absence of information pertaining to either systematic or random parts, smoothing is used for separation. This is usually carried out assuming that the systematic part is smooth and the random part is rough. Smoothing is an exploratory operation, a means of gaining insight into the nature of data without precisely-formulated models or hypotheses. Smoothing is often achieved by some sort of averaging (low-pass filtering). Once the smooth part is determined, the difference between the original message and the smooth part is used to present the rough part. The rough part is usually utilized to make reliability statements regarding the systematic part. For data with a time index (time series), one popular smoothing technique is the so-called moving average. The idea is to average the neighboring values and to move it along the time axes.

Why Extreme Values?

In many applications, it is not appropriate to focus on averages alone. In fact, there are many instances where extreme values and values with low frequencies are of more concern. Examples include: large natural disasters compared to moderate ones; weak components or links compared to their average counterparts; large insurance claims compared to average claims.

Extreme values are usually analyzed using one of the three major theories: The "Extreme Value Theory" that deals with maxima or minima of the subsamples, the "Threshold Theory" that deals with values above or below a specified threshold, and the "Theory of Records" that deals with values larger (smaller) than all the previous values.

These theories deal with the actual values of the extremes. The frequencies of extremes are analyzed using the

"Theory of Exceedances." This theory deals exclusively with number of times a chosen threshold is exceeded. In most applications, the number of exceedances and values of excesses over a threshold are combined to yield a more detailed analysis. For example, insurance companies analyze both the number of times a "large" claim is made and the amount by which these claims exceed a specific large threshold. Reliability engineers study both the number of extreme loads, such as large earthquakes, and their magnitudes.

Extreme Value Theory

Extreme value theory deals with annual (or any other periodic) maxima or minima. Specifically, the theory is based on dividing the sample into a subsamples and fitting a distribution for maxima or minima of the subsamples. For example, data may consist of largest earthquakes in California for each of the last 100 years.

As in most statistical theories, first the distribution of the largest or the smallest values was derived for a finite sample. Then, by letting sample size tend to infinity, the limiting distribution of extreme values was obtained. For this a typical maximum Y_n is reduced with a location parameter β_n and a scale parameter α_n (assumed to be positive) such that the distribution of standardized extremes $(Y_n - \beta_n) / \alpha_n$ is non-degenerate. The forms of the limiting distributions are specified by the extreme value theorem. This theorem states that there are three possible types of limiting distributions for maxima. They are known as the Gumbel distribution (Type *I*), the Fréchet distribution (Type *II*), and the Weibull distribution (Type *III*). These three forms can be combined to yield the so-called generalized extreme value distribution.

Most classical distributions fall in the domain of attraction of one of these three types. For example, the distribution of maxima of samples from a normal distribution tends to the Gumbel distribution. More generally, the necessary and sufficient conditions for a particular distribution to fall in domain of attraction of one of the three types are known. Only distributions unbounded to the right can have a Fréchet distribution as a limit. Only distributions with finite right end point can have a Weibull as a limit. The Gumbel distribution can be the limit of bounded or unbounded distributions.

How do we decide which of the three limiting distributions to fit to the data? Theoretically, we can use the fact that each of the classical distributions falls in the "domain of attraction" of one of the limiting distributions above. This works if distribution of the original data is known. Unfortunately, in practice such information is not usually available and decisions should be based on the area of application or on expert opinion. When information about the appropriate limiting distribution is absent, statistical goodness-of-fit may be used.

Since extreme value distributions are fitted to, for example, annual maxima or minima, some relevant data related to the years with several large observed values could be discarded and some less informative data related to the years with no real large values could be retained. The threshold theory discussed next avoids this problem.

Threshold Theory

Threshold theory allows one to make inferences about the values above or below a threshold, that is, the upper or the lower tails of a distribution. It considers the excesses, the differences between the observations over the threshold and the threshold itself. Like extreme value distributions, there are three models for tails. They are long tail Pareto, medium tail exponential, and short tail distribution with an end point.

Again, most classical distributions fall in domain of attraction of one these tail models. It has been shown that the natural parametric family of distributions to consider for excesses (tail) is the Generalized Pareto Distribution (*GPD*). In practice the proposed method is to treat the excesses as independent random variables and to fit the *GPD* to them. The choice of threshold is, to a large extent, a matter of judgment depending on what is considered large or small.

The theory is very useful when modeling large values based on observed large values is of main concern. Clearly the modeling and prediction of large earthquakes should be based on past large earthquakes not on the medium or small earthquakes.

Theory of Records

The theory of records deals with values that are strictly greater than or less than all previous values. Usually the first value is counted a record. Then a value is a record (upper record or record high) if it is bigger than all previous values. The study of record values, their frequencies, times of their occurrences, their distances from each other, etc. constitutes the theory of records.

Formally the theory deals with four main random variables: the number of records in a sequence of n observations, the record times, the waiting time between the records, and the record values. It is interesting to note that the first three can be investigated using non-parametric or distribution-free methods whereas the last one requires parametric methods.

Records in general and sports records in particular are of great interest, and their occurrence usually results in a great deal of excitement and the media attention.

Traditionally, data values with high frequencies and averages have been the focus of statistical analysis and modeling. This has rested on the celebrated *central limit theorem*. Extremes, rare events, and records values have been mostly avoided and often treated as outliers rather than important information. But low-frequency high-consequence events are very important. We think that there is a need to introduce students to these vital concepts.

Reza Noubary teaches at Bloomsburg University, in Bloomsburg, PA. His research interests include time series analysis, geostatistics, reliability, risk analysis, and applications of mathematics in sports.

EMPLOYMENT OPPORTUNITIES

ALASKA

University of Alaska Southeast (Juneau)
Assistant or Associate Professor of Mathematics at the University of Alaska Southeast (Juneau): This is a bipartite (teaching and service), tenure-track position beginning August 2008. The position will remain open until filled; however, first consideration will be given to applications received by January 11, 2008. Members of the search committee will participate in the Employment Center at the 2008 Joint Meeting. Go to www.uakjobs.com/applicants/Central?quickFind=60450 for position announcement and for information about the UAS Mathematics Program go to http://www.uas.alaska.edu/math/. UAS is an AA/EO Employer and Educational Institution.

ARKANSAS

Henderson State University
Mathematics, Assistant Professor or Instructor: Doctorate in mathematics, mathematics education or related field preferred; master's degree in same required; teach full range of undergraduate courses. For more information and application procedures, please visit www.hsu.edu/Affirmative-Action. Henderson State University, Arkadelphia AR is an affirmative action/ADA, EOE. Women and minorities are especially encouraged to apply.

CANADA

McGill University
The Department of Mathematics and Statistics invites applications for a tenure-track position in discrete mathematics or continuous optimization. While the appointment is expected to be made at the level of an Assistant Professor, the Department would consider applicants for a senior position. The candidate must have a doctoral degree at the date of appointment. They are also expected to have demonstrated the capacity for independent research of excellent quality. Selection criteria include research accomplishments, as well as potential contributions to the educational programs of the Department at the graduate and undergraduate levels.

Applications with a curriculum vitae, a list of publications, a research outline, an account of teaching experience, a statement on teaching, and the names, phone numbers and e-mail addresses of at least four references (with one addressing the teaching record) should be sent to:

Professor Bruce Shepherd
Chair, Discrete Mathematics or Continuous Optimization Search Committee
Department of Mathematics
and Statistics
McGill University
805 Sherbrooke Street West
Montreal QC H3A 2K6 Canada

Candidates must arrange to have the letters of recommendation sent directly to the above address. Candidates are encouraged to include copies of up to three selected reprints or preprints with their applications. To ensure full consideration, applications must be received by January 15, 2008.

To facilitate notification of the outcome of the search, candidates should send an email to the address DMCOSearch08@math.mcgill.ca at the time of application.

McGill University is committed to equity in employment and diversity. It welcomes applications from indigenous peoples, visible minorities, ethnic minorities, persons with disabilities, women, persons of minority sexual orientations and gender identities and others who may contribute to further diversification. All qualified applicants are encouraged to apply; however, in accordance with Canadian immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada.

CONNECTICUT

Fairfield University
The Department of Mathematics and Computer Science at Fairfield University invites applications for three tenure track assistant professorships, to begin in September 2008. A doctorate in mathematics is required. A solid commitment to teaching, and strong evidence of research potential, are essential. We are looking for (1) one person who will be expected to conduct research with undergraduate students and (2) two people who will be expected to teach some courses in our graduate program. Graduate courses include, but are not limited to, year-long sequences in Abstract and Linear Algebra, Applied Mathematics, Financial Mathematics, Real and Complex Analysis, and Probability and Statistics. In addition, the successful candidates will share a willingness to participate in the university's core curriculum, which includes two semesters of mathematics for all undergraduates.

Fairfield University, the Jesuit University of Southern New England, is a comprehensive university with about 3,200 undergraduates and a strong emphasis on liberal arts education. The department offers a BS and an MS in mathematics. The MS program is an evening program and attracts students from various walks of life – secondary school teachers, eventual Ph.D. candidates, and people working in industry, among others. The teaching load is 3 courses/9 credit hours per semester and consists predominantly of courses at the undergraduate level.

Fairfield offers competitive salaries and compensation benefits. The picturesque campus is located on Long Island Sound in southwestern Connecticut, about 50 miles from New York City. Fairfield is an Affirmative Action/Equal Opportunity Employer. For further details see http://cs.fairfield.edu/mathhire. Applicants should send a letter of application, a curriculum vitae, teaching and research statements, and three letters of recommendation commenting on the applicant's experience and promise as a teacher and scholar, to Matt Coleman, Chair of the Department of Mathematics and Computer Science, Fairfield University, Fairfield CT 06824-5195. Please indicate in your cover letter the position for which you are applying.

Full consideration will be given to complete applications received by January 15, 2008. We will be interviewing at the Joint Mathematics Meetings in San Diego, January 6-9. Please let us know if you will be attending.

DISTRICT OF COLUMBIA

American University
Tenure-track Assistant Professor in the Mathematics and Statistics Department at American University, beginning Fall 2008. Qualified candidates will have a strong background in Mathematics or Statistics. Ph.D. and teaching experience required. American University is an EEO/AA employer. Minority and women candidates are encouraged to apply. See math.american.edu/positions, or contact the Department of Mathematics and Statistics at (202) 885-3120 for details.

FLORIDA

Lakeland College
Assistant Professor of Mathematics
Lakeland College, an independent liberal arts institution located in northeastern Wisconsin, invites applications for a full-time, tenure-track position of Assistant Professor – Mathematics, beginning in August, 2008. The candidates should have the ability to teach a wide range of undergraduate courses in Mathematics and the ability to teach some computer science courses will be an advantage. The candidates should be committed to quality teaching and advising and be willing to participate in the College's interdisciplinary general education program.

A PhD in mathematics is required. Some college teaching experience is preferred. Compensation will be commensurate with background and experience and a comprehensive benefit program is offered.

Interested candidates should submit a letter of interest, current resume, a statement of teaching philosophy and three current letters of recommendation to: Director of Human Resources, Lakeland College, P.O. Box 359, Sheboygan, WI. 53082-0359; or email to: schoemerjr@lakeland.edu. Review of applications will begin January 28, 2005 and will continue until the position is filled. For additional information on Lakeland College, please access our web site at www.Lakeland.edu.

An affirmative action / equal opportunity employer

IOWA

University of Iowa
Actuarial science tenure-track assistant professor starting 8/08. Ph.D. required 8/20/08. Actuarial Fellowship or Associateship highly preferred. Industrial experience helpful. Duties include teaching and research in actuarial science and/or financial mathematics, involvement in Ph.D. program, and supervision of Ph.D. students. Selection begins 12/03/07. CV, three reference letters, and transcript for recent Ph.D.s to Actuarial Search, Statistics & Actuarial Science, Univ. of Iowa, Iowa City, IA 52242-1409.actuarial-search@stat.uiowa.edu

Women, minorities encouraged to apply. AA/EOE.

MAINE

Colby College
Mathematics Department
The Department of Mathematics at Colby College invites applications for a one-year sabbatical replacement position in mathematics at the assistant professor or instructor level, beginning September 1, 2008. Ph.D. in mathematics preferred; A.B.D. considered. Five course teaching load. Evidence of exceptional teaching ability is required. The ability to teach a course in the history of mathematics is desirable but not required.

Send curriculum vitae, a statement on teaching and research, and three letters of recommendation (all in hard copy) to: Mathematics Search Chair, Department of Mathematics, Colby College, 5830 Mayflower Hill, Waterville, ME 04901. We cannot accept applications in electronic form. Review of applications will begin on January 15, 2008 and will continue until the position is filled.

Colby is a highly selective liberal arts college located in central Maine. The college is a three-hour drive north of Boston and has easy access to lakes, skiing, the ocean, and other recreational and cultural activities. For more information about the position and the department, visit our web site at www.colby.edu/math.

Colby is an Equal Opportunity/Affirmative Action employer, committed to excellence through diversity, and strongly encourages applications and nominations of persons of color, women, and members of other under-represented groups. For more information about the College, please visit the Colby Web site at www.colby.edu.

MARYLAND

Montgomery College
A Learning College
Office of Human Reaources
Your Resource to Excellence
Consider Montgomery College for your next career move!

Montgomery College, one of Maryland's oldest community colleges, is a multi-campus institution located in Montgomery County, Maryland. It has earned a reputation as one of the leading community colleges in the nation by applying a winning formula: excellence in teaching; innovative partnerships; and unrivaled leadership.

Montgomery College is seeking a full-time Mathematics faculty member for the Rockville Campus. Assignment begins August, 2008. For more details and to apply online, please visit: https://jobs.montgomerycollege.edu.

Starting salary range is $44,096 to $63,596 per year. Online applications must be received by 12 noon, Tuesday January 2, 2007.

Mathematics Faculty – Position #2688 – Rockville Campus

Required Qualifications:
- A Master's Degree or Ph.D. in Mathematics, Mathematics Education, or a

strongly related field.

- At least 18 semester hours of graduate level courses in mathematics.
- Coursework that supports the candidate's capacity to teach the spectrum of courses offered by the Mathematics Department.
- At least one year of recent full-time experience (or the equivalent) teaching mathematics courses typical of community college offering.

Desirable Qualifications :

- Involvement in programs for improving student success.
- Experience in using graphing calculators.
- Experience using computer algebra systems such as Matlab, Maple or Mathematica in mathematics courses.

Application Procedures:

In order to be considered for the position, you must complete the following steps:

- Create the Montgomery College online employment application.

To create an application and to apply online, please visit: https://jobs.montgomerycollege.edu

- After you complete your application, please be sure to search jobs and click on the Rockville Campus Mathematics position and apply to the job.

PLEASE NOTE:

- The online application deadline is 12 noon, Wednesday, January 2, 2008.
- Incomplete applications will not be considered.

Office of Human Resources – 240-567-5353.

Montgomery College is an equal opportunity employer committed to fostering a diverse academic community among its student body, faculty, and staff.

MASSACHUSETTS

Williams College

Williams College Department of Mathematics and Statistics invites applications for a newly authorized visiting position in mathematics for the 2008-2009 year, at the rank of assistant professor. A Ph.D. is required. Send a vita and three letters of recommendation on teaching and research to: Visitor Hiring Committee, Department of Mathematics and Statistics, Williams College, Williamstown, MA 01267. Consideration of applications will begin on November 15th and continue until the position is filled. Williams College is dedicated to providing a welcoming intellectual environment for all of its faculty, staff and students; as an AA/EOE employer, Williams especially welcomes applications from women and minority candidates.

Williams College

The Williams College Department of Mathematics and Statistics invites applications for one tenure track position in mathematics, beginning fall 2008, at the rank of assistant professor (in an exceptional case, a more advanced appointment may be considered). We are seeking a highly qualified candidate who has demonstrated excellence in teaching and research, and who will have a Ph.D. by the time of appointment.

Williams College is a private, residential, highly selective liberal arts college with an undergraduate enrollment of approximately 2,000 students. The teaching load is two courses per 12-week semester and a winter term course every other January. In addition to excellence in teaching, an active and successful research program is expected.

To apply, please send a vita and have three letters of recommendation on teaching and research sent to the Hiring Committee, Department of Mathematics and Statistics, Williams College, Williamstown, MA 01267. Teaching and research statements are also welcome. Evaluation of applications will begin on or after November 15 and will continue until the position is filled. Williams College is dedicated to providing a welcoming intellectual environment for all of its faculty, staff and students; as an EEO/AA employer, Williams especially encourages applications from women and minorities. For more information on the Department of Mathematics and Statistics, visit http://www.williams.edu/Mathematics.

NEW HAMPSHIRE

Dartmouth College

John Wesley Young Research Instructorship

The John Wesley Young Instructorship is a postdoctoral, two- to three-year appointment intended for promising Ph.D. graduates with strong interests in both research and teaching and whose research interests overlap a department member's. Current research areas include applied mathematics, combinatorics, geometry, logic, non-commutative geometry, number theory, operator algebras, probability, set theory and topology. Instructors teach four ten-week courses distributed over three terms, though one of these terms in residence may be free of teaching. The assignments normally include introductory, advanced undergraduate, and graduate courses. Instructors usually teach at least one course in their own specialty. This appointment is for 26 months with a monthly salary of $4667, and a possible 12 month renewal. Salary includes two-month research stipend for Instructors in residence during two of the three summer months. To be eligible for a 2008-2011 Instructorship, candidate must be able to complete all requirements for the Ph.D. degree before September, 2008. Applications may be obtained at http://www.math.dartmouth.edu/recruiting/ or http://www.mathjobs.org Position ID: 237-JWY. General inquiries can be directed to Annette Luce, Department of Mathematics, Dartmouth College, 6188 Kemeny Hall, Hanover, New Hampshire 03755-3551. At least one referee should comment on applicant's teaching ability; at least two referees should write about applicant's research ability. Applications received by January 5, 2008 receive first consideration; applications will be accepted until position is filled. Dartmouth College is committed to diversity and strongly encourages applications from women and minorities.

NEW YORK

Niagara University

www.niagara.edu The Mathematics Department at Niagara University, a private Catholic institution sponsored by the Vincentian Community seeks Assistant Professor, tenure track, August 2008 start.

Requirements: Strong commitment to undergraduate teaching, ability to do scholarly research, Ph.D. in Mathematics, Statistics or related field.

Candidate to teach a broad range of classes from introductory statistics to senior seminar; should possess the ability to work with students both inside and outside the classroom, including student research; should be interested in teaching mathematics to pre-service teachers.

Located near scenic Niagara Falls, Niagara University is a predominantly undergraduate liberal arts university.

Application letter, vitae and three recommendation letters: Dr. Richard Cramer-Benjamin, Chairperson, Mathematics Department, Niagara University, NY 14109-2044. Applications reviewed until position filled. AA/EOE

NORTH CAROLINA

Western Carolina University
Department Head, Mathematics
and Computer Science
Western Carolina University invites applications for the position of Head of the Mathematics and Computer Science Department. This is a twelve-month position, with a requested start date of July 1, 2008. A doctorate in the Mathematical Sciences from an appropriately accredited institution, scholarly credentials and experience commensurate with appointment at the rank of Full Professor or Associate Professor, and evidence of excellence in teaching, research, and academic leadership are required. Screening begins January 10, 2008 and continues until the position is filled. To apply visit: https://jobs.wcu.edu/applicants/Central?quickFind=51042. Western Carolina University, a campus of the University of North Carolina, is a vibrant and growing university, and is an AA/EOE employer that conducts background checks before employment. Proper documentation of identity and employability are required at the time of employment.

Western Carolina University
Mathematics Education
Tenure-track Assistant Professor in mathematics education beginning August 2008 in a department that has graduated the western region outstanding mathematics education student of the year for NC for each of the past 17 years. Doctorate in mathematics education or a related field with the equivalent of a master's in mathematics is required from an appropriately accredited institution. Excellence in teaching, a commitment to ongoing research and service are required. Screening begins December 10, 2007 and continues until the position is filled. To apply visit: https://jobs.wcu.edu/applicants/Central?quickFind=51041. Western Carolina University, a campus of the University of North Carolina, is an AA/EOE employer that conducts background checks before employment. Proper documentation of identity and employability are required at the time of employment.

PENNSYLVANIA

California University of PA
Tenure-track position at California University of PA in MATHEMATICS: Effective August 2008. A PhD in Mathematics is required. Teaching experience at the college/university level, and practical experience, such as consulting, is preferred. The successful candidate will have a strong desire to teach, actively recruit students, and participate in the development of web-based courses and/or programs. Candidates should be experienced in the use of innovative approaches that are student-centered, inquiry-based, and hands-on oriented. For more information about the position, and instructions about how to apply (deadline is January 11, 2008): http://www.cup.edu/employment/index.jsp . Cal U is M/F/D/V/AA/EEO.

SOUTH CAROLINA

Central Carolina Technical College
Mathematics Instructor (2 positions): #020901MA & #139217MA. Responsible for teaching college credit algebra, statistics, trigonometry, geometry and calculus classes at main and off campus locations. Requires Master's Degree in mathematics or a Master's Degree with 18 graduate semester hours in mathematics. Post-secondary teaching experience with ability to teach all levels of college math and Master's Degree in mathematics or Master's Degree with 18 graduate semester hours in mathematics preferred. Apply online at http://jobs.sc.com or visit www.cctech.edu.

Questions? Contact the Personnel Office by email: personnel@cctech.edu or by mail: Central Carolina Technical College

506 N. Guignard Drive
Sumter, SC 29150
EOE/AA

TEXAS

The University of Texas at Tyler
The University of Texas at Tyler invites applications for the position of Chair of the Department of Mathematics to begin fall 2008. The university seeks candidates who will energetically lead the department in continuing to build excellent undergraduate and graduate programs and will mentor faculty in teaching, research, and service.

The successful candidate will have a PhD in mathematics, an outstanding record of teaching and research commensurate with a tenured faculty appointment, effective leadership, administrative, and interpersonal skills, and the ability to lead the faculty in obtaining external funding.

Located 90 miles east of Dallas in the beautiful piney woods of East Texas, The University of Texas at Tyler has an enrollment of about 6000 students. The Department of Mathematics offers degrees at the undergraduate and graduate levels. For general information about The University of Texas at Tyler, visit www.uttyler.edu. The Department of Mathematics has a web site at http://math.uttyler.edu.

Please submit (electronically as attachments, if possible) a letter of application, curriculum vitae, unofficial transcripts, a brief description of research plans, statement of teaching philosophy, statement of leadership philosophy, and names and email addresses of at least four references to Dr. Don Killebrew, Chair, Department of Mathematics Chair Search Committee, dkille@mail.uttyl.edu. Paper submissions can be sent to Department of Mathematics, The University of Texas at Tyler, 3900 University Blvd., Tyler, Texas 75799.

Review of applications will begin immediately and continue until the position is filled. Applicants must be prepared to furnish the university with proof of eligibility to work in the United States. UT Tyler is an Equal Employment Opportunity/Affirmative Action Employer.

UTAH

Brigham Young University
Applications are invited for visiting professorships at any level (assistant, associate, or full professor) in the Department of Mathematics at Brigham Young University. The department has a strong commitment to undergraduate education and has a small, but strong, doctoral program.

Qualifications: Ph.D. in mathematics or related field; demonstrated excellence in teaching; desire and ability to teach undergraduate and graduate level mathematics, including courses at the freshman level; desire and ability to conduct high quality mathematical research.

Responsibilities: Teaching mathematics at the undergraduate and graduate level, including courses at the freshman level; conducting and directing independent research; collaborating with other faculty at the university; supporting university, college, and department goals and missions.

Review of applications will begin on December 1, 2007 and will continue until the position is filled. To apply, go to http://yjobs.byu.edu. For further information about the department and the university go to http://math.byu.edu.

Brigham Young University is an equal opportunity employer. Preference is given to qualified candidates who are members in good standing of the affiliated church, The Church of Jesus Christ of Latter-day Saints.

BSC BRIDGEWATER STATE COLLEGE

BRIDGEWATER STATE COLLEGE

Department of Mathematics and Computer Science
Assistant Professor (Position #0639)

Responsibilities: Teaching of mathematics at all levels. Applicants able to teach a wide variety of courses and demonstrated teaching excellence in the classroom will be given special consideration.

Minimum Qualifications: The candidate should possess a Ph.D. in Mathematics, or expect to be granted the degree before September 1, 2008.

Applicants should be strongly committed to excellence in teaching and advising, and to working in a multicultural environment that fosters diversity. They should also have an ability to use technology effectively in teaching and learning, the ability to work collaboratively, evidence of scholarly activity, and a commitment to public higher education.

SALARY: Commensurate with qualifications and experience.

Appointment/Start Date: Fall 2008

Application Process: Please apply on-line at: **http://www.bridgew.edu/HR/Joblist/**

Bridgewater State College is an affirmative action/equal opportunity employer which actively seeks to increase the diversity of its workforce.

http://www.bridgew.edu

The Mathematical Association of America

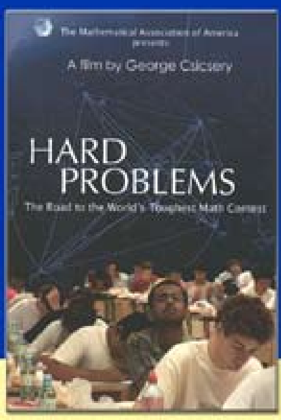
Invites you to

The Exclusive World Premiere Screening of

Hard Problems

The Road to the World's Toughest Math Contest

a film by George Csicsery



Follow the journey of the six high school students who represented the United States in 2006 at the world's toughest math competition – the International Mathematical Olympiad (IMO).

Hard Problems gives you behind-the-scenes access to an extraordinary group of individuals. Enter a world of dedication, perseverance, and rigorous preparation. Experience the joys and frustrations related to trying to solve incredibly challenging math problems against competitors from 90 countries and against the clock.

Join the MAA for a reception and the world premiere

Tuesday, January 8

6:00-8:00 p.m.

please refer to the JMM program for room location

Stop by and meet George Csicsery at the American Mathematics Competitions Booth Wednesday, January 9 from 9:00-11:00 a.m.

Pick up your copy of the DVD at the MAA Publications Booth for the discounted price of $17.50* at anytime during the meeting!

All prices final, sale only good during 2008 Joint Mathematics Meetings in San Diego
Price includes 7.75% sales tax

The Mathematical Association of America
1529 Eighteenth St., NW
Washington, DC 20036

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