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FOCUS

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Inside

On the cover: Bill Sullivan works with a Math 003 *student in the computer lab at the University of Maryland, College Park. See the article on page 4.*

FOCUS Deadlines

	February	March	April
Editorial Copy	December 15	January 18	February 13
Display Ads	December 21	January 29	February 25
Employment Ads	December 10	January 15	February 11

Announcing *Convergence*

The MAA has received a grant from the National Science Foundation to begin production of a new online magazine on the history of mathematics and its use in teaching. It will be called *Convergence: An Online Magazine Where Mathematics, History, and Teaching Interact*. The magazine will be part of the MAA's *Mathematical Sciences Digital Library* (MathDL) and will complement the existing *Journal of Online Mathematics and its Applications* (JOMA). The target audience is teachers of grades 9–14 mathematics, be they secondary teachers, two- or four-year college teachers, or college teachers preparing secondary teachers. ("Grade 9-14 mathematics" encompasses algebra, synthetic and analytic geometry, trigonometry, probability and statistics, elementary functions, calculus, linear algebra, and differential equations.) The editors of the magazine will be Victor J. Katz, from the University of the District of Columbia, and Frank Swetz, from Penn State University, Harrisburg.

The editors hope that this will be an exciting magazine for the whole mathematics community. The targeted launch date is **April 15, 2004**.

What will appear in *Convergence*? Here are some of the things we hope to include:

- *Expository articles dealing with the history of various topics in mathematics curriculum*. These will usually contain interactive components and color graphics, to take advantage of the capabilities of the Web. Articles will frequently be designed to appeal to multiple audiences, with hyperlinks offering more than one path through the material. In addition, we will create a discussion group for each article where readers can share suggestions as to how the material can be used in the classroom and point out strong points and possible pitfalls; authors would also have a chance to respond.

- *Translations of original sources*. These will generally be accompanied by commentary from experts showing the context of the works. If possible, interactive components will be used to help with the understanding of these materials. The goal of the translations will be to show teachers how ideas were developed in various cultures and how knowledge of this development is useful to teaching the same ideas to today's students.

- *Reviews* of current and past books, articles, and teaching aids on the history of mathematics of use to teachers, as well as reviews of websites providing information on the history of mathematics.

- *Lesson plans*. These will be short, fairly complete pieces designed to use history in the teaching of a topic. They will be set up so they can be used immediately by practicing teachers at various levels. Occasionally these will be linked to the topic of an expository article.

- *Historical problems*. These problems will appear in a section entitled "Problem of the Day," with new problems appearing daily. After publication, the problems will be archived in sections based on the main topic of the problem, such as algebra, geometry, trigonometry, or calculus.

- *What Happened Today in History?* Each day, there will be a listing of two to four "mathematical events" that happened on that date in history. Many of the items in this section will have links to other websites, so teachers can find out more about the particular person or event.

- *Quotation of the day*. A new and interesting quotation about mathematics from a historical figure will appear in this section each day.

- *An up-to-date guide* to what is happening around the world in the history of mathematics and its use in teaching. The magazine will report on past meetings and give notice of future meetings.

- *Historical illustrations*. Portraits of mathematicians or title pages of old books make wonderful illustrations to liven up a discussion or to post in the classroom.

The editors are actively looking for material and also for referees for this material. Please send ideas for articles, completed manuscripts, or any other items to Victor Katz at vkatz@udc.edu.

Developmental Mathematics: A New Approach

By William W. Adams

We begin with a familiar story. A student, we call him Tom, arrives at the University, happy to begin his college adventure. Almost immediately he is confronted with the Mathematics Placement Exam, designed to see if he is ready to enroll in a general education mathematics course (or in a credit-bearing course required by his major). The results of the Placement Exam unfortunately indicate that Tom is not prepared for the course he wants, and he must instead take a Developmental Mathematics Course. The results: he faces a delay in completing the needed mathematics course, he must take (for no credit) a course that he feels he has already taken, and to add insult to injury, he must pay an extra fee for the developmental course. Unhappiness, frustration and despair set in, the course is treated as a lowest priority (and often failed because of it), and an angry and frustrated student emerges.

Debra Franklin works with students in MATH 010/110.

But what is the University to do? Without such a test, Tom would register for a course he appears to be unprepared for. Data show that the result is frequently failure in the course, which would slow his progress and perhaps lead to his dropping out of the college.

Like numerous other institutions in the nation, the University of Maryland, College Park (UMCP), has been faced with this problem for many years. So, in the Fall of 2000 the University formed a campus committee to investigate, among other things, the issue of remediation in mathematics. The goal was to devise a plan that could be implemented for a large number of students, that would reduce the extra semester of developmental mathematics for many of these students, would be reasonably cost effective, and would not compromise teaching effectiveness in preparing the students for the course(s) they needed.

What emerged from committee discussion was a radical solution that completely cast aside the old Developmental Math program. It gained immediate strong support from the campus administrators, both bureaucratically and monetarily. With great effort (including building a new computer laboratory, creating a new curriculum, training mathematics teachers and training advisors campus wide), the new program was put into place in Fall 2001. Now in Fall 2003 we see that the program has been very effective; the purpose of this article is to describe the various features of the program, and include data substantiating the claims of success.

In the new program, as before, all entering students are given the Placement Examination during orientation. About 20-25% of the entering freshman class (about 1000 students) are judged deficient in mathematics preparation for a general education math course. We now break up these students into two groups.

The lowest 40% are told, as before, to take a full semester of Developmental Mathematics. This course, called Math 003, is self-paced using a computer platform and meets for 6 hours per week in a specially designated computer laboratory. A professional mathematics educator assesses the students' needs and abilities. They progress through their program under the guidance of this person and another assistant. The students are placed into one of five modules, depending on the credit bearing course they are headed for, which is either the general education course or one that prepares them for a further course. In any case, the course grade (pass/fail) is based on written examinations, written (graded) homework, and attendance, in addition to success on the computer modules. It should be emphasized that the self-paced format of this course is critical for the implementation of the program for the other group of students to be discussed next.

The remaining approximately 60% are placed into a combination course. These courses correspond to credit bearing courses numbered 11x, so for the sake of this discussion we lump them together by calling them Math 01x/11x. The courses met 5 days a week, rather than the usual 3 days a week. The first 5 weeks of the course constitute Math 01x, which reviews the developmental mathematics topics (especially algebra) necessary for success in the credit-bearing course,

Math 11x. Since the students enrolled in Math 01x were in the upper 60% of the students with deficient placement test scores, we felt that there was a good chance that an intense 5-week abbreviated form of the Developmental Mathematics course would suffice. However, to be sure, and to be legitimate about allowing the students to transfer to a credit-bearing course after 5 weeks, they were required to take the Placement Examination again at the end of 5 weeks. The same cut-off scores were required for a student to move into the Math 11x course as were required to enroll in Math 11x during orientation. If the student did not achieve such a score, then the student was placed back in the self-paced Math 003, with the good prospect of completing Math 003 by the end of the semester.

To our surprise and delight, we were able to let about 89% of the students proceed into the appropriate Math 11x course at the beginning of the 6th week. By continuing to meet 5 days a week until the end of the semester, the Math 11x course had approximately 45 sessions, which is about the number of sessions for the ordinary Math 11x course during the full semester. Moreover, the students in Math 11x continued in the same room with the same teacher as before. The re-registration from Math 01x to Math 11x was handled by the department, and the course Math 01x was erased from the student's record and was substituted by Math 11x. As far as the student was concerned, he/she had one 5 day a week course that met for the entire semester. Those who completed Math 11x successfully had completed their math requirement in one semester rather than two, as would have happened under the earlier regime.

Students in these courses were given exactly the same uniform final examination taken by the regular Math 11x students. As a result, our department could directly compare the results of the students who had to start with remediation with those who did not. Since the new program has now been running for a while, we are able to assess the results. We will concentrate on the Fall 2001 semester, but the results for further semesters are similar. We compared the grades of the students in 01x/11x with those who went into 11x directly and found that each had about the same ABC rate. Moreover, the grades on the actual final exams taken by both groups were about the same and in fact were often higher for the students starting in Math 01x.

We also followed up on the students who completed the Math 01x/11x course successfully. Many of these students were only taking the course to fulfill their General University Mathematics requirement and thus had completed this requirement in one semester instead of two and went away very happy with the new program. Most of the rest of the students who succeeded with the Math 01x/11x course had to take the elementary calculus course or the engineering calculus course. The elementary calculus students who started in the combined course were successful — in fact, about 7 percentage points more successful than the regular students. In the engineering calculus the combined course students did quite a bit worse in some semesters and about the same in others. Of course, the engineering sequence is much more demanding and the scores reflect the difficulty of catching up in a science/engineering track after inadequate high school preparation.

It is also important to be sure that the students who had to take the reformulated MATH 003, with its self-paced computer platform, were at least as successful as they were under the old program. For the Fall semester immediately preceding the institution of the new program we had two Developmental Math Programs, roughly high school Algebra I and II. Those who had to take Algebra I had about a 30% ABC rate in their next course, while those who had to take Algebra II had about a 47% ABC rate in their next course. The students who took Math 003 had a 35% ABC rate in the next course. Since these students are in fact the lower 40% among students who took these courses in the past. this self-paced course did its job at least as well as the old program.

We also conducted surveys of the students. The students were generally positive about the new program. Those in the Math 01x courses were especially pleased with the possibility of obtaining academic credit in one semester for the combined courses. Those in Math 003 liked the "module" approach of the course, which they felt gave them more control over the pace and the outcomes for the course. We also heard from many of the advisors around the campus who reported a large decrease in frustration levels for students forced into Developmental Math.

The main expense in setting up the new program was in building two new dedicated computer labs for Math 003. The remaining costs were relatively small and mainly involved developing the curriculum for the new courses. As for the ongoing costs, they are comparable to the costs for running the old program. It should be noted that previously the students paid a fee for taking Developmental Mathematics, and that remained true for either Math 003 or Math 01x.

In conclusion we note that the new program prepared the students at least comparably well to the old one. But with the new program hundreds of students (373 students in Fall 2001 alone!) had completed their basic math requirement in one semester, rather than the two that all of these students would have needed under the old program. As a second measure of success of the new program, at the end of the Fall 2001 semester, 80% of the students placed in Developmental Math had either completed or were prepared to complete their math requirement at the beginning of Spring 2002. By contrast in Fall 1999 only 64% of these students were even prepared to move on to their Math requirement in Spring 2000 (and, of course, none had completed it). This is also a dramatic improvement.

William W. Adams has done work in Number Theory and, more recently, in Computational Algebra. He has been at the University of Maryland at College Park for 33 years. He spent many years as the Associate Chair for the Undergraduate Program and it was during the last of these terms he became heavily involved with the inception and the realization of this new Developmental Math Program.

The Texas Octagon Massacre

By Fernando Q. Gouvêa

I first heard about it from the NASSMC Briefing Service, an email news service provided by the National Alliance of State Science and Mathematics Coalitions. The news item was about a big test in Texas. Apparently, they had run into trouble with an octagon. Here's what NASSMC News Brief #2100 said:

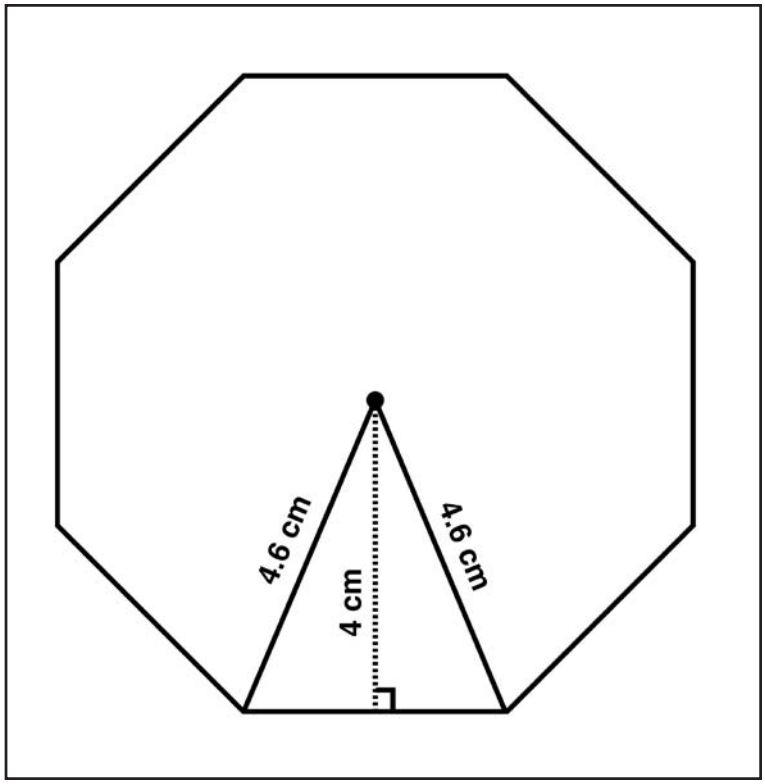
The Texas Education Agency announced yesterday that they will give all students credit for a confusing question on the 10th-grade math portion of the Texas Assessment of Knowledge and Skills (TAKS). The change boosts the passing rate on the exam from 71 percent to 73 percent of all 10th-graders.

The item asked students to figure the perimeter to the nearest centimeter of a pictured octagon. Students who correctly used the Pythagorean Theorem to find the answer would have arrived at an answer of 36 centimeters.

However, a math teacher attending a panel discussing questions for next year's test recently suggested that students who used trigonometry to find the answer would have selected another answer offered: 27 centimeters.

Being a rather unimaginative person, I found it difficult to understand how a regular octagon could have sides equal to both 36 cm and 27 cm. I mean, I have heard of the "true for you, not true for me" kind of thing, but this seemed to be stretching it a bit far.

Since the story included a reference to the *Houston Chronicle* online, I took a peek at their article. (It seems not to be online any more — it was published August 7, 2003 — but the press release from the Texas Education Agency, which created the test is still available at http://www.tea.state.tx.us/press/taksmath.html.) The actual problem appeared in the *Chronicle* article. I have redrawn the picture without changing any of the data.



The question asked for the perimeter of the octagon, to the nearest centimeter. The options were 41 cm, 36 cm, 27 cm, and 18 cm. As the article says, a straight application of the Pythagorean Theorem will lead to 36 cm as the perimeter: the square of the third side of the triangle is equal to 5.16, and the square root of that is roughly 2.27; multiply by 16 to get 36.35 and round to the nearest integer. So what's wrong?

Well, I figured it out, I think. But of course it's not true that "there are two correct answers." The truth is that no octagon with those measurements exists. If we believe the radius of 4.6, then the perimeter should be around 28 and the height should be 4.2. If we believe the height of 4, then the perimeter would be 26.5 or so. (Presumably, this is the calculation "using trigonometry" that leads to the answer 27.) If we really did lay out lots of right triangles with sides 4.6 and 4, what we'd actually get is something pretty close to a hexagon, since the arc cosine of 4/4.6 is about 29.59 degrees.

So how did they get those numbers? Well, I see two possibilities. One is that they did the computations for a hexagon and then changed to an octagon without changing the numbers. A more intriguing one is this: If you compute 4.6 times the cosine of 360/16 = 22.5 *with the calculator set to radians* you get –4.01. Ignore that minus sign, and tadah: an isosceles triangle with central angle 45 degrees, common side 4.6, and height 4.

That, of course, is just a guess. It bothers me, however, that the test makers decided to say that "there were two right answers." In fact the *Chronicle* quotes a Texas Education Agency spokesman who said that "It was just a coincidence that 27 was an answer on the test. We always would attempt to just have one answer." The truth is just that there was a wrong problem. And the final question is: how often does this happen?

Fernando Q. Gouvêa is Professor of Mathematics at Colby College in Waterville, ME, and the editor of FOCUS.

Teaching Preservice Teachers Like...Teachers?

By Linda Uselmann

As someone who resides in a small, forward-thinking mathematics department, I was always struck by my colleagues' drive to connect mathematics, especially in general education courses, to the world in which our students would some day live. It struck me that, as the person in charge of the mathematics courses for elementary teachers, this part of *my* job is extremely easy! I also discovered, however, that many mathematicians find themselves at a loss as to what kinds of things to include in content courses for preservice teachers. The ideas I present below were originally developed in the context of teaching elementary education majors, but can easily be extended into the realm of secondary education.

There are major arguments about what mathematics preservice teachers (especially at the elementary level) need to learn. Some call for a review of specific topics they will teach. One reason for this is the feeling that many of our students had poor experience with these basic topics in their own education and some have lost confidence. There are others who insist that higher mathematics topics are necessary in order for teachers to have the capacity to make connections and teach for understanding. There is also reality, which limits the time that mathematics departments get to spend with preservice teachers. Liping Ma's idea of "profound understanding of fundamental mathematics" (PUFM) seems to have struck somewhat of a balance among these viewpoints.

I argue that to develop PUFM we should treat preservice teachers like, well, *teachers* — pretty deep, huh? I have designed tasks that couch mathematics ideas in terms of how students with misconceptions might think. I find that this provides a review of elementary mathematics topics while pushing students to a deeper understanding of the material, which is often grounded in higher mathematics ideas. My students are motivated because they see the immediate relevance of the material. They are also challenged by the difficulty of the tasks, sometimes because of their own non- or mis-conceptions of the mathematics, and almost always because of the complexity inherent in the task. The tasks create a forum for them to discuss the material in terms of what the "student" does or does not understand, which allows them to work through their own conceptions of the mathematics (correct or not) without feeling threatened or self-conscious.

I design tasks to look like student responses, reasoning, and arguments about mathematical ideas. Some of the tasks are taken wholesale from student work, which local teachers generously share with me. Some are based upon my own experience teaching general education, middle school, and high school students. Others are based on mathematics education research. In the past several years, this research has done a good job of identifying trouble spots for mathematics students at all ages. Where research articles do not directly provide examples of faulty student reasoning, it is not too difficult to construct arguments that look like student work. (If you wish to further the look of authenticity, write a "student" argument on a piece of paper with your non-dominant hand before making it into a transparency. My students have trouble telling the fakes from the actual student work. It helps their concentration if they believe that students actually created the piece they're discussing.) Below are a couple of examples.

A student claims that 3 divided by 0 is equal to 3, because division tells you how many pieces you need to divide something into. If you divide 3 into no pieces, you still have three. Decide whether you agree or disagree with the student and make an argument for your case.

A student claims that $3^{-1} = -3$, since exponents mean you multiply the bottom number by itself the number of times that the exponent says. Multiplying 3 by itself negative one times makes negative three. Decide whether you agree or disagree with the student and make an argument for your case.

There are twelve inches per foot. So that means that if I inches are the same as F feet, then 12I = F. Is this correct or not?

Read and respond to the following child's response to this question: At one table, there are 5 kids sharing 3 giant cookies. At another table, they have 11 kids sharing 7 giant cookies. How many cookies do you need at the second table to make things fair? Response: Six and 3/5 cookies…because 6 over 10, and…this would change to 7 and 11 if we change the 7 down to 6 and we can't change the [number of kids] down to 10 we need to figure out how much goes into the remaining one and that would be 3/5 because that's the ratio.

Once I present a task, I leave the discussion open to the students. I've gotten the best results when small groups work on a task, and then the groups later share their ideas with the class. I try not to guide groups toward a particular idea or explanation; students continually surprise me with new approaches to explaining or solving the problems posed. I do, however, make sure the mathematics that they share is correct and that they do not simply impose their own thinking over that of the "student." I insist that they address the work of the "student," developing ideas for helping the "student" to realize a flaw in thinking and work toward a correct conception.

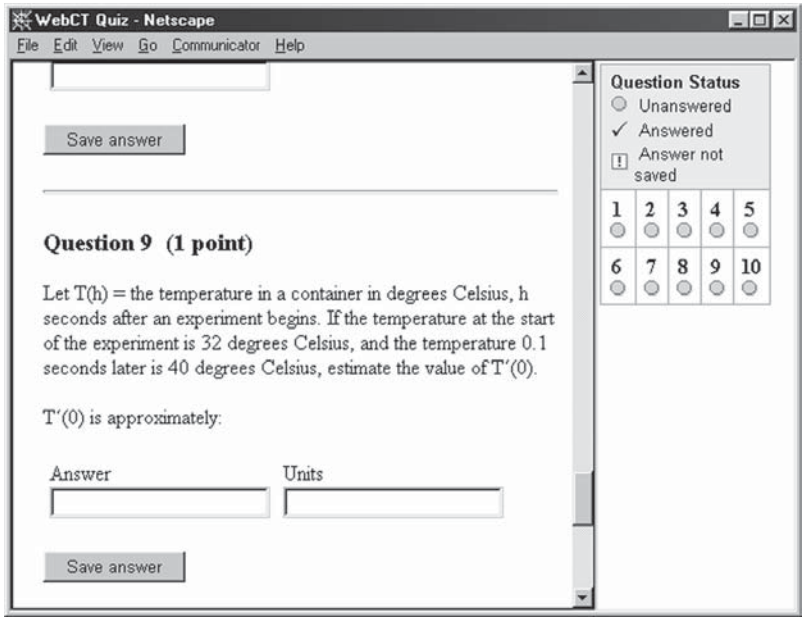
Nurturing this attitude of respect for students' reasoning and readiness for alternative modes of thought, I feel, is one of the most important benefits of this approach. The students have shared that they feel like professionals and appreciate that, even at this early point in their program. (I see mainly sophomores, plus or minus a semester.) Many have also commented that they feel they've learned more mathematics in these classes than they have in the past few years of their education. That is the clincher for me: that sort of comment tells me I've hit on a good idea worth sharing… which, of course, I just did.

Linda Uselmann is the Mathematics Education Specialist at Edgewood College, a small liberal arts college in Madison, WI. She teaches predominantly content and methods courses for future elementary and secondary teachers.

Using Online Quizzes: A Report From the Trenches

By Jeff Suzuki

Recently many web based learning tools have become available for teachers. Some are free, others require a license, but there is no doubt that they will become an integral part of the educational experience. I've worked with these resources for some years now, and offer the following "report from the trenches": my experience on what works, what doesn't, and how to keep yourself sane and happy while preparing web resources for your students. I will focus on using "online quizzes" and how they can be used to enhance proficiency in mathematics.



Practice Quizzes

A few years ago, I taught one section of a multi-section physical science course. The main exams in the course were multiple choice, so every week I placed online a ten question multiple choice "practice quiz" with questions similar to those that would be on the exam. Since there was no way to monitor who was actually taking the quizzes, I did not count the quizzes towards the student's final grade.

Student responses were very positive. Many liked the fact that they could practice exam questions (and see if their answers were correct) before the actual exam. I could see copies of my lecture notes (which I also placed online) and sample quizzes floating around campus before the major exams, so students were definitely making use of the resources available to them; this was reflected in their performance on exams as well. My greatest disappointment was that few students actually *took* the online quizzes: thus, they did not actually practice answering the questions, but simply printed them out and used them as a study guide. Hence:

Problem: Students see no value in practice.
Solution: Online quizzes must count towards a final grade.

Thus, if online quizzes are to be used, their use must be required. However, this runs into questions concerning academic integrity.

Solving the Academic Integrity Problem

There are two primary issues involved. The first is that even if students do their own work, a student who takes the quiz earlier could pass on information to students who have not yet taken the quiz.

Problem: Students will pass on information about the quiz to other students.
Solution: Each quiz must have so many variants that only the most general information (e.g., "You'll need to solve a linear equation") can be passed from student to student.

However, by giving students different quizzes, you are opening yourself up to the accusation that the quizzes are unfair: that someone received an "easier" quiz. We will see how to deal with this problem below.

The second issue is that, short of physical monitoring, it is impossible to verify who is actually taking the quiz and what materials they are using. I wrestled with this problem for a while before I realized I was approaching it from the wrong direction: I was focusing on the *quizzes* and forgetting *why* I wanted students to take them.

This is perhaps the most important lesson I learned: Technology allows us to do things we have never done before — but at the price of *requiring* us to do things we have never done before. Using technology to administer quizzes online is pointless if the quizzes must be taken in a classroom environment: all we have done is replace pen and paper with keyboard and screen. The greatest virtue of the online environment is its "anytime, anywhere" characteristic, and if we do not take advantage of this feature, there is no reason to go online in the first place.

But how much value can be assigned to a quiz if we do not know who did the work? We can solve this problem by comparing the online environment to another area where it is impossible to monitor who did the actual work: homework assignments.

Problem: It is impossible to monitor the online environment.
Solution: Treat the online environment as a homework environment.

Online Homework

The traditional way to develop proficiency in mathematics is through homework, and I firmly believe there are some things that students of mathematics should be able to do accurately and on time. But if a student "does" a homework problem incorrectly, in most cases the only consequence is a bad grade. Few students have the discipline to correct their mistakes, and even fewer faculty members have the resources to re-grade corrected assignments. Finally, the number of problems given in a typical textbook are limited by space considerations, and once these problems are "done", students will not redo them for more practice. The online quizzes provide an elegant solution once we stop viewing them as quizzes and instead view them as tools to build proficiency.

I set them up as follows. First, the questions are scored on an "all or nothing" basis: either the answer is correct, or it is incorrect (again, the goal is 100% accuracy). Second, the questions are drawn randomly from a large pool of questions, so that no two quizzes are alike (effectively preventing any useful information from being passed from student to student). Third, there was no time limit on how long a student could spend on a quiz: they could take as much time as they wanted to answer the questions. Fourth, there was also no time limit on when the student had to take the quiz: they could prepare for it as much as they wanted.

But last — and most important: the students can retake the quizzes as many times as they want, and only the highest grade is kept. I emphasize this fact to my students: it doesn't matter what you get at first; what matters is what you get at last. In effect, the quizzes provide problems for students to work on until they have mastered the topic at hand to their own satisfaction.

There are several benefits to this. First, the fact that students can retake the quiz as many times as they want means that they can continue practicing their problem-solving techniques. Second, many students have grown used to the idea that they "can't do math": they accept that a 70% is "good enough" for them since they don't have a "math mind." The online quizzes deny students this refuge by making it possible for them to eventually achieve a perfect score. I have used the online quizzes in three courses so far (precalculus twice and calculus I once), and based on this admittedly small sample I collected the data given in Table 1.

	Percentage of Quiz Scores That Are:		
Class	Perfect (100%)	90% or more	70% or more
Precalculus (21 students)	67%	77%	93%
Calculus (23 students)	70%	86%	96%

Table 1

	Quiz Averages					
	10 (perfect)		9 to <10		<9	
	n	Mean	n	Mean	n	Mean
Precalculus Test 1	3	83.3	8	77	2	75
Precalculus Test 2	–	–	3	93	5	54.4
Calculus Test 1	13	83.3	4	76.5	4	72
Calculus Test 2	5	81.4	11	82.3	5	60.3

Table 2

If we omit quizzes that students scored 100% on the first try (and thus had no reason to retake), and the quizzes that students began but did not complete (i.e., did not submit for grading), then each quiz was taken an average of 2.3 times. This leads me to:

Problem: We want students to practice, practice, practice.
Solution: If there is no penalty for multiple attempts, students will keep trying until they get a grade they are comfortable with.

This incidentally provides a solution to:

Problem: Students will perceive that some quizzes are "easier" than others.
Solution: If students can keep retaking the quiz until they get the "easy" one, they have no basis for complaint.

By treating the quiz as a homework assignment, we also sidestep the problem of academic integrity. Indeed, the online quiz is less likely to result in academic dishonesty than the regular homework assignment. In a regular homework assignment, one student can do the work and allow other students to copy their answers. With online quizzes, it is extremely unlikely that two students will have identical problem sets, so that copying is much less useful. Moreover, helping another student requires additional work — a powerful deterrent against academic dishonesty.

Assessment

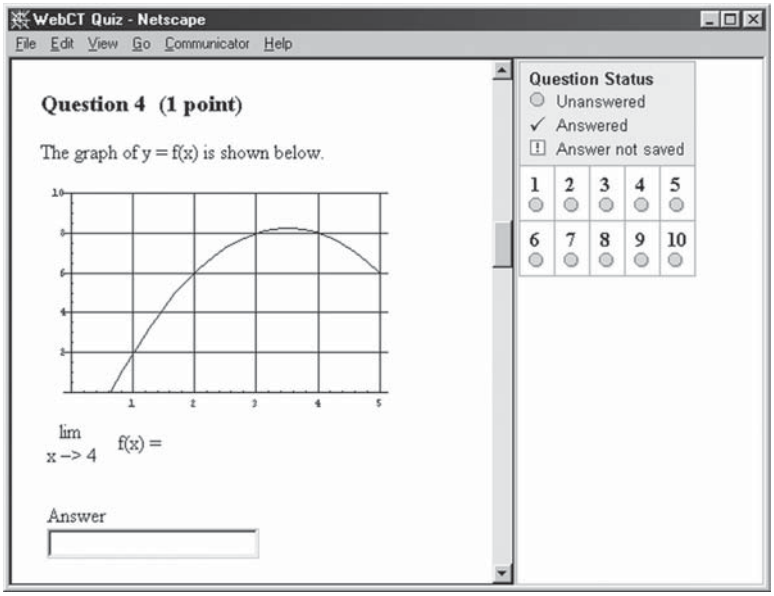
At this point I've used online quizzes in two classes (precalculus and calculus), and have obtained the results in Table 2 (which are, admittedly, based on very limited data).

Not surprisingly, those who did well on the quizzes did well on the exams. But bear in mind that the quiz scores reflect student persistence in taking and retaking a quiz until they earn a score they are comfortable with.

The Questions and the Answers

The key to making online quizzes work is the question set. A question for an online assessment tool generally has three parts: first, the question text; second, the acceptable answer(s); and third, any feedback that is returned to the student. For example, we might have:

Text: Solve: $3x + 5 = 8$
Answer: $x = 1$
Feedback: Isolate x by subtracting 5 from both sides. Then divide by the coefficient of x.



Next, imagine yourself to be a student. What sort of "correct" answer might you enter that is *not* "x = 1"? This step is vitally important: students will get extremely frustrated if they enter correct answers that are not graded as correct answers. Thus:

Problem: You must ensure that *every* possible correct answer will be scored as a correct answer.

There are several solutions. The easiest is to make the answers multiple choice. This, in my opinion, is the worst of all possible solutions, and should only be used when there are no other options (for example, when the question asks the student to graph a function) or you specifically want the students to practice taking multiple choice quizzes (as in my physical science course). Moreover, a multiple choice question places an additional burden on the author, who must create a good set of distractors (the wrong answers that appear correct).

The perfect solution to this problem of multiple correct answers is to allow as an answer every possible variant you can think of for the correct answer. Most web based learning tools allow you to enter in several possible "correct" answers; here, you could set the question so that it would accept "1" and "x = 1". However, this runs into another problem: if the problem is set to accept "x = 1" (with spaces), it will probably not accept "x=1" (without spaces); most systems are not "smart" enough to interpret symbolic answers. And what of answers like "x = 1.0000" and "1 = x"? Clearly, listing every possible "correct" answer is impossible.

Rather than try and anticipate every possible combination of spaces and format, it is better to give explicit directions for entering the answer. For example, you might add the instruction, "Enter ONLY the value of x", or end the question with, "x =". Thus:

Problem: You must ensure that *every* possible correct answer will be scored as a correct answer.
Solution: Make the directions for entering the answer as explicit as possible.

In some cases, I listed directions such as these at the beginning of the quiz. However:

Problem: Students ignore or forget any directions given to them at the beginning of a quiz.

This is a problem that we face even with paper assignments. Individual teachers will have to judge how much "hand holding" they are going to do. On the one hand, too much hand holding will clutter problems with unnecessary details (essentially instructions on how to use the keyboard), while too little hand holding will lead to arguments with students who entered the "right" answer in the wrong format.

Creating 10 Billion Quizzes On a Lazy Afternoon

The key to using the online quizzes in this fashion is to have a large pool of similar questions to draw from so that every time a student takes the quiz, they are faced with a different set of problems. The technical details for how to do this are best left to another article. Suffice it to say that, with a little understanding of spreadsheets and word processors, it is possible to create a basic problem template that can generate an enormous number of variants. By creating a quiz by drawing 10 questions from a pool of 50, over ten billion different quizzes can be generated, and there is less than a 2% chance that two quizzes have more than 4 questions in common. And it is just as easy to create 500 variants as it is to create 50.

Jeff Suzuki is Director of Quantitative Support at Bard College.

From Academia to Policy: My Career Journey

By Jennifer Slimowitz

Careers are funny things. Each person has his or her own strategies, desires, pathways, and journeys. It seems to me that there are two main approaches: the goal-oriented among us seem to say "I want to be X and work in field Y and therefore I will obtain training Z to get there." Others, like me, have a different philosophy: "Right now I enjoy something and it doesn't seem to be too detrimental long term, so I will spend some time doing it and will see what opportunities arise." I went to graduate school in mathematics only because I loved math and wanted to learn more.

Having started in academia, I have ended up somewhere very different. This article is about the motivations for and outcomes of that journey. In doing so, I hope to empower others to think hard about their career choices and to emphasize the importance of finding a "good fit." In addition, I will share some of what I have learned in my year as a Science and Technology Policy Fellow sponsored by the American Association for the Advancement of Science at the National Science Foundation.

As a graduate student, a post-doc, and an instructor at three different prestigious institutions, I was solving problems and making progress in my research in symplectic geometry. However, I was dissatisfied professionally, even though faculty members assured me that I was on the right path to obtain a tenure-track job at a good school.

I found myself becoming less engaged and less interested in academic math. For me, it is important to have colleagues with whom I work on a daily basis and to solve problems with direct relevance to my community (in the small or large sense). I realized that the ultra-specialized, esoteric nature of research mathematics and the isolation entailed by working in an academic department didn't suit me. Hence, I decided to search for positions where I could use my scientific background in a more collegial environment, tackling issues with a broader focus. Upon reflection, I think that if academic departments fostered a more collaborative atmosphere and if I felt my work was relevant and valued, I would have pursued a tenure-track faculty position. As it was, in the spring of 2001, I began my search for other opportunities within the university community.

I went to the career center. I took two tests: the Strong Interest Inventory Test and the Meyers-Briggs Personality Test. These are designed to help individuals compare their interests and personality to the interests and personalities of people who have different types of jobs. Although I would not base a major career decision on a test, it was gratifying to see that my "personality type" did not fit "math professor" *at all:* it validated my sense that I was in the wrong place. However, the types of careers that did match were things like "early childhood daycare provider" and "social worker" — fine careers, but ones in which I had no interest, for which I had no training, and for which my scientific skills would not be compensated or utilized.

I then spoke with university administrators, figuring that these were individuals with Ph.D.s who "did something different." After a great discussion with the director of the Office of Technology Transfer, I was able to work in that office dealing with the patenting and licensing of inventions developed at the university. This work gave me the opportunity to think about what was important to me. I realized that I loved the interactivity and the way my job involved a mix of science, business, and law. I also spent one year coordinating the development of a new professional master's program with tracks in three different fields: physics, environmental analysis, and geosciences. That taught me a great deal — including that it is hard to start up a new degree program at a university! I realized that I have some skill as a facilitator, and that I do enjoy the "people" work. As part of coordinating this program, I began developing a course in science policy. It seemed so interesting that I wanted to enroll myself.

Several years earlier, I had learned about the Science and Technology Policy Fellowships given out by the American Association for Advancement of Science (AAAS). The AAAS, along with many other professional societies, sponsors fellows to work for a year in different parts of the US government. Anyone with US citizenship and an M.D., D.V.M., or Ph.D. degree in science or engineering (including the social sciences) may apply. I checked out their website (http://fellowships.aaas.org), read bios of former fellows, and thought, "This is exactly what I want to do." I found stories of other people like me: scientists who wanted to explore options outside academia, wanted to be involved in civic service, and were curious about the opportunities that exist in Washington.

All arrows seemed to point in the same direction: I found the idea of science policy fascinating, the fellowship program seemed to fit, and, being a "Jersey Girl," I was eager to move back to the east coast. I applied for two fellowships from AAAS: the Diplomacy Fellowship (to work either at the United States Agency for International Development (USAID), the Department of State, or the Fogarty International Center at the National Institutes of Health (NIH)) and the NSF Fellowship to work at the National Science Foundation. I was invited to Washington, D.C., for a half-hour interview for the NSF program. I sat at a circular table with approximately ten interviewers, all of them with very interesting backgrounds that included positions with government agencies, non-profit organizations, universities, and international groups. It was a great interview that made me feel even more positive about the fellowship.

I accepted a placement at the NSF in the Division of Graduate Education, osten-

sibly to work on master's education issues and to work a bit with the National Science Board. I had two goals: to make a contribution to exciting projects and to learn what opportunities exist for me in Washington. I think I have succeeded in doing both.

Projects

When I arrived at NSF, priorities had changed, as they often do. I was working neither on master's education nor with the National Science Board. Instead, I undertook several different projects, four of which I will highlight.

First, I co-organized a workshop on the Future of Graduate Education held March 19 and 20, 2003 at NSF. This workshop was attended by over 100 stakeholders who wished to examine forces shaping the environment for graduate education (e.g. the economy, international affairs, information technology, and demographics) and think about what actions leaders in graduate education need to take. The attendees included representatives from government agencies, disciplinary societies, the industrial sector, and funding organizations, as well as innovators in graduate education, graduate deans, faculty members, recent graduates, and current students. The participants represented all fields of science and engineering. Information about the workshop, including a summary, can be found at http://www.ehr.nsf.gov/dge/InnovMTG.htm.

I also contributed to the Council of Graduate Schools (CGS) Ph.D. Completion Project, co-authoring a white paper on graduate student completion and attrition (which will be published) and speaking at two CGS workshops.

I helped to administer the Integrative Graduate Education and Research Traineeships (IGERT) program that funds universities to experiment with interdisciplinary, integrative graduate education. By assembling and moderating panels, I learned about important issues in graduate education and the NSF merit review process.

I participated in the Foundation-wide Workforce Working Group to help guide NSF activities dealing with science, technology, engineering, and mathematics workforce issues.

In addition, I participated in numerous local and national discussions held at NSF and elsewhere in Washington dealing with issues affecting graduate students and postdocs including breadth of training, stipends, and SEVIS regulations for international students and scholars. The experience of collaborating with the dedicated, knowledgeable people in my directorate and in other directorates at NSF has been invaluable.

Learning about Opportunities

During the two and one half week orientation that AAAS organized, I received my first taste of the wealth of opportunities in Washington. After this, I attended many meetings, set up informational interviews, and pursued connections to learn more.

Orientation was the civics class I never took, and a great one at that. We listened to speakers from all over Washington, D.C.: individuals from executive branch agencies, folks from "the Hill," individuals from the Library of Congress, lobbyists and journalists, representatives from non-profit organizations, professors from local universities with government expertise. It would have been worth coming to Washington for orientation alone.

Because I have been in Washington, D.C., all year, I have been able to attend seminars, workshops, and informal meetings on current topics ranging from education to the war with Iraq to genetic testing. These contacts have helped me understand the scope of possibilities in D.C. and have put my name on the radar screens of people who play a role in the policy-making process.

In my travels, I assembled a list of non-academic places where a mathematician could potentially apply for a policy type job. Who in the policy arena would hire a Ph.D. mathematician? It depends on the background of the mathematician. A very incomplete list of possible employers would include various branches of the Federal government (Departments, including Defense, Energy, Education, Homeland Security, and Commerce, the National Institute of Standards and Technology, NSF, NIH, NASA, etc.). It would also include think tanks such as the Brookings Institution, and RAND. Many non-profit organizations and foundations are involved in science policy, from the American Mathematical Society and the MAA to the Alfred P. Sloan Foundation and the Bill and Melinda Gates Foundation. International organizations, such as the World Bank, UNESCO, and the World Health Organization, might be an option, as would several corporations. Merck, Pfizer, and most other pharmaceutical and chemical companies, for example, have philanthropy divisions which fund science and math educational or research endeavors. Finally,

Fellowships or Internships in Science Policy

In addition to official employment, there are several opportunities for a fellowship or internship in the policy-making arena. Please refer to the websites below for more details; some of these programs require a Ph.D. but most do not.

AAAS Science and Technology Policy Fellowships https://fellowships.aaas.org

National Academies Christine Mirzayan Science and Technology Policy Internship Program
http://www7.nationalacademies.org/internship/

Presidential Management Intern Program
http://www.pmi.opm.gov/index.htm

White House Fellows Program
http://www.whitehouse.gov/fellows/

World Bank Young Professionals Program http://wbln1028.worldbank.org/hrs/careers.nsf/key/ypp

there are lobbying groups, state and local governments, the media, and government contractors.

I have learned to be persistent, to be brave, and to experiment. You never know who will help you or which contact might lead to something good, so you have to follow every possibility. Before I came to Washington, I felt that I had three or four career options, none of which seemed very exciting or appealing. Now, there are many possibilities I would like to explore. Earning a Ph.D. in mathematics was probably not the most expeditious route to a career in policy. However, the analytical skills, writing ability, teaching experience, and understanding of the university setting and research process, as well as the five minutes of credibility that come with the doctorate degree, have served me well in this environment. More valuable still is the confidence that I can work through hard problems and learn any needed material along the way.

What's Next?

I have accepted a position as a program officer at the National Academies on the Board on Mathematical Sciences and Their Applications. I will be directing studies on a wide range of broad mathematics issues. It will be exciting to take on this role of facilitating projects with technical underpinnings. I hope to find the mix of people, science, and civic contribution that I have been seeking.

I'm often asked if I miss doing research mathematics. The answer is no. I miss doing something that is technically difficult some days, and I miss the shock on peoples' faces when I told them I worked in the math department. I still do the puzzles in *Scientific American.* I miss the classroom teaching, but luckily there are many ways I can integrate teaching in my life and work.

And the future? I am sure that my future positions will be interactive and intellectually challenging, that they will engage many perspectives and serve the public. I would love to be involved in some international work. I hope that in five years I am doing something I have not yet dreamed about; just as five years ago I would never have dreamed of being in Washington today.

Jennifer Slimowitz can be reached at jslimowitz@nas.edu. *She welcomes comments and questions.*

Two New Columns on MAA Online

Two new columns began their run on MAA Online late in October. *Math Games* is in the tradition of Martin Gardner's famous column in *Scientific American*. It will appear weekly. *How Euler Did It* is a historical column that will appear monthly. The new columns join *MathTrek*, *Devlin's Angle*, and *Cut the Knot!*, all of which have been favorite places to visit on maa.org.

Ed Pegg Jr

Ed Pegg Jr., author of *Math Games*, is the webmaster of Math-puzzle.com, where he has collected an immense amount of material on recreational mathematics. His first few columns for MAA Online dealt with Paterson's worms, the Mobius function, and "Matrix Revolutions".

Ed Sandifer

Ed Sandifer, author of *How Euler Did It*, has been studying Euler for many years now. His column will share some of the fruits of his intensive reading of Euler's work. The first issue, dated November 2003, dealt with how Euler proved "Fermat's Little Theorem".

Current columns can be reached from the front page (look in the lower right hand side), or from http://www.maa.org/news/columns.html, where you can also find links to past columns.

Short Takes

By Fernando Q. Gouvêa

The Shape of Space

There are new ideas about the shape of the universe. In their paper "Dodecahedral space topology as an explanation for weak wide-angle temperature correlations in the cosmic microwave background," published in the October 9 edition of *Nature*, Jean-Pierre Luminet, Jeffrey R. Weeks, Alain Riazuelo, Roland Lehoucq, and Jean-Philippe Uzan argue that the evidence from the cosmic microwave background radiation suggests that the universe is topologically like a dodecahedron with opposite faces identified. This would imply, in particular, that the universe is rather smaller than most cosmologists think. As one might expect, many scientists are skeptical, but all seem to agree that the question is in principle decidable. See http://www.nature.com/nature/links/031009/031009-1.html for more information. The new theory was also featured in the October 9 issue of the *New York Times*.

Collecting Data on Students

The *No Child Left Behind* act requires schools to raise the achievement level of struggling students and to document this with various kinds of assessment. In a recent report, the National Center for Educational Accountability argues that this requires student-by-student data collection so that student performance can be tracked for several years. They argue that states need to create a way of identifying specific students so that they can collect longitudinal data. See http://nc4ea.org/index.cfm?pg=data_collection for the report.

University Leaders Hear Mixed Messages

A recent study argues that a careful examination of state high school exams shows that they "bear an inconsistent relationship to the knowledge and skills necessary for college success." The report, entitled Mixed Messages: What State High School Tests Communicate about Student Readiness for College, was produced by Standards for Success (S4S; see http://www.s4s.org), a three-year project of the Association of American Universities in partnership with The Pew Charitable Trusts. The goals of the project are to identify what students need to know and be able to do in order to succeed in entry-level university courses, to provide information on state high school assessments, and to work towards bringing these two into closer alignment. The study concluded that all 31 mathematics tests (from 20 different states) were "inconsistently aligned" with the standards developed by S4S as indicators of success at the college and university level. For more information, see http://cepr.uoregon.edu/MixedMessages/index.asp.

Sources: The shape of space: *Nature, The New York Times*. Longitudinal Studies: NASSMC Briefing Service, NCEA website. Mixed Messages: NASSMC Briefing Service, *Chronicle of Higher Education*, S4S website.

National Medals of Science Awarded

Eight distinguished scientists, including one MAA member, received the 2002 National Medal of Science at a ceremony held at the White House on November 6. President Bush announced the honorees on October 22 and awarded the medals personally. Among the 8 winners is MAA member James G. Glimm, chair of the Applied Mathematics Department at SUNY Stony Brook. Professor Glimm is recognized for his work in quantum field theory and statistical mechanics, which has influenced mathematical physics and probability. His significant contributions to shock-wave theory were specifically mentioned as a reason for the award. Glimm is also a member of the AMS and SIAM.

Also among the honorees is Edward Witten of the Institute for Advanced Study at Princeton, NJ. Witten, a theoretical physicist, was one of the creators of string theory. His deep insight into physics and the mathematics used to describe physical situations has led to significant developments in mathematics itself. Witten is a member of the American Mathematical Society.

The other recipients of the National Medals of Science were James E. Darnell, Jr. of Rockefeller University (Biology), Evelyn M. Witkin of Rutgers University (Biology), John I. Brauman of Stanford University (Chemistry), Leo L. Beranek of BBN Technologies (Engineering), Richard L. Garwin of Council on Foreign Relations (Physical Sciences, Policy), and W. Jason Morgan of Princeton University (Geohysics).

James G. Glimm

For more about the award and the winners, visit http://www.nsf.gov/od/lpa/news/03/pr03121.htm.

NSF Beat: Joint Biology and Mathematics Projects

By Sharon Cutler Ross

In March 2003, the NSF's Directorate for Biological Sciences, the Directorate for Education and Human Resources (EHR), and the Division of Mathematical Sciences issued a joint call for supplemental funding requests for projects that intensify undergraduate education at the interface of the mathematical and biological sciences. The new initiative, Interdisciplinary Training for Undergraduates in Biological and Mathematical Sciences (UBM), is intended to stimulate the development of a workforce prepared to work in the increasing number of areas where the two disciplines intersect. This article focuses on the eight proposals funded by EHR. A total of twenty-four proposals were funded.

Two of the EHR-funded projects are a complementary pair of studies on how biology and mathematics are integrated in undergraduate education. The Reinvention Center at SUNY Stony Brook (W. Katkin, project PI) is the base for research into the current state of undergraduate biology education at research universities with emphasis on how quantitative approaches are integrated into the curriculum. The study will also assess how mathematics majors are educated about the increasing uses of mathematics in biological research. The MAA (T. Straley, PI) will investigate similar questions at two-year colleges, liberal arts colleges, and comprehensive universities. The end product will be approximately 30 profiles of exemplary programs that incorporate biology, mathematics, and computer science describing the model(s) used, the core attributes of the project, faculty knowledge, and faculty rewards for interdisciplinary work.

The other six projects seek to engage undergraduates in various aspects of the mathematics-biology interface. At San Francisco State University (E. Conner, PI), the project will build on an existing program to encourage members of under-represented groups to pursue studies and work in environmental biology. Research experiences and mentoring by both mathematics and biology faculty form the core of the project.

Research experiences will also form the main activity for the Davidson College project (M. Dorcas, PI). A new REU community will be developed within the existing REU site by utilizing both mathematics and biology in the construction of computer simulations for use in the Neuroscience Laboratory Manual for the 21st Century.

At East Tennessee State University (J. Knisely, PI), the UBM funding will support a multi-stage instructional program to cross-train students to participate in REU-type activities with ongoing collaborations between mathematics and biology faculty.

Cross-disciplinary work focused on the analysis of biological networks will enable selected students at SUNY Genesco (A. Macula, PI) to investigate and appreciate the symbiosis between mathematics and biology.

The remaining two projects will provide research opportunities at the interface of mathematics and biology and also develop new interdisciplinary courses. Truman State University (J. Miller, PI) is creating a mathematical biology initiative pairing students with mentor-researchers from both disciplines. The new interdisciplinary courses will include introductory mathematical biology and upper-level modeling. At Youngstown State University (T. Smotzer, PI) the new courses will support the possible creation of a bio-mathematics track. One new course will be a projects-oriented curriculum where students collect data and analyze a research problem; this will rely heavily on current field research projects of the YSU faculty.

Addendum

The final CCLI-Adaptation and Implementation award for 2003, "A Problem- and Research-Based Curriculum for Preservice Elementary Educators" (University of Michigan, J. Flowers, PI) will be used to create four instructional units that can serve as the core of a model for teacher education. The project is based on the Connected Mathematics Project and Investigations in Number, Data, and Space.

HOLIDAY SCHEDULE

The MAA headquarters office
will be closed December 25, 2003 through January 1, 2004.

The MAA customer service department
(800) 331-1622
will be open except for
December 25, 2003 and January 1, 2004

Employment Opportunities

ARIZONA

The University of Arizona
Department of Mathematics
Tucson, AZ
The Department of Mathematics is seeking applications for tenure-track positions at either the Assistant, Associate or Full Professor level, which will begin in Fall 2004. By the time of appointment, candidates are expected to have a Ph.D. and excellent research record or potential, as well as a strong commitment to teaching. Rank and salary depend on the qualifications of the selected candidate(s).

The Department may also have postdoctoral or visiting positions for the 2004-2005 academic year (Ph.D. required).

Further information about the full range of the Department's research and educational activities may be found at http://www.math.arizona.edu.

Application review begins October 1, 2003 and continues as long as positions remain unfilled. Applications received before October 1, 2003 will receive the fullest consideration; applications received after January 2, 2004 are unlikely to be considered.

Please send a letter of interest (specifying position(s) applied for), an AMS Cover Sheet (which can be downloaded from http://www.ams.org/coversheet), a curriculum vitae with a list of publications, a statement of research interests, a statement of teaching experiences/philosophy and a minimum of three (3) letters of recommendation (enclose or arrange to be sent) to:

Personnel Committee
Department of Mathematics
University of Arizona
P.O. BOX 210089
Tucson, Arizona 85721-0089

The University of Arizona is an EEO/AA Employer-M/W/D/V

ARKANSAS

University of Arkansas at Little Rock
Mathematics Education Position
The University of Arkansas at Little Rock invites applications for a tenure track position in the Department of Mathematics and Statistics commencing Fall 2004. We seek a specialist in mathematics education with an earned doctorate in mathematics or mathematics education. The department is particularly interested in candidates with experience in the application of technology (including graphing calculators, hand held computers, computer algebra systems and other software) to mathematics education. Experience teaching mathematics courses designed for students preparing to be elementary, middle, or secondary teachers is desirable. Candidates must have good verbal and written communication skills. Candidates must show evidence of strong research potential, a proven commitment to excellence in teaching and a willingness to participate in mathematics education programs at all levels in cooperation with the College of Education. There is also the opportunity to participate in cross-disciplinary graduate and undergraduate programs with the new master's level program in Integrated Science and Mathematics.

The Strategic Plan of the College of Science and Mathematics is explicit in its strong commitment to enhancing K-12 mathematics and science education, especially through courses for pre-service teachers, professional development courses, and workshops for in-service teachers in neighboring institutions. This commitment provides opportunities for research and professional growth. The successful candidate for this position will play a key role in seeking external funding for mathematics and science initiatives, developing graduate programs in mathematics education, and in forming productive and robust partnerships with regional school districts.

The University of Arkansas at Little Rock is a metropolitan institution located in the population and cultural center of Arkansas. The current enrollment is about 12,000 students.

Salary and rank are competitive and will be commensurate with experience and credentials. Women and minorities are encouraged to apply.

Applicants should send their curriculum vitae, including publications list, and at least three letters of recommendations to: Mathematics Education Faculty Search Committee, Department of Mathematics and Statistics, University of Arkansas at Little Rock, 2801 South University, Little Rock, AR 72204. Applications will be reviewed beginning January 15, 2004. Applications will be accepted and reviewed until the position is filled.

The University of Arkansas at Little Rock is an equal opportunity, affirmative action employer and actively seeks the candidacy of minorities, women and persons with disabilities. Under Arkansas law, applications are subject to disclosure. Persons hired must have proof of legal authority to work in the United States.

CALIFORNIA

California State University Northridge
The Department of Mathematics invites applications for a tenure-track appointment at the assistant or associate professor level effective Fall 2004. The candidate must hold a Ph.D. in the mathematical sciences and have experience with projects involving K-12 education or a Ph.D. in mathematics education with a master's degree in mathematics at the time of the appointment. In addition, the candidate must have familiarity with K-12 mathematics education, either as a pre-college teacher, or as a leader in programs designed to prepare K-12 teachers. The candidate must have a strong commitment to excellence in teaching both at the undergraduate and graduate level; in particular we are seeking candidates with experience in teaching pre-service teachers. Research experience or potential for research and publication is expected.

A significant part of the appointee's service will involve the preparation of K-12 teachers. This will include, but is not limited to, the following: (1) student advisement, especially for math majors preparing to become secondary teachers, prospective elementary school teachers, and students in the teacher credential program; (2) teaching and coordinating courses specially designed for pre-service teachers, as well as participation in ongoing improvements in the design and assessment of those courses; (3) creation and maintenance of partnerships with colleagues in the College of Education, the Liberal Studies Program and mathematics teachers at local high schools. For more details regarding the responsibilities of the position please see the full ad on our web site http://www.csun.edu/math

Applicants should send a vita, the AMS standard cover sheet and three letters of recommendation, one of them addressing the candidate's teaching abilities, to the Hiring Committee, Department of Mathematics, CSUN, Northridge, CA 91330-8313 by January 5, 2004. Email (inquiries only) math.hiring1@csun.edu California State University is an Equal Opportunity, Title IX, sections 503 and 504 employer.

CONNECTICUT

Fairfield University
Assistant Professor
The Department of Mathematics and Computer Science at Fairfield University invites applications for a tenure-track assistant professorship in mathematics to begin in September, 2004. A doctorate in mathematics is required. Strong evidence of research potential, demonstrated success in classroom instruction and a solid commitment to teaching are essential.

Fairfield University, the Jesuit University of Southern New England, is a comprehensive university with about 3000 undergraduates and a strong emphasis on liberal arts education. Fairfield¤s Department of Mathematics & Computer Science consists of 14 full-time faculty members. The teaching load is three courses/nine credits per semester. Fairfield offers a very competitive benefits package. 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, and three letters of recommendation, which comment on the applicant's experience and promise as a teacher and scholar to Chris Bernhardt, Chair of the Department of Mathematics and Computer Science, Fairfield University, Fairfield, CT 06824. Full consideration will be given to complete applications received by January 15, 2004.

Fairfield University is an Affirmative Action/Equal Opportunity Employer. Visit our website at www.fairfield.edu

United States Coast Guard Academy
Faculty Position(s) Department of Mathematics
The United States Coast Guard Academy, located in New London, Connecticut, invites applications for one, possibly two, full-time, tenure-track positions in the Department of Mathematics beginning August 2004. The successful candidate(s) will teach undergraduate courses in Mathematics, Operations Research, and Statistics leading to a Bachelor of Science degree in Operations Research and Computer Analysis.

Candidates should possess a Ph.D. in Operations Research, Applied Mathematics, Statistics, or a related field. Teaching experience at the college level is preferred. Salary/rank will be commensurate with qualifications. Some citizenship restrictions may apply.

Individuals wishing to be considered should submit a letter of application summarizing specific qualifications, a current curriculum vitae, academic transcript(s), a statement of teaching philosophy, and three letters of reference to:

Mathematics Search Committee
c/o Prof. Ernest J. Manfred (dm)
U.S. Coast Guard Academy
27 Mohegan Avenue
New London, CT 06320-8101.

All application materials must be received by 31 January 2004.

The United States Coast Guard Academy is a highly selective federal military college, providing a rigorous undergraduate program along with the professional education and training to prepare young men and women for careers as commissioned officers in the United States Coast Guard. The United States Coast Guard is an Equal Opportunity, Affirmative Action Employer.

DISTRICT OF COLUMBIA

American University
Mathematics or Statistics. Tenure-track Assistant Professor, American University, beginning Fall 2004. American University is an affirmative action/equal opportunity employer, committed to a diverse faculty, staff, and student body. Minority and women candidates are encouraged to apply. For position in-formation and application instructions, see www.mathstat.american.edu/positions, or contact the Department of Mathematics and Statistics at (202) 885 3120.

ILLINOIS

North Park University
North Park University invites applications for a tenure-track position in mathematics. Rank dependent upon qualifications. Responsibilities include teaching introductory and advanced courses in mathematics, advising students, committee responsibilities and curriculum development. Ideal candidates will have demonstrated excellence in teaching and administration. Ph.D. in mathematics required.

North Park is sponsored by the Evangelical Covenant Church and we seek applicants with a personal commitment to multiculturalism and our mission of Christion higher education.

Interested applicants should submit a letter of intent, current vita, transcripts, and four names and addresses of references to: Alice Iverson, North Park University, 3225 W. Foster, Chicago, IL 60625-4895. By fax to: 773-244-4952 or email to: aiverson@northpark.edu. 773-244-5654 (phone). Review of applications will begin immediately and continue until the position is filled. For more information on North Park access our website at www.northpark.edu.

North Park is an equal opportunity employer. We encourage candidates from under-represented groups to apply.

KANSAS

Pittsburg State University
Chair, Mathematics Department. Tenure track, rank dependent on qualifications. Responsibilities: departmental administration, leadership in recruitment, community/university relations, development and planning, coordination of accreditation, fund raising, and teaching in area of specialty. Required: Ph.D. in mathematics or related field; significant record of teaching, professional, and scholarly/creative accomplishments; demonstrated administrative, organizational skills; effective leadership, communication skills; ability to interact effectively with colleagues, students, public school personnel, and the public. Preferred: area of expertise complementing fields of specialization of current faculty; demonstrated support of students' career preparation in secondary education and for advanced graduate degrees. Appointment date: June 6, 2004. Department information: http://www.pittstate.edu/math/math.html. Send application letter; statement of philosophy of teaching, scholarly/creative activity, and governance; resume/placement credentials; 5 names/addresses/telephone numbers of references; and 3 or more letters of recommendation (1 from faculty member, 1 from administration) to: Dr. Stephen Meats, Chairperson, Search Committee, Department of English, Pittsburg State University, 1701 S. Broadway, Pittsburg, KS 66762-7511. For first consideration, materials must be received by January 12, 2004. Pittsburg State University is an Equal Opportunity, Affirmative Action Employer.

MARYLAND

Salisbury University
Department of Mathematics
and Computer Science
Salisbury University invites applications for a tenure-track Assistant Professor position, pending budgetary authorization, starting 15 August 2004. A Ph.D. in mathematics is required. For complete position description and more information see: http://faculty.salisbury.edu/~mathcosc/. Screening of applicants will begin on December 17. Successful candidate must furnish proof of eligibility to work in the U.S. Salisbury University has a strong institutional commitment to diversity and is an Equal Opportunity / Affirmative Action employer, providing equal employment and educational opportunities to all those qualified, without regard to race, color, religion, national origin, sex, age, marital status, disability, or sexual orientation.

MISSOURI

William Jewell College
Assistant Professor of Mathematics
The Department of Mathematics at William Jewell College invites applications for the tenure-track position of Assistant Professor of Mathematics to begin August 2004. A Ph.D. in mathematics or closely related field is required. Area of specialty is open; however, applied, computational, or financial expertise along with the ability and desire to mentor students in scholarly activity is preferred. Successful applicant will be able to teach within a full range of undergraduate courses. Candidates must submit a cover letter, CV, statement of teaching philosophy, a brief plan for mentoring of undergraduates in scholarly activity, and arrange for three letters of reference to be sent to Mathematics Search Committee, WJC Box 1017, William Jewell College, Liberty, MO 64068. NO E-MAIL APPLICATIONS ACCEPTED. For more information about the college see http://www.jewell.edu/. William Jewell College, among the oldest colleges west of the Mississippi River, is one of a select group of 218 liberal arts colleges named by the Carnegie Foundation for the Advancement of Teaching and included among "America's Best Colleges" by U.S. News and World Report. William Jewell offers a liberal arts education within a distinctively Christian context.

NEW HAMPSHIRE

Dartmouth College
John Wesley Young Research Instructorship
The John Wesley Young Instructorship is a post-doctoral two-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 algebra, analysis, combinatorics, geometry, logic and set theory, number theory, probability, 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. Nine-month salary of $44,676.00 supplemented each year by summer research stipend of $9,928.00 for Instructors in residence for two months in summer. To be eligible for a 2004-2006 Instructorship, candidate must be able to complete all requirements for the Ph.D. degree before September, 2004. Applicants should get a copy of the application information and the required response-form at http://www.math.dartmouth.edu/recruiting/. Or, submit a letter of application, curriculum vitae, graduate school transcript, thesis abstract, statement of research plans and interests, and at least three, preferably four, letters of recommendation to

Donna Black, Department of Mathematics, Dartmouth College, 6188 Bradley Hall, Hanover, New Hampshire 03755-3551. At least one referee should write about applicant's ability; at least two referees should write about applicant's research ability. Applications received by January 5, 2004 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.

Dartmouth College
The Department of Mathematics anticipates a tenure-track opening with initial appointment in the 2004-2005 academic year. The position is for an Assistant Professor in Applied Mathematics who has practical experience in statistical techniques and methods. Various applied projects in the department are currently funded by NSF, NIH, and DoD. Active collaborations with computer science, the medical and engineering schools, and programs in cognitive neuroscience exist. Collaborations and/or appointments in Dartmouth's M.D./Ph.D. program, as well as Dartmouth's Institute for Secure Technologies Studies, are also possible. Candidates with several years of experience should be able to give evidence of a research program that has achieved peer-recognition and which promises future research leadership in the mathematical community. Candidates who do not have this level of experience must have demonstrated the potential for future mathematical research leadership in their Ph.D. work. In exceptional circumstances, an appointment to a higher level may be possible.

Candidates for the position must be committed to outstanding teaching and interaction with students at all levels of undergraduate and graduate study, and must demonstrate an exceptional potential for research. Candidates should have demonstrated practical experience in statistical techniques and methods and be eager to take responsibility for the department's statistics offerings.

To create an atmosphere supportive of research, Dartmouth offers new faculty members grants for research-related expenses, a quarter of sabbatical leave for each three academic years in residence and flexible scheduling of teaching responsibilities. The teaching responsibility in mathematics is two courses per quarter for two ten-week quarters or one course for each of two quarters and two courses for one quarter. The combination of committed colleagues and bright, responsive students encourages excellence in teaching at all levels.

To apply, get a copy of the application information and the required response-form at http://www.math.dartmouth.edu/recruiting/. Or, send a letter of application, curriculum vitae, and a brief statement of research results and interests, and arrange for four letters of reference, at least one of which specifically addresses teaching, to be sent to Donna Black, RecruitingSecretary, Department of Mathematics, Dartmouth College, 6188 Bradley Hall, Hanover, New Hampshire 03755-3551. Applications received by January 5, 2004 will receive first consideration.

Dartmouth College is committed to diversity and strongly encourages applications from women and minorities. Inquiries about the progress of the selection process may be directed to Dan Rockmore, Recruiting Chair.

NEW JERSEY

The College of New Jersey
Department of Mathematics & Statistics
Applications are invited for a tenure track position in Mathematics Education starting August 2004 with rank and salary dependent on qualifications. The position requires a doctorate in Mathematics Education, Mathematics, or Statistics with a strong background and interest in K-12 mathematics education. The successful candidate will be expected to conduct research in mathematics education and contribute to the teaching and service mission of the department at a level that will enhance the distinction of the program.

Normal teaching load is 3 courses per semester, which will include content and methods courses and/or supervision of student teachers. Reduced teaching loads and/or grants are available to support substantial scholarly activities.

Applicants should send a letter of interest highlighting their qualifications and research objectives, a current vita, including names/addresses of individuals providing recommendations, and three letters of recommendation addressing teaching and research to: Search Committee, Department of Mathematics & Statistics, The College of New Jersey, P.O. Box 7718, Ewing, NJ 08628-0718. Review of applications will begin December 2003 and will continue until the position is filled or the search is terminated. To enrich education through diversity, TCNJ is an AA/EOE. For more information about The College, see our web-site at: www.tcnj.edu.

NEW YORK

Borough of Manhattan Community College/CUNY
Join the Premier Community College in the Nation
Mathematics (13)
Appropriate Professorial Rank or Instructor
Teach mathematics courses from developmental math through differential equations. Productive scholarship, grantsmanship, mentoring student projects & service to college & department expected. Evening/Weekend schedule may be req. College-level teaching exp. req. Exp. in one or more of the following pref.: teacher education, graphing calculators, computer algebra systems, computer-based learning, software development &/or innovative pedagogy. Master's degree req. for Instructor, Doctorate req. for professorial titles. Doctorate pref. For Associate Professor & Professor, the candidate must have a record of significant achievement in the field. Vac.# 981.

Salary:

Instructor:	$32,133 - $52,123
Assistant Professor:	$35,031 - $61,111
Associate Professor:	$45,651 - $73,028
Professor:	$56,664 - $87,757

College Laboratory Technician

Responsible for running calculus and statistics laboratories. Assist instructors & students in using software. Train & supervise tutors. Maintain networks of Macintosh & other personal computers. Other duties as assigned by the chairperson. Evening/Weekend schedule may be req. Bachelor's degree in related field req. Proficiency in calculus & statistics req. Exp. with Macintosh & other personal computers and extensive knowledge of computer algebra systems essential. Ability to work well with others a must. Vac.# 982. Salary: $29,960 - $45,022

Refer to BMCC Vacancy # and Forward Two (2) Resumes Along With Two(2) Cover Letters to:

Office of Human Resources
Search Committee – (Vacancy #)
Borough of Manhattan Community College/CUNY
199 Chambers Street, New York, NY 10007

Visit our website: www.bmcc.cuny.edu

An Equal Opportunity/AffirmativeAction/American Disability Act Employer/IRCA Verification Required-No Phone calls, Please.

NORTH CAROLINA

Meredith College
Faculty Position-Mathematics
Meredith College seeks candidates for Assistant or Associate Professor in the Department of Mathematics and Computer Science to begin Aug. 2004 subject to budget approval. Applicants must have a doctorate with at least eighteen graduate hours in statistics. Send **resume, teaching philosophy, and three letters of support** by 12/1/03 to: Dr. Charles Davis, Head, Department of Mathematics and Computer Science, Meredith College, 3800 Hillsborough Street, Raleigh, NC 27607-5298. Complete job description at www.meredith.edu. Meredith College is an Equal Opportunity Employer and encourages minority applicants.

PENNSYLVANIA

Millersville University of Pennsylvania
Full-time, tenure-track assistant professorship to begin August 2004. Area of expertise in MATHEMATICS EDUCATION. The department, consisting of 20 faculty members and approximately 180 undergraduate majors, offers B.A. and B.S. degrees in mathematics and B.S.Ed. and M.Ed. degrees in mathematics education. Duties include an annual 24-hour teaching load, including mathematics courses for pre-service elementary and secondary teachers and a variety of undergraduate mathematics service courses, scholarly activity, student advisement, curriculum development in mathematics education at both the

undergraduate and graduate levels and committee work. Doctorate (or completion by second year of reappointment) in mathematics education or in mathematics with a specialization in mathematics education is required, including at least 30 hours of graduate level courses in pure or applied mathematics. Must exhibit evidence of strong commitment to excellence in teaching and continued scholarly activity, and have familiarity with current directions in mathematics education, including technology. Must complete a successful interview and teaching demonstration. Evidence of teaching effectiveness is a primary consideration. Preference will be given to candidates with experience teaching both K-12 and college-level mathematics. Candidates must be able to work effectively with professional groups and community groups. Salary/benefits are competitive. Completed application must be received by **January 20, 2004** to assure full consideration. E-mail applications will not be accepted. Send application letter, vita, copies of undergraduate and graduate transcripts and three letters of reference (at least two of which attest to recent teaching effectiveness) to Dr. Dorothee Blum, Search Committee/**FOC1203**, Department of Mathematics, Millersville University of Pennsylvania, P.O. Box 1002, Millersville, PA 17551-0302. An Equal Opportunity/Affirmative Action Institution.

Westminister College
Department of Mathematics
and Computer Science
Tenure-Track Position
Applications are invited for a tenure-track position in mathematics beginning in August 2004. Successful candidates must possess a Ph.D. for appointment at the rank of assistant professor, be committed to excellence in teaching in an undergraduate liberal arts environment, and be prepared to engage in continuing scholarly activity. The Department seeks candidates with broad intellectual interests. The teaching load for this position is six courses per academic year. We will be interviewing at the Phoenix meetings.

Westminster College, a coeducational, liberal arts institution, is located in a beautiful rural setting 50 miles northwest of Pittsburgh and 80 miles southeast of Cleveland. For more information, please visit our website at www.westminster.edu. Applicants should send a letter of application, curriculum vita, three letters of recommendation, summary of teaching evaluations, and graduate transcripts to Search Committee c/o Warren D. Hickman, Department of Mathematics and Computer Science, Westminster College, New Wilmington, PA 16172. hickmanw@westminster.edu Applicant review will begin December 1, 2003. ***EOE***

OKLAHOMA

The University of Oklahoma
Department of Mathematics
Applications are invited for one or more full-time, tenure-track position(s) in mathematics beginning 16 August 2004. The position(s) is initially budgeted at the assistant professor level, but an appointment at the associate professor level may be possible for an exceptional candidate with qualifications and experience appropriate to that rank. Normal duties consist of teaching two courses per semester, conducting research, and rendering service to the Department, University, and profession at a level appropriate to the faculty member's experience. The position(s) requires an earned doctorate and research interests that are compatible with those of the existing faculty; preference will be given to applicants with potential or demonstrated excellence in research and prior successful undergraduate teaching experience. Salary and benefits are competitive. For full consideration, applicants should send a completed AMS cover sheet, curriculum vitae, a description of current and planned research, and have three letters of recommendation (at least one of which must address the applicant's teaching experience and proficiency) sent to:

Search Committee
Department of Mathematics
The University of Oklahoma
601 Elm, PHSC 423
Norman, OK 73019-0315

Phone: 405-325-6711
FAX: 405-325-7484
E-mail: search@math.ou.edu

Screening of applications will begin on December 15, 2003 and will continue until the position(s) is filled.

The University of Oklahoma is an Equal Opportunity/Affirmative Action Employer. Women and Minorities are encouraged to Apply.

OREGON

University of Oregon
Department of Mathematics
Applications are invited for tenure-track Assistant or Associate Professor positions in all areas of pure and applied mathematics, statistics and mathematics education. Qualifications are a Ph.D. in the mathematical sciences, an excellent record of research accomplishment, and evidence of teaching ability. See http://darkwing.uoregon.edu~mathemployment.html

Competitive salary with excellent fringe benefits. Mail complete vita and at least three letters of recommendation to Search Committee, 1222 Department of Mathematics, University of Oregon, Eugene, OR 97403-1222. Application materials may NOT be submitted electronically.

Closing date is January 5, 2004. Women and minorities are encouraged to apply. The University of Oregon is an EO/AA/ADA Institution committed to diversity.

SOUTH CAROLINA

Coastal Carolina University
Assistant Professor of Mathematics and Statistics
The Department of Mathematics and Statistics at Coastal Carolina University is seeking candidates for two (2) tenure track positions at the rank of Assistant Professor beginning Fall 2004. Successful candidates must have an earned Ph.D. by August 2004. Background in Discrete Mathematics, Geometry, Applied Mathematics, Analysis or Statistics is preferred. Other research areas will be considered. Positions will include a teaching load of 12 credits per semester and conducting research in field of study. Course reduction in the second semester will be available for candidates with strong research performance.

Coastal Carolina University is a growing, state-supported liberal arts institution where the emphasis is on undergraduate education, and increasing importance is placed on faculty mentored student research projects and public service. The University is located approximately 10 miles west of Myrtle Beach, South Carolina.

Interested applicants should submit the standard AMS cover sheet, a letter of application, curriculum vitae, statement of teaching and research interests, and three letters of reference, at least one of which should address the candidate's teaching experience, to Dr. Prashant S. Sansgiry, Chair, Department of Mathematics and Statistics, Coastal Carolina University, P.O. Box 261954, Conway, SC 29528-6054. To ensure consideration, applications should be received by December 15, 2003. Review of candidates will continue until the positions are filled. Candidates should indicate if planning to be in attendance at the AMS annual meeting in Phoenix, Arizona in January 2004 in the letter of application.

For additional information about the Department of Mathematics and Statistics visit http://www.coastal.edu/math/.

Coastal Carolina University is an AA/EO employer.

Wofford College
Tenure Track Appointment beginning August 2004. Qualifications: Ph.D. in Mathematics, excellence in teaching undergraduates, continuing professional growth, ability to use technology to improve understanding, and reflective concern for the teaching and learning of mathematics. Salary commensurate with qualifications and experience. Send a letter of application, vita, graduate transcripts, and three letters of recommendation, at least one of which assesses teaching ability and potential, to Lee O. Hagglund, Chairman, Department of Mathematics, Wofford College, Spartanburg, SC 29303-3663. Go to http://dept.wofford.edu/mathematics/facultyposition.html

TENNESSEE

University of Tennessee
The University of Tennessee Department of Mathematics invites applications for the position of Head. A Ph.D. in Mathematical Sciences is required. The successful candidate should qualify to be tenured at the rank of Full Professor in the department. Evidence of a distinguished record of research and a commitment to teaching as well as administrative experience should be provided at the time of application. A commitment to supporting both pure and applied mathematics is expected. Strong leadership skills and the ability to

work effectively with colleagues, staff, and students are especially important characteristics. Experience with curricular matters, notable activity in professional associations, and experience with generating external funding are highly desirable. The successful candidate will also have an understanding of and demonstrated commitment to equal employment opportunities and affirmative action. The Mathematics Department currently consists of 39 full-time faculty, 30 full and part-time lecturers and 60 full-time graduate students representing both pure and applied mathematics. The faculty has a strong commitment to graduate and undergraduate teaching, is associated with many interdisciplinary programs, and maintains close research relationships with the Oak Ridge National Laboratory.

Applicants should submit a letter of application including current research interests and administrative philosophy, a curriculum vitae, and at least 3 letters of recommendation. Women and minorities are encouraged to apply. Address material to: Chair, Math Head Search Committee, Department of Mathematics, 121 Ayres Hall, University of Tennessee, Knoxville TN 37996-1300. Review of applications will begin February 1, 2004, and will continue until the position is filled.

The University of Tennessee ***is an EEO/AA/Title VI/Title IX/Section 504/ADA/ADEA institution in the provision of its education and employment programs and services.***

VIRGINIA

Shenandoah University
Mathematics Faculty: The Mathematics Department at Shenandoah University invites applications for a full-time, career contract track, assistant professor position in mathematics beginning in August 2004. A Ph.D. in mathematics is preferred. The successful candidate would be expected to teach introductory level mathematics courses as well as higher level courses such as Numerical Analysis and Biostatistics. Teaching is recognized as the most important faculty activity at Shenandoah University, and we seek faculty members who focus on individual student learning styles and motivations. The interaction of scholars in various disciplines and teaching fields is encouraged as the university develops interdisciplinary programs in health profession education. Academic service, such as mentoring students, and scholarship are also expected. Shenandoah encourages faculty/student collaborative research. Joint spousal applications are welcomed. Complete applications will include a statement of interest, including a statement of teaching philosophy, curriculum vitae, official transcripts, and three letters of recommendation. Send applications to: Dr. Elaine F. Magee, c/o Office of the Dean of Arts and Sciences, Shenandoah University, 1460 University Dr., Winchester, VA 22601-5195. Review of applications begins November 15 and continues until the position is filled. EOE. No phone calls, please.

Virginia Polytechnic Institute and State University
Assistant Professor Mathematics Education
Virginia Polytechnic Institute and State University (Virginia Tech) invites applications for a tenure track faculty position in Mathematics Education in the Department of Teaching & Learning at the Northern Virginia (Falls Church) location beginning August 10, 2004. Virginia Tech is an Equal Opportunity/Affirmative Action Institution. For complete job description, go to www.tandl.vt.edu.