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Inside

Cover artist John Johnson imagines a game show about mathematicians and colored hats. See page 4.

FOCUS Deadlines

	January	February	March
Editorial Copy	November 15	December 14	January 15
Display Ads	November 26	December 21	January 29
Employment Ads	November 12	December 10	January 15

Norway Establishes Abel Prize in Mathematics

Norway has established a new international prize in mathematics, named after Niels Henrik Abel (1802-1829), the most famous Norwegian mathematician of the 19th century. Jens Stoltenberg, the Norwegian Prime Minister, announced that the Norwegian government will set up a $22 million fund to endow the prize in 2002, the two hundredth anniversary of Abel's birth. The Abel Prize will be awarded annually beginning in 2003. It will include a monetary award worth about $500,000. An independent international committee of mathematicians will choose the laureates.

"We need to strengthen mathematics and the sciences," Stoltenberg said. "Niels Henrik Abel was an internationally known Norwegian mathematician who nearly 200 years ago made a lasting impact in the world of science. An international prize in mathematics dedicated to his name, is an expression of the importance of mathematics, and is intended to encourage students and researchers."

The Norwegian Government hopes that the Abel Prize will increase public awareness of research in mathematics and that it will also reinforce Norway's image as a country that values knowledge and learning. The International Mathematical Union and European mathematical societies have expressed support for the prize.

An Abel Prize was first proposed in 1902, by Oscar II, then king of Sweden and Norway. When the union between the two countries was dissolved in 1905, the plan was abandoned. As a result, mathematics has never had an international prize of the same value and importance as the Nobel Prize. The hope of the Norwegian Government is that the Abel Prize will come to play that role.

For more information, see the September 7 issue of *Science* and the Norwegian Government web site at http://odin.dep.no/smk/engelsk/aktuelt/pressem/001001-990157/index-dok000-b-n-a.html. ■

From the Editor

As FOCUS goes to press, it is the early October, and we are just beginning to recover from the shock of September 11. We have only heard of one death directly related to the mathematics community: Daniel Lewin of Akamai, a good friend of mathematics and of the MAA. See page 14 for a short obituary.

The officers and staff of the MAA appreciates the notes and emails from members and friends expressing sorrow and concern for us in light of the terrorist attacks on America. In particular, the MAA thanks the Greek Mathematical Society and the Canadian Mathematical Society for their support and friendship.

This is a somber note with which to begin my third year as editor of FOCUS. This issue, which simultaneously looks back to the Madison MathFest and forward to future activities of the MAA, emphasizes the continuity of our lives and of the activities of the Association. Please continue to send me news about any events that might be of interest to MAA members. In particular, I'm always looking for cover images, for short expository articles about interesting new mathematics, and for good photographs of MAA people and events.

FOCUS is *your* newsletter. Please let me know what you'd like to see us do! You can contact me by email (the best way!) at fqgouvea@colby.edu, or by mail at Department of Mathematics, Colby College, Mayflower Hill 5836, Waterville, ME 04901.

Fernando Q. Gouvêa

Mathematics at the AAAS, February 2002

The American Association for the Advancement of Science will be holding its *Annual Meeting and Science Innovation Exposition* in Boston, MA on February 14–19, 2002. The program, as usual, includes several items of interest to mathematicians.

Several of the scheduled symposia concern the teaching of science and mathematics, including sessions on quantitative literacy, articulation between school and college, advanced mathematics and science in U.S. high schools, and gender issues. Other program items that have significant mathematical content include: a "Topical Lecture" by Carl Pomerance on "Hard Number Theory Problems and Cryptology." Further information, last minute updates, and online registration are located on the AAAS website: http://www.aaasmeeting.org. ■

JOMA Panel Session in San Diego

The MAA's new Journal of Online Mathematics and its Applications (JOMA) is now a year old. We will celebrate this event at the Joint Meetings in San Diego with a panel session featuring JOMA authors discussing their JOMA materials and their work in general. Members of the panel include:

- Dennis DeTurck, University of Pennsylvania
- John Kiltinen, Northern Michigan University
- Tom Leathrum, Jacksonville State University

The session will be introduced and moderated by JOMA editor David Smith (Duke University). The session will be held on Monday, January 7, 9:00 a.m.-10:30 a.m. The JOMA web site is http://www.maa-joma.org. This session has been organized by Lang Moore, Executive Editor of the Mathematical Sciences Digital Library (MathDL).

The Hat Problem and Hamming Codes

By Mira Bernstein

Consider the following two problems –one, an entertaining new puzzle, the other, an important practical question:

Problem 1: At a mathematical game show with n players, the host blindfolds the contestants and puts colored hats on their heads. The color of each person's hat– red or blue–is determined by a coin toss, independently of all the others. After the blindfolds come off, each player can see his teammates' hats, but not his own. When the host gives a signal, all players simultaneously either guess the color of their own hats or pass. If there are no incorrect guesses and at least one correct guess, the players share a $1,000,000 prize. There is no communication between the players during the show, but they are told the rules in advance and allowed to discuss their strategy. What should they do to maximize their chances of success?

Problem 2: In storing or transmitting digital data, there is always some risk of distortion: a 0 might accidentally flip to a 1 or vice versa. One way to deal with this problem is to introduce some redundancy into the transmission–for instance, by sending each bit multiple times. However, transmitting too many extra bits is costly and ineffective. How can we protect k bits of data against the possibility of an error by using the minimal number of additional "check bits"? Note that our method must not only detect the error, but also determine its precise location, so that the user can recover the original message every time.

On the surface, these two problems appear quite different. Underlying them, however, are very similar questions in the geometry of binary n-space. The problems are, in fact, dual to one another: they approach the same goal from opposite directions. This theoretical optimum is not attainable for most values of n and k, but when it is, the two problems have solutions based on the same "perfect" structure: the binary Hamming code.

Richard Hamming originally designed his code to tackle Problem 2, but let's begin our discussion with Problem 1, a recent hit in the mathematical community. An article in last April's *Science Times* [2] dates the puzzle's first appearance to 1998 and tells of it "spreading through networks of mathematicians like a juicy bit of gossip". Since the publication of the article, the gossip has spread ever faster and further. While the "hat problem" itself is just a restatement of an old question in coding theory, certain variations have led to new constructions that are the subject of current research. We discuss these briefly at the end of the article.

The Hat Problem

Many mathematicians, when they first encounter the hat problem, reason as follows. (a) Since the color of each hat is chosen independently, a player can obtain no useful information from studying her teammates' hats: whatever she sees and whatever she does, her probability of guessing correctly is always 1/2. (b) Since a single correct guess is enough to win, and a single incorrect guess spoils the game, a good strategy should always have most of the players passing, to minimize the risk. (c) Therefore, the optimal strategy is to have everyone pass, except for one designated player who (for example) always guesses "red". The probability of winning under this strategy is 1/2, and you can do no better.

The argument certainly sounds plausible enough. The first statement is certainly true, which seems to imply that nothing can be gained from cooperation among the players. In fact, however, cooperation allows the team to win with probability much higher than 1/2. Even with only three players, they can increase their chances to 3/4, and as the number of players grows, the probability of winning (under the correct strategy) rapidly approaches 1.

To explain why, it is better to introduce some notation and terminology. For n players, there are 2^n possible arrangements of hats; we refer to these as *configurations*. If we substitute 1 for "blue" and 0 for "red", the set of all configurations can be identified with binary n-space, $\mathbf{F}_2^n = \{0,1\}^n$. A *strategy* S is a complete set of instructions for each player: if you observe X, do Y (we consider only deterministic strategies). Given S, each possible hat configuration will be either "winning" or "losing". Denote the set of winning configurations by W_S and the set of losing configurations by L_S. Since all configurations are equally likely, the team's probability of winning is $|W_S|/2^n$. The goal, therefore, is to find S such that $|W_S|$ is maximal.

We might try to accomplish this goal by maximizing the frequency of correct guesses. However, a glance at statement (a) shows that this is hopeless. All it takes to change a good guess into a bad one is to change the guesser's hat. If the game is played 2^n times–once with each possible hat configuration–the total number of guesses made by the players will vary from strategy to strategy. However, the numbers of correct and incorrect guesses for a given strategy S will always be equal. Thus the expected fraction of correct guesses, both for an individual player and for the group as a whole, is 1/2, regardless of S.

The key to solving the hat problem is to realize that the guesses do not have to be distributed uniformly over the space of configurations. Our goal, after all, is to maximize not the number of correct guesses, but the size of W_S. Suppose that, under strategy S, the total number of guesses made by all players in all configurations is $2w$–of which, necessarily, w are correct and w are incorrect. Since a winning configuration requires at least one correct guess, $|W_S|$ cannot exceed the number of correct guesses, w. $|W_S|$ will be equal to w only if in each winning configuration, exactly one person guesses and the rest of the players pass. On the other hand, the minimal number of configurations in L_S is w/n. This can happen only if in every configuration *not* in W_S, all of the players guess incorrectly. (In particular, there should be no configurations where all players pass.) Intuitively, we want to spread out the correct guesses as widely as possible and to concentrate all the incorrect ones on just a few bad points. (Contrast this with statement (b), above.)

A strategy that achieves such a distribution of correct and incorrect guesses is called *perfect*. At this stage, we do not know whether perfect strategies exist, for any n. However, we do know that the probability of winning under a perfect strategy is

$$\frac{|W_S|}{|W_S|+|L_S|}=\frac{w}{w+\frac{w}{n}}=\frac{n}{n+1}$$

This gives an upper bound for what our team of n players can aspire to.

In fact, it is not hard to see that perfect strategies can exist only for very special values of n. We must have

$$2^n=|W_s|+|L_s|=w+\frac{w}{n}=\frac{w(n+1)}{n}$$

Since $|L_S|=w/n$ is an integer, we conclude that $n+1 \mid 2^n$, which is only possible if $n=2^m-1$ for some m. Remarkably, for all such n, perfect strategies do exist. Before going on, the reader may want to try her hand at finding such a strategy for the simplest case, $n = 3$.

Coverings

As we have seen, any strategy S partitions $\mathbb{F}_2^n$ into two disjoint subsets, L_S and W_S. For a perfect strategy, these subsets have specified sizes, but as yet we know little about their other properties. A natural question is: can every subset of $\mathbb{F}_2^n$ function as L_S for some strategy S? If not, what are the necessary and sufficient conditions?

The conditions, it turns out, are geometric. $\mathbb{F}_2^n$ has a natural metric space structure, the *Hamming metric*, in which the distance $d(x,y)$ between two vectors x, y in $\mathbb{F}_2^n$ is defined to be the number of entries where x and y differ. (In terms of our game, the distance between two hat configurations is the number of players whose hats would have to change color.) The *ball of radius r around a point y* is defined as usual: $B_r(y) = \{x \text{ in } \mathbb{F}_2^n : d(x, y) \le r\}$.

Fix a strategy S, and consider a point x in W_S. Since x is a winning configuration, the instructions in S must lead at least one player to guess his own hat color correctly. If we secretly change his hat, his instructions will still be the same–but in the new configuration his guess will be wrong, and the team will lose. Thus for every winning configuration x, some configuration at a distance 1 from x must be losing. Equivalently, each x in W_S is contained in a ball of radius 1 around some point y in L_S. Thus, together, the unit balls around the points of L_S cover the entire space of configurations. Formally, the union of the balls $B_1(y)$ for y in L_S is all of $\mathbb{F}_2^n$.

Conversely, given any set L with this property, we can construct a strategy S such that $L_S = L$. In this strategy, the instructions to Player i read as follows: "*You do not know what configuration of hats your team has been given. However, from looking at your teammates' hats, you can determine that it is one of two configurations, x and x', which differ only in the i-th coordinate (corresponding to the color of your own hat). Guessing your hat color is the same as guessing whether the actual configuration is x or x'. If exactly one of these configurations is in L, guess the other. If neither or both are in L, pass.*" The role of the covering condition is to ensure that in every configuration outside of L, at least one player will make a guess.

Readers familiar with coding theory or discrete geometry will recognize the definition of a *covering*. For any metric space X, we say that a subset C of X is an *r-covering of X* if the union of all $B_r(y)$ for y in C is equal to X. Coverings are easy to visualize in Euclidean space: just imagine filling a region with balls of radius r, possibly overlapping, in such a way that every point lies in ("is covered by") at least one ball.

What we have shown is that strategies for the n-player hat problem are exactly equivalent to 1-coverings of $\mathbb{F}_2^n$. The centers of the balls are precisely the points of L_S–the losing configurations. The challenge, therefore, is to minimize the number of balls, by "spreading them out" as evenly as possible and avoiding overlaps. Ideally, we would like to cover all of $\mathbb{F}_2^n$ without any of the balls overlapping at all. This is called a *perfect covering*, and corresponds, not surprisingly, to a perfect strategy. In Euclidean space, perfect coverings are impossible. In $\mathbb{F}_2^n$, they cannot exist unless the size of a unit ball ($n+1$ points) exactly divides the size of the whole space ($2n$ points). This leads to the same conclusion as before: $n = 2^m - 1$ for some m. We have thus reduced the hat problem to a classic question in coding theory: finding maximally efficient (if possible, perfect) 1-coverings in $\mathbb{F}_2^n$.

Packings

Let us now go back and look at Problem 2. Here our task is to transmit a k-bit message in such a way that the original can be recovered even if one bit in the transmission gets distorted. Suppose we use a total of n bits to transmit the message. In our original formulation, the goal was to minimize n given k, but we can also invert the problem and ask how we can maximize k given n.

To each of the 2^k possible messages, we assign a vector in $\mathbb{F}_2^n$, which is just the sequence of 0's and 1's that we intend to transmit. The resulting set of 2^k designated points in $\mathbb{F}_2^n$ is called a *code*; its elements are called *codewords*. Now suppose an error occurs in transmission: one bit is changed, and the addressee receives a vector at distance one from the intended codeword. If the received vector is itself a codeword, the addressee will not even notice the error. If the received vector is not in the code, the addressee will realize that something went wrong and will look for the closest codeword. However, if he finds multiple codewords at distance one from the received vector, he cannot be sure which one was intended. In either case, he will not be able to recover the message correctly. Thus we must devise our code in such a way that any vector contained in a unit ball around a codeword has distance at least 2 from any other codeword. In other words, the unit balls around the codewords must be disjoint.

There is a name for this condition: our code must be a *1-packing* of $\mathbb{F}_2^n$. In general, an *r-packing* of a metric space X is a subset C such that the balls of radius r centered at the points of C are disjoint. Recall that for coverings, the challenge was to use as *few* balls as possible and still have them fill the entire space. For packings, on the other hand, the challenge is to squeeze as *many* balls into the space as possible. A perfect covering is, at the same time, a perfect packing–an ideal equilibrium arrangement that solves both problems simultaneously. For $r > 1$, there is only a single instance of such a perfect arrangement (aside from some trivial cases): the Golay code, with $n = 23$, $r = 3$ [1]. But when $r = 1$, for every value of n where such an arrangement *can* exist, it *does* exist. These are the Hamming code.

Hamming Codes

Recall that perfect 1-coverings or 1-packings can exist only when $n = 2^m - 1$ for some m. Let P be the m x n matrix whose i-th column is the binary expansion of the number i, padded with extra 0's at the beginning if necessary. For instance, for $m = 3$,

$$P = \begin{pmatrix} 0001111 \\ 0110011 \\ 1010101 \end{pmatrix}$$

As usual, P defines a linear map from $\mathbb{F}_2^n$ to $\mathbb{F}_2^m$. The *binary Hamming code H* is the kernel of this map. Since P is always full-rank, H is a linear subspace of $\mathbb{F}_2^n$ of dimension $n - m$. Thus H contains $2^{n-m} = 2^n/(n+1)$ points, exactly the right number for a perfect 1-covering/1-packing.

To see that H really is both a packing and a covering, let's check that it gives a solution to both of the problems we have been discussing. (We could also have checked the packing and covering conditions directly, but it is more interesting and instructive to see H at work.)

Transmitting a message of k = n – m bits: It does not matter how we assign points of H to the 2^k possible messages. What matters is that when the addressee receives a vector x in $\mathbb{F}_2^n$, she should be able to determine which vector from H was actually transmitted. To do this, she simply computes Px. If the result is 0, then x was the intended transmission and no error has occurred. Otherwise, Px is the binary expansion of some integer i between 1 and m. To recover the original transmission, the addressee must change the i-th entry of x: this is the entry that got distorted in transmission.

The perfect strategy for n players: Before the game, each player is assigned a number from 1 to n. Once the hats are in place, each player mentally constructs the vector x corresponding to the hat configuration that he observes, with a 0 in his own entry. He then computes Px. If the result is 0, he guesses "1". If the result is the binary expansion of his own number, he guesses "0". Otherwise, he passes.

As an exercise, the reader can try to predict the actions of a team of seven players whose hats are Red, Blue, Red, Red, Blue, Blue, and Red. Who will guess and who passes if "1" = Blue? What about if "1" = Red? Is the answer surprising?

Open Problems: Imperfect Strategies and Multicolored Hats

When the number of players is not $2^m - 1$, the team has to settle for a 1-covering of $\mathbb{F}_2^n$ that is not perfect. A good measure of the "imperfection" of a 1-covering (or 1-packing) C is its *density, defined by* $d = |C|(n+1)/2^n$. For a packing, d is the fraction of the space $\mathbb{F}_2^n$ that is covered by the unit balls: $d \le 1$. For a covering, d is the average number of balls that contain each point of $\mathbb{F}_2^n$, so $d \ge 1$. In the perfect case, of course, $d = 1$.

Asymptotically, it is known that the densities of the best coverings and packings for all values of n come arbitrarily close to 1 (see [1]). However, these packings and coverings do not have a nice algebraic structure like the Hamming codes, and no general method is known for constructing them. For now, the best general advice we can offer a team of n players is to have $2^m - 1$ of them play according to a Hamming code strategy, while the rest pass. This is clearly not optimal (as n goes to infinity, d can get arbitrarily close to 2), but it is not too bad either: the probability of winning is still at least $n/(n+2)$.

The problem of finding optimal 1-coverings in $\mathbb{F}_2^n$ is hard, but it is not new. In contrast, if we try to play the game with more than two hat colors, we enter into uncharted territory. Let Q be a set of q colors, $q \ge 2$. In the configuration space Q^n, we can define L_S, W_S, and the Hamming metric exactly as before. We can even talk about perfect strategies –strategies in which, for each hat configuration, either one player guesses correctly or all guess incorrectly. But although there is a well-developed theory of coverings for $q \ge 2$ (for instance, the definition of a Hamming code can be extended to work over any finite field), a moment's thought shows that none of these results have any relevance to the multicolored hat problem. For $q \ge 2$, the condition on the set L_S is no longer the same as the 1-covering condition. It leads to a new sort of "code" that has never been studied before.

Recently, a few coding theorists have begun to tackle the multicolored hat problem. For instance, Hendrik Lenstra and Gadiel Seroussi have shown that no perfect strategies exist for $q \ge 2$. On the other hand, for any q, they can construct strategies which, as n approaches infinity, allow the team to win with probability approaching 1. (Remarkably, these strategies use *binary* Hamming codes for all q.) It is not clear what practical applications these constructions might have, but coding theory is full of unexpected connections. The original hat problem, once its geometric structure was exposed, seemed like the most natural instance of 1-coverings imaginable–yet no one had thought of it until a few years ago. Perhaps in a few more years, the codes that arise from the multicolored hat problem will also turn out to be useful in an entirely different–maybe even practical–context.

Acknowledgments: I am grateful to Gadiel Seroussi for sharing the slides from his recent talk, "On Hats and Other Covers". ■

References

[1] Cohen, G., Honkala, I., Litsyn, S., Lobstein, A., *Covering Codes*. North-Holland, 1997.

[2] Robinson, S., "Why Mathematicians Now Care About Their Hat Color." *The New York Times*, April 10, 2001. Online at http://www.msri.org/activities/jir/sarar/010410NYTArticle.html.

MAA looks for a New Treasurer

In January of 2002, Jerry Porter will complete ten years of service as MAA Treasurer, which followed eight years as an elected member of the Finance Committee. During that period, the MAA has been put in a much stronger financial position and its procedures have been modernized. But Porter has not only been the guardian of the MAA's finances. From the time he was first elected to the Board as the Governors from the EPADEL Section in 1980, he has repeatedly acted as the Association's conscience on human rights issues as well.

MAA President Ann Watkins has created a search committee charged with recommending a new Treasurer to the Board. The committee members are:

- Barbara Faires (chair), former chair of the Budget Committee;
- Ron Graham, member of the Investment Committee and soon to be President-Elect;
- Barbara Osofsky, First Vice-President.

The committee has issued the call for nominations printed below. ■

Call for Nominations: MAA Treasurer

The Committee charged with the responsibility of recommending candidates for the position of Treasurer of the MAA seeks input. Members of this Treasurer Search Committee are Barbara Faires, Chair, Ron Graham, and Barbara Osofsky. If you would like to suggest a candidate or would like to be considered yourself, please contact Barbara Faires by e-mail (faires@westminster.edu) as soon as possible.

The term of the treasurer position is five years. According to the MAA Bylaws,

- The Treasurer shall have the usual duties pertaining to the office including the collection of dues and the supervision and safekeeping of the funds of the Association.
- The Treasurer shall be responsible for the control and administration of all investment funds; endowment, trust, and gift funds; and such other funds as the Board may designate.

The Search Committee makes its recommendations for candidates for the position of Treasurer to the Executive Committee. The Executive Committee will present the nominations to the Board, which will elect the MAA Treasurer. ■

Report on the Mathematical Education of Teachers Released

Copies of the Conference Board of the Mathematical Sciences report on *The Mathematical Education of Teachers* were sent to mathematics departments across the nation in September. The report attempts to distill the essence of current thinking on curriculum and policy issues and to apply these ideas to programs for the preparation of future teachers. The authors hope that the report will motivate the mathematical community to get more seriously involved with teacher preparation. One of the major themes of the report is that school mathematics has intellectual substance and depth, and that this should guide the efforts to reform teacher preparation programs.

The report is available in two formats. Part I only, published by the MAA, can be obtained free of charge from CBMS (1529 Eighteenth St. NW, Washington, DC 20036, or send email to kolbe@math.georgetown.edu). The complete report (Parts I and II) was published by the American Mathematical Society. Both parts are also available online at http://www.maa.org/cbms. ■

Fermat's Last Tango Available on CD and Video

Both the cast album and a video recording of the York Theatre Company's production of *Fermat's Last Tango* are now available. As described in the November, 2000 issue of FOCUS, Fermat's Last Tango is a musical play by Joshua Rosenblum and Joanne Sydney Lessner based on Andrew Wiles' proof of Fermat's Last Theorem. The musical was described by *The New York Times* as "rollicking, whimsical, catchy and clever", and completed a successful run at the York in December 2000.

The CD, which will be distributed on the Original Cast Records label, contains all the musical numbers from the show. The accompanying booklet features the complete libretto, production photos, and essays by the authors and by Andrew Wiles. Visit http://www.fermatslasttango.com for more information about the cast recording and the play.

In addition, the Clay Mathematics Institute has produced a video recording of the musical. It is available in VHS and DVD formats and comes with a booklet discussing the production and the history of Fermat's Last Theorem and its proof. For information about obtaining the video, please visit the Clay Mathematics Institute web site at http://www.claymath.org. ■

An Experiment that Worked: Revising the Calculus Curriculum

By William W. Johnston, Alex M. McAllister, John H. Wilson

In 1998, at Centre College , we launched a significant curricular experiment with our introductory precalculus-calculus sequence. The *Precalculus* course was eliminated and the *Calculus I* course was reorganized with an emphasis on making functions, rather than the calculus tools, the primary objects of study. The outcomes of this revision have been quite positive: most significantly, they have led to an increase in both the number of students completing *Calculus II* and the number of students majoring in mathematics at Centre.

The Centre College academic calendar consists of three terms: a twelve week Fall Term, a six week Winter Term, and a twelve week Spring Term; every college course meets for 36 hours. Until the 1998–99 academic year, *Precalculus–Calculus I–Calculus II* was a standard Fall–Winter–Spring course sequence for freshmen, allowing those students with weaker mathematical backgrounds to complete *Calculus II* by the end of their first year and be on track for a mathematics or science major. While this plan seemed promising in theory, the results were quite disappointing.

During the 1990's, we found that more and more of our entering freshmen reported having some exposure to calculus in their high school preparation for college. In spite of this fact, we continued to place many students in the precalculus course. As a placement tool we use a test that measures knowledge of algebraic, trigonometric, exponential and logarithmic functions. Those students who had taken calculus in high school but did not perform well on the placement test believed they had taken a step backward in their mathematics education when they were enrolled in the precalculus course.

Even students who had not taken calculus often viewed the precalculus course as a repeat of a high school precalculus course they had failed to understand or see the point of in the first place. The argument that precalculus prepares students to study calculus was not persuasive even for those students who had been exposed to calculus in high school. These precalculus students often became very discouraged and most dropped out of mathematics altogether after one or two courses. In the fall terms from AY 92–93 to AY 97–98, 308 freshmen took precalculus, but only eight of those completed Calculus II in the spring, a retention rate of 2.6%.

Many students entering at the precalculus level were extremely bright and just as capable at understanding new concepts as those entering at the calculus level; they were usually "just" weaker in their algebraic and function skills. Surely we could find a way to shore up their weaknesses, while also furthering their forward progress in the mathematics curriculum.

In AY 97–98, we began making plans to eliminate the traditional precalculus course from the curriculum. We wanted to take advantage of two particular opportunities: our 12–6–12 academic calendar and the increasing number of freshmen exposed to calculus in high school. We read about curricular experiments mixing precalculus and calculus in the same course and the use of "just in time algebra". Instead of scheduling the traditional *Precalculus* in the fall followed by a compressed *Calculus I* in the winter, we realized that we could extend the *Calculus I* topics over a two-term fall/winter sequence and use the extra class meetings to reinforce precalculus concepts. Students following this track would be ready to enroll in *Calculus II* in the Spring Term.

As we began developing the syllabus for a new precalculus-calculus sequence, we decided we should do more than just teach the usual calculus course with some extra days of precalculus review. We devised a calculus course with a new and different perspective. The focus of our traditional *Calculus I* had been to define the three calculus tools (limit, derivative, and integral) and apply these tools to "any" known function. This approach worked well for those students who had a good understanding of the many different types of functions. Unfortunately, this traditional approach seemed to overwhelm students who did not have a working knowledge of the different types of functions to which we were applying the calculus tools.

We decided to organize the new precalculus-calculus sequence around three classes of functions – algebraic, exponential, and trigonometric. The primary objects of study are the functions, not the calculus tools used to investigate the functions; indeed, the heart of this revision is this paradigm shift from a calculus course designed around calculus tools to a sequence of calculus courses designed around functions. We named this two-course sequence *Math Functions I and II*, and Table 1 provides a general course outline.

About two-thirds of the first course (in the Fall Term) studies differential calculus for algebraic functions. We begin with a brief precalculus review with an emphasis on improving algebra skills. After that, a first exposure to limits, the definition of the derivative, rules of differentiation, and applications of the derivative all occur in the context of only algebraic functions. Students learn and understand how these tools of the calculus provide information about the behavior of the "safe and easy" algebraic functions. We spend the last weeks of the first course studying exponential and logarithmic functions and both limits and derivatives for these new functions. Thus, students learn about exponential and logarithmic functions in the context of an extended review of the differential calculus.

The second course (in the Winter Term) begins with the Mean Value Theorem and

Table 1:

General Syllabus for Math Functions I – Fall 2000 (36 class hours)	
Days 1 – 6	Algebraic Functions
Days 7 – 13	Limits of Algebraic Functions
Days 14 – 21	Derivatives of Algebraic Functions
Days 22 – 29	Applications of Derivatives (Related Rates, Optimization)
Days 30 – 36	Exponential and Logarithmic Functions and the Differential Calculus

General Syllabus for Math Functions II – Winter 2001 (36 class hours)	
Days 1 – 4	Applications of the Derivative (Graph Sketching, Differentials)
Days 5 – 8	Trigonometry
Days 9 – 13	Differential Calculus of Trigonometric Functions
Days 14 – 21	Riemann Sums and the Fundamental Theorem of Calculus
Days 22 – 24	Applications of the Integral

some graph sketching for algebraic, exponential, and logarithmic functions. We then take up the study of trigonometric functions. We start with the unit circle definitions and some basic trigonometric identities and then continue to investigate trigonometric functions using the tools of the differential calculus. The last third of the course takes up the study of integral calculus, particularly the Fundamental Theorem, for all of these different types of functions.

We have been very pleasantly surprised and encouraged by the initial success of this curriculum revision as measured by both the enrollment figures for our courses and the numbers of majors. The gains in retention from course to course are quite impressive.

- Winter Term calculus enrollment increased from fewer than 10 freshmen to more than 40;

- During the first three years of this new curriculum, an average of thirteen freshmen per year completed the introductory sequence *Mathematical Functions I and II* and *Calculus II*, compared to an average of one freshman per year completing the *Precalculus–Calculus I–Calculus II* during the previous six years;

- During the first two years of this new curriculum, six students who matriculated at the precalculus level later declared a mathematics major, compared to a total of only two students in the previous six years.

Anecdotal reaction to the new sequence of courses has also been quite positive. Students commented on course evaluations at the end of the two courses; here are some excerpts:

- "The [new courses] gave those of us who hadn't had calculus a chance to still major in math if we wanted to and those of us who already had calculus…a nice review."

- "Combining [*Math Functions I*] with [*Math Functions II*] is an excellent way to introduce calculus to students with little or no experience. Trust me on this."

- "Together, these two classes appropriately teach students the fundamentals of calculus."

- "I really liked the mixture of calculus and precalculus. It gave a great review and extra clarification of the subject."

- "I like [the way students taking either [*Math Functions I] or…Calculus* I…can still be at the same level in the spring."

At a time when we sense that a higher percentage of students may be entering college with an inadequate understanding of functions, mathematics programs across the country might do well to revisit course offerings with an eye on boosting enrollment in courses at the calculus level and beyond. There are many rich opportunities that come with the "problem" of students with weaker mathematical backgrounds, and we can enable these bright young minds to both understand and appreciate mathematics in all its beauty and power.

Any questions or comments about this curriculum revision and its outcomes can be addressed to William W. Johnston (johnston@centre.edu), Alex M. McAllister (alexmcal@centre.edu), and John H. Wilson (wilson@centre.edu). ■

Bill, Alex, and John teach mathematics at Centre College. Somehow, in the midst of revising their calculus curriculum, they find time to train for their annual croquet match with Centre's chemists.

An Interdisciplinary Educational Issues Seminar Emanating from the Mathematics Department

By Jeremy Case and Matthew DeLong

Considerable effort has been made in recent years by the mathematics community to improve the teaching and learning of mathematics. Similar efforts have been made in some of the sciences. Yet, we often are not aware of what the "other side" is doing.

For the past three years we have helped organize an Educational Issues Seminar for the faculty in the Science Division at Taylor University, a Christian liberal arts college with about thirty faculty members in the division. Such a seminar is one way to encourage these improvement efforts at a local level, and to pool resources from across the disciplines.

The seminar at Taylor is held monthly. The format of the seminar is for the attendees to read a short article or two on a teaching topic prior to the meeting, and then to use the reading as an instigator for a one-hour informal discussion on the topic. A lunch is provided for the participants to encourage attendance.

The purposes of the seminar are to foster conversations about teaching among the division members, to encourage the exchange of ideas on teaching philosophy and practices among the division members, to introduce faculty to books and articles on teaching issues, to connect new faculty with established faculty, and to connect faculty from different departments within the division. Ultimately, the goal is to make teaching a community product rather than an individual enterprise.

In this article we describe the history of the seminar, provide more details concerning its implementation, share some outcomes and disappointments. We also provide suggestions for establishing similar seminars.

History

As a graduate student at the University of Michigan, Matt was on the initial organizing committee for an Educational Issues Seminar for the graduate students and faculty of the Mathematics Department. That seminar was similar in format and purposes to the one described above.

Based on that experience, Matt organized a planning committee, which included Jeremy, for a similar seminar at Taylor. Because the Mathematics Department at Taylor is not large enough to sustain a robust seminar such as the one at Michigan, we decided to expand the scope to include the entire Science Division, consisting of the Biology, Chemistry, Computer Science, Environmental Science, Mathematics, and Physics Departments.

Professors from different disciplines get together at Taylor University for the Educational Issues Seminar.

During the Spring semester of 1999, a pilot version of the seminar was held with an average attendance of six. Feeling slightly disappointed at the turnout but hoping that we had a solution, we asked our dean to pay for lunch for the attendees the next year. During the 1999-2000 academic year, the seminar had an average attendance of nearly thirteen. Apparently, free food is a larger motivator to a college professor than an opportunity to discuss teaching! During 2000-2001, the seminar had an average attendance of nearly fifteen, which is 50% of the division faculty.

Implementation

To implement the seminar, the planning committee meets before the beginning of the school year to identify the seminar topics. Then the committee divides up the responsibilities for each seminar. Occasionally a guest speaker is invited, although the primary format of the seminar is for active discussion among the attendees.

Each month during the week preceding the seminar, the committee sends out email invitations to the entire division explaining the seminar topic and asking for an RSVP. The committee identifies the readings for the seminar, and then sends copies two days in advance of the seminar to those planning to attend. The committee orders and picks up the food. During the seminar, one of the committee members leads the discussion, although this is done rather informally. Finally, one of the committee members takes notes of the discussion, which are then emailed to the entire division.

The seminar topics have included student learning goals, assessment, motivating students, using questions to improve understanding, using course portfolios to document teaching, getting students to read the textbook, undergraduate research, cooperative learning, advising students, constructivism, teaching with technology, encouraging women and minorities in mathematics and the sciences, service learning, students' perceptions of what makes a good professor, faith and learning integration, and assigning grades.

Because the planning committee is mostly mathematics and physics professors, the suggested readings have been primarily drawn from literature in those disciplines. For example, many of the articles have been taken from the *MAA Notes* series and the journals *PRIMUS* and *Physics Today*. However, we make an effort to include readings of interest to the entire division.

Outcomes

When asked for feedback on the seminar, attendees said that the greatest benefit has been the building of friendships within the division. Even at a small school, time constraints can make it difficult to build relationships across departments or age groups. The seminar has been a fairly easy way to encourage such professional camaraderie. For example, our division tended to "bond" during the discussion of grades, when it was generally agreed that math and science students worked harder yet faced tougher grading standards than students in some of the other disciplines.

Some particular benefits to the Mathematics Department have come from the interaction among disciplines. For example, during a recent review of Taylor's core curriculum, the Mathematics Department discovered that faculty members across campus had stereotypical and uninformed views about mathematics. The seminar discussions showed that even some science faculty were unaware of the calculus reform movement or the current practices of mathematics teaching at Taylor. The seminar enabled the department to tell its story to its most vital client disciplines.

At the same time, the seminar has given the Mathematics Department a better understanding of the objectives of client disciplines so as to serve them better. It has also been illuminating for us to see how they try to meet these objectives in different settings.

Finally, we note that while several members have done some incremental experimentation due to the seminar, participants have not made wholesale changes in their teaching philosophies or practices. Rather, the seminar has encouraged awareness, personal examination, reflection, and dialogue on issues surrounding teaching.

Disappointments

Informal discussions can easily get "on the wrong track." As an example, we share an anecdote that occurred in a seminar on student expectations. This story also gives evidence to our previous observation that change is slow.

Instead of an introductory reading for the seminar on student expectations, we had a video for the attendees to watch. Jeremy took a video camera to the galleria of Taylor's library, which is a common student study hangout, and asked several students "What makes a good professor?" Contrary to our cynical preconceptions, most of the student responses dovetailed with many of the previous seminar issues that we had discussed—motivation, active learning, technology, etc.

We were excited by the fact that the students' ideas of good teaching practice coincided with many of the practices that we were exploring in our seminar. Unfortunately the discussion that followed didn't really recognize that fact. Instead the discussion focused on the fact that few of the students interviewed were science majors, and hence somehow "soft," and that this generation of students in general has a need to be entertained. Although those statements may in fact be true, we were disappointed that the larger point was missed.

Suggestions

Based on our experiences, we suggest the following advice for mathematics faculty who may be interested in starting a similar seminar at their home institutions.

First, organize a planning committee. Although one person could easily organize this kind of seminar, the multiple ideas and the extra hands of a planning committee will make the seminar more viable, more valuable, and more interesting to a variety of people. A planning committee will also give multiple individuals ownership in the seminar, guaranteeing a core group of supporters.

Second, invite different "types" of people to the seminar. In other words, if the seminar is organized in a large mathematics department, include everyone from beginning graduate students to full professors. If the seminar is organized in a smaller college, include faculty from several different disciplines. We have found that having a wide variety of viewpoints makes the seminar discussions more robust and enlightening. It is also important that the make-up of the planning committee be similarly diverse.

Finally, get funds for free food! As our attendance figures show, this is vital. A professor's life is hectic, and it can be difficult to give up one hour even for something as worthwhile as a collegial discussion. However, most professors also love a free lunch, and this may easily offset the extra hour.

Conclusion

We have found that the seminar has been a good public relations move for the Mathematics Department. Our administration has given the seminar very positive feedback, commending our activities to the Board of Trustees and asking us to propagate the seminar to other disciplines. We have a better understanding of our client disciplines and their needs while having an avenue to dispel stereotypes of an uninvolved, irrelevant, and aloof discipline. Rather, as the motivating force behind the seminar, the department can project itself as a leader in student-centered instruction that takes teaching and collaboration seriously. ■

Jeremy Case (jrcase@tayloru.edu) *is Associate Professor and Chair of the Mathematics Department at Taylor University. Matt DeLong* (mtdelong@tayloru.edu) *is Assistant Professor of Mathematics at Taylor. They are both Project NExT graduates. In addition to common interests in mathematics and teaching, Jeremy and Matt are both passionate about music, theater, and sports.*

Visiting Mathematicians

The MAA is seeking Visiting Mathematicians for one or both terms of academic year 2002-03. Areas of expertise that are of particular interest to the MAA are teacher preparation, public policy, public awareness, and on-line publishing. Contact Executive Director, Tina H. Straley, for more information at tstraley@maa.org.

The Math Forum has a New Home

The Math Forum, one of the pioneer mathematics websites, began life as the Geometry Forum through an NSF grant on the Swarthmore College campus. Under founding director Gene Klotz, its focus in its early days was on K-12 mathematics, and it soon enjoyed a large following. Since then it has grown into one of the largest mathematics sites on the web. The Math Forum has now been acquired by Drexel University and is now known as the *Math Forum @ Drexel*. The new address of the site is http://mathforum.org/. Pointers from the previous addresses will seamlessly redirect you to the new location.

Spearheaded by President Constantine Papadakis and under the direction of Dr. Harvill Eaton, Drexel University's senior vice president for research and graduate studies, the University will maintain the Math Forum @ Drexel site as a leading center for mathematics and mathematics education on the Internet. The site will continue to offer previous Math Forum services, and will introduce new features and communities to ensure the site remains on the cutting edge.

Drexel brings many strengths to the Math Forum, including expertise in mathematics, information science and technology, and education. See http://www.drexel.edu/univrel/aboutdu/ for more about the university. Drexel is Philadelphia's technological university. In 1983, it was the first university in the nation to require all students to have a personal computer. In 2000, Drexel became the first major university to operate a fully wireless CyberCampus.

The Math Forum staff believe that this is their right home for many reasons. Drexel is interested in online learning, technology in teaching, digital libraries, mathematics education, and similar issues. Moreover, Drexel brings an exciting combination of the practical and the theoretical into education. The Math Forum is very comfortable returning to the academic fold, certainly wiser for its dot.com experience. The staff is grateful to WebCT for its generous support and for the concern they displayed for the Math Forum Web site and their continuing research initiatives.

Although all of the Math Forum services will go forward, the Problems of the Week (PoWs) will initially provide services at a much lower level since they are so labor-intensive. The Math Forum will also go forward in new directions, and, for example, hopes to develop tools and techniques to train mentors for the PoWs so that they can be built up in a cost-effective way. Another avenue they hope to explore is using the Math Forum and other digital libraries to study student learning. Now that their energies are no longer focused on reorganization, the Math Forum staff is ready to pursue many other collaborations as well.

The Math Forum @ Drexel will be under the direction of Harvill Eaton. Kristina Lasher is the Forum director, and Gene Klotz (klotz@mathforum.org) will continue as the Math Forum's senior advisor. Bookmarks and links to the Math Forum should be changed to point to http://mathforum.org/. ■

In Memoriam Daniel M. Lewin

Daniel M Lewin, co-founder and Chief Technology Officer of Akamai Technologies, was on board one of the planes that were hijacked and crashed on September 11, 2001. Lewin was a brilliant computer scientist and a good friend of the mathematics community and in particular of the MAA. Akamai Technologies has been a valuable supporter of the American Mathematics Competitions/USA Mathematical Olympiad program of the Association. The MAA was deeply saddened by the news.

Lewin founded Akamai Technologies in September 1998, together with Tom Leighton and a group of computer scientists from MIT. As Chief Technology Officer, he was responsible for Akamai's research and development strategy and for many of the innovative ideas that led to Akamai's success. Lewin was 31 years old and is survived by his wife and two sons. The family has asked that contributions in Danny's memory be made to the Daniel Lewin Science Scholarship Fund, dedicated to providing scholarships to students pursuing careers in science.

More information on Lewin and on the Lewin Science Scholarship Fund can be found on Akamai's web site at http://www.akamai.com. ■

Happy Abstract Algebra Classes

By John Fraleigh

Every teacher of abstract algebra from whom I have heard says that undergraduates find abstract algebra to be a difficult subject. At the University of Rhode Island, we have only a one-semester course that is not required for all math majors, probably because the majors found it difficult. When I started teaching it, I had the usual experience: the A and B students of calculus were dismayed with their first test grades in the 60's or 70's, and the C students didn't like their grades in the 40's. There were dropouts before the first test. Some students appeared sullen. One student accused me of doing nonstandard mathematics.

I am ashamed that it was not until about the last ten years of my teaching career that I solved this problem, had happy abstract algebra classes, and was a happy and relaxed instructor. My solution may horrify some, and there might be grumblings of relaxed standards and watered down courses, but they really weren't and it works. I am convinced that the happy students learned more than others did before and had a greater appreciation of the beauty of the subject, precisely because they were relaxed.

My course grades were based on daily homework (2/7), three hour-long tests (3/7) and a final exam (2/7). The daily homework handed in consisted of about three of the problems suggested for that lesson, marked with an asterisk on the syllabus. I was often asked about them in class before they were passed in, and I obliged, trying of course to get students in the class to give solutions. Furthermore, I told the students that this homework was part of their notes and that I had no objection to their correcting it in class before they passed it in. Consequently, everyone had a pretty good homework average.

A week or more before each test and the final exam, I handed out a preparation, The students were told that the definitions and proofs requested on this preparation would be exactly the same on the actual test, but that data and structures would be altered in other questions. Thus if a preparation question asked if two groups were isomorphic, and why, the student could expect different groups on the test. If the preparation asked for the irreducible polynomial over the rational field for some algebraic number, the number would be different on the test. Finally and most important, each preparation stated clearly that students could work together and get help from anyone (student, graduate student, faculty) other than their instructor in working the preparation. I also told them in class that they should write it all out once with no notes, timing themselves so they could be sure that they could do it with no notes in the available 50 minutes (3 hours for the final).

John Fraleigh

Here is what happened. I was able to give tests that would have been unreasonable to expect students to do without the preparation and in the time allowed. Even so, most students finished the 50-minute tests in 40 minutes or less, and the final exam in less than 2 hours. The A students of calculus had semester grades in the 90's, the B's in the 80's, and so on. The number of students electing the class more than doubled. There were hardly any drops before Test 1. As I indicated above, the class was happy and relaxed, and so was I. In addition to a better knowledge and appreciation of the subject, some students also learned a very practical lesson. If you need help with some problem, be sure you ask a competent person, and even then, do your best to check that the information is valid.

This method might not be suitable for honor students at schools like Harvard, although the occasional student of that calibre that I had never seemed to feel insulted.

Anyone who wishes to see my syllabus, the preparation final exam and the actual final exam for Spring 2000 can find them at http://www.math.uri.edu/~fraleigh. ■

John Fraleigh received his MA in mathematics from Princeton University in 1956. He taught at Dartmouth College until 1962 when he joined the mathematics department at the University of Rhode Island. He was happily enjoying his December, 2000 retirement until Addison-Wesley pushed for a 7th edition of his text, A First Course in Abstract Algebra, *first published in 1967.*

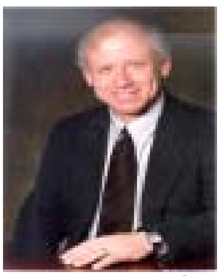
How do *you* teach Abstract Algebra?

FOCUS would be interested in hearing comments on this article and other innovative teaching ideas and stories about the teaching of Abstract Algebra at the undergraduate level. We'll run a report on what our readers have come up with in a couple of months. Send your comments to fqgouvea@colby.edu.

Sectional and National Awards for Distinguished Teaching

Twenty-four mathematicians received this year's Section Distinguished Teaching Awards, conferred at the Spring meetings of each of the Sections of the MAA. The list of all the winners appears on page 15. The twenty-four section award winners represent the very highest level of mathematics teaching. Dedicated, caring, inspiring, and innovative, they all richly deserve the honors accorded them by their sections. They are all winners

The three winners of the national Deborah and Franklin Tepper Haimo Award for Distinguished College or University Teaching of Mathematics are chosen from among the last two years' sectional winners. This year's winners are Dennis DeTurck of the University of Pennsylvania, Paul J. Sally, Jr. of the University of Chicago, and Edward L. Spitznagel, Jr. of Washington University in St. Louis. The three recipients of the Haimo Award will each give a talk at the January Joint Mathematics Meetings in San Diego. The talks will be on Tuesday, January 8, from 3:30 to 5:00 pm.


Dennis DeTurck

People reach for words like "creative" and "charismatic" when they want to describe Dennis DeTurck. In addition to being a brilliant classroom teacher who inspires students at all levels to learn and to love the subject, DeTurck has created a variety of programs to enhance the teaching and learning of mathematics and science. He founded the Middle Atlantic Consortium for Mathematics and its Applications Across the Curriculum, which creates and disseminates interdisciplinary course materials. He serves as the faculty coordinator for America Counts at the University of Pennsylvania, which sends some 40 undergraduates to spend 8 to 10 hours a week as tutors in West Philadelphia schools. He also plays an active role in the Penn Summer Science Academy, a pre-freshman program emphasizing Mathematics, Physics, and Chemistry. DeTurck is a creative user of technology. He teaches a web-based course on Ideas in Mathematics and was instrumental in introducing substantial use of computers in the calculus classes at Penn. His many-faceted work adds up to a distinguished career dedicated to the teaching of mathematics and science.

Paul Sally is a respected research mathematician working in representation theory, but he is also committed to educational excellence at all levels. His superb classroom teaching and his long-range educational programs have impacted thousands of students and teachers. Sally is Director of Undergraduate Studies in the Mathematics Department of the University of Chicago. In addition to his excellent classroom teaching, he has coached the Putnam team, helped to establish a math club, and has overseen calculus courses at all levels. He has had many Ph.D. students who have gone on to distinguished careers of their own.

But Sally also has had an impact on school mathematics. In 1983, he became director of the University of Chicago Mathematics Project, a leading education reform effort. Within this project he worked with teachers from school districts all over the country.

In 1992, Sally founded SESAME (Seminars for Elementary Specialists and Mathematics Educators), a professional development program for elementary school teachers in the Chicago public schools. He co-founded a Young Scholars Program for mathematically talented students, providing personal mentoring and encouragement. The broad impact of his work marks him as an exceptional educator.

Edward Spitznagel is described by members of the Mathematics Department at Washington University in St. Louis as their "preeminent teacher, preeminent statistics guru, and preeminent computer jock." His lectures on statistics are packed with real-world applications, often drawn from his own current research work. His courses make effective use of computers, with students typically using a computer on the second day of class. His breadth of scholarship and his collaborations with investigators in medicine, pharmacology, marketing, engineering, and psychology allow him to fill his examples from the real world. It is no wonder that students regularly oversubscribe his courses.


Edward Spitznagel

Spitznagel's creativity is not limited to statistics courses. When his department decided to create a calculus sequence for pre-med students, Spitznagel devised a course based on research in pharmacokinetics that introduces students to both statistical and calculus techniques in medicine. It has been enthusiastically received both by the students and by their pre-med advisors. Such creativity and dedication are typical of Spitznagel. He is a truly great teacher who has had extraordinary success in applying his vast practical experience and his great enthusiasm to the classroom.

Since teaching is one of the main concerns of the MAA, it is fitting that these sectional and national awards serve to identify, honor, and reward exceptional college and university teaching. J. J. Price, chair of the Committee on the Haimo Awards, noted that not all sections chose winners. "The national committee urges all sections to continue to nominate and recognize their outstanding teachers and encourages all members of the Association to nominate worthy candidates," he said. The participation of more MAA members in this process can only make the awards even more valuable as a tribute to talented teachers who have a deep impact on many student lives. ■

2001 Distinguished Teaching Award Winners

EPADEL Section
Dennis DeTurck
University of Pennsylvania

Florida Section
Scott Hochwald
University of North Florida

Illinois Section
Paul J. Sally
The University of Chicago

Indiana Section
Francis L. Jones
Huntington College

Iowa Section
Cathy Gorini
Maharishi University of Management

Kansas Section
Charles J. Himmelberg
University of Kansas

Kentucky Section
J. Brauch Fugate
University of Kentucky

LA-MS Section
Jeffrey L. Stuart
University of Southern Mississippi

MD-DC-VA Section
Elizabeth Mayfield
Hood College

Metro NY Section
Sheldon Gordon
SUNY at Farmingdale

Missouri Section
Louis J. Grimm
University of Missouri, Rolla

NE-SE South Dakota Section
Alan Peterson
University of Nebraska, Lincoln

North Central Section
Ted Vessey
St. Olaf College

Northeastern Section
Paul Blanchard
Boston University

Northern California Section
Wade Ellis
West Valley College

Ohio Section
Alan Stickney
Wittenberg University

Oklahoma-Arkansas Section
Stanley Eliason
University of Oklahoma

Pacific Northwest Section
Bruce Lind & Ron VanEnkevort
University of Puget Sound

Rocky Mountain Section
Jim Loats
Metropolitan State College of Denver

Seaway Section
David E. Mane
SUNY College at Oneonta

Southeastern Section
Johnny Henderson
Auburn University

Southwestern Section
William D. Stone
New Mexico Tech

Southern CA Section
Jennifer Quinn
Occidental College

Texas Section
Robert Northcutt
Southwest Texas State University

Wisconsin Section
Ranjan Roy
Beloit College

Mathematical Science Reports Suggest Improved Job Market

The Second and Third Reports from the Annual Survey of the Mathematical Sciences were released in July and September. Together, they show that job openings for mathematics PhDs increased by 22% in 1999-2000. The growth seems to be caused primarily by faculty retirements. After many years of difficult job markets, the report suggests that things may finally be improving. The Annual Survey is produced jointly by the American Mathematical Society, the American Statistical Association, the Institute of Mathematical Statistics, and the MAA. The reports were published in the *Notices* of the American Mathematical Society and can also be found online at http://www.ams.org/notices/.

The Chronicle of Higher Education published a story in its September 6 issue describing the results of the survey and including anecdotal evidence that the market is indeed heating up, with several departments reporting that they are hiring more people than they have in a long time. The article also notes that many mathematicians and statisticians are being hired outside academia, with the market for statisticians being particularly hot at the moment. ■

My MathFest

By Fernando Gouvêa

It was very hot in Madison this August. That much was clear from the moment I got off the plane. But the hotel was nicely situated, close to the State Capitol building and to a pleasant street with shops and eating places. I found an espresso shop and a bookstore specializing in science fiction and mysteries, so life was good. Plus, there was a shuttle to/from the place where most of the meeting would actually happen, so I wouldn't have to walk in the sun.

Walter and Mary Ellen Rudin

The meeting happened at the *Monona Terrace Community and Convention Center*, a beautiful building overlooking a beautiful lake. It wasn't too hard to get around, and it was pleasant to go into the book exhibit area and be able to look out over the lake.

The high points of this meeting were the plenary talks. Ingrid Daubechies gave a great set of Hedrick Lectures entitled *Wavelets in Action*. She managed to hit just the right level of technicality to keep the talks serious and interesting at the same time. The result was a model of what expository mathematical talks can be like.

There were lots of other good talks. I enjoyed Judy Grabiner's portrayal of *Newtonianism in Action* in her lecture on Colin Maclaurin, Robert Witte's explanation of *What I Have Learned From the Mathematics Community*, and Michael Starbird's discussion of *The Other Lessons: What Students Keep for Life*. Rhonda Hatcher's student lecture on methods for ranking football teams was interesting even for someone who cares not a whit for football (i.e., someone like me). Those were, of course, only some of the many talks. There was no way I could go to them all, so I'm sure I'm leaving out something really interesting that I just happened to miss.

In addition to the plenary talks, there were special sessions and mini-courses about all sorts of things, plus the usual book exhibit. I attended only a few of the talks given in special sessions (mostly the ones about *The Use of History in the Teaching of Mathematics*), but the ones I did go to were interesting and useful. And, of course, I spent time at the book exhibit, paging through new books, asking publishers to send review copies to MAA Online, and chatting with people.

MAA members at the 25 Year Member Banquet.

Since I am editor of FOCUS and of MAA Online, I have to attend committee meetings whenever I go to national meetings of the MAA. This time I was at the Board of Governors meeting (see the report below, written by the student visitors to that meeting), the Committee on Publications, and the Committee on Electronic Services. Committee meetings are never really fun, but these were at least productive.

Sylvia Wiegand

There were also several social events. The MC for the opening banquet was Edward Burger of Williams College, who had fun showing us several examples of "math in the news," ranging from the discussion of "fuzzy math" during the presidential campaign to the notorious "I'd rather go to math camp" ad. He then introduced Ezra Brown of Virginia Polytechnic who gave a light-hearted but serious talk on number theory and cryptography.

At the other end of the meeting, the banquet honoring long-time members of the MAA was also a remarkable event. Many people who have been members of the Association for 25 years or more were present, and all were recognized by name. A special tribute was paid to Walter and Mary Ellen Rudin of the University of Wisconsin at Madison. Friends and students told stories about the Rudins, but they were all upstaged by Mary Ellen herself, who had (of course) the best stories to tell. The banquet concluded with a talk by Sylvia Wiegand about the mathematicians in her family, from William Young and Grace Chisolm Young to the present day.

In all, MathFest was a pleasant and productive meeting, without the hustle and bustle of the winter meetings but with lots of interesting mathematics, interesting people, and good things to do. I met new ideas and interesting people, bought some books, and enjoyed myself. I think most of those who attended felt the same.

Photographs courtesy of Gerald J. Porter

Mathematicians on Michael Feldman's "Whad'ya Know?"

By Frank Morgan, Paul Holt, Joe Corneli, Nick Leger, and Eric Schoenfeld

"Where's the guy who's in KNOT theory?" asks Michael Feldman on his Madison PRI show "Whad'Ya Know?" during the MathFest.

Colin Adams waves from the back, and Feldman turns to others in the first row:

"And you guys are mostly, what, in bubbles?"

"Bubble math, that's right," answers Frank Morgan.

"So that's why you were blowing bubbles earlier."

"It was purely professional."

"So you make a living studying bubbles?"

"Absolutely. First we got one bubble, and then a double bubble, and then we'll work on the triple bubble, and… it's a whole career."

"Very exciting, very exciting for you. But you're studying bubbles and you call it mathematics."

"It's math. Everything's math!"

"Oh, don't give me that. [laughter] If everything was math, wouldn't I be making more money?"

"Aren't you?"

"Yes! Perhaps. Perhaps. We're not going into that math right now." He turns to the student beside Morgan. "Are you in bubbles, too?"

"Yeah, I'm working with him for the summer," responds Eric Schoenfeld.

"Is that long enough? Were you in bubbles before that?"

"No, I'm just an undergraduate."

Feldman moves on to the next student. "Okay, and you're in bubbles?"

"No, I do algebra," answers Sonja Mapes.

"You do algebra."

"Yeah."

"Bubbles don't interest you at all?"

"No, I don't like bubbles." [laughter]

"Don't care for bubbles?"

"I'm not good at bubbles. Bubbles are hard."

"I would think so." Feldman turns to the next student. "And then, are you in bubbles, or knots?"

"Yeah, I'm a part of the bubble group, too," answers Nick Leger.

Feldman turns to the woman beside him. "And then are you bubbles?"

"No, I'm an analyst—but the mathematical kind," answers Janine Wittwer.

Feldman moves on to the next student. "Okay, and what are you in?"

"What can I say – it's all about the bubbles," answers Paul Holt.

Feldman looks at the next student. "Bubbles."

"Ergodic theory," responds Kate Gruher.

"What?" [laughter]

"Ergodic theory."

"Oh, I have those theories. But what are they?"

"We study dynamical systems – like the planets going around the sun, as an example."

"Why don't you study something important, like bubbles? The planets going around the sun are all well and good, but it's not bubbles."

"We think it's kind of important."

Feldman turns to the last student. "Okay, and you are in…"

"More bubbles," says Joe Corneli.

"More bubbles, okay. And what is the lure of bubbles? I mean, what can you tell from a bubble?"

"It's got an interesting geometry."

"It's round." [laughter]

"Yeah, but try sticking a bunch of them together – it gets complicated."

"Well, everything does, that you stick together, you know…but that's true." Feldman returns to Morgan. "And then, so this has application? Can we make a better—let's say a better bomb—or a weapon of destruction—out of bubbles?

"Bomb, no…well, a better economy, maybe."

"Out of bubbles. Okay, fine, whatever, uh… [laughter] and are you paid for out of grants that come out of the taxpayers' pocket? [loud laughter] Speaking of bubbles, speaking of living on bubbles…"

"Yes." [laughter]

"Well, that's good, that's good. Is this the university—where are you from?"

"Williams College."

"Williams College, which is where?"

"Massachusetts—northwestern Mass."

"Massachusetts, let's hear it for Williams College, yes! Did you go there? It's the bubble capital of America–they're doing all the research—the important research —on the fundamental use of bubbles."

How did mathematicians end up on "Whad'Ya Know?" Charlotte Chell of Carthage College got some twenty tickets months before the MathFest. The Williams contingent, including several undergraduate research students, arrived early and occupied the front row. This show, of August 4, 2001, may be heard at the website http://www.notmuch.com. The mathematicians appear at the end of the third segment.

Student Section Members at Board of Governors Meeting

By Joseph Corneli (New College), Paul Holt (Williams College), Nicholas Leger (UT-Austin), and Eric Schoenfeld (Williams College)

We would like to share with the FOCUS readership our reflections on the summer meeting of the Board of Governors of the MAA, held in Madison just before the start of this August's MathFest. As special guests, we had the opportunity to meet and talk to many governors and officers. Student reporting on these meetings has become something of a tradition, one that we are pleased to continue here.

MAA President Ann Watkins

A good place to begin is with the observation that, for such a large meeting, things were really very well run. The speakers dealt respectfully with one another, especially when it came to settling opposing positions. On the other hand, the Board of Governors is not a body of professional bureaucrats, so for all the formality of the meeting, it was clear that at least a few people were learning some of Robert's Rules of Order as they went along. President Ann Watkins was an excellent facilitator.

Although the technical details evaded us, it was interesting to realize that the MAA has finances. Happily, they appear to be handled very well, through a mixture of both conservative and some less conservative investments.

Jim Daniel, MAA Executive Committee Member

One of the most important sources of revenue for the MAA is their publications. At one point in the meeting, Associate Director Don Albers brought in several tall stacks of books, the newest volumes. This was a fairly exciting moment, and copies were passed around for everyone to look at. Albers said, "If you ever want to judge a book by its cover, you should take a look at this one." And he produced a very beautiful volume, *Symmetry*, by Hans Walser.

The most emotional part of the meeting was the report by Titu Andreescu on the Mathematical Olympiad. Andreescu eloquently conveyed to the audience a glimpse of the feelings of excitement, love for mathematics, and camaraderie shared by the Olympiad competitors.

Lunch, when it came, was welcomed enthusiastically by everyone. The hotel staff, who were otherwise entirely punctilious, had neglected to number the tables. Two of us ended up sitting at table number 1 (after the numbering had been imposed by executive order), with President Ann Watkins, past President Gerald Alexanderson (one of the editors of *Mathematical People*), Second Vice President Frank Morgan, and John Watson, the Governor of the Oklahoma-Arkansas section. The other two of us sat with Executive Director Tina Straley, among others. The conversations we had at lunch were most enjoyable.

After lunch, out in the hall, we got involved in an interesting conversation about careers in mathematics with Straley and Chris Stevens, the director of Project NExT. Each described her own very exceptional career. Chris told us about something that we never heard the like of before, namely how as a recent graduate she had put her mathematics degree to use as an aide in the House of Representatives. We also compared notes on National Science Foundation Research Experiences for Undergraduates (REUs) with Joseph Gallian from the University of Minnesota at Duluth.

A highlight of the afternoon session was the characteristically carefully deliberation over a new prize for young faculty. It

Barbara Osofsky
MAA First Vice President

was necessary to decide, for example, how exactly one would qualify for the prize.

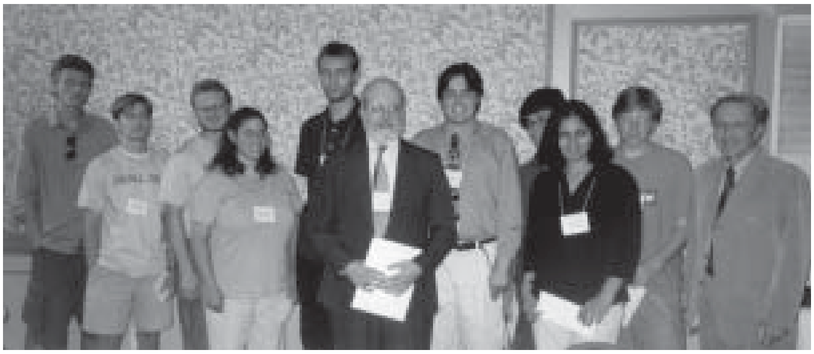
We enjoyed all of the interactions we had with so many distinguished mathematicians and supporters of the mathematical community. We also had a great time at MathFest, but as they say in the news business, that's another story. ■

Photographs courtesy of Gerald J. Porter

Report on the MAA Student Paper Sessions at the Madison MathFest

By Charles Dimminie

On Thursday and Friday, August 2–3, eight MAA Student Paper Sessions were held at the Madison MathFest. Sessions 1–4 were held from 1 to 5 P.M. on Thursday, and Sessions 5–8 took place from 1 to 5 P.M. on Friday.



Winners of the student poster sessions with Charles Dimminie.

The program included 46 talks involving 49 students from 32 colleges and universities. There were 27 student chapter members, of whom 16 qualified for travel grants. Three students had also spoken at previous MathFests. There were 23 students from six REU Programs (17 students from Williams College, 2 from Rutgers University, and 1 each from Indiana University, Mount Holyoke College, Lafayette College, and the University of Idaho).

Cash awards of $150.00 from the MAA were presented to the following students for outstanding presentations:

1. Aliyah Ali–Rutgers University (Rutgers University REU Program) —"Graphs and matrices."

2. Eric Katerman–Williams College (Williams College REU Program)—"Knot complements: the hyperbolic alter ego of our twisted friends."

3. Cody Patterson–Texas A&M University —"Distinct element vectors over finite groups."

4. John Meth–Indiana University—"Idempotent cocycles on cyclic groups."
5. Eva Kashat and Daniela Silva (jointly) –Wayne State University—"Geometric applications of a system of congruences."

6. Ellen Panofsky–Millersville University —"Geometric analysis of distance minimizing paths crossing the same rim of a circular can twice."
7. John Bryk–Williams College (Williams College REU Program)—"Completions of unique factorization domains."

8. Jarod Alper–Brown University (Lafayette College REU Program)—"The number theory of the composition algebra."

9. Nicholas Leger –University of Texas at Austin (Williams College REU Program) —"Double bubbles on flat two-dimensional tori –Part I."

10. D. Jacob Wildstrom –Massachusetts Institute of Technology (University of Idaho REU Program)— "On pairs of monochromatic and zero-sum hooked sets."

Also, a special research prize of $150.00 from the Council on Undergraduate Research was awarded to: Paul Holt – Williams College (Williams College REU Program)— "Double bubbles on flat two-dimensional tori – Part II."

Thanks are due to Katarina Briedova and Jim Tattersall for their assistance throughout the process of setting up the sessions and to Ron Barnes for chairing some of the sessions and evaluating the speakers.

Have You Moved?

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

Secretary's Report

By Martha Siegel, Secretary of the MAA

First, let me remind you of the results of the national elections. Dr. Ronald L. Graham was elected President-Elect. He will be President-Elect in 2002 and become President for a two-year term in January 2003. Newly elected 1st and 2nd Vice Presidents are Carl C. Cowen and Joseph A. Gallian, respectively.

In January, the Board elected Daniel P. Maki to the Budget and Audit Committees and the Executive Committee. He fills the unexpired term of Barbara T. Faires, who asked to be replaced.

Jim Tattersall, Associate Secretary

At the Board meeting in Madison, Treasurer, Gerald J. Porter, announced his intention to retire from that position. Jerry has served the MAA in so many ways and over so many years that it is difficult to imagine his absence from Executive Committee and Board of Governors meetings. He has served as Governor of the EPADEL Section, member of the Audit and Budget Committees, member and chair of the Investment Committee, and as chair of the Committee on Professional Development. He was the PI on several successful and innovative MAA projects, including the Interactive Mathematics Text Project, and he has helped to establish the Journal of Online Mathematics and Its Applications and the Digital Library. His commitment to the MAA involves both financial support and an enormous dedication of his time. A search is being conducted for a new Treasurer; the Search Committee, appointed by President Ann Watkins is chaired by Barbara Faires. Other members are Ronald L. Graham and Barbara L. Osofsky.

Also at the Board meeting, Underwood Dudley was elected as the editor to serve on the Executive Committee after December 31, 2001. Roger Horn will step down from the Executive Committee at that point, since he will be leaving his position as Editor of the *Monthly*. Bruce Palka has already been working as Editor-Elect. I want to thank Roger for all he has contributed to the MAA, for his incredible dedication to the editorial position, especially during his long recovery after a bad skiing accident. The Board also approved the recommendations of the Haimo Awards Committee and we are pleased to announce that the awards for Distinguished College or University Teaching of Mathematics will be presented to Dennis DeTurck, Paul J. Sally, and Edward Spitznagel at the January Prize Session in San Diego. Members should be sure to attend their talks at the San Diego meetings.

The Board also elected Jim Lewis of the University of Nebraska as Leitzel Lecturer for MathFest 2002 and established a standing Committee on Graduate Students. The Florida, Kansas, Michigan, Northeastern, Rocky Mountain, and Texas Sections presented their nominees for Certificates of Meritorious Service. The Board enthusiastically approved. Certificates will be presented in San Diego.

We now have three SIGMAAs: the SIGMAA for Research in Undergraduate Mathematics Education, the SIGMAA for Mathematicians in Business, Industry, and Government, and the SIGMAA for Statistics Education. We are thrilled with the progress of the SIGMAA program and we now have a standing Committee on SIGMAAs. I want to publicly acknowledge the hard work of its first chair, Ed Dubinsky. Stephan Carlson follows Ed as chair of the committee. He and his committee are reviewing applications of three more groups seeking to become SIGMAAs.

Our JPBM activity has been limited this year by the new structure of the group. The MAA Science Policy Committee, chaired by Lida Barrett, has been working diligently to keep the MAA informed and involved in national policy. Al Buccino has been the man behind the scenes in creating a terrific web page dedicated to science policy issues. I urge you to get into MAA Online and click on the science policy page on a regular basis.

Lida Barrett

The MathFest in Madison was extremely successful. Attendance was among the best we have ever had at a MathFest, the site was beautiful, and the program was superb. Hedrick Lecturer, Ingrid Daubechies, and Leitzel Lecturer, Bob Witte, as well as all those delivering Invited Addresses afforded all who attended an opportunity to enjoy mathematics in a relaxed and hospitable place. Thanks to Jim Tattersall, Associate Secretary, and all those involved in arranging the scientific and social programs.

Once again, I am struck by the caring and dedication of our members to the Association and to each other. I left Madison early because of a family emergency. Many members checked to be sure I was okay. To our friends in the Metro New York and the MD-DC-VA Sections and those in neighboring sections who may have had family or friends in the disaster area on September 11, I send my best wishes and my hopes that they will know peace in the days ahead. May we always recognize the importance of every human life. ■

Photographs courtesy of Gerald J. Porter

Call for Organizers: MAA Minicourses, Baltimore 2003

The MAA Committee on Minicourses is soliciting proposals for minicourses to be given at the Joint Mathematics Meeting in Baltimore, Maryland, January 15–18, 2003. Most minicourses are related to undergraduate curriculum, although any topic of interest to the MAA membership will be considered.

To find more information on how to submit a proposal, see http://www.maa.org/meetings/miniguide.htm. The deadline for submissions the Baltimore Joint Mathematics Meeting is December 1, 2001.

Call for Organizers: MAA Contributed Paper Sessions, Baltimore 2003

The MAA Committee on Sessions of Contributed Papers selects the topics and organizers for the contributed paper sessions at Mathfest and at the winter Joint Meeting. The committee would be delighted to hear from MAA members who are interested in organizing sessions or who have suggestions for topics.

Planning is now underway for the AMS-MAA-SIAM Joint Meeting in Baltimore, Maryland, January 15–18, 2003. The deadline for submissions for the Baltimore Joint Mathematics Meeting it is December 31, 2001.

Send (preferably by e-mail) proposal title, name(s) and address(es) of the organizer(s), and a one-page summary to the chair of the committee, Howard Penn.

E-mail: hlp@usna.edu
Address: Department of Mathematics
U.S. Naval Academy, Annapolis, MD 21402
Phone: (410) 293 6702
Fax: (410) 293 4883

Letter to the Editor

Online Tutorials and Mathematics Students

Mathematics students increasingly have access to online sources of tutorial assistance, whether from textbook publishers, educational institutions, or independent companies. Having recently been involved in a beta test of a new online tutorial site for calculus and precalculus (http://www.hotmath.com), I am wondering about the impact of these resources on student learning. Hotmath suggests on its site that the benefits of their tutorial homework assistance outweigh the risks of abuse by students. I am very curious to know if this is true in practice.

As a full-time faculty member at American River College (Sacramento, CA) and a math education graduate student at the University of California at Davis, I would welcome information from my teaching colleagues on any observations they might have made concerning how students use online tutorial sites, which ones they use, and what effect, for good or ill, the sites appear to have. Surely this is an area meriting further investigation.

I can be contacted via email at abarcellos@ucdavis.edu.

Anthony Barcellos
Department of Mathematics
American River College
& Graduate Group in Education
University of California, Davis

MATHEMATICAL ASSOCIATION OF AMERICA
DIRECTOR OF PROGRAMS AND SERVICES

The Mathematical Association of America (MAA) is seeking a highly qualified person for the position of Director of Programs and Services. Candidates should have a doctorate or the equivalent in a mathematical science or mathematics education and at least six years of experience as a collegiate faculty member. A candidate should have successful experiences in all or most of the following areas: grant proposal writing and project management; administration; improvements in teaching and learning; and MAA committees, sections or programs. Appointments may be made for two or three years, with the option of renewal for multiple years.

The Director oversee programs and member services which include professional development activities; program development; support of member run activities, including those of committees, sections, and special interest groups; grant management and support; preparation and submission of proposals to foundations and government agencies. The Director reports to the Executive Director. He/she is a key member in the MAA's staff leadership team, and will work closely with the Executive Director and other staff members, national officers, section officers, committee chairs, and others in strategic planning and program development.

The MAA, with 30,000 members, is the largest association in the world devoted to collegiate mathematics. Membership includes college and university faculty and students, high school teachers, individuals from business, industry and government, and others who enjoy mathematics. The Director of Programs and Services has responsibilities that encompass all major components and activities of the MAA. These include two annual national conferences, the summer MAA MathFest, and the winter Joint Mathematics Meeting organized with the American Mathematical Society; twenty-nine Sectional organizations that hold annual meetings and conduct professional development activities; publication of three scholarly journals, two magazines, a newsletter, and 15-20 books annually; over 100 committees and councils that are responsible for much of the work of the Association; and externally funded projects and programs.

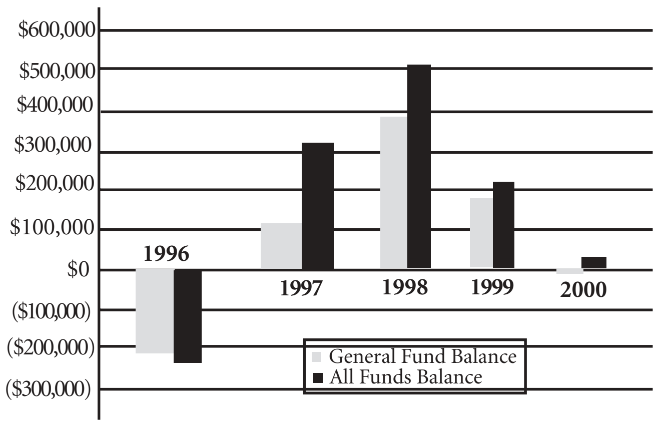
The deadline for submission of applications is January 21, 2002. Interviews will be held during the months of January and February. It is expected that the new Director will begin work by July 2002, earlier if possible. The position is located at the national headquarters of the MAA in Washington, DC. Salary will be based upon the candidate's credentials or current salary for a reassignment position. The MAA offers a generous benefits package.

Candidates should send a resume and letter of interest to:
Ms. Julie Kraman
Mathematical Association of America
1529 18th Street, NW
Washington, DC 20036.
Applications may be submitted electronically to jkraman@maa.org. References will be requested after review of applications. Applications from individuals from underrepresented groups are encouraged. Additional information about the MAA and its programs and services may be found on MAA's website: http://www.maa.org. AA/EOE.

Treasurer's Report—2000 Financial Year

Gerald J. Porter, Treasurer

The chart below gives an overview of the performance of the MAA Operating Funds (excluding extraordinary transfers from the Investment Fund) during the last five years. This year we include the American Mathematics Competitions (AMC) in the Operating Funds report. In the past the AMC was included in this report as an off-site project. The decision to integrate fully the AMC into the MAA budget and financial reports was made in recognition of the increasing role the AMC plays both in the Association's programmatic and financial activities. During this transition year we display below both the results without AMC (labeled General Fund) and with the AMC (labeled "All Funds"). "All Funds" includes the journal and book programs, meetings, the American Mathematics Competitions, governance, and member services. It does not include grant funded programs or the operation of the MAA headquarters buildings.



In 2000 there was a surplus of $46,627 in All Funds. This resulted from a surplus of $53,983 in the AMC and a deficit of $7,356 in the General Fund.

The Board of Governors had approved a budget for 2000 that had a $20,300 surplus in the General Fund and a $52,400 surplus for the AMC. The AMC results were in line with the budget; however, the General Fund results were $27,656 under budget. While this is a shortfall of only 0.5% of the total budget, it remains true that the Association must monitor its expenditures carefully or find a way to increase revenues significantly.

Income was $156,000 over budget while expenses were $184,000 over budget. Significant differences from budget include the following:

income over budget: dues $88,000; subscriptions $92,000; advertising $27,000; and interest income $30,000.
income under budget: book sales $115,000; discontinuance of placement test sales $28,000; and Greater MAA Fund $83,000.
expenses over budget: journal printing $50,000; marketing $100,000; fulfillment $70,000 and travel $40,000.
expenses under budget: salaries and benefits $40,000; scaled back JPBM $22,000.

The MAA Endowment Fund[1] decreased in value by 2% after the normal transfer of $48,017 to the Operating Fund for programs. At year end the value of the Endowment Fund was $2,413,904. This includes both restricted and unrestricted funds.

We discuss the operating budget, grant activity, the headquarters building fund, the American Mathematics Competitions and the investment fund individually below. Last but not least, I am glad to acknowledge the assistance of our Director of Finance, Neil Beskin, in preparing this report.

The Operating Budget

Where the money came from

	1999	2000
Dues	$2,008,578	$2,096,376
Contributions	$154,956	$115,598
Journals (other than member subscriptions)[2]	$921,875	$981,490
Publication other than journals	$1,025,461	$1,020,676
American Math Competitions/Olympiad	$987,444	$1,174,325
Transfer from Investments and Trusts[3]	$71,582	$84,062
Funded Programs		$28,849
Indirect Costs on Grants	$111,933	$137,585
Meetings/Minicourses/Short Courses	$295,580	$287,993
Building Management Fee	$25,000	$35,000
Miscellaneous	$111,102	$107,227
TOTAL	**$5,713,511**	**$6,069,181**

Where the money came from

Total income for 2000 was **$6,069,181** up from **$5,713,511** in 1999. This was derived as follows:

- **Dues** includes member dues, institutional dues, corporate dues, and a payment from the Life Membership Fund for life members.
- **Contributions** include the Greater MAA Fund, the dues supplement and other contributions to the Operating Fund but does not include contributions to the endowment or to the Building Fund.
- **Journals** include non-member subscriptions, sales of back issues, advertising, and royalties received. It does not include the portion of dues allocated to journals (see footnote[2]).
- **Publications** income includes sales of MAA books and reports, placement tests, and video tapes.
- **Investments and Trusts** are funds that are transferred from Investment Funds and Trusts to support specified prizes and other activities.
- **American Math Competitions and Olympiad** The MAA manages two high school and a junior high school national mathematics competition. These activities are managed from our office in Lincoln, Nebraska. Students who perform well on the high school examination are invited to compete for participation on the U.S. Math Olympiad team. This competition takes place through two additional exams, the AIME and the USAMO. Income comes from sales of the exams, old exams and contributions including an in-kind contri-

bution by the University of Nebraska at Lincoln. This contribution was $84,297 in 1999 and $87,668 in 2000. Prior to this report the income and expense of AMC were not included in this report. We have adjusted the 1999 report so that AMC is included.

- **Funded Programs** are programs to which a funding source has been dedicated. Currently there are two such programs. Student Chapters and Women and Mathematics. Student Chapters is funded from revenue from the MBNA MAA credit card program while Women and Mathematics is funded from royalities on the book, *She Does Math.*
- **Indirect Costs on Grants** is income on externally funded activities that support MAA administrative activities. Not all grantors pay indirect costs.
- **Meetings and Courses** are registration fees from minicourses, shortcourses, and the online courses, net income from the Joint Meeting and all income from the summer MathFest.
- **Building Management Fee** is a transfer from the Building Fund to the General Fund for management services.
- **Miscellaneous** includes various fees that we receive for managing activities (e.g., CBMS).

What happened in 2000

- Dues income increased by 4%, approximately the amount of the dues increase for 2000.
- Contributions to the Greater MAA Fund decreased by $40,000. This is a troubling trend that has continued for several years. The MAA is dependent upon the generosity of its members and we need to do a better job soliciting contributions.
- Journal subscriptions were up by more than the increase in subscription rates.
- Indirect cost recovery on grants increased by $26,000. This trend should continue in 2001 as the PREP and MathDL grants have a full year of funding.

Where the money went

Expenses[4] totaled **$6,022,555** in 2000 compared to **$5,490,046** in 1999.

- **Journals/Electronic Services** include the cost of publishing and distributing the *Monthly, Mathematics Magazine,* the *CMJ,* FOCUS, *Math Horizons*, and our electronic newsletter, MAA Online.
- **Publications** is the cost of our book and video publication program.
- **General Programs and Services** includes the cost of awards, minicourses, MAA portions of the Joint Meeting, the summer MathFest, section support, SUMMA, student chapters, project support, and our participation in joint projects and activities such as JPBM.
- **American Math Competitions and Olympiad** The 2000 AMC expenses include support for the Math Olympiad Dinner and the summer training program which were not included in the 1999 expenses. Prior to this report the income and expense of AMC were not included in this report.
- **Administration** is the cost of operating the Executive, Finance, Human Resources and Computer Service Departments. These costs are not allocated to other activities.

Where the money went

	1999	2000
Journals/Electronic Services	$1,810,724	$1,810,973
Publications	$540,379	$768,346
Inventory Allowance	$17,981	$16,064
General Programs, Services and Projects	$574,066	$686,362
American Math Competitions/Olympiad	$843,908	$1,071,905
Administration	$971,149	$1,027,881
Governance	$175,140	$164,591
Membership Processing	$275,707	$189,591
Development	$157,710	$264,760
Miscellaneous	$123,282	$22,082
TOTAL	**$5,490,046**	**$6,022,555**

- **Governance** includes the costs related to the Board of Governors, section officers, executive and finance committees, and the officers.
- **Membership Processing** is the cost of membership recruitment and fulfillment.
- **Development** includes the cost of the Development Department as well as costs related to the Greater MAA Fund. This is an investment in future gifts as well as present contributions.
- **Miscellaneous** included telephone, copying, postage and office supply expenses in 1999. In 2000 we have allocated most of these expenses to the various departments. The $100,000 decrease in expenses is artificial and corresponds to expense increases in administration, publications, membership processing and programs and services.

What happened in 2000

- It is difficult to make a direct comparison between 1999 and 2000 expenses since we continue to improve the way that expenses are assigned to activity. In particular, as we note above, telephone, copying and office supply expenses are now allocated to the departments.
- It was our goal to increase activity and staff in the member services department and that increase has resulted, as expected, in increased expenses.
- The increased expense in publication and the decreased expense in membership processing is in large part related to more accurate allocation of fulfillment expenses.
- We note that both meeting expense and income increased in 2000. This was due in large part to the very successful Washington, DC meeting. As usual we lost money on the summer meeting and made money on the winter meeting. As a result we broke even on meetings for the year.
- Both income and expense for AMC increased during 2000. The 2000 expenses include various Olympiad expenses not included in 1999. When one adjusts for these expenses the net income in 2000 was essentially the same as it was in 1999.

Externally Funded Projects

During 2000 the MAA received external project support of $1,069,600. This was up from $864,340 received in 1999. Indirect cost recovery of administrative expenses was $137,585 up from $111,933 in 1999. We expect that this will continue to increase in 2001 because of grants such as MathDL and PREP.

Building Fund

The Association owns two adjoining townhouses and a "carriage house" at 1527 and 1529 Eighteenth Street NW, Washington, DC. The MAA Washington office occupies 1529, most of the "carriage house," and a small amount of 1527. The remainder of 1527 is rented to other mathematical organizations including the AMS and CBMS. In 2000 we "charged" ourselves $225,000 for the space we occupied. That amount is included in Building Fund income.

Building Fund Income $335,709

Building Fund Expense $326,282

In 2000, depreciation on the building and renovations was $82,006. In 2000, the Building Fund received contributions of $26,180. This includes a gift of $25,000 from the Dolciani Foundation. Building rental income has decreased in recent years because of the loss of JPBM as a tenant. It is essential for the long term financial health of the buildings that we develop additional revenue streams to support the building expenses.

Endowment Fund

The MAA Endowment Fund includes both restricted and unrestricted funds. At the end of 2000 the Endowment was valued at $2,413,904, a 2% decrease from the end of 1999. During 2000, $48,017 was transferred from these funds to support prizes and other activities designated by the original donors to the MAA. An additional, $32,046 was transferred from the Sliffe Trust. A gift of $1,074 was added to the endowment of the Benefactor's Fund.

The MAA Endowment funds are, according to accounting standards, divided into Unrestricted, Temporarily Restricted and Permanently Restricted. The values of these funds at the end of 1999 and 2000 are as follows:

	December 31, 1999	December 31, 2000
Unrestricted Board Designated	$1,851,620	$1,820,382
Temporarily Restricted	$492,909	$416,614
Permanently Restricted	$118,210	$118,210
	$2,462,739	**$2,413,904**

Endowment Fund

The last will and testament of Edith May Sliffe established a fund (The Sliffe Fund) to fund awards to selected teachers whose teams qualified in the American Mathematics Competitions. The MAA was selected as the Trustee of this fund. On December 31, 2000 the Sliffe Fund had a value of $612,374. The MAA also is the trustee of a trust established by Clinton B. Ford in memory of Walter B. Ford. This trust had a value of $100,908 on December 31, 2000.

The MAA is also the beneficiary of two Charitable Remainder Unitrusts. At the end of 2000 these were carried on our balance sheet at a value of $336,511 in conformance with IRS rules.

General Fund Balance

The General Fund Balance is the cumulative sum of yearly balances in the General Fund. It is a measure of how the Association has done over time. This balance decreased last year by $7,356, which was the deficit in the General Fund for the year.

December 31, 1999	December 31, 2000
$218,240	$210,884

General Fund Balance

This is my last annual report as Treasurer. I will leave that position at the conclusion of the annual meeting in January 2002. It has been my good fortune to work with exceptionally dedicated individuals, both MAA volunteers and staff. Because of their efforts the MAA programs and financial strength has grown. The greatest asset that the MAA has is not its buildings or its finances; it is its members who are the true backbone of the Association. Because of their efforts the MAA will continue to prosper.

Supporting Materials

1. Expense and Income by Activity http://www.math.upenn.edu/~gjporter/maa/report2000 2000%20INCOME%20AND%20EXPENSE%20BY%20ACTIVITY.htm.

2. Statement of Financial Position http://www.math.upenn.edu/~gjporter/maa/report2000/STATEMENT%20OF%20FINANCIAL%20POSITION.htm.

3. Investment Fund Accounts http://www.math.upenn.edu/~gjporter/maa/report2000/MAA%20INVESTMENT%20FUND.htm.

4. Building Fund http://www.math.upenn.edu/~gjporter/maa/report2000/MAA%20BUILDING%20FUND.htm.

5. Grant Supported Programs http://www.math.upenn.edu/~gjporter/maa/report2000/GRANT%20SUPPORTED%20PROGRAMS.htm

[1.] We use the name "Endowment Fund" to distinguish these assets from the MAA Investment Fund which consists of Endowment assets plus two trusts that the MAA administers.

[2.]Dues income allocated to journals was as follows: *American Mathematical Monthly* $424,178, *Mathematics Magazine* $197,479, *College Math Journal* $190,066, FOCUS $159,912.

[3.] Investment and Trust Income in 2000 were allocated as follows: awards $22,851, joint meetings $2,001, MathFest $2,265, Sections $10,895, Finance Dept $5,273, Sliffe Awards $27,278, Public Awareness $5,000, Publications $8,500.

[4.] Expenses include direct expenses, allocated building expense, and allocated direct service expense for the publications, marketing, and member services department. costs attributable to Governance, the Executive and Finance Departments and the Development Department are not allocated. They appear as Administrative expenses.