Sinclair Mathnet

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FROM THE CHAIR

In the November 1998 issue of *Mathnet* I wrote about the external evaluation that the department had undergone the previous Spring Quarter. This was done by Professor Nancy Sattler, Curriculum Chair and former Department Chair at Terra Community College and former President of the Ohio Mathematical Association of Two Year Colleges. We are scheduled to undergo an external evaluation once again this year in the Spring, so I thought it would be a good time to review the recommendations that were made three and a half years ago and take stock of progress we have made in bringing about their completion. Shortly after the evaluation was delivered, the department met to review the suggestions made and prioritized what we considered the seven most important suggestions to pursue. Here is a list of those seven together with a brief assessment of what has been done:

1. Increase ratio of full- to part-time faculty.

In Fall Quarter of 1997 we stood at 15 tenure track faculty, 3 regular adjuncts, 3 special adjuncts and 32 part-time faculty members. We submitted requests for one new tenure track position and two new regular adjunct positions for the 1999-00 school year and a request for one new regular adjunct position for the 2000-01 school year. (The two regular adjunct positions for 1999-00 would have been supported by grant money and for two years only.) As of Fall Quarter of 2001, we stand at 15 tenure track faculty, 4 annually contracted faculty, 2 special adjuncts and 37 part time faculty. In light of current budget difficulties and expanding enrollment, it may be difficult to avoid further regression in this area let alone any improvement.

2. Update lab equipment.

Virtually all computers and printers in the Math Lab have been replaced since our last review. A department task force (Lyn Keeler and John Pfetzing) is now working on furniture replacement for the Math Lab, which is scheduled to take place this school year.

3. Develop departmental diagnostic tests for Mat 101, 102, 116 and l3l.

While a pilot was carried out and some work has been done by Len Ruth, this initiative remains far from completed. We need to discuss whether this remains a priority and, if so, take steps to get it completed soon.

4. Encourage faculty to use the computer classroom more.

Thanks to Barb Carruth, a number of workshops have been offered to acquaint faculty with the facilities in the computer classroom, to train them in their use and to encourage their use. However, success is questionable. In the 1997-98 school year faculty scheduled the room 121 times, in 2000-01 only 112 times. At the same time it must be recognized that the computer facilities in the Math and Science Technology Center and room 10327 have experienced increased usage for our statistics classes and our newly developed lab-based sections of Tech Math.

5. Apply hands on approach to other courses.

In Winter Quarter 1999 lab-based sections of Tech Math taught by Bob Chaney, Kay Cornelius and Barb Carruth became a regular part of our curriculum. In Fall Quarter of 1998 Math 110, a new course with an activity-based component developed by Susan Harris, Susan Myers and Kay Cornelius, became a regular part of our curriculum. Through the Learning Challenge Project for Math 101 lead by Susan Myers, we have experimented with incorporating an activity-based component into Math 101.

6. Invite high school teachers to colloquia.

Invitations were sent by Janel Gauby and Vickie Lair to numerous high schools for each of our colloquia. Unfortunately the response has been negligible.

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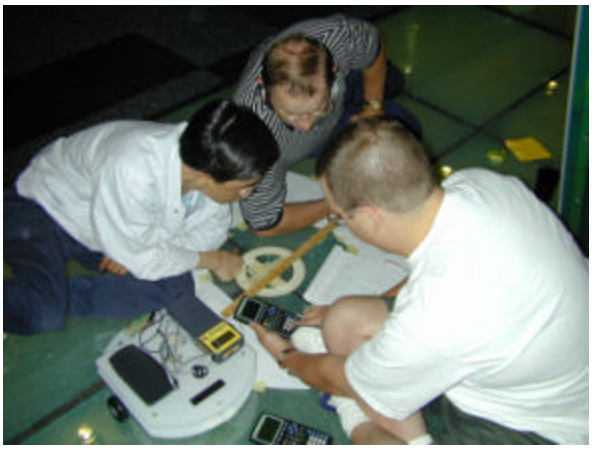
Award for Innovative Excellence in Teaching, Learning, and Technology

Bob Chaney was recently selected as Sinclair Community College's nominee to attend the Thirteenth International Conference on College Teaching and Learning in April, which makes him Sinclair's recipient of the Award for Innovative Excellence in Teaching, Learning, and Technology. The conference is sponsored by the Center for the Advancement of Teaching and Learning at Florida Community College at Jacksonville, Florida.

The annual conference emphasizes the use of innovative strategies, such as interactive and cooperative learning, combined with the use of technology to support higher education learning. About 1,000 faculty representing the major academic fields attend from colleges and universities throughout the world. Each college and university is eligible to nominate one full-time teaching faculty member who has contributed in the most highly creative ways to teaching, learning and technology. Colleges and universities select their candidate based on an institution-wide search using their own criteria.



Tech Math students are engaged in a vector activity involving SAM the Robot.

Statistics students collect real-world data to learn about statistical control processes.

At the conference, Bob will deliver a paper or poster session concerning his work. He will also be honored at a special awards ceremony that will include the presentation of an engraved plaque indicating his achievements. In addition, he will have his photograph and contributions published on the conference website.

Bob was chosen for this award for his work in helping to revise the Statistics and Tech Math sequences to include lab components, helping in the establishment and oversight of the Math - Science Technology Center and Room 10-327 to facilitate the teaching of these sections, helping in the work with SAM the robot, and disseminating his work both regionally and nationally through seminars and workshops. This is a very significant honor for both him and others who have played key roles in working with him on these initiatives.

Bob truly exemplifies the true spirit of the Learning College by giving students exciting and rewarding collaborative learning experiences to deepen and broaden their understanding of mathematics.

Congratulations Bob, on this well deserved honor!

The Golden Ratio

The Golden Ratio is an irrational number with several curious properties. It is often represented by ϕ, the Greek letter Phi, and is defined as the number that is equal to its own reciprocal plus one:

$$\phi = \frac{1}{\phi} + 1.$$

Multiplying both sides of this same equation by the Golden Ratio, we derive the interesting property that the square of the Golden Ratio is equal to the number itself plus one:

$$\phi^2 = \phi + 1.$$

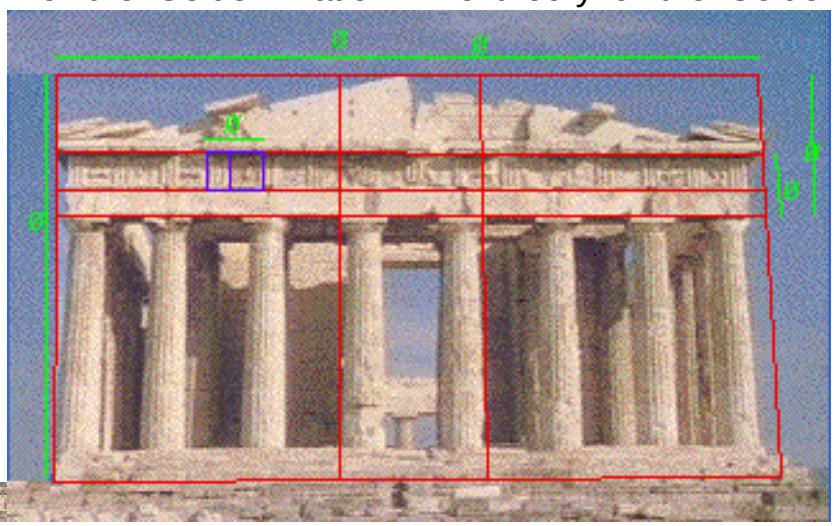
Since that equation can be written as $\phi^2 - \phi - 1 = 0$, we can derive the value of the Golden Ratio from the quadratic formula,

$$\phi = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}, \text{ with } a = 1,\ b = -1, \text{ and } c = -1.$$

This gives us: $$\phi = \frac{1 \pm \sqrt{1 - 4(1)(-1)}}{2(1)} = \frac{1 \pm \sqrt{5}}{2}.$$

These fractions reduce to 1.618 033 989 and -0.618 033 989. The first number is usually regarded as the Golden Ratio itself, the second as the negative of its reciprocal.

The Golden Ratio gets its name from the Golden Rectangle, a rectangle whose sides are in the proportion of the Golden Ratio. The theory of the Golden Rectangle is an artistic one, that the ratio is aesthetically pleasing, and so can be found spontaneously or deliberately turning up in a great deal of art. The front of the Parthenon, for instance, can be comfortably framed within a Golden Rectangle.



The Fibonacci Numbers

In Fibonacci's book, the *Liber Abbaci,* he introduces a problem for his readers to use to practice their arithmetic skills:

A pair of rabbits is put in a field and, if rabbits take a month to become mature and then produce a new pair every month after that, how many **pairs** will there be in twelve months time?

We assume the rabbits do not escape and none die. The answer involves the series of numbers:

1, 1, 2, 3, 5, 8, 13, 21, ….

Fibonacci himself did not attach a great deal of importance to this sequence of numbers; it was the French mathematician Edouard Lucas (1842-1891) who named them the **Fibonacci numbers** and who found many important applications for them.

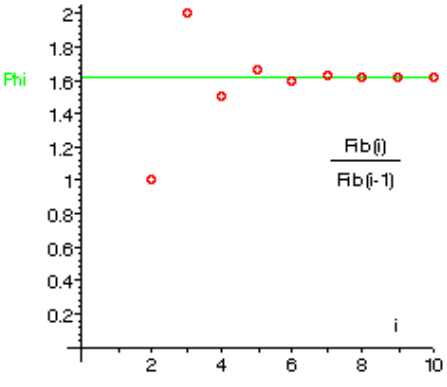
If we take the ratio of two successive numbers in the Fibonacci sequence,

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987,...

by dividing each term by the number before it, we will obtain the following sequence of numbers:

$\frac{1}{1} = 1,\ \frac{2}{1} = 2,\ \frac{3}{2} = 1.5,\ \frac{5}{3} = 1.666...,\ \frac{8}{5} = 1.6,\ \frac{13}{8} = 1.625,\ \frac{21}{13} = 1.61538...$

It is easier to see what is happening if we plot the ratios on a graph:



The ratio of the Fibonacci numbers approaches a particular value – the Golden Ratio!

The ratio between any two successive Fibonacci Numbers approaches a limit as the numbers get larger, and that limit is the Golden Ratio. Thus, 6765/4181 (the quotient of the 20th and 19th Fibonacci numbers) is 1.618033963, which only differs from the Golden Ratio by 0.000000025.

If $b_n = \frac{a_{n+1}}{a_n}$, then $\lim_{n\to\infty} b_n = \frac{1}{\lim_{n\to\infty} b_n} + 1$. (See "Test Your Skills.") This matches the definition for the Golden Ratio, so $\lim_{n\to\infty} b_n = \phi$.

Discontinuous Derivatives

When a student asked a question in my Calculus I class, I was not immediately sure how to correctly answer. It was about an exercise in the section on Rolle's Theorem and the Mean Value Theorem. The partial graph of a function f is given (Figure 1), and f is given as continuous and differentiable on $[-10,4]$. Also, f' is given as continuous. Students are asked to explain why f and f' must have at least one zero in the interval. Clearly, the Intermediate Value Theorem can be used. However, another question then asked students to explain whether the conditions of the continuity of f and f' were necessary. Since the differentiability of f on the interval implies f is continuous on the interval, the explicit statement that f is continuous is not needed. But I was not sure whether f' had to be continuous for f' to have a zero on $[-10,4]$. I told the class I would think about it further and get back with them.

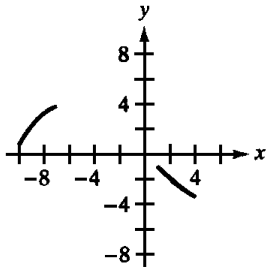


Figure 1

In consulting my analysis texts, I discovered that derivatives do posses the intermediate-value property. This comes from the following theorem attributed to Gaston Darboux (1842 – 1917): Suppose f is differentiable on $[a,b]$ and λ is a real number such that $f'(a) < \lambda < f'(b)$ or $f'(b) < \lambda < f'(a)$. Then there is $c \in (a,b)$ such that $f'(c) = \lambda$. This implies that a derivative must be special. For example, the greatest integer function cannot be the derivative of a function. I then began to wonder about differentiable functions that have discontinuous derivatives.

The simplest example is the function g given as follows:

$$g(x) = \begin{cases} x^2 \sin(1/x), & x \neq 0 \\ 0, & x = 0 \end{cases}.$$

The function g (Figure 2) is differentiable on $[-1,1]$, but its derivative g' is not continuous on $[-1,1]$ since it is not continuous at 0.

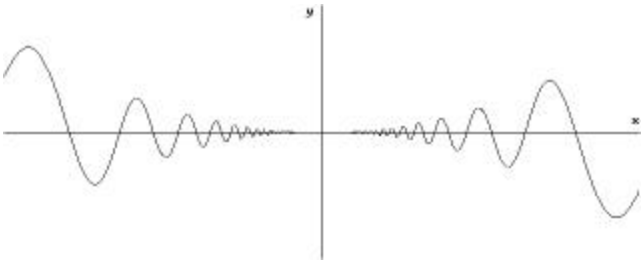


Figure 2

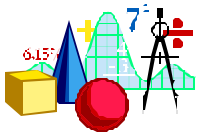
So how discontinuous can a derivative be? In 1881 Vito Volterra (1860 – 1940) described a function g that is differentiable on $[0,1]$, but whose derivative is discontinuous on an infinite set of points.* He showed g is differentiable and bounded, but not Riemann-integrable. In fact, it is discontinuous on a set of positive measure, for Henri Lebesgue (1875 – 1941) showed that a function is integrable in Riemann's sense if and only if the set of discontinuities has measure zero. (For example, the rationals have measure zero.) So this shows the qualifications that come with the Fundamental Theorem of Calculus are necessary since a derivative need not be Riemann-integrable.

*Volterra's function can be found in *Lebesgue's Theory of Integration* by Thomas Hawkins, AMS Chelsea Publishing, 2001, p. 57.

David Stott ■

Test Your Skills

We hope you have time to try this problem and to offer your solution to either Lyn Keeler or David Stott.



Given that a_n is the n^{th} term of the Fibonacci sequence and that $b_n = \dfrac{a_{n+1}}{a_n}$, show that

$$\lim_{n\to\infty} b_n = \frac{1}{\lim_{n\to\infty} b_n} + 1.$$

(Continued from page 1)

7. Expand distance learning.

In Winter Quarter l999, we began offering video sections of Math 102 taught by Susan Harris and Judy Gebhart. In Spring Quarter of 1999 Tom Wilson offered a section of Math 101 in the Interactive Classroom and Tony Ponder began offering Math 105 in the Interactive Classroom. In Winter Quarter of 2000, I began offering Web sections of Math 102. In addition, Web enhancements have been instituted in selected sections of Math 108 and Math 122 by Len Ruth and Barb Carruth.

I think that, for the most part, the Math Department has made a good effort to address those aspects of these recommendations over which it has control. The exceptions to this would be the departmentalized in-class diagnostic tests and the increased faculty usage of the computer classroom.

Other areas where I feel the Department has followed up on ideas specifically mentioned and encouraged by the evaluator include: establishment of the Math Help Room, keeping data on retention of students, not permitting students into class when they do not have the proper prerequisite skills, encouraging student use of the Math Lab and incorporating use of the Internet into the Math Lab. Other areas that were mentioned for which I do not think we have made good follow up include: keeping data on the placement of students using the Compass test as well as their scores on in-class diagnostic tests, promoting the idea of study groups and enlisting faculty to teach the Health Math class that are knowledgeable about the health care profession.

With that assessment, I thank you for the work you have done in responding to the direction given in the external evaluation to improve our department and I ask your support as we continue to attempt to carry out what remains to be done.

Al Giambrone ■

Reminders

- The Testing Center asks that you provide them with student ID numbers rather than social security numbers.
- Please remember that you are expected to meet and be on time for all classes. Doing this sets a good example of responsibility for your students. If your absence is unavoidable, please get a substitute from the sub list and notify the Office. If you are unable to get someone from the sub list, please contact the Office for help.
- Please do not dismiss class early. Even if you have completed covering the material, there are always students who can benefit from seeing a few more examples or taking a quiz or just working homework in class with you available to give them assistance if needed.
- When working in the Math Help Room, be careful about giving students help with graded assignments. When giving students graded outside assignments, make sure they understand what resources they are allowed to use and what they aren't, and take steps to insure that the credit you give them is for work they have done.

Harvey's Four Jokes Corner

July 4th conversation:
Preschool teacher: "Everyone in this country is free."
Student: "Oh, no they aren't. I'm four!"

Horses have six legs – they have forelegs in front, and two legs behind.

When a man marries he gets 16 wives: four richer, four poorer, four better, four worse.

Sign for a big dinner at King Arthur's in Camelot: "Have a square meal from a round table!"

July 5th problem: A man drank a fifth on the Fourth and couldn't go forth on the fifth.

A favorite date of citizen band radio operators: October 4th ("10-4")