

UNDERGRADUATE MATHEMATICS SEMINAR

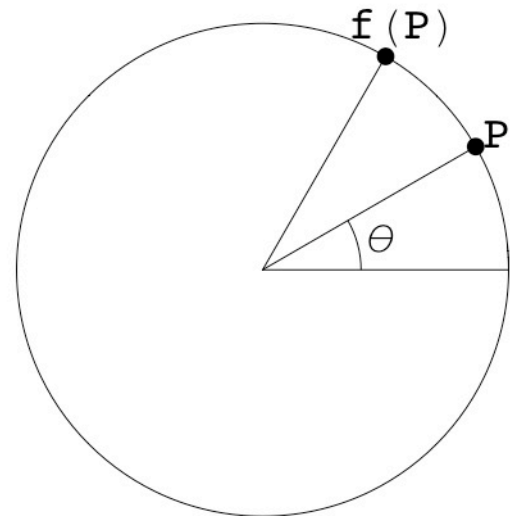
The next meeting of the seminar will be this coming **Monday February 12**, with refreshments beginning at 4:45 in the Math Commons Room, Bailey 204, and the lecture following at 5:00 in Bailey 201.

In this week's seminar, **Professor Susan Niefeld** will present the following talk:

TITLE: Chaos on the Circle

ABSTRACT: Take a point P on the unit circle in the plane and double the angle Θ to get a point $f(P)$. Repeating this process gives a set $\{P, f(P), f(f(P)), \dots\}$ of points, called *the orbit of P under f* . What kind of orbits can we find? Of course, that depends on the starting point P . Some orbits are finite, while others are not. Among the infinite ones, there are even orbits that hit every point on the circle.

This map is an example of a *chaotic dynamical system*. After presenting a definition of *chaos*, we will show that points on the unit circle can be represented by binary sequences, and use this representation to prove that the angle-doubling map f is chaotic.



Spring Term Scheduling

This coming spring term, the Mathematics Department is offering several interesting courses beyond the calculus sequence that are suitable for math majors and minors.

Math 130 is a course in ordinary differential equations. This course is required for majors and minors in applied mathematics and has a Math 115 prerequisite.

Math 199 is the department's "bridge course," intended to help students make the transition from computationally oriented courses to more theoretical proof-writing courses. As such, it carries WAC credit. Further, it is requirement for all math majors and minors. Math 199 is *usually* taken after a student has taken Math 115.

There are four courses being offered this spring that have a Math 199 prerequisite: Math 234 (Differential Equations), Math 235 (Number Theory), Math 332

(Abstract Algebra), and Math 480 (Foundations of Mathematics). As Level 1 courses, Math 234 and Math 235 are appropriate for students coming from Math 199. [**Be aware** that Math 234 is not open to students who have passed Math 130, and Math 235 is normally closed to students who have passed Math 221 (Cryptography) and vice versa.] Math 332 is a Level 2 course and is required for math majors. Math 480 is a Level 3 course and is a good choice, particularly, for students who wish to earn departmental honors and/or have interest in graduate school.

Each of the courses described above are petition (card) courses. You can sign-up on the web (<http://www.math.union.edu/>) for a card on Tuesday or Wednesday (13th, 14th). Results will be posted at the beginning of the following week. Students must then **come to the Math Department office** to accept their spot in the course on Monday or Tuesday (19th, 20th).

Pieces from Theses: A View from Leah Ziamandanis ('07)

From the *spring* term to the *fall* term of '06 I worked on my thesis under the advisement and guidance of Professor Julius Barbanel. Although it seems like an oddly timed schedule, this timing was necessary in order for me to both write a two-term honors thesis and to have a term abroad in Mexico in the winter term of '07, where I currently am.

Professor Barbanel was a familiar and favorite professor of mine at Union, so I was thrilled when he decided to accept my thesis proposal to study Ancient Greek Mathematics and the Origin of Calculus. His schedule was a little tight considering he was teaching a new course in ancient Greek mathematics, but my interest in the subject led to a thesis based on his course and therefore it worked out well.

My thesis began with my interest in the "controversy" over the true beginning of calculus. It is not a controversy in the way of a heated debate, although an exact consensus on who was the first to apply calculus in proofs is certainly up for discussion. At this point I had to buy a new backpack to hold the numerous 700 page books given to me to start familiarizing myself with the topic and the work of important Greek mathematicians including Eudoxus, Euclid, and Archimedes. I spent my first term reading and understanding the language and format of ancient proofs, which are in fact quite different from the concepts used in modern mathematics. Professor Barbanel had me reproduce and present ancient proofs without using fractions or the concept of volumes/areas as whole numbers. I could not even utilize a number line in my arguments.

The most interesting part of my research was the Method of Exhaustion, created by Eudoxus, and its

applications, as used by Archimedes. The (cont.) controversy begins to take shape here, when men who almost 2000 years before the next attempt at calculus were in essence using integrals to find a volume as compared to another. Many formulas that I take for granted today, such as the one stating that the volume of a cone is one third that of the cylinder that circumscribes it, were proved by Archimedes using this method - without modern calculus. (As part of my thesis, I learned to prove each formula as both an ancient mathematician and a modern mathematician would.) I first thought that the method of exhaustion received its name because it was so exhausting for me to understand and reproduce, but in reality it is because the method works with a concept extremely similar to modern day Riemann sums: A polygon with an even number sides circumscribed about a circle can be manipulated to have more and more sides so that its area will approach that of the circle. (Limits!)

Although the terminology of the ancient Greeks was not precise and their procedures left out a few concrete definitions, the actual mathematics, in my opinion, proved to be the first calculus ever performed by man. I am Greek and I have a profound interest in and love for mathematics so I am quite proud of this ancient accomplishment.

Overall I had a wonderful experience completing my first independent project of this size. I enjoyed working one on one with Professor Barbanel because he provided me with an environment where I could dictate what I wanted to investigate further, but with his advice and guidance along the way.

Problem of the Newsletter: February 9, 2007

Congratulations to **Susan Beckhardt** for suggesting last week's problem. You can view a solution to it on the first floor bulletin board in Bailey Hall.

Here is this week's problem: Last term, this column asked you to compute $\cos(72^\circ)$.

The answer was $\cos(72^\circ) = \frac{\sqrt{5}-1}{4}$. Use this to show that $(\tan^2 18^\circ)(\tan^2 54^\circ)$ is rational.

Professor Friedman will accept solutions to this problem until 12:00 noon Thursday, February 8.

DON'T FORGET TO
SIGN UP FOR
PETITION COURSES
ON FEB 13TH OR
FEB 14TH!