Department of Mathematics January 30, 2009

UNDERGRADUATE MATHEMATICS SEMINAR

The next seminar of the winter term will be:

DATE: **MONDAY, February 2nd**

Time & **4:15pm –** Refreshments in the Math Common Room, **Bailey 204**

Location: **4:30pm –** Seminar in **Bailey 207**

In this seminar, Union's very own **Professor Karl Zimmermann** will deliver the following talk:

TITLE: Prime Even Numbers

ABSTRACT: It is often useful to write an integer $n > 1$, as a product of primes, $n = p_1^{k_1} p_2^{k_2} \cdots p_r^{k_r}$. According to the Fundamental Theorem of Arithmetic, this is always possible, and in addition, the factorization is unique. In this talk, I'll illustrate what uniqueness means in this context, and give an elementary example of a number system in which unique factorization fails to hold. At the end of the talk, I'll mention the role that uniqueness of factorization played in 350 years of attempts to prove Fermat's Last Theorem.

For a preview of upcoming seminars and a list of past seminars, visit http://www.math.union.edu/~wangj/seminar09w.htm

Pieces from Theses: John Robens, '09

My senior thesis: what a nightmare! Or at least that's what I thought going into it. Most people on campus absolutely have a negative outlook on the idea of a thesis: independently doing research and writing quite a long paper explaining your work when everything is said and done. I can tell you right now, it's not as bad as you think. Before I dive in to my specific research, a few words of advice: don't wait, start early, use your advisor's knowledge, and write as many drafts as you possibly can.

My thesis was a bit different than other math theses, generally speaking. First off, I am an applied math major, so my topic was in a very interesting and applicable area. Looking through the possible topics offered, this one jumped right out at me as something I wanted to research. With professor Tønnesen-Friedman, I looked at different ways to model changes in body weight using differential equations. This was based off a few papers written by a former teacher of Professor Tønnesen-Friedman, at the University of Southern Denmark. Luckily for me, Professor Tønnesen-Friedman was able to find some great papers that were all closely related, and helped to explain the ideas of the topic more thoroughly. The aim of my thesis was to determine what factors had a more significant impact on weight gain, using mathematical models.

The two main factors I focused on were Energy Intake (EI), and Physical Activity Level (PAL). There were several other factors to take into consideration, but by making a few assumptions and using the values of the constants given in the papers I read, many of the factors became quite easy to deal with. I focused on a feedback model that was based on the body's response to EI and PAL. For most people, body weight is relatively stable over a long period of time, regardless of varying physical activity and food intake in day-to-day life. This suggests that the body has a sufficient feedback control from a person's body weight to their energy balance, or based on a person's EI and PAL, their body is able to maintain a stable body weight.

This is not true for everyone, and given the feedback model I examined, if a person's body

weight is slightly above a given reference body weight, there are very *few* cases where that person's weight is stable. After close inspection of the equations given in the papers, it became clear to me that we were dealing with a differential equation with two main parameters, and of course they were the feedback associated with EI and PAL. This led to 2 main cases with 4 bifurcations. The first case was the idea that the reference body weight is a steady state. This was dependent on an individual's feedback from energy intake and physical activity level. From this assumption, two bifurcations were examined, one by setting one of the parameters equal to zero, and the other from setting the other to zero. The same kinds of bifurcations were examined for the second case, which was assuming that the reference body weight was not a steady state.

The energy balance system turned out to be quite unstable. If someone is to continually develop obesity, they must constantly increase their EI or constantly decrease their PAL. The model showed that a decrease in PAL was closely related to an increase in body weight. It was also determined that a change in physical activity had about 10 times a greater impact on body weight than a change in energy intake. The great discovery of my thesis: the most efficient way to avoid obesity and a self-promoting weight gain is to maintain an adequate daily physical activity level, and adjust that physical activity level based on one's daily energy intake.

To sum up, dieting is great, but exercising is better. As far as the actual writing process is concerned, the hardest thing to do is to force yourself to set aside time to work on your thesis, especially at the start of the term. Give yourself guidelines and due dates if your advisor does not. Finally, I need to thank my advisor; none of this would have been possible without the fantastic advice and help from Professor Tønnesen-Friedman, so for that I thank you. Good luck, and remember to gloat a bit when all your friends are struggling with their 80 page two-term thesis - it feels great to be done.

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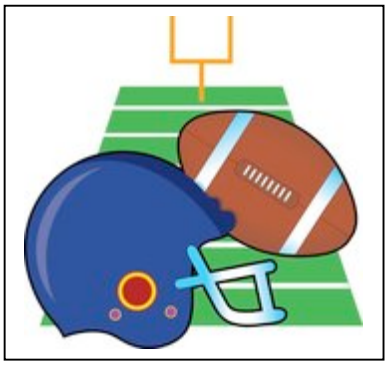
www.math.union.edu



Have a Super Sunday!

Problem of the Newsletter: January 30, 2009

Last week's Problem of the Newsletter drew a few responses with the correct answer (two points), but none with a complete proof.

Here is this week's problem: Last week's problem from the 2008 Putnam Exam was fun, so let's take another one. Having a little Linear Algebra in your background (from Math 115 or Math 340) might help you crack this nut:

Alan and Barbara play a game in which they take turns filling entries of an initially empty 2008 x 2008 array. Alan plays first. At each turn, a player chooses a real number and places it in a vacant entry. The game ends when all the entries are filled. Alan wins if the determinant of the resulting matrix is nonzero; Barbara wins if it is zero. Which player has a winning strategy?

Professor Friedman will accept solutions to this problem until 12:00 noon Thursday, February 5th. Email your solution to him (friedmap@union.edu) or put it in his mailbox in the Math Department's office on the second floor of Bailey Hall.