

# Goodσελλ Gazette

Carleton College  
Northfield MN 55057

The newsletter for the Carleton mathematics and statistics community

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## *Carleton Students Storm Boston*

Last week's *Gazette* noted that several math professors spent much of the week at the Joint Mathematics Meetings in Boston. They weren't the only people missing from the CMC, though: several Carleton students also attended the meetings, giving talks and presenting posters on their mathematical research. In particular, Jonathan Hahn presented a poster at the MAA Undergraduate Poster Session on "Classifying  $f$ -vectors of Manifolds with Boundary", Xin Chen presented a poster at the same session on "A Metacalibration Proof of the Isoperimetric Inequality on Constant Gaussian Curvature Surfaces", Justin Troyka gave a talk on "Restricted Symmetric Signed Permutations", Katie Storey gave a talk on "Eradicating Invasive Species through Sex Reversal", and Frank Firke presented a poster and gave a talk on "Extremal Graphs without 4-Cycles". Jonathan, Xin, Katie, and Frank's presentations were all based on work they did at various REUs over the summer, while Justin's talk grew out of work he and Andy Hardt did over the summer here at Carleton, which was supervised by Eric Egge. The math department is thrilled to be so well represented at the meetings!

## *The Tour Starts Today!*

As usual in winter term, we're offering the 1-credit (S/Cr/NC) Tour of Mathematics, which consists of eight talks, and anyone is welcome to attend any of the separate talks. The Tour meets on Friday afternoons at 3:30 (6a) in CMC 206, and the individual talks will be announced on the whiteboard as well as in the

*Gazette*. Next week, Eric Egge will speak on "The Alternating Sign Matrix Conjectures". (This week, depending on when you read this, Mark Krusemeyer either will speak or has already spoken on "Accidents, and Why 37 Is Evil".)

## *When is a Knot not Knotted?*

Speaker: Scott Taylor, Assistant Professor of Mathematics at Colby College

When and Where: Monday January 16, 6:30pm in CMC 206

As a freshman in college, John Milnor proved that the total curvature of a non-trivial knot is at least  $4\pi$ . His delightfully simple proof was a foretaste of the many wonderful contributions he would make to geometry and topology. In recognition of his achievements, Milnor was awarded the Fields Medal in 1962 and the Abel prize in 2011 (these are the top two prizes in mathematics; each somewhat akin to a Nobel Prize). In this talk, Scott Taylor will introduce the mathematical discipline of knot theory, outline Milnor's proof, and discuss connections to current research. The talk should be accessible to anyone who has taken some (preferably multivariable) calculus.

## *SUMO to Show "Moneyball" on January 20 in Weitz Cinema*

In collaboration with the Math Department, SUMO is playing the movie "Moneyball". This movie stars Brad Pitt in a biographical role as the Oakland Athletics' general manager attempting to build the most competitive team ever in 2002.

### *Math Beyond the Classroom*

Interested in studying math or statistics abroad or during the summer? Have stories to share? Come listen to fellow students talk about their experiences. Find out about the who, what, when, where, why, and how of the application processes and get some great advice besides! Join us on Tuesday, January 17, 12-1pm, in CMC 206. Lunch will be provided!

### *Problem Solving Group Returns*

After a brief hiatus while Mark and Eric attended the Joint Mathematics Meetings in Boston, the problem solving group has returned. This term we'll study old Konhauser problems in preparation for the 20th Annual Joseph Konhauser Problemfest, which will be at Macalester on Saturday, February 25. (Mark your calendar!) Please join us for some fun problems, and to see what it might take to retain the pizza trophy. As in the past, we'll meet on Wednesdays from 4:30 to 6 pm in CMC 328, but you're welcome to arrive late and/or leave early if you need to.

### *PROBLEMS OF THE WEEK*

1. How many times does the function

$$f(t) = \prod_{k=1}^{2012} [k \cos^4 t - (k^2 + 1) \sin^2 t \cos^2 t + k \sin^4 t]$$

change sign on the interval  $[0, 2\pi]$ ? (The symbol  $\prod$  stands for "product", just as  $\sum$  stands for "sum".)

2. Let  $f$  be a continuous function defined on the real numbers. Define a sequence of functions

$$f = f_0, f_1, \dots, f_n, \dots$$

by repeated integration, as follows:

$$f_0(x) = f(x)$$

$$\begin{aligned} f_1(x) &= \int_0^x f(t) dt \\ f_2(x) &= \int_0^x f_1(t) dt \\ &\vdots \\ f_n(x) &= \int_0^x f_{n-1}(t) dt. \end{aligned}$$

For example, we could have

$$f(x) = 6x + 2, f_1(x) = 3x^2 + 2x, f_2(x) = x^3 + x^2, \dots$$

or

$$f(x) = \cos(x), f_1(x) = \sin(x), f_2(x) = 1 - \cos(x), \dots$$

Show that for *any* continuous function  $f$  and any real number  $x$ ,

$$\lim_{n \rightarrow \infty} f_n(x) = 0.$$

Last week's second problem ended up being a bit garbled, sorry. "Scalinity" was a typo for "scalenity" (a word I made up, meaning the property of being scalene). More importantly, the sentence about measuring the distance was missing a dozen words or so; it should have read as follows: For each vertex of a triangle  $ABC$ , measure the distance along the opposite side between the "end" of the median (that is, the midpoint of the side) and the "end" of the angle bisector from that vertex, as a fraction of the total length of that opposite side. The corrupted version didn't stop John Snyder in Oconomowoc, who interpreted it correctly and proceeded to use *Mathematica* to solve the problem; he also solved the first problem. Solutions to either problem, as well as to the new problems posed above, are still most welcome.

- Mark Krusemeyer

Editors:	Max Bearak Deanna Haunsperger
Problems of the Week:	Mark Krusemeyer
Subscriptions & Web:	Sue Jandro