St. Olaf Mathematics Department

Math Mess

Department of Mathematics
St. Olaf College
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This Week's Mathematics Colloquium

Title: How We Spent Our January Interim: The 2004 Mathematics Practicum
Speakers: The Bagel Group, the Orchestra Group, and the Marrow Group
Time: Tuesday, March 9th, 1:30 pm - treats at 1:15
Place: SC 182

This Week's Colloquium

How is mathematics really used, in the real world, by real people, to solve real problems? In the Mathematics Practicum, offered each Interim, students find out. They work in teams for the full month on open-ended, sometimes ill-posed, real-world problems.

This year's Practicum students attacked three problems.

The Bagel Group (Scott Harris, Kristoff Hendrickson, Sara Krohn, Brian Peters, Dan Sinykin) kneaded data from the Bagel Brothers stores of southern Minnesota, analyzing and using statistical methods to investigate possible improvements in baking and ordering strategies for the bagel business.

The Orchestra Group (Colleen Curran, Anna Ericksen, Meredith Lotz, Chris Remien, Anna Swanson) analyzed ticket sales data for the Minnesota Orchestra, aiming to answer various questions: What types of concerts are most popular? Which people, and how many, continue buying tickets and eventually become subscribers? What factors determine patrons' ticket-purchasing patterns? Does anyone really want to hear boy sopranos? The Group will answer these questions and more – you'll never look at or hear the Minnesota Orchestra the same way again.

The Marrow Group (Tilman Achberger, Brett Aplin, Shraddha Mehta, Andrew Halvorsen, Andrea Rau) worked to provide an independent, center-specific comparison of one-year survival rates among the 106 transplant centers included in the National Marrow Donor Program (NMDP) dataset. Because transplant centers vary significantly in such factors as quantity and type of patients treated, the Group created a statistical model to control for such differences. The Group also used logistic regression to examine neutrophil recovery (engraftment versus no engraftment), hundred-days survival, six-month survival, and two-year survival rates as outcome variables.

Konhauser Results

Fifteen St. Olaf students travelled to St. Paul on Saturday, February 28, to participate in the12th annual Konhauser Problemfest at Macalester. Overall, 18 teams from 7 colleges competed. It was a tough contest - the top team, from Carleton, scored 64 points out of 100. In second place was the team of Michael Zahniser '04, Jason Saccomano '05, and Matthias Hunt '07, with 53 points. They won $25 apiece. Our all-first-year team of Paul Tveite, Joey Paulsen, and Becky Blessing placed 7th. Paul impressed the contest organizer by solving a problem that had taken him three days. Matt Handley '05, Janette Herbers '05, and Heather Wood '07 tied for 8th place, and our other two teams tied for 10th. It was a rewarding experience for everybody. Congratulations to all of our mathletes, and props to Randy Bailey for helping out with transportation and grading.

Teams of three had 3 hours to work on the ten problems. If you would like to try the problems for yourself, they can be found at http://www.macalester.edu/~mathcs/Konhauserproblemfest/KP2004.pdf

Pi Day!

Every year on March 14th, the world gathers together to celebrate the wonders of our most cherished number: the mysterious, beautiful, and irrational *Pi*. The St. Olaf community will kick off a weekend of mathematical revelry this *Friday, March 12, from 3 to 4 pm in SC 182*. Though the details of this opening ceremony are still enshrouded in secrecy, sources close to Pi tell us that many things can be expected: Pi-inspired music, Pi lore, recitations of Pi digits, and PIE! Lots of it. So come one and all to celebrate this most glorious of occasions!

Spring Actuarial Exam

St. Olaf College is an official host site of the Spring 2004 actuarial exam for Course 1, to be given on Wednesday, May 19, from 8:30 AM to 12:30 PM. The deadline for registration is April 1; application materials and information about study notes can be found at www.soa.org/eande/spring04_catalog/spring04_catalog.html.

Actuaries in the U.S. and Canada achieve professional status by passing a set of examinations prescribed by the Casualty Actuarial Society (www.casact.org) or the Society of Actuaries (www.soa.org). Course 1 is called Mathematical Foundations of Actuarial Science; its purpose is to develop and test knowledge of the fundamental mathematical tools for quantitatively assessing risk. A thorough command of calculus and probability topics is assumed, in addition to a very basic knowledge of insurance and risk management. Many past (and a few present) Oles have passed Course 1 while undergraduates, giving them an advantage in securing actuarial internships or permanent positions.

Quoting from www.beanactuary.org, “actuaries are the leading professionals in finding ways to manage risk; they are the analytic backbone of our society’s financial security programs; their work is intellectually challenging, and they are very well-paid.” For these reasons and more, actuary is consistently rated as one of the top jobs in America (#2 in the most recent ratings). Anyone interested in the actuarial examinations (or the actuarial profession in general) should feel free to contact Paul Roback (OMH206, x3861) or Amelia Taylor (OMH205, x3480) with any questions.

Congratulations, Alums!

Congratulations to Stephanie Libera '03 and Paul Tlucek '03 who won the third-place Richard V. Andree Award for high quality student-written articles published in the Pi Mu Epsilon Journal. Their paper, "Some Perfect Order Subset Groups," was published in the fall 2003 issue of the journal.

Last Week's Problem

A Martian word is any string consisting only of the letters X, Y, and Z. Prove that for any n, there is always one more Martian word of length n with an even number of Xs than with an odd number of Xs.

The problem was solved independently by all three members of our top Konhauser Team: **Michael Zahniser '04**, **Jason Saccomano '05**, and **Matthias Hunt '07**, as well as **Heather Wood '07** and **Bob Hanson** from the Chemistry department. The common approach was to use mathematical induction, since the result is very easy to prove for n=1. A more elegant technique is to construct an "almost-bijection". Let E(n) be the set of words of length n with an even number of Xs, and O(n) the set of words of length n with an odd number of Xs. Define f:O(n)->E(n) as follows. Given a word in O(n), find the first X or Y. If this is an X, change it to a Y, and vice versa. This changes an "odd word" to an "even word". Moreover, applying this rule twice gets you back where you started, so f is a one-to-one function. But it is not quite onto; it misses the word made up of all Zs. So f is a bijection between O(n) and E(n)\{Z...Z}, meaning there is one more even word than odd.

To use induction: let e(n) and o(n) denote the *number* of even and odd words respectively (not the sets). We will show that e(n)=o(n)+1 for all positive n. e(1)=2 (the words `Y' and `Z'), and o(n)=1 (the word `X'), so the result is true for n=1. Assume that e(k)=o(k)+1. Consider an even word of length k+1. If it starts with an X, then removing the first letter gives an odd word of length k. If it starts with a Y or a Z, then removing the first letter gives an even word of length k. These categories are disjoint, so we have that e(k+1)=o(k)+2e(k). Similarly, it can be shown that o(k+1) = e(k) + 2o(k). But then e(k+1)-o(k+1) = (o(k)+2e(k))-(e(k)+2o(k)) = e(k)-o(k), which by the induction hypothesis is 1. Thus e(n)=o(n)+1 for all positive n.

A third approach was suggested by Jason, and we worked together to flesh it out. Very slick! Take the expression $(X+Y+Z)^n$ and expand it out, but don't consolidate multiple appearances of the same letter into powers. This gives *all possible* words in the alphabet {X,Y,Z} of length n. Now, give each word a value by replacing every X by -1, every Y or Z by +1, and multiplying. (Jill! look! a homomorphism!) In this way, an even word gets coded as 1, and an odd word gets coded as -1. Adding up all such codes gives the number of even words minus the number of odd words. But at the same time, this sum is (-1+1+1)^n, which is 1.

Problem of the Week

Let x and y be any positive real numbers. (We can assume that x > y.) Two sequences $\{a_n\}$ and $\{b_n\}$ are defined by letting a_0 = x and b_0=y, and then for any n = 1, taking $a_{n+1} = (a_n+b_n)/2$, and $b_{n+1} = 2a_nb_n/(a_n+b_n)$. Prove that the sequences $\{a_n\}$ and $\{b_n\}$ converge to the same limit. (On last week's Konhauser Problemfest, problem #1 was to find the value of this limit when x = 200 and y = 4.)

*** Please submit all solutions by Thursday at noon to David Molnar by e-mail (molnar@stolaf.edu) or by placing them in his box at OMH 201.

If you would like to receive a copy of the Math Mess in your P.O. Box weekly, please e-mail Donna Brakke at brakke@stolaf.edu.

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