Individual Comps Talks

Some people haven't yet started to comps here in the Math & Stats Department. Others among us, however, are nearly done! This coming Tuesday, November 17th, six department majors will be giving their comps talks in CMC 209. Take a look at what they'll be speaking about just below, then be sure to stop by and support them while they demonstrate what they've learned! (You're likely to learn something new yourself as well!)

Title: The Mathematics of Waiting: Queuing Theory and its Applications
Speaker: Jordan Zoellmer
Time: 3:00 p.m.
Abstract: Whether it be at the dining hall, the post office, or the bookstore, we are all accustomed to standing in line. For both customers and service providers, waiting is an undesirable side effect of business, and it is therefore beneficial to understand on a mathematical level. For example, how long must customers typically wait? How long is the average line? How many servers are required to achieve a desired quality of service? Queuing theory studies waiting lines, or queues, in an attempt to answer questions like these ones. My comps talk will introduce queuing theory and apply it to a familiar "business": the Math Skills Center.

Title: Time Series and ARMA Model
Speaker: Ning Wang
Time: 3:30 p.m.
Abstract: In most of the contexts we've learned in statistics classes so far, there's an implicit assumption that observations are independent of each other. However, this is not true for all the data we encounter in real life. This presentation will talk about time series and its main features, autocorrelation and partial autocorrelation, as well as the autoregressive moving average (ARMA) model, which is widely used in time series analysis to make predictions.

Title: The Banach-Tarski Paradox
Speaker: Emily Pollard
Time: 4:00 p.m.
Abstract: Give Stefan Banach or Alfred Tarski a solid ball, and, voila! They'll turn it into two new solid balls, each one identical to the first! While this sounds like alchemy, magic, or just plain tomfoolery, in the world of mathematics, this is possible. Using Zermelo-Fraenkel set theory plus the Axiom of Choice, Banach and Tarski managed to prove that a solid sphere may be separated into a finite number of pieces and reassembled in such a way as to create two copies of itself. While the actual proof is quite dense and inaccessible, the intuition behind the proof is surprisingly easy to understand. In this talk, we'll explore this intuition. Soon you, too, will know how to create something from nothing!
Title: Singular Value Decompositions, Data Compression, and the Linear Least Squares Problem  
Speaker: Patrick Mayeda  
Time: 4:30 p.m.  
Abstract: Recall that an $n \times n$ matrix with linearly independent columns can be diagonalized so that the linear transformation can be easily visualized as a stretching or a compressing of vectors according to the eigenvalues. Now consider a matrix $A$ that isn’t necessarily square and whose columns aren’t necessarily linearly independent. Unsure of what comes next? Singular Value Decompositions, of course! My talk will introduce the concept as a tool that can be used in data compression and as a computationally wise solution to the linear least squares problem.

Title: Hypernumbers and Extrafunctions  
Speaker: Garo Moughalian  
Time: 5:00 p.m.  
Abstract: Have you ever wanted to stop worrying about how to deal with infinities and simply treat them like numbers? In this talk, we'll consider one way of doing this. I'll construct the enlarged set of numbers and show how to use it.  
Prerequisites: none.  
We'll be doing real analysis, algebra, and topology. We'll also touch upon set theory and functional analysis. Do come!

Title: Special Relativity with Accelleration  
Speaker: Kai Huang  
Time: 5:30 p.m.  
Abstract: Einstein’s special relativity theory is one of the fundamental theories of the modern physics that unites space and time. It is established based on two postulates that give rise to the Lorentz transformation. The consequences of special relativity can be derived from the Lorentz transformation, but usually the discussion is restricted to inertial reference frames. In this talk, I will introduce Minkowski spacetime geometry with the aim of solving special relativity problems involving accelerating frames.

New Addition to the Reading Nook: A Guide to Advanced Linear Algebra

You've probably taken linear algebra at Carleton, and if you've had a chance to take upper-level courses as well, chances are good that you've seen it popping up in a variety of other places. Taking a class in probability or differential equations guarantees that you'll find eigenvalues at some point or find yourself needing to take a linear transformation. And it doesn't stop there: linear algebra also crops up in Galois theory, analysis, and topology! And if that's not enough, or if you're curious to learn more, you could take the Advanced Linear Algebra course being offered in the Math & Stats Department this coming winter. But if you don't have six credits to spare, you could stop by the reading nook to flip through Steven H. Weintraub's *A Guide to Advanced Linear Algebra*. 
The book is directed at graduate students and professional mathematicians, so it's by no means introductory. However, it won't be unapproachable if you've already mastered the basics of the subject. It approaches linear algebra from an algebraic point of view; however, Weintraub's selection of topics isn't motivated only by their importance within linear algebra itself, but also by their applications throughout mathematics. Reading the book, you'll learn about the basic properties of determinants, discover additional structure that can be imposed on a vector space, be introduced to complex vector spaces, and learn about the ways in which Lie groups form a meeting space for algebra, analysis, and topology.

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Job, Graduate & Internship Opportunities

**MathPath: Camp Counselor**

Interested in spending part of the summer with bright young minds and learning math to boot? Macalester College is hosting MathPath Camp, the national summer camp for highly gifted middle-school math students, this July, and is seeking undergraduate camp counselors for the event. Counselors will work from June 24 to July 26, 2016. They will be paid a salary of $3000 and receive meals and on-campus housing, as well as reimbursement for reasonable travel expenses for their first year. Apply online at www.mathpath.org/FacultyandStaff.htm.

**University of Wisconsin-Whitewater: Master of Science in Applied Economics**

Have you considered graduate studies in a field that's not mathematics or statistics? Undergraduate math & stats majors often do well in studies of economics, even with limited prior economics training (as little as one economics class prior to enrollment)! The UW-Whitewater program provides students with exposure to advanced training in both theoretical and empirical economics. However, there is an emphasis on working with large data sets and becoming familiar with a wide array of computer programs. Job placement out of the program is highly successful, with an average starting salary of approximately $60,000. The program is competitively priced and offers several different degree options, including one that can be completed within a calendar year.

If you're interested, you can visit www.uww.edi/cobe/msecon or email David Welsch, the program coordinator, at welschd@uww.edu.

**TDC: Associate Consultant**

TDC is a Boston-based management consulting and research firm that specializes in working with nonprofit organizations seeking applicants for the Associate Consultant position. Associates should commit to staying with TDC for at least two years. Qualified candidates for the position will have a bachelors degree and a record of academic excellence, and should demonstrate interest in the nonprofit or social sectors. Desired skills include financial modeling; dataset construction, management and analysis; and an ability to conduct market research. Highly-qualified candidated will have experience conducting qualitative and quantitative research and possess excellent verbal and written communications skills. Apply through the Tunnel.

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Problems of the Week

Sad news: These are the last Problems of the Week for the year 2015. And, starting in January of 2016 there will be a new editor of this column. I hope you've enjoyed these diversions and have time for these last two while you are studying for exams. As before, please submit your solutions to one or both of these by putting them in my mailbox in the CMC, or by sending solutions by e-mail (gnelson). I will be looking for your solutions to these problems by November 23. Enjoy!

1. Find positive integers $n$ and $a_1, a_2, a_3, \ldots, a_n$ such that

$$a_1 + a_2 + a_3 + \ldots + a_n = 2015$$
and the product

\[ a_1 a_2 a_3 \ldots a_n \]

is as large as possible. Be sure to justify your choices.

2. Find, with proof, the minimum value of

\[ (s - t)^2 + \left( \sqrt{2 - s^2} - \frac{16}{t} \right)^2 \]

for \( 0 < s < \sqrt{2} \) and \( t > 0 \).

Solutions have appeared to the problems from the last regular issue of the Goodsell Gazette. Marshall Ma is continuing his streak of submitting solutions. He supplied correct answers to the first problem. As for the second problem, he had the correct answer but without justification. Congratulations! John Snyder of Oconomowoc also provided solutions. Marshall should check with Sue Jandro about receiving a prize from the B.B.O.P. (Big Box of Prizes).

-Gail Nelson

If you're having trouble seeing the problems of the week, try enabling images for the message!