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Group Comps Talks

Students who elected to pursue a Winter/Spring group comps project will present their findings on Tuesday, May 15 in Olin 141. Take a look at what they'll be speaking about 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!

Tuesday, May 15

Title: Applications of Statistical Learning Methods for Pattern Detection in Scatterplots
Speaker: Cari Comnick, Logan Crowl, Sophia Gunn, Aidan Mullan
Time: 3:30pm

Abstract: Through hundreds of thousands of years of evolution, the human brain has become an expert at detecting patterns and discerning meaning. Computers, on the other hand, have neither eyes nor evolution on their side. In this talk, we will discuss how a computer can be trained using statistical learning methods to detect patterns in scatterplots more efficiently and effectively than humans. Our research leads to the development of an automated procedure to detect relationships between variables in large data sets and opens the door to more powerful data analysis.

Title: Recovering Edge Conductivity Ranges in Electrical Networks Programming
Speaker: Maya Banks, Lynn Daniel, Angel Villa, Yuhao Wan
Time: 4:30pm

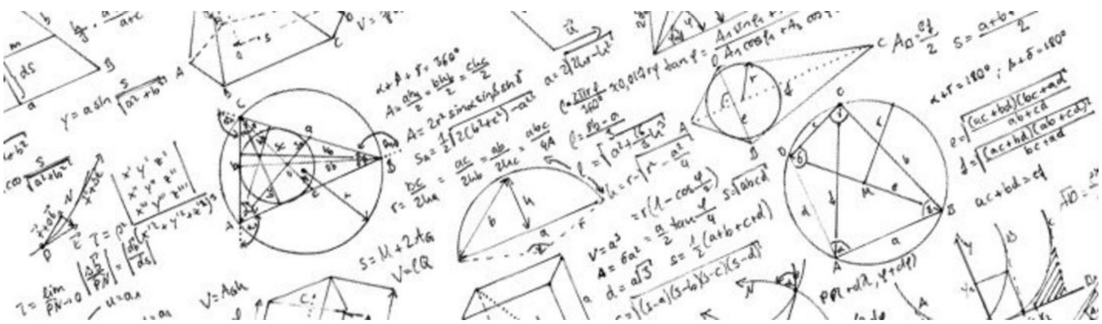
Abstract: One driving focus in network theory is to understand the inner workings of a network given only incomplete data about the way matter or information flows from one part of the network to another. We investigate the extent to which information about a certain type of network-- called electrical networks--can be recovered given only partial data. An electrical network is a graph whose edges are weighted by positive real numbers, that models the flow of current through a network of idealized resistors. To what extent can the individual conductivities in an electrical network be recovered if one only knows information between certain pairs? In this project, by examining the network's associated "medial graph", we show that the possible resistances for any edge in a circular planar electrical network always form a closed subinterval on $[0,\infty]$ where resistance 0 represents an edge deletion and ∞ represents an edge contraction.

Title: Counting COWs: Exploring Voting Systems
Speaker: Alice Antia, Jordan Aron, Maria Briseno Martinez, Seth Harris
Time: 5:30pm

Abstract: From the UN security council to the US's own legislative system, voting systems are commonly used to make decisions. These systems can be characterized by the number of different voters and which coalitions of these voters can pass a resolution. The collection of these coalitions is a Collection of Winners (COW) and defines a voting system. In our talk, we look at different approaches to organizing these voting systems in order to more effectively understand them, we look at the consequences of placing common sense restrictions on the types of COWs we allow, and we attempt to count the number of COWs that can occur with n voters under different constraints.

What's the Math and Stats Department Teaching Next Term?

Have you checked your registration number yet? Made a list of classes you're hoping to take next term? Let the course descriptions below guide you into an adventurous new year and new term within the Carleton Department of Mathematics and Statistics! There's something for everybody, from applied regression to combinatorial theory -- find out more below.



Math 236: Mathematical Structures
Instructor: Gail Nelson
Time: 3a
Prerequisite: Math 232 or consent of instructor

What lies beyond calculus and linear algebra? Are there possibly more math courses in your future? Mathematics is much more than solving max-min problems, techniques of integration, and inverting matrices. In fact, there are many branches of mathematics. In this course, we will study some of the structures and concepts that occur as common threads throughout these different branches. Our behind-the-scenes look at this subject will emphasize the development of problem-solving and proof-writing skills. This course should shed some light on what lurks in the hearts of mathematicians. If you think there may be upper-level math courses in your future, this course is for you.

Math 245: Applied Regression Analysis
Instructor: Andy Poppick

Time: 3a
Prerequisite: Math 215 (or equivalent) or 275

In your first statistics course, you learned how to describe the distribution of a single variable and also how to model relationships between two variables. However, many interesting problems require understanding relationships between a response variable and many predictor variables. This course is an introduction to regression models, which are used to solve exactly that problem. We'll cover models for continuous response variables (ordinary linear regression) as well as models for binary and count data (logistic and Poisson regression). Crucial practical questions to be addressed include: How do I build a regression model? Is my model a good description of my data? What do I mean by "good"? What do I want to use my model for? Can I answer substantive questions with my data and model, and can I accurately quantify my uncertainty? Can I make predictions with accurate uncertainties? Can I build a better model? The emphasis will be on data analysis and communication of results in realistic settings. We will make frequent use of R.

Math 251: Chaotic Dynamics
Instructor: Sam Patterson
Time: 2a
Prerequisite: Math 232 or consent of instructor

Dynamics is the mathematical study of systems that change with time. While dynamic natural processes have been studied using mathematical models since the time of Galileo, most of those models have been linear models because those are the ones that could be solved. Recently, however, attention has been turned to non-linear dynamical systems. This gave rise to the remarkable discovery that even very simple, deterministic, dynamical systems can exhibit astoundingly rich and even unpredictable behavior. In this course we develop the tools to understand the basic examples of Discrete Non-linear Dynamical Systems. Math 232 is a prerequisite and point-set topology, one of our critical tools, will be developed as needed.

Math 265: Probability
Instructor: Laura Chihara (2a), Josh Davis (5a)
Time: 2a, 5a
Prerequisite: Math 120 or 211

If the "immortal monkey" randomly strikes keys on a keyboard for eternity, what is the probability that it will eventually produce the complete works of Shakespeare? If in a small town, out of 12 car accidents that occurred in June 1986, four of them occurred on Friday the 13th, would this confirm your hunch that "13" is unlucky?

Probability is a fundamental branch of mathematics and is the foundation for all methods of statistical inference. In this course we will use the tools of counting and calculus to model random events, compute probabilities, and have lots of fun with balls in urns, poker hands, and coins and dice (fair or otherwise).

Math 280: Statistical Consulting
Instructor: Andy Poppick
Time: Tuesday only, 2/3c
Prerequisite: Math 245 and permission of the instructor

Students will work on data analysis projects solicited from the local community. We will also cover the fundamentals of being a statistical consultant, including matters of professionalism, ethics and communication.

Math 315: Bayesian Statistics
Instructor: Adam Loy
Time: 5a
Prerequisite: Math 275

For decades the world of statistics was dominated by "frequentist" methods. Bayesian statistics is an alternative school of thought founded upon the idea that our beliefs about the world are constantly revised with the incorporation of new information. While this idea is intuitive, Bayesian statistics was held back by the mathematical intractability of common inferential tasks. Computers have changed that. Today, Markov chain Monte Carlo (MCMC) methods are used by Bayesians to conduct statistical inference. In this course, we will explore the Bayesian philosophy and approach to statistical inference. We will start with the basic building blocks of inference and then explore common statistical models including regression and hierarchical models. Along the way, we will learn how and why MCMC works so that we can simulate from posterior distributions so that we are not restricted to models that can be "fit" using pencil and paper.

Math 333: Combinatorial Theory
Instructor: Eric Egge
Time: 3a
Prerequisite: Math 236 or consent of instructor

I looked in my sock drawer this morning and saw a jumbled collection of 36 socks, consisting of 6 socks in each of 6 colors. Each sock had a single letter stitched on it, and within each color, each of the letters J, S, E, A, K, and R appeared exactly once. In how many ways, I wondered, can I match my 36 socks into 18 pairs, so that both socks in each pair have the same color? Now that spring is finally here, and I don't actually need socks any more, can I display my socks in a 6 by 6 square, with no color or letter repeated in any row or column? Then my son wandered into the room. He has his own definition of which pairs of socks match, which seems to have nothing to do with letters or colors. If I close my eyes and start removing socks from the drawer, how many must I remove before I am guaranteed to have three socks in which each pair matches (according to my son) or three socks in which no pair matches?

If you, like me, are intrigued (or tormented) by questions like these, then combinatorics might be the right course for you. We'll study techniques for showing certain arrangements of things exist (or don't), and techniques for counting these arrangements when they do exist. Some of these counting techniques involve playing with power series, without worrying about convergence! We'll pay particular attention to counting sequences (like the Catalan numbers and the partition numbers) which have especially remarkable properties, and we'll use our counting techniques to prove some of the myriad identities involving the numbers in Pascal's triangle. We'll also make periodic forays into graph theory, and near the end of the course we'll see a "proof" of the four color theorem. Although this proof will have a gap (which I'll ask you to find), we will also learn about the key ideas in the actual proof of this famous result.

You don't need any previous knowledge of combinatorics to take this course, just experience with the proof techniques from structures, the ability to multiply polynomials, a willingness to try new and strange problems, and a sense of adventure.

Math 342: Abstract Algebra I
Instructor: Rafe Jones
Time: 4a
Prerequisite: Math 236 or permission of the instructor

Abstract algebra (not to be confused with elementary algebra, which you studied in high school or before) is a pillar of pure mathematics which supports a large body of work both within and outside of mathematics. In this course we will study groups, rings, and fields, which generalize ordinary arithmetic systems like "clock arithmetic," matrix multiplication, permutations, and the set of real numbers, in the same way that abstract vector spaces generalize R^n. Along the way we'll see how a few simple axioms that encode "obvious" rules of arithmetic can give rise to both a remarkably rich theory and a zoo of fascinating examples. Although most of abstract algebra was first studied for its intrinsic interest, ideas and results from the subject have also been applied in chemistry, in theoretical physics, in the design of error-correcting codes, and even in the study of symmetry and artistic patterns like those in Escher's "Regular Division of the Plane" drawings.

Problems of the Fortnight

This is a special issue, so there is no problem of the fortnight this week, but feel free to take a look at problems from past issues near the whiteboard.

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