Goodsell Gazette

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Comps Talk

Come support your friends in one last comps talk this term! The talk will be on Thursday, May 19 from 5-6 pm in CMC 306. Masks are required.

Title: Seeking Lines Using Resultants and More: Statistics on Cubic Surfaces Over Finite Fields
Speakers: Bryan Boehnke, David Krakaur, Jake Martens
Time: 5-6 pm

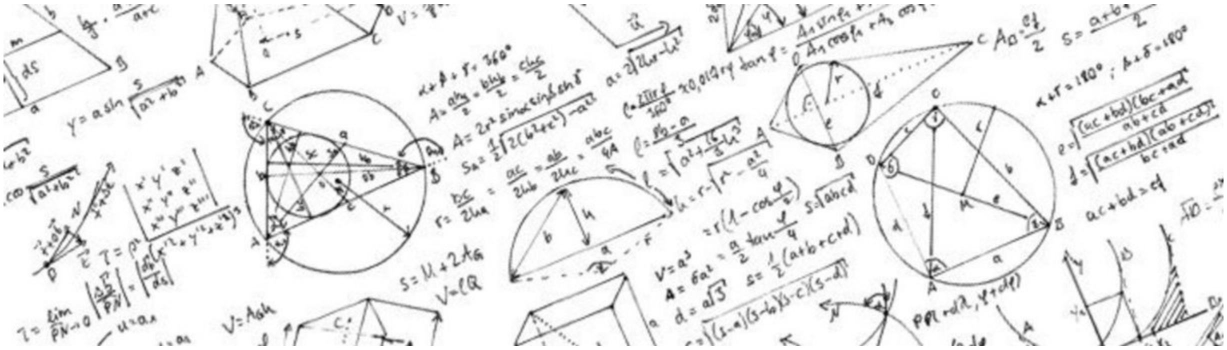
Abstract: We present an accessible introduction to the Cayley-Salmon theorem and the classical theory of cubic surfaces. We then describe methods for computing statistics in relation to these equations over finite fields, as motivated by recent work in arithmetic topology related to configurations on cubic surfaces. We explore, partially verifying and extending, point counts from a 2020 paper of Das and 2021 paper of McKean using the power of CRUG.

New SDAs!

SDAs (Student Departmental Advisers) are students who serve two very important roles in the department. First, they help students navigate the math and stats majors and the math minor. Second, they organize a variety of social events and get-togethers around the department. We are thrilled to announce our new SDAs for next year are David Chu, Michaela Polley and Gustavo Flores. Please join us in welcoming our new SDAs for 2022-23!

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 year? Let the course descriptions below guide you into an adventurous new term with the Carleton Department of Mathematics and Statistics! There's something for everybody, from Abstract Algebra to Applied Regression Analysis. Find out more below.



Math Classes

Math 236: Mathematical Structures
Instructor: Deanna Haunsperger
Time: 4a
Prerequisite: Math 232 or permission of instructor

How do we prove mathematical statements? How do we even think of possible statements, and what makes us suspect that a particular statement may be true? There are no easy, general answers. Mathematics is a complex subject, with a great variety of living and growing branches, and with deep roots that tap into the wisdom of many generations. Still, if you've ever wondered "How did anyone come up with that?", or "How can you really be sure of that?", about some mathematical result, taking this course may help dispel some of the mystery. We'll explore various concepts, especially from set theory, that are indispensable for most areas of advanced mathematics, and we'll spend considerable time developing theorem-proving and problem-solving skills. Along the way we'll take a new and closer look at some old friends, such as functions and relations: What are they really? In the final part of the course we'll use functions to compare "sizes" of various infinite sets. For example, we'll see that despite appearances, there are not any "more" rational numbers than there are integers; on the other hand, there are "more" real numbers than rational numbers. If you're considering a math major, taking this course should help you decide; also, "Structures" is a prerequisite for the majority of upper-level math courses.

Math 240: Probability
Instructor: Katie St Clair
Time: 1a and 2a
Prerequisite: Math 120 or Math 211

If your laptop is still going strong after five years, how much longer can you expect it to last before it dies? If you're shopping for a blender, should you go for the model with ten 5-star reviews or the one with three thousand reviews averaging only 4.3 stars? We all have to make decisions about what to do in uncertain situations, and this class is about quantifying that uncertainty and clarifying what we can expect when faced with uncertainty. In this course we introduce the fundamentiel ideas in the mathematical field of probability, which is the foundation for statistical inference, and discuss the distributions and random variables that come up most often in real-life situations.

Math 241: Ordinary Differential Equations
Instructor: Kate Meyer
Time: 3a

Prerequisite: Math 232 or instructor permission

Differential equations are a fundamental language used by mathematicians, scientists of the biological / physical / social persuasion, and engineers to understand and describe processes involving continuous change. In this course, we will study differential equations from both a practical and theoretical point of view. Our focus will be on developing differential equation models and exploring the mathematical ideas that arise within these models. Examples may include epidemiology, mechanical systems, love affairs, competition and cooperation of species, and more! The science will stay at an elementary level; our focus will be the mathematical ideas that arise in these models.

Math 282: Elementary Theory of Numbers (previously Math 312)
Instructor: Caroline Turnage-Butterbaugh
Time: 5a
Prerequisite: Math 236

The theory of numbers is primarily concerned with understanding the properties of the natural numbers and, more specifically, the primes. With such a broad topic at hand, it should not be too surprising that much is known and much is unknown. Some questions were asked and answered long ago. For example, Euclid (300BC) proved that yes, there are infinitely many primes. Some old questions were answered not too long ago. For example, it was only recently (2013) that Helfgott proved the Ternary Goldbach Conjecture (posed in the 1700s), that every odd number greater than 5 can be written as the sum of 3 primes. Some old questions still remain unsolved! For example, we do not know how to prove the Twin Prime Conjecture, that there are infinitely many pairs of primes whose difference is exactly 2.

In this course, we will study the numbers with "elementary" tools, which roughly equates to "tools developed before the development of calculus and abstract algebra." We will encounter the Euclidean algorithm, prime factorization, multiplicative functions, congruences, and quadratic reciprocity. This course is a great pick if you have just completed Math 236 Mathematical Structures and are wanting to further develop and strengthen your proof writing skills.

Math 342: Abstract Algebra
Instructor: Claudio Gómez-Gonzáles
Time: 2a
Prerequisite: Math 236 or instructor permission

Algebra is a pillar of modern mathematics concerned with the study of structure. As such, algebraic problems arise across mathematics, the physical sciences, art, and many other walks of life: from particle physics to textile production. In this course, we will draw inspiration from one of the oldest known mathematical problems—solving polynomials—and trace through some of the historic struggles that have informed modern algebraic theory. These considerations will take us through fields, groups, and rings, which generalize ordinary arithmetic systems like numbers, matrices, permutations, clock math, and the like. Along the way we'll see how a few simple axioms can give rise to a remarkably rich theory and a zoo of fascinating structures.

Math 344: Differential Geometry
Instructor: Rob Thompson
Time: 4a
Prerequisite: Math 236 or instructor permission

Local and global theory of curves, Frenet formulas. Local theory of surfaces, normal curvature, geodesics, Gaussian and mean curvatures, Theorema Egregium.

Math 395: Geometric Group Theory
Instructor: MurphyKate Montee
Time: 3a
Prerequisite: Math 342

Geometric group theory is the study of (infinite) groups using geometric tools. It's a relatively young field (developed in the 1980's) and it connects groups theory with geometry, combinatorics, topology, and more. Geometric group theorist Pierre de la Harpe wrote, "One of my personal beliefs is that fascination with symmetries and groups is one way of coping with frustrations of life's limitations: we like to recognize symmetries which allow us to recognize more than what we can see. In this sense, geometric group theory is a part of culture."

The underlying principle of geometric group theory is that if a group G acts "nicely" on a space, then information about that space tells us information about the group. In this class we will study groups acting on trees and (more generally) hyperbolic groups. Along the way we'll talk about metrics, graphs, hyperbolic geometry, surfaces, group presentations, and more. Many of the proofs will have a combinatorial flavor. (And if you haven't heard of any of those terms, don't worry! We'll cover the necessary information as we go.) This course counts toward the Algebra area of the math major.

Stats Classes

Stat 220: Introduction to Data Science
Instructor: Deepak Bastola
Time: 3a
Prerequisite: Stat 120, 230, or 250

The course introduces principles of data-scientific, reproducible research and dynamic programming using the R/RStudio ecosystem. We will explore various computational aspects of data analysis starting with data acquisition, data management, and data visualizations. At the core, this is a computational heavy course where you will use R extensively. If you would like to build some kind of expertise in R and develop analytical skills to devise statistically efficient machine learning models, this is the course for you. We will learn about data wrangling and explore various avenues to extract useful information from unstructured and messy data. We will use extensive visualization tools like ggplot and interactive platforms called Shiny, leaflet, or plotly to visualize our data. We will learn some of the modern classification algorithms, predictive models and other common statistical ensemble learning methods. We will learn the basic tools to help us effectively communicate statistical results to a general audience so that we can tell interesting and beautiful stories hidden in data with pretty visuals and sound statistical reasoning.

Stat 230: Applied Regression Analysis
Instructor: Adam Loy
Time: 2a
Prerequisite: Stat 120, Stat 250, or Stat AP 4/5

Does smoking cause cancer? How do we know this? Is there a gender wage gap after controlling for education and experience? How is this quantitative argument made? In our first statistics course we focus on modeling the relationship between a response variable and a single predictor; however, many questions cannot be answered using such models. In this course, we will explore how to incorporate multiple predictors into our models to answer complex questions. In addition to learning how to model continuous response variables, we will explore models for binomial and Poisson counts. This course emphasizes model building, model validation, and how to clearly communicate the results of our models. As the title suggests, this is an applied course so you will be working with new data sets each week, and you can expect to be a seasoned R user by the end of the term!

Stat 285: Statistical Consulting
Instructor: Andy Poppick
Time: Tuesday 10:10am - 11:55am
Prerequisite: Stats 230 (formerly Math 245) and instructor permission

Students will apply their statistical knowledge by analyzing data problems solicited from the Northfield community. Students will also learn basic consulting skills, including communication and ethics.

Stat 340: Bayesian Statistics
Instructor: Adam Loy
Time: 5a
Prerequisite: Stat 250

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 settings 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.

Problems of the Fortnight

Since this is a special edition of the Gazette, there are no Problems of the Fortnight. Check back next week for new problems!

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