Goodsell Gazette

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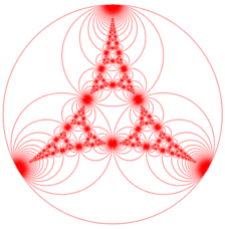
Meet Your New Professors!

Caroline Turnage - Butterbaugh

Caroline, originally from South Carolina, went to Wofford College also in South Carolina where she majored in French and Math. She, then, went on to recieve her Masters from Wake Forest College and her PhD from the University of Mississippi before completing a post doc at North Dakota State University. Caroline also taught at Duke University before coming here to Carleton. Caroline is an analytic number theorist; she uses complex analysis to study properties of prime numbers. Specifically, she is interested in the theory of the Riemann Zeta function and its generalizations called L functions. Recently, she started studying how to apply these techniques to study properties of algebraic number fields. Caroline, in her free time, likes to spend time with her dog named Pickles! She is also a trained tap dancer and was a part of a tap company in North Carolina. After completing her undergrad at a liberal arts school, Caroline's dream job was to teach at a liberal arts college. She is excited to be back in a small enviornment that feels like a community and where the administration values multiple aspects of students - not just their academics. Caroline is teaching Calc I and will be leading a comps group, and teaching Calc I, Elementary Number Theory, and Functions of a Complex Variable this winter and spring.

Mathematics and Statistics Colloquium



Speaker: Brianna Heggeseth, Macalester College
Date/Time: Tuesday, October 30, 4:00 p.m.
Location: CMC 206

Tree-based Clustering of Longitudinal Data

Abstract: There is variation in adiposity growth amongst children in the United States. We seek to characterize heterogeneity in growth patterns of childhood body mass index and explore possible associations with early-life factors. There is a growing literature to suggest that early-life exposure to a mixture of chemicals may increase the risk of unhealthy obesity development by disrupting hormonal processes that mediate growth, potentially explaining some variation in growth. To accommodate correlated exposures due to common sources and physical environment, we propose utilizing tree-based methods for finding children with similar growth patterns and similar exposure levels. We start by adapting the classic regression tree algorithm to define similarity in terms of growth pattern. We then illustrate how this approach allows the possible discovery of complex interactions between chemical exposures as well as non-linear associations. We then discuss how random forests could be used to determine the importance of the exposures in explaining the variation in growth.

Electronic Undergraduate Statistics Conference

Are you interested in hearing about statistics research conducted by other undergraduate students? Are you thinking about graduate school in statistics? Do you have questions about statistical careers? If so, consider tuning in for the Electronic Undergraduate Statistics Research Conference on Friday, November 2. For more information check out https://www.causeweb.org/usproc/eusrc/2018.

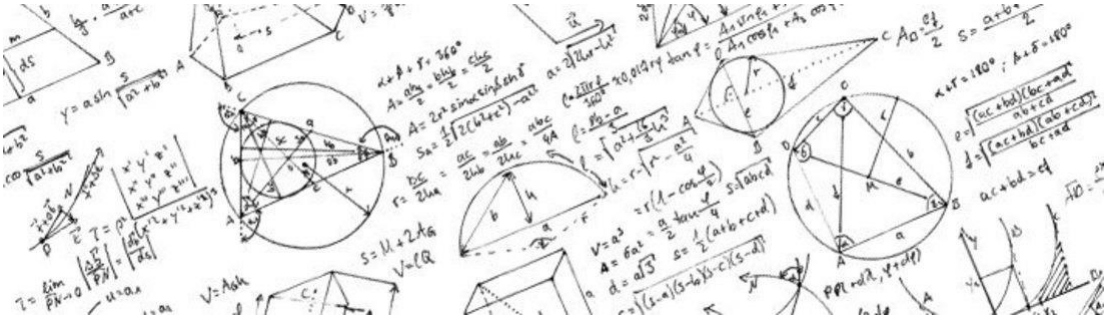
We have reserved Sayles-Hill 252 for group viewing, so stop by if you're interested! You can also register to watch individually if you register (https://www.causeweb.org/usproc/eusrc/2018/register).

Michigan Biostatistics Prospective Student Day

Are you interested in biostatistcs or interested in learning how statistics and math can be applied to medical, public health, and biological research? On Saturday, November 10, 9am - 1pm, the University of Michigan School of Public Health will hold a prospective student information session and prospective Master's and PhD students are encouraged to attend. Current students, faculty, and alumni will describe the exciting opportunities in this field, the outstanding job prospects post-graduation, and the admissions and financial support opportunities in the Department of Biostatistics at Michigan. For more information, directions to the Open house and to Register visit: http://sph.umich.edu/biostat/events/2018-information-day.html.

Special Edition: 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 winter term within the Carleton Department of Mathematics and Statistics! There's something for everybody, from probability to abstract algebra and from differential equations (which may be called ordinary but are, in fact, truly neat) to a 10-week lecture series by the Carleton faculty -- find out more below.



Math 206: A Tour of Mathematics
Instructor: Many of us
Time: Fridays only, 6a (3:30-4:30)

Are you considering a math or stats major, but wonder what those disciplines are all about? Maybe you're curious as to what research in mathematics or statistics even means. Are you already a major who would enjoy some fresh perspectives on, and new insights into, the subject you love? Join us for a series of

lectures on a variety of mathematical and statistical topics, with emphasis on exciting ideas, concepts and results rather than depth in a particular area. This course is offered annually, and you are allowed to register for it twice, in consecutive years: there should be no overlap with the 2018 Tour. 1 credit; attendance required.

Math 236: Mathematical Structures
Instructor: Rafe Jones
Time: 4a
Prerequisite: Math 232 or permission of the instructor

This course is an introduction to the mathematician's route to certainty: mathematical proof. We'll study set theory, formal logic, and axiomatic systems, which are the solid building blocks of mathematical arguments. We'll learn about techniques for discovering (or inventing) proofs, common methods of proof, and how to write good proofs; these are the tissues that tie the building blocks together. And we'll study some fascinating problems and mathematical truths that everyone should know, such as the many sizes of infinite sets.

Math 236 is the first course in our curriculum whose primary goal is to teach you how to write proofs. Because proofs are how mathematical truth is established, it will give you the keys to a whole new mathematical world - not to mention the necessary prerequisite for a slew of upper-level mathematics courses.

Math 241: Ordinary Differential Equations
Instructor: Mark Krusemeyer
Time: 3a
Prerequisite: Math 232 or permission of the instructor

In calculus you may well study separable first-order differential equations for a bit, but that's just the tip of the iceberg! In any field where mathematics is applied, you are likely to find equations relating unknown functions and their derivatives. Over the centuries, following the lead of Newton, Leibniz, and the Bernoullis, mathematicians have come to grips with many such equations. Naturally, they prefer to get exact solutions if possible, and we'll look at some of the systematic methods (and a few of the clever ad hoc tricks) that have been developed to find solutions. On the other hand, there are times when finding an exact solution is too difficult, or even potentially misleading - for instance, because the mathematical model that leads to the differential equation is imprecise to begin with. In such cases, it is often best to concentrate on the qualitative behavior of solutions; for example, you might try to predict what will happen in the long run.

In this course, you'll find plenty of calculus-style computation, including ample opportunity to brush up on your techniques of integration (Mathematica can help with some of that), but also a few theoretical discussions, some geometric ideas, and a bit of mathematical modeling. The textbook I expect we'll be using, which was written by a close (younger!) relative, does not really presuppose linear algebra, but concepts from linear algebra, ranging from vector spaces of functions through linear transformations and kernels to eigenvalues and eigenvectors, will be mentioned and used with some regularity in class.

Math 245: Applied Regression Analysis
Instructor: Laura Chihara
Time: 3a
Prerequisite: Math 215 (or equivalent) or 275

On the night of January 27, 1986, engineers at Morton Thiokol teleconferenced with engineers and managers at the Marshall Space Flight Center and Kennedy Space Center to determine whether it was

too cold (31 F) to launch space shuttle Challenger. Data from previous flights seemed to suggest that temperature had an effect on the integrity of the O-ring seals on the booster rockets, but the final recommendation was to launch the Challenger on schedule. Could a statistical analysis of the pre-accident data predicted the catastrophic failure of the shuttle? In this class, we will investigate the Challenger data and in general, learn statistical model building and model checking techniques. We will use the software package R to aid in the modeling.

Math 265: Probability
Instructor: Katie St. Clair
Time: 2a
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 275: Introduction to Statistical Inference
Instructor: Laura Chihara
Time: 2a
Prerequisite: Math 265

Statistics is the art and craft of studying data and understanding variability. Though mathematics (in particular, probability) governs the underlying theory, statistics is driven by applications to real problems. We will cover basic statistical inference as well as modern computational approaches, all in the context of investigating interesting questions that arise in scientific and public policy settings. We will use the software package R.

Math 280: Statistical Consulting
Instructor: Andy Poppick
Time: Tuesdays 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 285: Introduction to Data Science
Instructor: Adam Loy
Time: 5a
Prerequisite: Math 215 or Math 275

This course will cover the computational side of statistics that is not typically taught in an intro or methodology focused course like regression modeling. Most of data you encountered in your first (or second, or third, ..) stats course were contained in small, tidy .csv files with rows denoting your cases and columns containing your variables. The only messiness to these data may have been some missing values (NAs). We will start this course in data science by learning how to extract information from data in its "natural" state, which is often unstructured, messy and complex. To do this, we will learn methods for manipulating and merging data in standard and non-standard formats, data with date, time, or geolocation variables, text processing and regular expressions, and scraping the web for data. To effectively

communicate the information contained in these data, we will cover data visualization methods (or, as statisticians often call it, EDA) that go beyond a basic histogram or boxplot, including methods for creating interactive graphics. We may also cover some modern computationally-intensive statistical learning methods. We will primarily use the stat software R in this course.

Math 321: Real Analysis I
Instructor: Owen Biesel
Time: 4a
Prerequisite: Math 236 or permission of the instructor

How much can we trust the rules of calculus? Up till now, we've mostly looked at examples where everything works out nicely, but if we look hard, we can find a convergent series whose sum depends on the order of the terms, a multivariable function whose mixed partial derivatives aren't equal, a function that doesn't equal the integral of its derivative, and more. So how can we ever apply calculus to real-life problems and trust the results?

To answer, we'll go back to the beginning and put the concepts of "integral," "derivative," "continuity," "limit," and even "function" and "real number" on a solid theoretical footing. You'll practice using proofs to understand exactly when the principles of calculus hold, a skill with enormous importance for the theories of differential equations, dynamical systems, economics, and probability. This course is highly recommended for anyone considering grad school in math or statistics.

Math 344: Differential Geometry
Instructor: Gail Nelson
Time: 3a
Prerequisite: Math 236 and 232

This course is concerned with the study of shape and distance. Specifically, we will focus on these concepts for curves and surfaces in 3-space. Questions include: How do you define the distance between two points on a surface? In particular, how do you find the shortest path between them if that path must lie on the surface? Soap films assume a shape that minimizes surface area, given a boundary (such as a wire frame); how can we characterize the shape of such minimal surfaces? What should we mean by the curvature of a surface? Can this curvature be measured from within the surface, or do you need to step out of the surface to see how it is bent? How can we even hope to decide such things? With a lot of help from Gauss, we will come up with answers to these and other questions.

For this course, the most important tools you have so far are multivariable calculus (after all, this is differential geometry) and linear algebra. Additional tools we will develop include differential forms and tensors. These tools, along with the general framework of differential geometry, provide the basis for the study of Einstein's general theory of relativity.

Math 349: Methods of Teaching Mathematics
Instructor: Deanna Haunsperger
Time: 2/3c
Prerequisite: Junior or Senior Standing and permission of the instructor

How is mathematics taught? You've certainly seen mathematics taught, and if you're a tutor or have a friend in a lower-level math class, you've probably done some teaching. Is there a best way to teach? How do students learn mathematics? What is a lesson plan? What's important when you're in front of a class? Through readings and observations and practice, we'll discuss these questions and you'll develop your own answers. Enrollment in this course requires a time commitment outside of class observing in the Northfield public schools.

Math 352: Topics in Abstract Algebra
Instructor: Mark Krusemeyer
Time: 2a
Prerequisite: Math 342

So you liked Abstract Algebra I? Then it might well get even better, now that you have the tools to study a particular topic or two in some depth. This year's main topic is representation theory of finite groups. (There will be essentially no overlap between this class and last year's Math 352. We are offering Math 352 every year, but we will never have the same topic twice in successive years, so you can take "the" course - which will actually be two different courses - twice in a row.)

Representation theory, which involves describing the structure of groups by using their homomorphisms to matrix groups, is used in classifying and predicting elementary particles (which we won't do) and in chemistry, as well as in mathematics. It is a key tool in describing large finite groups (for an extreme example, consider the "monster" group, whose order is approximately 8×10^{53}. Clearly there is no hope of constructing a Cayley table for this group, let alone using such a table to gain insight; but the group can be described in terms of square matrices of size 196883.)

We will see some quite beautiful results in representation theory, but unfortunately it's hard to give an idea of them without first introducing more concepts than the scope of this "blurb" will allow. We'll also see some nice applications within group theory, probably including the theorem that if a group has order pq with p and q prime and $p < q$, then either the group is Abelian or q congruent to 1 (mod p).

Besides abstract algebra, we'll use some linear algebra (to understand the matrix groups, for one thing). Just how far we'll get will depend a bit on the background and interests of the participants. (There will be no textbook, although there will be a variety of books available for reference.) Math 352 is an adventure that is definitely recommended if you are thinking of graduate school in pure mathematics, but people with no such plans are welcome too!

Math 395: Topics in the Theory of Elliptic Curves
Instructor: Rafe Jones
Time: 5a
Prerequisite: Mathematics 342, an equivalent Budapest or Moscow Semester in Mathematics course or instructor permission

Elliptic curves lie at the intersection of geometry, algebra, and number theory, and provide a beautiful interplay among major ideas in each of these disciplines. An elliptic curve is at the same time a curve -- similar in some ways to a parabola in the plane -- and also a group, as two points may be "added" in a way that satisfies the group axioms. Thus geometry meets algebra. Points on such a curve with integer or rational coordinates have great significance in number theory, as they furnish solutions to Diophantine problems such as one posed by Fermat in the 1650s: find all positive integers x and y such that the cube of x is two more than the square of y. (Fermat found the solution x = 3 and y = 5 and it took 150 years to show there are no others.) In this course we will study the geometry of elliptic curves, points of finite order, points with integer coefficients, and points with rational coefficients. An enormous amount of current mathematical research involves elliptic curves, and we will discuss some of this ongoing work as we encounter the relevant ideas.

Problems of the Week

This is a special edition, so there are no problems this week! However, if you're interested, take a peek at last week's problems or even some from further back-- there are several back issues out near the whiteboard on the

second floor of the CMC.

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Problems of the Week: ***Mike Cohen***

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