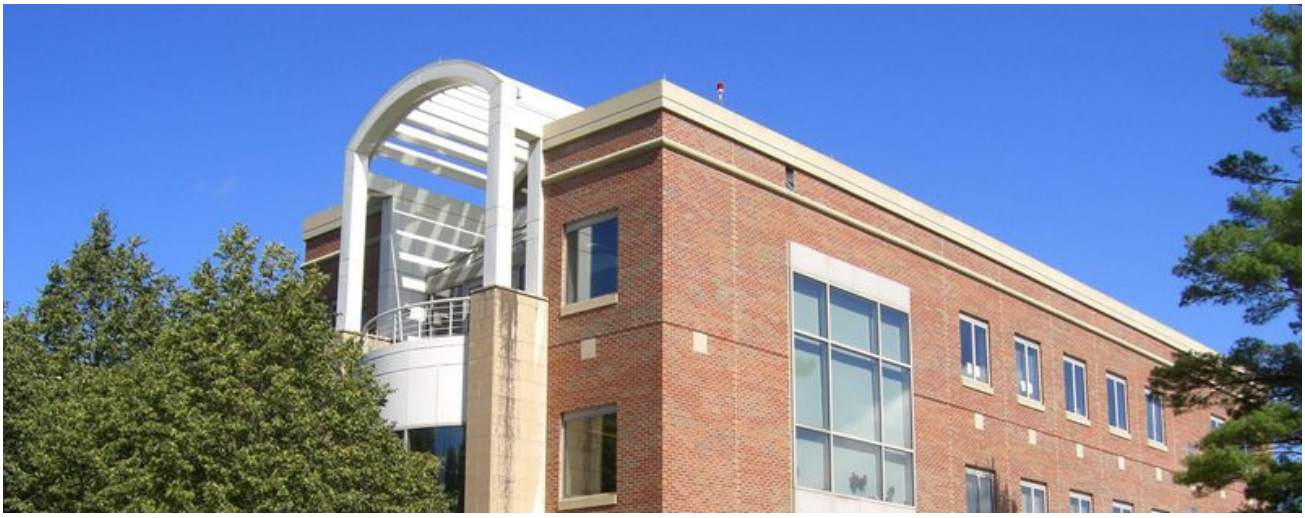
OCTOBER 20, 2023 VOL. 42, NO. 4

GOODSELL GAZETTE



MAST Department hosts Professor Della Dumbaugh

MAST Colloquium

Wednesday, October 25, 2023
Time: 3:30-4:30 pm
Location: Leighton 305
Talk Title: It's Possible: The Biography of a Book

Public Lecture

Thursday, October 26, 2023
Time: 7:00-8:00pm, with a cookie reception afterwards
Location: Boliou 104
Talk Title: Expect the Unexpected: Pioneers who Promoted Women in Math and Science

The Department of Mathematics and Statistics is pleased to host Professor Della Dumbaugh for a 3 day visit to campus funded in part by the Distinguished Women Visitors endowed fund and the Michael Morrill endowed fund. Professor Dumbaugh is a mathematician and historian of mathematics, focusing on the history of algebra and number theory. She is a professor of mathematics at the University of Richmond, and the editor-in-chief of The American Mathematical Monthly. In addition to various meetings with faculty and students, Professor Dumbaugh will give a MAST Colloquium and a public lecture. Please join us in welcoming Professor Dumbaugh!

2024 Winter Stats Courses

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

Have you checked your registration time yet? Made a list of classes you're hoping to take this winter? 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 Topology to Applied Regression. Find out more below.

STAT 220: Introduction to Data Science

Instructor: Deepak Bastola
Time: 1a
Prerequisite: Stat 120, Stat 230 or 250

Embark on a thrilling data odyssey with our hands-on course designed for the curious! Master powerful techniques to decipher messy data—clean it, process it, and visualize it like a pro. Gain expertise in manipulating elusive geolocation markers and timestamps. Unveil the secrets of text with regular expressions and unearth web treasures with advanced scraping tools. Plus, get a grip on cutting-edge predictive models that let you forecast trends and outcomes.

We won't just show you how, we'll equip you to tell compelling data stories using R, the statistical software that brings your analyses to life. From data visualization to predictive analytics, this course gives you the arsenal to become a modern-day data oracle. Don't miss this immersive experience—join us now and unleash the untapped power of data!

STAT 230: Applied Regression Analysis

Instructor: Adam Loy
Time: 5a
Prerequisite: Stat 120, Stat 250, Psychology 200, or AP score of 4 or 5

How is air pollution associated with mortality? How is flooding associated with snowmelt? 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 250: Introduction to Statistical Inference

Instructor: Andy Poppick
Time: 3a
Prerequisite: Math 240

Statistics is the discipline concerned with how data are used to make inferences about populations or processes exhibiting variability, and how to quantify uncertainty in those inferences. In this course, we develop tools to evaluate what we know and don't know about the observed world. We will introduce some of the theory behind inferential methods, using the language of probability, and we'll also learn to apply these methods in realistic settings. An additional emphasis will be placed on computational tools for data analysis, using R.

STAT 260: Introduction to Sampling Techniques

Instructor: Katie St. Clair
Time: 2a
Prerequisite: Stat 120, Stat 230, or Stat 250

This course covers a wide range of statistical sampling techniques that are used to make inferences about a population. We will discuss how to form estimates and quantify the sampling error using "sampling weights" when data is collected using sampling designs that are more complex than a simple random sample. We will also cover strategies for determining an “optimal" sampling design when resources (time/money) are limited. Time permitting, we may also cover how sampling weights are used in data visualization, regression models or chi-square hypothesis tests. Applications will be drawn from both the natural and social sciences, and we will use the R survey package extensively throughout the course.

STAT 285: Statistical Consulting

Instructor: Adam Loy
Time: 2-3c Tuesday only
Prerequisite: Stat 230 and instructor permission

In this course, you 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 ethics, professionalism, and communication.

2024 Winter Math Courses

MATH 206: Tour of Mathematics

Instructor: Claudio Gómez-Gonzáles
Time: 3:30-4:30 pm Friday only
Prerequisite: None

Are you considering a math major? Then you should definitely consider taking this series of eight lectures by math and stats faculty. They will present some striking ideas, concepts and results in an attempt to convey the breadth, beauty, and power of their areas. Credit for this 1-credit course will be based on attendance (and, at times, participation) only. Math 206 is offered annually, and you are allowed to register for it twice, in consecutive years: There should be essentially no overlap with the 2023 version of the Tour. Contact Claudio Gómez-Gonzáles if you have logistical questions.

MATH 236: Mathematical Structures

Instructor: Claudio Gómez-Gonzáles
Time: 2a
Prerequisite: Math 232 and either Math 210 or 211

How do we prove things? How do we even think of possible theorems; what makes us suspect that a particular conjecture may be true; indeed, what even is a proof? There are no easy, general answers. Mathematics is a complex subject, with a great variety of living and growing branches, and 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—and replace them with new ones! We'll explore various concepts, especially from set theory, that are indispensable across advanced mathematics, and we'll develop 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 be equipped to compare "sizes" of various infinite sets, a truly mind-bending joy. 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
Prerequisite: Math 120 or 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 new headphones, 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 fundamental 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: Joseph Johnson
Time: 4a
Prerequisite: Math 232 or instructor permission

Differential equations are a fundamental language used by mathematicians, scientists and engineers to understand and describe processes involving continuous change. In this course, we will study differential equations holistically, studying how to solve differential equations and discerning the behavior of differential equations we are not able to solve.

You will have the opportunity to examine modern and classical mathematical models and study how models are constructed. Mathematical models studied in class may include mechanical vibrations, synchronization of fireflies, disease spread, competition and cooperation of species, and more! The science will stay at an elementary level, the only expectation is to have the necessary mathematical background. If you are curious and want to chat about this course please contact Joseph Johnson (jjohnson16@carleton.edu)!

MATH 271: Computational Mathematics

Instructor: Rob Thompson
Time: 3a
Prerequisite: Math 232. Not open to students who have received credit for Mathematics 295 (Numerical Analysis)

Have you ever wanted to make things better? We can make things better together by learning to optimize in Math 271! Selecting the “best” thing is what optimization is all about. Finding the most likely strategy to win a game, the route that gets you there the quickest, the (nutritional) grocery list that costs the least, or the curve that most closely fits given data are all common examples of optimization problems.

The core of this course will be topics in linear optimization; we'll explore theory, applications, and computational approaches. We will study standard and integer linear programming, the simplex method, and duality. Applications will be selected from various disciplines including statistics, computational geometry, economics, game theory, graph theory, and more. After linear optimization we will study topics in quadratic and convex optimization as time allows.

MATH 282: Elementary Theory of Numbers

Instructor: Rafe Jones
Time: 3a
Prerequisite: Math 236 or instructor permission

Number theory begins -- but certainly doesn't end -- with the prime numbers, objects whose mysteries have persisted for thousands of years. The known and the unknown live side by side: how many prime numbers are there? How many prime numbers are there that are one more than a square? Euclid beautifully answered the first question 2300 years ago, while to date no one has answered the second. We will examine properties of the primes at length, and have some opportunities for experimental discovery. Along the way, we will brush up against some spectacular open problems.

In addition to primes, congruences will be our other main concern, with additional excursions into arithmetic functions, cyclotomic polynomials, and possibly other topics. For centuries number theory formed the cornerstone of "pure" mathematics -- that without any conceivable practical application. But very recently primes and congruences have been put to use in cryptography, and now play a role in vast numbers of everyday online transactions. We'll discuss how this works, and how it depends on no one being able to find a fast factorization algorithm for large numbers. Extra credit if you discover such an algorithm.

MATH 342: Abstract Algebra I

Instructor: Claudio Gómez-Gonzáles
Time: 4a
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 354: Topology

Instructor: Josh Davis
Time: 5a
Prerequisite: Math 236 or instructor permission

A big part of mathematical problem solving is ignoring unimportant details. And sometimes these "unimportant details" can be pretty huge. (Want to know whether a series converges? Feel free to ignore the first trillion terms.) Well, topology is a way to study mathematical spaces --- kind of like geometry. Unlike geometry, topology ignores huge amounts of detail. It ignores anything that changes, when we continuously deform a space. In other words, only phenomena that are invariant under continuous deformation are considered important. It turns out that there are many such phenomena, which have relevance throughout math and applications to physics, computer science, and other disciplines.

In this course, we'll spend roughly the first half learning "point-set" topology, including fundamental concepts such as compactness and connectedness. We'll spend the second half learning some "algebraic" topology, where we tackle topological problems by turning them into algebra problems. The work will be mainly theorem proving, often aided by intuition developed from examples and pictures.

MATH 361: Complex Analysis

Instructor: Caroline Turnage-Butterbaugh
Time: 2a
Prerequisite: Math 321 or instructor permission. Students who have already received credit for Math 261 may only take this course with instructor permission.

Behold the power and beauty of analysis in the complex plane! In this setting, if a function has one derivative, it has infinitely many derivatives. If two functions are differentiable in an open set and are equal in an arbitrarily small disc inside that open set, then the two functions are equal in the whole open set. If a function is bounded and differentiable everywhere then it must be... constant. As Riemann stated in 1851, "In effect, if one extends these functions by allowing complex values for the arguments, then there arises a harmony and regularity which without it would remain hidden." This course is recommended for those considering graduate school as well as anyone who loved the nuances of line integrals in Math 210/211.

Jerry Heuer MAA - NCS Team Problem Solving Competition

Do you enjoy solving (and attempting) challenging but very fun math problems with a group of friends? If so, you might want to sign up for this year's edition of the **Jerry Heuer MAA-NCS Team Competition**!

Named in honor of Professor Emeritus, Dr. Jerry Heuer, the contest **comprises teams of up to three** undergraduate students working collaboratively on ten challenging and intriguing math problems for three hours, under the supervision of faculty members.

This year's contest will take place on **Saturday November 11 between 9am and Noon** and will be scheduled to be in-person at Carleton College.

To sign up for the contest, just send an email to Sunrose Shrestha at sshrestha@carleton.edu and copy your team members, if you have a team already. If you don't have a team, then Sunrose will find someone for you to team up with!

Jobs, Internships, and Other Opportunities

Internships

Bruins-In-Genomics (B.I.G.) Summer Program
University of California, Los Angeles (UCLA). Due January 3, 2024

Student Research / Energy / Asia (Internship)
The Lantau Group. Due Rolling

Data Scientist Intern, Growth (Summer 2024)
Data Scientist Intern, Sales and Success (Summer 2024)
Notion. Due Sunday, October 22

Jobs

Full-time research assistant at UCLA

Professor Daniel Benjamin (UCLA) and his co-authors have a job opening for a full-time, two-year research assistant position starting in Summer 2024 and would love to advertise the position to the senior undergraduate students in your department. Applications will be reviewed on a rolling basis until the position is filled.

Student Research / Energy / Asia (Full-time)
The Lantau Group. Due Rolling

*For more information, please visit the Carleton Career Center!

Editors: Joyce Li, Caroline Turnage-Butterbaugh
Web & Subscriptions: Sue Jandro