Meet Your New Professors!

Claire Kelling
Claire is from the small town of Morrow, Ohio and has moved from small college town to small college town for her entire adult life. She received her undergraduate degrees in Statistics and Economics while also pursuing Women's Studies at Virginia Tech and received her Dual PhD in Statistics and Social Data Analytics from Penn State. Claire's research lies at the intersection of data analytics, criminology, public health, and political science. Her goal is to integrate evidence-based practice and policy on policing, crime, and other policy areas using the power of statistics and data. Claire will be teaching courses in introductory statistics, regression, and spatial statistics this year. She is excited to work with students as she forms her research group at Carleton. In her free time, Claire is eager to learn some outdoor winter sports and to kayak when it is not too cold.

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 chaotic dynamics to applied regression. Find out more below.

**Stats Courses**

**STAT 220: Introduction to Data Science**  
**Instructor:** Adam Loy  
**Time:** 1a  
**Prerequisites:** Stat 120 and 230 or 250

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 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 this 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.

STAT 230: Applied Regression Analysis  
Instructor: Claire Kelling  
Time: 3a  
Prerequisites: Stat 120, 250, Psyc 200, or AP Statistics Exam score of 4 or 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 250: Introduction to Statistical Inference  
Instructor: Katie St. Clair  
Time: 2a  
Prerequisites: Math 240

In probability we assumed perfect knowledge of a population, and used this knowledge to grapple with properties of random samples. In statistics, we flip the script: we now observe a random sample and wish to learn about our population. For example, we will discuss how to estimate the parameters for probability distributions based on data, rather than assuming they are known. This course uses probabilistic and computational tools to introduce statistical inference. While we will discuss the theory underlying these inferential methods, we will balance this theory with data-driven applications that illustrate how these methods are applied. Modern statistical practice also requires computation, so this class will introduce you to the R environment for statistical computing.

STAT 285: Statistical Consulting  
Instructor: Andy Poppick  
Time: 2-3c (Tuesdays only)  
Prerequisites: Stat 230 or instructor permission

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 ethics (particularly in the context of a
community partnership), professionalism and communication.

**STAT 330: Advanced Statistical Modeling**
*Instructor:* Laura Chihara  
*Time:* 4a  
*Prerequisites:* Stat 230 and Stat 250, familiarity with matrix algebra strongly recommended

In Stat 330, a central condition underlying all of the models encountered is that the observations be independent. But many data sets violate that condition. For example, longitudinal studies of test scores of children at different ages, analysis of birthweights of pups from the same litters, and electrical activity on different parts of the brain measured on a sample of patients all involve observations that are correlated. In this course, we will learn methods to address this problem; we will also learn about general linear models of which logistic and Poisson regression are special cases.

**Math Courses**

**MATH 206: A Tour of Mathematics**
*Instructor:* Deanna Haunsperger  
*Time:* 6a (Fridays only)  
*Prerequisites:* 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 2022 version of the Tour. Contact Deanna for any logistical questions.

**MATH 236: Mathematical Structures**
*Instructor:* Caroline Turnage-Butterbaugh  
*Time:* 5a  
*Prerequisites:* Math 232, and Math 120 or Math 211, or instructor permission

How do we know that mathematical theorems are true? You may have seen examples of mathematical proofs in previous classes, but how do you read and understand one? How do you write one yourself? The primary goal of this class is to teach you how to read and write proofs; in other words, you'll be learning how to communicate mathematical ideas like a mathematician. As such, you should expect to do a lot of writing, and probably less calculating than you are used to in a math class! If you've ever wondered why some math calculation works, this is the place to get the answer.

Along the way, we'll cover concepts including set theory, formal logic, different "sizes" of infinity, and even dig into old favorites like functions. We'll look at some statements that we've taken for granted in previous classes (e.g. the square root of 2 is irrational, there are infinitely many prime numbers, we can factor any natural number into primes,...) and work out how to write a convincing proof of them. Plus, Structures is a prerequisite for most of the upper-level math courses!

**MATH 240: Probability**
*Instructor:* Laura Chihara  
*Time:* 3a  
*Prerequisites:* 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 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 241: Ordinary Differential Equations
Instructor: Joseph Johnson
Time: 2a
Prerequisites: 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. Our focus will be on developing differential equation models and exploring the mathematical ideas that arise within these models. Examples may include Earth's energy balance, mechanical vibrations, 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 251: Chaotic Dynamics
Instructor: Sunrose Shrestha
Time: 3a
Prerequisites: Math 232 or instructor permission

Dynamics is the branch of mathematics that deals with the study of change. In this course we will focus on simple discrete non-linear dynamical systems that produce astoundingly rich and unpredictable behavior. We will carefully develop the tools to understand the behavior of such dynamical systems via topics including fixed points and their classifications, chaos and fractals, Julia and Mandelbrot sets in the complex plane, symbolic dynamics, Sharkovskii's theorem and more. Math 232 is a prerequisite and some experience with real analysis will be helpful but the required tools from real analysis will be developed as needed.

MATH 271: Computational Mathematics
Instructor: Rob Thompson
Time: 5a
Prerequisites: Math 232

Have you ever wanted to make things better? Of course you have! 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 center on topics in linear optimization, exploring 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.
MATH 321: Real Analysis
Instructor: Kate Meyer
Time: 4a
Prerequisites: Math 236 or instructor permission

When can we trust the rules of calculus? In previous courses you've likely seen examples where everything works out nicely. But if we look hard, we can find a function that doesn't equal the derivative of its integral, a convergent series whose sum depends on the order of the terms, 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 establish a stronger theoretical footing for the concepts of "integral," "derivative," "continuity," "limit," and even "function" and "real number." You'll use proofs to understand exactly when the principles of calculus hold, a skill with great importance for the theories of differential equations, economics, and probability. This course is recommended for students considering grad school in math or statistics.

MATH 352: Topics in Abstract Algebra
Instructor: Claudio Gómez-Gonzáles
Time: 3a
Prerequisites: Math 342

Representation theory is the study of mathematical structures via the tools of linear algebra: a representation can make abstract groups tangible by encoding their elements as matrices and multiplication laws as matrix operations. The first objects to be studied in this way were finite groups at the end of the nineteenth century, motivated by the powerful framework of characters in number theory, but the field has generalized incredibly due to the prevalence of symmetry throughout mathematics, physics, and beyond. Topics include group modules, semisimple algebras, and the theorem of Maschke; characters, orthogonality relations, and character tables; Fourier transformations and random walks. An introduction to computer algebra systems, such as Sage, will be an important aspect of the course.

Job, Internship, & Other Opportunities

Academic Programs
Graduate Student Virtual Open House, North Carolina State University Department of Mathematics, Saturday November 19th, 1pm to 3pm EST.

Internships
Policy and External Affairs Internship (Spring / Summer 2023), United States of Care. Due Sunday, October 23.
Research & Community Engagement Internship (Spring / Summer 2023), United States of Car. Due Sunday, October 23.
Summer Associate Internship, Client Service, New York (Summer 2023), AlphaSight. Due Monday, October 31.

Jobs
Pre-Doctoral Fellowship, Tobin Center for Economic Policy, Yale University. Due Sunday, October 23.
Minnesota Teaching Fellow, TNTP Teaching Fellows. Due Monday, October 24.
Analyst - Quantitative or Qualitative positions. Close Concerns. Due December 15th.

Associate, dQ&A. Due December 15th.

Computer Vision Engineering Intern or Electro-Optical Payloads Engineering Intern, Utah State University Space Dynamics Laboratory (SDL). Due January 1.

For more info and further opportunities, visit the Carleton Career Center.