Program NES/MAA Fall 2023 Conference Boston College

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	Speaker: Larissa Schroeder, U. of Nebraska, Omaha	
	Workshop: "What does this mean?" Mathematical language as a secret menu.	
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	Title: When randomness creates order: synchronization of random systems, from neurons to hipsters.	
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8:00 pm - 9:00 pm	Christie Lecture: Karen Lange, Wellesley College	Yawkey Ctr, Murray Fnctn Rm
	Title: Climbing (or Finding Paths) through Trees: Computing the difficulty of mathematical problems	

Schedule: Saturday, 18th November 2023

Time	Event	Location
8:00 am - 12:00 pm	Registration, Coffee, Tea	1st floor atrium 245 Beacon
8:00 am - 9:00 am	Breakfast snacks	1st floor atrium 245 Beacon
9:00 am - 10:00 am	Distinguished Teacher: James Quinlan, U. of So. Maine	245 Beacon 107
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10:30 am - 10:40 am	Break	1st floor atrium 245 Beacon
10:40 am - 12:00 pm	Contributed papers	245 Beacon 205/214/229/107
12:00 pm - 1:15 pm	Lunch	Yawkey Ctr, Murray Fnctn Rm
1:15 pm - 3:15 pm	Speakers: Larissa Schroeder, U. of Nebraska, Omaha	245 Beacon 107
	Fei Xue, University of Hartford	
	Title: Getting Started in the Scholarship of Teaching and Learning	

Section NExT Workshop Presenter: Larissa Schroeder, U. of Nebraska, Omaha

Title: "What does this mean?" Mathematical language as a secret menu

Abstract: In Mathematics for Human Flourishing, Francis Su introduces the idea of a "secret menu" - ideas and options that are theoretically available to everyone. In reality, a secret menu requires insider information to gain access. In this discussion, we will confront the question: is the common language we use to convey mathematical ideas or to ask questions a secret menu?

In this interactive session, attendees will explore how our use of language supports (or fails to support) the development of students' mathematical understanding. Attendees will complete a task and analyze the implications of the "mathematized" version, reflect on and discuss how specific language impacts student understanding in their courses, and brainstorm how to address these issues. The overarching goal is to heighten awareness of issues around written and oral language in our classroom beyond that typically associated with learning mathematics.

Bio: Dr. Schroeder is a Lecturer at the University of Nebraska at Omaha where she is part of a team implementing standards-based grading in courses below Calculus. She is also interested in supporting math faculty who engage in the scholarship of teaching and learning as a means to better understand the impact of pedagogical innovations in the classroom.

Invited Talk: Friday 3:15 PM – 4:15 PM **Location:** 245 Beacon 107

Presenter: Jonathan Touboul, Brandeis University

Title: When randomness creates order: synchronization of random systems, from neurons to hipsters.

Abstract: Random fluctuations are observed in every system, from electrical currents to electoral choices, fashion tastes and neuron's behavior. Through better materials, better sensors and technological progress, engineers have worked to reduce, as much as possible, the impact of random fluctuations on the systems they are conceiving. Living systems, that did not have some of these options, had to adapt to fluctuations and learn to produce reliable, rapid, reproducible, appropriate and accurate behaviors in the face of uncertainty. This talk will present mathematical theories relative to how this robustness has emerged, with a particular focus on synchronized activity, from neurons to fireflies to hipster fashion.

Bio: Jonathan Touboul is Professor of Mathematics at Brandeis University and faculty in the Brandeis neuroscience graduate program. He graduated from École Polytechnique, Paris, performed his PhD at Inria and École Normale Supérieure in Paris, a postdoc at the Department of Mathematics of the University of Pittsburgh, and was group leader at Collège de France, Paris (France) for 7 years prior to joining Brandeis. His research deals with the theory of dynamical systems and stochastic processes, and he enthusiastically applies these to biological problems, mostly in the domain of neurosciences, ecology and embryonic development.

Christie Lecture: Friday 8:00 PM – 9:00 PM **Location:** Yawkey Ctr 426 Murray Function Rm

Presenter: Karen Lange

Title: Climbing (or Finding Paths) through Trees: Computing the difficulty of mathematical problems

Abstract: : You can make a simple family tree by starting with a person at the root and then adding two branches for her parents, and then adding two branches for the parents of each of her two parents, and so on. Such a family tree is an example of a binary tree because each level of the tree has at most two branches. We'll see that every binary tree with infinitely many nodes has an infinite path; this result is called Weak Kőnig's Lemma. But just because we know a path exists, doesn't mean we can find it. Given Weak Kőnig's Lemma, it's natural to ask whether we can compute a path through a given binary tree with infinitely many nodes. It turns out the answer to this "Path Problem" is "no", so we say that the problem is not "computable". But then what exactly is the computational power of this Path Problem?

Using the Path Problem as a test case, we will explore the key ideas behind taking a "computable" perspective on mathematics (over an "existence" one) and describe an approach for measuring the computational power of mathematical problems. We'll see that the computational power of problems varies widely and studying problems' power helps to illuminate what really makes problems "tick".

This talk will highlight ideas from graph theory, theoretical computer science, and logic, but no background in any of these subjects is necessary.

Bio: Karen Lange is the Theresa Mall Mullarkey Associate Professor of Mathematics at Wellesley College. In her research, she studies the "balance scales" used to calibrate computational information and applies these tools to measure the difficulty of algebraic problems. She's also passionate about undergraduate mathematics education and teaches a seminar on writing for the public about mathematics. She earned her undergraduate degree at Swarthmore College and her doctoral degree at the University of Chicago, and she completed an NSF Postdoctoral Fellowship at the University of Notre Dame. She loves biking, hiking, cooking, and generally goofing off with her 9-year-old and 5-year-old kids (while her dog lounges on the couch).

NES/MAA Distinguished Teacher: Saturday 9:00 AM – 10 AM **Location:** 245 Beacon 107

Presenter: James Quinlan, University of Southern Maine

Title: After the bell rings: Engaging students outside the classroom

Abstract: In the world of (math) education, creating an engaging and enriching learning experience for students goes beyond classroom walls. This talk explores the transformative power of student-focused extracurricular activities in building a thriving community of learners. Educators can create a profound impact that extends into the classroom by fostering a dynamic environment that encourages active participation, collaboration, and personal growth.

Bio: Dr. Quinlan is an assistant professor of Computer Science at the University of Southern Maine and has taught university mathematics and computer science for over 15 years. As a computational scientist, Dr. Quinlan developed a stencil selection algorithm with an adaptive mesh refinement method for upscaling transmissibility in 3D subsurface flow simulations. Applications of this work include controlling groundwater contamination and predicting sequestered carbon dioxide escape rates. His current research interest is next-generation number systems in numerical linear algebra algorithms with high-performance computing and deep learning applications. Dr. Quinlan also serves as editor of the North American GeoGebra Journal, is a member of the MAA's national Committee on Technologies in Mathematics Education (CTME) and is the webmaster for the Northeastern section.

Invited Talk: Saturday 1:15 PM – 3:15 PM **Location:** 245 Beacon 107

Presenters: Larissa Schroeder, U. of Nebraska, Omaha, Fei Xue, University of Hartford

Title: Getting Started in the Scholarship of Teaching and Learning

Abstract: Dewar, Bennet and Fisher define the scholarship of teaching and learning (SoTL) as: *The intellectual work that faculty do when they use their disciplinary knowledge to investigate a question about their students' learning (and their teaching), gather evidence in a systematic way, submit their findings to peer review, and make them public for other to build upon*.

This workshop will introduce participants to the scholarship of teaching and learning (SoTL) and help them frame (or refine) a project of their own. We will present a taxonomy of SoTL questions, provide examples of SoTL projects, and discuss methods for investigation. With guidance from the presenters, participants will identify a teaching problem, pose a research question, and choose sources of data. In addition, we will touch on methods for data analysis, human subjects' requirements, venues for publication/presentation and additional resources for furthering their work.

Graduate Student Talks

4:30 PM - 4:50 PM

245 Beacon 205

Presenter: Rebecca Butler, University of New Hampshire
Title: Learning Assistant- Student Discourse on Implicit Differentiation
Abstract: Learning Assistants (LAs) are undergraduate near-peer tutors who aid instruction of collegiate courses in which they have previously been successful as students. It has been consistently shown that students in LA-supported STEM courses have more positive content related course outcomes than their peers without LA support. Little is known about why students in LA-supported courses evidence positive course outcomes, but it is conjectured that LAs facilitate these outcomes through their frequent and engaging interactions with students. While existing work broadly describes the pedagogical moves of LAs, this study contributes a subject-specific perspective on LA classroom practice. In particular, this study examines LA-student discourse around implicit differentiation in a Calculus I course in order to gain a nuanced understanding of classroom communication surrounding course material. In this talk, the analytic approach to classroom discourse, preliminary results of this analysis, and directions for continued work will be shared.

4:50 PM - 5:10 PM

245 Beacon 205

Presenter: Jessica Harter, University of New Hampshire
Title: Avoiding the Pitfalls and Blind Spots of the White Research Lens: Principles for Researchers
Abstract: Race plays an important role in identifying societal differences in wealth, education, health care, and other facets of life (Holland, 2008). Racial disparities are not a result of race but rather the outcome of systemic racism embedded in our institutions. Consequently, the examination of race is crucial to identify and rectify these inequities. All researchers, regardless of their racial background, can exhibit blind spots in their research often stemming from their personal experiences and participation in settings following White-dominated paradigms of scholarship (Bonilla-Silva & Zuberi, 2008). Research on race can be placed on a continuum, ranging from flawed scholarship where researchers fell victim to the White lens to exemplary scholarship where researchers were sensitive to their positionality and its potential impact on their research. Eliminating racial inequality requires that we document and study race, but in doing so we can inadvertently reproduce and perpetuate racial disparities rather than mitigate them (Zuberi, 2008). In this presentation, we will explore various principles researchers should follow in an effort to see the realities of racial phenomena and related inequalities with fewer pitfalls and fewer blind spots. The presentation will address fundamental questions such as: How does my race affect my research and what do I need to be aware of when conceiving of new research, conducting those investigations, and disseminating the results?

Undergraduate Student Talks Friday 5:10 PM – 6:30 PM

	5:10 PM - 5:30 PM
245 Beacon Room 205	*Arithmetical Structures on Canoe Paddle Graphs,* Ailie Wood, Wellesley College
245 Beacon Room 214	*Quadratic Triangles*, Samantha Blair, Keene State College
245 Beacon Room 229	*Enhancing the Exception Handling Capabilities of Genetic Algorithms with a Test Function Containing a Complex Gradient Landscape* Ephraim Zimmerman, Brandeis University
245 Beacon Room 107	Stock Return Prediction via Modified GBM Tianxin He, Boston University

	5:30 PM - 5:50 PM
245 Beacon Room 205	*k-steps Traversals for Cycles and Related Graphs* Jace Hollenbach, Jacob Jackson, Stonehill College
245 Beacon Room 214	*Subseries of Divergent Series* Megan Blanchette, Keene State College
245 Beacon Room 229	*A Mathematical Perspective into Algorithmic Trading Strategies* Khanh Nguyen, Boston University
245 Beacon Room 107	*City Level Electric Vehicle Growth Rate Forecasting Model Using Regression Analysis* Ziyi Shao, Boston University

	5:50 PM - 6:10 PM
245 Beacon Room 205	Adomian Decomposition Method for Zero Potential Ginzburg-Landau Equation Robert Vitale, Boston University
245 Beacon Room 214	*Redefining Velocity in Discrete Spaces using Quantized Motion Sequences (QMS)* Timothy Burke, University of Southern Maine
245 Beacon Room 229	*Transformations and symmetries* Tang Xien, Gordon College

	6:10 PM - 6:30 PM
245 Beacon Room 205	*Utilizing Longitudinal Cohort Data to Analyze Psychoeducational Characteristics to Improve Student Experiences and Achievement with a Focus on Mathematics* Luke Brown, Kinshu Gupta, Quinnipiac University
245 Beacon Room 214	*Differential Geometry: The Language of Spacetime* Bronwyn Rowton, Gordon College
245 Beacon Room 229	*Refining Distribution-Free Population Percentile Estimatior by Monte-Carlo Simulation Approach* Kejing Yan, Boston University
245 Beacon Room 107	Exploring Diabetes Correlations across Diverse Factors with Machine Learning Shiying Wu, Boston University

5:10 PM - 5:30 PM

245 Beacon Room 205

Presenter: Ailie Wood, Wellesley College
Title: Arithmetical Structures on Canoe Paddle Graphs
Abstract: Given a connected graph G with n vertices, an arithmetical structure on G is a pair of vectors $(d, r) \in \mathbb{Z}_{>0}^n \times \mathbb{Z}_{>0}^n$ satisfying $\big((d) - A\big)r = 0$ where A is the adjacency matrix of G. These arithmetical structures originally arose in the work of Lorenzini on degenerations of curves in algebraic geometry. In his work, Lorenzini proved there are finitely many arithmetical structures on any connected graph. This raises the natural question of counting how many arithmetical structures there are on a particular graph G. The number of arithmetical structures on paths, cycles, and trees have been counted in previous work. In our work, we investigate methods of obtaining and counting arithmetical structures on canoe paddle graphs, i.e., on graphs containing a cycle of n vertices connecting to the start of a path containing m vertices.

245 Beacon Room 214

Presenter: Samantha Blair, Keene State College
Title: Quadratic Triangles
Abstract: Mathematics contains many examples (e.g. Pythagorean Theorem, Kepler triangle) of interesting connections between algebraic relationships and geometric objects. Given positive constants a, b, c and a quadratic polynomial $ax^2 + bx + c$, we assume the terms ax^2, bx, and c are sides of a triangle. In this presentation, we present three results. The values of x that constitute valid triangles are two open, disjoint intervals I_1 and I_2 where $I_1 < I_2$ of real numbers.

Furthermore, there is a mapping $g: I_1 \to I_2$ which maps triangles to similar triangles. Finally, if $ax^2 + bx + c = (x - p)(x - q)$, we show how to find geometrically px and qx on the bx side of a quadratic triangle.

245 Beacon Room 229

Presenter: Ephraim Zimmerman, Brandeis University
Title: Enhancing the Exception Handling Capabilities of Genetic Algorithms with a Test Function Containing a Complex Gradient Landscape
Abstract: This study explores the benefits of using an adaptation of the Ackley artificial landscape to determine the efficacy of a genetic algorithm's ability to overcome the issues surrounding intricate data sets featuring null values, undefined spaces, infinite points, or substantial discontinuities in function output. These results aim to provide further insight into using genetic algorithms in practical contexts where these issues occur.

245 Beacon Room 107

Presenter: Tianxin He, Boston Univeristy
Title: Stock Return Prediction via Modified GBM
Abstract: Geometric Brownian Motion (GBM) serves as a mathematical model for forecasting stock price movements by assuming the logarithm of stock prices undergoes a random walk with a constant drift and volatility. This study investigates GBM's efficacy in simulating stock returns for Google while highlighting its inherent limitations. Aiming to offer a more robust and reliable model for forecasting stock market behavior, this research refines stock return predictions by integrating Kernel Density Estimation into the Geometric Brownian Motion framework.

5:30 PM - 5:50 PM

245 Beacon Room 205

Presenters: Jace Hollenbach, Jacob Jackson, Stonehill College
Title: k-steps Traversals for Cycles and Related Graphs
Abstract: Let G be a graph with p vertices. For $k \geq 2$, G is said to have a k-steps traversal if there exist a sequence of vertices $v_1, v_2, \cdots, v_p$, such that the distance between v_i and v_{i+1} is equal to k for each $i = 1, 2, \cdots, p-1$. If the distance between v_p and v_1 is also k, G is said to be k-steps Hamiltonian. The set of all positive integers k such that G has a k-steps traversal is called the $AL(k)$-spectrum. We investigate the $AL(k)$-spectrum for cycle graphs that are combined by a shared vertex.

245 Beacon Room 214

Presenter: Megan Blanchette, Keene State College
Title: Subseries of Divergent Series
Abstract: Let d be one of the digits 0, 1, 2, …, 9. For the Harmonic Series, remove any fraction whose denominator has at least one occurrence of d. The surprising result is that the remaining subseries converges. We shall prove that the same result holds if only fractions whose denominator have at least k occurrences of 9 are removed. The harmonic series is the p-series $\sum_{n=1}^{\infty} \frac{1}{n^p}$ with $p = 1$ and it is well known that the p-series diverges for $0 < p \leq 1$. In this more general situation, we determine the values of p for which $\sum_{no\ d\ in\ n} \frac{1}{n^p}$ converges and diverges.

245 Beacon Room 229

Presenter: Khanh Nguyen, Boston University
Title: A Mathematical Perspective into Algorithmic Trading Strategies
Abstract: Algorithmic trading, driven by algorithms and quantitative model, has revolutionized the financial markets by leveraging mathematical models and advanced algorithms to make real-time trading decision. In this presentation,

we delve into different algorithmic trading strategies, their performance, how they work, and why they succeed. Additionally, we will discuss how algorithmic trading changes the risk and returns of a portfolio compared to conventional trading and the challenges of algorithmic trading strategies application. Finally, we will consider how the rise of algorithmic trading will impact the financial industry.

245 Beacon Room 107

Presenter: Ziyi Shao, Boston University
Title: City Level Electric Vehicle Growth Rate Forecasting Model Using Regression Analysis
Abstract: The surge in the global Electric Vehicle (EV) market is in response to climate change imperatives. This study develops a predictive model employing regression analysis to forecast EV growth rates at the city level. Utilizing demographic data, historical EV penetration rates, charging infrastructure statistics, and government incentives from 2016 to 2022, the model aims to quantify the influence of these variables on EV adoption across urban environments. The anticipated output is a strategic tool for policymakers and investors, enhancing their ability to tailor and streamline efforts toward accommodating the burgeoning demand for EVs within diverse city landscapes.

5:50 PM - 6:10 PM

245 Beacon Room 205

Presenter: Robert Vitale, Boston University
Title: Adomian Decomposition Method for Zero Potential Ginzburg-Landau Equation
Abstract: The Adomian Decomposition Method (ADM) is a technique used to solve a large class of nonlinear systems, with the main advantage of producing a convergent power series solution whose terms are easily computed. Here, we show how this technique can be applied to provide accurate numerical solutions to a simplification of the Ginzburg-Landau equation, which is the key equation in the Ginzburg-Landau Theory for superconductivity.

245 Beacon Room 214

Presenter: Timothy Burke, University of Southern Maine
Title: Redefining Velocity in Discrete Spaces using Quantized Motion Sequences (QMS)
Abstract: In the study of motion, conceptualizing velocity as a continuous vector is straightforward in continuous spaces but poses challenges in discrete environments, such as those defined by integer lattice points. Traditional methods for approximating the path of an object in discrete space, like Bresenham's line algorithm, focus on incremental error correction to mimic continuous motion. However, this research takes a fundamentally different approach by going back to the drawing board to formalize how velocity might be inherently conceptualized in discrete space. The Quantized Motion Sequence (QMS) methodology emerges as an innovative solution to this challenge. QMS enables the translation of an object's velocity directly into the associated path, a sequence of x and y unit steps which encodes analogues of the directionality and magnitude of the continuous vector. This sequence is generated through a recursive process, resulting in a discrete approximation of the vector which demonstrates maximum scale and directional invariance. By redefining velocity through QMS, this research offers a novel perspective for understanding motion in discrete spaces, potentially enhancing movement analysis in both theoretical and practical applications, including simulation environments and computational algorithms.

245 Beacon Room 229

Presenter: Tang Xien, Gordon College
Title: Transformations and symmetries
Abstract: Introducing several basic transformations in Geometry and some of them can be expressed as matrices in Linear Algebra.

6:10 PM - 6:30 PM

245 Beacon Room 205

Presenter: Luke Brown, Kinshu Gupta, Quinnipiac University
Title: Utilizing Longitudinal Cohort Data to Analyze Psychoeducational Characteristics to Improve Student Experiences and Achievement with a Focus on Mathematics
Abstract: We started investigating the psychoeducational characteristics of college students' academic profiles as research assistants at the Office of Academic Innovation and Effectiveness at Quinnipiac University. Building upon our daily work of collecting, analyzing, and interpreting large-scale, longitudinal data to improve the academic experiences of students on campus, we joined Dr. Brian Darrow's research team investigating psychoeducational characteristics specific to mathematics learning and development. As part of this team, we were tasked with analyzing data from the administration of a new psychoeducational survey instrument. Analyses conducted by our office, to which we have contributed, suggest the utility of this instrument in measuring learning and developmental characteristics specific to mathematics, confirming and extending results from previous studies. In this presentation, we will detail our work on this team as well as our recent findings. This presentation is geared toward undergraduate students while also serving as a preview for our talk with Dr. Darrow later in the conference.

245 Beacon 214

Presenter: Bronwyn Rowton, Gordon College
Title: Differential Geometry: The Language of Spacetime
Abstract: Henri Poincare was the first to combine space and time to express four-dimensional spacetime. Those familiar with geometry may know that in three-dimensional space, the Pythagorean theorem can be used to measure distance - but what does distance mean on a curved surface, and how do we calculate it if we have to account for time as well? Differential geometry is the language by which the theory of general relativity is expressed, and it covers the geometry of curves, surfaces, and manifolds. The talk aims to give an overview of the differences between Euclidean geometry and differential geometry, and how we can use differential geometry to understand the "weirdness" of spacetime.

245 Beacon Room 229

Presenter: Kejing Yan, Boston University
Title: Refining Distribution-Free Population Percentile Estimatior by Monte-Carlo Simulation Approach
Abstract: Monte-Carlo simulation is a computational technique that uses repeated random sampling to estimate the probabilistic outcomes of a process. This research introduces a methodology for estimating percentiles of distribution-free populations by using Monte-Carlo simulations to reproduce percentiles, and Beta distribution to approximate the simulation outputs to provide generalization of percentile estimations for most distribution-free populations.

245 Beacon Room 107

Presenter: Shiying Wu, Boston University
Title: Exploring Diabetes Correlations across Diverse Factors with Machine Learning
Abstract: The increasing prevalence of diabetes has become a significant national concern, demanding a thorough investigation and intervention. Using data from the 2022 Behavioral Risk Factor Surveillance System (BRFSS), this research employs K means techniques to identify important variables within extensive datasets, which include various demographics and COVID-related factors. Subsequently, various machine learning models, including Random Forest, Decision Tree, Lasso Regression, and Neural Network, were developed and assessed. The primary aim of this study is to determine the most effective predictive model for diabetes. Through a detailed examination and comparison of the performance of these diverse models, this research aims to offer valuable insights into the realm of diabetes prediction, potentially assisting in the creation of more precise and efficient diagnostic tools. Consequently, this research represents a meaningful step toward mitigating the negative impacts of the growing diabetes epidemic and underscores the crucial role of data-driven analytics and machine learning in the field of public health research and policy development.

Contributed Talks: Saturday 10:40 AM - 12:00 noon

	10:40 AM - 11:00 AM
245 Beacon Room 205	*Using Proof Assistant Software to Teach Proofs* Dan Velleman, Amherst College/Univ. of Vermont
245 Beacon Room 214	*Simpson's, All The Way Down* Jeff Suzuki, Brooklyn College
245 Beacon Room 229	*Exploring the Impact of Vaccine Ideology in Infectious Disease Models* Jane HyoJin Lee, Stonehill College

	11:00 AM - 11:20 AM
245 Beacon Room 205	*Biostatistics for Health Sciences* Magdalena Luca, Mass College of Pharmacy & Health Sciences
245 Beacon Room 214	*Residues of rounded fractions and lattice points in conic sections* Caleb Shor, Western New England University
245 Beacon Room 229	*Realization graphs with small diameter* Michael Barrus, University of Rhode Island

	11:20 AM - 11:40 AM
245 Beacon Room 205	*Image Processing in College Math* Yevgeniy Galperin, East Stroudsburg University of PA
245 Beacon Room 214	*Centering Orthogonality, (decentering hand calculations) in Introductory Linear Algebra.* Jillian McLeod, U.S. Coast Guard Academy
245 Beacon Room 229	*On Learning and Development in Mathematics: Leveraging a Decade of Longitudinal Cohort Research to Identify and Characterize Psychoeducational Characteristics Specific to Mathematics* Brian Darrow Jr, Southern Connecticut State University

	11:40 AM - 12:00 noon
245 Beacon Room 205	*ARE YOU SURE YOU'RE 95% CONFIDENT? An Analysis of Intervals for Proportions* Clay King, Stonehill College
245 Beacon Room 214	*Uncertainty quantification for a metamodeling chain for urban air quality* Janelle Hammond, Stonehill College
245 Beacon Room 229	*Differentiable Monsters via Shifting* Cheng-Han Pan, Western New England University

10:40 AM - 11:00 AM

245 Beacon Room 205

Presenter: Dan Velleman, Amherst College/Univ. of Vermont
Title: Using Proof Assistant Software to Teach Proofs
Abstract: I will describe a project I recently completed: an online book called "How To Prove It with Lean." The book explains how students can use a computer proof assistant called Lean to help them learn to write mathematical proofs. I will describe the project and demonstrate the use of Lean to write some simple proofs."

245 Beacon Room 214

Presenter: Jeff Suzuki, Brooklyn College
Title: Simpson's, All The Way Down
Abstract: Suppose you go to your doctor to discuss treatment options. "Generally speaking, Treatment A is better, unless you're under 40, in which case Treatment B is better." "What if you're not under 40?" "In that case, Treatment B is ALSO

better." This surprising inversion is an example of Simpson's Paradox, which can occur when data is aggregated. Far from being a rare occurrence, Simpson's is in fact unavoidable: every data set includes multiple examples of Simpson's paradox. We'll see why, and consider its implications in the era of data mining and decision-making by expert systems.

245 Beacon Room 229

Presenter: Jane HyoJin Lee, Stonehill College
Title: Exploring the Impact of Vaccine Ideology in Infectious Disease Models
Abstract: Since the Covid-19 pandemic various modifications of SIR models have been introduced. In 2022, Ledder introduced the PUIRU model, incorporating ideological effects into the SIR model by splitting the susceptible population into two subpopulations: Pre-vaccinated P (willing to obtain the vaccine but not yet vaccinated) and Unvaccinated U (unable or unwilling to receive a vaccine). The PUIRU model assumes that Pre-vaccinated individuals will always get a vaccine booster, and Unvaccinated individuals will never be vaccinated. However, individuals may change their opinions on vaccination. In this talk, we will present a modification of the PUIRU model that includes a transition between Pre-vaccinated and Unvaccinated compartments. We will discuss the existence and stability of the endemic disease equilibrium using a simple transition function depending on disease prevalence and present some numerical simulation results.

11:00 AM - 11:20 AM

245 Beacon Room 205

Presenter: Magdalena Luca, Mass College of Pharmacy & Health Sciences
Title: Biostatistics for Health Sciences
Abstract: This presentation will address special teaching methods used in an upper-level biostatistics course for students enrolled in public health and other health sciences programs. In these programs, strong verbal and written communication skills are absolutely essential for students' communication with patients, prescription of drug treatments, and understanding of public health issues. In this biostatistics course, emphasis is placed on scientific reasoning: reading, writing, and interpreting statistical analyses found in peer-reviewed journal articles. These skills prepare our students well for in-depth understanding of scientific studies used in other courses, capstone seminars, and the MCAT. Students use scientific writing for all assignments and presentations. I will present specific examples of such teaching methods, such as assignments in which writing is an essential component.

245 Beacon Room 214

Presenter: Caleb Shor, Western New England University
Title: Residues of rounded fractions and lattice points in conic sections
Abstract: For a positive integer n, consider the fractions $n/1, n/2, \cdots, n/n$. If we round each fraction, we get a sequence of integers. We can then ask how many of those integers are in a given congruence class. In this talk, we will look at the following cases: rounding down and counting odd terms; rounding to the nearest integer and counting odd terms; and rounding down and counting the number of terms that are 1 mod 3. As we will see, these cases correspond, respectively, to the Dirichlet divisor problem, Gauss' circle problem, and the problem of counting points in a hexagonal lattice contained within a given circle.

245 Beacon Room 229

Presenter: Michael Barrus, University of Rhode Island
Title: Realization graphs with small diameter
Abstract: Given a degree sequence d of a finite graph, there are usually many different realizations of the sequence by labeled graphs. The realization graph of d is the graph whose vertices are these realizations, with edges corresponding

to a simple edge-swapping operation changing one realization into another. The realization graph is known to be connected for all d, but determining the distance between two realizations is not always an easy problem. After a quick introduction of the realization graph, we characterize degree sequences for which the realization graph has diameter 1. (This is joint work with Nathan Haronian of Brown University.) We then comment on what is known of realization graphs with diameter 2.

11:20 AM - 11:40 AM

245 Beacon Room 205

Presenter: Yevgeniy Galperin, East Stroudsburg University of PA
Title: Image Processing in College Math
Abstract: We discuss the use of basic and advanced image processing methods to provide meaningful context for reviewing key topics of the college mathematics curriculum, to help students gain confidence in using concepts and techniques of applied mathematics, to increase student awareness of recent developments in mathematical sciences, and to help students prepare for graduate studies.

245 Beacon Room 214

Presenter: Jillian McLeod, U.S. Coast Guard Academy
Title: Centering Orthogonality, (decentering hand calculations) in Introductory Linear Algebra.
Abstract: We give local (and perhaps broader) rationale for recent changes to our sophomore level Linear Algebra course toward infusing it with a variety of relevant data-science applications. In choosing to elevate orthogonality as a key organizing frame, we made some tradeoffs (less focus on determinants for instance) and some gains (such as including PCA as an application of the SVD). This presentation is an opportunity to interrogate these choices.

245 Beacon Room 229

Presenter: Brian Darrow Jr, Southern Connecticut State University
Title: On Learning and Development in Mathematics: Leveraging a Decade of Longitudinal Cohort Research to Identify and Characterize Psychoeducational Characteristics Specific to Mathematics
Abstract: Emerging from a decade of our longitudinal cohort research of tens of thousands of college students, in our recent work, we have identified that domain-general psychoeducational measures do not sufficiently explain learning and developmental experiences with respect to mathematics. Through the development and administration of new psychometric scales to nearly two thousand college students enrolled at both private and public institutions in several recent studies, we have identified psychoeducational constructs related to mathematics learning and development that are distinct from the other domain-general measures also under measure. Preliminary analyses suggest the utility of these items in describing collegiate learning outcomes and students' experiences in mathematics courses. In this presentation, we detail these empirical studies, report on ongoing work, and provide directions for future research.

11:40 AM - 12:00 noon

245 Beacon Room 205

Presenter: Clay King, Stonehill College
Title: ARE YOU SURE YOU'RE 95% CONFIDENT? An Analysis of Intervals for Proportions

Abstract: In introductory statistics classes, students are taught that a $(1-\alpha)\cdot 100\%$ confidence interval for p, the population proportion, can be obtained via the formula $\hat{p} = z_{\alpha/2}\sqrt{\frac{p(1-p)}{n}}$, but how good is this formula actually? The answer might surprise you. In this presentation, I will argue for a different approach to calculating confidence intervals for proportions and present another, already-established method that students are unlikely to have seen before.

245 Beacon Room 214

Presenter: Janelle Hammond, Stonehill College
Title: Uncertainty quantification for a metamodeling chain for urban air quality
Abstract: With increased pollutant emissions and exposure worldwide, studies on air pollution and health effects have become increasingly common. However, urban scale models generally have high computational costs, and parameters (e.g. traffic demand) are often unknown at micro scales, leading to high uncertainties.

Uncertainty quantification using assimilation of observational data can improve understanding and use of complex dispersion models. Model Order Reduction methods can render numerous simulations for uncertainty quantification, optimization, and exposure estimation feasible. Using our reduced-basis (RB) meta-model of a simulation chain at street resolution over Clermont-Ferrand, France, including operational models for dynamic traffic assignment, emissions, and atmospheric dispersion-reaction, we study the quantification and propagation of uncertainties by Monte Carlo (MC) methods.

We use two years of hourly observation data on traffic, pollutants, and meteorological conditions, and data on the urban geometry, traffic, vehicle fleet, and background surface emissions. After dimensional reduction of inputs by RB, each model in the chain is replaced by a non-intrusive meta-model. The full chain simulation requires nearly three hours, and the metamodel mere seconds.

Uncertainty in inputs throughout the simulation chain can be represented by probability density functions, then propagated through the model chain. We study the propagation of uncertainty in the complete chain using MC methods, comparing simulations to observations. Our access to a particularly rich data set on both traffic flow and pollutant concentration allows us to compute statistical scores on an ensemble for which we can describe its ability to represent observed uncertainty at two levels of the modeling chain. Recent advances on this project include implementation on high performance computing clusters allowing the quantification methods to account for a broader set of observation data and the optimization of the metamodeling chain implementation.

245 Beacon Room 229

Presenter: Cheng-Han Pan, Western New England University
Title: Differentiable Monsters via Shifting
Abstract: A Weierstrass' monster is known as a continuous function that is nowhere differentiable. By Lebesgue differentiation theorem, such a function must be nowhere-monotone. In this talk, we will sketch a simple construction of a differentiable one, that is, a nowhere-monotone everywhere-differentiable function, and address what's known and unknown in some related problems.

Math Competition Teams

Team name	Participants			
Statistically Significant	Kinshu Gupta	Luke Brown		Quinnipiac University
Team Hootie	Megan Blanchette	Samantha Blair		Keene State College

Irrationals	Nikolai Kivva	Catinca Alexandru	Mason Price	Brandeis University
Magimaticians	Presha	Khyatee		Wellesley College
The Sigma Solvers	Zhang Zhendian	Bhargavi Patil	Phoebe Huang	Mount Holyoke College
Supernova	Karena Zhang	Mengchan Geng		Mount Holyoke College
Aoba Johsai	Jacob Jackson	Jace Hollenbach		Stonehill College
team	Joe Wang	Emma Scully-Power		Boston College
Mathematical Menaces	Kate Bruderman	Elsa Frankel	Mili Alaniz	Wellesley College
Pair-allel	Bronwyn Rowton	Xien Tang		Gordon College
Better Late than Never	Nate Sorrell	Arabella Ji		Gordon College

Technology Notes

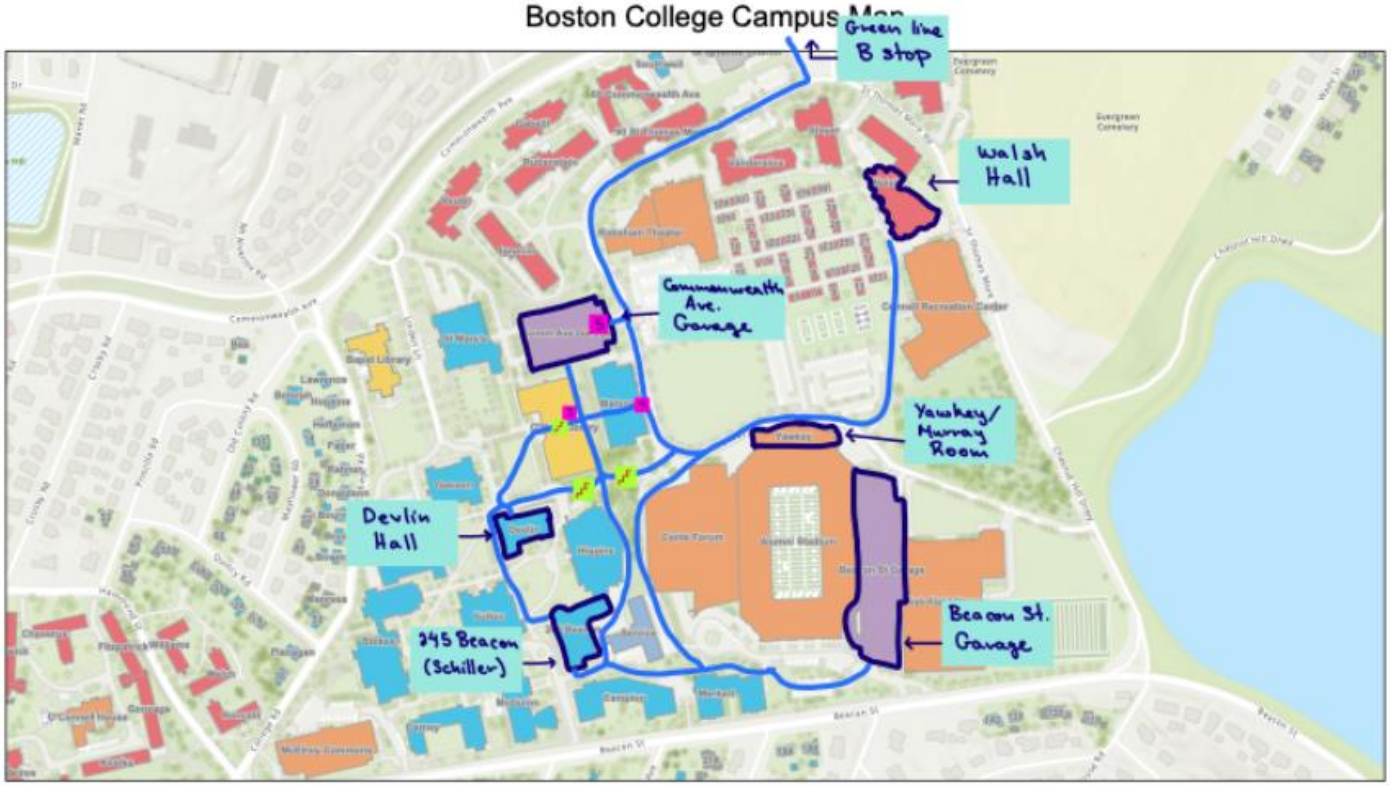
1. The Microsoft Office 360 will not be available on the classroom computers.

2. Classroom Audio Visual Presentation Methods
(a) Computer projection and the internet in the classroom will be available. If you have a PowerPoint presentation and are not bringing a laptop, convert the PowerPoint to a PDF PowerPoint. Bring the presentation on a thumb drive or email it to yourself.
(b) Connecting your Own Device - If you want to use your laptop, the classroom podiums have an HDMI cord to connect your device. Presenters will be responsible for bringing any adaptor/connector, to connect into the classroom HDMI cord.

3. WiFi is available through the Boston College Guest access.

Buildings & Parking

Boston College Campus Map



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Buildings Categories
- Recreation/Dining
- Academic/Administrative
- Houses
- Jesuit Residences
- Library
- Parking Garage
- Residence Hall
- Support/Other
- Context Buildings

- Stairs
- Elevator to # Floor

1:4,514

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0 0.05 0.1 0.2 km