MAA MATHEMATICAL ASSOCIATION OF AMERICA | SECTION METRO NEW YORK

MAA Metro NY

ANNUAL MEETING

April 26, 2025

THE MAA METROPOLITAN NEW YORK SECTION MEETING 2025

Dear MAA Metro New York Conference Participants,

It is both a privilege and an honor to welcome you to the annual meeting of the Mathematical Association of America Metropolitan New York Section (MAA Metro NY)!

We are excited for your participation in today's virtual gathering. The program includes a rich array of presentations designed to inform, inspire, and spark meaningful conversations. I extend my sincere gratitude to the MAA committee members and all the dedicated volunteers whose hard work and commitment have made this meeting possible.

A special thank you goes to our invited speakers, Dr. Emilie Purvine and Dr. Henry Ricardo, who will share with us some fascinating and thought-provoking mathematics. We are also deeply grateful to our sponsors—Pearson, Wiley, and Cengage—for their continued support and for providing valuable educational resources to our community.

We truly appreciate your presence and engagement today, and we warmly invite you to become more involved in our vibrant MAA Metro NY community.

This year's program highlights a wide range of topics in pure and applied mathematics, pedagogy and data science, with a dedicated student/faculty session. Be sure to check out our Metro NExT session, organized by Dr. Andrew Lee and Prof. Monica Morales Hernandez, as well as the workshop led by Dr. Sandie Han, Dr. Diana Samaroo, and Dr. Urmi Duttagupta.

We even have a poetry roundtable for poetically inclined students and faculty, beginning at 12:30 p.m., presided over by Dr. Joshua Hiller.

Thank you again for joining us. We hope you find inspiration, connection, and value throughout today's meeting.

Warm regards,
Boyan Kostadinov, MAA Metro NY Chair
on behalf of the MAA Metro New York Section

MATHEMATICAL ASSOCIATION OF AMERICA

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Emad Alfar, Bora Ferlengez, Johanna Franklin, Benjamin Gaines, Elena Goloubeva, Shamita Dutta Gupta, Richard Gustavson, Ezra Halleck, Sandie Han, Monica Morales Hernandez, Joshua Hiller, Brad Isaacson, Boyan Kostadinov (Chair), Andrew Lee, Eric Rowland, David Seppala-Holtzman, Satyanand Singh, and Andrew Vaughn.

CONTRIBUTED PAPER AND POSTER SESSIONS ORGANIZING COMMITTEE

Bora Ferlengez, Ezra Halleck, Boyan Kostadinov (Chair)

THE MAA METRO NY SECTION MEETING AGENDA
April 26, 2025

8:55-9:00 AM	**Welcome** Dr. Boyan Kostadinov, *Chair of the Metropolitan New York Section of the MAA*
9:05-9:50 AM	**Invited MAA AWM Presentation:** *Mathematics for Cyber Security* Dr. Emilie Purvine, Chief Data Scientist at *Pacific Northwest National Laboratory*
10:05-10:35 AM	**Sponsor Presentation: Pearson** *MyLab™ Math & Statistics – What's new, notable, and coming soon!* **Presenter**: Dr. Bonnie Rosenblatt, Math, Statistics, & Qualitative Business, Pearson
10:40-11:10 AM	**Sponsor Presentation: Wiley** *Bridging the Knowledge Gap and Encouraging Equity with Alta's Dynamic Remediation* **Presenters:** Dr. Whitney Porter, Gregory Schiliro, Digital Learning Specialist, Wiley
11:15-11:30 AM	**Coffee Break**
11:30-12:30 PM	**Contributed Paper Sessions** Mathematics Education Session (Presider: Dr. Shamita Dutta Gupta) Applied Mathematics Session (Presider: Dr. Johanna Franklin) Pure Mathematics Session (Presider: Dr. Brad Isaacson) Student/Faculty Session (Presider: Dr. Emad Alfar)
12:30-1:25 PM	**Lunch Break and Contributed Poster Session (**Supervisor: Dr. Benjamin Gaines) **Poetry Round Table** (Presider: Dr. Joshua Hiller)
1:30-2:15 PM	**Invited MAA MetroNY Presentation:** *Math Circles—Not for Squares* Dr. Henry Ricardo, Westchester Math Circle, Professor emeritus, *Medgar Evers College*
2:20-2:50 PM	**Sponsor Presentation: Cengage** *Addressing Student Readiness Gaps* **Presenter:** Tom Ziolkowski, Lead Product Marketing Manager, Cengage
3:00 - 4:00 PM	**Contributed Paper Sessions** Mathematics Education Session (Presider: Dr. Shamita Dutta Gupta) Applied Mathematics Session (Presider: Dr. Johanna Franklin) Pure Mathematics Session (Presider: Dr. Brad Isaacson) Student/Faculty Session (Presider: Dr. Emad Alfar)
3:00-3:30 PM	**Metro NExT Meeting**: *Advising Math Projects for Non-Math Majors* **Featured Speakers**: Dr. Andrew Lee and Prof. Monica Morales Hernandez
3:30-4:00 PM	**Workshop** *Using Data to Promote Inclusive STEM Learning Environments* **(**Presider: Dr. Ezra Halleck) **Organizers**: Dr. Sandie Han, *Medgar Evers College* Dr. Diana Samaroo, Dr. Urmi Duttagupta, *New York City College of Technology*
4:05-5:00 PM	**Business Meeting** (Presider: Dr. Boyan Kostadinov, Chair of the MAA Metro NY Section)

INVITED MAA AWM SPEAKER

Dr. Emilie Purvine, ***Pacific Northwest National Laboratory***

Title: Mathematics for Cyber Security

Abstract: The security of computer networks is crucial to maintain data privacy, intellectual property rights, and even to keep infrastructure functioning reliably. One might think that cyber security is the responsibility of computer scientists and network administrators. This is certainly true, but as adversaries change their tactics and become increasingly sophisticated, mathematicians are lending a hand. In this talk I will begin by introducing the landscape of computer networks, the cyber kill chain, and cyber security operations. I will present some of the main challenges facing cyber security today and show how mathematicians, like myself, are applying their skills in data modeling, anomaly detection, and machine learning to help provide situational awareness and keep computer networks resilient.

Bio: Dr. Emilie Purvine is a Chief Data Scientist and Team Lead for Complex Data Models at Pacific Northwest National Laboratory. Her academic background is in pure mathematics, with a bachelor's degree from University of Wisconsin - Madison and a PhD from Rutgers University where she studied enumerative combinatorics and discrete dynamics. Her research since joining PNNL in 2011 has focused on applications of combinatorics and computational topology together with theoretical advances needed to support the applications. Over her time at PNNL Emilie has been both principal investigator and technical staff on a number of projects in applications ranging from computational chemistry and biology to cyber security and power grid modeling. Her current research uses complex mathematical models to develop cyber analytics, study machine learning models for interpretability, and enhance digital biosecurity. Emilie also greatly values the ability to make mentoring a focus of her work. She loves to give presentations to students at all levels to provide an example of what a mathematician can do outside of academia. Interns and postgraduates (2-3 year temporary employees including post bachelors, post masters, and postdoc) are always included into her projects to promote on the job learning.

Outside of her core work activities Emilie has also been the chair of the MAA's Membership Committee and an associate editor of the AMS Notices. In her free time Emilie spends time with her friends and family, enjoys a good book, loves the outdoors and traveling to new destinations.

INVITED MAA METRO NY SPEAKER

Dr. Henry Ricardo, ***Westchester Math Circle***

Title: Math Circles - Not for Squares

Abstract: This talk will explore the history, philosophy, activities, and benefits of math circles, illuminated by the speaker's own involvement with three local math circles. The evolution of this type of mathematics organization can be compared to that of a religious group or a philosophical school of thought. My title hints at the mindset required of successful math circle mathematicians.

Bio: Dr. Ricardo retired from Medgar Evers College (CUNY) as Professor of Mathematics in 2009. He has been Secretary (2003-2009) and Governor (2008-2011) of the Metro NY Section, receiving its Award for Distinguished Achievement in 2009. He has written books on differential equations and on linear algebra. In retirement, he has continued his interest in mathematical problem solving and has seen his solutions published in various print and online journals across the world. He has also been involved in the activities of three math circles, offering enrichment to both teachers and pre-college students, especially regarding preparation for mathematical competitions.

SPONSOR PRESENTATIONS

Pearson

MyLab™ Math & Statistics – What's new, notable, and coming soon!

10:05 AM – 10:35 AM

Presenter: Dr. Bonnie Rosenblatt, *Pearson Faculty Advisor for Math & Statistics,*
Math Instructor at Reading Area Community College, PA

Abstract: Join Bonnie, Math instructor and Pearson Faculty Advisor, to explore innovations in MyLab™ Math & Statistics designed to help you teach your course your way. Learn about study features within the eText (such as translation to another language), AI assistance for you and your students, new GeoGebra questions, new assignment types for adding questions within your own videos, and for accepting multimedia submissions for projects. Learn about new settings, as well as features that are coming soon (automatic zeroes!). Some features are discipline and text specific.

Wiley

Bridging the Knowledge Gap and Encouraging Equity with Alta's Dynamic Remediation

10:40 AM – 11:10 AM

Presenters: Dr. Whitney Porter, Gregory Schiliro, *Digital Learning, Wiley*

Abstract: The mission of Wiley's affordable, accessible, and adaptive learning platform, Alta, is to bridge knowledge gaps and put achievement within reach for all students. In this presentation, we will explore how the power of adaptive learning can bridge prerequisite knowledge gaps and address state curriculum requirements without asking instructors to stretch themselves even further than they already do. Integral to this discussion will be an exploration of the qualitative and quantitative data about the success of Alta and adaptive learning as an equitable solution for students across all levels of math in higher education.

Cengage

Addressing Student Readiness Gaps

2:20 PM – 2:50 PM

Presenter: Tom Ziolkowski, *Lead Product Marketing Manager, Cengage*

Abstract: Prepare your students for success and help them overcome any readiness gaps they may have as they enter your precalculus and calculus courses. You'll learn about WebAssign learning resources and question types you can use at the beginning of the semester and throughout your course to get students up to speed and keep them on track. You can also save your valuable classroom time by taking advantage of tools that include tutorial support that provide support for students on their own time.

POETRY ROUNDTABLE
12:30 – 1:25 PM

Abstract: Come listen to mathematical poets read and talk about their poetry over lunch. Bring your math poems to share!
Presider and Organizer: Dr. Joshua Hiller, *Adelphi University*

METRO NExT NEW EXPERIENCES IN TEACHING:
Advising Math Projects for Non-Math Majors
3:00 PM – 3:30 PM

Metro NExT (New Experiences in Teaching) is a local version of MAA's Project NExT, a professional development program for new or recent PhDs in mathematics. Our goal is to build a community of new faculty and graduate students in the NY Metro MAA Section to help each other develop effective strategies for all aspects of our professional lives from teaching to research to service.

Abstract: This discussion session invites participants to share insights and strategies for advising mathematical projects designed for students majoring in fields outside of mathematics. At institutions where math courses serve a broad population, from business and biology to the social sciences and the arts, project-based learning can foster deeper engagement and interdisciplinary thinking. We will explore how to design accessible yet meaningful projects, balance mathematical depth with relevance to students' primary disciplines, and assess outcomes effectively. Participants are encouraged to bring examples, questions, and challenges from their own advising experiences.

Presiders and Organizers: Dr. Andrew Lee, *St. Thomas Aquinas College*
Prof. Monica Morales Hernandez, *Adelphi University*

WORKSHOP
Using Data to Promote Inclusive STEM Learning Environments
3:30 – 4:00 PM

Abstract: This presentation explores how unspoken assumptions and unconscious bias can influence STEM education, shape teaching approaches, curriculum design, and student engagement. These subtle barriers often affect perceptions of ability and access to support, limiting full participation in STEM fields. Participants will examine research-based practices—such as bias awareness training, adaptable teaching strategies, and focused student support—to promote more effective learning environments. Through interactive discussions and real classroom examples, attendees will gain practical tools to challenge stereotypes, improve student experiences, and foster classrooms that encourage curiosity, collaboration, and academic success.

Presider: Dr. Ezra Halleck, *New York City College of Technology*
Organizers: Dr. Sandie Han, *Medgar Evers College*,
Dr. Diana Samaroo and Dr. Urmi Duttagupta, *New York City College of Technology*

DISTINGUISHED TEACHING AWARD

The Carol Crawford Award for Excellence in Undergraduate Teaching

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Dr. Matthew Glomski, *Marist University*

Matthew Glomski is an associate professor with the Department of Mathematics at Marist University. He was born in Buffalo, NY and returned there to earn his PhD at the University at Buffalo in the field of differential equations.

It was in graduate school that Professor Glomski discovered his love of teaching mathematics. He joined the faculty at Marist College in 2007, where he has taught ever since. His dedication has been recognized with the Marist College's Board of Trustees Distinguished Teaching Award, the Center for Student-Athlete Enhancement's FOXPY's Faculty Recognition Award, the Special Services Awareness Recognition Award, and ten Student Government Association Faculty of the Year Awards for the School of Computer Science and Mathematics.

Professor Glomski's areas of research include differential equations and mathematical epidemiology, along with occasional side trips as a tourist in the fields of graph theory and combinatorics. He is an avid collaborator with students, having advised dozens on honors and independent research projects. He has been most proud to watch those students go on to present their work at local and national conferences, to publish their work, and to make their own way in the world of teaching and practicing mathematics.

He lives in Esopus, NY with his partner Laura. Soon they will be joined by a rescue dog Shooky to walk in the woods with.

JANET LIOU-MARK STUDENT AWARD

tahda queer, ***Hunter College, CUNY***

tahda queer is a math major at City University of New York. As a co-organizer of the Online Undergraduate Resource Fair for the Advancement and Alliance of Marginalized Mathematicians (OURFA^{2}M^2), tahda is passionate about re-humanizing mathematics. In the past, tahda has had the fortune to work with amazing people on various research projects, supported by the NYC Discrete Mathematics REU, the Summer Undergraduate Applied Mathematics Institute (SUAMI), Queens Experiences in Discrete Mathematics (QED), and the math REU at UC Santa Barbara.

Currently, tahda is conducting research in discrete probability under the advisement of Dr. Matthew Junge, modeling inflammatory damage in multiple sclerosis by generalizing a stochastic process known as chase-escape to include spontaneous conversion dynamics. Additionally, tahda is pursuing an independent study with Dr. Anna Pun, collaborating with other undergraduates to apply problem-solving skills to support local animal shelters.

JANET LIOU-MARK STUDENT AWARD

David Martinez, ***Baruch College, CUNY***

David Martinez is a Mathematics major with a minor in Computer Science at Baruch College, CUNY. He has participated in two NSF-funded Research Experiences for Undergraduates (REUs), one at QED York College and another at Texas State University in San Marcos. David will begin his Ph.D. studies in Mathematics this fall at the CUNY Graduate Center, focusing on algebraic combinatorics with the goal of becoming a professor.

He is currently continuing his research on the metric dimension of generalized theta graphs, (s,t)-core partitions, and the theory of polysymmetric functions.

SPECIAL RECOGNITION AWARD

Prof. Robert Suzzi Valli, ***Manhattan University***

Dr. Robert Suzzi Valli

October 19, 1984 - December 28, 2024

Dr. Robert Suzzi Valli was an extraordinary teacher whose warmth, dedication, and brilliance left an indelible mark on all who had the privilege to learn from him. Deeply admired by his students, he brought joy and clarity to even the most challenging subjects, making every lecture feel special. His genuine kindness, patient and dedicated mentorship, and tireless support—both inside and outside the classroom—fostered not just learning, but lasting inspiration. Whether through his contagious smile, late-night math club meetings, or one-on-one encouragement, Dr. Suzzi Valli shaped lives in ways that went far beyond academics.

Dr. Robert Suzzi Valli was known by all as kind, selfless, and generous. He brought pure joy to the many people in his life and his impact will remain long beyond his passing.

CONTRIBUTED PAPER SESSIONS

11:30 AM – 12:30 PM

RESEARCH SESSION: APPLIED MATHEMATICS

Presider: Dr. Johanna Franklin

11:30 a.m. Religious Affiliations and COVID-19 Vaccine Hesitancy Among US Adults: Insights from the NYU Immunization Study

Kayla D. Davie, PhD, Lecturer, New York City College of Technology
Jemar R. Bather, PhD, Statistical Director, Center for Anti-racism, Social Justice & Public Health, NYU School of Global Public Health
Prince A. Allotey, PhD, Assistant Teaching Professor of Statistics, University of Washington
Melody S. Goodman, PhD, Interim Dean, Professor of Biostatistics, New York University School of Global Public Health

Objectives: (1) To examine the associations between religious affiliation and COVID-19 vaccine hesitancy; (2) To investigate whether associations of religious affiliation varied by religious service attendance; and (3) To compare estimates across non-probability, probability, and combined (non-probability and probability) samples. **Methods**: We analyzed data from the 2021 NYU Immunization Study, a cross-sectional survey. Multivariable logistic regression models estimated the associations between religious affiliation, religious service attendance, and COVID-19 vaccine hesitancy across three samples: a probability sample, a non-probability sample, and a combined sample. Covariates included age, sex, employment status, educational attainment, household income, and candidates voted for in the 2020 presidential election. **Results**: In the probability sample, bivariate analyses suggest a statistically significant (0.62, p=0.044) association between COVID-19 vaccine hesitancy and religious affiliation. In the non-probability sample multivariable model, non-Christianity was less likely to be associated with vaccine hesitancy than Christianity (OR=0.50; 95% CI: 0.27,0.93). In all other bivariate and multivariable analyses, the association between vaccine hesitancy, religious affiliation, and religious service attendance is statistically insignificant. **Conclusions**: Our study provides valuable insights into the association between religious affiliation, religious service attendance, and vaccine hesitancy. The inconsistent and often statistically insignificant nature of this association across different samples suggests that targeting specific religious communities may not be most effective when designing public health initiatives and programs to increase vaccine acceptance.

11:45 a.m. Treating Solid Tumors with Chemotherapy and Angiogenic Inhibitors

Antonio Mastroberardino, United States Military Academy
Adam Glick, PeopleTec, Inc.

We investigate a system of nonlinear ordinary differential equations describing a microenvironment consisting of host cells, tumor cells, immune cells and endothelial cells while incorporating treatment combinations with chemotherapy and anti-angiogenesis therapy. We perform a dynamical systems analysis demonstrating that our model is able to capture the three phases of cancer immunoediting: elimination, equilibrium, and escape. In addition, we present transcritical bifurcations for relevant parameter values that correspond to the progression from the elimination phase to the equilibrium phase.

12:00 p.m. **Will an Airplane Fly?**

Vladimir Przhebelskiy, Malgorzata Marciniak, LaGuardia Community College of CUNY

An airplane will fly if the lifting force produced by its wing is equal to the airplane's weight. The common way to calculate the lifting force of a straight (upswept) finite wing at low speeds is Prandtl's lifting line theory which requires the use of calculus. We shall describe the precalculus only approach. If the wing has the shape of an ellipse (like on a Supermarine Spitfire airplane) there is an exact solution of pre-calculus level. For rectangular or tapered wings, we shall use an approach which uses Induced Lift Slope Factor (notation τ), suggested by H. Glauert. He also suggested induced drag factor, notation δ. Horner suggested the approximate formula for $\delta = AR \times f(\lambda)$, where AR Is aspect ratio and λ is taper ratio. We shall use a similar approach to calculate approximately tau. We shall also discuss other approaches to approximate τ with or without assumption of independence. We shall use this method to calculate the lifting force of a P-51 D Mustang airplane with the tapered wing.

12:15 p.m. **Bayesian Estimation of Extreme Quantiles and the Exceedance Distribution for Paretian Tails**

Douglas Johnston, Farmingdale State College, SUNY

Estimating extreme quantiles is an important task in many applications, including financial risk management and climatology. More important than estimating the quantile itself is to insure zero coverage error, which implies the quantile estimate should, on average, reflect the desired probability of exceedance. In this research, we show that for unconditional distributions isomorphic to the exponential, a Bayesian quantile estimate results in zero coverage error. This compares to the traditional maximum likelihood method, where the coverage error can be significant under small sample sizes even though it is unbiased. More generally, we prove a sufficient condition for an unbiased quantile estimator to result in coverage error. Interestingly, our result holds by virtue of using a Jeffreys prior for the unknown parameters and is independent of their actual prior. We also derive an expression for the distribution, and moments, of future exceedances which is vital for risk assessment. We extend our results to the conditional tail of distributions with asymptotic Paretian tails and, in particular, those in the Fréchet maximum domain of attraction. We illustrate our results using simulations for a variety of heavy-tailed distributions.

RESEARCH SESSION: PURE MATHEMATICS

Presider: Dr. Brad Isaacson

11:30 a.m. **Reciprocity Formulae for Generalized Dedekind and Hardy-Berndt Sums Involving Apostol-Bernoulli Functions**

Brad Isaacson, New York City College of Technology

This talk is concerned with generalized Dedekind and Hardy-Berndt sums and their corresponding reciprocity theorems. It emerges that the ingredients needed for certain reciprocity theorems are functions possessing suitable product formulas and Raabe-type multiplication formulas, for which the Bernoulli and Euler functions both enjoy. However, many functions possess these properties, and consequently, generalized sums involving these functions must also obey a reciprocity theorem of this type. In this talk, we consider a unification of the generalized Dedekind and Hardy-Berndt sums which involve Apostol-Bernoulli functions and present its reciprocity theorem which contains all the reciprocity theorems for the generalized Dedekind and Hardy-Berndt sums in the literature as special cases.

11:45 a.m. **Higher Diffeology Theory**

Emilio Minichiello, New York City College of Technology

Diffeological spaces are a generalization of manifolds that have gained a lot of popularity over the last few years. Using category theory, we can understand diffeological spaces deeply and explore what theorems of differential geometry still hold on this larger class of spaces and which do not. I will explain some results from my PhD thesis "Higher Diffeology Theory" using abstract methods like category theory, homotopy theory and sheaf theory to study diffeological spaces and develop their cohomology.

12:00 p.m. **Enumerating and Generating All Pairs of Positive Integers that Share the Same LCM and GCD**

David Seppala-Holtzman, St. Joseph's University

Given a pair of positive integers, L and G, where G divides L, we develop a formula that gives the number of unordered pairs of positive integers that share G as their greatest common divisor and L as their least common multiple. The derivation of this formula leads immediately to a method that generates all such pairs.

12:15 p.m. **Two Results Dealing with the Birthday Problem**

Robert Schutz, Consultant

A famous problem in elementary probability is the Birthday problem. It asks, if given a group of say size n, what is the smallest n such that the probability is greater than or equal to one half that there is at least one matching birthday in the group. The assumptions are that 1) A year is 365 days and 2) Days are equiprobable. After sketching in greater detail the birthday problem and its calculation, two results will be described. The first is about upper and lower bounds on calculation of the birthday problem using the arithmetic geometric and harmonic inequalities. The second is the case of unequal probabilities and how this affects the probability of a group having one match. It turns out that with unequal probabilities the probability of a match makes a match more likely.

PEDAGOGY SESSION: MATHEMATICS EDUCATION

Presider: Dr. Shamita Dutta Gupta

11:30 a.m. Utilizing an AI Math Bot as a Teaching Assistant in a First-Year University Mathematics Classroom to Explore Students' Learning of Calculus

Matthew Rudy Meangru, Abby Williams, Northeastern University

This study employs an AI math bot named Ada as a teaching assistant in first-year undergraduate calculus courses to explore the potential impact of AI technology on students' learning. Wenger's (1998) communities of practice framework serves as the overarching theoretical lens to understand how students engage in a practice with the presence of AI technology. Several studies have investigated the use of AI technology in learning calculus and its impact on students (Zhuang, 2025; Green, 2024; Sehran and Welcome, 2024). Even so, qualitative research on AI technology applied specifically as a teaching assistant in calculus classrooms is limited. This study employs a qualitative research method using Clandinin's (2022) narrative inquiry approach, which includes data collection through student interviews and reflections on students' engagement with Ada beyond the classroom. Additionally, data analysis includes dialogues from interviews and comparisons of students' solved calculus problems with Ada. The results aim to discuss how Ada—an AI math bot—impacts students' learning of calculus.

11:45 a.m. Experimentation with Calculus Courses

Shamita Dutta Gupta, Pace University

Post pandemic, students are often college bound with several deficiencies in prerequisite mathematics. Several strategies were developed over time to target and remedy these deficiencies. In this talk we will address some of these strategies developed, their utility and shortcomings.

12:00 p.m. A Symphony of Mathematics: How Music and Art Transform Mathematical Pedagogy

Lioubov Pogorelova, NYU Tandon School of Engineering and Stern School of Business

The history of mathematics holds prominence as a foundation for discoveries in the field of mathematics. To invent new ideas in mathematics, one must understand the historical evolution of mathematical methods and concepts. An intriguing question is whether the history of mathematics can provide pedagogical value and enhance students' learning. This paper explores how a historical approach to music and color may provide significant pedagogical value in studying mathematics, in particular, the topic of ratios. The paper is structured as follows. First, a brief historical analysis of mathematics and harmony uncovers connections between music and mathematics. Then a historical analysis of the connection between music and color is introduced. Finally, a proposed learning plan that unites music and visual art in the context of harmony is presented. Such an approach can help students develop intuition about the mathematics underpinning ratio analysis, as well as promote the holistic development of the senses that may contribute to a deeper understanding of mathematical ideas through different representations.

12:15 p.m. Integrating Human Rights Learning and Research Skills in a Statistics Course for Non-Majors

Maria Mercedes Franco, Queensborough Community College, CUNY

The presenter has designed a research-in-the-classroom (RIC) project that facilitates human rights learning in an introductory statistics course for non-majors at an urban community college: students work in groups to gather information and data about a human rights issue of their choice, identify trends, and conduct correlational analysis. The project ends with groups presenting or submitting a written report that includes the research/statistical analyses and ways in which people (including students themselves) can get involved and make a difference. The project uses equitable teaching practices and sets high expectations for all students. It also invites students to use mathematics/statistics as a tool for seeing and understanding the world around them while understanding bias, confounding variables, and the limitations and pitfalls of data-driven analyses and decision-making in social statistics. Assessments conducted over five implementations (class size: 20-25) of the project consistently demonstrate that this work enhances the learning and the attainment of general education and course-specific student learning outcomes as well as the acquisition of research skills. Although implementations have varied slightly, the student learning outcomes and skills assessed have not; thus the instruments/rubrics used in the assessments have remained the same: traditional course assessments and reflections; students' self-reported gains via Lopatto's Course-based Undergraduate Research Experience (CURE) survey; and College General Education Assessments of Student Artifacts for Analytic Reasoning, Quantitative Reasoning, and Information Management Skills using rubrics adapted from the AAC&U's VALUE Rubrics.

STUDENT/FACULTY SESSION

Presider: Dr. Emad Alfar

11:30 a.m. **Fast Evaluation in the Extrapolated Regularization Method**

Joseph Siebor, Svetlana Tlupova, Farmingdale State College
Adviser: Svetlana Tlupova, Farmingdale State College

Boundary integral equation methods are widely used in the solution of many partial differential equations. The kernels that appear in these surface integrals are nearly singular when evaluated near the boundary, and straightforward numerical integration produces inaccurate results. In Beale and Tlupova (Adv. Comput. Math, 2024), an extrapolated regularization method was proposed to accurately evaluate the nearly singular single and double-layer surface integrals for harmonic potentials or Stokes flow. The kernels are regularized using a smoothing parameter, and then a standard quadrature is applied. The integrals are computed this way for three smoothing parameter choices to find the extrapolated value to fifth order accuracy. In this work, we apply several techniques to reduce the computational cost of the extrapolated regularization method. First, we use a straightforward OpenMP parallelization over the target points. Second, we note that the effect of the regularization is local and evaluate only the local component of the sum for three values of the smoothing parameter. The non-local component of the sum is only evaluated once and re-used in the other sums. This component is still the computational bottleneck as it is O(N^2), where N is the system size. Finally, we apply the kernel-independent treecode to these far-field interactions to reduce the CPU time. We carry out experiments to determine optimal parameters both in terms of accuracy and efficiency of the computations.

11:45 a.m. **On Second Order Recurrences with Rational Parameters**

Maxwell Lippmann, Eric Rowland, Hamza Virk
Adviser: Eric Rowland: Hofstra University

The behavior of Lucas Sequences and 2nd-order Recurrences with integer parameters has been studied extensively. In this paper, we explore the properties of 2nd-order recurrences with rational, non-integer parameters. We try to search for integer and near integer sequences that satisfy these conditions and classify the unique restrictions on which terms can be integers, and which terms cannot be integers.

12:00 p.m. **Matrix Product Formulas for Generating Functions for p-Adic Valuations of Generalized Binomial Coefficients**

Arav Chand, Half Hollow Hills High School West
Adviser: Dr. Eric Rowland, Hofstra University

For the last 20 years, many researchers have been interested in divisibility properties of integer sequences arising from combinatorial structures. In particular, binomial coefficients have been the subject of several papers. Rowland found a matrix product formula for counting binomials by their divisibility by a prime p (p-adic valuations). I generalize this to a broader class of sequences, deriving analogous matrix product formulas for C-nomials – extensions of binomial coefficients based on integer sequences C inspired by Knuth and Wilf. This generalization shows that, surprisingly, Rowland's binomial matrices exhibit a universality across all C-nomial coefficients, expanding their known significance in combinatorics. To obtain this generalization, I used Mathematica to compute sequences of C-nomial generating functions, and identified linear relations between subsequences of the form s(p^e*n + r), for e>=0, 0<=r<p^e. Refining these initial relations through structural observations and change-of-basis techniques led to conjectured formulas. Next, by introducing classifications of

“ideal” and “somewhat-ideal” primes, I derived explicit p-adic valuation formulas for C-nomials. This allowed me to prove the conjectures using a counting argument relating C-nomial and binomial valuations. To manage repetitive casework, I designed an algorithm that systematically constructs the key vector factor in the matrix product. The sequences studied are k-regular, a notion introduced in 1992, suggesting connections to automata theory, including algorithmic analysis. This research deepens the understanding of divisibility in combinatorial structures by discovering strong relations to binomials, and significantly improves time complexity, enabling efficient computation of C-nomial properties.

12:15 p.m. Estimating Total Loss from a Compound Process

Mark Corrado Jr., Paul D’Amour, Farmingdale State College
Adviser: Douglas Johnston, Farmingdale State College

For insurance companies, a critical risk factor is that total losses exceed their capital reserves leading to insolvency. Total loss is a compound process where the number of losses and their sizes are random. We model the number of claims as a Poisson process and the size of claims as an Exponential distribution. We use mathematical tools, such as convolution, the Laplace transform, and statistical methods to solve for the probability distribution of total loss at some time in the future. This method requires numerical techniques, and we illustrate its accuracy by benchmarking against a known case. One of the main issues in applying this to real world data, however, is the unknown parameters of the underlying distributions must be determined from historical data. We derive the maximum likelihood estimate for the model’s parameters which are used to compute the cumulative distribution of total loss in the future. From this cumulative distribution, quantile estimates are computed which can be used to determine adequate capital reserves. We find, via simulations, that relying on only the single estimate of the parameters leads to a significant understatement in risk with too many exceedances above our estimated quantiles. Interestingly, this occurs even though the maximum likelihood estimates are unbiased. To improve performance, we develop a Bayesian approach where we integrate over the posterior distribution of the model parameters which results in an improved total loss risk-assessment. We illustrate our results using real-world insurance-claim data.

CONTRIBUTED PAPER SESSIONS

3:00 PM – 4:00 PM

RESEARCH SESSION: APPLIED MATHEMATICS

Presider: Dr. Johanna Franklin

3:00 p.m. **Thinking Inside the Box!**
Satyanand Singh, New York City College of Technology

In this presentation we illustrate and solve tantalizing mathematics problems by way of the pigeonhole principle. These problems appeal to both students and faculty. Here we illustrate how a seemingly simple principle can be used to solve interesting geometric and algebraic problems. The problems are easily accessible to students and provide impetus to delve deeper into mathematics and its applications.

3:15 p.m. **Phase-Field Modeling of Colloid-Polymer Mixtures in Microgravity**
Lauren Barnes, Iona University
Anand U. Oza, Lou Kondic, Boris Khusid, New Jersey Institute of Technology
William v. Meyer, NASA Glenn Research Center

In a microgravity environment, phase transitions in colloid-polymer suspensions give valuable insight into atomic-scale phase transitions. To explore the effects of fluid viscosity and other system parameters on phase behavior, we present simulation results of a phase-field model that couples a Cahn-Hilliard equation for the colloid concentration with the incompressible Stokes equations to include the effects of hydrodynamic interactions between particles and surrounding fluid in the low-Reynolds number limit. The model also incorporates the dependence of viscosity on the local colloid concentration, which influences the hydrodynamic behavior. We also present experimental results, extracted from images of experiments conducted by NASA on the International Space Station.

3:30 p.m. **Economical Impact of COVID-19 in the United States: County Level**
Angelica Tellez, New York City College of Technology
Adviser: Huseyin Yuce, New York City College of Technology

COVID-19 pandemic triggered an unprecedented economic crisis. Many measures of restrictions (lockdowns, travel advisory, social distancing, etc.), aimed to contain the virus's spread, led to extensive disruptions across industries. COVID-19's total cost to the U.S. economy was projected to reach $14 trillion by the end of 2023 (Hlavka and Rose, 2023). This study includes a descriptive analysis of economic data along with multivariate regressions to generate various estimates. Additionally, we examine the impact of vaccination rates on economic indicators. The research explores the economic effects of COVID-19 in the U.S., supported by statistical modeling.

3:45 p.m. **Extrapolated Regularization of Nearly Singular Integrals on Surfaces**
J. Thomas Beale, Duke University, and Svetlana Tlupova, Farmingdale State College

We will discuss recent work with J. Thomas Beale on the numerical evaluation of single and double layer integrals for harmonic potentials or Stokes flow, at points near the surface. The kernel is first regularized using a length scale parameter in order to control the discretization error. An extrapolation strategy is to compute the regularized integral for three choices of the smoothing parameter and solve for the extrapolated value of the integral with about fifth order accuracy, uniformly for target points on or near the surface. We will present some numerical examples and discuss suitable choices of the regularization parameter.

RESEARCH SESSION: PURE MATHEMATICS

Presider: Dr. Brad Isaacson

3:00 p.m. **Counting Some Families of Directed Planar Trees**
David Bradley, University of Maine, and Johann Thiel, New York City College of Technology

Consider the set of directed planar trees with the restriction that internal vertices have either two incoming edges and one outgoing edge, or two outgoing edges and no incoming edges. Each such tree can be associated with a cycle based on the direction of the edges adjacent to the tree's leaves. In this talk we describe a method, using generating functions, for counting all such trees associated with a given, fixed cycle.

3:15 p.m. **Fermat's Equation over Cyclotomic Fields**
Owen Sweeney, Iona University

For a prime l>3, we discuss the historical and practical significance of studying the Fermat equation of exponent l over the cyclotomic field Q(\mu_l). It is well known that Fermat's Last Theorem over the rational field is a closed problem. We discuss the classical separation of the problem (which carries over readily to the cyclotomic setting) into the first case, when the putative solution is coprime with l, and the second case, when the putative solution is not coprime with l, and some of what is currently known in each of these two cases. For example, if a certain integer i(l), referred to as the index of irregularity, is not too large, then there do not exist first case solutions. Similar criteria, which do not strictly depend on the magnitude of i(l), exist for the second case.

3:30 p.m. **Math Lessons from Sacred Texts**
Josh Hiller, Sokthan Yeng, Adelphi University

Many people have heard about the 'biblical pi' but did you know there are modern mathematical lessons and concepts that can be learned from a variety of religious and folk texts? In this talk we will explore several of these including stories from Buddhism, folk Hindu stories, and more.

PEDAGOGY SESSION: MATHEMATICS EDUCATION

Presider: Dr. Shamita Dutta Gupta

3:00 p.m. **Beyond the Numbers: Women's Impact on Mathematics**

Ashley Hickey, Zavrashtra Isaac, and Cassidy Shillingford, Molloy University
Adviser: Dr. Manyiu Tse, Molloy University

Over the years, women have made groundbreaking contributions to mathematics. However, they often face systemic barriers and exclusion from professional and academic environments. Notable early pioneers, such as Hypatia and Katherine Johnson, cultivated mathematical theories and challenged prevailing societal norms restricting women's mathematics roles. This paper examines women's historical and ongoing challenges in mathematics, illustrating the obstacles and advancements that characterize their experiences. Historically, women have been underrepresented in mathematical disciplines and often overlooked entirely. However, progress has been made through various initiatives to support and encourage female participation. Our research highlights the significant contributions made by these women in mathematics and the different programs emerging for women to pursue careers in mathematics. Despite ongoing gender bias and hostile work environments, we can foster a more inclusive and equitable future in mathematics for generations to come.

3:15 p.m. **Math Anxiety**

Joseph Grimando, Daniel Biscardi, Jenna Giammarusco, Molloy University
Adviser: Dr. Manyiu Tse, Molloy University

Math anxiety refers to a state of tension and stress when placed in mathematical situations. Math anxiety is a highly prevalent problem and persists from primary school to college. We will discuss research-based causes and symptoms of math anxiety. These causes include but are not limited to parents, students, teachers, and assessments. In addition, we will place a particular emphasis on working memory in relation to math anxiety. We conclude with possible teacher-centered strategies to reduce math anxiety for students.

3:30 p.m. **Meta-Problems in Mathematics**

Colleen McNally, Megan Guarascio, Ryan Jimenez, Molloy University
Adviser: Dr. Manyiu Tse, Molloy University

A meta-problem in mathematics is one that focuses on a higher level of understanding in solving to help design questions with simple solutions and cleaner calculations. This way, students can concentrate on mathematical ideas, rather than calculations. We will explore different types of problems that can be viewed as "meta-problems." They include finding Pythagorean triples, "clean" cubic polynomials, and the Mean Value Theorem. We will discuss how teachers can leverage the meta-problems and create a richer learning experience in the classroom.

3:45 p.m. **Beyond Euler's Formula: Exploring the Multifaceted World of Polyhedra with HS Students**

Michael Wijaya, Trinity School

Polyhedra offers rich opportunities for mathematical exploration beyond Euler's formula and Pick's theorem. This year, I'm teaching a two-semester topics course focused on polyhedra and polytopes for high school students concurrently enrolled in calculus. We're exploring topics such as Steinitz's inequalities characterizing which triples (v,e,f) can be realized as polyhedra, Fourier-Motzkin elimination for linear inequalities, and Ehrhart theory for counting lattice points in polyhedra. A key challenge has been finding effective ways to make advanced topics accessible and engaging. Students actively explore new concepts through collaborative in-class activities, document their discoveries in writing, and share solutions asynchronously using Coauthor, an online collaboration platform. They also engage critically with writings and interviews of mathematicians, composing written responses to these materials. I'll conclude by reflecting on which instructional strategies have proven most effective, lessons learned, and planned adjustments for future iterations of this course.

STUDENT/FACULTY SESSION

Presider Dr. Emad Alfar

3:00 p.m. **Explicit Algebraic Numbers all Whose Integer Parts of Powers are Composite**

Suyeong Hahn (Choate Rosemary Hall), Ganghun Kim (the Lawrenceville School),
Minseung Kim (Collegiate School)
Adviser: Dan Ismailescu, Hofstra University

In 1994, Baker and Harman proved that there are uncountably many numbers α>1 such that $\lfloor\alpha^n\rfloor$ is composite for all positive integers n. Unfortunately, their method is not constructive, and it does not allow to identify explicit expressions for such α. To the best of our knowledge, there are currently only a handful of specific examples of real numbers α with the above property. In this paper, we present several explicit classes of algebraic integers α>1 such that $\lfloor\alpha^n\rfloor$ is composite for all but finitely many n. Our constructions include quadratic numbers, cubic numbers, and biquadratic numbers.
To illustrate some of our results, we prove that each of the following numbers:
$2 + \sqrt{7}$, $41 + 29\sqrt{5}$, $4 + 2\sqrt[3]{7} + \sqrt[3]{49}$, $(8 + 5\sqrt{3} + 3\sqrt{7} + 2\sqrt{21})/2$ has the desired property. In 2004, Alkauskas and Dubickas constructed irreducible polynomials of arbitrary degree d whose largest root α has the property that $\lfloor\alpha^n\rfloor$ is divisible by 2 for all n≥1. We generalize their result by showing that the same result holds if 2 is replaced by any other positive integer p.

3:15 p.m. **Recovering the Largest Fault-Free Rectangle from a Punctured Square**

Benjamin Cha (Choate Rosemary Hall), William Han (Horace Mann School),
Terry Lee (Thomas Jefferson School)
Adviser: Dan Ismailescu, Hofstra University

Given an axis-parallel unit square Q in the plane containing n points, the problem of finding an axis-parallel empty rectangle of maximum area contained in Q is one of the oldest problems in computational geometry. More precisely, we consider the following **Problem**: *Given S, a set of n points contained in the unit square $Q = [0, 1]^2$, let $f(S)$ denote the area of the largest axis-parallel rectangle that does not contain any of the points of S in its interior. Further, let $f(n)$ be the minimum value of $f(S)$ over all sets S of n points in Q. Estimate $f(n)$.* It is immediate that $f(1) = 1/2$. In 2013, Dumitrescu and Jiang determined the values of $f(2)$ and $f(4)$, and proved that $(1.25 - o(1))/n \leq f(n) \leq 4/n$. In this paper we determine $f(3)$ and obtain estimates for

$f(5)$ and $f(6)$. We also improve the general estimate by showing that $(1.31 - o(1))/n \leq f(n) \leq 1.91/n$. Our approach consists of two main steps. First, we make use of computers to search for efficient point placements, which prevent the existence of a large area of empty rectangle. Next, we attempt to prove that the point arrangements we identified earlier are indeed optimal. The general upper bound $f(n) \leq 1.91/n$ uses a construction involving the golden ratio and the Fibonacci sequence. We use elements of the theory of continued fractions and geometry of numbers to produce our record construction. Our results are significant as the problem arises in a number of practical situations, such as facility location, manufacturing, and electronic design automation.

3:30 p.m. Bending Without Breaking: A Review of Archimedean Spiral Antennas for Wearable Applications

Qiutong Ge, Suffolk County Community College
Adviser: Vera Hu, Suffolk County Community College

Conformal wearable antennas require flexible, efficient designs that maintain stable performance under mechanical deformation, and typical rigid and bulky antenna designs fail to meet this requirement. This work investigates the geometric advantages of Archimedean spiral antennas for wearable applications, emphasizing their frequency-independent behavior and adaptability to bending/stretching. Using MATLAB simulations, we analyze the radiation patterns of these spiral antennas under varying surface deformations and compare their performance to non-spiral counterparts. Results demonstrate that the Archimedean spiral's inherent geometric properties minimize performance degradation during deformation and enable robust operation in dynamic wearable environments. These properties illustrate the potential to apply Archimedean spiral antennas in biomedical, aerospace, and consumer wearable systems.

3:45 p.m. Exploratory Data Analysis and Visualization of SAT Performance in NYC Public Schools

Tanya Verma, Riverdale Country School
Adviser: Boyan Kostadinov, New York City College of Technology

In this presentation, we showcase an exploratory data analysis and a series of visualizations examining the performance of all New York City public schools on the SAT test for the 2010–2011 academic year. Our analysis considers both total SAT scores and math scores individually. We identify the highest-performing borough and schools, including notable specialized STEM institutions such as Stuyvesant High School and the Bronx High School of Science. Additionally, we investigate the distribution of SAT scores across the city and assess score variability by borough using standard deviation. Our findings reveal that Manhattan exhibited the greatest variation in scores.

CONTRIBUTED POSTER SESSION

12:30 PM – 1:25 PM

MISCELLANEOUS RESEARCH

Supervisor: Dr. Benjamin Gaines

On the Equality of Sums and Products for Certain Multisets

Hannah Bahn, Saint Ann's School
Adviser: Satyanand Singh, New York City College of Technology

We look at which multisets have sums that equal their products, and we start by examining whether we can find at least one multiset of equal sum and product of every length n. We will prove a method for finding all equal sum/product solutions for sets where two members of the set are greater than one. Then, we will use the divisor function to determine the exact number of solutions of this form for any given n.

Snack Quests and Circuses: Exploring Interactive Learning Modules in OpenLab

Rona Zhang, New York City College of Technology
Advisers: Satyanand Singh, Jonas Reitz, Kate Poirier, Ariane Masuda, Darya Krym, New York City College of Technology

Gamification of the educational process is one way in which students can be motivated to learn by approaching their studies from a more playful angle. Toward this end, several professors at the New York City College of Technology have collaborated to produce a series of fun interactive modules to help students familiarize themselves with topics known to be more challenging in their coursework. These modules are available on OpenLab for students to engage with these topics in a low-stakes, relaxed environment, and use charming illustrations, mini-games, and flashcards to help with retention of the material. Each module consists of several episodes that cover a related concept, and each episode builds upon the previous episode. Student researchers such as myself are available to provide feedback on the modules as well as support for students using them. In my poster, I present two of these modules – Dot's Snack Quest in Vector Land and The Great Gates and their Circuit Circus – and highlight some of their special features.

Interrupted Time Series with a Beta Prior

Paul Johnson, Clinical SAS Programmer, Ling Huang, Sacramento City College

There are many recent examples of research involving the use of interrupted time series (ITS) analysis. Roberts (2023) provides an introduction. Interrupted time series is a time series which is interrupted due to an intervention or exposure and of interest is the analysis of the time series pre- and post-intervention. Examples include from public health interventions. In our research we conduct an analysis of an interrupted time series when there are multiple interventions and the presence of so-called wild points (i.e., outliers) in the data. We obtained simulations on product yield using a Beta (20, 2) prior distribution. 100 chemical experiments were carried out by students (a simulation); in which at 3 distinct time points the instructor intervened in selecting the levels of the independent variables of experimentation. These interventions occurred just after the 10th, 54th and 80th experiments. The experiments were conducted over a 3-month (semester) time period. An interrupted time series analysis was conducted to see the effect of the interventions on the percent product yield.

Autocorrelations were examined using Durbin-Watson tests and ACF / PACF of the ARIMA fitting models were examined to find the required moving average and autoregressive parameters before a final model is obtained. Wild points / outliers were examined. The final model provides estimates for the changes in levels of yield from one intervention to the next; and for changes in trend between one intervention to the next. SAS® is used to perform the data analysis (SAS, 2017-2024).

Exploring Cancer Cell Type Heterogeneity and Treatment Response Using UMAP on RNA-Seq Data

Matthew Gootman, Anabel Ojeda, Adelphi University
Adviser: Joshua Hiller, Adelphi University

Understanding the relationship between cancer cell types and treatment response is crucial for advancing personalized medicine. In this project, we analyze single-cell RNA sequencing data from the MCF7 breast cancer cell line to identify gene expression patterns that may influence therapeutic outcomes. By applying Uniform Manifold Approximation and Projection (UMAP), we reduce high-dimensional gene expression data to a two-dimensional representation, which enhances our ability to visualize the inherent cellular heterogeneity present under hypoxic conditions. Following rigorous quality control, normalization, and selection of highly variable genes, we ensured that the data fed into UMAP accurately reflected the underlying biological variability. Unlike linear methods such as PCA, UMAP preserves both local and global structures and reveals subtle differences between cellular states. By tuning key hyperparameters, such as the number of neighbors and the minimum distance, we uncover distinct clusters that reflect varying responses to microenvironmental stress. Our analysis identifies subpopulations with unique molecular signatures, providing valuable insights into potential biomarkers and therapy-resistant cells. This work demonstrates the importance of advanced dimensionality reduction techniques in refining our understanding of tumor heterogeneity and informing personalized cancer treatment strategies.

Advancement of Laser Radar Accuracy by Using Lenses for Insect Detection

Andrii, Iarmolenko, the City College of New York
Adviser: Dr. Andrii Golovin, the City College of New York

Accurate detection and identification of insects are important for ecological monitoring and pest management in agriculture. Laser radar systems often need help with precision due to variable environmental conditions and target sizes. We explore the application of a Varioptic® liquid lens (Corning, NY) to enhance the resolution of laser radar systems in detecting and identifying insects. The Varioptic® liquid lens with adjustable focal length is controlled by LabView software integrated into a laser radar system. The LabView code will be developed and tested with the demo laser radar available at the Remote Sensing Lab of the Grove School of Engineering, CCNY. Previous results indicated a significant improvement in the detection resolution of the signal, particularly at different distances. Using the Varioptic® liquid lens allows for a higher value of signal-to-noise ratio and ensures a better detection of insects. This advancement in laser radar technology presents a promising tool for more effective monitoring and pest management.

Enhancing NWP Precipitation Forecasting in the NE U.S: Post-Processing for Deep Learning

Steven Aarons, Hunter College
Adviser: Dr. Yanna Chen, New York City College of Technology

Numerical Weather Prediction (NWP) computes the dynamics of the atmosphere and oceans to forecast the weather based on current conditions. While these models provide insights in medium-range weather forecasting, they often face limitations in accurately predicting precipitation quantity and type (p-type) as a result of regional variability and complex meteorological processes. Parameterization processes associated with precipitation are modeled by differential equations that cannot be explicitly solved, leading to errors that compound with increasing lead time. NWP forecasts often differ from observational data, especially in terms of precipitation and snow depth data. Past work examined the parameterization processes to enhance our understanding of how snowfall patterns, amounts, and p-types are influenced by the interactions between radiation, microphysics, and cumulus schemes within a case study. Even with recent advancements in NWP parameterization schemes, they cannot accurately resolve sub-grid processes and limit spatial resolution of the forecast to

grid box scale. To improve precipitation prediction, NWP model outputs can also be post- processed using deep learning (DL) methods. DL algorithms train neural networks in multiple "deep" layers through statistical techniques to identify patterns in data, leading to predictive analysis. We integrate DL techniques for the post-processing of several NWP models' raw outputs, to enhance precipitation prediction accuracy in the Albany area. Historical weather data and real-time weather station observations are used to refine and correct raw NWP outputs. DL approaches, such as convolutional neural networks and recurrent neural networks, will be compared, combined, and evaluated to determine if they are able to enhance forecasting skill and spatial resolution in precipitation prediction. This aims to improve emergency planning, resource management, and mitigation of extreme weather impacts in the region.

Leveraging Technology and GIS to Enhance Climate Resilience in New York City

Kazi Tasin, New York City College of Technology; Alijah Anyagwosi, Hunter College
Adviser: Tarendra Lakhankar, the City College of New York

New York City faces significant climate challenges, such as extreme weather events and increased flood risks, influenced by its diverse topography, dense urban landscape and aging infrastructure exacerbate these challenges, as evidenced by the widespread damage caused by Hurricane Sandy in 2012. In response to these challenges, the study combines physical and social sciences to tackle complex issues. Our goal is to assess and reduce climate risks, particularly in vulnerable, low-lying areas. We also prioritize climate equity, making sure that the needs of the communities most impacted are at the forefront of resilience planning. A thorough strategy will be employed to analyze and improve the resilience and sustainability of New York City.

Analysis of Atmospheric Correction Algorithms to Assess Climate Change Impacts on Lake Water Quality

Aisha, Malik, Hunter College; Fahmeda Khanom, New York City College of Technology
Advisers: Dr. Marzi AAzarderakhsh, New York City College of Technology
Dr. Abdou Bah, New York City College of Technology
Dr. Reginald Blake, New York City College of Technology

Inland waterways, including lakes, play a crucial role in sustaining ecosystems, providing drinking water, supporting biodiversity, and generating economic value. However, urbanization and industrialization have contributed to harmful algal blooms (HABs) and the decline of water quality, posing both ecological and economic risks. While traditional in situ monitoring of chlorophyll-a (chl-a), an indicator of HABs, is accurate, it is also labor- intensive and costly. Remote sensing offers a more efficient alternative by providing high-resolution spatial and temporal data. Satellite sensors, such as Landsat and Sentinel, have shown promise in detecting chl-a concentrations, proving to be cost-effective and reliable for large-scale HAB monitoring. Accurately correcting atmospheric effects in optically complex waters is a significant challenge, especially for high-precision applications like chl-a detection. Technical limitations such as spatial resolution, cloud coverage, and data accuracy hinder the broader use of satellite remote sensing. Furthermore, validating satellite-derived chl-a data requires accurate in situ measurements to minimize error propagation and ensure reliable assessments. This study leverages recent remote sensing satellite series, including Landsat 8 and 9 data, as well as historical datasets from clear mesotrophic and oligotrophic lakes in the Adirondacks. The effectiveness of various atmospheric correction algorithms is evaluated by comparing satellite- derived chl-a estimates within situ measurements. Preliminary results reveal significant variations in algorithm performance, particularly in their ability to detect chl-a accurately. While algorithms are sensitive to watercolor variations on an individual lake scale, stronger correlations between estimated and measured chl-a are observed in larger lakes. These findings emphasize the importance of selecting appropriate atmospheric correction techniques tailored to specific lake characteristics and conditions for accurate chl-a monitoring.

An Investigation into the Impacts of Hurricane Ida Across New York City

Naureen, Asha, New York City College of Technology
Advisers: Seon-Ho Kim, the City College of New York
Naresh Devineni, the Graduate Center of the City University of New York

Hurricane Ida was the most destructive hurricane of 2021, causing widespread damage across both the southern and northeastern United States. The aftermath of Hurricane Ida resulted in a rainfall record in New York City, with Central Park receiving 3.47 inches of rain within just one hour (NWS, 2021). Louisiana, New Jersey, and New York were heavily impacted by the storm's rainfall and flooding (NWS, 2021). Although Hurricane Ida had a significant impact, there remains a research gap, as the damages caused by the hurricane have seldom been compiled into a single, comprehensive resource. This study will analyze the damages caused by Hurricane Ida, focusing on affected states, and explore the recovery investments, including funding and resources allocated for rebuilding.

Urban Wind Trajectory Modeling and Validation Using Doppler Wind LiDAR

Joseph Rukaj, New York City College of Technology
Advisers: Daniela Viviana Vladutescu, New York City College of Technology
Yonghua WU, the City College of New York
Fred Moshary, the City College of New York

Doppler Wind LiDAR and RADAR systems give us insight on how wind patterns are formed within urban areas. Studying wind patterns in urban areas is vital for the health of citizens, since wind is important for dispersing pollution away from concentrated areas. High rise buildings are responsible for a majority of the New York Metropolitan area's unique wind trajectories, which pose a health concern for residents in the area. Therefore, careful analysis of wind interaction with urban infrastructure is crucial for providing residents with a safer environment. Other factors that influence wind are meteorological and environmental features, such as relative humidity, atmospheric chemistry which influences the ambient air temperature and pressure. Using a Halo Photonics StreamLine Scanning Doppler LiDAR system, we scanned areas to give us wind data about specific targets: at edges and in between buildings, at tops of buildings, and further out toward the skyline. These scans help us understand how wind interacts with corners and rooftops of buildings, as well as general velocities of wind. Mathematical models were derived using multiple environmental parameters. Using these models, we predicted and validated the wind velocity and direction during the study. Additional instruments were used for cross-validation.

Temporal Trends and Transport Modeling of Urban Aerosol Optical Depth (2020-2023)

Tianyi Zhao and Tahsinur Rahman, New York City College of Technology
Advisers: Daniela Viviana Vladutescu, New York City College of Technology
Yonghua WU, the City College of New York
Fred Moshary, the City College of New York

In this paper, we are studying the optical properties and seasonal variability of aerosols in and above the Planetary Boundary Layer (PBL) over New York City. The PBL is the lowest part of the Earth's atmosphere, directly influenced by its contact with the Earth's surface. It typically extends from a few hundred meters to a couple of kilometers in height, varying with time of day, weather conditions, and location. Within the PBL there are small aerosol particles that can be breathed into human lungs, leading to diseases of the respiratory tract and angiography, seriously affecting human health. PM2.5 (particulate matter with a diameter less than 2.5 um) is particularly known to pass the lung barrier and penetrate the bloodstream causing serious illnesses. In this study, we use a ceilometer, an active remote sensing instrument to measure the cloud distribution and aerosol concentration and optical depth. Based on the understanding of the features of the sun photometer, we can compare the aerosol from the ceilometer and sun photometer during the COVID-19 year 2020, and after COVID 2023. In addition to the ceilometer and sun photometer, the HYSPLIT model, and radiosonde data from the BNL balloons are used for a better understanding of the optical properties of the atmospheric constituents and their variation

with changes in the different atmospheric conditions. Furthermore, aerosols can be transported over long distances by wind currents and weather systems. In this regard, we will be using wind modeling to scientifically track aerosol transportation by simulating the movement and dispersion of airborne particles.

Analysis and Validation of Aerosol Optical Properties During and After the COVID-19 Pandemic

Tahsinur Rahman and Tianyi Zhao, New York City College of Technology
Advisers: Daniela Viviana Vladutescu, New York City College of Technology
Yonghua WU, the City College of New York
Fred Moshary, the City College of New York

Using the Multiwavelength Raman LiDAR (Light Detection and Ranging) system at CCNY, we investigated the optical properties of atmospheric particles and gasses for extended periods during the COVID-19 pandemic and after the pandemic. By emitting laser pulses at 355 nm, 532 nm, and 1064 nm, the LiDAR system allows us to measure vertical profiles of aerosol parameters such as backscatter and extinction coefficients, optical depth, LiDAR ratio, and Ångström exponent. The Ångström exponent is determined from the ratio of lidar returns at 532 nm and 1064 nm and provides information about the particle size. This study is important for us to understand the effects of aerosols on the environment and health. The paper compares the variation of man-made aerosol emissions during the pandemic with the same variables after COVID restrictions were lifted. The modeled parameters in this study are aerosol optical properties and aerosol and its impact on radiative forcing. Furthermore, we utilize HYSPLIT backward trajectories, CIMEL sun photometer, and microwave radiometer data to understand the aerosol sources and the impact of the atmospheric temperature, relative humidity, and water vapor on aerosol optical properties. The working principles behind each instrument are explained to better understand the used parameters in our model validations.

Evaluating Data Quality of Ocean Color Remote Sensing

Rosa Pavlak, New York City College of Technology
Advisers: Eder Herrera Estrella, the City College of New York
Alexander Gilerson, the City College of New York

Water-leaving radiance and remote sensing reflectance are measurements of various wavelengths utilized for the purpose of studying ocean composition, specifically the concentrations of chlorophyll, mineral particles, and dissolved organic matter. Remote sensing of ocean and coastal waters from satellite sensors poses challenges due to the fact that water-leaving radiance constitutes only about 10% of the total radiance captured by the sensor. As a result, a process of atmospheric correction is used to remove the effects of strong sky radiance, sun glint, and other extraneous factors on the data. The purpose of this study is to assess the accuracy of the resulting data by comparing the remote sensing data with measurements taken above the ocean surface from ocean platforms. The CCNY students use data from the Coastwatch portal, which provides water radiance measurements that are used as the basis for satellite data validation. Stations include Long Island Sound Coaster Observatory (LISCO), Chesapeake Bay, Casablanca Platform, SeaPRISM, and AAOT. Students gained hands-on experience working with this data and processing it from satellite sensors and ocean platforms to evaluate the quality of observations from NASA, NOAA, and the European Space Agency (ESA), including data from NASA's upcoming PACE mission. They also engaged with algorithms to estimate water parameters using remote sensing data.

Heating Monitoring in New York Subway System

Cesar Pascal, Isaac Morel, Tyler Ayala, Joseph Moise, the City College of New York, Borough of Manhattan Community College, New York City College of Technology
Advisers: Abdou Bah, Marzi Azarderakhsh, Hamid Norouzi, Reginald Blake, New York City College of Technology

NYC faces great challenges due to the rapidly changing climate. Many facilities including underground transportation infrastructure will be impacted severely from climate change effects, particularly the increasing heat waves. The variability of temperature in the subways of New York during the heat waves period could impact the health and safety not only of commuters but also the subway system personnel. However, the severity of such temperature change is not well known. For this reason, in this study, we conduct a thorough investigation of how temperatures change within the subway system.

Real Life Applications of Combinatorics

Emmanuel Oitamong, New York City College of Technology
Adviser: Dr. Satyanand Singh, New York City College of Technology

Combinatorics is a fundamental branch of mathematics that involves counting, arranging, and analyzing different configurations of objects. It has vast applications across various fields, such as computer science, biology, cryptography, and environmental modeling. Two key combinatorial techniques, binomial coefficients and stars and bars—serve as powerful tools for solving problems involving selection, arrangement, and distribution of objects. Binomial coefficients are used when we want to count how many ways we can choose a certain number of objects from a larger set, where the order doesn't matter. For example, how many ways can we select 3 students from a group of 10? The binomial coefficient helps us answer questions like this by counting all possible combinations. It's represented by the symbol where n is the total number of objects and k is how many we are choosing. The stars and bars method is used to solve problems where we need to distribute identical objects (often called "stars") into distinct groups (called "bars"). For example, if we have 5 identical candies and we want to distribute them among 3 children, the stars and bars method helps us count all possible ways to do this. The formula for the stars and bars method is: where "n" is the number of identical objects (stars) and "k" is the number of distinct groups (bins or categories). This formula counts the ways to distribute the objects into the groups.

AOD Retrieval and Cross-Network Validation in Urban Environments: AERONET and MESONET in NYC

Shervan McLean, New York City College of Technology
Adviser: Yanna Chen, New York City College of Technology

This study compares cloud-free Aerosol Optical Depth (AOD) measurements between two networks in New York City: Aerosol Robotic Network (AERONET) (CCNY site) and MESO - scale Net - work (MESONET) (BRON site). One year of level 2.0 AOD data at 500 nm and 870 nm from AERONET is compared with AOD retrieved from MESONET using the Langley method and Beer's Law. Solar irradiance is determined using the Langley method, which applies linear regression to observations taken under stable atmospheric conditions. Data are sampled at five-minute intervals. The agreement between the two datasets is evaluated using the coefficient of determination (R2), root-mean-square error (RMSE).

Geological Foundations of Engineering Landfills and Their Role in Advancing Energy-from-Waste Technology for Greenhouse Gas Mitigation and Sustainable Resource Management

Babacar Sarr, Harmony Divine, Rean Shahidullah, and Rizwan Chowdhury, the City College of New York, New York City College of Technology
Adviser: Dr. Masato Nakamura, New York City College of Technology

The engineering landfills represent a critical interdisciplinary technology, integrating principles of geology, public health, and sanitation to mitigate greenhouse gas emissions, particularly methane—a major contributor to global warming. Concurrently, Energy-from-Waste (EfW) technology leverages solid waste as a fuel source, facilitating the generation of electricity while reducing reliance on finite natural resources such as coal, natural gas, and oil. This undergraduate research examines the synergistic impact of engineering landfills and EfW technology, focusing on their potential to address the dual challenges of solid waste management and sustainable energy production. Quantitative analyses were conducted to evaluate the environmental and resource conservation benefits of these integrated approaches.

Dynamics of Urban Heat Island Effect in New York City

Brigette Alejandro, Hailah Nagi, and Zohaib Khan, New York City College of Technology
Adviser: Dr. Marzi Azarderakhsh, New York City College of Technology

The Urban Heat Island (UHI) effect leads to elevated temperatures in cities due to infrastructure, land cover, and limited vegetation. This study analyzes UHI patterns in New York City using existing satellite-derived temperature maps alongside vegetation indices, land use data, and socioeconomic factors. By examining spatial and temporal trends, the study explores correlations between heat intensity, green space distribution, and community demographics. The findings provide insights into the impact of UHIs and potential mitigation strategies to improve urban climate resilience.

Monitoring Heat in the Bronx Subway Stations

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New York City's subway system faces increasing thermal stress due to climate change, particularly during heat waves. This study investigates temperature and humidity conditions at street level and underground platforms across stations in the Bronx. Using portable sensors, mobile devices, and thermal infrared cameras, data were collected at different times of day, considering factors such as station depth, ventilation systems, and commuter density. Heat and humidity levels were further exacerbated by crowded situations during peak hours, highlighting the part that human activity plays in the subsurface Urban Heat Island (UHI) effect. These circumstances may impair infrastructure functioning and present health risks to employees and commuters. Results show that underground platforms are consistently hotter and more humid than street-level areas, with temperature differences averaging up to 3°C in stations without cooling systems. The most extreme conditions were recorded in stations lacking air tempering systems or fans, where average temperature differentials reached 0.875°F and humidity increased by over 6%. In contrast, stations equipped with climate control infrastructure showed smaller or even negative differences, highlighting the importance of proper ventilation and cooling technologies. This research contributes to the MTA; continuing Climate Resilience and Sustainability activities by identifying high-risk stations and directing focused heat mitigation strategies. As temperatures rise in New York City, continued monitoring and investment in cooling equipment are critical to ensuring the subway system safety, comfort, and resilience.

Monitoring Heat in Brooklyn Subway Stations

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Climate change has had a major effect on New York City causing challenges for reducing trapped heat. The underground transportation system is heavily impacted by the changing climate, and the issue is more severe during summer when heat waves are common. The goal of this research is to identify stations that are heavily impacted by these environmental conditions and evaluate them to help with developing heat mitigation strategies. Each researcher was assigned to a train service in Brooklyn, NYC to measure the relative humidity and air temperature at both the subway platform and street level. To conduct this project, humidity and temperature data loggers were used to measure, store, and record data inside stations and at street level to be shown in a presentable way. This data will then be used for analysis in determining which stations in Brooklyn are impacted more heavily than others by heat, furthermore, helping with reducing hot temperatures underground. From previous research, specifically during July 2024, when the city experienced three continuous heat waves which kept the average temperatures of the Brooklyn subway stations ranging from high eighties and low to mid ninety degrees Fahrenheit. The research continued through the winter starting in early February, and the weather conditions were nearly opposite compared to the summer readings. Where summer was sunny, humid, and hot through the duration of the collection process. Winter has been overcast, rainy, and cold. From our collective data, we noticed the air temperature and humidity were both higher at the platform level compared to the street level. Although efforts are being made towards climate resilience, the implementation needs to be swift and concentrated on the stations more impact. Climate change effects are significant, and this research will help with heat mitigation initiatives that can be implemented now to reduce warming effects in the future.

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