

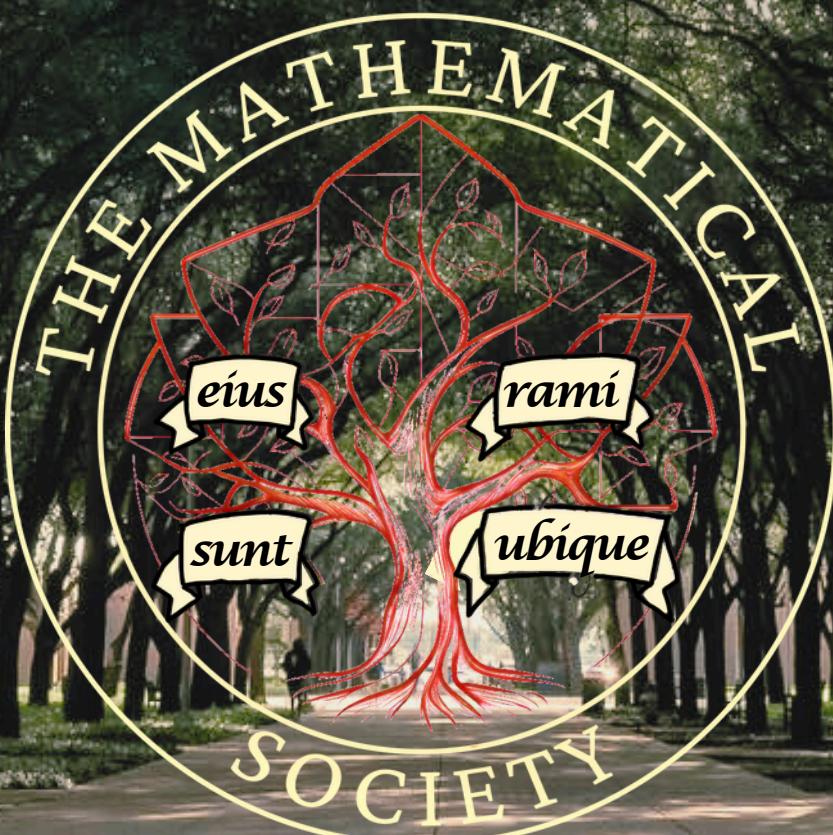
MATH IN FOCUS

School of Mathematics and Statistical Sciences

NEWSLETTER

VOL. 1

FALL 2024



at UTRGV
MMXXIII

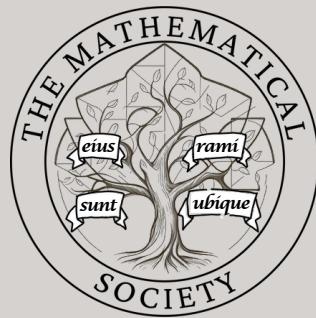


THE MATHEMATICAL SOCIETY

The goals of the Mathematical Society at UTRGV (MSOC) are to transform and enrich the landscape of mathematics throughout the Rio Grande Valley by creating collaborative systems that address the needs of the community. The MSOC strives to pipeline students, at all levels, into academic and research excellence by providing networking, coding, and professional development opportunities. To date, the MSOC has hosted over twenty events on campus. The MSOC was created in April of 2023 by its founding fathers, Dr. Timothy Huber, Dr. Mike Lindstrom, Dr. Andrew Alaniz, and Mr. Joseph Alanis. We currently have over forty active undergraduate and graduate members combined and seven faculty advisors. If you are interested in joining our organization, please visit our website and click join!

FIND ALL ABOUT
UPCOMING EVENTS IN
OUR WEBSITE:
WWW.MSOCUTRGV.COM

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MESSAGE FROM THE CHAIR

As we celebrate a record-breaking year in terms of enrollment, I want to take a moment to update you on some of the exciting initiatives and developments within the SMSS. The past year has been one of new ideas and new collaborations, and I am pleased to share the progress we have made on several fronts.

We are expanding Standards-Based Learning beyond Calculus I to better meet the needs of our students.

We are continuing our investment in bilingual courses and collegiate mathematics courses taught by UTRGV faculty at local high schools. Our ongoing collaboration with South Texas College is improving STEM student success through grant-funded efforts. This includes a \$1 million grant from the National Science Foundation led by Dr. Baofeng Feng.

This year marks the 4th year of the SMSS PhD program, with our first graduates set to complete the program within this academic year. Our graduate students are landing prestigious internships and jobs at national laboratories. Our department continues to connect with the community through Math Teachers' Circles, bringing faculty together with local high school teachers to discuss mathematics. This initiative is sponsored by the American Institute of Mathematics and is led by Dr. Hyung Kim.

I am excited to announce a new \$200,000 NSF grant for supercomputing infrastructure. Under Dr. Tamer Oraby's leadership, this project aims to elevate student preparation for the rapidly advancing fields of artificial intelligence and high-performance computing by revising our Linear Algebra, Probability and Statistics, and data science courses. Major new research grants also include those of Dr. Alexey Garber and Dr. Mike Lindstrom. As UTRGV nears its R1 classification, the increasing external funding earned by our faculty is critical for supporting our growth and research.

Thank you all for your continued dedication to advancing mathematics research and education at UTRGV.



Dr. Timothy Huber

Director of the School of Mathematics
and Statistical Sciences

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Shaping Minds and Models

Dr. Tamer Oraby's Inspiring Path from Classroom to Research Excellence at UTRGV



Dr. Tamer Oraby

Associate Professor

Photo taken by Mr. Jesus Alferez

Dr. Tamer Oraby is deeply passionate about both theoretical and applied statistical and mathematical approaches to addressing real-world challenges. Dr. Oraby's research is driven by problem-solving, where he carefully selects the appropriate tools to tackle specific research questions. He has published his research work in the *Journal of Theoretical Probability* as well as in the *Journal of Theoretical Biology*.

Recently, Dr. Oraby has developed a new method employing an approximate likelihood function to adjust for Berkson measurement error in statistical studies, which he derived analytically and validated through simulation. This year, he coauthored a paper with his Ph.D. student, Mr. Jose Galarza, introducing an innovative method in functional data learning using convolutional neural networks, showcasing exceptional performance. Additionally, Dr. Oraby has another manuscript under review, coauthored with his Ph.D. student Mrs. Wei Yin, in which they propose a novel replicator dynamical equation in behavioral game theory. This model captures boundedly rational human decision-making regarding vaccination during disease outbreaks.

One of Dr. Oraby's most cited papers, which examines the effect of lockdown timing as a COVID-19 control measure, was published in *Scientific Reports* (5-year impact factor of 4.3). The journal's editors recognized its significance by including it in two collections: the Editor's Choice for Epidemiological Modeling and the Journal Top 100. In this study, he utilized continuous-time Markov chains and multitype branching processes from stochastic processes, along with the tau-leaping simulation algorithm, to analyze and simulate the model. In another published COVID-19 study, he used a system of ordinary differential equations and applied the maximum likelihood method to estimate model parameters, enabling counterfactual analyses...Continued on page 10.

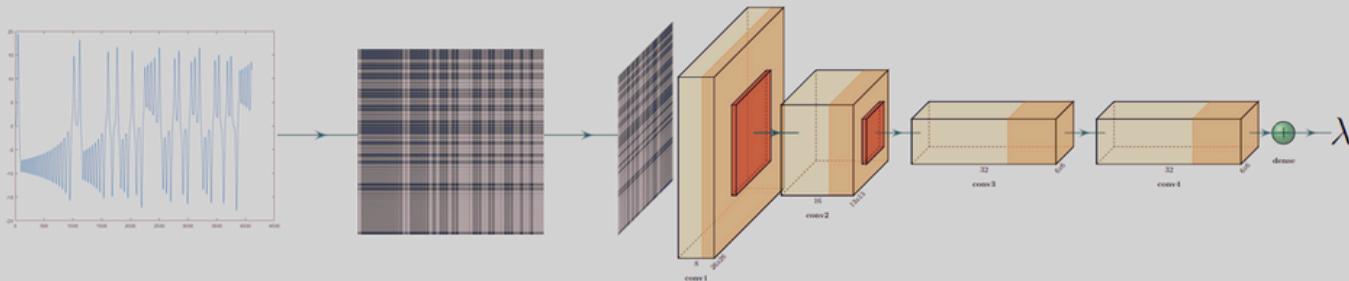


Figure: The procedure for the functional data regression and classification problems using convolutional neural networks.
Galarza, J., & Oraby, T. (2024). "Functional data learning using convolutional neural networks." *Machine Learning: Science and Technology*, 5(1), 015030.

Ramanujan's Prodigy

Mr. Jeffery Opoku is from Ghana, West Africa. He completed his bachelor's degree at the University of Ghana, Legon, and a Master of Philosophy (MPhil) at the Kwame Nkrumah University of Science and Technology in Kumasi. In August 2022, he began his PhD journey at UTRGV joining the computational math track under the mentorship of Dr. Timothy Huber, who has been incredibly influential and supportive.

Mr. Opoku's research focuses on Analytic Number Theory, with a keen interest in the works of Ramanujan. He explores the intricate connections between integer partitions and modular forms, studying the arithmetic properties of both restricted and unrestricted partition functions using polytopes and lattices, see figures. His work uncovers new congruences and structural behaviors in these functions, which are crucial for understanding their distributions. This research has broader implications for number theory, especially in areas like q-series and modular forms, enriching our understanding of the complex arithmetic structures underlying these classical objects.

Mr. Opoku's main goal is to become an analytic number theorist, following in the footsteps of his mentor and advisor, Dr. Huber. In addition, he aspires to become a vegan restauranteur and a wellness coach.

In describing the SMSS Mr. Opoku writes:

"I must say that the School of Mathematical and Statistical Sciences (SMSS) has been incredibly welcoming; the faculty and students have made my time here truly enjoyable. Outside of research, I love playing soccer and working out at the gym. The University's Recreational Center has become my second home, right after the SMSS."

He currently has two publications, one in *The Journal of Number Theory* titled "Ramanujan Type Congruences for Quotients of Klein Forms" and another in *The Ramanujan Journal* titled "Ramanujan-Fine Integrals for Level 10," with several more projects in progress.



Jeffery Opoku

Ph.D. Candidate

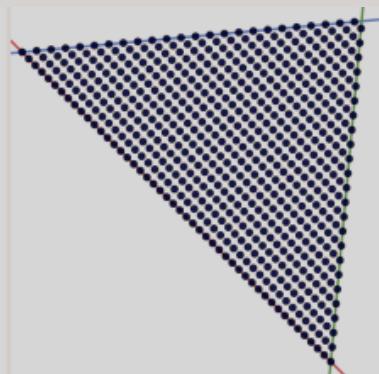


Figure: Lattice points corresponding to $a_0 = 94$ contained in the level 5 polytope.

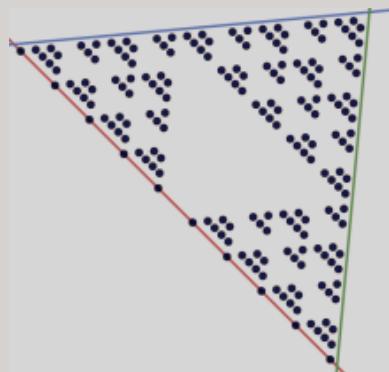


Figure: Lattice points corresponding to $a_0 = 94$ satisfying Ramanujan type congruences modulo all positive powers of 5.

What are Partitions?



Dr. Brandt Kronholm
Associate Professor



Figure: L-R: Bruce Berndt (UIUC), George Andrews (PSU), Ken Ono (UVA), Dr. Kronholm. This photograph was taken at Pennsylvania State University during the conference The Legacy of Ramanujan 2024: Celebrating the 85th birthdays of George Andrews & Bruce Berndt.

Dr. Kronholm is interested in integer partitions. The partitions of a given natural number n are the ways of writing n as sums of positive integers. For example, there are three partitions of 3: 3, 2+1, and 1+1+1 and we write $p(3)=3$. His research is focused on patterns within sequences of partition numbers. The first few values in the sequence of partition numbers are $p(1)=1$, $p(2)=2$, $p(3)=3$, $p(4)=5$, $p(5)=7$, $p(6)=11$. Can you guess what comes next?

Dr. Kronholm has two students who are currently working on their PhD, Joselyne Aniceto (to graduate 2025) and Jena Gregory (to graduate 2026). Jena and Dr. Kronholm published a paper titled “Iterated rascal triangles” in the journal *Aequationes Mathematicae*, in August 2023. Joselyne and Dr. Kronholm published a paper called “Hansraj Gupta’s ‘A technique in partitions’ revisited: congruences, cranks, and polyhedral geometry” in the *International Journal of Number Theory*. It will appear sometime soon.

Dr. Kronholm has been invited to present his research at some far-away conferences. In December of 2022 he spoke at the SASTRA Ramanujan Prize conference in Kumbakonam, India. In December of 2024, he will be speaking in Auckland, New Zealand, at the Joint International Meeting of the American Mathematical Society, the New Zealand Mathematical Society, and the Australian Mathematical Society in the special session on Special Functions, q-Series and Beyond.

In November 2024 Dr. Kronholm attended the Texas Undergraduate Math Conference at the not-very-far-away UT Tyler with Dr. Sifuentes and several UTRGV undergraduate research students.

William Keith (Michigan Tech), Dennis Eichhorn (UC Irvine), and Dr. Kronholm, have organized an AMS Special Session on Partition Theory and q-Series for the upcoming Joint Math Meetings in Seattle, Washington in January 2025. Both Joselyne Aniceto and Jena Gregory will be speaking in this session.

Figure: The partition triangle $P(18, 3)$ and the set $P(18, 3) = Z_3 \cap P(18, 3)$ of partitions it contains. The outer triangle is the intersection of the non-negative octant with the constraint $x_1 + x_2 + x_3 = 18$. Adding the inequality constraints $x_2 \geq x_3$ (shown in red), $x_2 \geq x_3$ (green) and $x_3 > 0$ (dashed blue) yields the half-open partition triangle $P(18, 3)$. The lattice points $\lambda \in P(18, 3)$ are shown as black dots.

Lecturer Spotlight



Dr. Sidketa Ida Fofana is currently a Lecturer II in the SMSS and co-initiated the first annual Florence Nightingale Day at UTRGV hosted on February 16th, 2024 on the Edinburg campus. The primary goals of the event were to honor and celebrate Florence Nightingale, to encourage connections among high schools and universities, and to recruit students into the statistics program. Dr. Fofana's research areas consist of cancer survival analysis, machine learning, causal inference, health economics, and health statistics. Dr. Fofana is collaborating with researchers from our department, the medical school, the college of business, and other institutions across the nation.

Dr. Sidketa Ida Fofana

Lecturer II

Figure: Florence Nightingale Day at UTRGV hosted on February 16th, 2024.



Do You Remember?

Mr. Joel Williams, recipient of the 2024 SMSS best graduate research award, works with Dr. Lindstrom investigating Alzheimer's Disease (AD), a disease which progressively impairs memory, focusing on the role of Amyloid Beta (A β) in different brain regions. A β proteins, which are cleaved from cell membranes and accumulate in the brain, are implicated in neuronal damage found in AD patients. His work models the production, diffusion, and internalization of A β to understand how these processes vary across different types of neurons and brain regions. By examining factors like the "oligomer cascade hypothesis," which proposes that A β oligomers are particularly toxic, Mr. Williams aims to uncover insights into the mechanisms driving AD progression, potentially informing future therapeutic strategies.

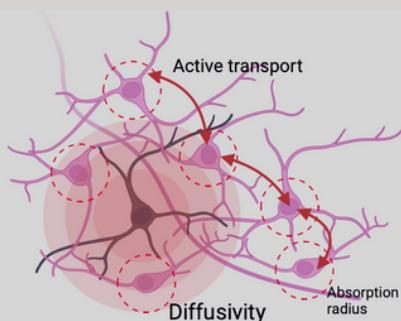


Figure: A depiction of mechanisms at work in the movement of proteins at the neuronal level.



Joel Williams

Ph.D. Student

Undergraduate Spotlight



Emily Payne
Undergraduate Student

Emily Payne's research interest in integer partitions sparked when her calculus II professor Dr. Kronholm lectured on power series. In the Summer of 2023, Dr. Kronholm extended an invitation to join the Research Experience for Undergraduates students (REU), where Emily and her undergraduate research team successfully proved a theorem extending a classical identity of the 18th century mathematician Leonhard Euler.

This past summer, Emily traveled to Oregon State University to participate in the Number Theory REU under the mentorship of Dr. Holly Swisher. Interestingly enough, they further generalized the result from her past REU experience and found an accompanying Beck-type companion identity. In addition, they proved several fixed perimeter analogues of classical partition results as well as analogous parity results for fixed perimeter partitions.

New Staff Spotlight



Melissa Garza
Admin Coordinator

Melissa Garza is the new Administrative Coordinator for the SMSS, bringing over seventeen years of professional experience and a solid background in high-volume academic office environments. With a Bachelor of Arts in Communication and a master's degree in Educational Technology (M.Ed.) from UTRGV. Melissa is dedicated to delivering exceptional operational support and possesses a wide range of skills that allow her to manage a plethora of administrative projects.



Nancy Navarro
Admin Assistant II

Nancy is the new Administrative Assistant II for the SMSS, who also shares a profound joy for Mathematics. Nancy is a mother to a four-year-old furry baby named Harlee Quinn (the chiweenie's name was inspired by the Batman movie character). Nancy notes that she has a healthy coffee addiction alongside the majority of the SMSS faculty.



Sofia Duran
Student Assistant

Sofia has been our amazing student assistant since the summer of 2024. She is a future alumna of the SMSS who aspires to become a mathematics teacher and is currently researching braid groups with Dr. Alaniz. On a lighter note, Sofia enjoys great food, math jokes and her comfy Converse shoes, which you can often see her wearing.

New Faculty



Dr. Thoa Thieu

Assistant Professor

Gran Sasso Science Institute

Research Interests:

Mathematical Biology, Applied Mathematics and Statistics



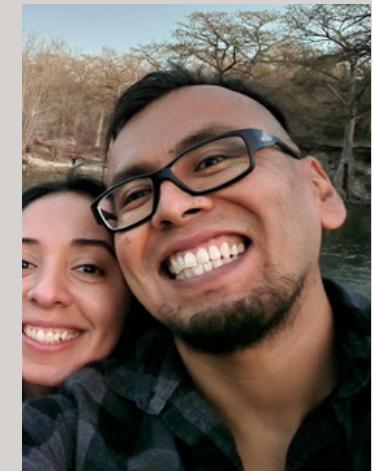
Dr. Liet Vo

Assistant Professor

The University of Tennessee

Research Interests:

Numerical Methods for SPDEs and Probability



Dr. Danny Lara

Lecturer I

University of Iowa

Research Interests:

Discrete Representation of General Type of Algebras



Ms. Teresa Padron

Lecturer I

UTRGV

Research Interests:

Optimization



Mrs. Yumi Clark

Lecturer I

University of Notre Dame

Research Interests:

Mathematics Education

Events & Conferences

Open Mathematics Competition

The Open Mathematics competition is an annual mathematical competition the MSOC hosts for high school, undergraduate, and graduate students. With serious cash prizes, the topics range from trigonometry to Real Analysis and beyond. The last two competitions (Spring and Fall 2024) have brought over 100 competitors to campus.



Pie Day: Pie Your Professor

The SMSS and MSOC join together to celebrate 3/14 Pie Day by pie-ing our beloved professors, Lecturer's, and GTA's ! Thank you to Dr. Huber and Dr. Sifuentes for participating !



Research Experience for Undergraduate (REU)

Over the 2024 summer, four student teams worked on NSF funded research in the UTRGV Math REU program supervised by Dr. Lindstrom, Dr. Oraby, Dr. Rodrigo, Dr. Sifuentes, and Dr. Suazo.



Lunch With the Professor

Lunch with the Professor is a research networking event to help graduate and undergraduate students join faculty research teams and is hosted by the MSOC, the most recent (October 2024) on the Brownsville campus.



SMSS Spring 2024 Award Ceremony

In the Spring of 2024, the SMSS students, faculty and staff gathered together to celebrate the completion of another academic year and to recognize their accomplishments.



History of Mathematics Study

Dr. Serbin, Dr. Fernández, and Dr. Ortiz-Galarza led a History of Mathematics Study Abroad Program in Summer 2024. This program addressed the life and contributions of prominent Italian mathematicians, like Galileo, Fibonacci, and da Vinci. The program also highlighted the influence of mathematics in art and architecture in the Middle Ages and the Renaissance.



C-STEM

The UTRGV Center of Excellence in STEM Education (C-STEM) offers two weekly workshops on students' academic, career, and professional development in EMAGC 2.412 and via Zoom. Right now is the opportune time to apply for summer research programs called "Research Experiences for Undergraduates" which typically last 6-8 weeks and provide the following benefits:

- roundtrip airfare to the university site
- lodging at the university dorms
- payment of \$5000-\$7000 to conduct research
- meeting/networking with other undergraduates,
- learning about existing graduate programs, and
- visiting a new city!

Visit <https://www.utrgv.edu/cstem/college-students/external-research-opportunities/index.htm> for a list of programs.

Additionally, visit the NSF REU website <https://new.nsf.gov/funding/initiatives/reu/search>

You can watch recordings of past workshops at <https://www.utrgv.edu/cstem/college-students/cstem-professional-development-workshops/index.htm>

Continued from page 3:

A year earlier, he employed Bayesian methods to analyze a zero-inflated Poisson model for the number of mosquitoes captured in traps in McAllen and Reynosa, further demonstrating his use of statistical approaches across a range of real-world problems. Since joining UTRGV, Dr. Oraby has published 33 peer-reviewed papers, many of which appear in prestigious journals such as *Scientific Reports*, *PLOS ONE*, *Proceedings of the Royal Society B*, *The Lancet*, and the *Journal of Management Information Systems*. Additionally, Dr. Oraby has contributed two book chapters and three peer-reviewed conference proceeding papers. Prior to his time at UTRGV, he had published 13 peer-reviewed papers and two book chapters.

Dr. Oraby's research spans collaborations with experts across diverse fields, including health sciences, medicine, social work, ecology, toxicology, information systems, and engineering. Some of his work has also garnered attention from scientific and health media outlets. Dr. Oraby regularly introduce his past and current projects to students in his classes, helping them grasp the vital role of statistics and modeling in scientific inquiry. Since joining UTRGV, Dr. Oraby has taught twenty-three different graduate and undergraduate courses in statistics. Over the years, he has mentored or co-mentored nine graduate students, twenty undergraduate students, and one high school student. Many of his students have co-authored peer-reviewed papers with him, and they have presented their work at various conferences, both orally and through posters. In recognition of his commitment to student development, Dr. Oraby has received the Student Mentorship Excellence Award from the College of Science at UTRGV in April 2019.

Recently, Dr. Oraby was invited to present a fifty-minute talk at the 6th Annual Cincinnati Symposium on Probability at the University of Cincinnati and to deliver the 2023-24 Lenora Lecture at Oberlin College in Ohio. Additionally, he served as the plenary speaker for statistics at the 8th Coastal Bend Conference at Texas A&M in Kingsville. In the summers of 2018 and 2019, he directed the Mathematical Association of America's National Research Experience for Undergraduate Program (MAA NREUP) at UTRGV as the PI, collaborating with co-PIs Drs. Erwin Suazo and Jasang Yoon. Each summer, the eight-week program involved four UTRGV undergraduate students who later continued into graduate schools. Dr. Oraby has also been the PI of an AIM-AHEAD pilot grant and co-PI on several other grants, including one funded by the Wellcome Trust, UK, to study the risk of vector borne diseases in South Texas.

Dr. Oraby works closely with his students to help them achieve their academic goals, always encouraging them to demonstrate independence in their research. Dr. Oraby believes that independence and perseverance are crucial for the next steps in their careers or further studies. Dr. Oraby's passion for research drives him to continually explore new methods for addressing complex research questions. As he often reminds his students—and aims to instill in them—he is a lifelong learner, and the pursuit of knowledge is a continuous journey we must all embrace.

We Are Hiring!

The Mathematical Society

- Searching for two tutors for Spring 2024 who can help with all undergraduate courses!
JobX Job ID: 6647
- Searching for journalist to help publish Math in Focus Magazine! JobX Job ID: 6162

Email: msoc@msocutrgv.com

SMSS Department

- Dr. Fernandez is looking for a GTA from January to June, 2025 to support his analysis in math education research. For more info email him at luis.fernandez01@utrgv.edu
JobX Job ID: 7145
- Searching for four student assistance for Spring 2024 to assist with Professional Development. JobX Job ID: 6162

Email: nancy.navarro@utrgv.edu

Research Classifieds!

Dr. Mike Lindstrom,

Modeling Neurodegenerative Diseases

Undergraduate

Summer 2025

mike.lindstrom@utrgv.edu

Dr. Dambaru Bhatta,

Fluid and Solid Mechanics & Heat/ Mass Transfer

All Levels/Any Level

Spring 2025 - Fall 2025 (Including Summer)

dambaru.bhatta@utrgv.edu

Dr. Luigi Ferraro,

Algebra

Jan - Jun 2025

Master's & Doctoral

luigi.ferraro@utrgv.edu

Dr. Paul Bracken,

Diff. Geo. , PDEs, & Mathematical Physics

Jan - Jun 2025

Undergraduate & Graduate

paul.bracken@utrgv.edu

Dr. Debanjana Kundu,

Elliptic Curves, Algebraic Number Theory

Jan - April 2025 & May - Aug 2025

All Levels/Any Level

debanjana.kundu@utrgv.edu

Dr. Hortensia Alzaga Elizondo,

Undergrad Math Education with a Focus on Proofs

Master's

Jan 2025

hortensia.alzagaelizondo@utrgv.edu

Dr. George Yanev,

Stats Inference for Branching Stochastic Processes

Jan - Jun 2025

Master's & Doctoral

george.yanev@utrgv.edu

Dr. Alexey Glazyrin,

Geometry, Combinatorics, & Discrete Math

Any Time

All Levels/Any Level

Alexey.Glazyrin@utrgv.edu

Dr. Brandt Kronholm,

Integer Partitions, Number Theory, & q-Series

Any Time

High School - Doctoral

brandt.kronholm@utrgv.edu

Dr. Alexey Garber,

Self-Assembly of Aperiodic Structures

Summer 2025

Master's & Doctoral

alexey.garber@utrgv.edu