THE

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Aₙ ₐPERIODIC NEWSLETTER
OF THE
DEPARTMENT OF MATHEMATICS
AT
UT SAN ANTONIO
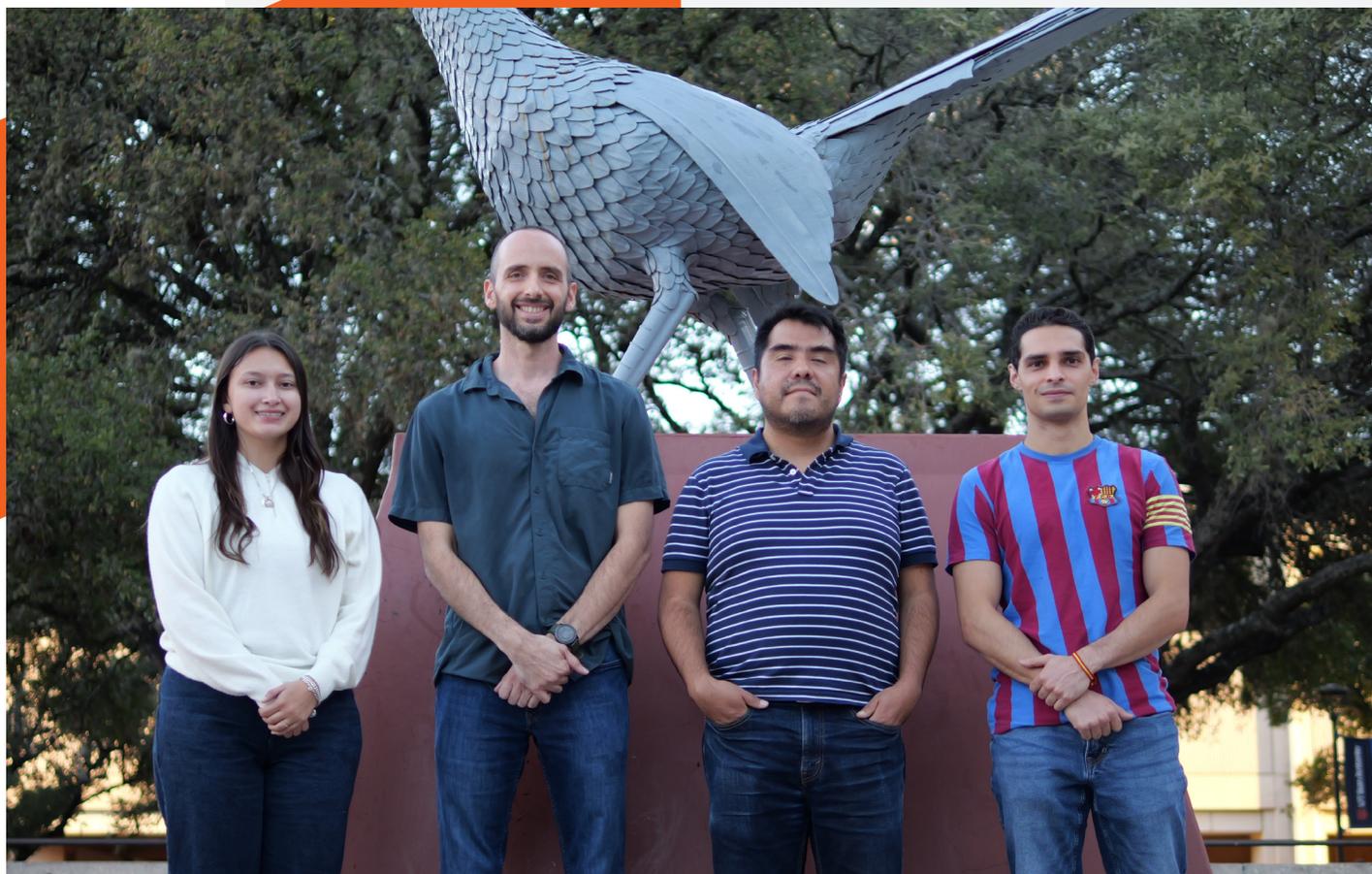
Department of Mathematics

1 UTSA Circle

San Antonio, TX 78249

November 2025

On the cover: UT San Antonio students working with Dr. Jose Morales who holds joint appointments in the Departments of Math & Physics. From left to right: Avery Tovar, Brandon Lippe, Dr. Morales, Mariano Alcalde.

Chair's Message

It's hard to believe we are at the end of November and the end of the semester is nearly upon us. Please keep in mind that whatever work your professors assign to you, it took time to create in order to appropriately target learning outcomes and then they need to grade it once you have completed it. They are likely as busy as you! However, they are in this field because they are invested in your learning and education so please take advantage of scheduled office hours for questions you may have.

Despite the fact that you like math, some of you may forget the obvious formula that is used to calculate grades. What do I mean? Suppose your final exam is 40% of your final grade and you have an 85% going into the final. If your goal is to pass with a 70%, maybe you can "coast" but if you aim for simply passing and end up doing horribly on the final exam, that might be enough to drop you to a non-passing grade (and all of you can do this sample calculation above to play out various scenarios). You are likely (i) juggling 5 or so courses, all with final exams, (ii) your time is limited, and (iii) there are only so many energy drinks you can or should drink in a day to stay awake, so be sure to budget your very-limited time wisely! Maybe that 1 hour of video game playing or scrolling on Instagram is the downtime you need to recharge but try to make sure it's not your preferred method of proscrastination. Buckling down at the end can make the difference for that one problem that might push you to the next grade higher. Study more rather than less but don't stress yourself out in the process. Winter break will be here soon enough.

So remember - stay strong as you push through these last few weeks of the semester!! Whether you've put in all the work that you've needed up until now or maybe, in hindsight, you have slacked a little more than you should have, these final few weeks are often when things come together. Be sure to take advantage of faculty office hours, Math Gym hours (**Math Gym in Flawn 3.02.08**), and studying with your fellow classmates whether they share your same section or not.

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From the Math UGAR

Hello math majors! Now is the time to be thinking about applying for scholarships. The College of Sciences has several, which you can find in the scholarship hub: https://onestop.utsa.edu/scholarships/hub/, so please take a few minutes to look through them. There are also tips on completing the General Application. Some are awarded based on financial need, some are awarded based on merit, and a few consider both. Some have other conditions like major or residency, and at least one gives preference to math majors. Each year, some of these go unused because no one even applies for them! If you have any questions about math scholarships, email ilse.cooper@utsa.edu, and for questions about scholarships in general, email cos.scholarships@utsa.edu. You can always contact me at zachery.sharon@utsa.edu with any other questions you have.

2025 Derivative Bee

On Wednesday, **November 5**, the second annual Derivative Bee took place as an electrifying evening for our Calculus I and Calculus II competitors. The event was filled with energy, quick thinking, and plenty of mathematical intensity as students put their derivative skills to the ultimate test.

Pictured: Grace Lin Shao, Andrew Vu, Leo Abeja, Ben Lavie, Blake Martinez, Aryan Rathee

Calculus I Division

The competition kicked off with two lively Kahoot rounds, where **Aryan Rathee** and **Leo Abeja** claimed top honors. In the elimination bracket, the excitement only grew as students battled through increasingly challenging problems. **Andrew Vu** secured **1st place**, followed by **Grace Lin Shao** in **2nd place**, with **Ben Lavie** earning the coveted **Wildcard** spot.

Calculus II Division

The Calculus II competitors faced an even tougher set of elimination rounds, marked by razor-thin margins and impressive displays of strategy and speed. **Ivan Garcia** emerged as the **1st-place** champion, with **Olivia Aubone** taking **2nd place**. **Durga Yerukala** and **Nina Bhakta** both fought their way to well-deserved **Wildcard** wins.

It was certainly a highly competitive and memorable night for all participants. The enthusiasm, teamwork, and mathematical talent on display made the evening a resounding success. We're already looking forward to welcoming everyone back and even new competitors in Spring 2026 for the first-ever Integral Bee!

Pictured: Nina Bhakta, Olivia Aubone, Ivan Garcia and Durga Yerukala

A **special thanks** goes out to all those folks that made this happen. Sean Beatty, Sage Bentley, Chris Duffer, Qiuchen Hai, Jose Iovino, Jason Jia, Glenn Lahodny, Elizabeth Lambert, Stephen Lee, Alicia Machuca, Jordan Miller, Cristobal Padilla, Stephen Pena, Cindy Roberts, Matthew Schurmann, and Diego Zuniga.

From the Math GAR

We are in the first year of our consolidated M.S. degree where you can choose between concentrations of Pure Mathematics, Applied-Industrial Mathematics, Mathematics Education, and General Mathematical Studies. (Previously, those were separate degrees.) The Graduate Catalog gives the details of the degree but sometimes the presentation can be overwhelming. We have created a flowchart that helps you visualize what is expected. You can find this at https://sciences.utsa.edu/_documents/mathematics/grad-degree-flow-charts.pdf. We will have a meeting within the next few weeks to go over the flowchart and answer questions you may have. Please look out for an email with further details.

Pursuing a doctorate in the mathematical sciences. If you are graduate student thinking of continuing on to a doctoral program or an undergrad who wants to go directly to a doctoral program after here, deadlines often range from Dec 1 through Feb 1 so please be proactive in identifying programs. Please use your faculty as resources!

<u>All students:</u> There will be a weekly spring seminar on *category theory with applications to geometry and topology*, run by Dr. Stephen Peña. The seminar will build from foundations (categories, functors, limits) through sheaves and stacks, with constant emphasis on geometric examples.

  Topics include:
- Universal properties and (co)limits in geometry
- Sheaf theory and cohomology
- Sites and Grothendieck topologies
- Introduction to stacks and higher categories
- Applications to bundles, moduli spaces, and gauge theory

No prior category theory is required, though familiarity with some topology and geometry will be useful. All are welcome, of course.

Format: Weekly meetings for 10-12 weeks. Dr. Peña will present in the early weeks with student presentations toward the end. If you are interested, please email stephen.pena@utsa.edu.

Student Research - Opportunities

Whether you are an undergraduate or a graduate student, it's never to *early* to think about research. This great hands-on experience is often what motivated your professors to continue to their studies in math in graduate school and beyond. If you are a junior or sophomore taking junior-level math courses, this is the perfect time to start thinking about **paid math research during the summer**. These are collectively called **Research Experiences for Undergraduates (REUs)** and are opportunities for undergraduate students to conduct research in math. Different locations have different requirements so don't just assume it's not for you. Please explore the links below and ask your math faculty for advice if you are unsure. These can be competitive so if you are considering this, don't just apply to one. Deadlines are often mid-December through mid-February so please search early!

Some links for REU sites and other student opportunities:

From the AMS (American Mathematical Society): **https://www.ams.org/learning-careers/students/emp-reu**
From the NSF **https://www.nsf.gov/funding/initiatives/reu/search?f%5b0%5d=reu_research_area:25741**
From SIAM: **https://www.siam.org/programs-initiatives/education-resources/resources-for-undergraduates/**
From NSA: **https://apply.intelligencecareers.gov/student-tiles** (see link for Director's Summer Program (DSP))

Research at UT San Antonio

If you can't apply or don't get in (or even if you do!!), consider asking one of your professors if they have research projects that you could work on. Not all do, and it would be an indpendent time commitment, but the opportunity is life-changing! Ask, and if the answer is no, ask someone else. Check out our department website for some of the research areas that our faculty work in.

Present your research at conferences

Once your research, whether from an REU or a professor here, gets to a certain place, you should consider presenting the work in a conference. There are many conferences that allow students to present and there is often funding available for students to attend. Even if it is a local conference, it can be worth the day trip or weekend excursion to go. This applies to both undergraduate students and graduate students. Organizations that are particularly student friendly in terms of opportunities include AMS, MAA (Mathematical Association of America), SIAM (Society for Industrial and Applied Mathematics), SACNAS (Society for the Advancement of Chicanos and Native Americans in Science – although anyone is welcome to join and participate!). Some of our undergraduate students featured in this edition presented their work at the Texas Undergraduate Mathematics Conference, October 17-18! Getting involved in research as an undergraduate will be the best avenue for you to start attending and even presenting in conferences.

Seminars and colloquia

We will often have colloquia or seminars, usually on Fridays 4-5pm when they happen. Please look for flyers on the bulletin board outside the department or check on the math webpage on the right tab under Seminars & Events. All students, undergrad or grad, as well as faculty or others are welcome to attend. Even if it is not your area of interest, getting exposed to this variety is part of overall academic growth. And cookies are served!

Student Research - Highlights

We have a number of student researchers, conducting research under professors' guidance either individually or in groups, and as either undergraduates or graduate students. What is presented here is a brief glimpse of the work they are doing. Some are at the start of their project while others are near or at the end! Behind each of these projects is the research of one of the UT San Antonio math professors.

Lauren Estrada

Lauren Estrada, a master's student in her final semester at UTSA, has been working with **Dr. Zhuolin Qu** as a Graduate Research Assistant (GRA) since January 2025 on a project that integrates mathematical modeling, human behavior, and public health: *Modeling Human Behavior in Mosquito-Borne Disease Prevention.*

Research Project: Mosquito-borne diseases continue to be a persistent global challenge. While traditional mathematical models—such as SEIR–SEI frameworks—are valuable for understanding disease spread, they often overlook how human behavior influences transmission. This project bridges that gap by connecting disease dynamics with the Transtheoretical Model of Behavior Change, which describes how individuals move from being unaware of risk to consistently taking protective action. This socio-biological perspective helps capture how behavior affects and responds to disease threats.

Lauren's key contribution has been the analysis of a newly collected survey dataset (N = 60) measuring community Knowledge, Attitudes, and Practices (KAP) related to mosquitoes and the diseases they transmit. She is helping quantify how people perceive risk, how prepared they feel, and what protective measures they use. These insights are essential for calibrating the behavioral stages in the model and for identifying factors that shape real-world intervention success.

In addition to her data-analysis work, Lauren has presented this research at a professional conference, sharing the project's goals and behavioral framework with a broader scientific audience. Lauren will be moving into an industry role in early 2026, and her work on this project has strengthened her skills in data analysis, quantitative modeling, and scientific communication.
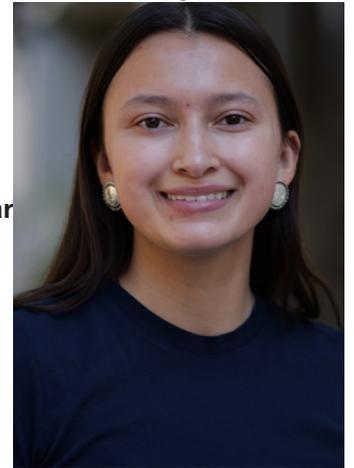
Dr. José Morales' Team

Mariano Alcalde collaborates with **Dr. José Morales** on the theory of open quantum systems with environmental memory (non-Markovian dynamics). He uses master-equation and phase-space methods, supported by numerical simulations, to study decoherence and information flow. He has also developed nanophotonics simulations for quantum optics and theoretical AMO models of collective light–matter interactions for applications in quantum information and thermodynamics. He is also interested in the foundations of quantum mechanics and the philosophy of physics.
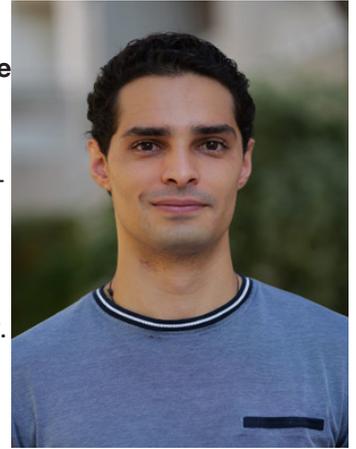
Brandon Lippe works with **Dr. José Morales** studying the Wigner formulation of open quantum systems and quantum algorithms for Stochastic Gradient Descent (SGD). They study the continuous time limit of the SGD algorithm and how it relates to the Wigner-Fokker-Planck equation for modelling quantum transport under Markovian noise. More broadly, his work focuses on finding or developing newer mathematical models/algorithms and applying them to physics problems.

Avery Tovar has a research focus on open quantum systems, with an emphasis on the Wigner-Fokker-Planck (WFP) equation under the mentorship of **Dr. José Morales**. She is developing a Monte Carlo solver that models the time evolution of quantum systems interacting with their environment. In this project, she transforms the WFP into its stochastic differential form and integrates it using the Euler-Maruyama method, incorporating drift and diffusion terms, as well as a tunable friction parameter.

Collin Sunes

Colin works with **Dr. Stephen Peña** on the mathematical foundations of quantum theory, particularly within the framework of gauge field theory. His research focuses on how geometry and symmetry principles underlie the structure of physical laws, and how gauge invariance provides a unifying language between classical and quantum descriptions. His work explores the mathematical consistency of gauge fields and their quantization, as well as connections between field theory, topology, and operator algebras. This research reflects his broader goal of understanding the deep correspondence between mathematics and physics, particularly in the realm of quantum field theory.

Josh Hamilton

Olivia Aubone

Ken Soto

Luca Iovino

Nick Stipanovic

Olivia, Josh, Luca, and Ken, together with Nick Stipanovic of Trinity University, are working on Quantum Foundations under the direction of **Dr. Jose Iovino**. Olivia, Josh, Luca and Ken are math majors, while Ken and Josh are majoring in both mathematics and physics. Their joint results extend fundamental results of Birkhoff-von Neumann and Kochen-Specker; Kochen and Specker established the phenomenon of quantum contextuality, which extends the famous results of John Bell on quantum entanglement and quantum nonlocality. The results of Olivia, Joshua, Luca, Ken and Nick incorporate techniques of model theory, lattice theory, and projective geometry. They presented their work at theTexas Undergraduate Mathematics Conference, October 17-18 held at St. Mary's University!
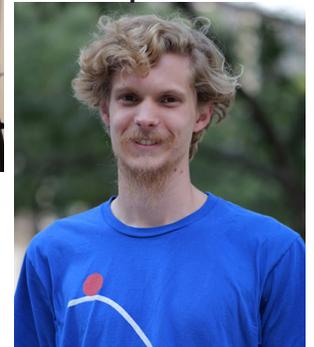
Jake Borawski

Jake is studying quantum from the perspective of model theory and topological dynamics under the direction of **Dr. Jose Iovino**. The goal of his research is to use the classification of Rosenthal compacta from topology to obtain new computational complexity classes in quantum computational complexity.

Two final notes

- If you missed the first newsletter, you can always find them here: https://sciences.utsa.edu/mathematics/students/newsletters.html
- If you're at the point where you're wondering *why math?* I encourage you to check out *A Word from the Mathematics Chair*: https://sciences.utsa.edu/mathematics/word-from-chair.

And a spotlight on some of our students and faculty!!!

We finish by highlighting *three* of our graduate students and one of our undergraduate students. In addition, we are highlighting one of our faculty as well. Each is featured in the last pages of the newsletter. Congratulations Lauren, Carl, Angelo, Mariano, and Dr. Morales! Keep up the great work!!!

FACULTY SPOTLIGHT

Jose Morales Escalante

Undergrad major: Bachelor in Physics (Licenciatura en Física, UNAM)

Graduate degree: Ph. D. in Computational Science, Enginering, and Mathematics (The University of Texas at Austin)

Current research interest(s): The mathematical and computational modeling of open quantum systems (ranging from electron transport in semiconductors to noisy quantum channels), using a range of computational techniques going from traditional numerics to modern machine learning methods.

Favorite color: Blue.

Favorite non-academic activity: Soccer (both playing it and watching it, if/when I have time...)

Favorite city that you've lived in or visited: Venice, Italy (visited for vacation)

What advice would you give a student thinking about a career that uses math?

The world is moving really fast, so a career where creative skills are developed is the safest bet. In my humble opinion, those careers in STEM at the moment are math and physics. AI models cannot do 100% creative tasks and therefore a creative career where math skills are used, developed, and fine-tuned makes you irrepleaceable by artificial intelligence. Try to think of the connections between math and other different areas in STEM, that will give you a very different perspective of the topics due to the interdiscipline.

STUDENT SPOTLIGHT

Lauren Estrada

Major: M.S. Applied Industrial Mathematics
Hometown: Floresville, TX
Favorite color: Pink
Favorite movie: The Proposal
If you could have one superpower, what would it be?
I would choose time manipulation. I've said so many times this year that if I just had a little more time in my day, I would be unstoppable.

What are your career goals?
My short-term goal is to work in a government role focused on mathematical modeling and applied problem-solving. In the long term, I want to pursue a PhD in Applied Mathematics because I genuinely love learning and want to understand mathematics as deeply as possible.

What has been your favorite class so far (and why)?
It's honestly hard to pick just one favorite class, so I'll list a few I have really enjoyed: History of Mathematics, Linear Algebra, Intro to Cryptography, Differential Geometry, Mathematical Biology, Directed Research, Data Analytics, and Numerical Analysis. These classes were so amazing thanks to a mix of content, professors, and peers.

What advice would you give the incoming grad student or graduating senior?
My advice would be to get as involved as possible, take advantage of every opportunity to learn and connect.

STUDENT SPOTLIGHT

Carl Jones

Major: M.S. in Mathematics, concentration in Applied Mathematics
Hometown: Lake Elsinore, CA
Favorite color: gray
Favorite artist: tied between Frank Frazetta, Mike Mignola, Yoshitaka Amano, and Jackson Pollock
Fun fact about you: My fun fact is that I can't think of any fun facts about me

What are your career goals?
Currently loving teaching, but I do intend to continue pursuing research in utility-grade fusion power

What advice would you give the incoming freshman?
It's okay to not know exactly what you're doing, or to have a robust plan. A general idea, lots of motivation and resilience, and the ability to be flexible and adaptable will take you farther than a plan decided down to the smallest details. It is enough to find a direction that your feet seem to naturally fall into and follow it. That said, two things to remember: (1) use a calendar and make a schedule. Don't hold yourself accountable to every minute, but certainly to every day, and (2) always be willing to slog through something you hate if you know it'll lead to something you love.
Being focused on being "optimal" is the death of joy, and often you just end up doing things the hardest way to get the worst results despite all the time you waste trying to be perfect. It's fine to simply be as critical and analytical as you can, try to make the best decisions with the resources and knowledge available, and stay open-minded. Cast a wide net, so you have a broad base of experience to pull from. Specialization is for insects and isn't economically viable anymore, either.
Remember that working together will get better results than going it alone, and results will always speak louder than the romanticism or ego of the rugged individual. Finally, make sure you're the kind of adult that children trust and enjoy being around. It's the best measure of succeeding at life..

STUDENT SPOTLIGHT

Angelo Lomeli

Major: Master's in Mathematics
Hometown: Maywood California
Favorite color: Purple
Favorite artist: Francisco Goya
Favorite Movie: Godzilla Minus One
Fun fact about you: Before starting my master's degree, I planned on studying high-energy physics.

What has been your favorite class so far (and why)?
Graduate Algebra II. I've always liked math, especially abstract algebra, but this class introduced me to some really clever applications that I hadn't considered studying before.

What are your career goals?
Currently, I hope to finish my master's degree and then either go into industry to work on code-based cryptography or apply to a doctoral program in the same field.

If you could have one superpower, what would it be?
Reconfigure matter.

What advice would you give the incoming grad student or graduating senior?
Reach out to others, there are a lot of opportunities you can miss if you play it too safe or take the easy path.

STUDENT SPOTLIGHT

Mariano Alcalde

Major: B.S. in Physics, Math.
Hometown: Mexico City
Favorite color: Red
Favorite artist: I don't have one, but I love Led Zeppelin's music
Favorite movie: The Lord of the Rings: The Return of the King
Fun fact about you: I love swimming

What has been your favorite class so far (and why)?
Unifying Concepts in Physics by Professor López Mobilia. I loved it because it was a class where we delved exclusively into the Foundations of Physics, which included the so-called Interpretations of QM and even an introduction to GR.

What are your career goals?
I want to become a theoretical physicist and work in academia.

If you could have one superpower, what would it be?
Immortality.

What advice would you give the incoming freshman?
Take advantage of the professors you have. Ask them about research opportunities, seminars, books, etc. They will be glad to help you.