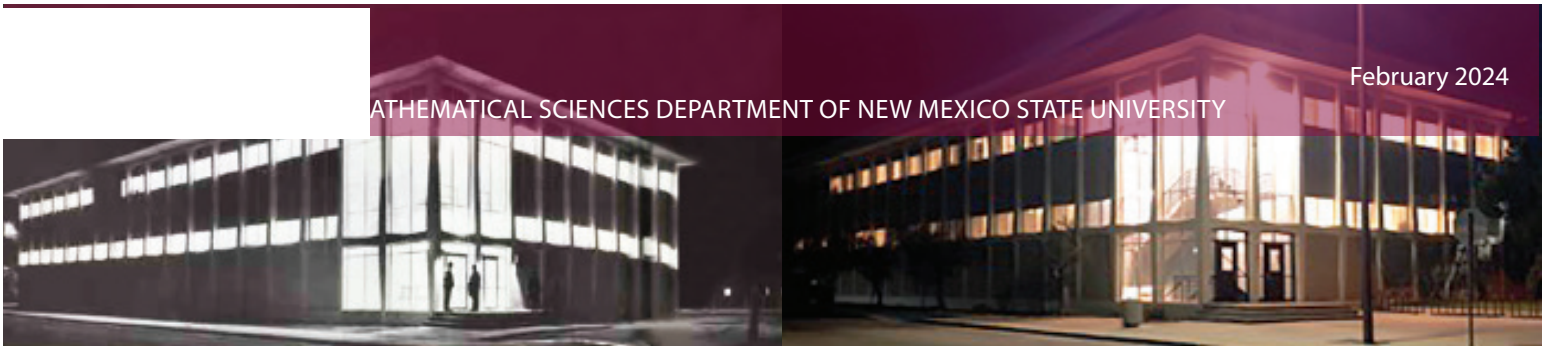
ATHEMATICAL SCIENCES DEPARTMENT OF NEW MEXICO STATE UNIVERSITY
February 2024



EXPAND AND REJUVENATE

A breeze of optimism marked the start of the academic year 2023-2024 in the Department of Mathematics. Everyone has returned to in class teaching and life in the department burst into a fresh phase. Public activities returned to normal with seminars and colloquia held mostly in person. This fall time springtide was spearheaded by the successful hires at the assistant professor level in commutative algebra (Dr. Michael DiPasquale), functional analysis (Dr. Boyu Li) and math education (Dr. Adaline De Chenne) and the addition of two new postdoctoral positions (Dr. Yang Hu in topology and Dr. Arvind Kumar in commutative algebra) that is intended to expand in the next years. With three more college-track assistant professors added (Drs. Maria Cruz-Quinones, Zach Letterhos, and Brady Rocks), we can count on eight new enthusiastic faculty ready to jump-start the research and teaching activities in our department. We are grateful for the long time contribution of Dr. Tiziana Giorgi who decided to join The University of Alabama as the chair of the Department of Mathematics.

The potential success story of Walden Hall's rehabilitation turned out to be a sour one. That is because remodeling hit a snag with ventilation problems and molding while funding ran low. The building has been used in the past for classrooms and tutoring, however it is desperately needed now for offices, as some faculty members needed to be relocated out of the Science Hall building, due to lack of space. Our graduate program, with 10 Master and 26 Ph.D. students would also greatly benefit from the office space offered by Walden Hall.

The main goal of the Math department, under the continued leadership of **Dr. Harding** as head and **Dr. DeBlassie** as associate head, is to find the most effective methods of outreach to expand the undergraduate program. The incoming class of majors this year seems bigger than it has been since 2020 and good students have been attracted to the new degree programs introduced in recent years. A bright future of the department is necessarily based on fulfilling our potential in teaching the next generation of mathematics majors.

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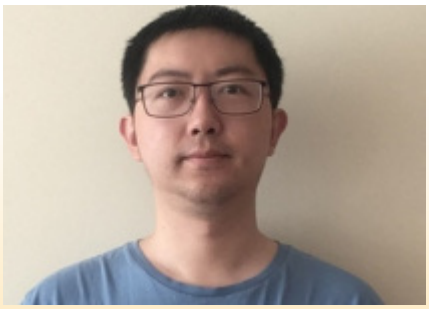
FACULTY SPOTLIGHT

THE DEPARTMENT OF MATHEMATICAL SCIENCES WELCOMES NEW FACULTY

Michael DiPasquale joined the Department of Mathematical Sciences faculty as a tenure-track assistant professor in August 2023. Dr. DiPasquale obtained his Ph.D. in 2015 in the area of computational commutative algebra and algebraic geometry from the University of Illinois at Urbana-Champaign, under the direction of Hal Schenck. He was a visiting assistant professor at Oklahoma State University from 2015-2018 and a postdoctoral scholar at Colorado State University from 2018-2021. Before joining the faculty at New Mexico State University, he was a tenure-track assistant professor at the University of South Alabama from 2021-2023.

Dr. DiPasquale's recent research interests are devoted to Koszul multi-Rees algebras and principal L-Borel ideals, homological characterizations for freeness of multi-arrangements, and duality for asymptotic invariants of restriction and extension for planar splines on triangulations.

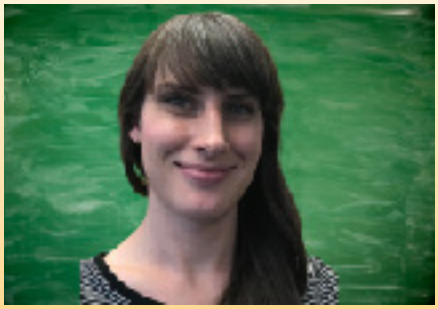
Boyu Li joined the Department of Mathematical Sciences faculty as a tenure-track assistant professor in August 2023. Dr. Li received his PhD in 2018 from University of Waterloo in Canada under the direction of Kenneth Davidson. After that, he was a PIMS postdoctoral fellow at University of Victoria and at University of Windsor. His research interests in functional analysis and self-similar actions emphasize the interplay among semigroups, groups, and graphs.



In his research work, Dr. Li studied Zappa-Szep actions of groups on product systems, Zappa-Szep product of a Fell bundle and a groupoid, and showed that the equivalence of Fell bundles is an equivalence relation.

He is also interested in math competitions and recreational math. He was a member of the University of Waterloo Putnam team that finished 5th place in North America. He has worked as a quantitative analyst at TD securities and is interested in real life applications of mathematics.

Adaline De Chenne joined the Department of Mathematical Sciences faculty as a tenure-track assistant professor in August 2023. Dr. De Chenne received her PhD in math education from Oregon State University in 2023 under the supervision of Elise Lockwood. Her research interests are in combinatorics education and computational thinking. Her research has included examining how undergraduate students use computer programming in Python as a way to reason about counting problems, such as how students leverage a natural correspondence between programming elements like loops with conditionals and fundamental problem types such as combinations and permutations.

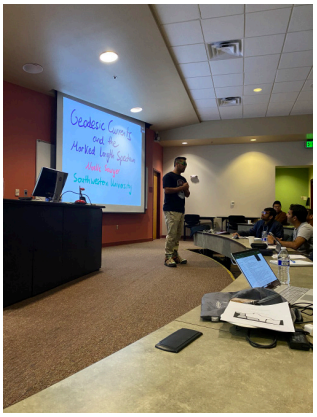


Recently, Dr. De Chenne has examined the semiotic representations students create and use as they develop combinatorial competence, and the role of the representations in their understanding and development of solutions.

RESEARCH HIGHLIGHTS

GRADUATE AND UNDERGRADUATE INVOLVEMENT

Dr. Prasit Bhattacharya was awarded a 3-year NSF topology grant in the amount of $319,000 . His proposed research extends the classical and powerful techniques in algebraic topology, the Steenrod operations, to equivariant homotopy theory with the goal of determining symmetries of various shapes that are not distinguished if one can be deformed to another continuously. During the weekend of October 28-29, he co-organized at NMSU the yearly regional conference, the South Central Topology Conference III.



There were eighty participants, with a majority of graduate students and young researchers highlighting the growing community in topology in the south-central region. This NSF grant supported this opportunity for graduate students and those early in their career, to meet researchers with similar interests, and potentially enhance their future collaboration.

This event featured six plenary talks, five of which were delivered by women showcasing the strength of minorities within STEM. A special colloquia has been also organized on the eve of this conference. Many participants arrived early and engaged in various social activities including hiking in some of the local trails, as well as in collaborative work utilizing the space available in Science Hall.

Dr. Michael DiPasquale is the PI on an NSF grant in algebra that has been jointly funded by the Algebra and Number Theory program and the Established Program to Stimulate Competitive Research (EPSCoR). The research involved in the project is in computational commutative algebra and algebraic geometry. A central aspect of these fields is the study of polynomials in many variables - or multivariate polynomials. Multivariate polynomials appear in a wide range of applications such as mechanical engineering, robotics, computer-aided design, and numerical partial differential equations. The research is clustered in three interconnected areas where multivariate polynomials play an essential role. The first is configurations of linear subspaces, such as lines in the plane. The second is interpolation, which involves fitting data with a polynomial model. The third is piecewise polynomial functions, or splines, such as the Bezier splines common in drawing programs. Each of these fields have major unsolved conjectures revolving around the impact of combinatorics and geometry on corresponding algebraic objects. A recurring theme of the project is to use rigidity theory, which has its origins in structural engineering, to elucidate this impact. Several lines of inquiry are a collaborative effort among the disparate communities of numerical analysis, rigidity theory, commutative algebra, and algebraic geometry. The project includes training opportunities for graduate students. At the University of South Alabama, this grant supported Ryann Firestine during the second year of her master's thesis. She is now at Auburn University as a Ph.D. student.

The Logic and Foundations group formed by Drs. **Bezhanishvil**i, **Harding**, **Morandi** and **Shapirovskiy** was awarded a 5-year $1.4 million NSF grant for a Research Training Group (RTG) in Logic and its Application that will put about $115,000 directly to our undergraduate majors and graduate students each year. The RTG supports each year a cohort of five undergraduate students, two graduate students an a post-doctoral position. One of the ideas of the project is to have a "thematic problem" each year. In the Fall 2023 and Spring 2024 the thematic problem discussed is Modal Logic, an area on the nexus of mathematical logic and theoretical computer science, with many interesting problems from logic, other branches of mathematics (topology, algebra, category theory), and theory of algorithms. The group organizes weekly seminars conducted by two graduate students, who present advanced material on various models of modal logic, while mentoring the undergraduate students on much simpler structures.

Additionally, seminars on recent advances and open problems in the field of modal logic will be presented by postdoctoral faculty. This seminar has the potential to provide a structured environment that can motivate the cohort at all levels. The vertical structure is designed to lower the barriers faced by talented students in imagining and realizing a life in research mathematics and has the potential of becoming an economically viable model for minority serving institutions to move students to top levels of mathematical research.

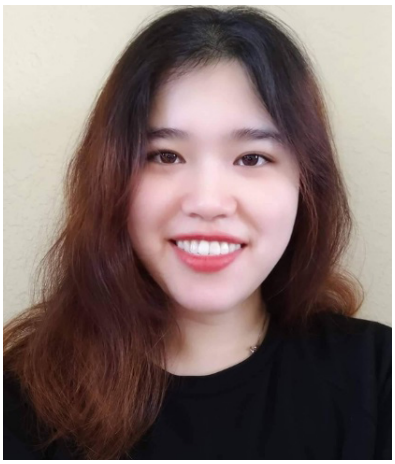
Dr. Louiza Fouli is co-PI of a 5-year $3 million NSF grant NMSU-MAS, Mejorando las Aulas en STEM/Improving STEM Classrooms. The grant supports the faculty professional development in teaching, with evidence-based strategies to enhance student success. The project aims to enhance the success of a diverse population of students through faculty professional development focused on equitable and inclusive teaching practices with the goal of increasing the number of Hispanic, first-generation, and low-income students in STEM areas and developing role models for future generations of students.

This project investigates the impact of a specific model of faculty professional development in teaching, using four faculty teams that are each directed by an experienced coach. The teams meet regulary during Fall semester to learn about, and prepare to implement evidence-based strategies to enhance student success in their classes. This year, the focus is on implementing various active learning strategies in the classroom. The research is focused on the goal of understanding how faculty make decisions on teaching strategies considering institutional equity, diversity, and inclusivity (EID), and how faculty engagement with such active learning practices impacts the success of a diverse STEM student population. Teaching evaluations will be performed in the Spring semesters to determine the impact of the project activities on student success and to determine the extent to which specific interventions have the intended impact on students in the context of an HSI and land grant institution.

RECOGNIZING SUCCESS

Graduate Students Accomplishements

Chau Hoang is the recipient of Outstanding Graduate Student Awards from New Mexico State University for the academic year 2023 - 2024. Chau earned her Bachelor of Science in Mathematics from Danang University of Education, where she received many awards and supports, such as Odon Vallet Scholarship from Recontres du Vietnam Founation, Academica Merit Scholarship in Mathematics from the Vietnam Ministry of Education and Training. Notably, in 2015 Chau was the third prize winner in Analysis and Algebra sessions of the Vietnam National Mathematical Olympiad. Being recognized for her dedication and aspirations, Chau was granted the opportunity to study abroad at NMSU, from which she obtained a Master of Science degree in Mathematics in 2020, and is currently pursuing a PhD degree in Applied Mathematics.



Her research interests are in stochastic differential equations with applications to biological and medical problems. This includes: (1) stochastic interaction between three cell populations of normal T, CAR T and tumor in CAR T-cell therapy; (2) stochastic models for ontogenetic growth of organisms, that encompass the general growth patterns of a large number of species; (3) stochastic models for interactions among cell populations, such as engineered viruses, uninfected and infected tumor cells, innate immune and adaptive immune cells.

Another outstanding graduate student, **Tingting Tong**, received many awards during the academic year 2023-2024: Nita Swartz Endowed Scholarship, Joseph E. Kist Department of Mathematical Sciences Graduate Studies Current Use Fund, and Arts and Sciences Spring 2024 Graduate Student Travel Award.
Tingting earned her Bachelor and Master of Science in Mathematics from Qingdao Univeristy, China in 2018, after which she started her studies at NMSU. In 2020 she obtained the Master of Science degree in Mathematics at NMSU and she is expecting to defend her Ph.D thesis in Spring 2024. Tingting is a student of Dr. Tonghui Wang and her research interests in Mathematical Statistics are related to skew distributions and the A priori procedure under various settings. She has a significant number of publications, among with the paper she co-authored jointly with David Trafimow, Ziyuan Wang, and Tonghui Wang, on " *Gain-probability diagrams as an alternative to significance testing in economics and finance*" received the Outstanding Paper Award by the Asian Journal of Economics and Banking in 2023.

EXPLORING BEAUTY IN MATH: TINGTING TONG

'Tis a Gift to be Simple

Tingting Tong remembers peaceful summers as a child, playing in the cool, shallow waters of two rivers that converge at her small village in northern China. Several generations of her family were farmers there, and her father ran a small business in town. Theirs was a joyful, modest life, and she thrived in its simplicity. She never imagined she would begin her adult life passing on the values of hard work and dedication to a new generation of students in the United States.

HYPOTHESIS TEST

Although Tingting loved her idyllic childhood in Tongxinzhuang, her options were limited after graduating from high school. Most of her friends dropped out of school to start families, and careers were almost non-existent for young women. "That was not the life I wanted."

Although she was a good student, Tingting didn't know what to study in college. Being around her father's company and watching him balance the books led her to mathematics. "I knew that math is the foundation of many other subjects, so that's the reason I chose it for my major," she says.

She pursued a bachelor's degree from Qingdao University on the northeastern coast of China, and four years later, graduated at the top of her class. "I discovered the beauty and charm of mathematics," she adds. "Math is everywhere - in the things we read, the objects we see, in nature. I like the relationship between me and math - simple and pure."

STATISTICALLY SPEAKING

During college Tingting attended an academic conference where one of the speakers, NMSU professor Dr. Tonghui Wang, made an impression on her. "I thought, 'Maybe I can find success by being a teacher to pass on the things I love about mathematics.'" She decided to explore New Mexico State University for her master's degree, and six months later was living in Las Cruces, working in Dr. Wang's research group.

"I want to help students excel in their future endeavors," she explains. In addition to teaching new generations of math students at the college level, she wants to use her specialty in statistics to solve real-world problems.

Tingting received the Nita Swartz Endowed Scholarship in 2023, providing much-needed funding for graduate students pursuing the field of education. Now with a husband and baby daughter added to the equation, Tingting is grateful for the extra support. "My expenses are much higher than they were when I was single, so I am very thankful to Nita Swartz for this incredible gift." She is also aware of the legacy of Nita's husband, Dr. Charles Swartz, a 50+ year professor emeritus of mathematics at NMSU who authored many textbooks that still dot the bookshelves in Walden Hall.

FROM TACOS TO SNOW

Once Tingting receives her Ph.D. in mathematics next spring, she plans to remain in Las Cruces to teach for one more year as her husband completes his doctorate at NMSU. From there, the world is open to this young family.

"New Mexico has been wonderful - I love tacos (especially with green sauce), I enjoy taking my daughter swimming, and my husband likes going to basketball games," she shares. "But there is much of the United States we would still like to explore, and we want to go somewhere with snow." Boston, New York, Chicago and Denver all sound intriguing to Tingting.

Wherever they land, Tingting wants to continue sharing her love of math with students, and she predicts that her family will remain very down-to-earth. "Just the simple life for me."

EDWARD O. THORP: AN AGGIE FOR ALL MARKETS

From Las Vegas to Wall Street: How I Beat the Dealer and the Market

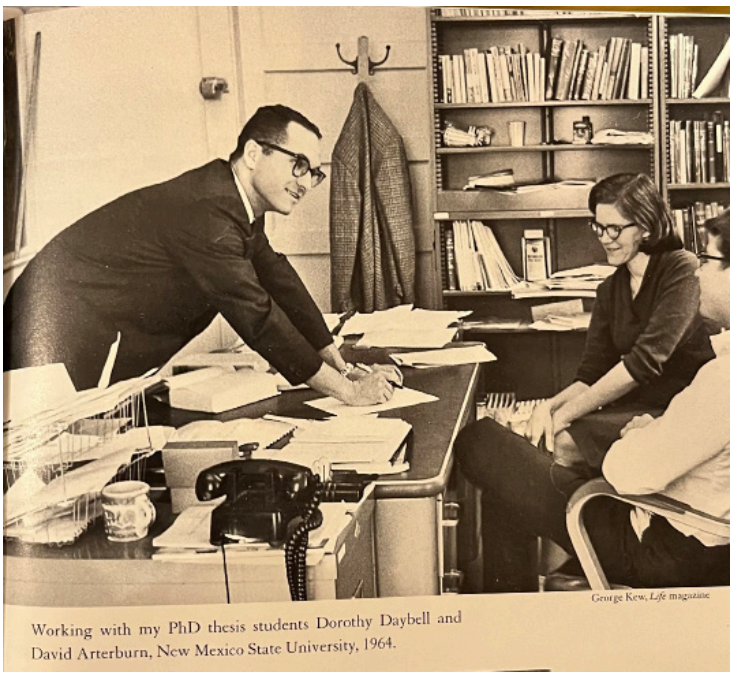
Edward O. Thorp's journey from a mathematician to a market maestro is a tale of intellect, innovation, and intuition. His tenure at New Mexico State University (NMSU) marked a pivotal phase in this journey, intertwining academic rigor with groundbreaking explorations in probability and finance.

The Move to New Mexico State University

In the early 1960s, NMSU was on a mission to elevate its academic standing, fueled by a substantial grant from the National Science Foundation. This ambition led them to Edward Thorp, a promising young mathematician. Thorp, enticed by the opportunity to shape a burgeoning PhD program and the promise of a better climate for his family, chose NMSU over other prestigious offers. This decision, seen by many of his peers as a gamble, was a testament to Thorp's penchant for unconventional choices.

A Time of Intense Creativity and Exploration

Thorp's arrival in Las Cruces, a town then of 37,000 people, coincided with a period of intense personal and professional growth. He was deeply involved in teaching graduate courses, conducting mathematical research, and supervising doctoral theses. This period was also marked by his foray into the world of casino gambling, specifically blackjack.
His book, "Beat the Dealer," initially titled "Fortune's Formula: A Winning Strategy for Blackjack," was born out of his successful casino experiments and mathematical prowess. The book, which would later revolutionize casino gambling strategies, was written amidst a whirlwind of activities including a summer in Los Angeles, collaboration with Claude Shannon, and the birth of his second child. He would even appear on the TV game show "To tell the Truth" https://www.youtube.com/watch?v=hPIW-OJugG4&t=6s as 'Ed Thorp, associate professor of Mathematics at New Mexico State!'



George Kew, *Life* magazine

Working with my PhD thesis students Dorothy Daybell and David Arterburn, New Mexico State University, 1964.

The Blackjack Ventures and Beyond

Thorp's blackjack adventures were not just confined to the academic realm. He tested his theories in the casinos of Nevada, often accompanied by his wife Vivian, who played a crucial role in his training. His strategies, based on mathematical calculations and card counting, were not only successful but also drew attention from both casino operators and gambling enthusiasts.

EDWARD O. THORP: AN AGGIE FOR ALL MARKETS CONTINUED

His time at NMSU also saw him exploring other casino games like baccarat. Along with extreme extrovert Ralph Crouch, the chairman of the Mathematics Department, and Kay Hafen, the university controller, Thorp devised a card counting system for baccarat while hosting get-togethers fueled by "Las Cruces Punch". Their exploits in the casinos were a blend of mathematical precision and covert operations, often leading to significant winnings but also attracting the wary eyes of casino management. A few laced coffees and a cut brake line and Dr. Thorp decided there might be safer places to use his theories.

The Intersection of Gambling and Investing

Thorp's experiences in gambling laid the groundwork for his later ventures into the world of finance. His success in casinos made him ponder the similarities between gambling and stock market investments. Using the royalties from his blackjack book and his gambling winnings, Thorp began exploring the stock market. His approach to investing, much like his gambling strategies, was grounded in mathematical analysis and probability theory.

Legacy and Impact

Edward O. Thorp's tenure at NMSU was more than just an academic appointment; it was a period of profound exploration and discovery. His work bridged the gap between theoretical mathematics and practical application, influencing both the gambling and financial worlds.

Thorp's legacy is not just in the strategies he developed but also in his approach to problem-solving, which combined rigorous mathematical analysis with a willingness to challenge conventional wisdom.

As Thorp himself reflected, his time in New Mexico was not just about academic growth but also about personal development. It was here that he honed his skills, not just as a mathematician and a gambler, but as a thinker who could see patterns and opportunities where others saw randomness and risk. His journey from Las Vegas to Wall Street, with a pivotal stop at NMSU, is a testament to the power of interdisciplinary thinking and the endless possibilities that arise when one dares to venture beyond the beaten path.

MATHEMATICAL SCIENCES COLLOQUIA

08/25/23: *Michael DiPasquale*, NMSU
"Two Perspectives on Affine Semigroup"

09/01/23: *Yang Hu*, NMSU
"A Calculus Approach to Vector Bundle Enumerations"

09/22/23: *Frank Sottile*, Texas A&M University
"Galois Groups in Enumerative Geometry"

10/06/23: *Arvind Kumar*, NMSU
"Regularity Bound of Generalized Binomial Edge Ideal of Graphs"

10/20/23: *Andrew Comech*, Texas A&M
"Stability Solitary Waves in the Nonlinear Dirac Equation"

10/27/23: *Agnès Beaudry*, University of Colorado,
"It's The Great Grading, Edgar Brown";

10/27/23: Katherine Poirier, New York City College of Technology, "Applying Chain-level Poincaré Duality to String Topology"

10/27/23: *Zhouli Xu*, University of California, San Diego, "Stable Homotopy Groups of Spheres and Motivic Homotopy Theory"

11/03/23: *Boyu Li*, NMSU
"Zappa-Szep Product, Self-Similar Action, and Imprimitivity Theorems"

11/10/23: *Chris Peterson*, Colorado State University
"The Geometry of Digital Images"

11/17/23: *Min Kang*, North Carolina State University,
"Stochastic Particle Systems with Redistribution and their Connection to Large Networks"

12/01/23: *Naoki Masuda*, University at Buffalo
"Temporal Networks: State-Transition Dynamics, Embedding, and Switching Network Modeling

12/01/23: Søren Galatius, University of Copenhagen, Denmark, " Pontryagin Classes of Euclidean Bundles"

The department has been very fortunate to receive many gifts this year. These generous donations will have a great impact on our students and research mission. We are very grateful.