MATHEMATICS NEWSLETTER

THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE
Mathematics

Sports Analytics: A Conversation About Teaching and Learning DATA 367

page 4

Stellarator Design, Plasma Confinement, and Nuclear Fusion

page 6

IN THIS ISSUE

SIGN UP TODAY!

Scan the code below and be the first to hear about:

- upcoming public lectures
- new giving opportunities
- other news and events
- **Go paperless!**

Please consider opting-in to get our newsletter delivered to you by email.

We would love to keep in touch.

math.arizona.edu/subscribe

Producer and Editor:
Guadalupe Lozano

Design:
Chris Bohnsack, BohnsackDesign.com

Cover, top: T. Sunn Pedersen, M. Otte, S. Lazerson, P. Helander, S. Bozhenkov, C. Biedermann, T. Klinger, R. C. Wolf, H. -S. Bosch & The Wendelstein 7-X Team, CC BY 4.0, via Wikimedia Commons

The Department of Mathematics Newsletter 2022

Volume XXII, Single Issue, is published annually by The University of Arizona Department of Mathematics, PO Box 210089, Tucson, AZ 85721-0089.

View from the Chair

By Doug Ulmer

As I write, we are nearing the middle of the Fall semester with classes, seminars, and meetings in full swing. As we continue our slow emergence from more than two years of Covid, it is worthwhile to feature a few of the great things happening in our teaching, research, and programs.

Tragically, however, our equilibrium was shattered two weeks ago by the senseless murder of Tom Meixner, our friend and colleague in Hydrology and Atmospheric Sciences. I got to work closely with Tom as a fellow department head in Science, and he will be dearly missed.

On a more positive note, I am happy to welcome valuable new additions to the department, including four staff members, four Career Track faculty, a Global Professor who will teach at our Beijing microcampus, and six new Post-Doctoral Fellows—learn more about them within. Faculty members Sarah Andrews, Taryn Laird, and DeAnna McDonald were promoted to Lecturer, and Assistant Professors Christoph Keller and Hang Xue were promoted to Associate Professors and granted tenure. Congratulations to all!

After more than 35 years of service, Professor Nick Ercolani retired in September. Nick has been a mainstay of the department for many years. He served as Department Head, carried out world-class research, organized innovative seminars, and was especially successful mentoring and advising students, something that just earned him the 2022 College of Science Distinguished Student Mentoring Award (see within for more on Nick's outstanding mentoring).

Earlier this year Professor Deb Hughes Hallett received the 2022 American Mathematical Society Award for Impact on the Teaching and Learning of Mathematics. She is described as a "brilliant leader," "beloved mentor," and "tireless advocate." Senior Lecturer Donna Krawczyk received the 2022 Galileo Circle Copernicus Award for "extraordinary accomplishments that significantly advance the mission of the department and the College of Science." Associate Professor Jennifer Wolfe received the 2022 College of Science Innovation in Teaching Award in recognition of her outstanding educational innovation around complex instruction, and Laurie Varecka, Academic Advisor and Assistant Director of the Math Center, received the 2022 College of Science Distinguished Advising Award for her many contributions.

We continue to expand our course and degree offerings in Data Science. This includes a new dual-degree program in Statistics and Data Science at the Capital University of Economics and Business in Beijing, where faculty in the new category of Global Professor will teach the advanced courses, and a new professional Master's degree in Data Science expected to start in Fall 2023.

We are always grateful for the financial and moral support of our many donors and friends, and we look forward to restarting in-person outreach events like the Bartlett Memorial lecture next Spring. I remain confident that our department will continue to fulfill its missions with excellence, commitment, and creativity. Meanwhile, please enjoy learning about Stellarators and nuclear fusion, sport analytics teaching, students conference participation, and more. We wish you all the best for health, prosperity, and fulfilling work and relationships.

Doug Ulmer is a mathematician whose research emphasizes fundamental, curiosity-driven problems in number theory and algebraic geometry. He also enjoys building academic programs and research institutions with lasting impact.

Contact him at: ulmer@math.arizona.edu


Department of Mathematics
The University of Arizona®
ARIZONA WINTER SCHOOL 2023
Southwest Center
for Arithmetic Geometry
http://swc.math.arizona.edu
Deadline to apply:
November 15th, 2022
UNLIKELY INTERSECTIONS
Laura DeMarco
Arithmetic dynamics and intersection problems
Jonathan Pila
Point-counting and applications
Thomas Scanlon
Model theoretic origins and approaches to unlikely intersection problems
Jacob Tsimerman
Special point problems and their arithmetic
with Boris Zilber, Clay Lecturer
TUCSON, MARCH 4-8, 2023
Funded by the National Science Foundation
Supported by the National Security Agency
and organized in partnership
with the Clay Mathematics Institute

Sports Analytics: A Conversation About Teaching and Learning DATA 367

Sports analytics adds a dose of flare to big data for sports fans and mathematically oriented enthusiasts alike. The idea of a sports analytics class using data from students' own college sports teams seems like a dream. Lecturer Aaron Ekstrom enthusiastically teaches DATA 367 every chance he gets, and sat down with newsletter editor and Associate Research Professor Guada Lozano to talk about it. Jericho Lawson, a past Undergraduate Teaching Assistant (UTA) for the class, comments on his class experience at the end of the article.

Guada Lozano (GL): Can you tell us about our sports analytics class and its appeal to your students?

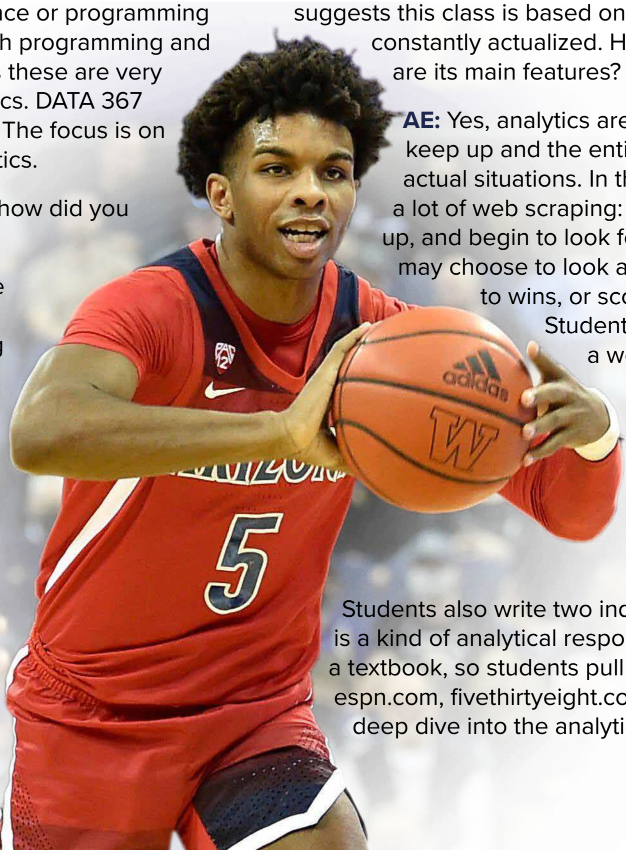
Aaron Ekstrom (AE): DATA 367 is a nice mingling of people's passion for sports with data science. Some students get into it because they might like fantasy football, or listening to discussions about their favorite sport. Some of them just like sports, and that's their entry way. There's no data science or programming required to join, but we do start playing with programming and talking about regression on the first day, as these are very interlinked with the history of sports analytics. DATA 367 is a very practical, "hands on data" course. The focus is on implementation rather than theory of statistics.

GL: What do you love about this class and how did you come upon the opportunity to teach it?

AE: What I love most is the chance to delve with students into the difference between spouting off theories and actually exploring and having a rationale for sound arguments. For example, the question as to whether Eli Manning belongs in the football Hall of Fame is bound to come up in a couple of years when he retires. So, does he belong? How might we distinguish opinion versus data-backed comparison with quarterbacks who are in the Hall of Fame versus those who didn't make it?

I've always loved sports. I watch lots of baseball and lots of football. I am always intrigued by analytics, and I've tinkered myself a bit with baseball wagering, playing with predicting best bets based on game data. While we obviously don't talk about waging or betting in the classroom, this all spurred my interest in teaching this kind of class. So, when I was asked [to teach] the answer was "Yes, absolutely!"

GL: You mentioned Eli Manning and his retirement, which suggests this class is based on sports happenings that are constantly actualized. How is the class organized? What are its main features?



AE: Yes, analytics are actualized faster than we can keep up and the entire course is about examining actual situations. In the first part of the course we do a lot of web scraping: finding data online, cleaning it up, and begin to look for and find patterns. Students may choose to look at something that correlates to wins, or scoring, or points allowed, etc. Students learn roughly one technique a week and have a programming assignment each week. We also do lots of team presentations. The second half of the course is organized around a single project that students work on in teams to apply previous learning.

Students also write two individual papers. The first paper is a kind of analytical response to an article. We don't have a textbook, so students pull current articles from sites like espn.com, fivethirtyeight.com, etc. The point is to take a deep dive into the analytics discussed and argue whether the article's thesis is well supported by the data and the analysis. For example, an article may make an argument about the QBR (total Quarter Back Rating—a proprietary statistic measuring quarterback performance in American football). To critique it, students first ask: How does one actually measure the quality of a quarterback play using QBR? What goes into it? Or to critique an article on baseball analytics, students might first ask: Does a larger WAR (Wins Above Replacement—a statistical measure of a player's value to their team) correlate to better play? The second paper is a chance to personalize the learning to an analytic or sport of choice. A student might ask: How do I explore a new way to measure the quality of the goaltender in hockey?

GL: One remarkable feature of this class is the opportunity for students to work with our own campus coaches and student athletes. Can you give us an example of how this has happened in practice?

AE: One of my favorite examples is about the women's tennis team. While the Pac-12 schedule is set for them, teams also get to select a number of matches that they can schedule independently, usually early in the season. In tennis, unlike basketball or football, the decision on who gets to compete is completely formulaic. The formula ranks teams based on number of quality wins and other factors. So, the question on the coach's mind was: Can we choose our independent match schedule to maximize our chances of getting into the tournament? Should we play teams we can easily beat? Or highly ranked teams so that our wins are really quality ones?

A group of students analyzed the situation, worked with the formula, applied some analytics to it and made some recommendations to the coach that I understand the coach will implement in future years. Remarkably, the coach was impressed enough to keep working with the students into the summer to fine tune what the recommendation should be. It was really cool.

GL: It sounds like this class creates really outstanding learning experiences for the students. Who are your students? How does the class add value to their learning or major, in your view?

AE: There are roughly two student groups: those who are just getting started in their data science journey or minoring in data science, and those who already have data science expertise and are taking the course as a kind of capstone. The combination is great—everybody brings something special to the table. The younger students might say "Oh, wow, this is a really a cool problem!" And the older students might say "Actually, we could apply this technique I learned in another class." This gets the younger students interested in what that class was, etc. It becomes free advertising for our program and other campus classes.

The blend of student expertise also makes for outstanding collaborations. A team that worked on the mechanics of baseball swinging, for example, included a physiology major who had studied the actual mechanics of body motion. Her expertise combined with that of students who loved the sport and those who had a good handle in programming made for an outstanding project.

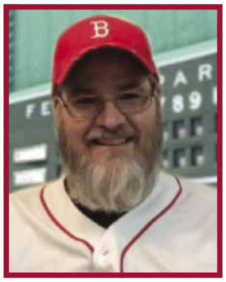
GL: If you could wish with a magic wand, what would you change or tweak about this course?

AE: What comes to mind right away is maintaining our relationships with the coaches. These partnerships require essential trust building each time, as coaches are very interested in reciprocal collaboration yet understandably weary of sharing data, for example. One thing is to enhance team performance and quite another is to supply sensitive information to the competition.

GL: In closing, what might you say to someone interested in teaching sports analytics, DATA 367 in particular?

AE: Make sure you love working with data and enjoy programming. Ideally, make sure you love sports, because you can't really fake any of the elements that go into the authentic, open debates that drive the learning. Is Lebron James the greatest basketball player of all time? Is Michael Jordan? What is the data-backed argument for each position? They played in different eras—how can we compare them?

Regardless of your connection to sports, be curious and open to learning. This past Spring, thanks to one of my international students, I finally learned about cricket. I'm by no means an expert, but at least I can now watch a match and understand why it might last three days. The bottom line is be into it, as with all teaching. To get students into it, you have to be into it. ◂



Aaron "Dr. X" Ekstrom holds a Ph.D. in number theory, is an avid data-enthusiast, a life-long Red Sox fan, and a Lecturer in Mathematics at UArizona.

Contact him at: aaron@math.arizona.edu

"For sports fans, mathematics students, and everyone else in between, this unique offering is a chance to learn and experience something that not many classes at UArizona offer. As both a student and a UTA for this course, I enjoyed learning advanced statistical methods, presenting to athletics personnel, and most of all, having a chance to impact how coaches and athletes at UArizona changed their gameplan.

Being a UTA for Dr. Ekstrom gave me a chance to help students understand a coding language, develop statistical skills, and foster a liking for sports for those that came in uninterested in the topic."

–Jericho Lawson

Jericho Lawson is a third year Ph.D. student in the Applied Statistics program at the University of California, Riverside. He graduated from UArizona in 2020 with a B.S. in Mathematics, and Statistics & Data Science.

Stellarator Design, Plasma Confinement, and Nuclear Fusion

By Lise-Marie Imbert-Gerard

Nuclear fusion is a chemical reaction that powers our sun and stars. The process of combining light nuclei to form heavier nuclei releases large amounts of energy, and it is considered a potential way to a large-scale and carbon-free source of energy.

To achieve fusion conditions in experiments, sufficient pressure and temperature are required to create a hot cloud of charged ions and free electrons, referred to as a plasma. Confining a plasma to high pressure and high temperature for long enough time represents a considerable challenge.

Various confinement concepts have been explored since the 1940s. Among them, magnetic confinement devices leverage the electric conductivity of the charged plasma particles: the charged cloud is contained in response to an externally imposed magnetic field, which can be produced by external coils. The Tokamak and the Stellarator are two promising types of toroidal (doughnut-shaped) magnetic confinement devices.

While they are both toroidal, the geometry of these two confinement devices differs. The Tokamak is axisymmetric. This means the device model exhibits rotational symmetry around an axis and can thus be described using two-dimensions. On the other hand, the Stellarator's promise relies on breaking this axial symmetry. Thus, describing Stellarator models require a fully three-dimensional geometry.

As one might anticipate, the simplicity of the Tokamak's geometry comes in hand with some inherent difficulties in terms of particle confinement. The Stellarator's more complex geometry is better suited to deliver better magnetic confinement properties. Yet, such confinement properties turn out to be very sensitive to "hidden" symmetries in the Stellarator's 3-dimensional geometry, so studying how to achieve models with optimal geometric properties has become critical. This has been the focus of the interdisciplinary collaboration Hidden Symmetries and Fusion Energy funded by the Simons Foundation[1] since 2018. The word "hidden" refers to the fact that it is not the confinement field itself, but rather some other quantities depending it (e.g., the field's magnitude) that are symmetric.

How does one pursue designing ideal Stellarator geometries for optimal plasma confinement? The dynamic coupling between electromagnetic fields and charged particles is central to the operation of any fusion device and holds the key to the answer. Mathematically, this dynamic coupling can be studied using a large hierarchy of models of increasing complexity, a complexity tied to the need to model the interplay between widely different length and time scales. To describe the motion of a plasma in time, either fluid or kinetic models can be utilized. Yet to describe a plasma that

---

[1] The Simmons Foundation, simonsfoundation.org, has aimed to advance research frontiers in mathematics and the basic sciences through grants and program funding since 1994.

[2] Imbert-Gerard, L-M., & Greengard, L. (2017). Pseudo-spectral methods for the Laplace-Beltrami equation and the Hodge decomposition on surfaces of genus one. Numerical Methods for PDEs, 33, 941–955

[3] Malhotra, D., Cerfon, A., Imbert-Gerard, L-M., & O'Neil, M. (2019). Taylor States in Stellarators: A Fast High-order Boundary Integral Solver. Journal of Computational Physics, 397

is in some average sense at rest, equilibrium models are needed. Equilibrium models and the stability of their solutions are of particular interest to guarantee long-term confinement.

Coming up with a Stellarator design means (1) defining an equilibrium magnetic field with desired confinement properties, and (2) defining coils able to precisely approximate the proposed field (see Figures 1, 2 and 3). The problem can then be stated as either a "one-stage" approach, where both the field and the coils are designed simultaneously, or a "two-stage" approach, where the field is designed first and the coils are designed in a separate second stage.

In either scenario, both the field and the coils are approximated using numerical methods and computer simulations. Such simulations call for leveraging techniques to optimize confinement or stability properties of the magnetic field starting from an initial guess and solving equilibrium problems at each step of the optimization process. In order to speed up these computations, numerical methods can take advantage of boundary integral equations—equations used to effectively reformulate a problem initially expressed in terms of partial differential equations. This integral formulation is advantageous in reducing the problem from a 3-dimensional context (a volume) to a 2-dimensional one (a surface).

Together with collaborators Malhotra, Cerfon, and O'Neil, we developed such a method with emphasis on high accuracy and fast computing time,[2, 3] including evaluation of singular integrals on smooth toroidal surfaces. Our method is implemented through code known as BIEST (Boundary Integral Equation Solver for Taylor states) which is available on Github, a popular online, open-source software repository.

We are currently working on extending our method and code to work for a larger class of surfaces, surfaces that more closely capture critical features of the geometry in actual Stellarator designs. More specifically, our existing method assumes globally smooth surfaces. But, as it turns out, the surface separating (magnetically) confined and unconfined plasmas—the so-called separatrix—has a sharp edge (the edge occurs where flux surfaces cross at an angle). Understanding how to extend our computational approach to surfaces with an edge, like the domain bounded by the separatrix, would hence be useful and desirable.

Lise-Marie Imbert-Gerard, originally from France, is an Associate Professor of Mathematics at UArizona. She works on applied and computational mathematics with a focus on numerical methods and numerical analysis for integral and partial differential equations.

Contact her at lmig@math.arizona.edu.

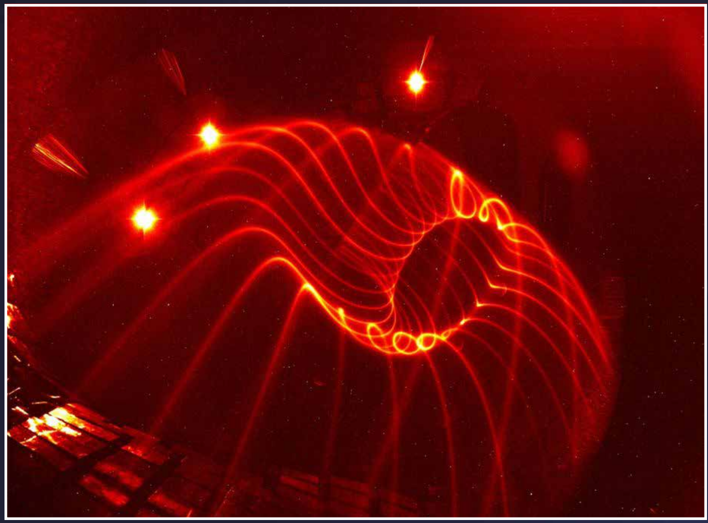


Fig 1. Image of an experimentally generated Stellarator magnetic field designed for the Stellarator experiments Wendelstein 7-X (W7X) at the Max-Planck Institute in Germany. Source: Wikimedia Commons (see credits on Page 2).

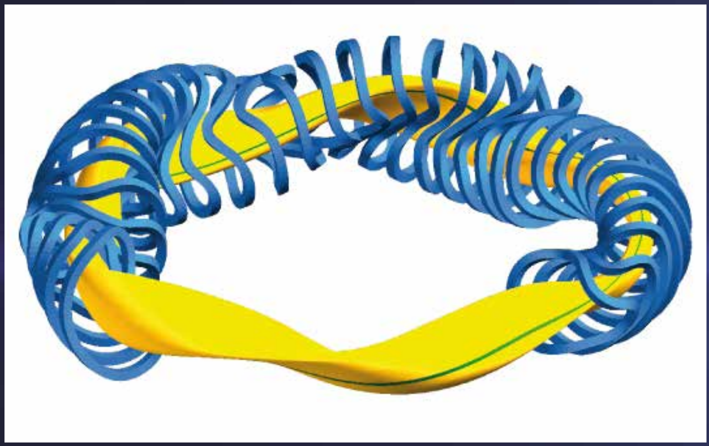


Fig 2. Image of computer generated coils (blue) and plasma boundary (yellow) designed for the W7X Stellarator W7X experiments at Max-Planck (see also Fig. 1 caption). Source: Wikimedia Commons.

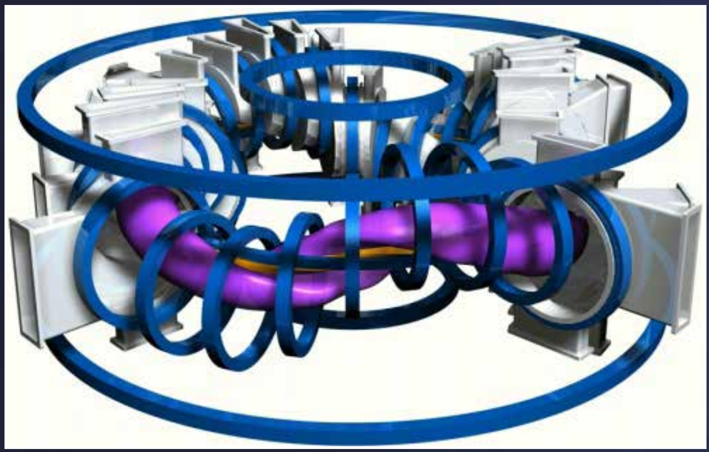


Fig 3. A second Stellarator model with additional coil structure (blue) but simpler coil geometry around the plasma boundary (purple). This design is that of the TJ-II Stellarator experiments at the National Fusion Laboratory in Spain. Source: Wikimedia Commons.

BIOGRAPHIES

Global Faculty

Ruhul Ali Khan was born and raised in West Bengal, India. He earned a Bachelor's in mathematics from University of Calcutta in 2013. He received his Master's in applied mathematics in 2015 and Ph.D. in 2021 both from Indian Institute of Engineering Science and Technology, Shibpur. Afterward, Ruhul worked as a visiting scientist at the Indian Statistical Institute, Delhi. His research interests are broadly in the area of statistical inference, reliability theory, survival analysis, stochastic ordering and ROC curve analysis. In his spare time, Ruhul enjoys playing cricket and watching cricket and soccer.

Instructional Faculty

Louis Cheney has taught college algebra for over 7 years now and enjoys the content of the course. He has over a decade of teaching experience, most of which is at the grade 9-12 level. Louis likes to swim during the summer, enjoys mountain biking, and comes from a large family. He is honored to be a part of the mathematics department and hopes what he brings to the table can be utilized.

Jon Fortney graduated from the University of Pennsylvania with a B.A. in mathematics and actuarial science. He later attended Arizona State University for his Ph.D. in mathematics, focusing on geometric mechanics. His final year in graduate school was spent in the Netherlands on a Fulbright Fellowship. After graduating he lived and worked in the Middle East for over a decade. He is the author of two undergraduate-level mathematics textbooks and is currently working on his third. He enjoys reading fiction and fantasy and is currently working on a Master's degree in Buddhist Studies.

Deborah Holt received her Master's degree in actuarial science mathematics from George Mason University near Washington, D.C., in 2001. She spent her early career as an Actuarial Assistant for Navy Mutual Aid Association. She then moved to the International Monetary Fund to work as a research assistant. She left this position to home educate her daughter who is currently a second-year college student. Deborah and her husband moved to the Tucson area in January 2022. She loves the outdoors: from gardening and mountain biking to walking her three dogs.

Continued on page 9....

Five Years in Review

By Doug Ulmer

I completed my five-year term as Department Head this summer, so this is a good time to look back and also to look forward.

When I arrived, I was the fifth (!) Department Head in 4.5 years, so creating more stability and structure was the first task. I developed a team of Associate Heads to manage various aspects of our operation and to build leadership capacity. The people who stepped up for those roles have done great things, and I expect that they will be major assets to the department in the future.

One of the greatest strengths of the department is the fact that it is a "big tent" including research in all areas of the mathematical sciences, a spectrum of educational efforts involving faculty of all stripes, and truly robust outreach and service. I have worked hard to keep the tent populated, for example by greatly increasing collaboration with our two GIDPs (Graduate Interdisciplinary Programs) in Applied Mathematics and Statistics, increasing coordination with the CRR (Center for Recruitment and Retention of Mathematics Teachers) and by representing the School of Mathematical Sciences as a whole to university administrators and donors. This coordination has paid benefits in recruitment, expansion of degree programs, development, and external relations.

Another major task has been to let the world know about the great things happening here via nominations for awards and recognition. Our faculty, staff, and students have been recognized with Distinguished Professorships, major national career awards, Sloan Research Fellowships, NSF Graduate Fellowships, several Galileo Circle distinctions, and more. It has been very satisfying to see so many accomplishments honored.

The support of our donors and friends has also been gratifying and of major help. We received a gift of $1M toward naming CRR in honor of its founder, Professor Emeritus Fred Stevenson, who passed away in 2020. New gifts have also brought the Michael Tabor and William Velez Legacy funds to endowment level, and the Daniel Bartlett Memorial fund to its goal of $250K. And a new endowment in support of the Arizona Winter School is expected to surpass $50K by the end of 2022.

While support from our friends has increased, the same cannot be said of support from the state, so we are becoming more entrepreneurial in creating degree programs that generate additional revenue, including new professional Master's degrees and microcampus dual degree programs.

We are also working very hard to rebuild faculty numbers and to diversify the faculty in the process. There has been excellent support recently from the College of Science and the Office of the Provost for these endeavors, and they will surely result in the department developing stronger programs and more capacity to serve our students.

In closing, College of Science Dean Carmala Garzione has asked me to continue as Department Head, and I have agreed (although I hope to take a sabbatical in the next couple of years). I am optimistic about the future of the department, and I look forward to continuing to work with our community to realize its full potential.

In the Words of His Students: A Mentor to Inspire

By Jon Ramalheira-Tsu and many of Nick's students

In recognition of a lifetime of committed and heartfelt advising, Nick Ercolani's students nominated him for the 2022 College of Science Distinguished Mentoring Award, which he won this year.

We wanted to share some of what we wrote about Nick in his nomination, as such letters don't get much airtime, yet hold invaluable sentiment and inspiration for anyone who knows Nick, as well as other mentors and mentees.

Throughout his 35-year career at UArizona, Nick mentored a large number of graduate students through his teaching, research, and dissertation supervision—inspiring, encouraging, and supporting us all in multiple ways. Unanimously recalled by all his students is Nick's "contagious passion for mathematics" and how it drew others in and fuelled their desire to delve deep into the field. His students describe Nick as both an inspiration and also a truly selfless supporter and defender of others.

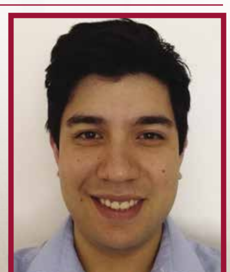
The many students who were lucky enough to have Nick directly as their advisor have benefitted from his continued commitment to their development in life, even long after graduating. One student describes Nick's influence in his life after graduating and pursuing a career in academia as "supportive, attentive, and always encouraging," describing how Nick was always available to provide counsel on research, teaching, and service, including service as a department chair. It is through this continued mentorship that Nick has, perhaps unknowingly, benefitted and impacted students in multiple other states and universities.

Nick has supervised the dissertations of 21 students, including 10 women and 11 men. In her nomination letter, one of Nick's advisees describes the significant role he played in her academic journey. She described how intimidating it was being a woman in mathematics but explained how Nick broke many of the barriers. "Nick was not intimidating," she said. "Though he did push me to work hard, I never felt like I had to prove anything to him. His genuine desire to learn mathematics seemed to be the focus and the root of his success as a mathematician, and that focus was passed on to us, his students." She felt there was no competition, because the excitement of learning was the focus. Indeed, this is where all of Nick's students are in agreement, his passion and pure joy of mathematics, as well as his belief in all his students, drove a healthy pursuit of success.

Nick's mentoring award recognition is timely. In September 2022, Nick retired from his role as Professor of Mathematics, though he continues to collaborate with many of his students. We are forever thankful and proud of Nick for all he has selflessly given us and taught us, mathematically and otherwise.

Jonathan Ramalheira-Tsu got his Ph.D. in 2020 from the University of Arizona under Nick Ercolani's supervision. He is now in Seattle, working for Liberty Mutual as a data scientist while maintaining a relationship with UArizona by continuing research collaborations with Nick.

Contact him at: jramalheiratsu@arizona.edu



Biographies continued from page 8....

Postdoctoral Research Associates

Maria Deliyianni was born in Nicosia, Cyprus, and earned her undergraduate degree from the University of Cyprus. In May 2022, she received her Ph.D. from the University of Maryland Baltimore County. Her research focuses on the analysis of partial differential equations with a main interest in the systems of fluid-structure interactions that arise in engineering applications. Outside of mathematics, Maria enjoys good food, reading books, and lifting weights.

Rongchang Liu was born in a village at Lijiang, a city in the mountainous southwestern China. He obtained his Bachelor's and Master's degree at Beihang University in Beijing. He received his Ph.D. in mathematics from Brigham Young University. He is interested in understanding chaotic behavior of differential equations by combining tools from dynamical systems, stochastic analysis and probability theory. In his spare time he enjoys playing video games, listening to music, cooking and running.

Kelly MacArthur (she/her) completed her Ph.D. in mathematics education at Montana State University. Her dissertation research centered the voices of STEM majors from historically marginalized groups to explore their views on humanizing undergraduate mathematics courses. Prior to this work, she was an Associate Professor Lecturer at the University of Utah where she taught collegiate mathematics and mentored Ph.D. students in their teaching for two decades.

Jay Mayfield completed his Ph.D. in applied mathematics at Iowa State University and previously received an M.S. in mathematics and B.S. in both mathematics and physics, all at Arkansas State University. His research areas are in numerical analysis, but he is working on extending his research interests into projects including deep learning, applied analysis, and sports analytics. Outside of math, he enjoys sports of all kinds, with a particular interest in basketball.

Arvind Suresh was born and raised in Kolkata, India. He earned a Bachelor's degree from Claremont McKenna College, and went on to receive his Ph.D. from the University of Georgia, where he learned to love number theory (and fear algebraic geometry). His research interests lie in arithmetic geometry; they include explicit construc-

Continued on page 11...

Future Mathematics Teachers: Power, Community, and Voice at National Conferences

by Cynthia O. Anhalt

Fourteen mathematics majors and graduates from the UArizona Secondary Mathematics Education Program attended the Western Regional Noyce Conference (WRNC) in Spring 2022.

This annual conference, sponsored by the National Science Foundation (NSF), aims to cultivate a growing, inclusive learning community of future mathematics teachers by delivering STEM teaching and learning professional development for regional Noyce Scholar and Fellow participants. Such cultivation is a specific goal of the Noyce grants (see 2018 UArizona Newsletter, p. 10-11, for example).

As PI of the AZ Noyce Project and member of the 2022 conference organizing committee, I strive to ensure all AZ Noyce participants have a rich and empowering conference experience, with time to visit with program mentors, engage in meaningful professional learning, build community with each other and other Noyce Scholars nationally, and meet exceptional mathematics education scholars.

The 2022 WRNC, held in San Diego, CA, brought together 270 Noyce Scholars and Fellows and over 80 project PIs from universities across the Western US region. All 270 Noyce Scholar participants attended my conference-wide keynote working session on mathematical modeling with NASA images and data of the melting Arctic Sea ice. They were also inspired by Harvey Mudd professor and keynote speaker Francis Su, author of the recently published book *Mathematics for Human Flourishing* (Yale University Press).

In July 2022, two AZ Noyce Scholars, mathematics majors Guadalupe Dominguez and Marina Careaga-Castellanos, attended and presented a poster at the NSF Noyce Summit in Washington, D.C. Noyce Scholars from across the U.S. attended the NSF/AAAS (American Association for the Advancement of Science) Noyce Summit.

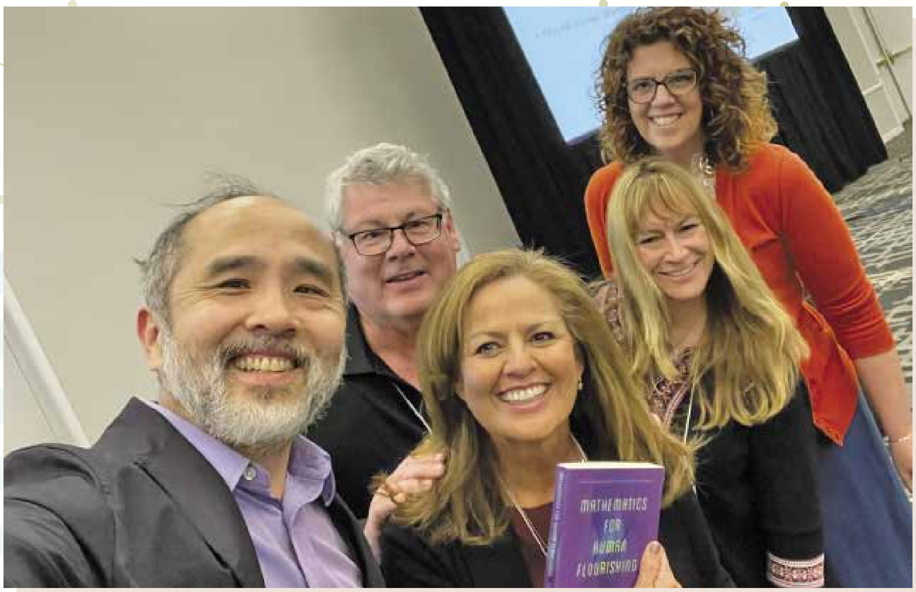
Set to end in 2022, the AZ Noyce Project has funded 37 undergraduate Noyce Scholars over its lifetime. Of the 37 Noyce Scholars, 27 have graduated and 10 will graduate within the next two years. Each graduate of the AZ Noyce Project is committed to teaching mathematics in a secondary school setting for a minimum of two years per each year of scholarship funding.

More on Arizona Noyce »

Cynthia O. Anhalt is an Associate Research Professor in the Department of Mathematics, Faculty Director of the Secondary Mathematics Education Program, and PI of the NSF-funded AZ Noyce Project, 2016-2022.

Contact her at: canhalt@math.arizona.edu

▲ **AZ Noyce Project team.** From top-left: Jorge Stimans, Lucas Smith, Nicole Boudrieau, Hunter Torres, Ulisses Valenzuela, Lupita Dominguez, Kayley Montes, Janet Kinsey, Madison Crosby, Jenna Mills, Marley Murrell, Cynthia Anhalt, Bailey Cooper, Liliana Mata Hernandez, Araceli Padilla.



▲ Harvey Mudd Professor and author Francis Su (left), AZ Noyce PI Cynthia Anhalt, holding Su's recent book, together with colleagues Lawrence Horvath, Donna Ross, and Stephanie Salomone at WRNC 2022, in San Diego, CA.

▲ **AZ Noyce Scholars** Dominguez and Careaga-Castellanos and their poster, Mathematical Modeling Embedded in Content and Pedagogy Courses: Cultivating Diverse Perspectives. Noyce 2022 NSF Summit, Washington, D.C.

Biographies continued from page 9....

tions of rational and irrational points on curves and abelian varieties. Arvind likes to spend his free time listening to classical music, watching Netflix and playing chess.

Pan Yan grew up in Ezhou, China. He did his undergraduate work in China, then moved to the United States for graduate school. He received his Master's degree from Oklahoma State University in 2016 and his Ph.D. from Ohio State University in 2022. His research is centered around number theory and representation theory. When he is not working Pan enjoys being outside, watching sports, and playing basketball.

Staff

Ariel Beggs grew up in Ohio and completed her B.A. from Wheaton College and her Master of Arts in Teaching from Dominican University. For the last 18 years, she has taught mathematics and science to middle school students. Before teaching, Ariel lived in Cambodia and then worked with Cambodian refugees in the Chicago area. During her free time, Ariel enjoys hiking, reading, playing games, and working on puzzles.

Sarah Morrison grew up in Surprise, Arizona, and is a fifth generation Arizonian. Before working at UArizona, she studied and worked at Arizona State University, graduated from Arizona Culinary Institute, and was a Pastry Baker at the Phoenician. She is looking forward to continuing her education in the upcoming Spring semester. Sarah enjoys baking, listening to and playing music, and spending time with friends and family. She is excited to be working in the academic office and has enjoyed getting to know and work with everyone!

Lien Nguyen graduated with a Bachelor's degree from the University of Economics of Ho Chi Minh City, Vietnam. After graduation she worked at VINATRANS, a logistics company, for 18 years. At the time she was a chief accountant and her job and career were going very well, but she had to give up that fine job and move to the United States and start all over. Upon arrival to the U.S., she attended Pima Community College and earned a Business Associates degree. At that time, she also achieved Third Team and First Team National Junior College Athletic Association for Tennis. After Pima College, she worked for Astra Canyon Group LLC as an accounting specialist for 2 years. Now she is so happy to be part of the business office team of the UArizona Department of Mathematics. ◀

THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE
Mathematics

The University of Arizona
Department of Mathematics
PO Box 210089
Tucson, AZ 85721-0089

2022 UArizona Mathematics Master's and Ph.D. Recipients

Doctoral Degrees

Utkarsh Agrawal
Central Values of Degree Six L-Functions: The Case of Hilbert Modular Forms

Advisor: Hang Xue
Employer: Ben-Gurion University of the Negev, Beer Sheva, Israel
Position: Postdoctoral Researcher

Eric Elert
Algorithms for Finite Dimensional Algebras Over Finite Fields using Basic Algebras

Advisor: Klaus Lux
Employer: Savannah College of Art and Design, Savannah, GA
Position: Liberal Arts Professor

Mohammad Javed Latifi Jebelli
Loop Group Factorization, Lattice Systems and OPUC (Orthogonal Polynomials on the Unit Circle)

Advisor: Douglas Pickrell
Employer: Dartmouth College, Hanover, NH
Position: Postdoctoral Researcher

Kyle Priver
Generalizing Bondal-Orlov Criteria for Deligne-Mumford Stacks

Advisor: Jack Hall

Jocelyn Rios
Critically Examining the Multilingual Undergraduate Mathematics Classroom: A Mixed Methods Study

Advisor: Aditya Adiredja
Employer: Colorado State University, Fort Collins, CO
Position: Postdoctoral Fellow

Ruiyang Wu
New Dimension Reduction Methods for Quadratic Discriminant Analysis

Advisor: Ning Hao
Employer: New York University School of Global Public Health, New York, NY
Position: Postdoctoral Researcher

Master's Degrees

Abigayle Dirdak
The Gale Transform

Advisor: Anton Izosimov

Conner Hatton
Gambler's Ruin: The Limiting Distribution of Points Visited Exactly Once of a Simple Random Walk up to Time of Exit and the Influencer Voter Model

Advisor: Sunder Sethuraman

Jorge Ledesma
Trivial source modules

Advisor: Klaus Lux

Owen MacDonald
Almost Sure Convergence of Adjacent Weights in a Preferential Attachment Random Graph

Advisor: Sunder Sethuraman

A complete list of graduates since 1992, including links to recent theses, may be found online »