IN THIS ISSUE

Fall 2020
Volume XX, Single Issue

THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE
Mathematics

MATHEMATICS

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- Other news and events

We would love to keep in touch.

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Message from the Chair

By Doug Ulmer

I'm writing this on Monday, November 1st, a day of great uncertainty around politics, economics, health, and justice.

Looking back, it has been **a year unlike any other**. As the seriousness of the pandemic became clear in early March, we extended spring break by a week and prepared to transition to fully online teaching. With over 100 instructors and tens of thousands of students, this was no small matter, but we did it with **incredible flexibility and teamwork.** By the end of the semester, it was clear that much instruction would be online at least through the fall, so **our staff put in incredible effort over the summer to develop support structures, new modes of communication, and training for everyone.** That effort has proved its worth as instruction started almost fully online and has only recently added significant face-to-face components. While hoping for the pandemic to subside, we continue to prepare for all eventualities in the spring.

It's important to recognize **how difficult this situation has been for our students, especially the less privileged** among them. Getting an education and "becoming an adult" has become more difficult and dramatically more uncertain.

Meanwhile, research continues apace, and **our faculty continue to be recognized at the highest levels.** I am delighted to report that Professor **Marta Civil** was named University Distinguished Outreach Professor in recognition of “innovative work which brilliantly merges outreach and research, making her an internationally renowned scholar as well as an invaluable community member.” Professor **Vladimir Zakharov** was awarded the Bogoliubov Medal of the Russian Academy of Sciences for his outstanding achievements in Mathematics (both pure and applied) and Theoretical Physics. The prize, one of the highest honors bestowed by the Russian Academy, is awarded only every five years, and he is the fifth recipient. Major **research and training awards** went to a team led by Associate Professor **Kevin Lin** (a $2M NSF award for Data Driven Discovery), another team including Assistant Professor **Brandon Levin** (a $1.2M Focused Research Group), and a third team including Associate Research Professor **Guada Lozano** ($3M Title V grant to improve success in STEM among Hispanic and low-income students). There were also a number of new individual investigator grants, as well as several prizes for excellent teaching and research.

We added **several new members to the team,** most notably Professor **Laura Miller** (joining us from UNC Chapel Hill), Associate Professor **Lise-Marie Imbert-Gérard** (from U Maryland), and Assistant Professor Tonatiuh Sanchez-Vizuet (from NYU). And we marked 50 years (!) of service to the department and university by Professor **Jim Cushing**. See page 6 for more about his research.

We are **grateful as ever for the support of our alumni and friends**, especially in this period of great uncertainty. See pages 4 and 8 for tributes to two of our major donors.

Looking forward, I am confident that our department will continue to fulfill its missions with commitment, creativity, and energy. Meanwhile, please enjoy this newsletter, and keep in touch. **We wish you all the best for the health, prosperity, and safety of you and your loved ones.** ▲

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**

Join Us for a First-Ever Arizona Winter School for Undergraduates and Junior Graduate Students!

By Bryden Cais

Aiming to **diversify and expand our reach,** and cultivate students' interest in number theory **earlier in their mathematical careers**, the 2021 Arizona Winter School (AWS) will be different from previous years.

The AWS 2021 virtual program will be:

- focused on **instruction & training,** rather than research
- aimed at **undergraduates** and **junior graduate students.**

AWS will offer **two different focus themes**, starting in January, then March.

To find out more, or access AWS lectures & resources, please scan the code, or type the URL: swc.math.arizona.edu.

You may also contact **Bryden Cais, AWS Director** at cais@math.arizona.edu

Southwest Center for Arithmetic Geometry

Department of Mathematics The University of Arizona®

ARIZONA WINTER SEMESTER 2021

Virtual School on Number Theory

1 Modular groups and modular forms

Alex Barrios
A friendly introduction to the theory of modular forms

Lori Watson
An introduction to modular groups

January 25–March 3, 2021

2 *p*-adic numbers and Quadratic forms

Renee Bell
Strange new landscape: an exploration of the p-adic numbers and modular forms

Charlotte Chan
Quadratic forms and the local-global principle

March 22 –April 30, 2021

To register visit: http://swc.math.arizona.edu/
Apply for funding by 12/07/2020

Funded by the National Science Foundation

BIOGRAPHIES

Tenured Faculty

Laura Miller is a Professor of Mathematics at the University of Arizona. She received her Master's in Zoology from Duke University and her Ph.D. from the Courant Institute of Mathematics at NYU where she studied the aerodynamics of tiny insect flight. Laura then continued her work in mathematical biomechanics and physiology at the University of Utah as a postdoc and at the University of North Carolina as a faculty member where she began an experimental lab, which she is now moving to the Biological Sciences West Building at UArizona. Using her training in both mathematics and biology, she aims to better understand how organisms interact with air and water. Her current research interests include the feeding and swimming mechanics of jellyfish, the fluid dynamics of tubular heart pumping, the aerodynamics of flight in the smallest insects and spiders, and flows through corals. In her spare time, Laura enjoys horseback riding, walking her dog, and scuba diving.

Tenure-track Faculty

Lise-Marie Imbert-Gérard is from France, where she studied at ENS Cachan and received her Ph.D. from Universite Paris 6. She then moved to the U.S. to become a postdoc at the Courant Institute, and she joins the University of Arizona from the University of Maryland. As an applied and a computational mathematician, Lise-Marie studies partial differential equation models with variable coefficients, focusing on wave propagation in inhomogeneous media. She is currently developing and analyzing numerical methods for applications in aeroacoustics, specifically for anisotropic media and electromagnetic waves. Lise-Marie is very excited by the interdisciplinary environment offered by UArizona. She also enjoys teaching topics in scientific computing and numerical methods with a coding component. On a more personal note, she wishes to discover mountain biking opportunities around Tucson, to learn about the local culture, and to make Tucson home!

Tonatiuh Sánchez-Vizuet was born in Mexico City. He obtained a Bachelor's degree in Physics and a Master's degree in Mathematics from

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BIOGRAPHIES

Bartlett Memorial Lecture: Twelve Years in Review

The Daniel Bartlett memorial endowment was created in 2008 in honor Daniel Bartlett, a remarkable rising mathematician who passed away suddenly in 2006. Since its establishment, numerous contributions to the endowment and to the Daniel Bartlett memorial scholarship have supported 10 Bartlett Memorial Lectures in Mathematics, and 14 outstanding graduate students in mathematics.

Daniel Bartlett

This year, 2020, **we look back at the collection of Bartlett Memorial Lectures to date.** Touching on a wide spectrum of topics, from the mathematics in **Salvador Dali's art** to **winning the lottery** and **sports analytics**, each lecture gives the general audiences a window into the nature of the work mathematicians do and contribute towards.

The 2020 lecture, to be given by best-selling author Simon Singh on his most recent book **The Simpsons and Their Mathematical Secrets** has been postponed until it is possible to have a large live event once again.

The inaugural Bartlett Memorial Lecture was delivered by Daniel's undergraduate advisor at Harvard University, Barry Mazur. At the time of his death, Daniel was beginning work in algebraic number theory, the area he envisioned would ground his dissertation work at the University of Arizona.

Bartlett Memorial Lectures have been filmed since 2010 and may be viewed online. To access them, or to find out more about Daniel Bartlett and the Bartlett Memorial Scholarship, please scan the code, or type the *URL: math.arizona.edu/outreach/Bartlett_lecture/*

Daniel Bartlett Memorial Lectures

2008 | Barry Mazur
THE UNITY OF MATHEMATICS

2009 | Jeffrey Weeks
THE SHAPE OF SPACE

2010 | Thomas Banchoff
THE FOURTH DIMENSION AND SALVADOR DALI

2011 | Art Benjamin
THE SECRETS OF MENTAL MATH

2012| Robert Devaney
CHAOS GAMES AND FRACTAL IMAGES

2013 | Hugh Woodin
THE INFINITE FAR BEYOND

2015 | Bryna Kra
PATTERNS AND DISORDER: HOW RANDOM CAN RANDOM BE?

2016 | Momar Dieng
DEMOCRACY IN NUMBERS: A TALE OF TWO ELECTIONS

2017 | Jordan Ellenberg
HOW TO USE MATH TO GET RICH IN THE LOTTERY

2018 | George Hart
MAKING MATH VISIBLE

2019 | Tim Chartier
GET IN THE GAME

Upcoming | Simon Singh
HOMER'S LAST THEOREM

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BIOGRAPHIES

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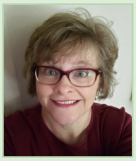
the National Autonomous University of Mexico (UNAM), and a Ph.D. in Applied Mathematics from the University of Delaware. He was a postdoctoral associate at NYU's Courant Institute from 2016 to 2020. Tonatiuh's research revolves around the development of computational methods for the simulation of physical processes. In particular, he is interested in elastic wave propagation, wave scattering, and magnetic equilibrium of plasmas in fusion reactors. Outside of mathematics, he enjoys hiking, playing classical and bass guitar, and would never refuse to play a game (or two, or twenty...) of chess, invariably opening with 1 d4.

Visiting Associate Professor

Aaron Wootton was raised in Clevedon, a coastal town in England. He received a Bachelor's in Mathematics and Philosophy from the University of Southampton, and his Ph.D. from the University of Arizona under Klaus Lux. Aaron is a professor at the University of Portland, and has held visiting positions at the University of Southampton and Alfred University. Aaron's research focuses on symmetry groups of surfaces and he is the founder and editor of the Springer book series "Foundations for Undergraduate Research in Mathematics." Recent honors include the 2018 Outstanding Research Award in Mathematics from the Willamette Valley Chapter of Sigma Xi, and the 2020 Distinguished Teacher Award from the Pacific Northwest Section of the MAA. Outside interests include soccer, and drumming for a punk rock band.

Instructional Faculty



Janet Sipes grew up in Texas. She completed the Ph.D. coursework in Mathematics (analysis and algebra) at the University of Missouri prior to spending six years on the faculty at the University of Southern Indiana. Enduring a final episode in graduate school, she completed a Ph.D. in Undergraduate Mathematics

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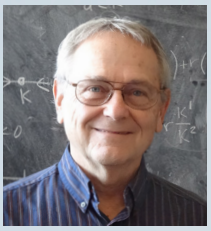
BIOGRAPHIES

Modeling Gull Behavior During Climate Warming: Can Egg Cannibalism be a Survival Strategy?

By Jim Cushing



SEABIRDS AND CLIMATE CHANGE

For the past 15 years, my colleagues and I, with support from the National Science Foundation's program in mathematical biology, have studied the effects of climate change on the behavior of marine birds, mammals, and reptiles. Our focus has been, primarily, on colonial seabirds breeding in the Pacific Northwest. Our field research location is on Protection Island, a U.S. Fish & Wildlife Refuge located in the Strait of Juan de Fuca, off the northeastern coast of the State of Washington. There, tens of thousands of glaucous-winged gulls (Larus glaucescens) form seasonal breeding colonies.

Protection Island in the Strait of Juan de Fuca in Washington, USA . An aerial photo of the island in summer. Source: P.A. Lawrence, LLC. / Alamy Stock Photo

A major contributor to climate change at this site is an increase in mean sea temperature, (over 2C during the last 50 years), which disturbs the major fish and zooplankton food resources of the gulls. My research collaborator, Jim Hayward (professor of biology, Andrews University), together with many students, has collected large amounts of data on numerous behavioral activities of the gulls since the early 1970's. My other research collaborator, Shandelle Henson (professor mathematics and ecology, Andrews University), worked with me during the 1990's on an interdisciplinary project that studied insect populations (flour beetles) in a controlled laboratory setting[1].

FROM THE LAB TO THE FIELD

Our modeling goal was to bring the methodologies we used in our laboratory setting to a field project, especially one with an abundance time series data—data that we could use to understand and explain past population dynamics and predict future changes due to climate warming.

During the first few years of our collaboration we focused on correlating numerous environmental variables with a suite of behavioral activities of gulls, such as mating, foraging for food, resting/loafing, preening, and sleeping. The models were used to predict, from a parameterization using data from one season, what Jim Hayward and his students would see in the field the next year. The resounding success of this project[4] provided **confidence that mathematical models could be predictive in our field setting.** With this gained confidence, we turned our attention to phenomena associated with climate change.

Glaucous-winged gulls, sentinels of climate change.

While we cannot perform controlled and replicated experiments on the gull colonies, el Niño years (which occur on average every 4 to 5 years) **provide natural experimental settings for climate change**, in that during these years mean sea surface temperature significantly increases. By observing animal behavior during these years, we should get clues as to what their behavior would likely be under permanently warmed conditions. We can use models to predict whether the behavior is, in the long run, adaptive or threatening to survival.

EGG CANNIBALISM AS A SURVIVAL STRATEGY

The most striking change in the gull breeding colonies during el Niño years is a high increase in egg cannibalism. In one el Niño year, for example, nearly 50% of eggs laid were cannibalized! While **cannibalism perhaps seems unlikely to be a viable long-term survival strategy**—one that would be adaptive by Darwinian principles—our models show that it indeed can be.

Using Darwinian dynamic (evolutionary game theoretic) versions of discrete-time structured population models, we identify circumstances under which evolution will select for cannibalistic behavior in a resource degraded environment to allow population survival. Moreover, this evolutionary outcome is a so-called evolutionarily stable strategy[2].

Yet, our model also shows the threat of extinction is not eliminated by the evolutionary selection of cannibalism: **a major disturbance that lowers the population level too far might cause the population to go extinct**. Further, our model points to a tipping point (mathematically, a saddle-node bifurcation point) for environmental resource availability. Below this point, a sudden, catastrophic population crash to extinction will occur.

Glaucus Gull glaucous-winged gull eating an egg. Source/ Copyright: 123RF.com, Dmytro Pylypenko

ADAPTIVE FEMALE BEHAVIOR

A second striking occurrence during el Niño years is reproductive synchrony: female gulls, who can lay an egg only every other day, synchronize their egg laying on the same days. One hypothesis to explain this phenomenon is ecology's "predator saturation effect". According to this principle the probability an individual egg will be cannibalized is reduced in the presence of many eggs. **Could this be a female gull strategy to protect her eggs when cannibalism is high in the colony?** The extension of our cannibalism model suggests that, indeed, as evolution selects for a higher cannibalism rate, the females synchronize their egg laying. Mathematically, this modeling project was of special interest because standard stability and bifurcation methods were inapplicable to the Darwinian equations: we needed to derive new theorems and analytic methods[5].

These are but two of many mathematical modeling projects carried out by our interdisciplinary "Seabird Team" over the last 15 years. Read more in our forthcoming book[3]. ▲

Jim Michael Cushing has been a professor in the Department of Mathematics since 1968 and a member of the Interdisciplinary Program in Applied Mathematics since its inception in 1976. He is a Fellow of the American Mathematical Society, a Humboldt Fellow, and member-at-large in Sigma Xi, the scientific research honor society. His research interests lie in the derivation and analysis of models in population, ecological, and evolutionary dynamics.

Contact him at: **cushing@math.arizona.edu**

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[2] *JM Cushing, SM Henson and JL Hayward, An evolutionary game theoretic model of cannibalism, Natural Resource Modeling 28, No. 4 (2015), 497–521.*

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[4] *SM Henson, B Dennis, JL Hayward, JM Cushing and JG Galusha, Predicting the dynamics of animal behavior in field populations, Animal Behavior 74, No. 1 (2007), 103-110.*

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BIOGRAPHIES

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Education (Grades 9-20) in December 2019. She is interested in undergraduates' understandings of mathematical notation and how issues with communication offer a partial explanation for difficulties students experience in courses such as linear algebra. She enjoys cooking and nature.

Postdoctoral Research Associates

Darlayne Addabbo is the 2020 Hano Rund Postdoctoral fellow. She is from Teaneck, New Jersey. She graduated summa cum laude with high honors in Mathematics from Rutgers University in 2011. She earned her Master's and Ph.D. degrees from the University of Illinois at Urbana-Champaign. She was previously a Visiting Assistant Professor at the University of Notre Dame. Her research interests are in integrable systems and vertex operator algebras. She is excited to continue to broaden her research program and further develop her teaching here at the University of Arizona. In her spare time, she enjoys traveling, reading, and talking with her twin sister, who is a virologist at the University of Minnesota.

Kevin Childers was born in Salt Lake City, Utah. He received his Bachelor's and Master's degrees in Mathematics from Brigham Young University and his Ph.D. in Mathematics from the University of Utah before moving to Tucson. He researches number theory, especially Galois representations, as well as artificial neural networks. He is an avid rock climber and enjoys spending time with his wife and three kids.

Weinan Wang grew up in a small town in China and obtained his Bachelor's degree in Mathematics and Applied Mathematics in China. He then came to the U.S. for graduate school and received his Ph.D. in Applied Mathematics from University of Southern California. His main research interests lie in the areas of nonlinear partial differential equations and fluid dynamics. Weinan enjoys spending time outdoors and playing soccer.

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BIOGRAPHIES

Scientist, Mother, Community College Professor:

Dr. Katharine McLean's Legacy for Traditionally Minoritized Students

In early 2017, John McLean, a math alumnus, past chair of our External Advocacy Board, and retired president and CEO of Areté, came to us with a vision: to create a gift that would support historically underprivileged and minoritized students pursuing science and mathematics.

The inspiration for John's pursuit, the catalyst and mentor behind the name of his fund, was his mother, an Arizona community college chemistry professor who earned a Ph.D. ahead of her time, and dedicated over 35 years of her life to college teaching.

The Katharine Wiedman McLean endowment is meant to extend her legacy by encouraging scientific engagement among first generation college students, community college students transferring to university, and undergraduate math majors with a passion for teaching.

Katharine Weidman McLean

To date, over 13 undergraduates have been recognized as Weidman McLean Scholars

McLEAN TRANSFER SCHOLARS *(award amount $2,000)*

2020 | Sean Driskill, Physics Major

2019 | Tru Quach, Electrical Engineering Major

2018 | Erika Miller (Leatherwood), Mathematics Major

2017 | Gary Sousa, Computer Science Major

McLEAN FIRST-GENERATION SCHOLARS *(award amount $2,000)*

2020 | Jiyun Di

2019 | Yuzexi Yang

2018 | Jericho Lawson

2017| Christopher Druta

McLEAN EDUCATION SCHOLARS *all Secondary Education Mathematics Majors (award amounts: $1,000 – $3,000)*

2020 | Esteban Manriquez

2020 | Mason Perkins

2019 | Wiktoria Latocha

2019 | Jenna Mills

2018 | Marley Murrell

2017 | Erika Friedemann

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McLean Scholars, In Their Own Words.

"From what I have learned from Dr. Katharine McLean, her lifetime devotion to teaching and helping thousands of students is indeed very admirable and inspirational. Your generosity is a big motivation for me to keep working hard so I will not let that kindness down."

—McLean Arizona Transfer Scholar

"I am now one step closer to becoming the mathematics teacher that I have always wanted to be, one that creates an equitable and enjoyable learning environment while also helping reduce the negative stigma around the subject of mathematics."

—McLean Mathematics Education Scholar

"Your generosity has inspired me to help others who wish to pursue education and give back to the communities who need it most. I hope one day I will be able to help students achieve their goals the same way you have helped me."

—McLean Mathematics Education Scholar

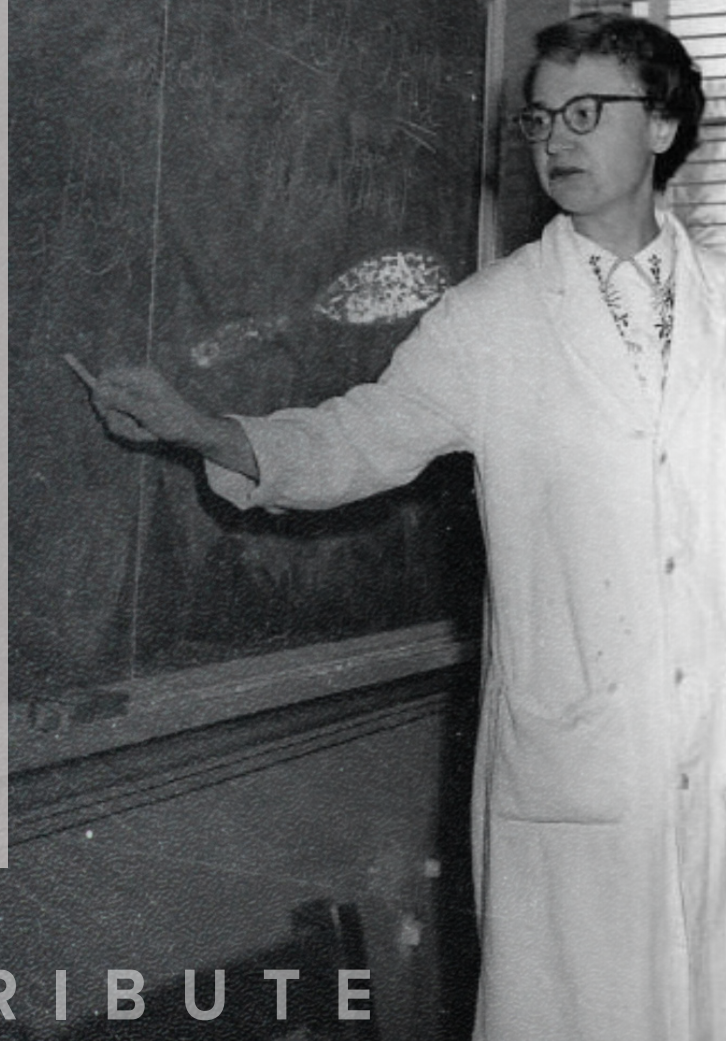
KATHARINE McLEAN: A BIOGRAPHY BY JOHN McLEAN

Dr. Katharine McLean's lifelong passion was teaching and mentoring young people, and over the span of her 35-year career at Phoenix College she touched the lives of thousands of students. She was particularly gratified to help first generation students succeed in college, and helped many students make the transition from community college to the university.

Dr. McLean graduated from Cornell University in 1948, where she learned calculus from future Nobel laureate Richard Feynman. She then studied biochemistry at the University of Illinois, graduating with a Ph.D. in 1951 at age 23. She started her professional career at Redstone Arsenal, working with many of the original rocket pioneers at the dawn of the space age.

In 1952, she and her husband Claude (also a chemist) moved to Phoenix, Arizona, where she raised three children while teaching chemistry at Phoenix College. Her passion for teaching was undimmed after 37 years of college level instruction, and she continued her calling by tutoring primary grade students in reading and comprehension following her retirement in 1995.

When not in the classroom, the trilingual Dr. McLean (English, Spanish, German) enjoyed traveling with her family throughout Mexico, and was particularly fond of visiting her many friends in our sister state of Sonora. She succumbed to complications of Parkinson's disease in 2011.



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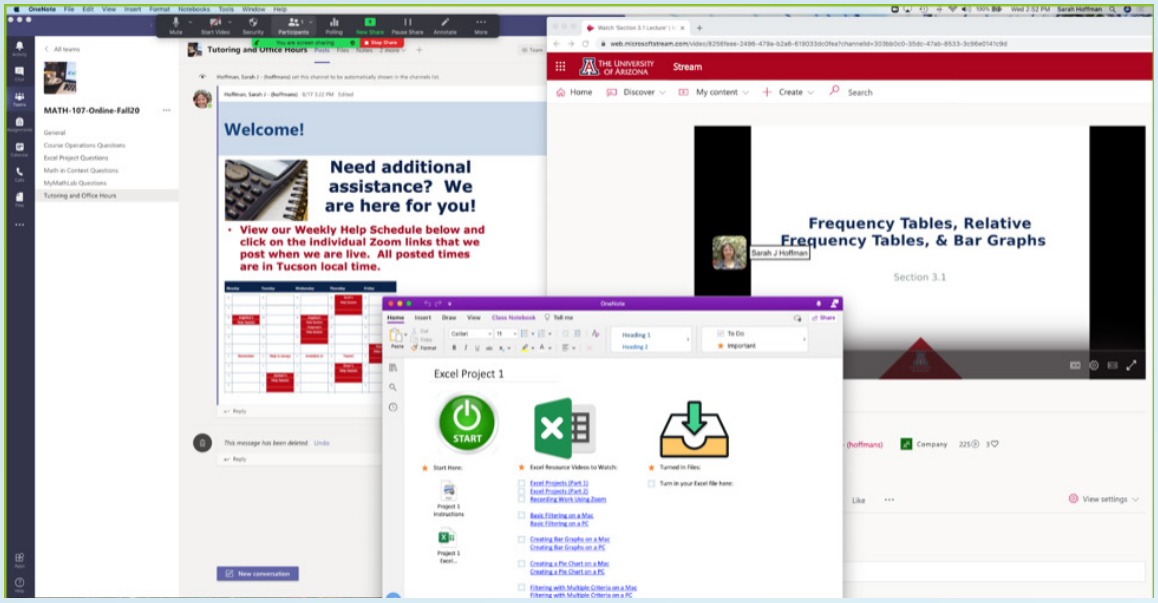
Teaching Victories in Uncertain Times

By Sarah Hoffman

This March, many of us in education grappled with how to provide the same quality instruction to our students when our finely tuned, in-person delivery methods became unusable. Now, months into online learning, it is time to assess and reevaluate how we can best educate our students. What aspects of online learning might continue to be valuable when we return to our physical classrooms? Here are some things I have noticed as an entry-level course instructor:

I became accessible. Our students live in a world of instant communications. Embedding my virtual classroom in Teams (a platform that enables virtual collaboration) opened up the option of direct messaging. Suddenly, I became transparent with my students about my availability and became approachable to an extent that I never have been before. And the students are responding. I get far more direct messages about questions than I ever got emails. And when we can't easily discuss a question over text messages, we can immediately join a Zoom room and solve the problem face-to-face.



Notes became interactive and customizable. Living versions of class notes that I can constantly access have replaced bound physical copies. The use of OneNote's Class Notebook allows each student to have their own digital notebook integrating lecture videos, Excel and calculator resource videos, and digital slides. Not only can students personalize their class materials, but instructors and students can now collaborate and communicate in new ways. For example, virtual office hours are greatly enhanced by my having access to students' virtual notebooks. I can also monitor the progress of students who are struggling and reach out to them almost in real time.

Students interact with mathematics. My students are taught that they must learn to write, speak, and use math in the real world in order to truly master it. With multimedia projects, students are now writing more mathematics, recording Zoom demonstrations of how to use technology, and verbally presenting math in context through virtual presentations that we never had time for in the classroom. And with a pandemic in effect and weekly campus reentry briefings taking place, our students are getting to see that the skills they learn inside our classroom matter as they navigate the real world.

For both teachers and students, the state of education has been forever altered. I plan to hold on to these newly found Teaching Victories to enhance my teaching in the years to come. What are your victories? ▲

Sarah Hoffman, a Senior Lecturer in the Department of Mathematics, earned a Master's in Mathematics from the University of Arizona. As an educator and a contributing author to Explorations in College Algebra, her passion is bringing quantitative literacy to general audiences. She has been involved in improving online education for nearly ten years.

Contact her at: **shoffman@math.arizona.edu**

Learning in Unprecedented Times: Perspectives From a Senior Math Major

By Madison Delmoe

The recent pandemic and time of social distancing has created **many unprecedented challenges for college students.** While universities have made tremendous efforts to preserve the academic rigor and value of their degrees, students have needed to make adjustments to their own learning techniques in order to continue mastering their subjects.

These insights come from **my experience studying mathematics in this new learning environment** and aim to help other students continue thriving in their studies despite current challenges.

1. **Self-compassion is hard to come by when struggling to understand course material.** In the Zoom world, the only individual students see who appears to articulate class content is the professor. During in person courses, I can sense my peers around me working through challenging material and at times struggling with me, so I know that I am not alone in confusion. Being told how difficult my courses are offers little validation; I still feel like the only person who is confused.

2. **Collaborating on assignments and studying together is much more difficult.** In mathematics, we are encouraged to work together on problems because our peers often provide insights and perspectives on problems that aid our own understanding. It is much more difficult to reach out to peers, especially in cases in which we don't know them from prior coursework.

3. **Professors seem robotic over the internet.** Professors are often intimidating under normal circumstances and are even less approachable over Zoom. It is difficult for students to sense simply humanness, compassion, and patience through a computer screen.

4. **Writing is much more challenging without access to varied, spontaneous conversation.** Even when writing scientific papers, which do not directly relate to things I would ordinarily converse about, I struggle to put my ideas into sentences.

5. **Less access to nature weighs on creative thinking.** Walking through our beautiful campus stimulates my mind. Whenever stuck on a challenging homework exercise or my research project, I like to explore campus. In these walks, I often found myself thinking of solutions in ways that are elusive now, thinking in isolation.

6. **Opportunities for human connection and validation have all but disappeared.** Much of my motivation comes from others' reactions of excitement to my work because I see how powerful and interesting research can be. Participating in events such as the Everything is Math and Bartlett lectures gives students a unique opportunity to connect with others over shared interest in mathematics. ▲

Madison Delmoe is an undergraduate mathematics major hoping to pursue a Ph.D. in Algebraic Geometry. She enjoys STEM outreach, ballet, hiking, playing with her dogs, motorcycling, and sewing.

Contact her at: **madisondelmoe@email.arizona.edu**

SNAPSHOTS

BIOGRAPHIES

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Avinash Jagdish Karamchandani was born in the suburbs of Detroit and spent his formative years there, in Little Rock, and in Northwest Ohio. He attended Case Western Reserve University as an undergraduate, where, having a wide range of interests, he completed majors in math, physics, and electrical engineering. Avinash eventually embraced applied math and did his Ph.D. in the Engineering Sciences and Applied Math at Northwestern University. His current research interests center around applied dynamical systems, including the modeling and analysis of complex biological and sociological phenomena, and with particular interest in emergent dynamics and reduced models. Outside of mathematics and whenever he finds the time, Avinash enjoys learning and playing classical guitar.

Christian Parkinson was born in California, but spent his childhood in Maryland and Colorado. Before joining the UArizona Mathematics Department, he received his Bachelor's and Master's degrees from the Colorado School of Mines, and his Ph.D. from UCLA. He is broadly interested in applied mathematics, with specialty in applied optimal control theory, level set methods, Hamilton-Jacobi equations and related topics. In his free time, he enjoys cooking, reading, watching movies or sports, playing tennis, and hunting down the best craft beer.

Staff

Hanh Do grew up in Hanoi, Vietnam. She has a diversity of education and experience. Before coming to the U.S., Hanh earned two degrees in International Economics and Finance. She is an Eller College of Management graduate who went on to earn her Certified Public Accountant (CPA) and Certified Government Financial Manager (CGFM) credentials. Hanh has been working at the University of Arizona for more than 10 years. She is passionate about helping faculty, staff, and students. Her experiences involve a broad range of areas including financial and budgeting, research management, HR and payroll, office staff training, process improvement, and other activities to ensure a high level of financial integrity and operation effectiveness. Hanh enjoys cooking, having friends come over, and traveling.

BIOGRAPHIES

THE UNIVERSITY OF ARIZONA
COLLEGE OF SCIENCE
Mathematics

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

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UArizona Mathematics Master and Ph.D. Recipients, 2020

A complete list of graduates since 1992, including master's recipients and links to recent theses, may be found online at: *math.arizona.edu/people/grads/recent*

Doctoral Degrees

Ryan Coatney. A Responsibile Softmax Layer in Deep Learning
- Advisor: Marek Rycklik

Philip Hoskins. Analytical and Numerical Study of Inverse Problems Arising in Some Novel Imaging Modalities
- Advisor: Leonid Kunyansky
- Employer: Raytheon, Tucson, AZ
- Position: Senior Systems Engineer

Spencer Lunderman. Feature-Based Parameter Estimation of the Nonlinear Cloud and Rain Equation and Global Bayesian Optimization in Data Assimilation
- Advisor: Matthias Morzfeld
- Employer: Independent Model Validation at CIT Bank, Pasadena, CA
- Position: Independent Model Validation

Zhaorui (Jerry) Luo. Probabilistic Graphical Model Inference and Learning in Crowdsourcing and Turbulence
- Advisor: Junming Yin

Rachel Oliver. Superiority of Bayes Estimators Over the MLE in High Dimensional Models on Compact Riemannian Manifolds and its Implication for Nonparametric Bayes
- Advisor: Rabindra Bhattacharya
- Employer: Rincon Research Corporation, Tucson, AZ
- Position: Research Scientist

Jason Quinones. Mathematical Aspects of Gauge Theory: Nahm's Equations and Jacobi Forms
- Advisor: Christoph Keller
- Employer: Gallaudet University, Washington, DC
- Position: Assistant Professor

Jonathan Ramalheira-Tsu. The Full Kostant-Toda Lattice, Combinatorial Algorithms and Ultra-Discrete Dynamics
- Advisor: Nicholas Ercolani

J. David Taylor. Extending Oda's Theorem to Curves with Ordinary Singularities
- Advisor: Bryden Cais

Brandon Tippings. Discrete Painlevé Equations, Orthogonal Polynomials, and Counting Maps
- Advisor: Nicholas Ercolani

Master Degrees

Brian Bennett. An Exploration of Parent-Child Conversations at a Mathematics Exhibit
- Advisor: Marta Civil

Madhav Kuashish. Assumption Digging in Euclidean Geometry
- Advisor: Rebecca McGraw

Chloe Ondracek. In-Depth Study of Lieb-Robinson Bound Proof
- Advisor: Robert Sims

Fany Salazar. Mathematical Conversations with Mexican Mothers: Why Teachers Should Care
- Advisor: Marta Civil

Alyssa Turnquist. What Mathematics Graduate Teaching Assistants Value in a Professional Development Program
- Advisor: Marta Civil