A MAGAZINE FOR
MATHEMATICS ALUMNI AND FRIENDS

math MATTERS

COMING FROM A SMALL TOWN— OPPORTUNITIES TO GROW ARE EXPONENTIAL.

Meet Meredith Tucker ('23 mathematics)
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IOWA STATE UNIVERSITY
Department of Mathematics

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Dear alumni and friends,

I'm delighted to present this issue of Math Matters. Our last issue was published in 2019 – pre-pandemic. Much has changed since then, including yours truly as chair of the department. My term as chair began in July 2022, and I am honored to have the opportunity to play a leadership and support role in the impact our faculty, students, staff, and alumni are making in communities throughout the world.

One of our biggest challenges continues to be supporting incoming students as they still feel the effects of the pandemic. However, I am proud of the innovations and efforts of everyone in the department to support students and create solutions to bridge learning gaps and help them along their academic journey. Indeed, Iowa State University's new strategic plan identifies being "the most student-centric leading research university," and the department is committed to fulfilling its crucial role in student success. For example, several faculty ran "bootcamps" during the first few weekends of the fall 2022 semester to help students sharpen their mathematical skills. Other faculty are involved in an innovative curriculum development project to use Iowa State's recently instituted winter session of courses to help students stay on track in calculus courses.

Our faculty continue to conduct cutting-edge, world-class research. You'll read about Dr. Claus Kadelka, whose research group modeled different vaccination strategies to optimize the mitigation of the contagion spread. We have faculty that are receiving newly awarded external funding from the U.S. Department of Agriculture and the National Geospatial Intelligence Agency, in addition to our traditional sources of the National Science Foundation and the Simons Foundation. Our faculty are also becoming key members of the university's efforts in data science/

artificial intelligence research and teaching. We are seeing numerous positive outcomes of these efforts, as will you in our feature stories on Meredith Tucker and Blake Heimann, whose careers are math-informed and data-centric.

It is an exciting time in the world of mathematics – as the world relies more and more on data, our faculty, students, and alumni become increasingly critical to tomorrow's innovation. We would love to hear from you about your experiences and contributions! I welcome your updates and thoughts on the news you'd like to hear from us.

We couldn't fit all of our news into just one issue, but I hope you enjoy this update.

Eric Weber
Chair, Department of Mathematics

ENCOURAGING WOMEN IN MATHEMATICS

SONIA KOVALEVSKY DAY

is an event that brings female and non-binary middle school students and their teachers to the Iowa State University campus to engage in fun, mathematically themed activities. On April 1, the department hosted nearly 70 participants. The students enjoyed interactive learning activities focused on optimization, topology, and graph theory. The goal of the event is to increase female and non-binary middle school students' interest in mathematics and encourage them to pursue science, technology, engineering, and mathematics (STEM) studies and careers.

Middle school students engage in interactive math activities at Iowa State. (Submitted photos).

nearly **70** PARTICIPANTS

"Do Dogs Know Calculus?"

– Timothy Pennings, *'87 Ph.D. mathematics*

CALCULUS – GONE TO THE DOGS

The department hosted Dr. Timothy Pennings ('87 Ph.D. mathematics) who gave a distinguished colloquium presentation of "Do Dogs Know Calculus?" on April 14. Pennings talked of his experience with Elvis, his faithful canine companion who enjoyed fetching sticks tossed into Lake Michigan. Pennings realized that Elvis was in fact trying to get to the stick as quickly as possible through a strategic combination of running down the shoreline and swimming in the water. Pennings' conclusion is – *Yes! Dogs do know calculus!*

Seeking podcast guests!

The department is now producing a podcast series targeted to our current student population. Our goal is to introduce our students to the abundant career opportunities available to them as mathematically and quantitatively inclined individuals.

If you have an interesting career story to share with our students, please reach out to us via email: mathematics@iastate.edu.

Inaugural Graduate Research Symposium

In a first for the department, the mathematics Graduate Student Organization (GSO) held a one-day research symposium. The symposium consisted of four one-hour talks selected by the students, a poster session open to all graduate students, and a catered lunch. The April 15 symposium coincided with the department's External Advisory Council (EAC) meeting. EAC members were impressed with the quality of the students' research and their presentations.

LIVE AWARDS CEREMONY

The annual awards ceremony was broadcast live for the first time via webcast on April 14. The ceremony recognizes outstanding accomplishments of students and faculty through scholarships, fellowships and excellence awards, promotions, and other notable honors. The webcast allowed students' families to watch their students be recognized from as far away as India! The department will broadcast future awards ceremonies; next year's information can be found on the mathematics website beginning in April 2024.

Disease model by math

Findings from a disease model developed by a research team at Iowa State University may help public health officials evaluate and improve strategies for the next pandemic.

BY RACHEL CRAMER

Claus Kadelka, associate professor of mathematics. (Hannah Wright/Iowa State University).

Nearly two years ago, the U.S. Centers for Disease Control and Prevention released its recommendations for a phased COVID-19 vaccine rollout. The agency prioritized groups based on occupation, age, living condition, and high-risk medical conditions in an effort to protect the vulnerable and reduce deaths.

But Claus Kadelka, associate professor of mathematics and lead author of a new paper in the Journal of Theoretical Biology, says future pandemic responses should also consider ethnicity and social contact patterns that affect disease dynamics.

"Many researchers in this field focus primarily on age. Who should get the vaccine first: older people who are the most vulnerable or younger people who have more contacts and can more easily spread the disease? Not considering other social dimensions when developing a vaccination strategy can lead to different or wrong predictions about the best way to prevent deaths," said Kadelka.

The researchers point to multiple studies showing that people of color have been disproportionately affected by COVID-19. The infection rate in predominantly Black counties in the U.S. was three times higher than predominantly white counties in 2020, and the Navajo Nation had more cases per capita than any state in the country.

One reason for the disparity, they explain, is that people of color are more likely to work in public-facing and high-contact jobs (e.g., transportation services, grocery stores, meat packing facilities), which do not easily allow for physical distancing and remote work. People of color are also more likely to live in higher-density or multi-generational housing where it's harder to quarantine and prevent the spread of the virus.

Using data from the CDC, U.S. Census Bureau and U.S. Bureau of Labor, the researchers applied a model they developed last year and incorporated different contact rates and occupational hazards by age and ethnicity. They then utilized the Iowa State supercomputer to analyze 2.9 million different vaccination strategies to identify those that achieved specific goals, such as minimizing infections or deaths from COVID-19.

Specific findings

"Our first big take-away from the study is that 'ethnic homophily,' the concept that people tend to interact more frequently with people from the same demographic group, matters," said Kadelka. "The best strategy that included ethnicity prevented more deaths than the best strategy without ethnicity."

Kadelka said the second big finding is less intuitive.

"When trying to minimize the number of deaths, it is best to get the vaccine to the oldest people of color first, because they are at immediate risk, followed by working-age, non-Hispanic whites and non-Hispanic Asians with high-contact jobs, so they stop spreading the virus through the community."

As to whether the optimal vaccine strategy in the model would have had the same effect in the real world, Kadelka said it's hard to know because many social and disease characteristics, like detailed contact patterns and factors affecting susceptibility to infection, are still poorly understood. But he hopes the study will spur more research in the intersection of epidemiology and sociology.

The ISU researchers emphasized that prioritizing COVID-19 vaccine access based on ethnicity is not a theoretical concept. Two states, Montana and Vermont, opened vaccine eligibility to people of color before the general public in the spring of 2021.

They also cited a study that found three dozen states set aside some of their allotted vaccines for certain residents and communities based on disadvantages in income, education and housing.

Disease models, like the one Kadelka's team developed and are continuing to work on, may help public health officials improve strategies when vaccines are in limited supply.

"Not considering other social dimensions when developing a vaccination strategy can lead to different or wrong predictions about the best way to prevent deaths."

— Claus Kadelka
associate professor of mathematics

Changing the world with mathematics

by Emily Carreon

Blake Heimann,
'17 mathematics, economics.
(Submitted photo).

"I'm a strong advocate for people interning while at university. It's a great way to help fund your lifestyle as well as give you good experience to build that up for your career later."

B lake Heimann ('17 mathematics, economics) considers attending Iowa State University one of the most important decisions of his professional career. From gaining connections at an Iowa State career fair, to working three different internships, to moving from New York to London, his experience during and after college was nothing short of an adventure. Now, as an alumnus of Iowa State, he understands his impact on the world and how the university prepared him for life after graduation.

The flexibility of a dual degree

As a freshman, Heimann was originally enrolled in the College of Engineering with a major in construction engineering. With interests in hands-on work and solving complex problems, he considered pursuing a career in a mechanical field. Heimann's father had a similar job, so construction engineering felt familiar and comfortable. But while an engineering degree presents a very direct career path, Heimann learned that an economics and math degree would provide him with the flexibility he desired.

"Having the flexibility of the math and economics degree really helped because there isn't a specific job that you're guaranteed to be lined up for when you walk away with those degrees," Heimann said.

Soon after declaring a mathematics and economics double major, Heimann took the opportunity to explore the different clubs and extracurriculars the majors offered. Internships were also a priority.

"Joining these clubs and getting these internships exposed me to what the world outside of academics looked like in these spaces," Heimann said. "I also tried to get an internship every summer because that

was really my validation for figuring out, 'OK, is this the career trajectory I want to go on?'"

With internships in construction engineering, real estate, and insurance, he had broad experiences and a diverse skill set following graduation from Iowa State.

"I'm a strong advocate for people interning while at university. It's a great way to help fund your lifestyle as well as give you good experience to build on for your career later," Heimann said.

After Heimann graduated from Iowa State in 2017, he devoted his time to finding a job. An Iowa State career fair landed him a position with TD Ameritrade. He relocated to New York and worked in a rotational program aimed toward analytics. This role piqued his interest in finance.

"Joining these clubs and getting these internships exposed me to what the world outside of academics looked like in these spaces. I also tried to get an internship every summer because that was really my validation for figuring out, 'OK, is this the career trajectory I want to go on?'"

"Some of that job was client analytics to support their product department as well as emerging technologies, so while that was product oriented it exposed me to machine learning and the AI space," Heimann said. "Then when I moved into the financial risk department, that's where things really clicked."

'Spinning plates'

Now, as a senior associate of quantitative research at WisdomTree Asset Management, based in London, Heimann works in a role he is passionate about and where he feels supported.

His team works to create systematic investment strategies that come in the form of exchange traded funds (ETF) or exchange traded products (ETP). His role is primarily research-based while also interacting with clients through presentations and keeping them updated via other materials.

When it comes to Heimann's day-to-day schedule, every day presents a new challenge. He uses the term "spinning plates" to describe the necessity for managing multiple objectives.

"It sometimes ends up being a bit of a chaotic day, but it's a good type of chaos because the markets are unpredictable, and you have to be willing to adapt. It really keeps you on your toes," Heimann said.

Heimann's firm was supportive when he decided to uproot his life in New York City and move across the ocean to London. From juggling moving costs to finding a temporary living situation, Heimann praises his firm for assisting him through the transition.

"In general, it was a good experience to have. It takes a lot to drop everything and move to another country. I'm very grateful to have the support that my firm gave me with making the process easy," Heimann said.

Realizing your impact

Heimann commends Iowa State for preparing him for a successful future. Now, he encourages current Iowa State students to grasp as many opportunities as possible.

"Collaborate as much as you can because you're not going to get far doing things alone," Heimann said. "The second thing is to get out and get exposed to how you can impact the world with the things you're learning at university."

A future full of mathematics

by Emily Carreon

Meredith Tucker ('23 mathematics) has had an exciting and action-packed four years at Iowa State. From career fairs to internships to curriculum development for future teachers, Tucker has enjoyed a variety of college experiences. After graduation, she is hopeful about her future and career potential.

From small to big

Tucker comes from a small town in Iowa called Strawberry Point. She described the opportunity to grow exponentially – coming from a small town to a bigger college town like Ames – as her proudest moment.

"Growing up in a small town, you're with the same 30 people from kindergarten to graduation. So, there are a lot more chances to meet people here. I feel like I've definitely changed as a person for the better," Tucker said.

When Tucker came to Iowa State as a freshman, she considered how choosing a degree in mathematics would benefit her future plans and career.

"I had no clue what I wanted to do at all. But I knew that I could do anything with math and then I could always switch out if I found something better. But as I got along with the math major, I found that I enjoyed it and liked the experience," Tucker said.

Gaining experience

As a mathematics major with a minor in data science, Tucker has sharpened her problem-solving and analyzing skills through hands-on work experience. In the spring of 2021, she was selected for a highly sought-after co-op opportunity with Collins Aerospace, a highly competitive employer within the aerospace engineering industry. In this role, she worked with a team that helped analyze and evaluate supplier performance.

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Meredith Tucker, '23 mathematics.
(Hannah Wright/Iowa State University).

top photo:
**Meredith Tucker,
presenting her final summary
as a data analytics intern
with John Deere.**
(Submitted photo).

right photo:
**Meredith takes a break
at the John Deere Classic
on the PGA Tour.**
(Submitted photo).

> **I THINK I WOULD HAVE FELT LOST IN MY JOB SEARCH AND LIFE PLAN IF I HADN'T PARTICIPATED IN MY INTERNSHIPS. I NOT ONLY HAVE A GREATER IDEA OF WHAT OTHER OPTIONS ARE AVAILABLE TO ME, BUT I ALSO HAVE A GREATER UNDERSTANDING OF HOW THESE COMPANIES FUNCTION.**

"I helped work on a program to analyze the accuracy of a delivery date provided by a supplier to form later predictions. I also created a manual for users to be able to navigate a new internal web-based interface we released," Tucker said.

The co-op also offered Tucker the opportunity to gain new connections and relationships by working with other interns. Originally, the co-op was meant to take place in North Carolina, but it ended up being remote, challenging Tucker to adapt quickly to a new environment.

"It was supposed to be in-person when I accepted that internship. At the time, it seemed crazy to me to take a semester off from school. I felt like everything that I had planned was kind of going off the rails," Tucker said.

Luckily, Tucker's advisor was nothing but supportive during the transition, even helping Tucker search for apartments in North Carolina.

"I don't think I would have accepted that amazing opportunity without her support," Tucker said.

In the summer of 2022, Tucker accepted an internship with John Deere as a data analytics intern where she learned new coding languages and tools. She received lots of support from her co-workers and mentors during her final project.

"My proudest moment during my John Deere internship was when I was presenting my final summary presentation. I was really surprised at the fantastic reaction everyone had to my presentation and how excited people were about what I worked on," Tucker said.

Moving forward

Currently, Tucker is working closely with Eric Weber, chair of the Department of Mathematics, on an Iowa Space Grant Consortium-funded project to develop data science content for pre-service mathematics teachers.

Weber says that Tucker has been a fantastic contributor to the project, and that her passion for solving problems will serve her well in the future.

"She's brought strong technical skills in mathematical and data science techniques as well as an eagerness to use those techniques to design important content for the curriculum we developed," Weber said. "I am confident Meredith will be successful in her career because of those skills she learned as a student at ISU."

Now that Tucker has completed her college education, she is inspiring others in the mathematics department to make connections and enjoy their college experience while they can. She is also encouraging others to reach out and find good internship experiences.

"I think I would have felt lost in my job search and life plan if I hadn't participated in my internships," Tucker said. "I not only have a greater idea of what other options are available to me, but I also have a greater understanding of how these companies function."

Ryan Martin
Scott Hanna Professor

MTA DISTINGUISHED GUEST FELLOWSHIP at the Renyi Institute of Mathematics in Budapest, Hungary. Funded by the Hungarian Academy of Sciences.

This prestigious award has been bestowed upon Martin to collaborate with internationally renowned mathematicians in the world's premiere mathematical research institute. It is the most prestigious visitation fellowship that the Hungarian Academy of Sciences provides. It is impossible to participate as a distinguished visitor without visiting the Rényi Institute itself.

As part of the visit, Martin plans to bring his two Ph.D. students, Enrique Gomez Leos and Nick Veldt, for a 3-4 week visit each and a postdoc for a 1-2 week visit.

As with his prior Fulbright, Martin expects a flurry of research activity to result from the visit as well as providing him with a well of techniques and avenues of research with which to train decades of students to come.

RESEARCH HIGHLIGHTS

Kimberly Hadaway
Ph.D. candidate

Hadaway received a prestigious National Science Foundation Graduate Fellowship, providing three years of support for her graduate studies in graph theory. Her work focuses on understanding how certain properties of graphs change with the addition or deletion of edges.

David Herzog
associate professor of mathematics

Herzog received a three-year grant from the National Science Foundation titled *"Degenerate diffusions in finite and infinite dimensions: smoothing and convergence."*

Joey Iverson
assistant professor of mathematics

Iverson received a three-year grant jointly funded by the National Science Foundation and the National Geospatial Intelligence Agency titled *"Principled machine learning and packing subspaces for improved spatiotemporal data processing."*

Bernard Lidický
Scott Hanna Professor

Lidický received a three-year grant from the National Science Foundation titled *"FRG: Collaborative Research: Extremal Combinatorics and Flag Algebras."* The $1.5 million award is a collaboration between the University of Illinois-Urbana Champaign, University of Colorado-Denver, and Iowa State University.

Rana Parshad
associate professor of mathematics

Parshad received a three-year grant from the U.S. Department of Agriculture titled *"Bottom-up trophic cascades: How a changing climate can shift plant-pest-natural enemy dynamics."*

Kostya Slutsky
assistant professor of mathematics

Slutsky received a three-year grant from the National Science Foundation titled *"Orbit Equivalences in Borel Dynamics."*

Eric Weber
professor and chair of the department of mathematics

Weber received a three-year grant jointly funded by the National Science Foundation and the National Geospatial Intelligence Agency titled *"Quantifying Human Mobility using Topological and Time-Frequency Analysis."* This award is a collaboration with Assistant Professor of Sociology Shannon Harper.

Ruoyu Wu
assistant professor of mathematics

Wu received a three-year grant from the National Science Foundation titled *"Scaling limits of queueing systems on graphs."*

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❯ It all adds up

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