Mathematics at UMW

a newsletter of the Department of Mathematics at the University of Mary Washington

Welcome from the Chair

There is something about the smell of new or the dawn of something new and exciting particularly when we think of the promise and potential such a thing represents. This new academic year is no exception, as it offers many opportunities for our community of scholars and learners. Some of these come wrapped in unexpected ways. From global pandemic whose evolution and control entail solving a system of differential equations, to presidential elections that present unique challenges in the collection and the processing of vast amounts of data, the skills derived from courses in mathematics and statistics are always in very high demand.

My colleagues and I are happy to be back, and to have you back, as we anticipate outstanding times of scholarship within and beyond the lecture halls. In a few weeks, four students who participated in this year's summer science institute will share their research with us. We also hope to see increased involvement of some of our alums with a career/coaching panel and with presentations about their current areas of work.

As a community that deliberately celebrates and promotes a knowledge and data-driven economy, our hopes are high as we passionately discharge our duties and collaborate in advancing knowledge through interdisciplinary projects. I am happy to welcome you and to encourage you in your pursuits as you seek to master and promote the amazing gains derived from studying mathematics, statistics, actuarial science, data science, etc.

With best wishes for a productive year,

Julius N. Esunge Professor and Chair, Department of Mathematics

Honors Projects

Kayla Kippes completed her departmental honors thesis, Using a Distributive Approach to Model Insurance Loss, under the guidance of Dr. Melody Denhere. Kayla explored different probability distributions that are commonly used with insurance data in an effort to determine a distribution that works best for car insurance. She estimated the shape and scale parameters of the Weibull and Gamma distributions using the method of moments and maximum likelihood estimation techniques. She also considered other right-skewed distributions such as Pareto, Rayleigh and Lognormal distributions. Through simulations and by analyzing an auto insurance dataset, Kayla was able to determine that the Gamma and Weibull distributions resulted in a better fit to model the data. She also analyzed different attributes that



University of Mary Washington

Continued on page 2

Honors Projects - continued from page 1

could affect insurance claim and determined that the age of the driver and the time of the incident (morning, afternoon, evening) resulted in different parameter estimates for the Weibull distribution. Kayla was honored with the department's Oscar Schultz Award, which is given annually to an outstanding math major who demonstrates "the desire and potential to master the art of mathematics." Kayla is currently a graduate student at North Carolina State University where she is pursuing a master's degree in statistics. Ω

Summer Science Institute

Catherine Nguyen and **Tori Mueller** collaborated to address the Susceptible-Infected-Recovered-Susceptible (SIRS) model for COVID-19 under the guidance of **Dr**. **Leo Lee**. Catherine used analytical methods on three simplified models derived from the original, illuminating various aspects of the model. In the first model, *S* was solved implicitly over time, assuming a zero-recovery rate. The second model introduced a time-dependent contact rate, and an exact solution was again derived implicitly for *S*. Lastly, the third model assumed no contact rate, with all terms being solved implicitly for *I*. These solutions demonstrate how individuals can impact the spread of COVID-19 in various scenarios.

On the other hand, Tori applied numerical approximation methods to simulate the model. She utilized MATLAB to develop her own code, generating reliable graphs and predicting future trends. She also manipulated parameters, particularly by increasing the reinfection rate, gaining valuable insights into how trends might evolve when new strains of the virus emerge and immunity wanes. She then provided comparisons between the outcomes of the numerical methods and collected data. The results of these methods offer graphical insights into COVID-19 trends, providing time for appropriate actions to be taken to avoid potential major outbreaks in the future.



Christopher Hudert and **Miranda Herd** worked on projects with **Dr. Julius Esunge**. Christopher skillfully handled a project on the interplay between statistics and music. Through experimentation with code written in Python, he was able to show the decomposition of a music file into deterministic and stochastic components by means of a filtered stochastic integral.

Miranda's project focused on modeling an optimal portfolio given a range of possible investment options. She was able to work through ideas like Sharpe's ratio, the Capital Asset Pricing Model, and efficient frontiers to determine the optimal portfolio using historical data for scenarios involving three and five different assets. Ω

Sumner Wins Teaching Award

At the opening faculty meeting of the year in August, **Dr. Suzanne Sumner** received the Grellet C. Simpson Award for Excellence in Undergraduate Teaching. This award, honoring UMW's fourth president, is given annually to a full-time faculty member who exhibits quality teaching and values the liberal arts. In addition to developing and teaching numerous math courses for the department, Dr. Sumner is also a founding instructor of UMW's Race and Revolution FSEM, which she teaches regularly. Her nominators for the award reference her "what would you get on the bus for?" assignment, which asks students to focus on a cause for which they would choose to be an activist. Dr. Sumner is known for supporting students both in and out of the classroom, often hosting informal problem sessions to help her students grasp challenging concepts. Ω



Faculty Notes

Melody Denhere published a research article, *Generalized Signed-Rank Estimation and Selection for the Functional Linear Model*, in the *Statistics* journal.

Julius Esunge submitted three papers, one of which appeared in print in the *Journal of Stochastic Analysis*.

Randall Helmstutler served as a mentor, presenter, and program facilitator for the 2023 Beard Leadership Circle, a year-long professional development program for department chairs offered by COPLAC. The Beard group met in Sonoma, California for a week in July to discuss current issues affecting academic units at public institutions. Dr. Helmstutler also assisted in moderating a mini-course in active pedagogy at the MAA's Mathfest meeting in Tampa in August

Debra Hydorn was a coauthor, with Tyler Frankel, on the article "Investigating the potential impact of coal ash runoff on freshwater Seminole ramshorn snail (Planorgella duryi) under laboratory conditions" that was published in *Chemosophere* in January, 2023. Dr. Hydorn conducted the statistical analyses of the data that were discussed in the article. Other coauthors on the article are Liana Giancarlo (Chemistry), Ben Kisila (Earth and Environmental Science), and Catherine Crowell, a recent graduate of Mary Washington who did undergraduate research under Dr. Frankel's mentorship.

Leo Lee served as a co-chair for the Applied Mathematics and Statistics Symposium at the U.S. - Korea Conference 2023 held in Dallas, TX. Additionally, he delivered a talk titled "Exploring Dynamics of HIV Infections: An Analysis of the Susceptible-Infected-Virus Model in Deterministic and Stochastic Forms" during the conference.

Suzanne Sumner and Faculty Emerita Marie Sheckels attended the MOVES (Mathematics of Various Entertaining Subjects) "Threads through Mathematics" Conference in New York City. Dr. Sumner presented a workshop titled "Fish and Fowl: Weaving Ribbon," and Dr. Sheckels presented "Designing Log Cabin Quilts and Afghans." Ω



Alumni Spotlight: Christopher Lloyd

Tell us about your education and/or career path since graduating from UMW. What is your current role?

After graduating from the University of Mary Washington in 2016 with a major in mathematics and a minor in computer science, I entered the University of Virginia's mathematics Ph.D. program. Under the careful guidance of my advisor Dr. Nicholas J. Kuhn I successfully proved a new result, bundled my 165page thesis together, and graduated with my Ph.D. in the Spring of 2021.



After graduating I began work as a mathematician for the Federal Aviation Administration. In this role I work on improving the efficiency of the National Airspace System. I have had the opportunity to travel internationally to conferences and present papers.

Tell us about your involvement in undergraduate research with math faculty. How did you initiate that experience?

During my final year, Dr. Helmstutler approached me about the prospect of working on an undergraduate honors thesis. This opportunity gives the student a tiny taste of what writing a Ph.D. might be like. The research problem was in the area of non-commutative cryptography. Most modern cryptography relies on the key fact that you can multiply two numbers a and b as either ab or ba and get the same thing. This area of research tries to figure out how to make cryptography work using a's and b's where ab is not equal to ba. The hope would be that this might yield a stronger form of encryption.

The key takeaway from my experience doing undergraduate research is perseverance. Most problems (in math and life) do not have solutions, and for those that do, you have to work hard.

What advice do you have for a current or prospective student?

University of Mary Washington is an excellent place to be exposed to lots of different subjects. Even if you think you know what you want to study, it is still worth taking subjects out of your comfort zone. My biggest regret in my undergraduate career was not taking enough statistics courses.

How did your time at UMW prepare you for your career?

I am of the opinion that a degree in mathematics teaches you how to think clearly and articulate yourself. This skill is completely transferable to any domain. A mathematician is constantly asking themselves questions like "are these assumptions true?", "do I need all of these assumptions?", "what happens if I remove this constraint?" This is why math majors are very hirable.

What non-math skill did you acquire at UMW that has been helpful in your life after UMW?

Collaboration and communication skills. At its core, math is about communicating ideas effectively and clearly. You may have come up with the best idea ever, but if no one can understand it, then it is of no use. Studying math can be a lot of fun, especially if you form a group of math major friends to study together with. It will really help your communication skills. Ω



SCAN ME

Check out our website cas.umw.edu/math

View our page devoted to our alumni and, better yet, email Dr. Esunge at jesunge@umw.edu to get yourself included!



Are you a member of our Facebook group? Look up UMW Mathematics and join today!