Mathematics at UMW

Fall 2022

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

Welcome from the Chair

Farmer Hall is bustling anew as we all return from nearly two years of dealing with a pandemic whose trajectory remains uncertain, but slightly more predictable. At the heart of the work of many mathematicians is the desire to understand and capture in the simplest possible way any prevailing trends and patterns to better anticipate what lies ahead. Our students and faculty have shown determination, passion and commitment to foster a strong community of inquisitive and dynamic learners. Thus, we begin this semester, and the academic year, with most of our classes meeting in person, and we are hopeful for truly rewarding times and many "aha" moments.

Our return to face-to-face lectures allows us to continue engaging our students, alumni, and faculty in meaningful ways. In particular, we will welcome one or two colloquium speakers, and have another faculty member speak during our ***Life of a Mathematician*** seminar series. We will also be hosting a career and alumni panel to complete our robust course offerings in equipping current students for their pursuits beyond UMW.

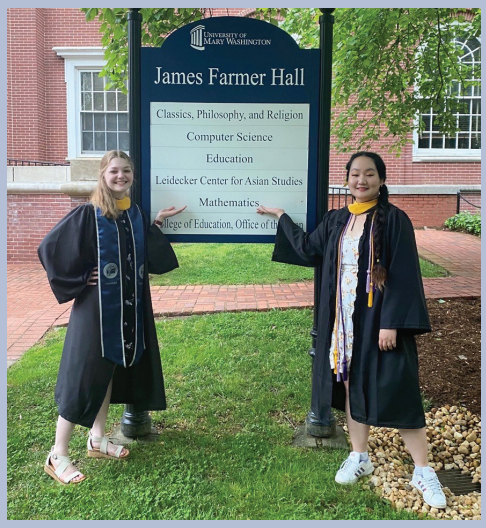
Last year brought us wonderful news with the tenure and promotion of Dr. Jeb Collins, who is now an associate professor. We are also delighted to receive administrative support from Mrs. Vivian Garnett-Lynch, as well as our dynamic students who serve the department as aides during the semester. I hope that this year brings all of us many joys and many exciting developments.

With best wishes for a fruitful year,

Julius N. Esunge
Chair, Department of Mathematics, UMW

Honors Projects

Timothy Corbett completed his honors thesis *Einstein's Equation, Lagrangians for General Relativity, and The ADM Formalism* with **Dr. Yuan-Jen Chiang** in May 2022 which fulfilled UMW Honor Program as well. Timothy presented it virtually at an MAA Meeting in Florida in February 2022 and is currently enrolled in a PhD program in Mathematical Physics at Georgetown University.



Caitlin Holt completed a thesis project under the guidance of **Dr. Leo Lee**, applying the Susceptible-Exposed-Infected-Quarantined-Recovered model to COVID-19. In her honors thesis, she derived an analytical solution to a simplified version of the model, created by making various assumptions about the original model. Then she generated computational solutions using algorithms based on numerical methods such as Euler's Method, Runge-Kutta Method, and Multistep Methods. Her honors project was very successful. As a result, Caitlin delivered a poster presentation at the undergraduate mathematics and statistics conference at James Madison University, and all of her hard work culminated in an excellent 41-page long honors thesis. In addition, she

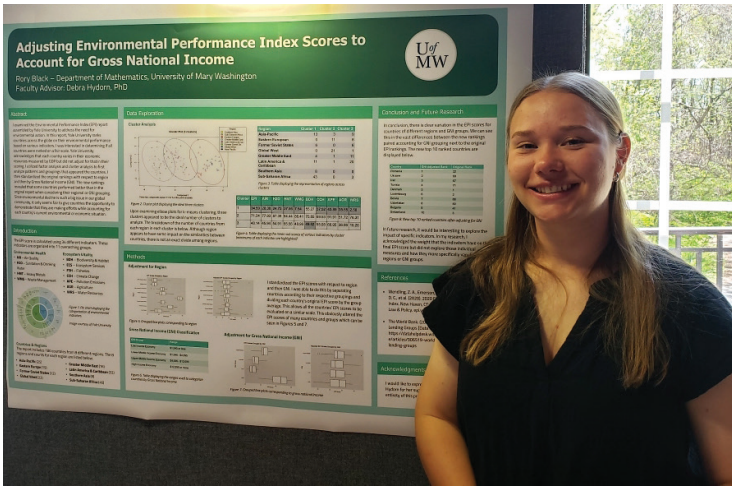
continued on page 2

University *of* Mary Washington

Honors Projects continued

wrote an article with her research collaborator Trevor Drinkwater, which they submitted to a math journal.

Lynn Sherman defended her honors thesis *ElGamal Encryption in the General Linear Groups,* which was supervised by **Dr. Helmstutler**. In her work, Lynn examined matrix-oriented analogues of the discrete log problem, using this new formulation to extend the ElGamal cryptosystem to matrices. She also analyzed the security of this new scheme against a brute force attack, requiring her to become familiar with some deeper topics in abstract algebra. Lynn is now in the Ph.D. program in mathematics at the University of Tennessee.



Rory Black completed her Honors program project with **Dr. Hydorn** on *Adjusting Environmental Performance Index Scores to Account for Gross National Income.* In addition to investigating differences between countries due to GNI, Rory also investigated regional differences in the EPI. She also conducted a cluster analysis to explore differences and similarities between countries based on factors used to define the EPI.

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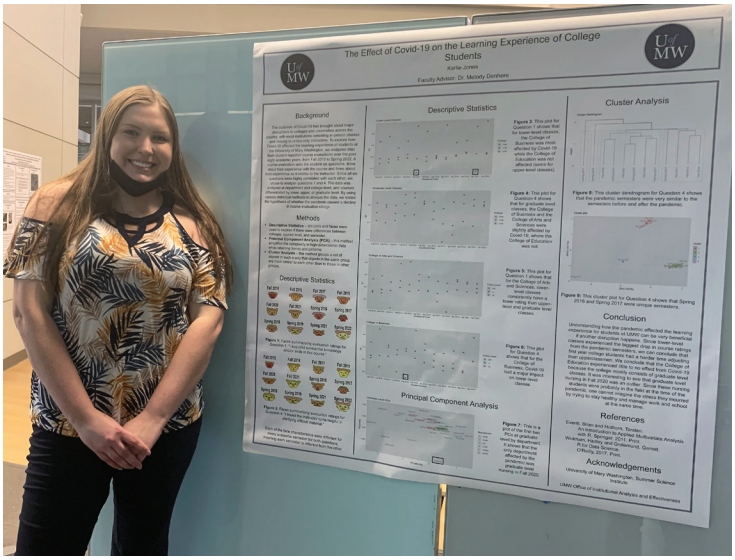
Jenna Diehl and **Karlie Jones** worked on statistical projects with **Dr. Melody Denhere**, analyzing UMW's historic data provided by the Office of Institutional Analysis and Effectiveness.

Jenna's project, *Analyzing Trends in College Majors*, explored trends in the degrees conferred at UMW. The objective of this research was to explore the occurrence of trends in college majors over a twenty-year period. Multivariate statistical methods were used to analyze this data by department and by



college. There was strong evidence that the degrees conferred across the different departments were different over the years. Using cluster analysis, Jenna was able to show that while there was little change in trends between consecutive years, in the long run students' choices of majors was evolving with time.

Karlie analyzed the course evaluations ratings at UMW using different statistical tools. Her project titled, *The Effect of Covid-19 on the Learning Experience of College Students*, analyzed data from student-reported course evaluations over the past eight academic years, from Fall 2015 to Spring 2022. The goal of the project was to determine if the pandemic semesters (Spring 2020 to Spring 2021) had lower course ratings when compared with non-pandemic semesters. Karlie used a variety of statistical methods and determined that there was evidence that the learning experience for students in lower-level classes (first-years/sophomores) was the most affected compared to students in upper-level and graduate level classes. Among the colleges, the College of Education was the least affected by the pandemic compared to the College of Arts and Sciences and the College of Business.

Summer Faculty Research Program at Dahlgren

This summer **Dr. Jeb Collins** participated in the Summer Faculty Research Program organized by the Office of Naval Research. This is a program where faculty members from various academic institutions have the opportunity to work on research projects at Navy research labs. This allows faculty member to broaden their research focus as well as develop lasting relationships between government researchers and academic faculty. Dr. Collins worked with Blake Van Winkle

at the Naval Surface Warfare Center - Dahlgren Division this summer. His research involved a generalization of a Monte Carlo Tree Search. This is a method popularly used by AlphaGo, the first computer program to defeat a professional human Go player. The Dahlgren labs are looking to use a generalized version of this method to consider continuous states instead of discrete states. The goal is to use the method to develop a trajectory tube for flight vehicles, given their initial conditions and various other flight parameters. In particular, Dr. Collins used an unsupervised machine learning algorithm called clustering to take the partial data of a Monte Carlo tree to determine the missing information of the tree. This is useful as determining the full tree is computationally expensive, while using clustering to fill in missing pieces is much cheaper. Dr. Collins will continue working with Mr. Van Winkle throughout the next academic year to further the research started over the summer.

Faculty Notes

Yuan-Jen Chiang published two research articles in refereed journals including "Second Variation Formula and Stability of Exponentially Subelliptic Harmonic Maps" in *Complex Analysis and Operator Theory* by Springer. She also virtually presented a publication at the International Conference on Physics and Its Applications in San Francisco CA in July 2022.

Randall Helmstutler travelled to Sonoma State University in California to participate in the Beard Leadership Circle, a year-long academic leadership development program offered by the Council of Public Liberal Arts Colleges. He also attended several virtual conferences, including the Metropolitan New York section meeting of the MAA, where he gave a talk on the discrete log problem in matrix groups.

Janusz Konieczny published the research article "Semigroups of transformations whose restrictions belong to a given semigroup" in the journal **Semigroup Forum**. He also co-authored a research article, "Matrix theory for independence algebras", published in the journal **Linear Algebra and Its Applications**. His Erdős number is now 2.

Leo Lee attended the U.S. - Korea Conference 2022 and gave a talk titled "Computational and Mathematical Approaches to a Modified SEIR Model for COVID-19".

In August 2022, **Suzanne Sumner** and Liane Houghtalin (Classics) delivered the presentation "Puzzling Mathematics in Ancient Greek and Latin" for the MOVES (Mathematics of Various Entertaining Subjects) Conference in New York City.

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Upcoming events

This academic year will feature two departmental colloquia as well as the next speaker in our *Life of a Mathematician* series. For the colloquia, we will welcome Dr. Carolyn Chun on Wednesday, October 19th and Dr. Miranda Teboh Ewunglem for a talk on Wednesday, February 15th. Titles and abstracts for each of these talks will be published on our departmental website when available.

Our next speaker in the *Life of a Mathematician* series is **Dr. Keith Mellinger**, Dean of the College of Arts and Sciences and professor of mathematics. Dr. Mellinger will be presenting on March 15th. For times, locations, and more details about these talks and other departmental events, please check our website, and be on the lookout for fliers posted around Farmer Hall.

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

Check out our website
cas.umw.edu/math

SCAN ME

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