

Mathematics at UMW

Fall 2021

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

Welcome from the Chair

You have heard the saying that when life gives you lemons, make lemonade. Last year was unique in many regards. Together, we boldly embraced the challenges of an environment for which we had no prior experience and pushed through with delivering our curriculum and our program with courage. Our students and our faculty deserve credit for showing great flexibility and adaptability in the midst of a global pandemic.

This year affords us the opportunity to continue our excellent work with the majority of our classes meeting in person. The excitement and joys of being back together does not blind us to the need to maintain our guard and observe the underlying measures to mitigate the spread of the pandemic and its variants. For us, mathematicians and statisticians, this environment of uncertainty and dynamic changes is, in a strange way, fertile for our work. The examples and

opportunities for learning and scholarship are plentiful, and we will continue to leverage them.

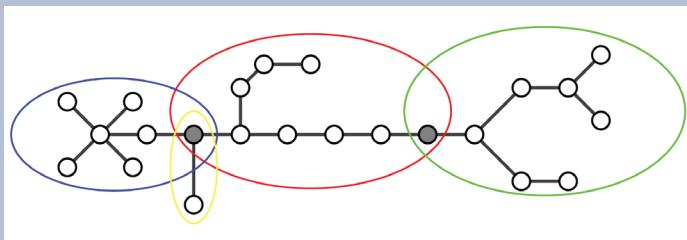
We are looking forward to a fantastic year of learning and working together as we seek to utilize the available online and in-person spaces. As you come to campus, you will find a few changes in the building as some faculty have moved offices following last year's retirement of our esteemed colleague Dr. Marie Sheckels. Our Office Manager, Ms. Katina Taylor, is now in Farmer 129, Ms. Jen Magee is in Farmer 127, and my office is in Farmer 123, while Mr. Perkins is in Farmer B50. I am also pleased to announce Dr. Janusz Konieczny (Dr. K) as the next speaker in the *Life of a Mathematician* series.

With best wishes for a productive year,

Julius N. Esunge
Chair, Department of Mathematics, UMW

Honors Projects

Paige Beidelman completed a departmental honors thesis with **Dr. Jeb Collins**. The title of her thesis was *Game Chromatic Number on Segmented Caterpillars*. Paige has done multiple summer research projects during her time at UMW, all of which have been in graph theory. She began



this work with Dr. Collins in the fall of 2020, learning a new subfield of graph theory called competitive graph theory. This involves playing a game on a graph with two players. Her work involves examining these games to determine under what conditions one of the players always has a winning strategy. Paige is currently pursuing her master's degree in education at Mary Washington.

Makayla Ferrell wrote her honors thesis *Simulations of an Attack on RSA* under the direction of **Dr. Randall Helmstutler**. For her project Makayla examined how the well-known baby-step/giant-step algorithm could be exploited to recover the private key from an RSA public key. Her idea was to use the algorithm, not once, but twice in order to generate multiple solutions to a certain equation to potentially find the private key. She coded several hundred simulations of her attack on actual RSA keys, showing that her method worked in all cases. It remains to be shown how this new attack would scale to large moduli.

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Honors Projects continued

Makayla now works as a software engineer for the Department of Defense and is pursuing her master's degree in computer science at Georgia Tech.

Brandon Williams continued his SSI project to investigate the behavior of confidence intervals for model parameters for nonlinear source functions, completing his honors thesis under the direction of **Dr. Debra Hydorn**. Brandon wrote a program to simulate fitting the model to data that was randomly generated for each source model using the same source models from the summer and the same specifications (number of data points, degree of curvature, amount of variation). He found that, for many of the models, the simulated capture percentage for 95% confidence intervals was less than 95%. He also investigated the use of bootstrap confidence intervals but was unable to include this in his project results. Brandon is currently working as a Research Assistant for the Statistics Department for the Investment Company Institute.

Lehman and Sheckels Present in New *Life of a Mathematician* Series

In October 2020, **Larry Lehman** gave the inaugural talk in the department's new *Life of a Mathematician* series. *Life of a Mathematician* is a series of colloquia by members of the mathematics department designed to give students insight into the lives of faculty members outside of the classroom. In his talk, Prof. Lehman recounted his early days as a number-obsessed 4-year-old, his inspiration for pursuing a math major in college, his experiences as a graduate student at the University of Virginia, and his teaching and research interests at Mary Washington.

The second talk in the series featured **Marie Sheckels**. Prof. Sheckels explained how an experimental teaching program in her eighth-grade math class and being involved in lesson-planning sparked her interest in mathematics education. She shared about her work experience before coming to Mary Washington, the variety of classes she taught in both mathematics and education, and her extensive grant work related to course development and teacher preparation.

Check the math department's events page for information about more talks in this series, including the upcoming talk by Professor **Janusz Konieczny** in Fall 2021.

Darden Award Winners

Two math majors received the Colgate W. Darden award at this year's graduation. This award is given to the graduating senior(s) with the highest cumulative GPA. Math majors **Katherine Safian** and **Margaret Gregory** were honored with the award. Both students were inducted into both Phi Beta Kappa and Pi Mu Epsilon honor societies.



Katherine Safian graduated as a Mathematics major with a minor in Spanish. Kate graduated with a 4.0 math GPA and an overall GPA of 3.99. She completed the honors program and graduated with university honors. Katherine will be back at UMW for one more year, doing her graduate studies with the College of Education. Afterwards, she plans to teach middle or high school

math at a Virginia public school.

Margaret Gregory graduated with a double major in math and physics, and with honors in physics. She received an A in all her mathematics and physics courses at UMW. Margaret is currently a Ph.D. student in physical oceanography at Massachusetts Institute of Technology.



Department Hosts Visiting Scholar Ken Ono



In February, the math department hosted a virtual visit from Phi Beta Kappa Visiting Scholar Ken Ono. Dr. Ono, the Thomas Jefferson Professor of Mathematics at the University of Virginia, was an executive producer and mathematics consultant of the film "The Man who knew Infinity." During his visit, Dr. Ono visited several classes and gave the public lecture "Why does Ramanujan, 'The Man Who Knew Infinity,' matter?" His lecture described the life and achievements of Ramanujan via movie clips and anecdotes. Prior to the visit, math majors enjoyed a film showing of "The Man who knew Infinity."

Dr. Ono's presentation for Dr. Sumner's History of Mathematics class was "My Search for Ramanujan: How I learned to Count," which described how his life has intertwined with Ramanujan's. For Dr. Helmstutler's Mathematical Cryptography class, Dr. Ono lectured on "What is the Riemann hypothesis, and why does it matter?" In Dr. Sheckels' Finite Mathematics class, Dr. Ono's lecture was on the topic "Adding and Counting. Partitions and Applications." Dr. Lehman's Algebraic Number Theory class was treated to Dr. Ono's "Proof that Fermat's Last Theorem is almost always true." Videos of these lectures are posted at the UMW Mathematics Department events page.

Jepson SSI

Trevor Drinkwater and **Caitlin Holt** worked together to solve the Susceptible-Exposed-Infected-Recovered-Passed (SEIRP) and the Susceptible-Infected-Vaccinated-Recovered (SIVR) models for the COVID-19 under the direction of **Dr. Leo Lee**. Trevor used the SEIRP model to study the trends of the epidemic in the U.S., India, and Virginia; his results provided an illustrative picture of the declining trend of infected populations in all studied regions. He found analytical solutions to two simplified versions of the model giving exact results; these solutions show how pre-symptomatic and asymptomatic individuals affect the spread of COVID-19. On the other hand, Caitlin investigated trends in infections and vaccinations for the COVID-19 using the SIVR model. She developed algorithms using various numerical methods and wrote computer codes to generate graphs and approximate solutions of the model. Her results could be used to predict future trends in infection and vaccination rates and provide time for appropriate actions to be taken to avoid possible major outbreaks.

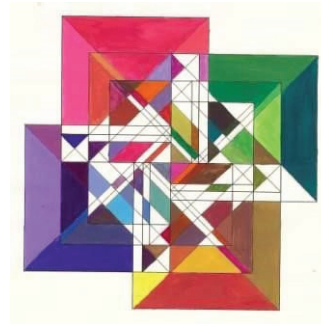
Mathematical FSEMs Featured in MAA Book



A new publication by the Mathematical Association of America (MAA) includes three chapters that describe First-Year Seminars (FSEMs) offered by Mathematics Department faculty. *Mathematical Themes in a First-Year Seminar* includes descriptions of 36 seminars divided into eight sections. The first section, on Cryptography,

Research, Writing, and Speaking Skills Through a Seminar on Cryptology, written by **Keith Mellinger** and **Randall Helmstutler**. Their chapter describes the inquiry-based approach to teaching the technical topics of the course, while also explaining how the topics naturally allow for research and communication assessments. **Jen Magee** and **Jeb Collins** have also taught this FSEM.

The section on Mathematics, Art, and the Natural World includes descriptions of two UMW seminars. In *The Art of Mathematics as a First-Year Seminar*, **Debra Hydorn** explains how she introduces students to the geometric properties and categories of mathematical patterns through



the art of M.C. Escher. Students in this seminar explore Euclidean and non-Euclidean geometries and the role of perspective in art. In addition to papers and oral presentations, students complete two art projects for this seminar: one for which they create a tessellation and another where they explore geometry in art using Geometer's Sketchpad. **Marie Sheckels** has also taught this FSEM. In **Suzanne Sumner's** chapter, *The Mathematics of Chaos as a First-Year Seminar*, she describes her efforts to incorporate primary sources, inquiry-based learning, writing, and speaking assignments so that the students discover patterns in chaos and fractals. Former UMW faculty member Jeff Edmunds was the first to teach this FSEM. The eBook version of this MAA publication is available free to members of MAA.

Faculty Notes

Yuan-Jen Chiang published three research articles in refereed journals including one in the European Journal of Math. She also delivered a presentation at the 8th European Congress of Math.

Julius Esunge hosted a special session of applications of stochastic analysis at the (virtual) Joint Mathematics Meetings in January 2021, submitted a proposal for the joint American and European Mathematical Society meetings in Grenoble, France, and published two papers.

Randall Helmstutler was the invited speaker in the Department of Mathematics and Statistics colloquium at Connecticut College in March. There, he gave a talk on the current state of research in non-commutative cryptography.

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Faculty Notes continued

He also gave the joint talk *Reimagining Virginia High School Mathematics* with alumna Jenny Polm (class of 2005) at the fall meeting of the MD-DC-VA section of the Mathematical Association of America.

Debra Hydorn gave a presentation about the Community Engagement activities in one of her Introduction to Statistics sections at the AAC&U PKAL Transforming STEM Higher Education virtual conference in November 2019. She was also an invited participant in AAC&U's Knowledge Exchange Institute to discuss approaches to increasing participation in the STEM disciplines.

Janusz Konieczny received the 2021 Waple Faculty Professional Achievement Award. He also published three research articles in refereed journals.

Leo Lee attended the U.S.-Korea Conference 2020 and gave a talk "Solutions of the Model of HIV-1 Dynamics" as an invited speaker.

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!