

A Newsletter of The University of Tennessee at Chattanooga Department of Mathematics

Issue 1 Fall 2019

Note From the Department Head



Dr. Chris Cox | Department Head

As we wrap up the semester and enjoy a well-deserved holiday break, it's a good time to reflect on six months of having the privilege to work at UTC.

I knew when I started in July that the UTC Math department is highly productive in teaching, research, and service, though I didn't realize the extent to which the department is firing on all cylinders. Several of our faculty members have had their online courses certified through the Quality Matters course-review system. The Math Plaza is providing valuable tutoring, online test-taking, and other services to our students.

A graph in the UTC ORSP 2019 Annual Report shows that the Math Department leads the College of Arts and Sciences, dollar-wise, in proposals submitted (over \$2 million) and awards (\$324,000). In the past 3 years, faculty have seen nearly 100 research papers appear, another 60 either submitted or under review and delivered more than 50 conference presentations. Grant funding is supporting research by faculty and students (both graduate and undergraduate). Our faculty members continue to help with the Tennessee Mathematics Teachers Association Exam and run an annual Math Poster Competition for area middle and high school students, most recently involving around 200 students. We're making plans to host the American Math Society's SE Sectional Meeting in October 2020.

There are many more brag-worthy items that I've left out because of space limitations. More details about some of our recent accomplishments are in this newsletter. Our multi-talented administrative specialist, Heather Heinlein, is the point person for the newsletter as well as the blogpost (Mathematics News on the department website) that she set up this year. We welcome your input, including newsworthy items to post on the blog.

Here's hoping that we all have a safe and restorative holiday as we look forward to what I anticipate will be a rewarding and productive 2020.

-Chris

Department of Mathematics Completes Successful Fall 2019 Colloquium Series



The Department of Mathematics Colloquium Series has wrapped up a successful fall semester. The department hosted five research talks this semester covering a wide range of topics in Mathematics.

The series began in September when the department hosted Dr. Taufiquar Khan from Clemson University. He shared his research on Sparsity Regularization Using Wavelets in Electrical Impedance Tomography. In October, Dr. Tao Lin visited from Virginia Tech University and spoke about Immersed Finite Element Methods and Some Applications.

November proved to be the busiest month with three talks. The first talk was given by UTC Ph.D. Computational Science – Applied Mathematics student Christopher Corley. He shared his research on The Density of Complex Zeros of Random Sums. Later in the month, the department was happy to host Dr. Rajeev Kumar from the Oak Ridge Laboratory who gave two research talks. The first was on Field Theoretic Methods for Polymers as part of the Colloquium Series. He also gave a talk on Understanding Electrostatic Correlations in Polymers as part of the UTC Department of Mathematics/SimCenter Colloquium Series.

The department looks forward to an active spring semester. Stay tuned for announcements on upcoming talks!.

RESEARCH EXPERIENCES FOR UNDERGRADUATES



2019 NSF Mathematics REU Summer Program Ends with Student Research Presentations

The department's NSF Mathematics REU Summer Program in mathematical analysis has had a remarkable first year. This REU program provides an intensive eight-week research experience that prepares advanced undergraduates for the rigours of graduate level research in mathematics.

Eleven talented undergraduates selected from a pool of 105 applicants from top U.S. institutions came to UTC to work under the mentorship of Andrew Ledoan, Jin Wang, and Roger Nichols on original research on the interface of analytic number theory and harmonic analysis, differential equations and mathematical modelling, including optimal control simulation, and functional analysis and operator theory.

The REU program's Special Summer Mathematics Colloquium Series, augmented by fun group activities, presented unique opportunities for the REU students to interact with visiting mathematicians and scientists from Alabama, Georgia, Kentucky, and Tennessee, whose research advances the frontiers of mathematical analysis and its applications.

The results of this summer research will be announced to the mathematical community through arXiv.org. Their manuscripts will also be submitted for publication in peer reviewed journals.

We are very proud of our first class of REU students and their hard work and accomplishments. We are looking forward to an equally spectacular second year for the REU program.



Department of Mathematics Welcomes New Department Head

Dr. Christopher Cox announced as the new Department Head for the Department of Mathematics to begin 2019-20 academic year.

The Department of Mathematics is pleased to welcome Dr. Christopher Cox as the new Department Head. Dr. Cox arrived in Chattanooga in July 2019 from Clemson University where he was a professor and chair of the Mathematical Sciences Department. In his final year at Clemson the Department transitioned to the School of Mathematical and Statistical Sciences, with Dr. Cox as the Acting Director.

He has taught courses at all levels, from freshman calculus through graduate level numerical analysis. Dr. Cox's research interests are primarily in the area of modeling of fluid flows, including filtration and polymer processing, often using finite element methods.



Pi Mu Epsilon Hosts Annual Sudoku Showdown

The Pi Mu Epsilon chapter of the Department of Mathematics hosted their annual Sudoku Showdown competition on Saturday, November 16, 2019. This is an annual competition held to benefit the Chattanooga Community Kitchen. Participants contributed items for the Community Kitchen in lieu of an entrance fee.

This year's winner was Connor McPherson. McPherson is a current Computer Science major and Mathematics minor at UTC. First prize was a gift card to a local restaurant and was presented by Matthew McCarver, President of Pi Mu Epsilon.



UTC Graduate Named Math Plaza Supervisor

Trevor Thomas joins the Department of Mathematics faculty and staff to oversee the Math Plaza.

The Department of Mathematics is happy to welcome Trevor Thomas as the new Math Plaza Supervisor. Thomas is originally from Rockford, IL but moved to Chattanooga in 2016 to work on his Master's degree in Mathematics at the University of Tennessee at Chattanooga. He graduated in 2018 with a Masters of Science degree in Mathematics with a concentration in Education.

He worked for the Department of Mathematics as a Visiting Lecturer for the 2018-19 academic year and began his position as Math Plaza Supervisor on August 1, 2019. Thomas looks forward to revamping how the Math Plaza is run as well as implementing some much needed updates to the Plaza itself. He plans to focus on upgrading the computers, designing marketing materials and revamping old testing policies to make testing in the plaza more streamlined for tutors and students alike. He is also hoping to create a separate testing area in the Plaza for students to have tests proctored in a less distracted environment and adding tutoring sessions on a weekly basis in addition to the drop-in tutoring services that are currently offered.



Gao Awarded Internal BRIC Grant

Dr. Lani Gao, Associate Professor in Statistics, most recently won an internal BRIC grant (\$25,000), from the UT Health Science Center and UT College of Medicine who are partnering with the University of Tennessee Chattanooga to support a new inter-institutional collaborative research pilot grant program.

The title of the project is "Association of Hyperchloremia and In-Hospital Mortality Among Critically III Adult Patients". The award period is from January 1, 2020 -December 31, 2020. The aim of the this project is to investigate the association between hyperchloremia and in-hospital mortality. The proposed retrospective study of associations between hyperchloremia and mortality for intensive care patients will add to the existing body of knowledge and has the potential to lead to the development of a clinical intervention to rapidly identify and treat ICU patients to reduce in-hospital mortality rates.

As the PI of UTC campus, Dr. Gao will design, develop and conduct statistical methods for the data analysis and collaborate with Dr. Patrick Koo and Dr. Jensen Hyde from UT College of Medicine and Erlanger Hospital to seek future external grant opportunities.

Dr. Gao will be mentoring one graduate student who is interested in this project and the selected graduate student can

be partially supported by this grant.

Colby Wolfe Wins Stan Byrd Mathematics Problem Competition for Fall 2019

Colby Wolfe, a Computer Science: Software Systems major and Mathematics minor, has won the Stan Byrd Mathematics Problem contest for the Fall 2019 semester. This math problem contest was originally organized by Dr. Stan Byrd during his time in the Department of Mathematics. The Stan Byrd Mathematics Problem contest was established in Fall 2017 following the retirement of

Dr. Byrd to carry on the legacy of the contest. Each semester, students are given a math problem to work out. The winning student receives a small award from the department.



Math Moments Issue 1 Fall 2019

GRANTS



Gao Collaborates on National Science Foundation Grant

Dr. Lani Gao, Associate Professor in Statistics, was recently awarded a research grant from the National Science Foundation titled "Transforming Data Science Education through a Portable and Sustainable Anthropocentric Data Analytics for Community Enrichment Program". The grant is for \$723,641 to be used between Oct. 2019 to Sep. 2022. As Co-Pi, Dr. Gao will collaborate with Dr. Yu Liang (Pl). Dr. Tony Skjellum, Dr. Dalei Wu and Dr. Hemant Jain.

With the support of this grant, Dr. Gao will be able to support 4 of the department's current undergraduate math majors who will work on projects in data science under the supervision of Dr. Gao.

The project endeavors to promote undergraduate training in data science. An interdisciplinary and multi-institutional collaboration will strive to establish an infrastructure that accommodates 41 students and spans the entire four years of their college career. The project aspires to enhance current data science and related curricula of the participating institutions, as two of them have data science programs for undergraduate and graduate students. To attract students with a broad range of interests, ADACE will consist of four core modules: mathematics foundation, computational foundation, data science, and data science applications. It will also integrate multiple interdisciplinary and human-centric community projects.



Wang Awarded Three Year Grant From the National Institutes of Health

Dr. Jin Wang Awarded a research grant from the National Institutes of Health worth \$340,000 over three years.

Dr. Jin Wang, Professor and UNUM Chair of Excellence in Applied Mathematics, was recently awarded a research grant from the National Institute of General Medical Sciences under the National Institutes of Health (NIH). The amount awarded is \$340,000 and the project runs from 2019 to 2022. With the support of this NIH grant, Dr. Wang will study the dynamics of cholera using mathematical modeling and numerical simulation.

Cholera is an acute waterborne infection characterized by severe diarrhea. Although the disease has been known since ancient times, cholera continues to devastate impoverished populations that have limited access to clean water and sanitation resources. Seven cholera pandemics have occurred in the past 200 years, with the seventh pandemic originating in 1961 and ongoing at present. In particular, more than 1 million cases were reported during the recent Yemen cholera outbreak in 2017.

The persistence of cholera indicates that our current knowledge and control strategies for this disease are inadequate. Particularly, our understanding of the bacterial dynamics associated with Vibrio cholerae, the causative agent for cholera, remains limited at present. To improve such understanding, Dr. Wang plans to conduct a deep investigation into the evolution, growth and multiplication of the pathogenic bacterium Vibrio cholera under various biotic and abiotic conditions, based on mathematical and computational modeling. Meanwhile, Dr. Wang will collaborate with Dr. David Giles, Associate Professor of Biology, and Dr. Bradley Harris, Assistant Professor of Chemical Engineering, on this project. Drs. Giles and Harris will conduct lab experiments to validate the modeling results and to guide the development and refinement of the mathematical models. Overall, this project represents an interdisciplinary effort and highlights the application of mathematics in the biomedical fields.

Department of Mathematics Celebrates Fall and Summer 2019 Graduates

The Department of Mathematics would like to congratulate our Fall and Summer 2019 Graduates! <u>Summer 2019 Graduates</u> Lisa Nanni, M.S. Mathematics Daniel Plaisted, M.S. Mathematics

Fall 2019 Graduates

Ashley McMullen, B.S. Math: STEM Education Joshua Nowlin, B.S. Math: Actuarial Science Brittany Olton, B.S. Math: Actuarial Science Drew Woods, B.S. Math: Actuarial Science

GRANTS



Multi-Year RUI Grant from the National Science Foundation Awarded to Panagiotou

Dr. Eleni Panagitou awarded Research in Undergraduate Instituions grant from National Science Foundation

Dr. Eleni Panagiotou, Assistant Professor in Mathematics in the UTC Department of Mathematics, has been awarded a 3-year, \$125,000 Research in Undergraduate Institutions (RUI) grant from the National Science Foundation (NSF). The NSF RUI program supports faculty in research that engages them in their professional fields, builds capacity for research, and supports the integration for research and undergraduate education.

Dr. Panagiotou's grant is entitled Computational Methods for Measuring Topological Entanglement in Polymers. The project aims to investigate the effects of polymer entanglement and architecture on material properties using computational and mathematical techniques.

The project consists of an inter-disciplinary effort with researchers from Mathematics and Chemical Engineering to solve the problem of quantifying the effects of topological entanglement and polymer architecture to material properties of polymers. Understanding how microscopic properties affect material properties will lead not only to the smart manufacturing of new materials, but also to the understanding of living matter.

This study advances knowledge at the area of topology and geometry, by defining and studying new tools for measuring the geometrical/topological complexity of open curves in space and also advances computational infrastructure, by designing and prototyping algorithms in reusable code, that in particular, studies aspects in entangled polymer simulations (such as fluid-structure interactions for such systems and topological interactions).

This holistic approach will thoroughly study entanglement in polymers of varying architecture that are currently of great interest in materials and manufacturing and nanotechnology, with the potential of immediate impact of our results to practical manufacturing. This project has educational objectives including strong impact on undergraduate research with a commitment in promoting underrepresented groups in STEM.



Weerasena Awarded PREP Grant from UTC

Dr. Lakmali Weeraena, Assistant Professor in Mathematics in the UTC Department of Mathematics, has been awarded a 1-year, \$8,799, Faculty Pre-Tenure Enhancement Program (PREP) grant from the Office of Research and Sponsored programs at UTC. Her research interests focus on (1) Developing methods to compute and approximate solutions of multi-objective optimization problems (MOPs); (2) Theoretical analysis resulting from the approximation of solution sets of MOPs; and 3) Develop mathematical models for applications in fields such as engineering, conservation biology, and management. With the support of this grant, Dr. Weerasena will study the multi-objective mathematical models in conservation biology.

Dr. Weerasena's grant is entitled a multi-objective (MO) optimization approach for designing a connected reserve system for conservation biology. The project consists of an inter-disciplinary effort with a community partner (Reflection Riding Arboretum and Nature Center is a nonprofit arboretum, botanical garden, nature center). Conservation biologists and wildlife managers are challenged with designing protected area networks optimal for biodiversity conservation. Although the protection of extensive wildlands with the full assemblage of native species in large population sizes is the ecologically prudent solution, such targets are unrealistic due to limitations in funds and other resources. The development of conservation prioritization methods is imperative so that limited lands can be effectively used for biodiversity conservation. These prioritization methods should ensure the long-term protection of biological species.

In this project Dr. Weerasena develops a multi-objective mathematical model to simultaneously optimize availability of species (plants/animals) and distance between reserve sites by designing a totally connected reserve system subject to a fixed budgetary restriction. The solutions of MOPs is driven by the concept of Pareto optimality. Finding the Pareto set is a challenging task because even if Pareto points can be theoretically characterized, their computation is often computationally expensive.

This project has substantial educational and outreach components. It will advance understanding both in the philosophy of efficient algorithms in MO and in the application of such theoretical frameworks in real-life problem solving. When selecting students for the project, priority will be given to those from groups underrepresented in STEM.



Dillard Places in UTC Accessibility Contest

Ross Dillard, Adjunct faculty in the UTC Department of Mathematics, has placed in the Accessibility in UTC Learn contest. He placed 2nd and 3rd in the contestfor his Math 1830 Calculus for Management, Life and Social Sciences courses. The contest was sponsored by The Walker Center for Teaching and Learning as a way to encourage faculty to make documents in UTC Learn more accessible to everyone and support our efforts to become a more inclusive campus. Faculty utilized the Ally tool within Canvas to access and improve overall course accessibility, including making improvements to documents and content presented within course pages to improve their accessibility scores.

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Alumni Update

Math Department Graduate Passes Next Actuarial Exam

Since graduating in the spring of 2019, Stephen Adam has passed the IFM (Investment and Finance Markets) actuarial exam, in which MATH 4350 Mathematics of Finance plays a crucial role. The exam shared many

topics with the course, such as forwards, margin calls with futures, mean-variance portfolio theory and efficient frontiers, the capital asset pricing model, put-call parity, the options binomial pricing model, and the Black–Scholes model. Stephen passed the P (Probability) exam during his last semester at UTC. He currently works as an actuarial assistant at BlueCross BlueShield of Tennessee.



Graduate Programs Update from the Graduate Coordinator

Math Graduate Program making its mark in 2019

This academic year, the Department of Mathematics has been focused on rebuilding its M.S. program, which currently has eight students. Two new students will join the Education concentration in the spring semester of 2020 and three new students will be part of the Applied Mathematics concentration in the fall semester of 2020. Our department also offers a Post-Baccalaureate Certificate in Computational and Applied Statistics, which currently has two students.

Maame Korsah, a current M.S. student in the Pre-Professional concentration, will receive a graduate research assistantship from Dr. Jin Wang for the summer of 2020 to work on a project in mathematical biology.

The Ph.D. in Computational Science - Applied Mathematics program continues to attract students with a strong interest in Computational and Applied Mathematics and equips them with advanced tools, such as computational techniques and methodologies, for professional and academic careers.

Our Ph.D. students are producing important scholarship. In particular, Chayu Yang has published six papers in mathematical biology in reputable journals and recently presented a talk at the Fifth International Conference on Computational and Mathematical Population Dynamics in Fort Lauderdale, Florida. Yang is on track to graduate in Spring 2020. Conrad Ratchford has published two papers, also in mathematical biology. Both Yang and Ratchford helped mentor four of the eleven undergraduate participants in the department's 2019 REU Summer Program.

Aruna Saram has published a paper in computational statistics. Finally, Christopher Corley will present his paper in probability and mathematical statistics at the 2020 AMS Spring Southeastern Sectional Meeting at University of Virginia.



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