UNCG

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Department of Mathematics & Statistics Annual Report 2013-2014

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1. Summary

Ratnasingham Shivaji,
H. Barton Excellence Professor & Department Head

I feel fortunate to be part of and to lead a growing department with very talented faculty and staff members. In Fall of 2013, we added four tenure track/tenured faculty to our department. We also hired an Academic Professional. Two of our associate professors were promoted to the rank of full professor and one of our lecturers was promoted to the rank of Senior Lecturer. During the academic year 2013-14, we had six full professors, ten associate professors, six assistant professors, one academic professional, one senior lecturer, two lecturers and three staff members.

The department had a remarkable year in terms of research productivity. During the calendar year 2013 the faculty has published 48 refereed journal articles, four refereed book chapters, and eight refereed conference papers for a total of 60 refereed publications. The faculty also published one book and one conference proceedings. The faculty made 69 presentations, with 31 at international destinations. Thanks to our continued enhancement of grant proposal submissions we have had a healthy success rate in securing funding in the academic year 2013-14. This includes receiving several competitive research grants: three from NSF, one from NSA, and two from the Simons Foundation. The department continued to be home to *Journal of Statistical Theory and Practice* (a Taylor and Francis publication) and *Topology and its Applications* (an Elsevier publication), two internationally renowned journals.

The department hosted the 2013 UNCG Regional Mathematics and Statistics Conference in November, 2013 (attended by 157 participants) and the Summer School in Computational Number Theory in summer of 2013 (attended by 26 participants). These conferences were supported by funding from NSF, NSA and MAA. The department continued to host the Helen Barton Lecture Series in Computational Mathematics and the Helen Barton Lecture Series in Mathematical Sciences, along with seminar series in Applied Math, Math Biology, Algebra, Combinatorics & Number Theory, Topology, Statistics as well as Ashby Dialogue colloquium series. In addition, the department hosted a Math Ed Colloquium jointly with the RISE group. The department also hosted several research visitors.

We continued enhancements to our PhD program in Computational Mathematics, which includes opening a new specialty track in computational statistics. We made concerted efforts towards graduate student recruitment through visits to many institutions in the USA and abroad and through participation in graduate recruitment events hosted by the American Mathematical Society (AMS), Mathematical Association of America (MAA), and the Society of Industrial and Applied Mathematics (SIAM). Our efforts to attract students included mailing of information about our graduate programs to schools in the United States and abroad. The “Graduate Tea” hosted by us for our students served as a good venue to discuss many useful issues with the students. The department’s continued membership with

IMA (Institute of Mathematics and its Applications) has allowed for continued participation of graduate students (and members of our faculty) in various workshops and conferences organized by IMA

We continued our efforts to build a positive image for the department among other units at UNCG, as well as outside UNCG. As part of this effort, we hosted a continental breakfast for all Guilford County high school math teachers at their professional development event, a "Welcome to the Department" party for our freshman math majors, and the State Math Contest. We also lent support and assistance at the Guilford County Schools' High School Teaching and Learning Sessions, the Spartan Showcase, Fall and Spring Faculty Phone-a-Thons, UNCG Educational Fest for 7^{th} and 8^{th} graders from Guilford County Schools, and the Destination UNCG event. In addition to these efforts aimed at increasing recruitment, we have taken several measures to help improve student retention. Examples of these measures are, lowering of class sizes for our 100 level courses; an enhanced Math Help Center to provide answers and clarifications to students' questions; a new Math Emporium Lab combining the best components of traditional and online classes in College Algebra and Pre-calculus courses (for approximately 200 students); and active involvement in AToMs living learning community freshman STEM majors.

As part of our efforts to improve instruction and enhance opportunities for students, we have collected data for the past three years on the "DFW" rates in all our 100-level classes and are currently working with the course coordinators on programs that can help achieve better results. We feel that the root cause for the student's struggle with these courses is that they either lack the prerequisite knowledge or have forgotten what they had learned. We are looking at the possibility of providing these students with opportunities to learn/revise this prerequisite material during the first few weeks of the classes. The department also created a new course, MAT 190 Precalculus, which is a one semester version of our two semester precalculus sequence. The course is designed to allow students with a sufficiently good high school mathematics background to speed up their entrance into the calculus sequence. It is especially suitable for science majors. The department continued to offer funding for undergraduate research via the Undergraduate Research Awards in Mathematics and Statistics and the new campus wide Research Experience in Statistics program. This year, we had 85 total Undergraduate first majors and 15 undergraduate students who are majoring in mathematics as a second major.

The Math Club of our department continues to be very active. The goal of this club is to create a community for Undergraduate and Graduate Math enthusiasts. The 2013-2014 academic year marked the third year of the Math Club's official recognition by UNCG. The club continues to meet every other Wednesday and is centered around talks given by the department's very talented faculty and graduate students. Also the Association for Women in Mathematics Student Chapter (AWM) was inaugurated during the 2013-2014 academic year.

Construction of our new departmental conference room was completed this year and we are delighted to name it as Jerry and Theresa Vaughan Conference Room. Professor Jerry Vaughan has been a faculty member for more than 40 years, and he has also sponsored and established the Dr. Theresa Phillips Vaughan Math Scholarship and the Dr. Jerry E. Vaughan Math Scholarship in the department. Professor Theresa Vaughan was also faculty member of our department during the period of 1987-2008.

During the recent years donations to the department's enrichment fund, and to existing scholarships were provided by: Mrs. Teresa Black Sink, Mrs. Frankie Hubbard, Ms. Gloria Edwards Thornton, Mrs.

Dorothy Taylor Howell and Mr. William E. Howell, Mrs. Marilou Martin Bradley, Mrs. Susan Blanton Senn, Mrs. Jean Fleming Roosa, Ms. Lillian Boney, Ms. Nancy Taylor, Ms. Christine Posey, Mrs. Linda Downs Philips, Mrs. Vicky Langley, Dr. Jerry Vaughan, Mrs. Vicky Langely and Mr. Gene Langley, Ms. Patricia Cranford Yegge, and Ms. Joan Foster Allan. Our sincere gratitude goes to all our donors.

In closing, let me say that the success of our department is the result of hard work from our faculty, staff and students. We had several leaders in this area who have brought extra recognition to the department. Our undergraduate and graduate students were involved in various research publications and conference presentations. Dr. Thomas Lewis was selected as a 2014-2015 Project NExT (New Experiences in Teaching) Fellow. Project NExT is a professional development program for new or recent Ph.D.s in the mathematical sciences, and is sponsored by the Mathematical Association of America (MAA). Dr. Jan Rychtar received an excellent review in *Science* for his book, "Game-Theoretical Models in Biology," published in March 2013. He was one of the three UNCG nominees for the prestigious Blavatnik Award for Young Scientists, and holds a five year (2012-17) Simons Foundation Grant. Also, he and Dr. Jonathan Rowell received a three year (2014-17) National Science Foundation (NSF) Research Experiences for Undergraduate Research (REU) Site award. Dr. Clifford Smyth holds a two year (2013-15) National Security Agency (NSA) grant and was awarded a Bernard-Glickman Dean's Professorship for 2013−2014. Dr. Talia Fernós was awarded a three year (2013−2016) National Science Foundation (NSF) research grant, Dr. Haimeng Zhang was awarded a two year (2013-15) NSF research grant, and I received a five year (2014-19) Simons Foundation Grant. Dr. Greg Bell was awarded a New Directions Professorship at the IMA for fall 2013.

I invite you to kindly read details of our activities and achievements in the report that follows.

2. Faculty and Staff

2.1 Faculty

Greg Bell, Associate Professor
Director of Graduate Studies

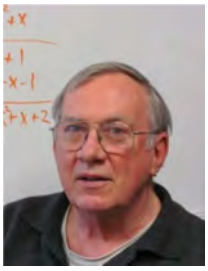
Dr. Bell earned his Ph.D. in 2005 from the University of Florida and joined the UNCG faculty in 2005. His research focus is on geometric group theory, geometric topology, and asymptotic invariants of groups.

Dagny Grillis Butler, Lecturer

Dr. Butler earned her M.S. in 2009 and her Ph.D. in 2014 from Mississippi State University and joined the UNCG faculty in 2011. Her research interests include reaction diffusion equations on exterior domains with nonlinear boundary conditions.

Maya Chhetri, Professor
Director of the Math Help Center & Coordinator of the Math Emporium

Dr. Chhetri earned a Ph.D. in 1999 from Mississippi State University and joined the UNCG faculty in 1999. Her research focus is on nonlinear elliptic boundary value problems.



Paul Duvall, Professor

Dr. Duvall earned a Ph.D. in 1967 from the University of Georgia and joined the UNCG faculty in 1986. His research focus is on number theory, cryptography and combinatorics.

Igor Erovenko, Associate Professor

Dr. Erovenko earned a Ph.D. in 2002 from the University of Virginia and joined the UNCG faculty in 2002. His research focus is on combinatorial properties of linear groups and bounded generation of S-arithmetic groups.

Richard Fabiano, Professor
Director of Undergraduate Studies

Dr. Fabiano earned a Ph.D. in 1996 from Virginia Tech and joined the UNCG faculty in 1996. His research focus is on applied mathematics, differential equations, and control theory.

Talia Fernós, Assistant Professor

Dr. Fernós earned a Ph.D. in 2006 from the University of Illinois at Chicago and joined the UNCG faculty in 2010. Her research focus is on infinite groups from both geometric and analytical perspectives.

Xiaoli Gao, Associate Professor

Dr. Gao earned a Ph.D. in Statistics from the University of Iowa (2008). She joined the UNCG faculty in 2013. Her research interests include high-dimensional data analysis, shrinkage analysis, statistical genetics, change point and survival analysis.

Sat Gupta, Professor
Associate Head

Dr. Gupta earned a Ph.D. in Mathematics from the University of Delhi (1977) and a Ph.D. in Statistics from Colorado State University (1987). He joined the UNCG faculty in 2004. His research focus is on sampling designs, time series forecasting, and biostatistics.

Tracey Howell, Academic Professional

Dr. Howell returned to the department in 2012−2013 as a lecturer. She received her Ph.D. in Teacher Education and Higher Education from UNCG in 2013. She was appointed to an Academic Professional position starting from Fall 2013. Her research focuses on instructional practices that support students' mathematical argumentation, instruction in highly-impacted schools, and teacher learning of students' mathematical thinking.

Thomas Lewis, Assistant Professor

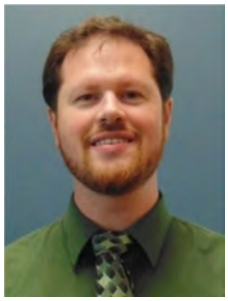
Dr. Lewis earned a Ph.D. in Mathematics from the University of Tennessee (2013). He joined the UNCG faculty in 2013. His research focuses on numerical PDEs and applied mathematics.

Sebastian Pauli, Associate Professor

Dr. Pauli received his Ph.D. from Concordia University in Montreal in 2001. He joined UNCG in 2006. His research focus is on computational number theory, computational class field theory and the distribution of the zeros of the derivatives of the Riemann Zeta function.

Scott Richter, Associate Professor
Director of the Statistical Consulting Center

Dr. Richter earned a Ph.D. in 1997 from Oklahoma State University and joined the UNCG faculty in 2001. His research focus is on nonparametric methods and multiple comparisons.



Jonathan Rowell, Assistant Professor

Dr. Rowell earned a Ph.D. in 2003 from Cornell University, and he joined the UNCG faculty in 2012. His primary research studies the application of game theory and differential equations to biological problems ranging from the cellular level to the population level.

Dohyoung Ryang, Assistant Professor

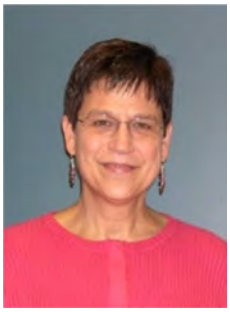
Dr. Ryang earned a Ph.D. in 2005 and an Ed.D. in 2010 from the University of Alabama, Tuscaloosa. He joined the UNCG faculty in 2010. His research focus is on mathematics education and geometric group theory.

Jan Rychtář, Associate Professor

Dr. Rychtář earned a Ph.D. in 2004 from the University of Alberta and joined the UNCG faculty in 2004. His research focus is on mathematical biology, game theory and functional analysis.

Filip Saidak, Associate Professor

Dr. Saidak received a Ph.D. in 2001 from Queen's University in Ontario, Canada and joined the UNCG faculty in 2005. His research focus is on classical questions concerning prime numbers and their distribution, and the location of zeros of the Riemann zeta function and its derivatives.



Carol Seaman, Associate Professor
Program Coordinator for Secondary Licensure in Mathematics

Dr. Seaman earned a Ph.D. in 2000 from Central Michigan University and joined the faculty at UNCG in 2008. Her research focus is on undergraduate mathematics education.

Insuk Shim, Lecturer

Ms. Shim earned a M.A. in 2006 from the University of Alabama, Tuscaloosa and joined the UNCG faculty in 2011. Her research interests include the “Multivariate Markovian arrival process” in Statistics.

Ratnasingham Shivaji, H. Barton Excellence Professor

Department Head, W.L. Giles Distinguished Professor
Emeritus of Mathematics (Mississippi State University)

Dr. Shivaji earned a Ph.D. in 1981 from Heriot-Watt University in Edinburgh, Scotland and joined UNCG in 2011. His research focus is on partial differential equations, in particular, nonlinear elliptic boundary value problems.

Clifford Smyth, Assistant Professor

Dr. Smyth earned a Ph.D. in 2001 from Rutgers University and joined the UNCG faculty in 2008. His research focus is on combinatorial probability, computational complexity, and discrete geometry.

Brett Tangedal, Associate Professor

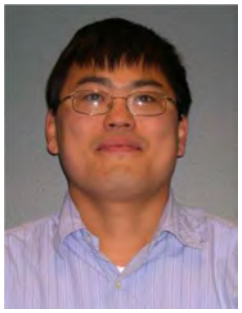
Dr. Tangedal earned a Ph.D. from the University of California at San Diego in 1994 and joined the faculty at UNCG in 2007. His research focus is on algebraic number theory with a particular emphasis on explicit class field theory.

Jerry Vaughan, Professor

Dr. Vaughan earned a Ph.D. in 1965 from Duke University and joined the UNCG faculty in 1973. His research focus is on general topology, set theory and logic, functional analysis, and set-theoretic topology.

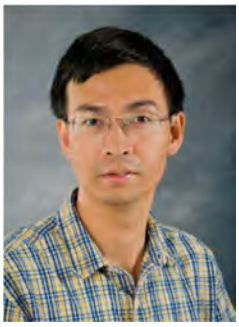
Walker Weigel, Senior Lecturer

Ms. Weigel earned a M.A. in 1967 from UNC-Chapel Hill and joined the UNCG faculty in 1985. Her research interests include new approaches and improvements to teaching through the use of online components, iclickers, and other pedagogical tools.



Dan Yasaki, Assistant Professor

Dr. Yasaki earned a Ph.D. in 2005 from Duke University and joined the UNCG faculty in 2008. His research focus is on modular forms, particularly the connection between explicit reduction theory of quadratic forms and the computation of Hecke data for automorphic forms.



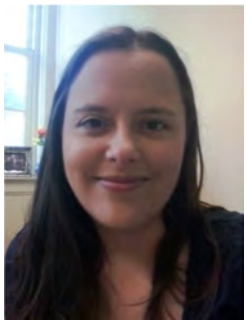
Haimeng Zhang, Associate Professor

Dr. Zhang earned a Ph.D. in Applied Mathematics (Statistics) from the University of California in 1998. He joined the UNCG faculty in 2013. His research focuses on the statistical analysis of global-scale processes and phenomena.

2.2. Staff

Richard Cheek
Systems Administrator

Mr. Cheek graduated from UNCG with his M.S. degree in Computer Science in 1998 and has been the Systems Administrator for the Department since 1999.



Haley Childers
Business Services Coordinator (Office Manager)

Ms. Childers received her B.A. in Art History from UNCG in 2009 and her M.S. Degree in Library and Information Studies from UNCG in 2012. She joined the Department in December of 2005.

Michelle Miller
Administrative Support Associate

Mrs. Miller received her Bachelor of Music from Wheaton College in 2008 and her Master of Music from UNCG in 2012. She joined the Department in June of 2013.

3. Tenure & Promotions, Awards & Honors

Promotions

Dr. Maya Chhetri was promoted from Associate Professor to the full Professor rank starting in Fall 2013.

Dr. Richard Fabiano was promoted from Associate Professor to the full Professor rank starting in Fall 2013.

Ms. Walker Weigel was promoted from Lecturer to the Senior Lecturer rank starting in Fall 2013.

Awards

Dr. Clifford Smyth holds a three year (2012–2015) National Security Agency (NSA) award. The funding will support his *Correlation Inequalities* project. Additionally, Dr. Clifford Smyth has been awarded a Bernard-Glickman Dean's Professorship for 2013-14. This professorship recognizes the accomplishments and potential of outstanding junior faculty in the College of Arts and Sciences.

Dr. Talia Fernós was awarded a three year (2013–2016) National Science Foundation (NSF) research grant. Grant work will focus on rigidity of isometric Hilbert space actions using the tool of low dimensional cohomology. Dr. Talia Fernós also received a 2013 New Faculty Grant and a 2013 Summer Excellence Research Award from UNCG.

Dr. Haimeng Zhang received a two year (2013-2015) NSF research grant. The work on this grant will focus on the statistical analysis of global-scale processes and phenomena.

Dr. Jan Rychtar and **Dr. Jonathan Rowell** received a three year (2014-2017) NSF Research Experience for Undergraduates site grant. The title of the program is Mathematical Biology at UNCG. Dr. Jan Rychtar also holds a five year (2012-2017) Simon's Foundation grant for his project titled "Game-theoretical models in biology".

Dr. Thomas Lewis was selected as a 2014-15 Project NExT Fellow (New Experiences in Teaching). Project NExT is a professional development program for new or recent Ph.D.'s in the mathematical sciences, and is sponsored by the Mathematical Association of America (MAA).

Dr. Greg Bell was chosen as one of the two 2014 New Directions Professors by the Institute for Mathematics and its Applications (IMA) at Minnesota. Dr. Bell's visit to the IMA in Fall 2013 coincided with the thematic year program on Scientific and Engineering Applications of Algebraic Topology.

Dr. Ratnasingham Shivaji received a five year (2014-2019) Simons Foundation Grant for his Project titled, "Analysis of nonlinear eigenvalue problems and applications."

UNCG Mathematics students **Austin Lawson** and **Hollan Foltz** were awarded Lloyd International Honors College Student Excellence Awards, UNCG's highest academic honor for undergraduates.

Austin Lawson receiving his graduation certificate

Hollan Foltz receiving his graduation certificate

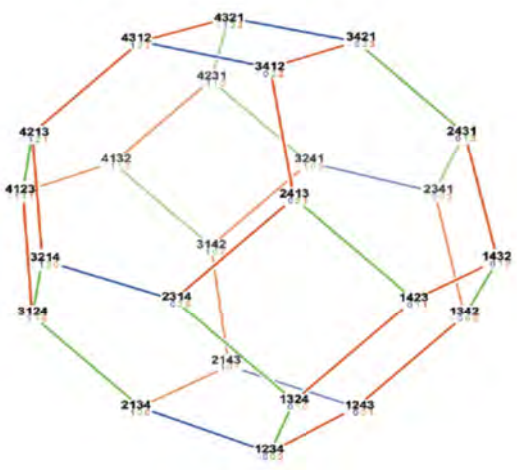
4. Faculty Research Profile

4.1 Research Groups

Applied Mathematics

Applied mathematics is a discipline that develops mathematical techniques and concepts that can be used in understanding the natural and social sciences. Researchers at UNCG carry out research in differential equations, control theory, game theory, stochastic processes, graph theory, combinatorial probability and mathematical biology. Areas of application include modeling of reaction-diffusion processes, flexible structure, stealing behaviors, vector/ host affinity's effect on disease spread and the behavior of random networks. Faculty are actively involved in organizing conferences in specified research areas as well as annual conferences targeted only for students. Most faculty in this group have also done work with undergraduate students that resulted in journal publications as well as numerous conference presentations. Faculty involved in this research group is Maya Chhetri, Richard Fabiano, Thomas Lewis, Jonathan Rowell, Jan Rychtar, Ratnasingham Shivaji and Clifford Smyth. Ph.D. Students in these areas: Abraham Abebe, Quinn Morris, Catherine Payne, James Rudzinski, and Byungjae Son.

Combinatorics, Group Theory and Topology



Combinatorics, Group Theory and Topology are three active areas of research in pure mathematics at UNCG. The Combinatorics Group works with combinatorial probability, computational complexity, and discrete geometry. Group Theory research areas include geometric group theory, representation theory, and arithmetic groups. UNCG's topologists work with general and set- theoretic topology, geometric topology, and asymptotic topology. Faculty involved in this research group: Greg Bell, Paul Duvall, Igor Erovenko, Talia Fernós, Clifford Smyth and Jerry Vaughan. PhD students in these areas: Danielle Moran, Michael Palmer, and James Rudzinski.

Mathematical Biology

Understanding the evolution of cooperation, modeling disease transmission in mosquitos, understanding the behavior of dung beetles, tracking of mice and bats, understanding the mating of honey bees or knowing how much fish to harvest all have one thing in common—mathematics. The Department of Mathematics and Statistics is proud to be a part of this truly interdisciplinary research. The faculty offer expertise to assist UNCG faculty and graduate students with their research in biology and beyond. Faculty involved in this research group are Maya Chhetri, Sat Gupta, Sebastian Pauli, Jonathan Rowell, Jan Rychtar, Ratnasingham Shivaji and Clifford Smyth.

Number Theory

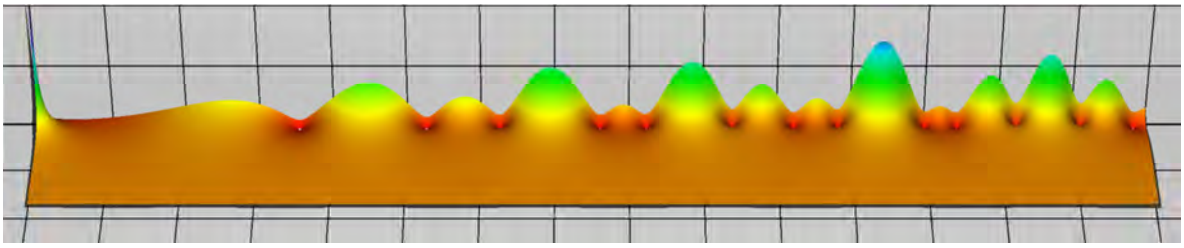
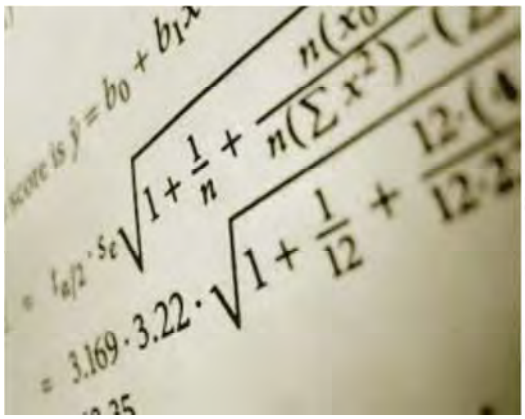


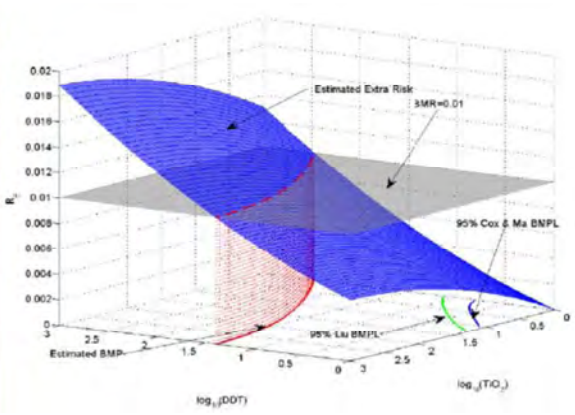
Figure: $\zeta(\sigma+it)$ for $0\le\sigma\le 8$ and $0.1\le t\le 60$

Number theory is one of the oldest research areas in pure mathematics. It is concerned with the study of integers (in particular prime numbers) and generalizations thereof. In the last 30 years number theory has found many applications, especially in cryptography. The members of the number theory group at UNCG work in several areas of number theory, including algebraic, analytic, and computational number theory and modular forms. The members of this research group are Sebastian Pauli, Filip Saidak, Brett Tangedal, and Dan Yasaki. Ph.D. students in this area: Ricky Farr, Paula Hamby, Jonathan Milstead, and Brian Sinclair.

For more details about the activities and research of the number theory group, visit:
http://www.uncg.edu/mat/numbertheory/

Applied Statistics





The statistics group in the department consists of four full time faculty (Dr. Sat Gupta, Professor; Dr. Scott Richter, Associate Professor; Dr. Haimeng Zhang, Associate Professor; and Dr. Xiaoli Gao, Associate Professor).

The focus of Dr. Gupta's research is in the area of sample surveys. Dr. Richter specializes in nonparametric methods and multiple comparisons. Dr. Zhang specializes in survival analysis, spatial statistics and applied probability, and Dr. Gao specializes in high dimensional data analysis and statistical genetics. The statistics group is engaged in both disciplinary research in their respective areas of specialty as well as interdisciplinary research in collaboration with other on-campus/off-campus researchers. They serve as co-investigators or key personnel on externally funded projects as well as undergraduate research projects through the NSF funded Math/Bio and REU projects, and through the newly established RESU program (Research Experience in Statistics for Undergraduates). The Statistics group also provides support through the Statistical Consulting Center to researchers across many disciplines at all stages of research, including assistance with articulating research questions and designing data collection, often for grant proposals, subsequent data analysis and interpretation, and manuscript preparation. These collaborations often lead to peer-reviewed journal articles. PhD students in statistics are Wei Chen, Chris Vanlangenberg, Jeong Sihm and Tanja Zatezalo.

4.2 2013 Publications

Refereed Articles

Greg Bell

Bell, G.C. and Nagórko, A. A new construction for universal spaces for asymptotic dimension. *Topology and its Applications*, 160 (1), 159−169.

Maya Chhetri

Chhetri, M., Girg, Petr. Existence of positive solutions for a class of superlinear semipositone systems. *Journal of Math. Anal. Appl.*, 408, 781−788.

Crowe, M. L., Rychtar, J., Rueppell, O., **Chhetri, M.**, & Gupta, S. N. Proving the Proof - Interdisciplinary Undergraduate Research Positively Impacts Students. *Topics from the 8th Annual UNCG Regional Mathematics and Statistics Conference, Springer*.

Richard Fabiano

Fabiano, R.H. A semidiscrete approximation scheme for neutral delay-differential equations. *International Journal of Numerical Analysis and Modeling*, 10 (3), 712−726.

Fabiano, R.H. A stability result for a scalar neutral equation with multiple delays. *Proceedings of the 52nd IEEE Conference on Decision and Control*, Florence Italy, 1089−1094.

Xiaoli Gao

Ahmed, S. E., Gao, X. Efficient adaptive estimation strategies in high dimensional partially linear regression models. *Contemporary Mathematics*. In press.

Sat Gupta

Gill, T. S., Tuck, A., **Gupta, S.**, Crowe, M., & Figueroa, J. A Field Test of Optional Unrelated Question Randomized Response Models: Estimates of Risky Sexual Behaviors. *Springer Proceedings in Mathematics and Statistics Series*, 64, 135-146.

Khan, Z., Shabbir, J., & **Gupta, S. N.** A New Sampling Design for Systematic Sampling. *Communications in Statistics-Theory and Methods*, 42, 2659-2670.

Sihm, J. & **Gupta, S.** A Two-Stage Binary Optional Randomized Response Model. *Communications in Statistics-Simulation and Computation*. (In press).

Subramani, J., **Gupta, S.**, & Prabavathy, G. Circular Systematic Sampling in the Presence of Linear Trend. *American Journal of Mathematical and Management Sciences*. (In press).

Khan, Z., **Gupta, S. N.**, & Shabbir, J. Diagonal Circular Systematic Sampling. *Journal of Statistical Theory and Practice*. (In press).

Letvak, S., **Gupta, S.**, & Ruhm, C. Differences in Health, Productivity and Quality of Care in Younger and Older Nurses. *Journal of Nursing Management,* 21, 914-921.

Dingman, D., Schulz, S., Wyrick, D., Bibeau, D., & **Gupta, S.** Does Providing Nutrition Information at Vending Machines Reduce Calories Per Item Sold? *Journal of Public Health Policy*. (In press).

Crowe, M., Respet, E., Rychtar, J., & **Gupta, S.** Effect of Density and Extra Dung on Brood Parasitism in the Dung Beetle, Onthophagus Taurus. *Journal of Insect Behavior*, 26 (2), 253-259.

Gupta, S. N. & Shabbir, J. Estimation of finite population mean in stratified sampling with two auxiliary variables under double sampling design. *Communications in Statistics-Theory and Methods*. (In press).

Subramani, J. & **Gupta, S.** Generalized modified linear systematic sampling scheme for finite populations. *Hacettepe Journal of Mathematics and Statistics*. (In press).

Khan, Z., Shabbir, J., & **Gupta, S. N.** Generalized Systematic Sampling. *Communications in Statistics-Simulation and Computation*. (In press).

Haq, A., Shabbir, J., & **Gupta, S. N.** Improved Exponential Ratio Type Estimators in Stratified Random Sampling. *Pakistan Journal of Statistics*, 29 (1), 13-31.

Sousa, R., **Gupta, S.**, Shabbir, J., & Corte-Real, P. Improved Mean Estimation of a Sensitive Variable Using Auxiliary Information in Stratified Sampling. *Journal of Statistics and Management Systems*. (In press).

Gupta, S. N., Tuck, A., Gill, T. S., & Crowe, M. Optional Unrelated-Question Randomized Response Models. *Involve*, 6 (4), 483-492.

Schug, G. R., **Gupta, S. N.**, Cowgill, L., Sciulli, P., & Blatt, S. Panel Regression Formulas for Stature and Body Mass Estimation in Immature Human Skeletons. *Journal of Archaeological Science*, 40, 1-11.

Crowe, M., Rychtar, J., Rueppell, O., Chhetri, M., Remmington, D., and **Gupta, Sat**. Proving the Proof - Interdisciplinary Undergraduate Research Positively Impacts Students. *Springer Proceedings in Mathematics & Statistics*, 64, 25-29.

Thomas Lewis

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Scott Richter

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Dohyoung Ryang

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Jan Rychtář

Ross, C., Rueppell, O., & **Rychtar, J.** A spatially organized population model to study the evolution of cooperation in species with discrete life-history stages. *Springer Proceedings in Mathematics & Statistics*, 64, 147−154.

Bruni, M., Broom, M., & **Rychtar, J.** Analysing territorial models on graphs. *Involve*, 7 (2), 129-149. (In press).

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Filip Saidak

Matiyasevich, Y., **Saidak, F.**, & Zvengrowski, P. Monotonicity of the Riemann zeta and related functions. *Acta Arithmetica*. (In press).

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Ratnasingham Shivaji

Castro, A., Ko, E., & **Shivaji, R.** A uniqueness result for a singular nonlinear eigenvalue problem. *Proceedings of the Royal Society of Edinburgh, Section: A Mathematics* . Vol. 143A, 739-744

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Ko, E., Lee, E., & **Shivaji, R.** Multiplicity results for classes of singular problems on an exterior domain. *Discrete and Continuous Dynamical Systems - Series S, 33 (11/12)*, 5153-5166.

Ali, J. & **Shivaji, R.** Positive solutions for 3 X 3 elliptic bi-variant reaction systems with combined nonlinear effects. *Communications on Applied Nonlinear Analysis, 17 (1)*, 147-156

Sankar, L., Sasi, S., & **Shivaji, R.** Semipositone problems with falling zeros on exterior domains. *Journal of Mathematical Analysis and Applications, 401 (1)*, 146-153.

Butler, D., **Shivaji, R.**, & Tuck, A. S-Shaped bifurcation curves for logistic grown and weak Allee effect growth models with grazing on an interior patch. *Electronic Journal of Differential Equations*, Conf. 20, 15-25.

Lee, E. K., Ko, E., **Shivaji, R.**, & Son, B. Uniqueness of positive solutions for a singular nonlinear eigenvalue problem when a parameter is large. *Bulletin of the Belgian Mathematical Society. Simon Stevin*. (In press).

Clifford Smyth

Mahlburg, K., **Smyth, C.** Symmetric Polynomials and Symmetric Mean Inequalities. *Electronic Journal of Combinatorics* ,Vol. 20, Issue 3, 34.

Smyth, C. The BKR inequalities on finite distributive lattices. *Combinatorics, Probability and Computing (CPC)*, Vol. 22, Issue 04, 612−626.

Brett Tangedal

Tangedal, B., Young, P. Explicit Computation of Gross-Stark Units over Real Quadratic Fields. *Journal of Number Theory*, Vol. 133, 1045−1061.

Dan Yasaki

Yasaki, D. Perfect unary forms over real quadratic field. *Journal de Théorie des Nombres de Bordeaux*, 1–17.

Gunnells, P. E., **Yasaki, D.** Modular forms and elliptic curves over the cubic field of discriminant −23, *International Journal of Number Theory*, 9, no. 1, 53–76.

Gunnells, P.E., Hajir, F., **Yasaki, D.** Modular forms and elliptic curves over the field of fifth roots of unity, *Experimental Mathematics*, 22, no. 2, 203–216.

Yasaki, D. Integral cohomology of certain Picard modular surfaces. *Journal of Number Theory*, 134, 13-28. (In press).

Haimeng Zhang

Rao, M. B., **Zhang, H.**, Huang, C., Cheng, F. A Discrete Probability Problem in Card Shuffling. *Communications in Statistics−Theory and Methods*. (In press).

4.3 2013 Conference Proceedings, Book Chapters, Books and Monographs

Conference Proceedings

Chhetri, M., **Gupta, S., Rychtar, J., Shivaji, R**., & Topics from the 8th Annual Regional Mathematics and Statistics Conference*, Springer*.

Books

Broom, M. & **Rychtář, J.** Game-Theoretical Models in Biology, CRC Press

Book Chapters

Bell, G. C. An Invitation to Asymptotic Dimension, Office Hours with a Geometric Group Theorist, Princeton University Press. In press.

Szydlik, J. E., Beam, J., Kuennen, E., & **Seaman, C. E.** Probability and Statistics for Prospective Middle Grades Teachers. Resources for Preparing Middle School Mathematics Teachers: MAA Notes #80., *Mathematical Association of America*.

Szydlik, J. E., Beam, J., Kuennen, E., & **Seaman, C. E.** The Middle School Program at the University of Wisconsin Oshkosh. Resources for Preparing Middle School Mathematics Teachers: MAA Notes #80, *Mathematical Association of America.*

Smyth, C. D. Equilateral sets in l_p^d, In Janos Pach (Ed.), Algorithms and Combinatorics Vol 39: Thirty Essays on Geometric Graph Theory (pp. 483-488). New York: *Springer-Verlag*.

4.4 2013 Research Presentations

Greg Bell

On asymptotic properties of some infinite graph products. 28th Summer Topology Conference on Topology and its Applications, North Bay, ON, Canada.

Bell, G. C. *Asymptotic dimension and group actions*. IMA Special Year Seminar, Minneapolis, Minnesota.

Maya Chhetri

Existence of positive solutions for a class of superlinear semipositone systems. Sectional AMS meeting, Philadelphia, PA.

Existence of positive solutions for a class of p-Laplacian superlinear semipositone problems. Nonlinear Analysis 2013, Pilsen, Czech Republic.

Existence of positive solutions for a class of p-Laplacian superlinear semipositone problems, Mathematical Congress of Americas, Guanajuato, Mexico.

Existence of positive solutions for a class of p-Laplacian superlinear semipositone problems. Joint Mathematics Meeting, San Diego, CA.

Existence of positive solutions for a class of superlinear semipositone systems. The Southeastern-Atlantic Regional Conference on Differential Equations, Knoxville, TN.

Richard Fabiano

Stability and approximation for a scalar neutral equation with multiple delays. Southeastern Atlantic Regional Conference on Differential Equations, University of Tennessee, Knoxville, TN.

A Stability result for a scalar neutral equation with multiple delays. 52nd IEEE Conference on Decision and Control, Florence, Italy.

Talia Fernós

Rigidity of actions on CAT(0) cube complexes. Tufts University Geometric Group Theory Seminar, Medford, MA.

Rigidity of actions on CAT (0) cube complexes. MSRI Hot Topics: Surface subgroups and cube complexes, Mathematical Sciences Research Institute, Berkeley, CA.

Rigidity of actions on CAT(0) cube complexes. AWM Research Symposium 2013 Special Session in Geometric Group Theory, Santa Clara, California.

Rigidity of actions on CAT(0) cube complexes. Trinity University, Mathematics Department Colloquium, San Antonio, Texas.

Newton, Einstein, and Gromov: What is the shape of our universe? UNCG Math Club, Greensboro, North Carolina.

Trees and their isometries. Undergraduate Seminar, San Antonio, Texas.

Xiaoli Gao

The KLAN for Complex Grouped Variable Selection. 6th International Conference of the ERCIM WG on Computational and Methodological Statistics (ERCIM 2013), London, UK.

Sat Gupta

New Binary RRT Models and their Validation. Invited talk at University of Delhi, Delhi, India.

Newer Trends in Statistical Research. Invited talk at University of Delhi, , Delhi, India.

Optional RRT Models: Applications, Efficiency, and Privacy Protection. Invited talk at the Conference on Statistics and Informatics in Agricultural Research, Varanasi, India.

Data Analysis – Choosing the Correct Analysis Tools. Invited talk at the University of Madras, Chennai, India.

Optional RRT Models: Do they really lead to loss of Privacy? Invited talk at the International Conference on Recent Developments in Statistical Theory and Practice, Pondicherry University, Pondicherry, India.

Newer Trends in Statistical Research in the 21st Century. Keynote address at the International Conference on Recent Developments in Statistical Theory and Practice, Pondicherry University, Pondicherry, India.

Field Work Validation of Optional Unrelated Question RRT Models – Predictors of STD. Invited talk at University of Delhi, Delhi, India.

Optional RRT Models: Efficiency vs. Privacy Protection. Invited Talk at New University of Lisbon, Lisbon, Portugal.

Randomized Response Models: Efficiency vs. Privacy Protection. Invited talk at Statistics Department, Hacettepe University in Ankara, Ankara, Turkey.

Some New Results in Optional Randomized Response Models. Invited talk at the Statistics Department, Mimar Sinan University, Istanbul, Turkey.

Some New Results in Optional Randomized Response Models. Invited talk at the Statistics Department, University of Delhi, Delhi, India.

Optional Randomized Response Models: Efficiency vs. Privacy Protection. Invited talk at UNC- Chapel Hill, Chapel Hill, North Carolina.

Thomas Lewis

Survey of Numerical PDEs - The Interior-Penalty Discontinuous Galerkin Method (IPDG). UNCG Applied Math Seminar, Greensboro, North Carolina.

Survey of Numerical PDEs - The Finite Element Method. UNCG Applied Math Seminar, Greensboro, North Carolina.

Finite Difference Methods for Fully Nonlinear Second Order PDEs and Applications. UNCG Math Dept Colloquium, Greensboro, North Carolina.

Finite Difference and Discontinuous Galerkin Numerical Methods for Fully Nonlinear Second Order PDEs with Applications to Stochastic Optimal Control. CSM Applied Math Seminar, ORNL, Oak Ridge, Tennessee.

Sebastian Pauli

Introduction to Computing. UNCG Summer School in Computational Number Theory, Greensboro, North Carolina.

Konstruktion von Klassenkörpern über lokalen Körpern. Zahlentheorie Seminar UniPaderborn, Paderborn, Germany.

More Zeros of the Derivatives of the Riemann Zeta Function on the Left Half Plane. UNCG AC/NT Seminar, Greensboro, North Carolina.

Constructing Class Fields over Local Fields. UNCG AC/NT Seminar, Greensboro, North Carolina.

An OM Algorithm. Symbolic Computation Seminar NCSU, Raleigh, North Carolina.

Scott Richter

Comparing scale using medians and permutation test. Joint Statistical Meetings, Montreal, Canada-Quebec.

Jonathan Rowell

Adaptive Movement Dynamics: Concepts and Consequences of Ideal Motivation within Populations. UNCG Math Dept Colloquium, Greensboro, North Carolina.

Dohyoung Ryang

Does gender affect the mathematics teaching efficacy? MAA Southeastern Section Conference, Winthrop University, Rock Hill, SC.

Cardano's method to solve a cubic equation. NCCTM Conference, Greensboro, North Carolina.

Jan Rychtář

The evolution of cooperation – kin selection and greenbeard genes. 67th Annual Conference of ISAS, Varanasi, India.

The evolution of cooperation – kin selection and greenbeard genes. Recent Developments on Statistical Theory and Practice, Puducherry, India.

Math Biology Research for UNCG Undergraduate students. DRS (SAP) Programme University of Delhi, New Delhi, India.

Producer-scrounger games. Oxford University, Center of Mathematical Biology seminar, Oxford, United Kingdom.

Producer-scrounger games and the effect of fighting cost. Modelling Biological Evolution 2013: Recent Progress, Current Challenges and Future Directions, Leicester, United Kingdom.

The effect of information asymmetry in Producer-Scrounger games. 2013 Joint Mathematics Meeting, San Diego, California.

The effect of the cost on the fighting behavior. MAA meeting, Rock Hill, South Carolina.

The evolution of cooperation – kin selection and greenbeard genes. Duke University Probability seminar, Durham, North Carolina.

Carol Seaman

North Carolina Elementary Mathematics Add-On License Program. 2013 Joint Mathematics Meeting, San Diego, California.

STEM Program Evaluation: Perspectives and Lessons Learned. AACU Project Kaleidoscope, San Diego, California.

Ratnasingham Shivaji

Plenary Lecture. International Workshop on Advances in PDE Modeling and Computation, ITT Madras, Madras, India.

Plenary Lecture. ASPIRE Undergraduate Mathematics Conference, Fort Myers, FL.

Invited Special Session Paper. AMS Annual Meeting in San Diego, CA (Invited special session paper).

Colloquium. Ryerson University, Toronto, Canada.

Colloquium. Graduate School, City University of New York, New York, NY.

Colloquium. TATA Institute for Fundamental Research, Bangalore, India.

Colloquium. Indian Institute of Technology, Chennai, India.

Colloquium. University of West Bohemia, Czech Republic.

Colloquium. Technical University of Madrid, Spain.

Colloquium. Universidad Politecnica de Madrid, Spain.

Colloquium. Akron University, Ohio.

Colloquium. Florida Gulf Coast University, Ft. Myers, FL.

Clifford Smyth

Percolation. Seminar, Faculty research overview talks, AC/NT Seminar, UNCG, Greensboro, NC.

Means and Row-Column Correlation. Algebra and Combinatorics Seminar, NC State University, Raleigh, North Carolina.

Jerry Vaughan

Fibers of continuous functions on $ \psi$-spaces. International Conference on Topology and Geometry 2013 Joint with the Sixth Japan-Mexico Topology Symposium, Shimae University, Matsue, Japan.

Dan Yasaki

Algorithms for lattices and algebraic automorphic forms. AIM workshop, American Institute of Mathematics, Palo Alto, California.

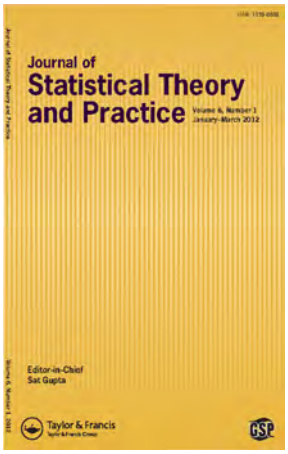
On the Cohomology of Linear Groups Over Imaginary Quadratic Fields. Southeast Meeting on Numbers 2013, High Point University, High Point, NC.

Modular Forms and Elliptic Curves Over the Cubic Field of Discriminant −23. AMS Eastern sectional meeting special session on Arithmetic Cohomology, Boston College, Chestnut Hill, MA.

4.5 Department Journals

Journal of Statistical Theory and Practice

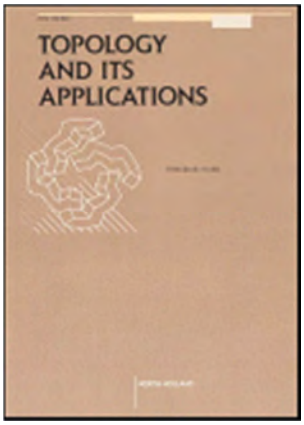
The Journal of Statistical Theory and Practice (http://www.tandfonline.com/loi/UJSP20) was conceived and started in 2007 by Professor Sat Gupta, Department of Mathematics and Statistics at the University of North Carolina at Greensboro. It is published by *Taylor and Francis*. Its editorial board boasts of some of the most eminent academics in the field of statistics such as C. R. Rao (Penn State), Joe Gani (Australian National University), Alan Gelfand (Duke University), Sergio Verdu (Princeton University), Dan Zelterman (Yale University), Sastry Pantula (Oregon State University), and Pranab Sen (UNC Chapel Hill).



The main goal of JSTP is to publish expeditiously original research papers covering theory and applications of statistics. Each paper is refereed by two anonymous referees in addition to one of the Associate Editors. The usual turnaround time for the first review is 90 days. From time to time, the journal also publishes biographies of eminent statisticians in its Life and Work sequence. Some of the eminent statisticians/mathematicians who have been featured include R. A Fisher, S. N. Roy, Leonhard Euler, Jack Kiefer, C. R. Rao, and Charles Heyde.

The journal publishes four issues every year, with 56 papers appearing in Vol. 7, 2013. This volume published two special issues - *Design of Experiments and Related Combinatorics in Memory of Professor Jagdish N. Srivastava* (Ed. Sudhir Gupta & Rahul Mukerjee, and *Statistical Methods in Medical Sciences* (Ed. Sujit Ghosh & Heejung Bang). Sat Gupta serves as Editor-in-chief for the journal.

Topology and its Applications



Professor Jerry Vaughan, along with his colleague Jan van Mill (Vrije Universiteit, Amsterdam) are Editors-in-Chief of the research journal *Topology and its Applications* (http://www.journals.elsevier.com/topology-and-its-applications) published by Elsevier Science B.V. They and four managing editors will handle submissions. The journal is primarily devoted to publishing original research papers in most areas of topology such as algebraic, general, geometric, and set-theoretic topology, as well as papers that concern interaction between and applications of topology to other mathematical disciplines, e.g., topological algebra, topological dynamics, functional analysis, category theory, theoretical computer science, etc. The journal, which began in 1971, continues to grow. The number of submissions has more than doubled during the past ten years. The journal published 17 issues in 2013; for a total of 2,566 pages.

5. External Grants

New Awards Administered by Mathematics and Statistics:

PROP #	Lead PI	Other Personnel	Award Title	Start Award Date	End Award Date	Sponsor	Award Amount
13-0171	**Fernos, Talia**		Low Dimensional Cohomology and the Geometry of Hilbert Space	8/12/13	7/31/16	National Science Foundation	$115,952
14-0209	**Zhang, Haimeng**		Collaborative research: Axially symmetric processes and intrinsic random functions on the sphere	12/4/13	8/31/15	National Science Foundation	$47,468
13-0114	**Yasaki, Dan**	**Tangedal, Brett; Saidak, Filip; Pauli, Sebastian**	UNCG Summer School in Computational Number Theory	2/28/14	3/31/16	National Science Foundation	$17,916
14-0054	**Rychtar, Jan**	**Rowell, Jonathan;** Rueppell, Olav	REU Site: Mathematical Biology at the University of North Carolina at Greensboro	3/11/14	4/30/17	National Science Foundation	$275,952
14-0213	**Gupta, Sat**	**Rychtar, Jan;** Suthaharan, Shan	Advances in Interdisciplinary Statistics and Combinatorics	4/22/14	5/31/15	National Science Foundation	$10,000
12-0350	**Smyth, Clifford**		Correlation inequalities	5/5/14	1/1/15	DOD National Security Agency	$25,989
14-0252	**Shivaji, Ratnasingham**		Analysis of nonlinear eigenvalue problems and applications	5/14/14	8/31/19	Simons Foundation	$35,000
						Total:	**$528,277**

Continuing Awards Administered by Mathematics and Statistics:

PROP #	Lead PI	Other Personnel	Award Title	Start Award Date	Award End Date	Sponsor	Award Amount
12-0162	**Gupta, Sat**		International Conference on Advances in Interdisciplinary Statistics and Combinatorics	11/11/11	6/30/15	North Carolina Chapter of the American Statistical Association	$3,500
12-0205	**Gupta, Sat**	**Rychtar, Jan; Richter, Scott**	International Conference on Advances in Interdisciplinary Statistics and Combinatorics	2/16/12	8/31/14	National Science Foundation	$20,000
12-0316	**Rychtar, Jan**	**Chhetri, Maya; Shivaji, Ratnasingham; Gupta, Sat**	The 8th Annual UNCG Regional Mathematics and Statistics Conference	5/23/12	8/31/13	National Science Foundation	$10,000
12-0323	**Rychtar, Jan**		Game-theoretical models in biology	7/19/12	8/31/17	Simons Foundation	$35,000
13-0115	**Yasaki, Dan**	**Tangedal, Brett; Saidak, Filip; Pauli, Sebastian**	UNCG Summer School in Computational Number Theory	2/20/13	3/31/16	National Science Foundation	$17,916
13-0276	**Bell, Greg**		Scientific and Engineering Applications of Algebraic Topology	7/19/12	12/15/13	University of Minnesota Institute for Mathematics and its Applications	$20,000
13-0334	**Rychtar, Jan**		Game Theory and Applications	4/24/13	12/31/13	Mathematical Association of America	$26,360
12-0350	**Smyth, Clifford**		Correlation inequalities	5/7/13	1/1/15	DOD National Security Agency	$28,514
13-0314	**Rychtar, Jan**	**Chhetri, Maya; Shivaji, Ratnasingham; Gupta, Sat**	The Annual UNCG Regional Mathematics & Statistics Conference	6/28/13	8/31/16	National Science Foundation	$42,000
13-0115	**Yasaki, Dan**	**Pauli, Sebastian; Tangedal, Brett**	UNCG Summer School in Computational Number Theory	4/1/13	9/30/14	NSA Mathematical Sciences Program	$14,600

New Awards Administered by other Departments:

PROP #	Department	Mathematics and Statistics Personnel	Award Title	Start Award Date	End Award Date	Sponsor	Award Amount
13-0407	Health and Human Sciences	**Richter, Scott**	Food Insecurity: How is it related to home food environment, pregnancy and birth outcomes among WIC Pregnant Women	1/13/14	3/31/15	Educational and Research Institutions	$25,000
14-0139	School of Education	**Seaman, Carol**	Core-Math III: Supporting Teachers in Using Learning Trajectories to Implement the Common Core State Standards for Mathematics	4/1/14	9/30/15	UNCGA North Carolina Quest	$149,928

Continuing Awards Administered by other Departments:

PROP #	Department	Mathematics and Statistics Personnel	Award Title	Start Award Date	End Award Date	Sponsor	Award Amount
11-0407	School of Nursing	**Richter, Scott; Gupta, Sat**	TRIAD-2 Center for Health Disparities Research	6/1/12	4/30/16	National Institute of Health	$60,768.95

6. Undergraduate Program

6.1. Various Programs

Richard Fabiano, Director of Undergraduate Studies

We offer the following undergraduate programs:

-BA in Mathematics
-BA in Mathematics with teaching licensure
-BS in Mathematics with concentration in mathematics
-BS in Mathematics with concentration in Statistics

However, some students who enrolled in our program before Fall 2012 continue their course of study in some older degree programs and concentrations included in the chart below.

Undergraduate Degree Program with concentrations	**2013–2014 Student Enrollment**
BA in Mathematics with teaching licensure	22
BA in Mathematics with concentration in mathematics	19
BS in Mathematics with concentration in mathematics	32
BS in Mathematics with concentration in statistics	13
BS in Mathematics with concentration in applied mathematics	5
BS in Mathematics with concentration in pure mathematics	8
BS in Mathematics with concentration in pure mathematics with teaching licensure	1
OVERVIEW: Undergraduate Degree Program	**2013–2014 Student Enrollment**
BA in Mathematics	41
BS in Mathematics	59

The Department of Mathematics and Statistics continues to conduct formal assessment of the General Education Mathematics (GMT) courses. The assessment was embedded in the final exams of all GMT marked courses. Most of the questions on the exams were allocated to verify achievement of one or several GMT student learning outcomes. The data we gather as a result of this exercise leads us to believe that students who achieve at least an average mastery of a GMT course material in the context of the actual subject taught in the class (which we view as getting a final grade of C or better) demonstrate successful achievement of all GMT SLOs (Student Learning Outcomes). Several department faculty participated in the GMT Recertification committee, which in Spring, 2014, redesigned the SLO's for the GMT courses. This same committee will work next year to assess and recertify all General Education GMT courses in the university.

The department completed the approval process for the new precalculus course MAT 190 (Precalculus), which will be offered for the first time in Fall, 2014 (it was previously offered on an experimental basis). The course is designed to provide a one-semester option to our existing two-semester precalculus sequence, and is especially useful for STEM majors with a strong high school mathematics background who don't already place into calculus. On a related note, we redesigned and streamlined our online placement tests to account for this new course. We are now better able to offer both majors and nonmajors the appropriate course options and placement in mathematics and statistics. Also a faculty committee has selected a new textbook for the calculus sequence, and will continue working to examine the readiness of students as they enter the calculus sequence.

The department nominated two mathematics majors for the Student Excellence Award, which is the highest academic honor bestowed by the university. Both nominated students, Hollan Foltz and Austin Lawson, won the award.

As part of our commitment for high quality instruction in the classroom, we continued to keep the sizes of all lecture sections in all mathematics and statistics classes at 50, while most of the classes at the level above remedial have a limit of 35 seats and all classes at 300 level or above are limited to 25 students per section.

During the 2013−2014 academic year, the following students completed their degrees: Matthew Adams, Jasmine Anderson, Cassandra Brownell, Kristin Cudequest, Jordan Eliseo, Hollan Foltz, David Giron, Dallas Hayes, Kayla Jackson, Ian Jenkins, Austin Lawson, Zachary Leach, Yang Lu, Toni MacReynolds, Daphne McLaughlin, Heather Outlaw, Thomas Parrish, Nicholas Perrone, William Phillips, Matthew Reed, Jovan Simmons, Joseph Splawn, and Jason Stalls.

-Jordan Eliseo, who graduated in May 2014 with his BS in Mathematics, accepted a position with IBM in Austin Texas. He will be a Software Developer for IBM Cloud Services. He will be designing new software solutions for the cloud architecture for corporate companies such as Yelp and eBay.

Pictures from the May 2014 Departmental Graduation Ceremony


ATHLETE








6.2. Recruitment and Retention

Over the last several years and during the 2013-2014 year in particular, the Department of Mathematics and Statistics has been working to increase the number of undergraduate mathematics majors at UNCG and to retain those students in the department throughout their years at UNCG. In addition to lowering the class sizes of our 100-level mathematics courses and providing a new Mathematics Help Center where students can come for assistance with their mathematical questions, we have opened a new Mathematics Emporium lab which combines the best components of traditional and online classes for approximately 200 students in our College Algebra and Precalculus courses. We also participate in and support with faculty involvement the AToMS living learning community for freshmen STEM (Chemistry & Biochemistry, Computer Science, Mathematics & Statistics, and Physics & Astronomy) majors. In order to more fully address issues of recruitment and retention of mathematics majors, the department added an Academic Professional position, which was filled by Dr. Tracey Howell in Fall 2013. Other departmental initiatives and opportunities intended to support enrollment and retention of undergraduate mathematics majors are listed below.

Activities

- Carol Seaman advises all mathematics majors seeking secondary certification throughout their undergraduate program and Tracey Howell advises all freshman mathematics majors.
- Tracey Howell and Carol Seaman have been and will continue to attend Guilford County Schools High School Teaching and Learning Sessions to lend support and assistance.
- In August 2013, the department sponsored a continental breakfast for all Guilford County high school math teachers at their opening professional development event.
- A "Welcome to the Department" Party was held on September 29, 2013 for first-year mathematics majors.
- Tracey Howell attended the Spartan Showcase on October 10, 2013 and sent follow-up emails to 15 potential UNCG applicants.
- Carol Seaman and Rich Fabiano participated in the Fall Faculty Phone-a-Thon during the week of November 18-21, 2013.
- Tracey Howell and Carol Seaman participated in the UNCG Educational Fest on December 11, 2013 for 7th and 8th graders from Guilford County Schools.

- Carol Seaman and Tracey Howell participated in the Spring Faculty Phone-a-Thon during on Wednesday, February 19, 2014. Tracey Howell then sent follow-up emails to the 32 admitted students.
- Tracey Howell, Rich Fabiano, and Carol Seaman participated in Destination UNCG 2014. They were able to meet with 12 admitted students who expressed an interest in majoring in mathematics. Tracey Howell also contacted the students via email.

Carol Seaman, Dohyoung Ryang, Walker Weigel at

Spartan Education Day December 11, 2013

Organizations for Mathematics Majors

- Alpha Student Chapter of the North Carolina Council of Teachers of Mathematics (Faculty Advisors: Dohyoung Ryang & Tracey Howell)
- Student Chapter of the Association for Women in Mathematics (Faculty Advisor: Talia Fernos)
- Math Club (Faculty Advisor: Dan Yasaki)
- Student Chapter of the Mathematical Association of America (Faculty Advisor: Greg Bell)
- Pi Mu Epsilon (Faculty Advisor: Richard Fabiano)

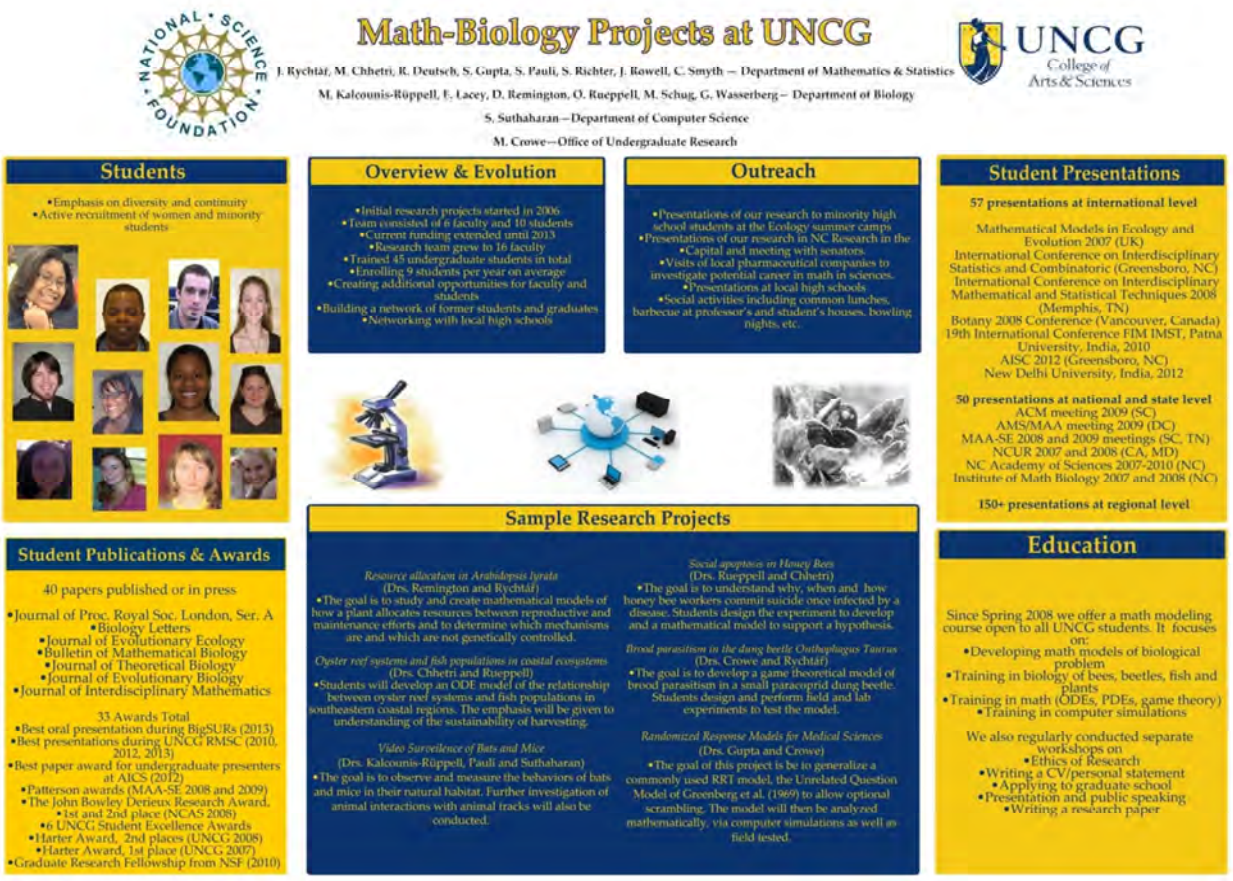
Grant Submissions for Proposals to Strengthen the UNCG Mathematics Program

- Spencer Foundation (2013)
- TeMALe UNC-GA Grant (2013)
- WIDER NSF Grant (2013)
- CAUSE NSF Grant (2014)
- NOYCE NSF Grant (2014)

7. Undergraduate Research Program

Background and history

The major push for undergraduate research in the Department started in 2005 with the establishment of a math/biology research group by Drs. Rychtar, Chhetri and Gupta from the Department of Mathematics and Statistics, Drs. Rueppell and Remington from the Department of Biology, and Dr. Crowe from the Office of Undergraduate Research. The group has been funded by two major NSF grants; 0634182 (2006-2010) and 0926288 (2009-2013). Over the years, this research has involved 16 faculty and over 45 undergraduate students. The students and faculty received 33 awards and recognitions, gave over 250 presentations, and published over 40 research articles in major international journals.



2013 National Research Experience for Undergraduates Program

Summary

Jan Rychtář (UNCG), Tsvetanka Sendova (Bennett College) and Hyunju Oh (Bennett College) received funding from the Mathematical Association of America (MAA) for the for the project “Game Theory and Applications”. The award is part of the National Research Experience for Undergraduates Program funded through MAA by the National Science Foundation's Division of Mathematical Sciences and the National Security Agency. During the 6 weeks, from May 1, 2013 to June 15, 2013, they engaged Hakimah Smith, Marwah Jasim, Jasmine Everett, KeYona Barton, and Corbin Smith, all African-American female undergraduate students from Bennett College, Greensboro, NC in the research projects. The students worked in groups under the supervision of project directors. They were introduced to the fundamental game-theoretical concepts such as Nash equilibria and evolutionarily stable strategy and learned how to use computational tools (such as Maple or a freeware program NetLogo) as well as analytical tools (optimization and linear algebra) to identify such strategies in real game theoretical models with applications in biology and medicine. The students were further trained in all aspects of research, starting with the ethics code, going through the workshops on using library and online resources and ending with training in delivering oral presentations as well as in using LaTeX to write mathematical papers.

Research Projects

The Invasion of Asian Carp of the Upper Mississippi River

Asian carps were imported from China in the 1970s to help clean commercial ponds. However, they subsequently migrated from ponds into the Mississippi, where they quickly reached high population density. They are considered invasive species, highly detrimental to the ecological balance, as they threaten the native fish population, eating up the algae and other organisms essential for the survival of the native fish. The Asian carp now threatens the Great Lakes. In July 2012 Congress enacted the "Stop Invasive Species Act", which requires the U.S. Corp of Engineers to implement measures, which will prevent Asian Carp from invading the Great Lakes from the Mississippi through the Chicago area canal system. The goal of this project is to gain a better understanding of the interaction between native species and Asian carp. Students will develop and analyze game=theoretical models related to the Hawk-Dove-Retaliator game to study the Mississippi invasion of the Asian Carp and its competition with native fish. Specifically, students will study the speed of the invasion and how it depends on various parameters of the game; with the aim to identify values that slow down (or even stop) the invasion. With the help of computer simulations, they will also study how the spatial structure of the river (or the canals) affects the invasion process. H. Smith, M. Jasim and J. Everett work on this project.

The emergence of invasive tumor cells

The tumor cells can come in different phenotypes which in turn gain different advantage under various metabolic conditions. Basanta et al. 2008 (Evolutionary game theory elucidates the role of glycolysis in glioma progression and invasion) describe three different phenotypes: AG (autonomous growth), GLY (anaerobic glycolysis) and INV (invasive) and study an evolutionary game between those phenotypes. The game can be described as generalized Rock-Paper-Scissors game and authors’ main objective was to identify conditions for which the INV phenotype appears (as in those cases, the tumor spreads). As part of this proposed project, the students will a) completely analyze the above game with 3 phenotypes, and then build on this work to b) incorporate more phenotypes into the game and c) incorporate spatial aspects of the tumors that have been neglected in previous models. The main objective will stay the

same as in the original – identify conditions that allow (or prevent) INV phenotype to appear in order to help device tumor treatment strategies. K. Barton and C. Smith work on this project.

Outcomes

- Presentations at NC A&T, June 5, 2013
- Ke'Yona Barton and Corbin Smith and Jasmine Everett, Marwah Jasim, and Hakimah Smith delivered presentations at UNCG RMSC conference, November 2, 2013.
- Ke'Yona Barton and Corbin Smith received an award for the outstanding student presentation in the undergraduate student category during the UNCG RMSC conference, November 2, 2013.
- Jasmine Everett and Hakimah Smith have presented "Modeling the Asian Carp Invasion Using Mathematical Evolutionary Game Theory" at MAA poster session, the 2014 Joint Mathematics Meeting, Baltimore, MD, January 17, 2014.
- Ke'Yona Barton, Corbin Smith, Jan Rychtar and Tsvetanka Sendova: Modeling of Breast Cancer Through Evolutionary Game Theory, submitted in International Journal on Mathematical Methods and Models in Biosciences
- Jasmine Everett, Hakimah Smith, Marwah Jasim, Hyunju Oh and Jan Rychtar: Modeling the Asian Carp Invasion Using Mathematical Evolutionary Game Theory, submitted to Springer Proceedings in Mathematics and Statistics

Acknowledgement

This program is an MAA activity funded by NSA (grant H98230-13-1-0270) and NSF (grant DMS-1156582).

From the left: Tsetanka Sendova, Jan Rychtář, Hyunju Oh, Ke'Yona Barton, Corbin Smith, Marwah Jasim, Jasmine Everett, Hakimah Smith

2014 National Research Experience for Undergraduates Program

Summary

Jan Rychtář (UNCG) and Hyunju Oh (Bennett College) received funding from the Mathematical Association of America (MAA) for the project "Game Theory and Applications". The award is part of the National Research Experience for Undergraduates Program funded through MAA by the National Science Foundation. During the 6 weeks, from May 19, 2014 to June 27, 2014, they engaged Aaleah Lancaster, Kira Crawford, Marie Paulemond and Chasity Dorsett, all African-American female undergraduate students from Bennett College, Greensboro, NC in the research projects. The students worked in groups under the supervision of project directors similarly to the structure of 2013 NREUp program.

Research Projects

Modelling the Prevention of African Sleeping Sickness disease

African sleeping sickness is a parasitic disease transferred by tsetse flies to humans and other animals such as cows. The sickness is caused by protozoa of the species *Trypanosoma brucei*. We used a SIR compartment model (Damian Kajunguri et al. Modelling the use of insecticide-treated cattle to control tsetse and trypanosoma brucei rhodesiense in a multi-host population. Bulletin of mathematical biology, 76(3):673–696, 2014) to study the disease in the population where a proportion of cows is being treated by an insecticide to limit the tsetse transmission. The model allows us to study the basic reproduction number of the disease, as a function of the proportion of cattle being treated with insecticide per day. We used vaccination game framework (Chris T Bauch and David JD Earn. Vaccination and the theory of games. Proceedings of the National Academy of Sciences of the United States of America, 101(36):13391–13394, 2004) to get the optimal proportions of the cows to treat for the individual farmers.

Modeling the prevention of the Dengue Fever

Dengue Fever is one of the most important vector-borne infections that have emerged as a worldwide problem beginning in the 1950's. This infection is transmitted by its principal vector *Aedes Stegomyia aegypti*. We studied and used a SIR compartment model (Amaku et al. A comparative analysis of the relative efficacy of vector-control strategies against dengue fever. Bulletin of mathematical biology, 76(3):697–717, 2014). The model yields the basic reproduction number and the force of infection for Dengue Fever as a function of many parameters; most notably the death rate for mosquitoes, and daily rate of biting from the mosquitoes. Each of these parameters can be influenced by human behavior (for example by eliminating the standing water sites, using insecticide to kill adult mosquitos, or to limit exposure to bites). We used vaccination game framework developed in (Chris T Bauch and David JD Earn. Vaccination and the theory of games. Proceedings of the National Academy of Sciences of the United States of America, 101(36):13391–13394, 2004) to get the behavior that is optimal for the individual.

Outcomes

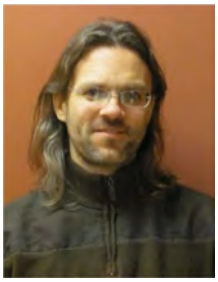
- Presentations at Bennett College, June 25, 2014
- Presentations at NC A&T, July 18, 2014
- Kira Crawford and Aaleah Lancaster presented the talk "Mathematical Model of African Sleeping Sickness" at UNCG RMSC conference
- Marie Paulemond and Chasity Dorsett presented the talk "Dynamic Modeling for Dengue Fever" at UNCG RMSC conference Kira Crawford and Aaleah Lancaster presented the talk "Mathematical Model of African Sleeping Sickness" at 2014 Annual Biomedical Research Conference for Minority Students (ABRCMS), San Antonio, TX, November 14, 2014.
- Marie Paulemond and Chasity Dorsett presented the talk "Dynamic Modeling for Dengue Fever" at 2014 Annual Biomedical Research Conference for Minority Students (ABRCMS), San Antonio, TX, November 14, 2014.

Acknowledgement

This program is an MAA activity funded by NSF (grants DMS-1156582 and DMS-13

(From the left: Hyunju Oh, Chasity Dorsett, Kira Crawford, Aaleah Lancaster, Marie Paulemond, Jan Rychtar)

2014 National Science Foundation funded Research Experiences for Undergraduates Program (REU site)



Jan Rychtar, PI

Jonathan Rowell, co-PI

2014 REU site

Jan Rychtar, Jonathan Rowell and Olav Rueppell received the NSF grant "REU Site: Mathematical Biology at the University of North Carolina at Greensboro," which supports undergraduate students during the summer months of 2014, 2015 and 2016. For ten weeks in 2014 (mid-May to the end of July), the PIs worked with eight undergraduate students that came from Appalachian State University, Bennett College, Miami University, Michigan State University, NC State University, UNCG and UNC Wilmington. Here at UNCG, the students worked on four projects related to the evolution of cooperation. The students and the faculty mentors presented the results of their research at the numerous conferences in the Fall 2014 and Spring 2015, including AISC 2014, BEER 2014, NIMBioS 2014, UNCG RMSC 2014, AMS-SE 2014, and JMM 2015. Manuscripts have also been submitted to peer reviewed journals in mathematical biology.

The 2014 cohort was gender-balanced with four male and four female students. In addition, three out of eight students came from under-represented minorities, specifically African American and Hispanic. Student ages ranged from 18 to 22, encompassing freshmen, sophomores, juniors, and seniors, and their prior course work in mathematics and statistics varied extensively.

The ten-week program consisted of two distinct phases. In the first two-week period, the students underwent a broad training suitable for the preparation of mathematical biologists. Morning sessions covered technical subjects such as programming in Matlab and typesetting with LATEX, while the afternoons were devoted to instruction in a number of topics in mathematics and biology as well as general academic skills. A doctoral student within our department was responsible for the morning sessions, and he offered programming and mathematical consultancy during the research phase of the program. The PIs provided the bulk of the mathematical and biology training in the afternoon. A second graduate student, now enrolled in a doctoral program in behavioral ecology at Cornell University, led discussions on reviewing the literature, academic writing and other skills. In addition to this instruction, the students undertook daily mini-projects that encapsulated the lessons of the day and in which they would need to work together to prepare a finalized report. For the remaining eight weeks of the program, the students worked on their research projects. They were required to give daily elevator-talk synopses of their work as well as weekly formal presentations. In keeping with the goal of introducing the students to a complete biomathematics research environment, one graduate assistant also organized a weekly journal club in which each participant led a discussion on a paper of their choice.

Bennett College students at Math Bio REU

The REU program culminated with student presentations in a formal symposium attended by faculty from across the university. Research and writing have continued for each team since the conclusion of the summer.

Research projects

All research projects were loosely connected to the prisoner's dilemma game. The prisoner's dilemma is a classic problem in game theory in which two arrested individuals are each given a choice between confessing to a committed crime or remaining silent. By remaining silent (and thus cooperating with one another) the two prisoners could escape punishment with only minor sanctions. If either confessed during interrogation, however, harsher criminal penalties would be imposed. Because confession may lead to a reduction in one's own sentencing in either circumstance, each prisoner independently finds it advantageous to defect from their partner and confess to the crime. From a larger philosophical perspective, the prisoner's dilemma invites the question of how cooperation and in-group honesty could arise or be maintained given any social system's vulnerability to exploitation by bad actors (Defectors). This conundrum has been raised in both economics and evolutionary game theory and it remains an open area of debate. In the four projects detailed below, our student teams each worked on problems of cooperation using different mathematical approaches and by framing their questions in different contexts.

Evolution of Cooperation in Mobile population

The first student project concerned a system of discrete agents operating within a sparsely populated network of patches. The project focused on how these agents moved about the network and formed aggregations. As with many agent-based simulation studies the project model involves stochastically

driven events (e.g. movement, competition) in the lifespan of an individual agent. The distinguishing feature of the research conducted here was the mobility of the agents. Each agent move aimed at maximizing agent's long term fitness. We have investigated how various parameters of the simulation influenced the evolution of cooperation. We found that both greater mobility and larger neighborhood size inhibit the evolution of cooperation because it allows the defectors to find the cooperators faster and exploit them more.

Age-Structured Populations

Math-Bio REU students

The second project, also directed by Dr. Rychtar, studied the fixation rate of cooperation within an age-structured agent-based network. This project derived some of its motivation from the work of Dr. Olav Rueppell, a member of UNCG's Department of Biology. Many animals have distinct life phases (pre-reproductive, reproductive, and post-reproductive) in which interactions vary with respect to the age of individuals, and that the duration of these phases was subject to selection pressures. The model of this project shared many features with the previous project (e.g. agents that could be either Cooperators or Defectors), but the system transpired on a two-dimensional lattice network of sites and each agent was fixed at a particular location. Individuals were subject to aging and mortality events as well as reproduction and competition for resources with individuals in neighboring cells. The propensity of these events were influenced by an individual's fitness score, itself a function of the present and historic compositions of its neighborhood. We focused on the effects of memory of past interactions and neighborhood size on the evolution of cooperation. We showed that larger neighborhood sizes are detrimental to cooperation. Further, we showed that larger memories actually hurt the spread of cooperation in small neighborhood sizes. For larger neighborhood sizes, however, longer memories are more favorable to the spread of cooperation than shorter memories.

Social Dynamics

The third project regarded the contest between cooperation and defection as a question of behavioral responses amid shifting social compositions. Prior research into the trustworthiness of public signals had shown that one could obtain results that diverged from classic game theory outcomes when there was a mixed-constituent audience or multiple players involved. This project adapted that idea to describe the behavioral changes within a society composed of three inter-dependent classes (taxpayer elites, government and law enforcement, general citizens). Members of each class had a binary choice of actions for dealing with society at large (e.g. being charitable or stingy with resources) that could be equated with either cooperation or defection according to an external assessment of what constituted a just or ideal society. Our goal was to determine the underlying structural dynamics of these models and, secondarily, the conditions necessary to maintain a utopian social archetype where all classes adopted their respective equivalent of cooperate. Charitability was lost under most parametric combinations without a utopian preference among the elite taxpayers, and society either defaulted to a dystopian

outcome or cycled through periods of oppression, relaxation, rioting and restoration of order. Although social ideals could stabilize the utopian archetype, that alone did not eliminate the possibility of other attractors within the system, and the system remained initial condition dependent.

Cooperation and Kleptoparasitism

The final project placed cooperation and defection in the context of theoretical ecology and per capita fitness functions. A number of papers have recently established a framework for studying the dynamics and spatial distributions of populations capable of adaptive movement. For this project, we considered three variations of a fitness function that describes the local performance in recovering resources from the environment. The three variations are stereotypical expressions of selfishness, cooperation, and exploitation. Respectively, these variations consist of a fitness function that strictly declines with density, another which features an Allee effect at smaller densities, and an exploitative interaction wherein gathered resources are transferred from host individuals to kleptoparasites. We found that host fitness functions mediated the community dynamics under invasion from parasites, with destabilizing cycles affecting cooperative hosts in high resources. Moreover, selfish and cooperative populations were mutually exclusive to one another.

Student Awards

- Hollan Foltz and Austin Lawson won a 2013−2014 Student Excellence Award from the Honors Council of the Lloyd International Honors College. This award is UNCG's highest academic honor for undergraduates.

- Caitlin Ross won the award for the Outstanding Student Presentation during 9th annual UNCG RMSC, November 2013

Student Papers (Undergraduate students in bold)

Butler, D., Shivaji, R., and **Tuck, A.** (2013): S-shaped bifurcation curves for logistic growth and weak Allee effect growth models with grazing on an interior patch, accepted for publication, Electronic Journal of Differential Equations (Conf. Series)

Broom, M., Rychtar, J., and **Sykes, D.** (2013) "The effect of information on payoffs in kleptoparasitic interactions," To appear in *Springer Proceedings in Mathematics & Statistics*.

Ross, C., Rueppell, O., and Rychtar, J.(2013): A spatially organized population model to study the evolution of cooperation in species with discrete life-history stages. To appear in *Springer Proceedings in Mathematics & Statistics.*

Gill, T., Tuck, A., Gupta, S., Crowe, M., and **Figueroa, J.** (2013): A Field Test of Optional Unrelated Question Randomized Response Models: Estimates of Risky Sexual Behaviors. *Topics from the 8th Annual UNCG Regional Mathematics, and Statistics Conference, Springer Proceedings in Mathematics and Statistics Series,* Vol. 64, 135-146

Kalcounis-Rueppell, M., **Parrish, T.,** and Pauli, S. (2013): Application of Object Tracking in Video Recordings to the Observation of Mice in the Wild To appear in *Springer Proceedings in Mathematics & Statistics*.

Gupta, S., **Tuck, A., Spears Gill, T.**, and Crowe, M.: Optional unrelated-question randomized response models, *Involve: A Journal of Mathematics*, Vol. 6 (4), 483-492

Ross C. R., Rychtar J., and Rueppell O. (submitted 2013) Life history structure affects the evolution of cooperation. In preparation for Proc. R. Soc. London B.

DeFelice D. S., Ross C., Simone-Finstrom M., Sukumalan and P., Rueppell O. (submitted 2013) Geographic Variation in Polyandry of the Eastern Honey Bee, Apis cerana. In preparation for Naturwissenschaften.

Broom, M., Rychtar, J., and **Sykes, D.** (submitted 2013). "Kleptoparasitic interactions under asymmetric resource valuation," Mathematical Modelling of Natural Phenomena. In press.

Dixon L. R., Kuster R.D., and Rueppell O. (in press 2013) Reproduction, social behavior, and aging trajectories in honey bee workers. AGE. doi:10.1007/s11357-013-9546-7.

Ross C. R., Rueppell O., and Rychtar J. (2013) A spatially organized population model to study the evolution of cooperation in species with discrete life-history stages. Springer Proceedings in Mathematics & Statistics, in press.

Crowe, M. L., **Raspet, E.,** Rychtar, J., and Gupta, S. (2013): Effect of Density and Extra Dung on Brood Parasitism in the Dung Beetle, Onthophagus taurus, Journal of Insect Behavior 26 (2), 253-259

Major student conference presentations in 2013-14

Presentations by undergraduate students. * denotes the student, the first name is the presenter (although in some instances, both students were co-presenting)

Frederick Beck* and Clifford Smyth: The Lonely Runner Conjecture, 7th Annual Carolyn & Norwood Thomas, Undergraduate Research Expo, UNCG, 2013.

Benjamin Manifold*, Matina Kalcounis Rueppell, and Sebastian Pauli: Automated Tracking of Small Objects in Video Recordings, Undergraduate Research Conference at the Interface of Biology and Mathematics, NIMBioS, Knoxville, TN, 2013.

David Sykes*, and Jan Rychtar: Kleptoparasitic Interactions and Internal States, Undergraduate Research Conference at the Interface of Biology and Mathematics, NIMBioS, Knoxville, TN.

Caitlin Ross*, Dominick DeFelice*, and Olav Rueppell: An Investigation of Genome Features and Their Effect on Meiotic Recombination Rates in Apis mellifera, Undergraduate Research Conference at the Interface of Biology and Mathematics, NIMBioS, Knoxville, TN.

Qi Zhang*, Tracy Spears*, and Sat Gupta: Risky Sexual Behaviors among College Students - Predictors of STD, UNCG RMSC, Greensboro, NC.

David Sykes* and Jan Rychtar: Kleptoparasitic Interactions and Internal States, UNCG RMSC, Greensboro, NC.

Caitlin Ross*, Dominique DeFelice* and Olav Rueppell: An Investigation of Genome Features and Their Effect on Meiotic Recombination Rates in Apis mellifera, UNCG RMSC, Greensboro, NC.

Tracy Spears Gill*, Anna Tuck*, Sat Gupta, Mary Crowe and Jennifer Figueroa: A Field Test of Optional Unrelated Question Randomized Response Models, Advances in Statistical Methods for the Analysis of Observational and Experimental Data, NC State University, Raleigh, NC.

Caitlin Ross*, Jan Rychtar, and Olav Rueppell: Effect of Varying Life Stages on the Evolution of Altruism. NCUR, La Crosse, Wisconsin, 2013.

Caitlin Ross*, Jan Rychtar and Olav Rueppell: The effect of varying life stages on the evolution of altruism, National Conference of Undergraduate Research, University of Wisconsin – Madison, 2013.

David Sykes * and Jan Rychtar: Resource Holding Potential and Kleptoparasitism. NCUR, La Crosse, Wisconsin, 2013.

Tracy Spears Gill* and Jan Rychtar: Application of Game-Theoretical Models to Influenza Vaccination Decisions, BigSURs, High Point, NC.

Benjamin Manifold*, Thomas Parrish*, Sebastian Pauli and Matina Kalcounis-Rueppell: A Computer-Vision Approach for the Automated Analysis of Peromyscus californicus Behavior. UNCG OUR Expo, Greensboro, North Carolina.

Jennifer Figueroa* and David Remington: Development and Resource Allocation Patterns in Arabidopsis Lyrata. UNCG OUR Expo, Greensboro, North Carolina.

Anna Tuck*, Tracy Spears* and Sat Gupta: Estimating Sexual Behaviors Among College Students Using Optional Unrelated Question RRT Models. UNCG OUR Expo, Greensboro, North Carolina.

Anna Tuck* and Ratnasingham Shivaji: Population Dynamics Model with Logistic Growth, Weak Allee Effect, and Grazing on an Interior Patch, Mathematical Association of America MD-DC-VA Section Meeting , Salisbury University - Salisbury, MD, 2013

Tracy Spears* and Jan Rychtar: Influenza Vaccination: Game-Theoretical Models. UNCG OUR Expo, Greensboro, North Carolina.

Caitlin Ross*, Jan Rychtar and Olav Rueppell: The Effect of Life History Structures on the Evolution of Altruism. UNCG OUR Expo, Greensboro, North Carolina.

David Sykes* and Jan Rychtar: Individualized Resource Valuation in Kleptoparasitic Interactions. UNCG OUR Expo, Greensboro, North Carolina.

Tracy Spears* and Jan Rychtar: Influenza vaccination game. Game Theory seminar, Bennett College, Greensboro, North Carolina.

David Sykes* and Jan Rychtar: Costs and Benefits of Kleptoparasitic Interactions. Game Theory seminar, Bennett College, Greensboro, North Carolina.

David Sykes* and Jan Rychtar: Cost-Benefit Analysis of Kleptoparasitic Interactions. 2013 Joint Mathematics Meeting, San Diego, California, 2013.

David Sykes* and Jan Rychtar: Resource holding potential and parasitism, National Conference of Undergraduate Research, University of Wisconsin – Madison, 2013.

Undergraduate Research Awards in Mathematics and Statistics

These awards have been established by Dr. Ratnasingham Shivaji to promote research in Mathematics and Statistics done by undergraduate students and they are funded by Helen Barton funds.

An award can be given to an undergraduate student majoring in mathematics or a related area that contributed to a research program of a Mathematics and Statistics faculty member. The student has to present the results of the work and is highly encouraged to submit a research paper.

During 2013, the following students have been funded:

Anna Tuck (Dr. R. Shivaji):

A population dynamics model with logistics growth, and grazing in an interior patch.

The findings have been presented at the departmental colloquia, the Mathematical Association of America MD-DC-VA Sectional Meeting, Salisbury, MD, 2013 and the related paper

Butler, D., Shivaji, R., and Tuck, A. (2013): S-shaped bifurcation curves for logistic growth and weak Allee effect growth models with grazing on an interior patch, accepted for publication, Electronic Journal of Differential Equations (Conf. Series)

David Sykes (Dr. J. Rychtář):

Mathematical Models of Kleptoparasitism

The findings have been presented at the 2013 UNCG RMSC conference and the related paper

Broom, M., Rychtář, J., & Sykes, D.: Kleptoparasitic interactions under asymmetric resource valuation," is accepted in the Mathematical Modelling of Natural Phenomena.

Qi Zhang (Dr. Sat Gupta):

Modeling Risky Sexual Behaviors among College Students using Optional RRT Models

The findings have been presented at the UNCG RMSC conference, 11/2/2013 and the related paper

Qi Zhang, Haseeb Kazi, Sat Gupta: Modeling Risky Sexual Behavior Among College Students--Predictors of STD is accepted for publication in the Topics from the 9th Annual UNCG Regional Mathematics, and Statistics Conference, Springer Proceedings in Mathematics and Statistics Series.

8. Graduate Programs

Year in Review

Greg Bell, Director of Graduate Studies

Greg Bell created a graduate handbook that clearly outlines policies, procedures, and expectations for all MA and PhD students. This handbook was distributed to all current students and placed on the website. The department expanded qualifying exam options to include a new exam in number theory. We also created two new graduate courses in statistics to facilitate a statistics focus within the Computational Mathematics PhD. In August 2014 Abraham Abebe became our first PhD graduate. He worked with Maya Chhetri and his dissertation was titled "Positive Solutions of Nonlinear Elliptic Boundary Value Problems." Abraham is currently an assistant professor (non-tenure track) at Temple University. Our second PhD student completed the requirements for her PhD in August and will graduate in December. Danielle Moran worked with Greg Bell and her dissertation was titled "Permanence results for dimension-theoretic coarse notions." Danielle is currently an Assistant Professor (tenure track) at Guilford College.

Abraham Abebe

Danielle Moran

We had the following Master's graduates: Ricky L. Shepherd and Robert Stoesen

2014 Departmental Graduation Ceremony

Graduate Student Research

Our PhD and MA students continue to be active members of the UNCG research community.

During the 2013-2014 Academic Year, the following papers were co-authored by UNCG graduate students (graduate students' names appear in bold face).

1. **Abraham Abebe** and Maya Chhetri, Nonexistance of positive radial solutions to a quasilinear semipositone systems, revision submitted to Journal of Mathematical Analysis and Applications.
2. **Abraham Abebe,** Maya Chhetri, Lakshmi Sankar, and R Shivaji, Positive solutions for a class of superlinear semipositone systems on exterior domains, submitted to Boundary Value Problems.
3. **Abraham Abebe**, Maya Chhetri, and R. Shivaji, Positive solutions for a class of multiparameter elliptic systems, submitted to Dynamics of Continuous, Discrete and Impulsive Systems.
4. **Jonathan Milstead,** Sebastian Pauli, and **Brian Sinclair,** Constructing splitting fields of polynomials over local fields, (in press) Topics from the 9th Annual Regional Mathematics and Statistics Conference.
5. C. Awtrey, N. Miles, **J. Milstead,** C. Shill, and E. Stronsider, Galois groups of degree 12 2-adic fields, (in press) Involve: A Journal of Mathematics.
6. Gregory Bell and **Danielle Moran,** Free product-like permanence results for some coarse invariants, submitted to International Journal of Algebra and Computation.
7. **Catherine Payne** and Jerry Vaughan, Fibers of continuous real-valued functions on \psi-spaces, submitted to Topology and its Applications.
8. **Jeong Sihm** and Sat Gupta, A two-stage binary optional randomized response model, (in press) Communications in Statistics – Simulation and Computation.
9. **Jeong Sihm**, Anu Chhabra, and Sat Gupta, An optional unrelated question RRT model, (in press) Involve: A Journal of Mathematics.
10. Eunkyung Ko, Eun Kyong Lee, R. Shivaji, and **Byungjae Son**, Uniqueness of positive solutions for a singular nonlinear eigenvalue problem when a parameter is large, bulletin of the Belgian Mathematical Society – Simon Stevin 21 (2014), 179—184.

Graduate Student Presentations

Our PhD and MA students gave several talks at conferences across the Southeastern United States.

1. **Abraham Abebe** and Maya Chhetri: Positive solutions for a class of superlinear semipositone systems on exterior domains, at the Joint Mathematics Meeting in Baltimore, MD, January, 2014.
2. **Abraham Abebe** and Maya Chhetri: Nonexistence of positive radial solutions to a quasilinear semipositone systems, 9th UNCG-RMSC conference in Greensboro, NC, November, 2013.
3. **Adam Eury** and Maya Chhetri, "Positive solutions for a class of one dimensional p-Laplacian problems", 9th UNCG-RMSC conference in Greensboro, NC, November, 2013.
4. **Adam Eury** and Maya Chhetri, "Positive solutions for a class of one dimensional p-Laplacian problems", Math Club, UNCG, October, 2013.

5. **Adam Eury** and Maya Chhetri, "Positive solutions for a class of one dimensional p-Laplacian problems", South Eastern Atlantic Regional Conference on Differential Equations, Knoxville, TN, September, 2013.
6. **Abraham Abebe** and Maya Chhetri: Nonexistence of positive radial solutions to a quasilinear semipositone systems, South Eastern Atlantic Regional Conference on Differential Equations, Knoxville, TN, September, 2013.
7. Eunkyung Ko, Eun Kyoung Lee, R. Shivaji and **Byungjae Son**, Uniqueness of positive solutions for a singular nonlinear eigenvalue problem when a parameter is large, 33rd Southeastern-Atlantic Regional Conference Differential Equations, University of Tennessee, TN, September, 2013.
8. **Jeong Sihm**, Anu Chhabra, and Sat Gupta, "A Binary Optional Unrelated Question RRT Model" at 2013 NC-ASA Symposium, NCSU, Raleigh, NC, October 5, 2013.
9. Eunkyung Ko, Eun Kyoung Lee, R. Shivaji and **Byungjae Son**, Uniqueness of positive solutions for a singular nonlinear eigenvalue problem when a parameter is large, The 9th Annual UNCG Regional Mathematics and Statistics Conference, University of North Carolina at Greensboro, NC, November, 2013.
10. **Jeong Sihm**, Anu Chhabra, and Sat Gupta, "A Modified Optional Unrelated Question RRT Model" at The 9th Annual UNCG Regional Mathematics and Statistics Conference, UNCG, Greensboro, NC (Nov 2, 2013).
11. **Catherine Payne** and Jerry Vaughan, Continuous functions on \psi-spaces, 2014 Spring Topology Conference, Richmond VA, March 2014.
12. **Sinclair, B**., and Pauli, S., Enumerating p-adic field extensions with additional invariants, SouthEast Regional Meeting on Numbers 2014, Wofford College, Spartanburg, SC.

Additionally, **Paula Hamby** and **Brian Sinclair** gave research talks at the UNCG Algebra, Combinatorics, and Number Theory seminar.

1. **Paula Hamby**, Elliptic Curve, Absolute Galois, and Trace of Frobenius: Examples, AC/NT Seminar, Fall, 2013.
2. **Sinclair, B.**, Root Partitions and Recursion in OM Algorithms, AC/NT Seminar, UNCG, Fall 2013.
3. **Sinclair, B.**, A Family of Eisenstein Polynomials Generating Totally Ramified Extensions," AC/NT Seminar, UNCG, Spring 2014.

Finally, most of our graduate students attended conferences, workshops, or summer schools during the 2013-2014 Academic Year.

1. **Byungjae Son** and **Adam Eury** attended the 2013 PI Summer Graduate Program, University of Minnesota, MN, July 2013.
2. **Jeong Sihm** attended Advances in Statistical Methods for the Analysis of Observational and Experimental Data (A Symposium in Honor of Anastasios A. (Butch) Tsiatis), Department of Statistics, NCSU, Raleigh, NC in July 2013.
3. **Byungjae Son** attended the 33rd Southeastern-Atlantic Regional Conference Differential Equations, University of Tennessee, TN, September, 2013.
4. **Paula Hamby** attended the Palmetto Number Theory Series (PANTS XX), Davidson College, September, 2013.

5. **Jeong Sihm and Tanja Zatezalo** attended the NC-ASA Symposium, Raleigh, NC, October 2013.
6. **Danielle Moran, Catherine Payne, Jeong Sihm, Byungjae Son, and Tanja Zatezalo** attended the 9th Annual UNCG Regional Mathematics and Statistics Conference in November 2013.
7. **Catherine Payne** attended the 2014 Spring Topology and Dynamical Systems conference in Richmond, VA.
8. **Jonathan Milstead and Brian Sinclair** attended the SouthEast Regional Meeting on Numbers (SERMON XXVII) 2014, Wofford College, April 2014.
9. **Paula Hamby, Jonathan Milstead, and Brian Sinclair** attended the UNCG Summer School on Modular Forms and Geometry, UNCG, May, 2014.
10. **Paula Hamby** attended the Building Bridges Summer School and Workshop, University of Bristol, June, 2014.
11. **James Rudzinski** attended the SIAM conference on Discrete Mathematics in Minneapolis in June 2014.

Graduate Student Recruiting

In addition to sending information packets to nearly 30 universities, we attended recruiting events at the Joint Meeting of the AMS and MAA in Baltimore, and distributed recruitment materials at the MAA recruiting fair and at a SIAM meeting. We also made campus visits to Winthrop, ASU, UNCW, and UNCA. This resulted in a 66% increase in the number of applications to our PhD and MA programs.

Dr. Maya Chhetri recruiting at AMS, January 2014

Graduate Tea 2013

We hosted a "Graduate Tea" for our students. At this event we discussed several issues of concern and importance to our graduate students, including our new departmental requirement that all GTAs enroll in at least 9 hours per semester. This new rule caused an unforeseen increase in fees for our GTAs this year. We paid this for the students for Spring 2014 and began implementing the new 9 hour requirement from January 2014. Support from several faculty members to offer several seminar courses above their own course loads was crucial in implementing this new 9 hour requirement. We very strongly believe this will help the students to be sucessful in obtaining their degrees in an appropriate timeframe.

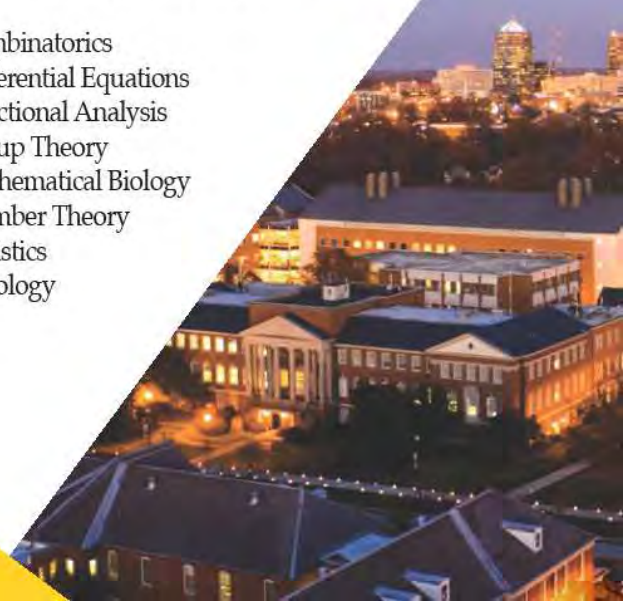
THE UNIVERSITY of NORTH CAROLINA
GREENSBORO

Department *of*
Mathematics *and* Statistics

Computational Mathematics Ph.D. Program

Departmental areas of research include:

- Combinatorics
- Differential Equations
- Functional Analysis
- Group Theory
- Mathematical Biology
- Number Theory
- Statistics
- Topology



For more information, go to
www.uncg.edu/mat

9. Funding Opportunities for Students

Scholarships

Our department offers numerous scholarships, each of which has different requirements and restrictions. These include:

- Helen Barton Scholarship;
- Ione Holt Grogan Scholarship;
- Vicky Langley Math Scholarship;
- Judith J. Mendenhall Scholarship;
- Mary D. Murray Scholarship in Mathematics;
- Eldon E. and Christine J. Posey Mathematics Scholarship;
- Cornelia Strong Scholarship;
- Dr. Theresa Phillips Vaughan Math Scholarship;
- Bertha Barnwell Vielhauer Endowed Scholarship.

2013–2014 Scholarship Recipients

- **Helen Barton Scholarship**:
  Abraham Abebe, Ricky Farr
- **Ione Holt Grogan Scholarship**:
  Austin Lawson
- **Vicky Martin Langley Math Scholarship**:
  Austin Lawson
- **Judith L. Mendenhall Scholarship**:
  Caitlin Ross
- **Mary D. Murray Scholarship in Mathematics**:
  Matthew Johnson, Catherine Payne, Landon Pierce
- **Eldon E. and Christine J. Posey Scholarship**:
  Thomas Woosley
- **Cornelia Strong Scholarship**:
  Ricky Farr
- **Dr. Theresa Phillips Vaughan Math Scholarship**:
  Adam Eury, Catherine Payne
- **Bertha Barnwell Vielhauer Endowed Scholarship**:
  Hollan Foltz, Benjamin Manifold, Nicholas Perrone

Undergraduate Research Scholarships

- Helen Barton Undergraduate Research Awards in Mathematics and Statistics
- Undergraduate Research Assistantships in Mathematics and Statistics

There are also numerous other opportunities to financially support mathematics education at UNCG:

1. STAMPS (Science, Technology and Math Preparation Scholarships) awards up to $6750 per year in scholarship support to students who major in Biology, Chemistry & Biochemistry, Computer Science, Geographic Information Science & Earth Science, Mathematics & Statistics, or Physics & Astronomy.

2. The College of Arts & Sciences UNCG Scholarships has several different scholarships for general arts and sciences. Many of these scholarships are available to undergraduate full-time students majoring in mathematics.

3. The Department of Mathematics and Statistics offers grader positions to senior qualified undergraduate students.

Graduate Assistantships

Our Graduate students are usually funded via graduate assistantships. Their duties include one or a combination of the following: teaching lower level Mathematics or Statistics courses, tutoring in the Math Help Center, or monitoring the Math Emporium Lab.

Graduate Assistantship levels:

- **$10,800+tuition waivers** for the M.A. in Mathematics (Mathematics/Applied Statistics Concentration)
- **$18,000+tuition waivers** for the Ph.D. Program in Computational Mathematics

For the 2013−14 academic year, we had sixteen Ph.D. Students and five Masters students that were funded through Graduate Assistantships.

Graduate Teaching Assistants in 2013–2014

Ph.D.	**Ph.D.**	**M.A.**
Abraham Abebe	Bonnie Roberson	David Barron
Wei Chen	James Rudzinski	Adam Eury
Ricky Farr	Jeong Sep Sihm	Lance Everhart
Paula Hamby	Brian Sinclair	Robert Stoeson
Jonathan Milstead	Byungjae Son	Yi Yang (C.S.)
Danielle Moran	Christopher Vanlangenberg	
Quinn Morris	Tanja Zatezalo	
Michael Palmer		
Catherine Payne		

10. Mathematics Education Program

Dr. Carol Seaman

The program is coordinated by the math education faculty consisting of Dr. Carol E. Seaman, Associate Professor of Mathematics and Program Coordinator for Secondary Licensure in Mathematics, Dr. Dohyoung Ryang, Assistant Professor of Mathematics, and Dr. Tracey Howell, Academic Professional in Mathematics Education. They are responsible for teaching all courses that are specifically designated for undergraduate students seeking teaching licensure in mathematics, namely, MAT 303 (Topics in Mathematics), MAT 304 (Introduction to the Foundations of Geometry), MAT 330 (Axiomatic Foundations of Geometry), MAT 405 (Foundations of Mathematics for Teaching I), and MAT 406 (Foundations of Mathematics for Teaching II). In addition, we teach the following 500-level courses for School of Education master's students in Mathematics Education: MAT 503 (Problem-Solving in Mathematics, MAT 513 (Historical Development of Mathematics), and MAT 520 (Non-Euclidean Geometries).

In addition to the specific courses listed above, we also teach 100-level mathematics courses (College Algebra, Precalculus, Calculus I) in which undergraduate students are first introduced to the learning of mathematics at the college level. In particular, Dr. Howell works within the Emporium Model (WLL courses), bringing her expertise in student-centered pedagogy and technology-mediated learning to the Precalculus series. Students enrolled in WLL courses are required to attend a 1 hour class meeting every week and to spend a minimum of 3 hours per week in a Math Emporium Lab working on online learning assignments. The goal of the weekly class meeting is to expand the students' understanding of selected course topics through problem solving, group work, and other pedagogical methods. The 3 hours students are required to spend in a Math Emporium Lab working on online mathematics assignments are facilitated by teaching assistants specifically trained to assist students enrolled in WLL courses.

Students in the BA-HS major in mathematics (those seeking licensure in secondary mathematics) must complete all requirements for a BA in mathematics, including all general education and College of Arts and Sciences requirements, as well as completing MAT 330, MAT 405, MAT 406, 15 hours of professional education coursework, 100 hours of internship in local high schools, and a final semester of student teaching. The last page of this report presents the details of the program of study. Students must maintain a 2.5 GPA in mathematics to qualify for student teaching. At the end of their program of study, students also complete an electronic portfolio of licensure evidences (as specified by the state of North Carolina) and take the Praxis II in mathematics as part of their application to the state for a teaching license.

In addition to teaching mathematics courses for preservice and in-service teachers, we advise all undergraduate students in the BA-HS in mathematics major and all freshmen majoring in mathematics, participate in the Council of Program Coordinators (a School of Education initiative that administers all the professional requirements of the teacher preparation programs at UNCG), write and administer grants related to mathematics education, lead department efforts to recruit and retain mathematics majors, present professional development opportunities for teachers in local school districts, engage in

scholarly research in undergraduate mathematics education and make presentations about this research to national research conferences. In February 2014 Drs. Seaman and Howell made presentations of their work at the national conference of the Research Council on Mathematics Learning in San Antonio TX.

In addition to these activities within the department Dr. Seaman, Dr. Ryang, and Dr. Howell participate in the RISE (Research and Instruction in STEM Education) Network on campus for which Dr. Seaman serves as faculty facilitator. In this capacity Dr. Seaman attended the national Project Kaleidoscope (PKAL) Academic Renewal Conference on "Next Generation STEM Learning: Investigate, Innovate, Inspire*" in October 2013 and presented the results of the evaluation of UNCG's STEM living learning community, AToMS (Achieving Together in Mathematics and Science).*

We also participate in state and regional conferences that have a focus on mathematics education such as the Southeast Region of the MAA (MAA-SE), the North Carolina Council of Teachers of Mathematics (NCCTM), and the regional meetings of Project Kaleidoscope (NCPKAL). Dr. Ryang presented a talk at the October 2013 meeting of NCCTM entitled "Cardano's method to solve a cubic equation."

Dr. Seaman and Dr. Howell both participated in the second year of the STEM living and learning community entitled Achieving Together in Mathematics and Science (AToMS). The goal of AToMS is to attract students into STEM fields (including STEM teaching) and retain them. Students in AToMS have the choice to live together while enrolling in common integrated courses or may live off campus or anywhere on campus while still enrolling in these same common integrated courses and participating in co-curricular experiences. These experiences in AToMS strengthen students' scientific and/or mathematical knowledge through the use of student-oriented teaching methods and improve the students' communication skills to enable them to convey concepts in science and mathematics to each other and to those in the outside community.

In the 2012-2013 year, Dr. Seaman partnered with Dr. Holt Wilson of the department of Teacher Education and Higher Education and with Dr. Kimberly Hewitt of the department of Educational Leadership and Cultural Foundations to write a grant proposal entitled *Core-Math II: Assisting Teachers' Implementation of the Common Core State Standards for Mathematics With Learning Trajectories, Reform-Oriented Pedagogy, and Leadership for Supporting and Sustaining Instructional Change*, which was funded through the NC Quest state grant program. In 2013-2014 Dr. Seaman and Dr. Howell participated in delivering a 96-hour professional development experience for 15 elementary (K-5) teachers in Rockingham County during the school year as part of this grant.

In 2012-2013 Dr. Ryang reorganized the UNCG student chapter of the North Carolina Council of Teachers of Mathematics, named Alpha. In spring 2014, with Dr. Ryang on research leave, Dr. Howell took over as faculty sponsor of this organization of undergraduate and graduate students preparing to teach K-12 mathematics. Under her leadership the club will meet monthly for informal presentations by outside speakers, for service projects, and for fun!

11. Lecture Series, Colloquia, Seminars and Research Visitors

11.1 Helen Barton Lecture Series in Computational Mathematics and Mathematical Sciences

Computational Mathematics:

The Lecture Series in Computational Mathematics at UNCG has been organized by the Department of Mathematics and Statistics since Fall 2011. The target audience is graduate students and upper level undergraduate students, as well as faculty members. Experts in their fields will cover a variety of topics in computational mathematics and computational statistics, as well as their applications in other disciplines. A particular aim of the lecture series is to spark interest among students in the newer trends in computational mathematics and its applications. The organizing committee of the lecture series consists of Sat Gupta, Sebastian Pauli, Jan Rychtář (chair), and Clifford Smyth.

Mathematical Sciences:

The Lecture Series in Mathematical Sciences at UNCG has been organized by the Department of Mathematics and Statistics since Spring 2012. The target audience is graduate students and upper level undergraduate students, as well as faculty members. This lecture series features a very distinguished mathematician who gives a series of three lectures on a topic in the mathematical sciences. A particular aim of the lecture series is to spark interest among students in the newer trends in the mathematical sciences and its applications. The organizer for the lecture series is Maya Chhetri.

UNCG

HELEN BARTON LECTURE SERIES IN COMPUTATIONAL MATHEMATICS

FALL 2013–SPRING 2014

Sponsored by:
The Department of Mathematics and Statistics

Speakers

Leonard A. Stefanski (North Carolina State University)
Variable Selection in Measurement Error
October 31, 2013 at 4pm in Petty 213, Refreshments at 3:30 in Petty 116

Laura Taalman (James Madison University)
Making Mathematics Real: Knot theory, experimental mathematics, and 3D printing
November 21,2013 at 4pm in Petty 213, Refreshments at 3:30 in Petty 116

Harold M. Stark (University of California, San Diego)
Explorations in Number Theory
March 20, 2014 at 4pm in Petty 219, Refreshments at 3:30 in Petty 116

Jerry Reiter (Duke University)
Missing data in longitudinal studies: The case for refreshment samples
April 3, 2014 at 4pm in Petty 219, Refreshments at 3:30 in Petty 116

Greg Forest (University of North Carolina at Chapel Hill)
The Virtual Lung Project at UNC
April 21, 2014 at 4pm in Petty 219, Refreshments at 3:30 in Petty 116

Organizing Committee: Sat Gupta, Sebastian Pauli, Jan Rychtář (Chair), and Clifford Smyth

For abstracts and further information see
http://www.uncg.edu/mat/talks/lecture-series.html

THE UNIVERSITY of NORTH CAROLINA
GREENSBORO
Department of Mathematics & Statistics

Helen Barton Lecture Series in Mathematical Sciences

Dr. Philip K. Maini

Wolfson Centre for Mathematical Biology
University of Oxford

Professor Philip K. Maini received his DPhil in 1985 under the supervision of Prof J.D. Murray, FRS. Currently he is a Professor and the Director of the Wolfson Centre for Mathematical Biology (CMB) at Oxford. He is currently on the editorial boards of a large number of journals, including serving as the Editor-in-Chief of the Bulletin of Mathematical Biology. He has also been an elected member of the Boards of the Society for Mathematical Biology (SMB) and European Society for Mathematical and Theoretical Biology (ESMBTB).

His present research projects include the modelling of avascular and vascular tumours, normal and abnormal wound healing, and a number of applications of mathematical modelling in pattern formation in early development, as well as the theoretical analysis of the mathematical models that arise in all these applications. He has over 300 publications in the field and has held visiting positions at a number of universities worldwide. He co-authored a Bellman Prize winning paper (1997), was awarded a Royal Society Leverhulme Trust Senior Research Fellowship for 2001-2 and a Royal Society-Wolfson Research Merit Award (2006-11). In 2009 he was awarded the LMS Naylor Prize and Lectureship.

For more information, please see: http://www.uncg.edu/math/talks/index.html or contact Dr. Maya Chhetri at maya@uncg.edu.

Mathematical Modelling for the Life and Medical Sciences

Abstract

This series of lectures will give an overview of the role and impact of mathematical modelling in the life and medical sciences. The models considered will range from coupled systems of partial differential equations, to hybrid models, to cell-based discrete models. Applications will include animal coat markings, digit formation, and cancer progression.

Lecture 1

Monday, March 24, 2014
Reception: Lounge, Petty 116, 3:30-4:00 PM
Lecture: Petty 219, 4:00 PM

How did the zebra get its stripes?

This lecture will present Turing's 1952 model for biological pattern formation and trace its effect and impact over the subsequent 60 years.

Lecture 2

Tuesday, March 25, 2014
Reception: Lounge, Petty 116, 3:30-4:00 PM
Lecture: Petty 219, 4:00 PM

Models of cancer development.

This lecture will present mathematical models for aspects of cancerous tumour growth and development.

Lecture 3

Wednesday, March 26, 2014
Reception: Lounge, Petty 116, 3:30-4:00 PM
Lecture: Petty 219, 4:00 PM

Modelling collective cell movement in biology.

This lecture will present a number of different modelling frameworks for collective cell motion with applications to epithelial cell movement and neural crest cell migration. It will be shown that, at least in the simplest settings, these apparently very different modelling approaches are all underpinned by a nonlinear diffusion equation.

11.2 Colloquia

Tadanobu Watanabe	Kennesaw State University	10/16/2013 and 10/17/2013	Mathematics Education in Japan/Fraction Teaching and Learning in Japan
Akihiko Takahashi	DePaul University	1/22/2014	Lesson Study: a fundamental driver for mathematics teacher development/Supporting the Effective Implementation of a New Mathematics Curriculum: A case study of school-based study at a Japanese public elementary school
Steve Wise	University of Tennessee Knoxville	3/31/2014	Convergence of a Mixed Finite Element Method for a Cahn-Hilliard-Stokes System
Yufeng Liu	University of North Carolina at Chapel Hill	4/16/2014	Joint Estimation of Multiple Dependent Gaussian Graphical Models
Scott Aaronson	MIT	4/28/2014	Quantum Computing and the Limits of the Efficiently Computable

11.3 External Seminar Speakers

Dhagash Mehta	North Carolina State University	9/30/2013	Applications of Algebraic Geometry in Theoretical Physics and Chemistry
Nicolette Meshkat	North Carolina State University	10/9/2013	Identifiable Reparametrizations of Biological Models
Chad Awtrey	Elon University	10/23/2013	Computational Galois theory: absolute resolvents and subfield > information
Caitlin Stern	University of North Carolina at Chapel Hill	10/23/2013	The role of competition in the evolution of sociality
Matthew Rudd	Sewanee: University of the South	10/28/2013	Nonlinear averaging and parabolic flows
Lindsay Waldrop	University of North Carolina at Chapel Hill	10/30/2013	Sniffing crabs kick the challenges posed by changing Reynolds number
Simon Tavener	Colorado State University	11/1/2013	Stochastic inverse problems for deterministic models
Kristina Martin	North Carolina State University	11/4/2013	Semigroup Solutions of the Initial Value Problem for the n-dimensional Wave Equation
Alexander Chen	University of North Carolina at Chapel Hill	11/8/2013	Transient antibody-mucin interactions produce a dynamic molecular shield against viral invasion
Nick Lowman	North Carolina State University	11/11/2013	Dispersive hydrodynamics in viscous fluid conduits
Brian Pigott	Wake Forest University	11/15/2013	Asymptotic Stability for KdV Solitons in Weighted Spaces Via Iteration

Andreas Aristotelous	Duke University	11/18/2013	Discontinuous Galerkin Methods for Cahn-Hilliard Type Models
Sarah Raynor	Wake Forest University	2/3/2014	Asymptotic Stability of Solitons for the Korteweg-deVries Equation
Jan Hannig	University of North Carolina at Chapel Hill	2/5/2014	Generalized Fiducial Inference
Miaohua Jiang	Wake Forest University	3/17/2014	Towards an Agent-based Deterministic Network Model of Infectious Disease
Hrishikesh Chakraborty	University of South Carolina	2/18/2014	Resampling Method to Estimate Intra-cluster Correlation for Clustered Binary Data
Athanasios Gentimis	North Carolina State University	2/18/2014	Topological Data Analysis and Directed Filtrations
Dhanya Rajendran	Indian Institute of Science (IISC)	3/28/2014	Critical Growth Elliptic Problem with Singular Discontinuous Nonlinearity in R^2
Yichuan Zhao	Georgia State University	4/4/2014	Smoothed jackknife empirical likelihood inference for ROC curves with missing data
Chad Awtrey, Chris Shill, and Erin Strosnider	Elon University	4/9/2014	Classifying degree 14 p-adic fields
Zachary Abernathy	Winthrop University	4/11/2014	Bridging Functional Analysis and Cancer Biology
Steve Robinson	Wake Forest University	4/14/2014	An Introduction to the Fucik Spectrum
Jason Brinkley	East Carolina University	4/15/2014	Examining the Public Health Impact of Personalized Medicine: Dynamic Treatment Regimes, Attributable Benefit, and Causal Inference

Yichao Wu	North Carolina State University	4/22/2014	Automatic structure recovery for additive models
Jesse Patsolic	Wake Forest University	4/30/2014	Polynomials with a Small Number of Non-Zero Terms

11.4 UNCG Seminar Speakers

Sebastian Pauli	UNCG	8/28/2013	Constructing Class Fields over Local Fields
Ratnasingham Shivaji	UNCG	9/16/2013	A Bifurcation Result and an Existence Result for a Nonlinear Boundary Value Problem
Brian Sinclair	UNCG	9/18/2013	Recursions in OM algorithms
Jan Rychtar	UNCG	9/18/2013	The evolution of cooperation-kin selection and greenbeard genes
Ratnasingham Shivaji	UNCG	9/23/2013	A Bifurcation Result and Existence Result for a Nonlinear Boundary Value Problem, Part 2
Haimeng Zhang	UNCG	9/24/2013	Statistics Seminar
Thomas Lewis	UNCG	10/7/2013	Survey of Numerical PDEs: The Finite Element Method
Dan Yasaki	UNCG	10/16/2013	Reciprocity Laws
Thomas Lewis	UNCG	10/21/2013	Survey of Numerical PDEs: Discontinuous Galerkin Methods
Jennifer Toller Erausquin	UNCG	10/23/2013	Using Multilevel Modeling to Understand Multiple Layers of Influence on Women's HIV Risk
Ricky Farr	UNCG	10/30/2013	Zeros of Derivatives of the Dirichlet Eta Function
Danielle Moran	UNCG	11/6/2013	A permanence result for Property A

Xiaoli Gao	UNCG	11/12/2013	The K-th Largest Norm Shrinkage Operator for Complex Grouped Variable Selection
Ben Manifold	UNCG	11/13/2013	Automated Analysis of Peromyscus californicus Behavior
Thomas Parrish	UNCG	11/13/2013	An Introduction to the Kalman Filter with Applications to Automated Video Processing
David Remington	UNCG	11/19/2013	The Road Less Traveled: Developmental Modeling of Genetically Correlated Traits
Paula Hamby	UNCG	11/20/2013	Elliptic Curve, Absolute Galois, and Trace of Frobenius: Examples
Danielle Moran	UNCG	1/15/2014	A permanence result for Property A
Ricky Farr	UNCG	1/22/2014	Fractional derivatives of Dirichlet L-functions and Their Computation
Jonathan Rowell	UNCG	1/24/2014	A Primer in Game Theory, Replicator Equations, and Directed Movement
Jonathan Milstead	UNCG	2/5/2014	Fieker-Klüners
Jonathan Rowell	UNCG	2/21/2014	Replicator Dynamics and Public Signals
Brian Sinclair	UNCG	2/26/2014	A Family of Eisenstein Polynomials Generating Totally Ramified Extensions
Jonathan Rowell	UNCG	2/28/2014	Replicator Dynamics and Sexual Selection on Mate Preferences
Gideon Wasserberg	UNCG	3/19/2014	The role of mode of transmission in understanding, predicting, and controlling wildlife and zoonotic infectious diseases
Christopher Rhea	UNCG	4/2/2014	A dynamic system's approach to understanding fall recovery while walking
Greg Bell	UNCG	4/7/2014	An overview of topological data analysis

Sat Gupta	UNCG	4/8/2014	Some Interesting Issues Associated with Newer Families of Randomized Response Models
Olav Rueppell	UNCG	4/11/2014	The essential role of modeling and mathematics in sociobiology
Ricky Farr	UNCG	4/23/2014	On a Conjecture by Kreminski
Paula Hamby	UNCG	4/23/2014	An Introduction to Artin L-Functions
Brian Sinclair	UNCG	4/23/2014	The Number of Extensions of a p-adic Field with Given Ramification Invariants

11.5 Research Visitors

Research Visitor	Institution	Dates Visited	Host
Simon Tavener	Colorado State University	10/31–11/3/2013	Jan Rychtar
Jerome Goddard	Auburn University of Montgomery	11/8–11/11/2013; 3/21–3/26/2014	R. Shivaji
Laura Taalman	James Madison University	11/21–11/22/2013	Jan Rychtar
Petr Girg	University of West Bohemia, Czech Republic	12/7–12/21/2013 06/11-07/02/2014	Maya Chhetri
Akihiko Takahashi	DePaul University	1/21−1/22/2014	Dohyoung Ryang
Harold Stark	University of California San Diego	3/18–3/27/2014	Brett Tangedal
Eunkyung Ko	TIFR, Bangalore, India	3/19–3/24/2014	R. Shivaji
Philip Maini	University of Oxford	3/23–3/27/2014	Maya Chhetri
Steve Wise	University of Tennessee Knoxville	3/30–4/1/2014	Thomas Lewis
Pavel Drabek	University of West Bohemia, Czech Republic	5/10–5/18/2014	R. Shivaji

Paul Gunnells	University of Massachusetts Amherst	5/18–5/23/2014	Dan Yasaki
Avner Ash	Boston College	5/18–5/23/2014	Dan Yasaki
Matt Greenberg	University of Calgary	5/18–5/23/2014	Dan Yasaki
Dhanya Rajendran	Indian Institute of Science (IISC)	3/20-4/2/2014	R. Shivaji

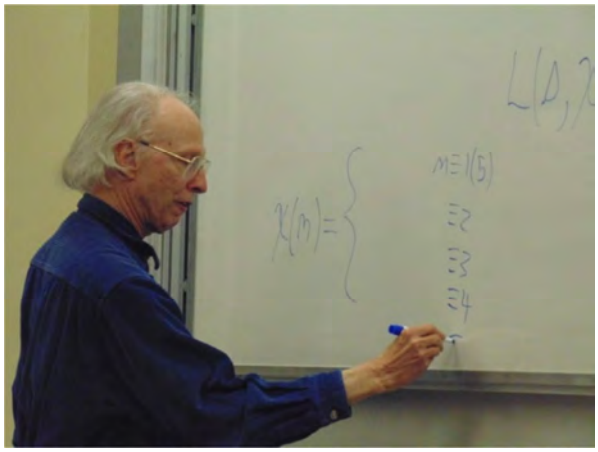
Some research visitors from the 2013–2014 academic year

Laura Taalman, James Madison University

Alexander Chen, UNC Chapel Hill

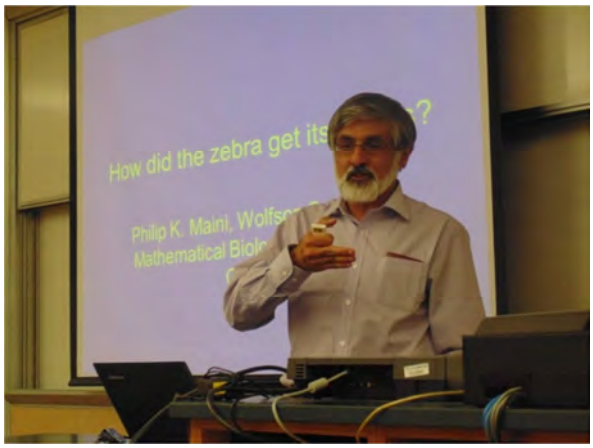
Leonard Stefanski, North Carolina State University

Greg Forest, University of North Carolina at Chapel Hill



Harold Mead Stark, University of California, San Diego

Jerry Reiter, Duke University



Philip K. Maini, University of Oxford

Scott Aaronson, MIT

Steve Robinson, Wake Forest University

11.6 Carolina Topology Seminar

The Carolina Topology Seminar is a research seminar on topics in topology and its applications of interest to the participants. These topics currently include general topology, set-theoretic topology, set theory, and to a lesser extent, real analysis, complex Hilbert spaces and interactions between topology, logic and matroid theory. Presentations at the seminar include talks by invited visitors, talks on research by the participants, presentation of papers of interest to the seminar, and presentation of student work, including topics from master's thesis and Ph.D. dissertations.

The seminar has proudly welcomed many distinguished guest speakers over the years. Speakers from the USA include Andreas Blass (Ann Arbor, MI) William Fleissner (Lawrence, KS), Paul Gartside (Pittsburgh, PA), Judy Roitman (Lawrence, KS), and Scott Williams (Buffalo, NY). International speakers include: A.V. Arhangelskii (Moscow), K.P. Hart (Delft), Istvan Juhasz, (Budapest), Jan van Mill (Amsterdam), Akihiro Okuyama (Kobe), Petr Simon (Prague), Paul Szeptycki (Toronto), Vladimir Tkachuk (Mexico City).

The origin of the seminar can be traced back to a series of mini-conferences that met once or twice a year mostly at UNC-Greensboro, but also other universities in the Carolinas and Virginia, beginning around 1974. In the 1990's the mini-conferences were replaced by a series special sessions at fall meetings of the Southeastern Section of the American Mathematical Society. In 2000 the seminar as currently constituted began meeting approximately every two weeks. Occasionally, photos of the seminar are posted at http://www.uncg.edu/~vaughanj/topseminar.html.

Topology Seminar Participants

12. Service Profile

The departmental faculty was very actively involved on various Department, College and University committees. Four major service programs provided by the department are: The Math Help Center, The Math Emporium, The Statistical Consulting Center, and the State Math Contest.

12.1 Math Help Center

Director, Maya Chhetri

Services:

- Free tutoring is available to all UNCG students enrolled in 100-level MAT and STA courses as well as MAT 292 and STA 271/290. This is a walk-in service in Curry 210 and is open Monday, Wednesday 9am-3pm and 5pm-7pm, (9am-3:30 and 5:30-7:30 in spring 2014), Tuesday, Thursday 9am-7pm and Friday 10am-1pm.
- We have expanded MHC service to include more upper level courses since Fall 2012. Now we offer tutoring for the upper level MAT/STA courses such as MAT 253 (Discrete Mathematical Structure), 293 (Calculus III), 310 (Elementary Linear Algebra), 311 (Introduction to Abstract Algebra), 390 (Ordinary Differential Equations), 394 (Calculus IV) and STA 290. One Graduate Teaching Assistants is responsible for tutoring one of these courses in MHC.
- We no longer use paper log-sheet to keep track of students' sign-in and sign-out. Each student is asked to sign-in and sign-out using their UNCG user name and enter their class information from the drop-down menu. They are able to leave feedback/comments/suggestions when they sign-out including the experience they had with the tutor.
- In addition to this tutoring service, MHC also arranges **Review Sessions** for courses covered in MHC upon the request of course coordinators. Some coordinator requested review sessions a week prior to mid-term exams – MAT 112. Review Sessions for other MAT courses conducted by Graduate Teaching Assistants were not well attended except for STA 108. **The Director decided to discontinue weekly Review Sessions except for STA 108.**
- The Director of MHC also hires undergraduate mathematics majors with math GPA higher than 3.0 to help instructors in grading, managing on-line materials and proctoring exams for lower level courses. We also hire competent undergraduate math majors to become a TA at Math Emporium Lab and they work alongside graduate TAs in the lab.

Fall 2013 Activities

1. 10 Graduate Teaching Assistants tutored in Math Help Center and some of them conducted review sessions before mid-term exams.
2. 2106 student visits were recorded in MHC.
3. 11 undergraduate students helped 12 instructors in their classes.

Spring 2014 Activities

1. 12 GTAs tutored in Math Help Center and some of them conducted either weekly review sessions or before mid-term exams.
2. 2261 student visits were recorded in MHC.
3. 12 undergraduate students helped 16 instructors in their classes.

12.2 Math Emporium

Math Emporium Coordinator, Maya Chhetri

In Fall 2013, ITS opened a new computer lab in 313 Graham Building. This is the largest teaching lab on campus with 60 client workstations. The lab is equipped with a SMART Podium (interactive pen display), a Mondopad (large touch tablet with videoconferencing capabilities), two SMART Boards (interactive whiteboards), a Prometheum ActivBoard (an interactive whiteboard) and a Prometheum ActivExpression response system (a student response system that produces real-time results). Math emporium courses (WLL marker) get the priority for lab reservation even though it is open for all.

Until Spring 2014, 50% of WLL courses were taught exclusively in Graham 313. However, starting Fall 2014, all WLL courses will be taught in the lab. Students in the course were always required to attend at least 3 hours of lab outside the meeting time with the instructor and we will continue to require that.

Fall 2013 – 87 students in MAT 115 (WLL) and 75 students in MAT 150 (WLL) took the final exam

Spring 2014 – 92 students in MAT 115 (WLL) and 85 students in MAT 150 (WLL) took the final exam

Common Final exam scores from different teaching formats will be analyzed to determine the impact of such format in student success. In Spring 2014, MAT 150 (WLL) course also participated in the evaluation of such pedagogy change by teams of graduate students from Educational Research Methods (supervised by Dr. Holly Downs). We are hoping to get some feedback from this participation which will help enhance the program further.

12.3 Statistical Consulting Center

Director of the Statistical Consulting Center, Scott Richter

The Statistical Consulting Center (SCC) offers consultation and advice to University researchers engaged
in:

- the design of studies and experiments (including proposal preparation)
- the statistical and graphical analysis of data
- the appropriate choice, application and presentation of statistical methods

Faculty that serve as consultants for the 2013–14 academic year are Scott Richter, Sat Gupta, Xiaoli Gao, and Haimeng Zhang.

Using the Center

Faculty and staff: General consultation is provided to faculty and staff free of charge. However, researchers routinely list consultants as co-authors on journal publications or paper presentations, and as co-PIs on research grants, as recognition for their service. Researchers are encouraged to interact with a consultant as early as possible in a study, preferably at the planning stage. To obtain assistance, send a brief description of the scope and type of assistance anticipated to scc@uncg.edu.

Graduate students: Graduate students who wish to use the SCC must register for STA 667 during the semester in which they plan to use the Center. The student will then be entitled to one hour of consulting per week for that semester. STA 667 is designed to be a learning experience for both the consultants and their clients. The SCC points out problems, tries to correct errors, suggests possible solutions, and assists in the analysis of the results. Every attempt is made to increase the understanding of problems and possible solutions. Students must obtain permission to enroll in a STA 667 section. Students should send a brief description of the research topic, as well as the scope and type of assistance anticipated to scc@uncg.edu, to be referred to a consultant.

2013-14 Highlights

- Faculty consultants assisted researchers from many disciplines across campus, including: Biology, Chemistry and Biochemistry, Communication Sciences and Disorders, Educational Research Methodology, Computer Science, Consumer Apparel and Retail Sciences, Genetic Counseling, Institute for Community and Economic Engagement, Nutrition, Psychology, and Public Health Education.
- 15 students enrolled in STA 677 and worked with faculty consultants to complete graduate research projects. These collaborations resulted in three manuscripts submitted, one of which was recently accepted by the *Journal of Public Health Policy*. (Dingham, Schulz, Wyrick, Bibeau & Gupta: Does Providing Nutrition Information at Vending Machines Reduce Calories Per Item Sold?)
- Three manuscripts appeared in 2013−14 stemming from SCC collaborations, and nine others were submitted.
- Faculty consultants participated in externally funded interdisciplinary grant projects with faculty in Anthropology and Nutrition, as well as the campus-wide TRIAD 2 Center for Health Disparities Research, a collaborative effort involving the Schools of Nursing, Health and Human Sciences, and College of Arts and Sciences, the Institute for Health, Science and Society; and the Center for New North Carolinians at UNCG; as well as the Moses Cone Heart Center, the Guilford County School System, and HealthServe Medical Clinic.
- Work on expanding services of the SCC continued, including developing several workshops, and creating a network of quantitative experts from across campus. The SCC website was expanded to include many additional resources for researchers. The Department hosted a Statistics Luncheon on November 8, 2013, attended by 15 faculty and staff. Representatives were present from the Departments of Mathematics and Statistics and Biology within the College, from the Schools of Business, Education, and Health and Human Sciences, as well as from Information Technology Services. Ideas for increased collaboration among units for advancing statistics awareness and practice on campus were discussed, including: creating a directory of faculty able to provide quantitative expertise; organizing an annual Statistics Day; holding regular brown-bag research discussions; developing workshops on statistical design and reporting of results; involving the Statistical Consulting Center more as a methodology resource for grant proposals.

Goals for 2014–15

In addition to continuing active collaborations with researchers at UNCG and beyond, the SCC plans to begin offering regular workshops starting in the Fall of 2014. We will continue to expand and better organize the quantitative network on campus and help increase awareness of available statistical resources and further enhance quantitative research capabilities at UNCG. A Statistics Day to bring together researchers is planned, as well as monthly brown bag research discussions.

12.4 State Math Contest

Tracey Howell, organizer

The State Mathematics Contest is a problem-solving competition through which students interested in mathematics can become familiar with more sophisticated and advanced mathematical concepts and ideas that are not covered in traditional school curricula. The contest has been in existence for over 40 years in the state of North Carolina. During that time, over 100,000 students have taken part in the qualifying rounds and over 2,500 students have advanced to the state finals. Each year, the culmination of the contest is a final test that determines statewide winners. Currently, North Carolina is divided into three regions (Eastern, Central, and Western) and the final test is administered simultaneously at one site in each region.

On Thursday, May 1, 2014, the Department of Mathematics and Statistics hosted the Central Region State Mathematics Contest Finals. Students from 19 middle schools and high schools participated in one of two levels. Fifteen students competed in Level 1 and 36 students competed in Level 2. All students received a Certificate of Participation and the top 10 competitors in each level received trophies. Faculty from the Department along with several undergraduates assisted the students, their parents, and coaches throughout the day and helped to make the experience a rewarding and memorable one for the students.

13. Collaborations with IMA

Director of IMA, Dr. Fadil Santosa addressing UNCG faculty and students

The Institute for Mathematics and its Applications (IMA)

UNCG is a participating institution member of the Institute for Mathematics and its Applications (IMA) at Minnesota since January 2012.

To introduce some background, the Institute for Mathematics and its Applications connects scientists, engineers, and mathematicians in order to address scientific and technological challenges in a collaborative, engaging environment, developing transformative, new mathematics and exploring its applications, while training the next generation of researchers and educators. Founded in 1982, the Institute for Mathematics and its Applications (IMA) is an NSF-funded visitors' institute that has grown to become among the most influential math institutes in the world. Located on the University of Minnesota campus, it is one of eight NSF Mathematical Sciences Research Institutes. The IMA has no permanent faculty, but rather is a flux of visitors and postdoctoral researchers.

The IMA aims to achieve synergy between mathematics and its applications, develop transformative mathematical research through interdisciplinary exploration, strengthen and broaden the workforce that confronts pressing challenges facing science and society, and effectively communicate the role of mathematics in our world. The IMA utilizes many strategies and mechanisms to realize these goals, from its annual thematic program to hot topics workshops to seminars and public lectures.

When UNCG first became a participating member of the IMA, several meetings were held with Terri Shelton, Vice Chancellor for Research and Economic Development, to discuss how the department can best support the university research enterprise, and in the process help itself by offering new avenues for our faculty and students resulted in the membership in IMA. We extend our deepest gratitude to the UNCG Office of Research and Economic Development for continuing to provide this valuable membership.

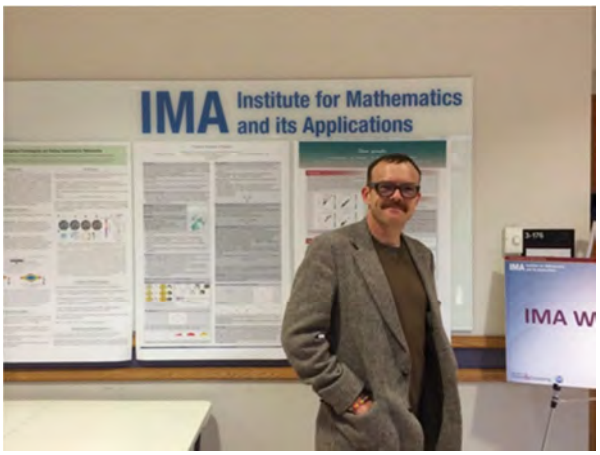
For more information, see the website http://www.ima.umn.edu

Descriptions of various faculty and students who have participated in IMA events to date.

Faculty

Greg Bell, Associate Professor, Department of Mathematics & Statistics

In 2014 the Institute for Mathematics and its Applications chose Greg Bell to be one of two New Directions Professors. The New Directions Professorship is a unique opportunity for mid-career mathematicians to branch in new directions from the research at the IMA.



Greg Bell at IMA

As a New Directions professor, Dr. Bell was expected to live in Minneapolis and be an active participant in all thematic year activities at the IMA on the University of Minnesota campus in Minneapolis. The expected outcome for a New Directions Professor is the beginning of a research program influenced by participation in the IMA's thematic year.

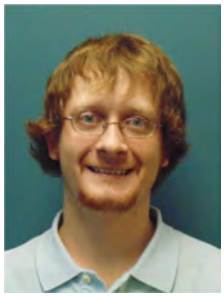
Dr. Bell's visit to the IMA coincided with the thematic year program on Scientific and Engineering Applications of Algebraic Topology. During his time there, Dr. Bell attended a mini-workshop on Statistics for Topologists, and three week-long workshops: Topological Data Analysis, Modern Applications of Homology and Cohomology, and Topological Structures in Computational Biology.

Broadly speaking, computational topology seeks to apply the powerful tools of algebraic topology to real-world and computational problems. The specific area that Dr. Bell has begun to work in is Topological Data Analysis, or TDA. TDA is motivated by the idea that data has shape and that its shape is important. Dr. Bell's background is in group theory and topology; his research concerns the large-scale geometry and topology of groups. In particular, he studies large-scale dimension-theoretic invariants of Cayley graphs associated to finitely generated groups. TDA is similar to his research in that it applies topological techniques (which concern continuous phenomena) to discrete metric spaces (of which data sets are an example).

In addition to these workshops, Dr. Bell participated in weekly seminars on Computational Topology given by experts in the field as well as IMA post-doctoral fellows. He also learned to use Matlab and Python to compute topological invariants associated to data sets with packages such as Javaplex and Perseus.

As a direct result of interactions with experts at the IMA, Dr. Bell began working on a project in TDA on directed persistence modules with Thanos Gentimis of North Carolina State University.

The work at the IMA and his experience using computations in problems that historically belong to the realm of pure mathematics also serve to further the mission of the Computational Mathematics PhD program at UNCG. His experience will be applied to help students in topology select an appropriate computational component to the dissertation. The contacts he made at the IMA can also serve as external members of dissertation committees to ensure high quality of computational aspects of the dissertation.



Thomas Lewis, Assistant Professor, Department of Mathematics & Statistics

Dr. Lewis attended a Hot Topics workshop concerning Mathematics at the Interface of Partial Differential Equations (PDEs), the Calculus of Variations, and Materials Science on May 21-23, 2014, at the Institute for Mathematics and its Applications (IMA). The conference featured sixteen invited talks from an international group of experts, a poster session, and various networking opportunities. Dr. Lewis' participation was fully funded by the IMA, and he was privileged to meet with several of the speakers and the IMA representatives. The conference was dedicated to and attended by Robert V. Kohn, a world-renowned applied mathematician that has profoundly impacted the mathematical analysis of problems arising in materials science.

The workshop provided Dr. Lewis the opportunity to learn more about the applications of PDEs in materials science. He was able to further develop his background in computational techniques for multi-scale problems while also learning more about the computation of models involving stochastic dynamics. The computational talks were well complemented by experts in PDEs and materials science that were able to offer unique insight into the physical phenomena and the underlying models. By bringing together such a diverse group of researchers, a deeper understanding of the mathematical difficulties associated with materials science was gained by all of the 70+ participants while important topics for future research were identified and formulated in a context accessible to applied mathematicians from a wide-range of research specialties.

Dagny Butler, Lecturer, Department of Mathematics & Statistics

Ms. Butler attended the IMA's *Career Choices for Women in Mathematical Sciences* workshop at the University of Minnesota in Minneapolis on March 3-5, 2013. While there, she did a poster presentation on her research titled, "Existence of Alternate Steady States in a Phosphorus Cycling Model." She also attended several lectures and panel discussions which were given by women mathematicians who work in academia, government labs, the financial industry,

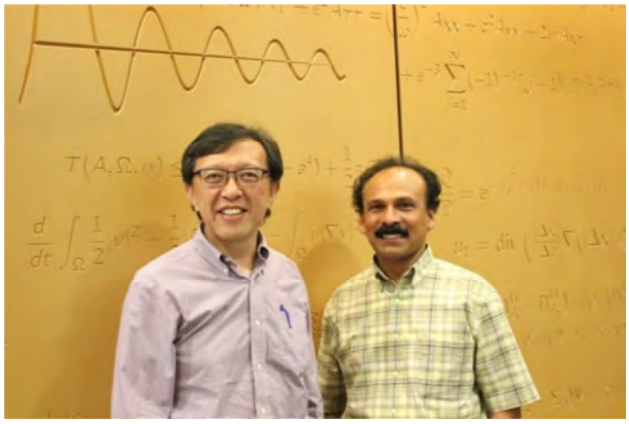
engineering, insurance, and other fields. They shared the details of their careers, which was helpful because it showed a great variety in the mathematical world. They also gave advice on finding the right career, job hunting, negotiating, progressing in your career, work-life balance, and other helpful tips. Additionally, the workshop offered several lunches and dinners for networking, so she was able to meet several successful women mathematicians and get advice from them personally. Overall, this was a very well organized workshop with chances not only for research discussions but also for gaining genuinely helpful advice for choosing a career after graduation.

In June 2012, Ms. Butler attended the IMA's Mathematical Modeling in Industry workshop. It was held at the University of Calgary, and was a ten day workshop. She thoroughly enjoyed her time at this workshop. There were seven different research teams each comprised of a mentor from industry and six graduate students. Ms. Butler was put on a team with Dr. Effrosini Tsouchnika who works at Siemens in Germany; they were working on a research project titled, "Validation of Service Concepts for Oil Drilling by Simulation." Basically, in this project, they wanted to maximize the oil production and minimize the service costs, while taking into account all of the same conditions and constraints that a normal oil company would have to consider. At the end of the project, they were required to present their findings to all the workshop mentors and attendees, as well as write a technical report.

Working on this project was very beneficial to Ms. Butler, because up to that point in her life, she had only worked in academia. She knew that she loved teaching, but had never had the opportunity to explore what it would be like to use her mathematical skills for a career in industry. She learned about many things during the workshop; some of which were working for management, having a strict deadline, using computer software for simulation, working with multiple other people in a group setting, being told exactly what they had to research, using mathematical techniques to optimize a problem, getting to use math for real-world applications, etc. It was interesting to see how different industry is from life at a university. She felt like she gained much from this exposure, and it will help her be better informed when she graduates with her doctorate and is applying for jobs. (Dr. Dagny Butler is now employed at Blue Cross Blue Shield in Jackson, Mississippi).

Shan Suthaharan, Associate Professor, Department of Computer Science

Dr. Suthaharan attended a new direction workshop in Applied Statistics and Machine Learning on June 17–28, 2013 at the Institute for Mathematics and its Applications (IMA). His participation was fully funded by IMA. This workshop provided Dr. Suthaharan an opportunity to learn modern statistical techniques and apply them to Machine Learning (ML) problem in Big Data environment.



Dr. Fadil Santosa (Director of IMA) and Dr. Shan Suthaharan

During this workshop he conducted a mini research project with Chris Vanlangenberg (who is a Ph.D. student in the

UNCG Department of Mathematics and Statistics) and YunKyong Hyon to address network intrusion detection problem using ML techniques, and presented the results and findings at the end of the workshop. In addition to the excellent academic qualities and new knowledge, the course also provided Dr. Suthaharan with an excellent networking opportunity, which led to his current visiting scholar appointment at UC Berkeley. Dr. Suthaharan is currently working on Deep Learning (a modern ML technique) research project with Professor Bin Yu, who was one of the organizers of the new direction workshop at IMA.

Students

Abraham Abebe, PhD student, Department of Mathematics & Statistics

Abraham participated in the *Mathematical Modeling in Industry Summer Workshop – XVI* in June 2012, which was held at the University of Calgary. In this workshop, Abraham was able to gain new mathematical skills and techniques and to meet experts in industry. He was able to work on real life problems with mathematicians and industry personnel to come up with a solution that is useful for real industry applications. He explored many applied mathematics applications in industry. Among these applications, he was also involved in an active research in cancer radiotherapy techniques and how to apply mathematical skills to improve and optimize cancer radiotherapy. During this ten day workshop, collaborations were formed with mathematics graduate students, professors, and medical experts. As a result of the collaboration and team work, they published a paper in the *Journal of Physics in Medicine and Biology*. The title of their research was, *A moment-based approach for DVH-guided radiotherapy treatment plan optimization*. In October 2013, he also participated (funded by the IMA) in the 51st meeting of the Society of Natural Philosophy, held November 14−16, 2013 at the University of Minnesota.

Adam Eury, Masters student, Department of Mathematics & Statistics

Adam Eury attended the 2013 PI Summer Graduate Program at the University of Minnesota, MN on July 15−August 2, 2013. The program was titled "Flow, Geometric Motion, Deformation, and Mass Transport in Physiological Processes." He learned about the fundamentals of mathematical and computational methods used in studying mechanisms that underlie physiological and material processes. The majority of the workshop consisted of lecturers presenting their research topics which included numerical analysis of nonlinear partial differential equations, kinetic theory, and solid and fluid mechanics and how they related to topics such as the motion of biomembranes, solid-fluid interaction, and morphogenesis of growing tissues. A few times participants broke into small groups to discuss the material that Mark Peletier presented. An experimental scientist at the University of Minnesota named Ronald Siegel gave a talk explaining how his experimental evidence in drug delivery studies related to the mathematical models. Attendees had the opportunity to see a demonstration in his lab. Overall, Adam had a great

time attending the program. The exposure to how particular areas of applied mathematics were being used to study biological material science was very rewarding.

Paula Hamby, PhD student, Department of Mathematics & Statistics

Paula attended the *IMA Special Workshop: Career Options for Women in Mathematical Sciences* held March 3–5, 2013 at the University of Minnesota. The workshop consisted of presentations from successful women in both industry and academics about their roles as mathematicians, the differences between careers in industry and academics, and issues that pertained specifically to women. There were several discussion panels including, *Job Search and Career Development Skills in the Industry and Quantitative Finance Sector* and *The Challenges and Opportunities of New Paradigms in Research and Education.*

Graduate student, Paula Hamby, at IMA event, *Career Options for Women in Mathematical Sciences.*

Catherine Payne, PhD student, Department of Mathematics & Statistics

Catherine attended the *IMA Special Workshop: Career Options for Women in Mathematical Sciences* on March 3–5, 2013. She heard many mathematicians speaking about a wide variety of careers in mathematics, both in academia and industry. It was a great opportunity for her to think about which of the various types of jobs appeals to her the most, and to see what kind of mathematics is used in different jobs. There were also many chances to meet other mathematicians and students from many different areas and talk with them about their research. She particularly enjoyed seeing other students present their posters about their research, since she had never seen a poster presentation before. It was particularly interesting to see all of the other areas people are studying and to see how they put it together into one poster to present. The most important part of the conference for Catherine was to see how many different jobs mathematicians hold and to hear what those jobs are like on a day-to-day basis.

IMA event, *Career Options for Women in Mathematical Sciences*. Attended by graduate students Paula Hamby and Catherine Payne and lecturer Dagny Butler.

Byungjae Son, PhD Student, Department of Mathematics & Statistics

Byungjae attended the *2013 PI Summer Graduate Program: Flow, Geometric Motion, Deformation, and Mass Transport in Physiological Processes*. This program consisted of lectures, tutorial sessions, and poster sessions. Each main lecturer provided fundamental concepts of gradient flows and differential geometric for 8 hours. Dr. Mark Peletier talked about Variational Modelling, which was of particular interest to Byungjae. In his lecture, he gave simple examples to show modelling procedure. Dr. Peletier explained a concept of entropy and, using this, showed expression of free energy, which is well-known in thermodynamics and statistical mechanics. Additionally, he introduced Wasserstein metric, gradient flows and dissipation. His lecture was very good, but not easy. However, using tutorial session, Byungjae could read Dr. Peletier's lecture notes, think about the exercise problem, and ask him questions. In the poster session, Byungjae could learn real problems which were ongoing.

<u>Conference Funding Received:</u>

Advances in Interdisciplinary Statistics and Combinatorics, October 5-7, 2012
Funding from IMA: $2,000

14. Conferences

14.1 UNCG-RMSC: UNCG Regional Mathematics and Statistics Conference

The Department is home to a very prestigious NSF supported annual student research conference called UNCG-RMSC. The conference is expanding every year and attracts very bright student researchers.

Background and history

Conference in numbers				
Year	Student presenters	Student attendees	Faculty	Schools Represented
2005	12	23	12	5
2006	12	30	13	9
2007	15	36	14	9
2008	11	28	12	10
2009	20	44	21	12
2010	26	64	22	16
2011	48	132	30	27
2012	56	120	44	36
2013	57	115	42	35

The UNCG Regional Mathematics and Statistics Conference started under the name UNCG – RUMC (The University of North Carolina at Greensboro–Regional Undergraduate Mathematics Conference). The first edition of the conference took place in 2005 and we have run the conference each year since. The emphasis of the conference used to be on interdisciplinary mathematics with particular focus on mathematical biology. However, the topics of conference presentation by students were always open to all areas of research in mathematical sciences since the opportunity to listen to a wide variety of talks gives undergraduate students a better foundation for their choice of a more focused study program.

In 2008 one former undergraduate presenter returned to the conference as a graduate student and in 2009 we already had 3 presentations by returning graduate students (6 presentations by graduate students in total). In 2010, out of 26 student presentations, 11 were delivered by graduate students. The undergraduate students enjoyed the presentations of the more mathematically mature graduate

students and the graduate students benefited as they tried to make their work accessible to an undergraduate audience. In 2013, we also had two presentations by high-school students and we will attract high-school presenter in the future years as well.

The 9th Annual UNCG RMSC 2013


Jan Rychtar, Main Organizer

UNCG-RMSC is an annual one day conference promoting student research in mathematics, statistics, and their applications in various fields. The 2013 conference was held on Saturday, November 2, 2013. Jan Rychtář served as conference chair and Sat Gupta, Maya Chhetri, and Ratnasingham Shivaji were co-organizers. The conference featured two plenary presentations by invited speakers:

- Simon Tavener, Colorado State University: Evolution of resistance to white pine blister rust in high-elevation pines
- Jerry Reiter, Duke University: Protecting Data Confidentiality in an Era Without Privacy

The conference was attended by 157 participants (115 students: 3 high-school, 68 undergraduate, 44 graduate students, and 42 faculty) from a total of 35 schools attended conference. The participants came from groups underrepresented in STEM disciplines (61 female students, 17 female faculty; and also 21 African American, 3 American/Alaskan Native, and 2 Hispanic).

The schools with the largest number of participants were UNCG (39), Winthrop University (20), Elon University (13), Bennett College (10), Clemson University (9), Kennesaw State University (7), Clayton State University (6), NC State University (6).

The students delivered a total of 57 presentations. 29 presentations were delivered by undergraduate students, 26 by graduate students and as a special highlight of the conference, 2 presentations were delivered by high-school students. All presentations were evaluated by a group of faculty volunteers. The results of the best presentation competition are as follows:

The following 9 students have won the award for the **outstanding student presentation**:

- Graduate student category
    - Tim Antonelli (NC State)
    - Heather Hardeman (Wake Forest)
    - Amanda Traud (NC State)
- Undergraduate student category
    - Ke'Yona Barton and Corbin Smith (Bennett College)
    - Eric Kernsfeld (Tuffts University)
    - Caitlin Ross (UNCG)
- High-school student category
    - Manu-Sankara Gargeya (The Early College at Guilford)
    - Saumya Goel (Grimsley High School)

All UNCG RMSC presenters were invited to submit papers to the refereed issue, *Topics from the 9th Annual UNCG Regional Mathematics and Statistics Conference*, to be published by Springer as part of its Springer Proceedings in Mathematics and Statistics series.

Conference funding

Funding and support for this conference is provided by the National Science Foundation (grant DMS–1332369), the UNCG Department of Mathematics and Statistics and the UNCG College of Arts and Sciences.

Jerry Reiter, Duke University

Simon Tavener, Colorado State University

Participants gathering before the start of the conference.

14.2 2014 UNCG Summer School in Computational Number Theory: Computational Algebraic Number Theory

From May 19 to May 23, 2014, the University of North Carolina at Greensboro hosted a summer school entitled Modular Forms and Geometry. There were 28 participants, including 17 graduate students (5 UNCG and 12 external) and one undergraduate student from UNCG.

Modular forms play an increasingly important role in number theory and arithmetic geometry. The main focus of the summer school was the study of computational aspects of modular forms and related objects. Topics included classical modular forms and modular symbols, group cohomology and Galois representations, and lattice enumeration and isometry testing techniques to compute with spaces of modular forms for compact forms of classical groups.

The lectures in the summer school were given by:

1. Avner Ash (Boston College)
2. Paul Gunnells (UMass)
3. Matt Greenberg (Calgary)

On a typical day, the talks were given in the morning and in the afternoon students worked in groups to solve problems related to this material. The talks early in the week introduced the students to the subject. The talks later in the week covered related areas of current research and unsolved problems. The problems given to the students included exercises of theoretical nature as well as programming problems and computer experiments. All problems were aimed at increasing the students' understanding of the material by working with it.

Additional information, including links, slides, and notes from some of the lectures, and problem sets can be found on the website at http://www.uncg.edu/math/numbertheory/summerschool/2014.html

Figure Above: UNCG Summer School in Computational Number Theory 2014 participants: William Cocke (BYU), Lance Everhart (UNCG), Ricky Farr (UNCG), Thomas Alden Gassert (UMass Amherst), Paul Gunnells (UMass), Paula Hamby (UNCG), Jeffery Hein (Dartmouth College), Brian Hwang (Cal Tech), Andrew Jones (Sheffield), Benjamin Manifold (UNCG), Tianyi Mao (CUNY), James Martin (North Texas), Jolanta Marzec (Bristol), Jonathan Milstead (UNCG), Richard Moy (Northwestern), Jesse Patsolic (Wake Forest), Sebastian Pauli (UNCG), James Ricci (Wesleyan), Filip Saidak (UNCG), Brian Sinclair (UNCG), Karen Taylor (Bronx Community College), Ka Lun (Allan) (Wong, Hawaii), Dan Yasaki (UNCG).

Acknowledgements

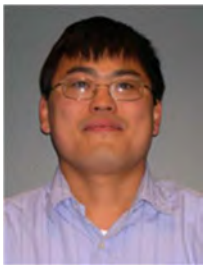
This project was supported by UNCG, the NSA (H98230-13-1-0253), and the NSF (DMS- 1303565).

The conference organizers were:

Sebastian Pauli

Filip Saidak

Brett Tangedal

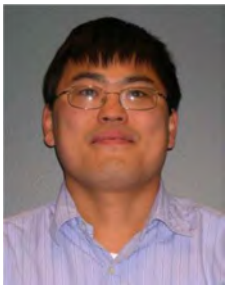


Dan Yasaki

15. Math Club & Pi Mu Epsilon Chapter
15.1 Math Club

Cassandra Brownell
President

UNCG Math Club



Dan Yasaki,
Faculty Advisor

The 2013−2014 academic year was the third year of the UNCG Math Club, whose goal is to create a community for Undergraduate and Graduate Math enthusiasts. The club met every other Wednesday. Turnout was great and they quickly attracted a core group of members. Most meetings centered on talks given by the department's very talented Faculty and Graduate students. And the talks covered fun and glamorous topics such as the topology, computation, differential equations, and the mathematics behind pitching baseballs. The club has been so successful with Dr. Dan Yasaki as the club's advisor; their status received official recognition by UNCG. Cassandra Brownell served as President and David Barron served as Secretary.

Wednesday, September 25th, 2013 Speaker: Dr. Haimeng Zhang, UNCG Title: Probabilistic Recurrence Relations	Wednesday, January 22nd, 2014 Math Puzzles!
Wednesday, October 9th, 2013 Speaker: Adam Eury, UNCG Master's Student Title: Positive Solutions for a Class of One Dimensional p-Laplacian Problems	Wednesday, February 5th, 2014 Movie: Proof
Wednesday, October 23rd, 2013 Speaker: Dr. Rudy Gordh, Guilford College Title: Generalized Arcs and Cells – Fixed Points, Chaos and Metrization	Wednesday, February 19th, 2014 Speaker: Dr. Edgar Parker, Guilford College Title: Pitching Downhill, Mathematical Models of Baseball Pitching
Wednesday, November 6th, 2013 Speaker: David Barron, UNCG Master's Student Title: Turing completeness of certain string rewriting systems	Wednesday, March 5th, 2014 Math Puzzles!
Wednesday, November 13th, 2013 Speaker: Dr. Talia Fernos, UNCG Title: Newton, Einstein and Gromov: What is the shape of our universe?	Wednesday, April 2nd, 2014 TED Talks – Steven Wolfram: Computing a Theory of Everything Kevin Slain: How Algorithms Shape Our World
Wednesday, November 20th, 2013 Speaker: Lincoln Financial Title: Take Charge of Your Career: Pursue Opportunities in Lincoln Financial Group's Actuarial Development Program	Wednesday, April 15th, 2014 Speaker: Dr. Greg Bell, UNCG Title: Hanging Pictures and Sharing Bikes, The Fundamental Group and Homotopy

15.2 Pi Mu Epsilon Chapter

Richard Fabiano, Chapter Liaison

Pi Mu Epsilon is the national honor society for outstanding students of mathematics.

Each year the faculty carefully screens the academic records of mathematics majors and other students studying advanced mathematics. Those students who satisfy the rigorous induction requirements and receive the approval of the faculty are extended an invitation to join Pi Mu Epsilon. This year our North Carolina Epsilon chapter inducted four new members:

Frederick Beck, Hollan Foltz, Austin Lawson, and Caitlin Ross.

We held an induction banquet to honor these students on April 28, 2014, at the Saigon Vietnamese Restaurant. The banquet was attended by new inductees and their guests, and several faculty members.

Pi Mu Epsilon dinner at Saigon Vietnamese Restaurant

15.3 UNCG student chapter of the Association for Women in Math

Talia Fernos
Faculty advisor

Paula Hamby
Chapter President

The UNCG student chapter of the Association for Women in Math was founded Fall 2013. Professor Talia Fernos coordinates its activities. During its first year, the chapter met several times in a variety of settings. Several meet-and-greets were held, where chapter members had a chance to meet and interact with female faculty and visiting female scholars. The chapter also co-hosted events with the Math club.

The chapter meetings provide female students of math and affiliated areas a space to get to know each other, thereby fostering mentoring relationships that develop in an organic way.

AWM Meeting

16. Departmental Spaces

Jerry and Theresa Vaughan Conference Room Dedication Ceremony was held on October 9, 2013. The conference room is dedicated to Jerry & Theresa Vaughan for their outstanding contributions to the UNC-Greensboro Department of Mathematics and Statistics.

Petty 149

Arts and Sciences Dean Timothy Johnston and Dr. Vaughan

Dr. Jerry Vaughan

Other Department Spaces:

The **Math Emporium** is located in Graham 303.

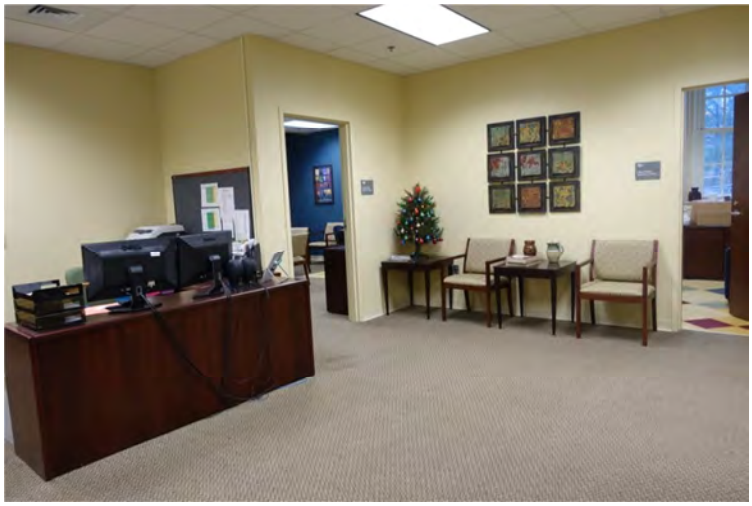
The **Math Help Center** is located in Curry 210 and provides tutoring services to undergraduate students enrolled in mathematics courses at UNCG.

The **Undergraduate Lounge** is located in Petty 206.

The **Department library** is located in Petty 119.

The **faculty lounge** is located in Petty 120.

The **Math Department office** is located in Petty 116.



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