Mary Macy Petty Building

UNCG

Department of
Mathematics & Statistics
Annual Report
2014-2015

Contents

1.   Summary

Ratnasingham Shivaji,
H. Barton Excellence Professor & Department Head

It has been a great pleasure to be a part of and to lead a very productive department with very talented faculty and staff members. Two of our associate professors were promoted to the rank of full professor and two of our assistant professors were promoted to the rank of associate professor with tenure. During the academic year 2014-15, we had eight full professors, ten associate professors, four 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 2014 the faculty has published 51 refereed journal articles, 1 refereed book chapters, and 3 refereed conference papers for a total of 55 refereed publications. The faculty made 59 presentations, with 10 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 2014-15. This includes receiving several competitive research grants from NSF, from NSA, and from the Simons Foundation. Please see below data on our funding record for the 2011-2014 years.

Grant Awards by Academic Year
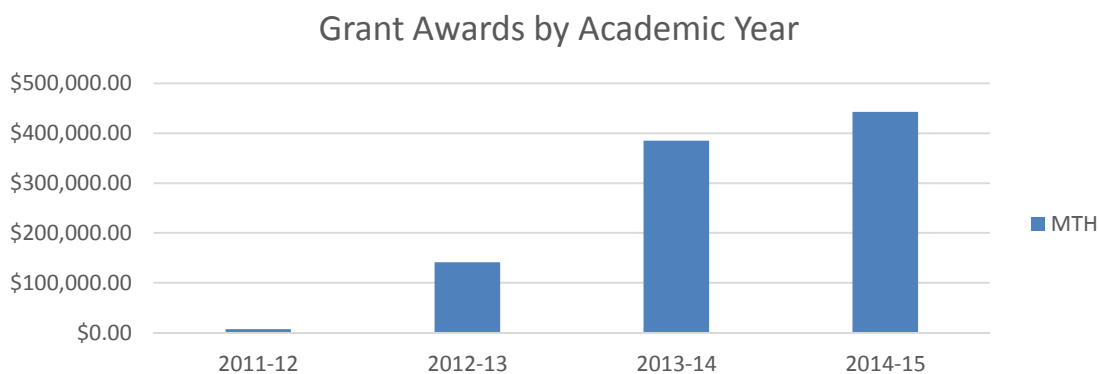
The department continued to be home to *Journal of Statistical Theory and Practice* (a Taylor and Francis publication) and *Topology and its Applications* (an Elsevier publication), two internationally renowned journals. Our Department is also (through the collaboration with UNCG library) starting *The North Carolina Journal of Mathematics and Statistics.* The journal will publish high quality, refereed, open access articles and software from all areas of Mathematics and Statistics at no charge to the authors. Jan Rychtář and Sebastian Pauli will serve as the managing editors.

The department continued to host the Helen Barton Lecture Series in Computational Mathematics and the Helen Barton Lecture Series in Mathematical Sciences, along with a Colloquia series and Seminar series in Applied Math, Math Biology, Algebra, Combinatorics & Number Theory, Topology, and Statistics. The department also hosted several research visitors. The department hosted the 2014 UNCG Regional Mathematics and Statistics Conference in November, 2014 (attended by 169 participants) and the Summer School in Computational Number Theory in summer of 2014 (attended by 11 participants). These conferences were supported by funding from NSF, NSA and MAA.

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 the 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 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, and Destination UNCG events. 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; and a Math Emporium Lab combining the best components of traditional and online classes in College Algebra and Pre-calculus courses (for approximately 400 students).

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 101 total undergraduate first majors and 10 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 2014-2015 academic year marked the fourth 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, 2014-15 marked the second academic year the Association for Women in Mathematics Student Chapter (AWM) has been active.

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, Ms. Mary McCrary Jackson, Mrs. Katherine Bland Davis, Ms. Nancy Coulter Geller, Mrs. Brownie Harrington Stencil, Ms. Walker Weigel, Ms. Kaye S. H. Edwards, Ms. Betsy Jordan Whitson, Ms. Linda Jeanne Bennetts, Ms. Nancy Lois Tucker, and Ms. Joan Foster Allan. Our sincere gratitude goes to all our donors.

In closing, I am delighted to say that the success of our department is due to the diligent work of our faculty, staff and students. Our students authored significant number of journal publications, and also presented several talks at research conferences. Here follows selected highlights of our faculty achievements: Dr. Thomas Lewis was a Mathematical Association of America 2014-15 Project NExT (New Experience in Teaching) Fellow, Dr. Talia Fernos received the 2015-16 Dean's Professorship award, Dr. Jan Rychtář was supported by a Simons Foundation grant and with Dr. Johnathan Rowell he also hosted National Science Foundation (NSF) funded Summer Research Experiences for Undergraduates (REU) programs at UNCG, Dr. Clifford Smyth's research was supported by an National Security Agency grant, Dr. Talia Fernos's and Dr. Haimeng Zhang's research were supported by NSF grants, and my research was supported by a Simons Foundation grant. Beginning Fall 2015, we were also awarded new Simons Foundation research grants for Dr. Xioli Gao and Dr. Clifford Smyth, and an NSF research grant for me.

Enjoy reading in this report all the details of our activities and achievements.

2. Faculty and Staff

2.1 Faculty

Greg Bell, Associate Professor
Director of Graduate Studies

Dr. Bell earned his Ph.D. in 2002 from the University of Florida and joined the UNCG faculty in 2005. He currently serves as the Director of Graduate Studies. His research focus is on geometric group theory, geometric topology, and asymptotic invariants of groups.

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.
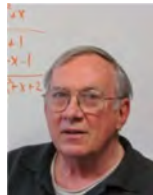
Paul Duvall, Professor

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. After 28 years of service, Paul retired at the end of the 2014-15 academic year. He had served as Department Head from 1986-2001, and Graduate Director from 2001-2011.

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

Dr. Fabiano earned a Ph.D. in 1986 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 earned 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, 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, multiple comparisons, and interdisciplinary research.

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, 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 nonlinear elliptic boundary value problems, reaction diffusion equations and mathematical ecology.

Clifford Smyth, Associate 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 interests include new approaches and improvements to teaching through the use of online components iclickers, and other pedagogical tools.

Dan Yasaki, Associate 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
University Program Associate

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.

Alyssa Holster
Administrative Support Associate

Ms. Holster received her Bachelor's degree in Interdisciplinary Studies in 2014 from Western Kentucky University. She joined the Department in September 2014. She resigned in July 2015 to pursue full time employment.

Alyssa Wharton
Administrative Support Associate

Ms. Wharton received her B.A. in Design from UNCG in 2013. She joined the Department in August 2015.

3. Tenure, Promotions, Awards & Honors

Promotions

Dr. Scott Richter was promoted from Associate Professor to the full Professor rank starting in Fall 2014

Dr. Jan Rychtář was promoted from Associate Professor to the full Professor rank starting in Fall 2014.
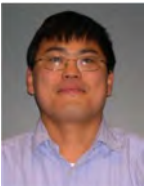

Ms. Haley Childers was promoted from Business Services Coordinator to University Program Associate in Spring 2015.

Tenure and Promotions

Dr. Clifford Smyth was promoted from Assistant Professor to the Associate Professor rank with tenure starting in Fall 2014.

Dr. Dan Yasaki was promoted from Assistant Professor to the Associate Professor rank with tenure starting in Fall 2014.

Awards

Dr. Clifford Smyth was supported by a two year (2013-2015) National Security Agency (NSA) award. The funding supported his *Correlation Inequalities* project. Dr. Smyth also received a Simons Foundation Grant for his Project titled, "Collaboration in Combinatorics." This award will last from 2015 to 2020.

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. She has been selected to receive a Candace Bernard and Robert Glickman Dean's Professorship in the College of Arts & Sciences for the academic year 2015-16.

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

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. Ratnasingham Shivaji received a five year (2014-2019) Simons Foundation Grant for his Project titled, "Analysis of nonlinear eigenvalue problems and applications." He has been notified that he is also receiving a three year (2015-2018) NSF research grant for his project titled, "Collaborative Research: Mathematical and Experimental Analysis of Ecological Models: Patches, Landscapes and Conditional Dispersal on the Boundary".

Dr. Xiaoli Gao received a Simons Foundation Grant for her Project titled, "Robust Estimation and Signal Approximation for High-dimensional Data." This award will last from 2015 to 2020.

Dr. Jan Rychtář holds a five year (2012-2017) Simon's Foundation grant for his project titled "Game-theoretical models in biology". Dr. Rychtář was also selected by the Department to receive the Department of mathematics and Statistics Award for Distinguished Service in 2014. He was also selected as the recipient of the Thomas Undergraduate Research Mentor Award presented by the Undergraduate Research, Scholarship and Creativity Office at UNCG.

Dr. Jan Rychtář (PI) and **Dr. Jonathan Rowell** (co-PI) received a three year (2014-2017) NSF Research Experiences for Undergraduates site grant. The title of the program is Mathematical Biology at UNCG.

Ms. Haley Childers was selected to receive the Department of Mathematics and Statistics Award for Distinguished Service in 2014. She also received one of two 2015 UNCG Staff Excellence Award.

Dr. Jan Rychtář and Ms. Haley Childers receiving the Department of Mathematics and Statistics Award for Distinguished Service in 2014.

Ms. Haley Childers receiving one of two 2015 UNCG Staff Excellence Awards.

4. Faculty Research Profile

4.1 Research Groups

Applied Mathematics

**Rich Fabiano with Ph.D. student Catherine Payne**

Applied mathematics is a discipline that develops mathematical techniques and concepts which can be used in understanding the natural and social sciences. Researchers at UNCG carry out research in differential equations, numerical analysis, 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 involved in this research group are Maya Chhetri, Richard Fabiano, Thomas Lewis, Jonathan Rowell, Jan Rychtář, Ratnasingham Shivaji and Clifford Smyth. Ph.D. Students in these areas: Quinn Morris, Catherine Payne, and Byungjae Son; Abraham Abebe (Ph.D. 2014) is an alumna of this group who is currently an Assistant Professor at Temple University.

Ratnasingham Shivaji with Ph.D. students Byungjae Son, Quinn Morris, and Catherine Payne
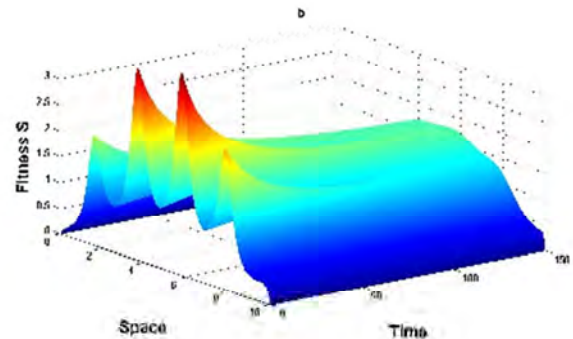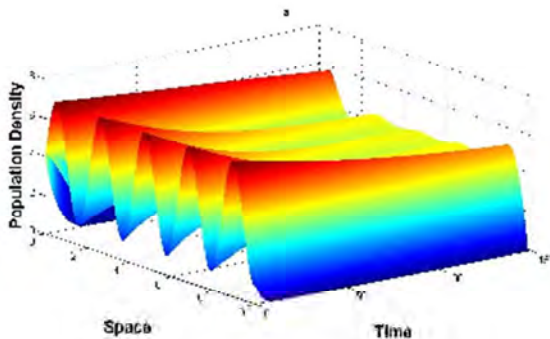
Combinatorics, Group Theory, and Topology
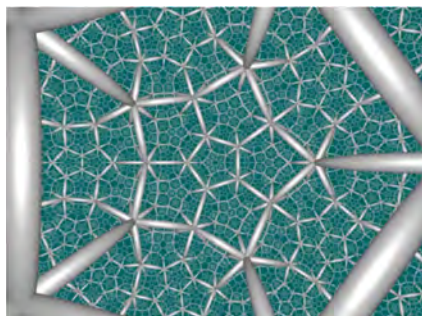
Combinatorics, Group Theory, and Topology are three active areas of research in pure mathematics at UNCG. The Combinatorics Group works with combinatorial probability, computational complexity, and discrete geometry. Group Theory research areas include geometric group theory, representation theory, and arithmetic groups. UNCG's topologists work with general and set-theoretic topology, geometric topology, asymptotic topology, and computational topology. Faculty involved in this research group: Greg Bell, Igor Erovenko, Talia Fernós, Clifford Smyth, and Jerry Vaughan. James Rudzinski is a current PhD student in this research group; Dani Moran (PhD 2014) is an alumna of this group, who is currently an Assistant Professor at Guilford College.
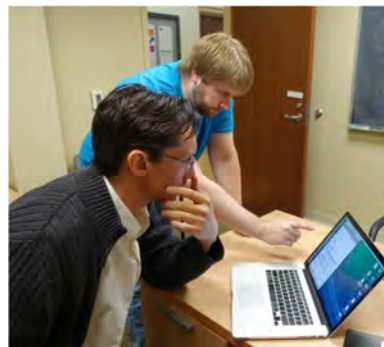
Clifford Smyth with Ph.D. student James Rudzinski

Greg Bell with MA students Austin Lawson and Josh Martin

Mathematical Biology

Understanding the evolution of cooperation, modeling disease transmission and vaccination decisions, understanding the effect of structured populations, modeling plant pollination, and analyzing genomic data 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. The primary faculty involved in this research group are Jonathan Rowell and Jan Rychtář with many other faculty including Maya Chhetri, Sat Gupta, Sebastian Pauli, Scott Richter, Ratnasingham Shivaji and Clifford Smyth contributing as well. We have developed close collaboration with Drs. Rueppell, Kalcounis-Rueppell, Remington, Schug, Wasserberg and other
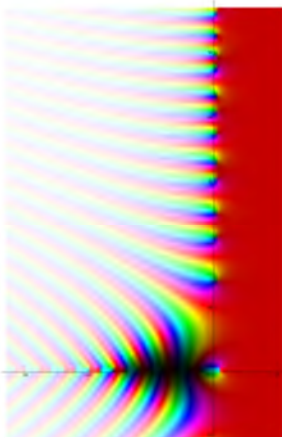

2015 NSF REU Participants

members of the Department of Biology at UNCG. Ratnasingham Shivaji is involved in collaborative research with James Cronin, an Ecologist at Louisiana State University.

Olav Rueppell, Jan Rychtar, Ratnasingham Shivaji, Sebastian Pauli, Martina Kalcounis-Rueppell, and Jonathan Rowell

Number Theory

The colored plot shows the Riemann zeta function for $-33 \leq \sigma \leq 11$ and $-11 \leq t \leq 57$, where the magnitude is indicated by brightness and the argument is represented by hue.

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

Sebastian Pauli with Ph.D. student Ricky Farr.

are Sebastian Pauli, Filip Saidak, Brett Tangedal, and Dan Yasaki. Current PhD students are Ricky Farr and Jonathan Milstead. Brian Sinclair (Ph.D. 2015) is an alumna of this group, who is currently at the Bureau of Labor Statistics.

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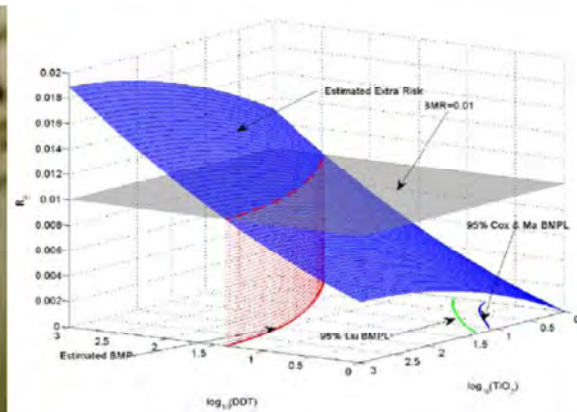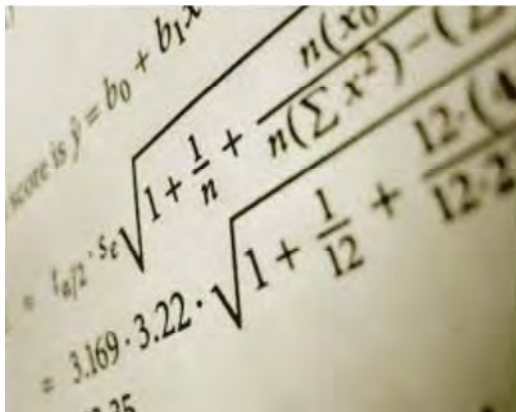
The statistics group in the department consists of four full time faculty (Dr. Sat Gupta, Professor; Dr. Scott Richter, Professor; Dr. Haimeng Zhang, Associate Professor; and Dr. Xiaoli Gao, Associate Professor).

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

Xiaoli Gao with MA student Bin Luo

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. The Statistics group also provides support through the Statistical Consulting Center to researchers across many disciplines at all stages of research.   PhD students in statistics are Wei Chen, Jeong Sihm, Chris Vanlangenberg, and Tanja Zatezalo.

Haimeng Zhang with Ph.D. student
Chris Vanlangenberg

Sat Gupta with Ph.D. student
Jeong Sep Sihm

4.2 2014 Refereed Articles

Maya Chhetri
Chhetri, M. & Drabek, P. Principal eigenvalue of the p-Laplacian operator in exterior domain. *Results in Mathematics,* 66 (3-4), 461-468.

Abebe, A., **Chhetri, M.,** Sankar, L., & Shivaji, R. Positive solutions for a class of superlinear semipositone systems on exterior domains. *Boundary Value Problems,* 198.

Chhetri, M. & Petr, G. Asymptotically linear systems near and at resonance*. Boundary Value Problems,* 242.

Chhetri, M., Drabek, P., & Shivaji, R. Existence of positive solutions for a class of p-Laplacian superlinear semipositone problems. *Proceedings of The Royal Society of Edinburgh, Section: A Mathematics*.

Abebe, A., **Chhetri, M.,** & Shivaji, R. Positive solutions for a class of multiparameter elliptic systems. *Dynamics of Continuous, Discrete, and Impulsive Systems*.

Talia Fernos

Fernos, T. & Singla, P. Images of Real Representations of $SL_n(Z_p)$. *Glasgow Mathematical Journal.*

Xiaoli Gao

Gao, X. & Ahmed, E. S. Efficient adaptive estimation in high-dimensional partially linear regression model *Contemporary Mathematics*.

Sat Gupta

Dingman, D., Schulz, M., Wyrick, D., Bibeau, D., & **Gupta, S.** Factors Related to the Number of Fast Food Meals Obtained by College Meal Plan for Students. *Journal of American College Health,* 62 (8), 562-569.

Koyuncu, N., **Gupta, S**., & Sousa, R. Exponential Type Estimators of the Mean of a Sensitive Variable in the Presence of Non-Sensitive Auxiliary Information. C*ommunications in Statistics-Simulation and Computation*, 43 (7), 1583-1594.

Subramani, J. & **Gupta, S.** Generalized modified linear systematic sampling scheme for finite populations. *Hacettepe Journal of Mathematics and Statistics*, 43 (3), 529-542.

Shabbir, J. & **Gupta, S.** An improved generalized difference-cum-ratio type estimator for the population variance in two phase sampling using two auxiliary variables. *Communications in Statistics-Simulation and Computation*, 43 (10), 2540-2550.

Shabbir, J., Haq, A., & **Gupta, S.** A New Difference-Cum-Exponential Type Estimator of Finite Population Mean in Simple Random Sampling. *Revista Colombiana de Estadística*, 37 (1), 199-211.

Stoeson, R., McLamb, K., Deaton, L. and **Gupta, S.**, Weight loss Through Bariatric Surgery: Some Issues, *Springer Proceedings in Mathematics & Statistics*.

Gupta, S., Kalucha, G., Shabbir, J., & Dass, B. K. Estimation of Finite Population Mean Using Optional RRT Models in the Presence of Non-Sensitive Auxiliary Information. *American Journal of Mathematical and Management Sciences*, 33 (2), 147-159.

Subramani, J., **Gupta, S.**, & Prabavathy, G. Circular Systematic Sampling in the Presence of Linear Trend. *American Journal of Mathematical and Management Sciences*, 33 (1), 1-19.

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*, 17 (5-6), 503-518.

Shabbir, J. & **Gupta, S.** A Note on Generalized Exponential Type Estimator for Population Variance in Survey Sampling. *Colombian Journal of Statistics*.

Sihm, J. S., Chhabra, A., & **Gupta, S.** An Optional Unrelated Question RRT Model. *Involve*.

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.*

Al-Omari, A. & **Gupta, S.** Double Quartile Ranked Set Sampling for Estimating Population Ratio using Auxiliary Information. *Pakistan Journal of Statistics*.

Zinn, J., Wood, F., **Gupta, S.**, Swofford, V., & Morgan, M. Examining Neurosurgical Surgical Site Infections. *OR Nurse*.

Yadav, S., Kadilar, C., Shabbir, J., & **Gupta, S.** Improved Family of Estimators of Population Variance in Simple Random Sampling. *Journal of Statistical Theory and Practice.*

Shabbir, J., Hussain, Z., & **Gupta, S.** Improved estimation of finite population median under two-phase sampling when using two auxiliary variables. *Scientia Iranica*.

Shen, W., Baldwin, J., Collins et al., B., **Gupta, S.**, & McIntosh, M. Low level of trans-10, cis-12 conjugated linoleic acid decreases adiposity and increases browning independent of inflammatory signaling in overweight Sv129 mice. *Journal of Nutritional Biochemistry.*

Kalucha, G., Dass, B. K., & **Gupta, S.** Ratio Estimation of Finite Population Mean Using Optional Randomized Response Models. *Journal of Statistical Theory and Practice.*

Tom Lewis
Lewis, T. & Neilan, M. Convergence analysis of a symmetric dual-wind discontinuous Galerkin method. *Journal of Scientific Computing,* 59 (3), 602-625.

Feng, X. & **Lewis, T.** Local discontinuous Galerkin methods for one-dimensional second order fully nonlinear elliptic and parabolic equations. *Journal of Scientific Computing,* 59 (2), 129-157.

Feng, X. & **Lewis, T.** Mixed interior penalty discontinuous Galerkin methods for one-dimensional fully nonlinear second order elliptic and parabolic equations. *Journal of Computational Mathematics,* 32 (2), 107-135.

Feng, X. & **Lewis, T.** Mixed interior penalty discontinuous Galerkin methods for fully nonlinear second order elliptic and parabolic equations in high dimensions. *Numerical Methods for Partial Differential Equations,* 30 (5), 1538-1557.

Sebastian Pauli
Milstead, J., **Pauli, S.**, & Sinclair, B. Constructing splitting fields of polynomials over local fields. *Springer Proceedings in Mathematics & Statistics*.

Scott Richter
Richter, S. J. & Stavn, R. H. Determining Functional Relations in Multivariate Oceanographic Systems: Model II Multiple Linear Regression. *Journal of Atmospheric and Oceanic Technology,* 31 (7), 1663-1672.

Saari, S., **Richter, S. J.**, Robbins, M., & Faeth, S. H. Bottom-up regulates top-down: hybridization of plant symbionts negatively affects predators? *Oikos,* 123 (5), 545-552.

Dohyoung Ryang
Ryang, D. Development and validation of the Mathematics Teaching Efficacy Scale: Confirmatory factor analysis. *The Mathemtical Education*.

Ryang, D. How to develop a scale in mathematics education research. *Research in Mathematical Education*.

Ryang, D. The development of the teaching and learning conceptions questionnaire short form. *Korean Journal of Teacher Education Research*.

Jan Rychtář
Broom, M., **Rychtář, J.**, & Sykes, D. Kleptoparasitic interactions under asymmetric resource valuation. *Mathematical Modelling of Natural Phenomena,* 9 (3), 138-147.

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Filip Saidak
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Ratnasingham Shivaji

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Abebe, A., Chhetri, M., Sankar, L., & **Shivaji, R.** Positive solutions for a class of superlinear semipositone systems on exterior domains. *Boundary Value Problems*, 198.

Jerry Vaughn

Vaughan, J. Continuous real-valued functions on ψ-spaces. *Topology and its Applications*.

Dan Yasaki

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

Donnelly, S., Gunnells, P. E., Klages-Mundt, A., & **Yasaki, D.** A table of elliptic curves over the cubic field of discriminant −23. *Experimental Mathematics*.

Haimeng Zhang

Zhang, H. & Huang, C. A Note on processes with random stationary increments. *Statistics and Probability Letters,* 94, 153-161.

4.3 2014 Book Chapters, Books and Monographs

Bell, G. C. An Invitation to Asymptotic Dimension. *Office Hours with a Geometric Group theorist*.

4.4 2014 Research Presentations

Greg Bell
Topological data analysis and directed filtrations. Colloquium, UNCA, Asheville, North Carolina.

TDA and directed filtrations. UNCG Topology Seminar, Greensboro, North Carolina.

Topological data analysis through directed filtrations. 38th Annual SIAM SEAS, Melbourne, Florida.

Maya Chhetri
An existence result for p-q Laplacian semipositone systems. 10th Mississippi State Conference on Differential Equations and Computational Simulations, Starkville, Mississippi.

Local behavior of continua of solutions for asymptotically linear systems near resonance. The 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Madrid, Spain.

Positive solutions of superlinear semipositone problems. The 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Madrid, Spain.

Local behavior of continua of solutions for an asymptotically linear systems. Joint Mathematics Meetings, Baltimore, Maryland.

Solutions of nonlinear boundary value problems. Colloquium, Winthrop University, Rock Hill, South Carolina.

Positive solutions of superlinear semipositone problems. Differential Equations Seminar, UT Knoxville, Knoxville, Tennessee.

Xiaoli Gao
Robust feature selection with fussy group information. International Conference on Advances in Interdisciplinary Statistics and Combinatorics, Greensboro, North Carolina.

Complex grouped variable selection. ISBIS and SLDM Joint Meeting, Durham, North Carolina.

Sat Gupta
New paradigms in RRT models. Colloquium, University of Louisiana, Lafayette, Louisiana.

Some interesting issues associated with newer families of randomized response models. Seminar, UNCG, Greensboro, North Carolina.

Statistics –valid science or a clever tool to prove your point. Seminar, UNCG Math/Bio REU, Greensboro, North Carolina.

Ratio and regression estimation of finite population mean using optional randomized response models. LinStat International Conference, Linkoping University, Linkoping, Sweden.

Estimating finite population mean for sensitive variables using auxiliary information. Colloquium, LSU – HSC, New Orleans, Louisiana.

Estimating finite population mean. National Meet of Research Scholars in Mathematical Sciences, Jammu University, Jammu, India.

Role of quantitative methods in academic and non-academic settings. Colloquium, Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya Gwalior, India.

A two-step approach to ratio estimation of finite population mean using optional randomized response models. 8th International Conference of the Institute for Mathematics, Bioinformatics, Information Technology and Computer Science, Kolkata, India.

Tom Lewis
Finite difference methods for nonlinear partial differential equations. Colloquium, North Carolina A&T, Greensboro, North Carolina.

Numerical differentiation and the approximation of boundary value problems. Colloquium, Wake Forest University, Winston-Salem, North Carolina.

An introduction to numerical differentiation and its application to differential equations. Seminar, UNCG Math-Bio REU, Greensboro, North Carolina.

Finite difference and discontinuous Galerkin methods for fully nonlinear second order PDEs. PITT Computational Mathematics Seminar, Pittsburgh, Pennsylvania.

A discontinuous Galerkin differential calculus and applications to numerical partial differential equations. MSU-UAB Conference on Differential Equations and Computational Simulations, Starkville, Mississippi.

Motivating a penalty-free DG method for elliptic problems. The Finite Element Circus, Detroit, Michigan. *The Dual-Wind Discontinuous Galerkin Method.* AMS Southeastern Section Meeting, Knoxville, Tennessee.

Sebastian Pauli
Enumerating extensions of p-adic fields with given invariants. Computational Tools for Number Theory and Algebra, Barcelona, Spain.

A guide to OM algorithms. AMS Fall Southeastern Section Meeting, Greensboro, North Carolina.

Scott Richter
Statistical consulting. Advances in Interdisciplinary Statistics and Combinatorics, Greensboro, North Carolina.

Nonparametric methods for comparing particle size distributions. Joint Statistical Meetings, Boston, Massachusetts.

Comparing scale using medians and permutation tests. Statistics Seminar, UNCG Dept. of Mathematics and Statistics, Greensboro, North Carolina.

Jonathan Rowell
Cooperative behavior in theory and practice: leading undergraduate research in behavioral mathematical biology. International Symposium on Behavioral Ecology, Education and Research, Claremont, California.

Adaptive population movement amid incomplete information: implications for harvesting and community dynamics. Evolution, Raleigh, North Carolina.

A dynamic paradox in a model of auxin-mediated growth of hypocotyl plant cells. UNC/Duke Integrative and Mathematical Physiology Seminar, Chapel Hill, North Carolina.

Replicator dynamics and sexual selection on mate preferences. UNCG Mathematical Biology Seminar, Greensboro, North Carolina.

Replicator dynamics and public signals. UNCG Mathematical Biology Seminar, Greensboro, North Carolina.

A primer in game theory, replicator equations, and directed movement. UNCG Mathematical Biology Seminar, Greensboro, North Carolina.

Harvesting ideally motivated populations: ecological and evolutionary implications. American Mathematical Society Fall Southeastern Section Meeting, Greensboro, North Carolina.

Dohyoung Ryang
Developing and using the MTES. Spring Conference of Korea Society of Mathematical Education, Seoul, Republic of Korea.

Jan Rychtář
Ideal cost-free distributions in structured populations for general payoff functions. International Conference on Advances in Interdisciplinary Statistics and Combinatorics, Greensboro, North Carolina.

Mentoring interdisciplinary research projects. International Conference on Advances in Interdisciplinary Statistics and Combinatorics, Greensboro, North Carolina.

The evolution of cooperation – kin selection and greenbeard genes. Colloquium, NCAT, Greensboro, North Carolina.

The evolution of cooperation – kin selection and greenbeard genes. Colloquium, Bennett College, Greensboro, North Carolina.

The evolution of cooperation – kin selection and greenbeard genes. Joint Mathematics Meetings, Baltimore, Maryland.

Habitat selection game in structured populations. AMS Southeastern Section Meeting, Greensboro, North Carolina.

Carol Seaman
Understanding the connection: Students' mathematical thinking and teachers' MKT. Research Council on Mathematics Learning, San Antonio, Texas.

Ratnasingham Shivaji
Subsolutions: A journey from positone to infinite semipositone problems.   Colloquium, Indian Institute of Technology, Chennai, India.

Existence results for a class of superlinear semipositone systems. AIMS 10th International Conference on Dynamical Systems, Differential Equations and Applications, Madrid, Spain.

An existence result for a class of pq-Laplacian semipositone system. Differential Equations and Nonlinear Analysis Workshop at CCMS, Claremont, California.

A uniqueness result for a singular positone problem.   AMS Annual Meeting, Baltimore, Maryland.

Uniqueness of positive radial solutions for a class of semipositone problems on the exterior of a ball.   Workshop on Mathematical Biology and Nonlinear Analysis, Coral Gables, Florida.

Existence results for classes of steady state reaction diffusion equations.   Colloquium, Old Dominion University, Norfolk, Virginia.

Boundary value problems- An Introduction.   Colloquium, Winthrop University, Rock Hill, South Carolina.

Existence results for classes of steady state reaction diffusion equations.   Colloquium, UNC-Wilmington, Wilmington, North Carolina.

Clifford Smyth
Revolutionaries and spies. AMS Sectional Meeting at the University of North Carolina at Greensboro, Greensboro, NC, Special Session on Recent Developments in Graph Theory and Hypergraph Theory, Greensboro, North Carolina.

Jerry Vaughn
Fibers of real-valued continuous functions on ψ-spaces. Spring Topology Conference, Richmond, Virginia.

ψ-spaces on an uncountable cardinal κ with a MADF of cardinality κ. American Mathematical Association Fall Southeastern Section Meeting, Greensboro, North Carolina.

Dan Yasaki
Modular forms and elliptic curves over the cubic field of discriminant −23. Curves and Automorphic Forms, Tempe, Arizona.

Modular forms and elliptic curves over the cubic field of discriminant -23. UNC-Duke Number Theory Seminar, Durham, North Carolina.
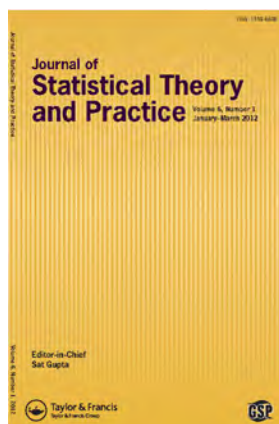
Haimeng Zhang
Covariance structures of axially symmetric spatial processes on the sphere. International Conference on Advances in Interdisciplinary Statistics and Combinatorics, Greensboro, North Carolina.

4.5 Department Journals

Journal of Statistical Theory and Practice

http://www.tandfonline.com/loi/UJSP20

Sat Gupta,
Editor-in-Chief

The Journal of Statistical Theory and Practice was conceived and started in 2007 by Professor Sat Gupta, who continues to serve as its Editor-in-Chief. 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 44 papers and two book reviews appearing in Vol. 8, 2014. This volume also published two special issues - Design of Experiments and Related Combinatorics in Memory of Professor Jagdish N. Srivastava (Ed. Sudhir Gupta & Rahul Mukerjee), and Advances in Interdisciplinary Statistics and Combinatorics (Ed. Cem Kadilar & Hulya Cingi, Hacettepe University,Ankara, Turkey)

Topology and its Applications

http://www.journals.elsevier.com/topology-and-its-applications/

Topology and its Applications, published by Elsevier Science B.V. in Amsterdam, is a research journal devoted to publishing original research papers of moderate length.
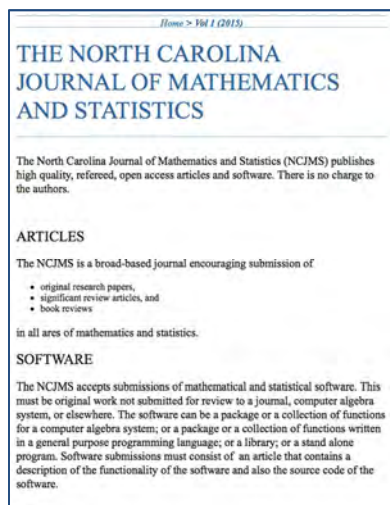
Jerry Vaughan,
Editor-in-Chief

However, a limited number of carefully selected survey or expository papers are also included. The mathematical focus of the journal is that suggested by the title: Research in **Topology**. Certainly the subject includes the **algebraic**, general, **geometric**, and set-**theoretic** facets of topology as well as areas of interactions between topology and other mathematical disciplines, e.g. topological algebra, topological dynamics, functional analysis, theoretical computer science, and category theory.

The Editors-in-Chief of the journal are Professor Jan van Mill (University of Amsterdam) and Professor Jerry E. Vaughan (UNC-Greensboro). They and four managing editors handle all submissions. The journal, which began in 1971, has published over 180 volumes, and all articles published after 48 months have unrestricted access and will remain permanently free to read and download. In 2014 the journal published 17 volumes for a total of 3200 pages.

The North Carolina Journal of Mathematics and Statistics

THE NORTH CAROLINA JOURNAL OF MATHEMATICS AND STATISTICS

The North Carolina Journal of Mathematics and Statistics (NCJMS) publishes high quality, refereed, open access articles and software. There is no charge to the authors.

ARTICLES

The NCJMS is a broad-based journal encouraging submission of
- original research papers,
- significant review articles, and
- book reviews

in all ares of mathematics and statistics.

SOFTWARE

The NCJMS accepts submissions of mathematical and statistical software. This must be original work not submitted for review to a journal, computer algebra system, or elsewhere. The software can be a package or a collection of functions for a computer algebra system; or a package or a collection of functions written in a general purpose programming language; or a library; or a stand alone program. Software submissions must consist of an article that contains a description of the functionality of the software and also the source code of the software.

http://ncjms.uncg.edu/

The North Carolina Journal of Mathematics and Statistics (NCJMS) was conceived and started in 2014 by Professor Jan Rychtář form the Department of Mathematics and

Jan Rychtář and Sebastian Pauli, Managing Editors

Statistics at the University of North Carolina at Greensboro. It is an online open access journal that publishes high quality, refereed articles and software from all areas of mathematics and statistics at no charge to the authors. Currently, Drs. Jan Rychtář and Sebastian Pauli are the managing editors.

The NCJMS publishes original research papers and significant review articles. Moreover, it is one of the few mathematics and statistics journals that also accept software submissions. Software submissions are peer reviewed and consist of two parts: an article that contains a description of the functionality of the software and the source code of the software. When accepted both are made available on the journals web site. The editorial board of the NCJMS currently consists of Greg Bell, Maya Chhetri, Sat Gupta, Sebastian Pauli, Jan Rychtář, Filip Saidak and Jerry Vaughan from UNCG as well as of Chad Awtrey (Elon University) and Stephen Robinson (Wake Forest University). The board is expected to grow and to encompass most departments of mathematics and statistics in North Carolina. Currently, Drs. Jan Rychtář and Sebastian Pauli are the managing editors. The first issue of the journal is expected to be published towards the end of 2015.

5.   External Grants

5.1 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
N/A	**Rychtář, Jan**	Oh, Hyunju; Oh, Joon-Yeoul	National Research Experience for Undergraduates Program (NREUP)	5/1/15	7/31/15	Mathematical Association of America	$25,716
14-0087	**Yasaki, Dan**		Voronoi Reduction Theory and Applications to Arithmetic Groups	5/01/15	5/1/17	National Security Agency	$20,000
15-0322	**Seaman, Carol**	Sametz, Lynn	UNCG's NC Science Festival	4/10/15	4/26/15	University of North Carolina at Chapel Hill	$2,500

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**	**Rychtář, Jan; Richter, Scott**	International Conference on Advances in Interdisciplinary Statistics and Combinatorics	2/16/12	8/31/14	National Science Foundation	$20,000
12-0323	**Rychtář, 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
12-0350	**Smyth, Clifford**		Correlation inequalities	1/1/13	1/1/15	DOD National Security Agency	$76,767
13-0314	**Rychtář, 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	National Security Agency	$14,600
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	**Rychtář, Jan**	**Rowell, Jonathan;** Rueppell, Olav	REU Site: Mathematical Biology at UNCG	3/11/14	4/30/17	National Science Foundation	$275,952
14-0213	**Gupta, Sat**	**Rychtář, Jan;** Suthaharan, Shan	International Conference on Advances in Interdisciplinary Statistics and Combinatorics	4/22/14	5/31/15	National Science Foundation	$10,000
14-0252	**Shivaji, Ratnasingham**		Analysis of nonlinear eigenvalue problems and applications	5/14/14	8/31/19	Simons Foundation	$35,000

Future Awards Administered by Mathematics and Statistics:

PROP #	Lead PI	Other Personnel	Award Title	Start Award Date	End Award Date	Sponsor	Award Amount
15-0198	Shivaji, Ratnasingham		Collaborative Research: Mathematical and Experimental Analysis of Ecological Models; Patches, Landscapes and Conditional Dispersal on the Boundary	8/15/15	7/31/18	National Science Foundation	$203,834
15-0301	Smyth, Clifford		Collaboration in Combinatorics	9/1/2015	8/31/2021	Simons Foundation	$35,000
15-0290	Gao, Xiaoli		Robust Estimation and Signal Approximation for High dimensional Data	9/1/2015	8/31/2020	Simons Foundation	$35,000
N/A	Rychtář, Jan	Shivaji, Ratnasingham; Bell, Greg; Yasaki, Dan; Pauli, Sebastian	Preparation for Industrial Careers in Mathematical Sciences (PIC Math)	1/1/2016	5/31/2016	Mathematical Association of America	$6,500
15-0295	Fabiano, Richard	Chhetri, Maya; Lewis, Thomas	Southeastern Atlantic Regional Conference on Differential Equations 2015	8/01/15	4/30/16	National Science Foundation	$24,000

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
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

5.2 Internal Grants
New Awards Administered by Mathematics and Statistics:

PROP #	Lead PI	Other Personnel	Award Title	Start Award Date	End Award Date	Sponsor	Award Amount
N/A	**Bell, Greg**		Faculty First Summer Scholarship Support Award	4/9/15	6/30/15	UNCG- Office of Research and Economic Development	$2,297
N/A	**Lewis, Tom**		Faculty First Summer Scholarship Support Award	4/9/15	6/30/15	UNCG- Office of Research and Economic Development	$5,000

Future Awards Administered by Mathematics and Statistics:

PROP #	Lead PI	Other Personnel	Award Title	Start Award Date	End Award Date	Sponsor	Award Amount
N/A	**Gao, Xiaoli**		New Faculty Grant	8/1/15	6/30/16	UNCG- Office of Research and Economic Development	$4,000

6.   Undergraduate Programs

6.1 Programs
Degree Programs

Mathematics is an excellent major for the student whose immediate objective is to acquire a strong liberal arts education. The goal of all of the Department's programs is to produce students who are both technically competent and sufficiently well grounded in theory that they can contribute to fundamental research in their chosen specialty. There are many opportunities for the undergraduate majors in the mathematics in industry, government, business, and secondary school teaching. Graduates may go on to work as an actuary with insurance companies; as a data analyst with pharmaceutical, biotechnology, or health care companies; as a quality assurance specialist with engineering companies; or in government agencies such as FDA, EPA or USDA.

Dan Yasaki, Director of Undergraduate Studies

An undergraduate major in the mathematics also provides excellent preparation for graduate studies in many areas, including actuarial sciences, computer science, economics, engineering, law, mathematics, operations research, and statistics. The majors can be specialized to allow preparation for any of these goals.

The Department of Mathematics and Statistics offers undergraduate programs leading to

- BA in Mathematics;
- BA in Mathematics with High School Teaching Licensure;
- BS in Mathematics with concentration in Mathematics;
- BS in Mathematics with concentration in Statistics.

The BA program is more flexible than the BS program. It allows one to specialize in mathematics and at the same time either to follow a broad liberal arts program or to specialize in a second area (possibly even taking a second major). The BS program is more technically oriented; it provides solid preparation for work or study in mathematics or a related field. Students wanting to go to graduate school are encouraged to consider the BS degree or the new Accelerated Degree Program (ADP) to earn a BS and MA in 5 years. We also offer minors in mathematics and statistics.

Table 1. Student enrollment in 2014-2015

Program	Fall 2014	Spring 2015
BA	16	17
BA HS Teaching Licensure	23	20
BS Mathematics concentration	41	38
BS Statistics concentration	19	23
2nd Majors	10	7
Total	**109**	**105**

Curriculum

We continue our efforts in service courses as well as producing graduates that are better prepared for the STEM (Science, Technology, Engineering, and Math) fields.

As part of our commitment for high quality instruction in the classroom, we have continued to keep the sizes of all lecture sections in mathematics and statistics classes at 50. Class size caps go down to 35 starting at Calculus and drop to 25 in courses at the 300 level and above.

The review of UNCG's General Education program and its courses is a continuous process that requires faculty guidance and participation. Recertification is necessary in order to ensure that GEC courses continue to meet the learning outcomes for which they were approved. The Faculty Senate approved our revised Student Learning Outcomes of the Mathematics (GMT) requirement of the General Education Program on September 3, 2014.

- SLO1 Reason in mathematical systems beyond data manipulation.
- SLO2 Formulate and use mathematical models to solve real-world problems.
- SLO3 Communicate mathematical solutions clearly and effectively.

The following mathematics and statistics courses were recertified with the GMT marker in Spring 2015: MAT 112, MAT 115, MAT 120, MAT 150, MAT 151, MAT 190, MAT 191, and STA 108.

The new Pre-calculus course MAT 190 was offered for the first time in Fall 2014. The course is a single semester preparation for Calculus and is especially useful for getting majors in the STEM field quickly through the Calculus sequence. We also strengthened the grade requirements for mathematics and statistics courses that count toward our programs. Beginning in Fall 2015, only those courses in which a student earns a C or better will count toward the major or minor. Finally, we began collecting empirical data measuring the readiness of the students in MAT 191. This data will be used to design additional services and support for these STEM majors to lower DFW rates and help at-risk students succeed.

Graduates

During the 2014-2015 academic year, twenty-two students earned a Bachelor's degree in mathematics: Caitlin Adam, Frederick Beck III, Joshua Ciliberto, Jordan Eliseo, Stephanie Falcon, Edwin Faulkner, Elia Feldman, Ayana Littlejohn, Bingxue Liu, Benjamin Manifold, Megan McElroy, Eric McKenzie, Nicole Medlin, Kirsti Oxendine, Benjamin Preston, John Satterfield, James Spinks, David Sykes, Stephanie Webster, Na Wen, Hlee Xiong, and Thomas Woosley.

Our graduates leave UNCG and follow a variety of successful paths. A sample is given below.

- Jordan Eliseo has accepted a position in Austin Texas as a Software Developer for IBM Cloud Services, designing new software solutions for the cloud architecture for corporate companies such as Yelp and eBay.
- David Sykes will enter the PhD program in mathematics at Texas A&M.
- Stephanie Webster will enter the Post-Baccalaureate Program in mathematics at the Center for Women in Mathematics at Smith College, a prestigious NSF funded program helps prepare women to pursue a higher degree in the mathematical sciences.
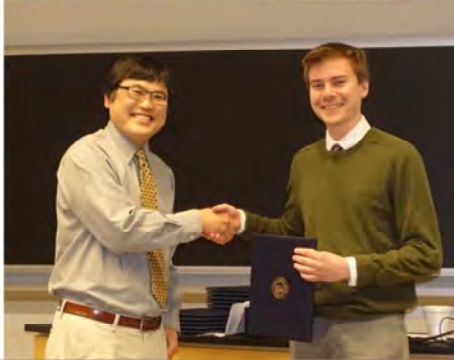
BA & BS Graduates at the Department Graduation Ceremony

6.2 Recruitment and Retention

Over the last several years and the 2014-2015 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 Mathematics Help Center where students can come for assistance with their mathematical questions, we have doubled the number of students taking courses in our Mathematics Emporium lab. Our Emporium-model classes combine the best components of traditional and online classes

Undergraduate Recruitment Event

for approximately 400 students in our College Algebra and Precalculus courses each semester. 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 first year 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 2014, the department sponsored a continental breakfast for all Guilford County high school math teachers at their opening professional development event.
- The department prepared "Welcome to the Department!" boxes for first-year mathematics majors.

- Tracey Howell, Carol Seaman, and Dan Yasaki participated in numerous recruiting programs throughout 2014-2015, including the Spartan Showcase, the Fall Faculty Phone-a-Thon, the Spring Faculty Phone-a-Thon, and Destination UNCG.

Organizations for Mathematics Majors

- Alpha Student Chapter of the North Carolina Council of Teachers of Mathematics (Faculty Advisor: 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

Carol Seaman, Dohyoung Ryang, Walker Weigel at Undergraduate Recruiting Event

7.   Undergraduate Research Programs

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. Rychtář, 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.

2015 National Research Experience for Undergraduates Program

Summary

Jan Rychtář (UNCG), Hyunju Oh (Bennett College) and Joon-Yeoul Oh (Texas A&M University-Kingsville) received funding from the Mathematical Association of America (MAA) for the for the "Game Theory and Applications" project. 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 25, 2015 to July 3, 2015, engaged Aaleah Lancaster, Rhoni Moffit, Qaleelah Smith and Keearera Hood, all African-American female undergraduate students from Bennett College, Greensboro, NC in research projects.

2015 is the third year of such a successful collaboration between UNCG and Bennett College; similar programs took place in 2014 and 2013.

Projects

Hurricane evacuation

During the hurricane season, residents in southeast coast area experience frequent warnings for hurricanes. The residents need to be evacuated to safety at least 20 to 50 miles away from the impacted area. With a mass evacuation, even 24-hour notice may not be enough since necessities such as lodging are limited and the actual evacuation distance can easily be more than 100 miles. When a hurricane is approaching, the residents prepare with installing blocks on windows, buying gas/food and deciding if and when to evacuate. In general, if they are getting ready too early, the cost to prepare is too high due to the frequent false warnings (long term hurricane path predictions are not yet reliable). However, if the residents wait almost till the end, their lives get threatened (short term predictions are relatively accurate). Moreover, when everybody evacuates at the same time, there will be logistical issues such as traffic congestions and no fuel in gas stations. The goal of this project is to find an optimal evacuation time. The optimal time depends on individual circumstances and risks (for example, a family with young children is in a different situation than a single healthy young person) and the objective is to find the time as a function of the individual risk and the rick distribution within the population.

Patrolling the US Border

U.S. Customs and Border Protection (CBP), is responsible for securing the border between U.S. ports of entry and has divided the 2,000-mile U.S. border with Mexico among nine Border Patrol sectors. CBP reported spending about $3 billion to support Border Patrol's efforts on the southwest border in fiscal year 2010 alone, and apprehending over 445,000 illegal entries and seizing over 2.4 million pounds of marijuana. The number of border patrol officers has been increased but because of the limitation of patrolling personnel and budget, it is critical to allocate resources appropriately. The goal of this project is to optimize border patrol routes. The infiltrators' goal is to enter US successfully while patrols intend to capture infiltrators to prevent illegal cross-border activities. Students will develop various models with the objective to find optimal routes and patrolling patterns for the optimal border protection.

Acknowledgement

2015 National Science Foundation funded Research Experiences for Undergraduates Program (REU site)

REU site: Mathematical Biology at UNCG
Summers of 2014 and 2015

DMS Grant # 1359187 (2014-2017)

THE UNIVERSITY of NORTH CAROLINA
GREENSBORO
Department of Mathematics & Statistics

2014 Participants

Students at REU 2014

Bennett College Students at REU 2014

Research Projects
- Territorial Games
- Vaccination Game Theory
- Comparative Analysis of Transcriptomic Data
- Evolutionary Graph Theory
- Evolution of Cooperation
- Age-Structured Populations
- Social Dynamics
- Cooperation and Kleptoparasitism

Student Institutions
- Appalachian State University
- Bennett College
- Florida Southern College
- Gonzaga University
- Grinnell College
- Mercer University
- Miami University
- Michigan State University
- North Carolina State University
- Northern Kentucky University
- Texas Christian University
- University of North Carolina at Greensboro
- University of North Carolina at Wilmington
- Winthrop University
- Worcester Polytechnic Institute

Outcomes
50 (and counting) student presentations, including presentations at
- International Conference of Undergraduate Research
- International Symposium on Biomathematics and Ecology Education and Research
- AMS-MAA Meetings

2015 Participants

For more information, visit
www.uncg.edu/mat/bio-math/REU

Main Organizers

Jan Rychtar
Research: Game Theory, Mathematical Biology

Jonathan Rowell
Research: Game Theory, Mathematical Biology

Olav Rueppell
Research: Behavioral Genetics, Aging and Demography, Social insects

Jan Rychtář, 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 2015 (mid-May to the end of July), the PIs worked with ten undergraduate students that came from Worcester Polytechnic Institute, Mercer University, Northern Kentucky University, Grinnell College, Winthrop University, Gonzaga University, Florida Southern College, Texas Christian University and UNCG.

The 2015 cohort consisted from 7 female and 3 male students, , three out of ten students came from under-represented minorities, specifically they were African American, Hispanic and America/Alaskan native women. Student maturity varied from freshmen to seniors, and their prior course work in mathematics, statistics and biology varied extensively.

2015 NSF REU participants

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. Quinn Morris, 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. Catherine Payne, also a doctoral student within our department 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, we also organized a weekly journal club in which each participant led a discussion on a paper of their choice.

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.

2015 NSF REU participants

Research projects

The students were split into 5 pairs and each pair worked on one of the following research projects.

Vaccination Game Theory

As witnessed by the recent outbreak of measles, there is a gap between interest of the individuals and the interest of the population as a whole. From the individuals' perspective, the benefits of vaccination (i.e. not getting the disease) may not be high enough to outweigh the cost of the vaccination (i.e. potential vaccine side effects) especially when majority of the population is vaccinated that the disease outbreak seems highly unlikely. Such scenarios are successfully modeled by game theory. During the Summer 2015, our team worked on developing game theoretical models for spatially structured populations.

Evolutionary Graph Theory

A population structure is often modeled using graphs. Individuals are assumed to live on the vertices of the graph and can interact only with their neighbors. The classical evolutionary graph theory (EGT) has been very successful in capturing the basic principles and reasons behind the evolution of cooperation in the structured population. However, some underlying assumptions behind the EGT are highly unrealistic and especially for heterogeneous populations can lead to anomalies where some individuals are forced to interact with too many of their neighbors. During our summer 2015 project, we provided an alternative underlying model and studied the classical results in this new setting.

Machine Learning and Territorial Invasion Games

Many animals are territorial and a lot of animal interactions revolve around the territories, the protection of its own territory against an aggression of a neighbor, or an aggressive invasion into

neighbor's territory. Especially for highly heterogeneous population structure, finding optimal behavior (to protect or to invade) is analytically impossible and we have thus adopted several machine learning techniques to help us to gain an insight into how the population structure influences the optimal behavior.

Evolution of Cooperation
In a biological context, the evolution of cooperation can be conceived as a contest between populations who exhibit alternate organizing principles that control the fitness performance of their respective individuals. These differences influence not only the local dynamics of interact groups but also their spatial distribution within a regional community. During the 2015 summer, we continue to develop a population dynamics model formulated in the first year of our program and consider alternate mechanisms by which cooperation could be introduced and reinforced, including mutation, step-wise transition states, and behavioral switching.

Comparative Analysis of Transcriptomic Data
The life sciences are revolutionized by massive genomic data generation. Most of these data are in the form of genome-wide gene expression analysis (transcriptomics). In this project, we evaluate the current statistical methods to relate different data sets to each other, specifically determining significant overlap in differentially regulated gene sets. We will relax the underlying assumption of gene equality and model gene expression profiles assuming genomes that harbor different classes of genes. These simulations will assess how current methods may have to be adjusted to biological reality.

Student Authored Articles (UNCG students in bold)

D. Suarez, P. Suthaharan, J. Rowell, J. Rychtář. Evolution of Cooperation in Mobile Populations. To appear in *Spora*, a journal of Biomathematics.

Mark Broom, Jan Rychtář, **David Sykes**. Kleptopasasitic interactions under asymmetric resource valuation. *Mathematical Modeling of Natural Phenomena*, 9 (03), 138-147.

David Sykes, Jan Rychtář. A Game Theoretic Approach to Valuating Toxoplasmosis Vaccination Strategies, submitted.

Zhang, Q., Kazi, H. and Gupta, S. Modeling Risky Sexual Behaviors among College Students – Predictors of STD. To appear in *Springer Proceeding in Mathematics and Statistics.*

Student Presentations (UNCG students in bold)

- **David Suarez**, Praveen Suthaharan, Elizabeth Bergen, Jonathan Rowell, Jan Rychtář: Influence of Individual's Mobility and Neighborhood Size on the Evolution of Cooperation, The 10th Annual UNCG RMSC conference, November 1, 2014, University of North Carolina at Greensboro, Greensboro, NC, USA

- **David Sykes**, Jan Rychtář: Toxoplasmosis Vaccination Strategies, The 10th Annual UNCG RMSC conference, November 1, 2014, University of North Carolina at Greensboro, Greensboro, NC, USA
- **David Suarez**, Praveen Suthaharan, Elizabeth Bergen, Jonathan Rowell, Jan Rychtář: Greater Mobility and Larger Neighborhood Size Inhibit the Evolution of Cooperation, 2014 International Conference on Advances in Interdisciplinary Statistics and Combinatorics, October 10-12, 2014, University of North Carolina at Greensboro, Greensboro, NC
- **Anna Paula Tognasoli**, Jan Rychtář, Gideon Wasserberg: Game-Theoretical Model of Oviposition Site-Selection of Gravid Female Mosquitoes, 2014 International Conference on Advances in Interdisciplinary Statistics and Combinatorics, October 10-12, 2014, University of North Carolina at Greensboro, Greensboro, NC
- **David Sykes**, Jan Rychtář: Toxoplasmosis Vaccination Strategies, 2014 International Conference on Advances in Interdisciplinary Statistics and Combinatorics, October 10-12, 2014, University of North Carolina at Greensboro, Greensboro, NC
- Praveen Suthaharan, **David Suarez**, Elizabeth Bergen, Jonathan Rowell, Jan Rychtář: Evolution of Cooperation in Mobile Populations, 2014 Behavioral Ecology Education and Research, October 10-12, 2014, Harvey Mudd College, Claremont, CA
- Praveen Suthaharan, **David Suarez**, Jonathan Rowell, Jan Rychtář: Evolution of Cooperation in mobile populations, July 18, 2014, Joint Joint NCAT-UNCG REU minisymposium, Greensboro, NC
- Praveen Suthaharan, **David Suarez**, Jonathan Rowell, Jan Rychtář: Evolution of Cooperation in mobile populations, July 11, 2014, Joint UNCG-Winthrop Math-Biology REU minisymposium, Greensboro, NC
- Praveen Suthaharan, **David Suarez**, Jonathan Rowell, Jan Rychtář: Evolution of Cooperation in mobile populations, June 19, 2014, Duke University Math-Biology REU minisymposium, Durham, NC

8. Graduate Programs

Academic Year in Review

The 2014-2015 Academic Year was the most exciting year in the history of our department's graduate programs! In August of 2014, we graduated our first PhD student, Abraham Abebe. In December of 2014, Danielle Moran became our second PhD graduate. Finally, in May of 2015, Brian Sinclair was awarded his PhD. Additionally, Adam Eury received his MA degree in December 2015.

Greg Bell, Director of Graduate Studies

The graduate committee has begun to restructure the MA program with a view towards creating concentrations that are more directly linked to specific career paths. We continued our strong push for graduate recruitments at local, state, and national levels. Our graduate students continued to engage in discipline-based scholarship as demonstrated by their refereed journal articles and research presentations both at UNCG and at conferences around the nation. Our students were involved with IMA activities, summer research programs, and more.

PhD Degrees Awarded

In August 2014, Abraham Abebe was awarded the first PhD in Computational Mathematics at UNCG. Abraham worked under the supervision of Maya Chhetri. His dissertation was titled *Positive solutions of nonlinear elliptic boundary value problems.* His dissertation focuses on the study of positive steady states to classes of nonlinear reaction diffusion (elliptic) systems on bounded domains as well as on other exterior domains with Dirichlet boundary conditions. He studied such systems in the challenging case when the reaction terms are negative at the origin – so-called semipositone problems. He established several results that directly contribute to and enhance the literature on semipositone problems, including existence, non-existence, and multiplicity results for classes of superlinear and sublinear systems. His results were established via the method of sub-super solutions, degree theory arguments, *a priori* bounds, and energy analysis. Abraham works as a non-tenure track assistant professor at Temple University in Philadelphia, PA.

In December 2014, Danielle Moran was awarded a PhD in Computational Mathematics. Dani worked under the supervision of Greg Bell. Her dissertation was titled *Permanence results for dimension-theoretic coarse notions.* Her dissertation focused on an area of mathematics known as coarse topology. Coarse topology is the study of interesting topological properties of discrete spaces. She focuses on a coarse analog of dimension and several generalizations of it. After extending the class of metric spaces for which these properties are known, she generalizes these properties to all coarse spaces and explores the relationships between these generalized notions. Finally, she gives a brief discussion of computational topology, highlighting how to generate the Rips and Čech simplicial complexes from a set of data and provides code written to generate these complexes in Sage. Dani is currently a tenure-track assistant professor at Guilford College in Greensboro, NC.

Brian Sinclair was awarded his PhD in Computational Mathematics in May 2015. He worked under the supervision of Sebastian Pauli on his dissertation titled *Algorithms for enumerating invariants and extensions of local fields.* His work concerns the classification of field extensions and the decomposition of global ideals. The main goal of his work is present efficient algorithms, leveraging the Newton polygons and residual polynomials, to solve many of these problems faster and more efficiently than present methods. Considering additional invariants, he extends Krasner's mass formula, dramatically improves general extension enumeration using the reduced Eisenstein polynomials of Monge, and provides a detailed account of algorithms that compute Okutsu invariants using the lens of partitioning the set of zeros of polynomials. Brian currently works for the Bureau of Labor Statistics.

MA Degrees Awarded

Adam Eury earned his MA degree with Maya Chhetri in December 2014. Adam's thesis was titled *Positive solutions for a class of one dimensional p-Laplacian problems.* In it, he investigates the number of positive solutions for nonlinear boundary value problems (BVPs) with respect to a positive parameter. The nonlinearities he considers are smooth nondecreasing functions that are eventually positive. By utilizing the so-called quadrature method, he discusses existence, nonexistence, uniqueness, and multiplicity of positive solutions depending on the behavior of the nonlinearity near the origin, its concave or convex property, and asymptotic behavior at infinity. Adam is currently a Fullstack Web Developer in Charlotte, NC.

Ph.D. & MA Graduates with their advisors

Graduate Student Research

Research papers (UNCG students in bold)

Abraham Abebe

- **A. Abebe**, M. Chhetri, L. Sankar, and R. Shivaji, Positive solutions for a class of superlinear semipositone systems on exterior domains, *Boundary Value Problems*, 198, (2014).
- **A. Abebe**, M. Chhetri and R. Shivaji, Positive solutions for a class of multiparameter elliptic systems, to appear in *Dynamics of Continuous, Discrete, and Impulsive Systems, Series A*.

Jonathan Milstead

- C. Awtrey, N. Miles, **J. Milstead**, C. Shill, and E. Strosnider, Galois groups of degree 14 2-adic fields, *Involve* 8-2, (2015) 331–338.
- **Jonathan Milstead**, Sebastian Pauli, and Brian Sinclair, Constructing Splitting Fields of Polynomials over Local Fields, *Springer Proceedings in Mathematics & Statistics,* 109, (2015)101-124.

Danielle Moran

- Gregory C. Bell and **Danielle S. Moran,** On constructions preserving the asymptotic topology of metric spaces, *North Carolina Journal of Mathematics and Statistics*, 1, (2015) 46–57.

Quinn Morris

- R. Dhanya, **Q. Morris** and R. Shivaji, Existence of positive radial solutions for superlinear semipositone problems on the exterior of a ball, to appear in *Journal of Mathematical Analysis and Application.*

Catherine Payne

- Jerry Vaughan and **Catherine Payne**, Fibers of continuous real-valued functions on ψ-spaces, *Topology and Applications*, 195, (2015) 256-265.

Jeong Sep Sihm

- **Sihm, J. S.,** & Gupta, S., A two-stage binary optional randomized response model. *Communications in Statistics - Simulation and Computation,* 44 (9), (2015) 2278-2296.

Brian Sinclair

- Jonathan Milstead, Sebastian Pauli, and **Brian Sinclair**, Constructing Splitting Fields of Polynomials over Local Fields, *Springer Proceedings in Mathematics and Statistics,* 109, (2015) 101-124.
- Sebastian Pauli and **Brian Sinclair,** Enumerating Extensions of (π)-Adic Fields with Given Invariants, submitted.
- **Brian Sinclair**, Counting extensions of $\mathfrak{p}$-adic fields with given invariants, submitted.

Byungjae Son

- Eun Kyoung Lee, R. Shivaji and **Byungjae Son**, Positive radial solutions to classes of singular problems on the exterior domain of a ball, to appear in *Journal of Mathematical Analysis and Application.*

- R. Shivaji and **Byungjae Son**, Bifurcation and multiplicity results for classes of p, q Laplacian systems, to appear in *Topological Methods in Nonlinear Analysis*.

Nicholas Stewart
- Virginia C. Moser, **Nicholas Stewart**, Danielle L. Freeborn, James Crooks, Denise K. MacMillan, Joan M. Hedge, Charles E. Wood, Rebecca L. McMahen, Mark J. Strynar, and David W. Herr, Assessment of serum biomarkers in rats after exposure to pesticides of different chemical classes. *Toxicology and Applied Pharmacology*, 282, (2015) 161—174.

Robert Stoesen
- **Robert Stoesen**, Kristin McLamb, Laurie Deaton and Sat Gupta, Weight loss Through Bariatric Surgery: Some Issues, *Springer Proceedings in Mathematics & Statistics*, 109, (2015) 125-133.

Conference talks

Aida Briceño
- The Dynamics of Offensive Messages in the World of Social Media, The 10th Annual UNCG Regional Mathematics and Statistics Conference, University of North Carolina at Greensboro, November 2014

Ricky Farr
- On Non-Integer Stieltjes Constants and Fractional Differentiation, AMS Southeastern Sectional Meeting on November 9, 2014.

Dani Moran
- Groups as metric spaces, The 10th Annual UNCG Regional Mathematics and Statistics Conference, University of North Carolina at Greensboro, November 2014

Quinn Morris
- Some Results on Positive, Radial Solutions for Superlinear Problems, Wake Forest University Colloquium Talk, October, 2014
- Positive, Radial Solutions of Superlinear, Semipositone Problems. 2014 MSU Conference on Differential Equations & Computational Simulations, Mississippi State University, October, 2014.
- Positive, Radial Solutions of Superlinear, Semipositone Problems. 2015 Triangle Area Graduate Mathematics Conference, NC State University, March, 2015.
- Existence of positive, radial solutions for superlinear, semipositone problems on the exterior of a ball. 2015 AMS Western Sectional, Special Session on Nonlinear PDE and Variational Methods, University of Nevada at Las Vegas, April, 2015.

Catherine Payne
- Continuous Functions on Psi-spaces, AMS Southeastern Sectional Meeting, Greensboro, NC, November 9, 2014.

James Rudzinski
- Pilesize dynamic one-pile nim, The 10th Annual UNCG Regional Mathematics and Statistics Conference, University of North Carolina at Greensboro, November 2014

- Pilesize Dynamic One-Pile Nim and Beatty's Theorem, AMS Southeastern Sectional Meeting on November 9, 2014.

Jeong Sep Sihm
- A Modified Binary Optional RRT Model, AISC, Greensboro, NC, October 2014.

Brian Sinclair
- An Invariant for Extensions of p-adic Fields based on Residual Polynomials, SouthEast Regional Meeting on Numbers (SERMON) 2015 in Rock Hill, SC.
- Enumerating Extensions of p-adic Fields with Given Invariants, AMS Fall Southeastern Sectional Meeting in Greensboro, NC.
- Enumerating Extensions of p-adic Fields with Given Invariants, Palmetto Number Theory Series (PANTS) XXII in Orangeburg, SC.

Byungjae Son
- Bifurcation and multiplicity results for classes of p Laplacian equations, Spring Western Sectional Meeting, University of Nevada, April 2015
- Bifurcation and multiplicity results for classes of p Laplacian equations, Triangle Area Graduate Mathematics Conference, North Carolina State University, March 2015
- Bifurcation and multiplicity results for classes of p Laplacian equations, AMS Fall Southeastern Sectional Meeting, University of North Carolina at Greensboro, November 2014
- Bifurcation and multiplicity results for classes of p Laplacian equations, 10th Mississippi State Conference on Differential Equations and Computational Simulations, Mississippi State University, October 2014

Arpad Szarka
- Cumulative Risk Assessment: US and EU Methodological Approaches, International Society of Exposure Science Conference, Cincinnati, OH, October 2014.
- Cumulative Exposure: What we know and what we need to know, OpenTox USA conference, Baltimore, MD, February 2015.

Conferences, Workshops, Summer Schools attended

Lance Everhart
- The 10th Annual UNCG Regional Mathematics and Statistics Conference, University of North Carolina at Greensboro, November 2014
- UNCG Summer School in Computational Number Theory 2015

Ricky Farr
- UNCG Summer School in Computational Number Theory 2015

Paula Hamby
- Building Bridges 2nd EU/US Summer School and Workshop on Automorphic Forms.

Jonathan Milstead
- The 10th Annual UNCG Regional Mathematics and Statistics Conference, University of North Carolina at Greensboro, November 2014
- UNCG Summer School in Computational Number Theory 2015

Catherine Payne
- 10th Mississippi State Conference on Differential Equations and Computational Simulations during October 23-25, 2014.

James Rudzinski
- UNCG Summer School in Computational Number Theory 2015

Jeong Sep Sihm
- The 10th Annual UNCG Regional Mathematics and Statistics Conference, University of North Carolina at Greensboro, November 2014

Brian Sinclair
- UNCG Summer School in Computational Number Theory 2015

Byungjae Son
- 6th Symposium on Analysis and PDEs, Purdue University, June 2015 (Accepted for participation)
- Triangle Area Graduate Mathematics Conference, North Carolina State University, March 2015
- AMS Fall Southeastern Sectional Meeting, University of North Carolina at Greensboro, November 2014
- The 10th Annual UNCG Regional Mathematics and Statistics Conference, University of North Carolina at Greensboro, November 2014

Arpad Szarka
- Symposium organizer "Pesticide Exposure and Risk Assessment." ISES, Cincinnati, OH, October 2014.

Chris Vanlangenberg
- The 10th Annual UNCG Regional Mathematics and Statistics Conference, University of North Carolina at Greensboro, November 2014

Stephanie Webster
- UNCG Summer School in Computational Number Theory 2015

Awards and Recognition

Ricky Farr

- The Helen Barton Scholarship

Paula Hamby
- Mary D. Murray Scholarship in Mathematics

Catherine Payne
- The Helen Barton Scholarship
- The Cornelia Strong Scholarship
- Dr. Theresa Phillips Vaughan Math Scholarship

Byungjae Son
- The Helen Barton Scholarship

Nicholas Stewart
- Graduate School Summer Research Award

Graduate Student Recruiting Efforts

Graduate Recruitment event at AMS meeting in San Antonio

In 2014-2015, the department actively sought to recruit talented new students to our PhD and MA programs. In addition to sending information packets to many universities, we made campus visits to Wake Forest University, Winthrop University, NC A&T, Kennesaw State University, and Georgia Southern University.

We also had recruitment tables at the Joint Meetings of the AMS and MAA in San Antonio, the AMS Fall Sectional Meeting in Greensboro, the 10th annual RMSC in Greensboro, the NIMBioS Undergraduate Research Conference in Knoxville, and the MAA Southeastern Sectional Meeting in Wilmington, after which we sent more than 90 follow-up emails to the students that we visited with.

Finally, we met with students involved in the UNCG Math-Bio REU and students involved with the NREUP program to discuss our graduate programs.

Graduate Recruitment event at the MAA meeting in Wilmington

The department made great strides in increasing the number and quality of applications to our programs. In Fall 2014 we experienced a surge of applications to the PhD program and the increase in the number of admits is indicative of an increase in quality.

	Fall 2012	Fall 2013	Fall 2014	Fall 2015
PhD Apps	15	11	23	16
MA Apps	15	17	20	17
PBC Apps	1	2	3	2
Admits	14	15	15	29
Offers	7	5	9	8
Joined	8	7	8	7

Graduate Tea

In Spring 2015, the department hosted a Graduate Student Tea. This year we hosted Associate Dean Denise Baker from the College of Arts and Sciences. Associate Dean Baker's office determines allocations of graduate assistantships and waivers within the College.

Associate Dean Denise Baker at the 2014 Fall Graduate Tea

As in past years, this gathering was informal with no set program. Instead it served as a time for the faculty and graduate students to mingle and network in a stress-free environment.

2015 Spring Graduate Tea

Proposed New Concentrations

In an effort to increase interest in our MA program, the department has begun to investigate creating four new concentrations within that degree program. We will also begin to offer many graduate courses in mathematics later in the day, to make pursuing an MA degree more attractive to part-time students.

Concentration in Biomathematics

Biomathematics refers to research on the edge of mathematics and biology. In particular it provides the opportunity for powerful mathematical tools to be applied to problems in life sciences. This concentration will prepare students for careers as mathematicians in life sciences, such as health care, medical research, public health, and pharmaceutics. The combination of training in mathematics and statistics, a life science and computer science will afford them the flexibility to conduct quantitative research in life sciences of their choosing and make them employable in the respective industries.

The concentration is targeted towards students with a background in mathematics, statistics, biology, chemistry, or computer science, who want to pursue a career as a mathematician in areas related to biology.

Concentration in Teaching College Mathematics

The MA in Mathematics with Concentration in Teaching College Mathematics will prepare students to be mathematics teachers at the community college or university level. Throughout the southeastern United States, accredited colleges require teachers to have 18 graduate-level hours in the discipline. This program will provide these 18 hours of graduate-level mathematics training while giving students the flexibility to enrich their career by taking courses in pedagogy, educational research, and higher education. Historically, many of the department's MA graduates pursue careers in teaching at the college level (with some student leaving the program after having completed the 18-hour requirement). We hope by adding the flexibility of taking coursework in teaching-related disciplines we will attract

students to the degree and retain them to the completion of the degree. Every effort will be made to offer graduate-level MAT courses at times that are accommodating to part-time evening students.

The MA in Mathematics with Concentration in Teaching College Mathematics is intended for students wishing to pursue a career in teaching at the community college level. This 34-hour concentration includes at least 18 graduate-level semester hours of mathematics courses and as many as 16 semester hours devoted to education and pedagogy. Graduates with this concentration will not only be competent mathematicians, but they will also have the confidence to step into a classroom immediately upon graduation.

Concentration in Actuarial Mathematics

Haimeng Zhang helps with preparation for an Actuarial Math Professional Exam

Actuaries are professionals who analyze financial risk of future events. It demands a substantial training in mathematics, statistics, economics, and finance so that actuaries can quantify these risks by building and evaluating mathematical/statistical models. To attain professional standing as an actuary requires successful completion of a sequence of examinations offered by the Society of Actuaries and the Casualty Actuarial Society. This program is designed to prepare students for employment in the actuarial field by offering coursework related to the preliminary actuarial examinations while providing actuarial related educational experience.

The target student population for this program will be students with a bachelor's degree in mathematics, statistics, economics, finance or a related field who want to pursue an actuarial career, as well as students with experience in the actuarial industry who want to advance their career. Students in the accelerated degree programs in mathematics will also find this option attractive.

Concentration in Data Analytics

Big data arise in many fields due to the development of high-technology. Therefore, Big Data Analytics Master's Degrees are needed to close the big-data talent gap in current big-data world. Our data analytics concentration is a single integrated course of study and designed to produce a well-rounded analytics professional. The Program has a practical orientation by training students for tackling genuine analytics problems with most recent real data using leading tools.

The program is for students who have a bachelor's degree in mathematics, statistics, computer sciences or quantitative business fields who want to pursue an analysis career, as well as working professionals who want to advance their career.

Proposed Changes to Qualifying Exams

In September 2014, the Department's Graduate Studies Committee met to review our PhD degree requirements in an effort to ensure alignment with the Graduate School's requirements and to ensure that they function as intended for our students. The committee decided to propose the following changes.

Under the current regulations, students must choose one exam from Group I, students **must** pass three exams before the start of their fifth semester, and students may make no more than five total attempts to pass these exams.

Group I Exams	Group II Exams		
Algebra	Combinatorics /Graph Theory	Mathematical Statistics	Topology
Analysis	Design and Sampling	Numerical Mathematics	
Linear Algebra	Differential Equations	Number Theory	

The committee's recommended changes will better align our program with the Graduate School's suggested timeline, enable the department to offer more diverse courses, and allow incoming students to take courses that better align with their research interests.

Group I shall be expanded to the following four courses and renamed to "Qualifying Exams." The corresponding courses shall be offered each year.

Proposed Qualifying Exams	
Algebra	Analysis
Linear Algebra	Mathematical Statistics

Each student shall be required to pass two qualifying exams before the beginning of their third semester in the program. Exams shall be offered in May (within one week of the end of term) and in August (one week prior to term). Students who do not pass two qualifying exams before their third semester shall be placed on probationary status and their funding may be revoked.

The graduate school requires students to submit a Plan of Study, which includes forming a dissertation committee, once they've earned 18 semester hours. Students shall form this committee and with the consultation of the dissertation advisor and committee, the student shall pass a written exam in an appropriate subject selected by the committee. This exam shall be called the preliminary exam, as required by the graduate school. Unanimous approval of the committee is required for the student to pass the preliminary exam. This exam need not be tied to a specific course.

The written portion of the preliminary exam must be passed prior to the start of the student's fourth year (seventh semester), which will better align with the Graduate School's requirement that this exam take place after 75% of the coursework for the degree has been completed.

Passing this exam and the oral topic defense are required for the student to apply for candidacy and begin to take dissertation hours.

9.   Funding Opportunities for Students

Departmental Scholarships

Each year, we award thousands of dollars of scholarships resulting from gifts from our many generous donors. These are open to math majors and graduate students.

- 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

2014-2015 Scholarship Recipients

- **Helen Barton Scholarship**:
  Ricky Farr, Catherine Payne, Byungjae Son
- **Ione Holt Grogan Scholarship**:
  Ryan Dickerson, David Suarez
- **Vicky Martin Langley Math Scholarship**:
  Thomas Woosley
- **Judith L. Mendenhall Scholarship**:
  Stephanie Webster
- **Mary D. Murray Scholarship in Mathematics**:
  Paula Hamby
- **Eldon E. and Christine J. Posey Scholarship**: Aaron Lee

- **Cornelia Strong Scholarship**:
  Catherine Payne
- **Dr. Theresa Phillips Vaughan Math Scholarship**:
  Catherine Payne
- **Bertha Barnwell Vielhauer Endowed Scholarship**:
  David Suarez, Stephanie Webster, Thomas Woosley

Undergraduate Research Scholarships

The Department of Mathematics and Statistics is offering Undergraduate Research Awards to any undergraduate student majoring in mathematics or a related area that contributed to a research program of a Mathematics and Statistics faculty member. The award comes as $500 stipend that can be earned multiple times for clearly defined projects. This opportunity is currently being provided via the Helen Barton Excellence Professorship funds. In Fall 2014, Ana Paula Tognasoli worked with Jan Rychtář on the project "Game-Theoretical Model of Oviposition Site-Selection of Gravid Female Mosquitoes" and successfully completed all the requirements for the URAMS award by presenting during the AISC 2014 conference.

David Sykes explaining his research results

Graduate Assistantships

Many of our graduate students work as Graduate Teaching Assistants. 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:

TA Quinn Morris lecturing

• $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 2014–15 academic year, we funded 13 full-time Ph.D. Students and eight full-time MA students through Graduate Assistantships. We also provided partial funding to one student in computer science.

Math Emporium

**TA Catherine Payne lecturing at the
Math Emporium**

2014-15 Graduate Teaching Assistants

PhD Students		MA Students	
Aida Briceño	Wei Chen	Cassandra Brownell	Lance Everhart
Paula Hamby	Matthew Jester	Austin Lawson	Bin Luo
Jonathan Milstead	Quinn Morris	Joshua Martin	Qi Zhang
Catherine Payne	James Rudzinski	Tyler Wendell (CS)	
Jeong Sep Sihm	Nicholas Stewart	Padmaja Reddy (CS)	
Byungjae Son	Chris Vanlangenberg		
Tanja Zatezalo			

Other Scholarships

- STAMPS (Science, Technology and Math Preparation Scholarships) awards of approximately $7000 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.
- Project ENRICH is a program in the UNCG School of Education that partners local teachers with students interested in becoming science or math teachers in K-12 education through a teacher residency program.
- 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.

10. Mathematics Education Program

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), MAT 406 (Foundations of Mathematics for Teaching II), and MAT 465 (Student Teaching and Seminar – Secondary Mathematics). 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) for master's students and for mathematics majors.

In addition to the specific courses listed above, we also teach 100-level mathematics courses (College Algebra, Precalculus I and II, 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 seeking teaching licensure in secondary mathematics must complete all requirements for a BA in mathematics, including all general education and College of Arts and Sciences requirements, in addition to completing MAT 330, MAT 405, MAT 406, 12 hours of professional education coursework (in the School of Education), 100 hours of internship in local high schools, and a final semester of student teaching (MAT 465). The last page of this report presents the details of the program of study. Students must maintain a 3.0 overall GPA to enter teacher education and also must maintain a 2.5 GPA in mathematics to qualify for student teaching. At the end of their program of study, students 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 2015 Drs. Seaman and Howell made presentations of their work at the national conference of the Research Council on Mathematics Learning in Las Vegas NV.

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. 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. Howell and Dr. Seaman are co-conference chairs for the 2015 Annual Conference of NCCTM and Dr. Howell served in the same capacity for the 2014 NCCTM Conference.

We support several activities of the NCCTM that are designed for middle grades and secondary mathematics students within North Carolina. Every year we host the central region of the State Math Test at UNCG, providing local support for the event, including the help of our undergraduate pre-service teachers. Additionally, we participate in the State Math Fair held each year in Raleigh.

In the 2013-2014 year, Dr. Seaman partnered with Dr. Holt Wilson and Dr. Kerri Richardson of the department of Teacher Education and Higher Education to write a grant proposal entitled *Core-Math III: Supporting Teachers in Using Learning Trajectories to Implement the Common Core State Standards in Mathematics,* which was funded through the NC Quest state grant program. In 2014-2015 Dr. Seaman served as mathematics consultant for the 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 meets 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 2014–SPRING 2015

Sponsored by:
The Department of Mathematics and Statistics

Speakers

Dan Zelterman (Yale University)
Statistical Inference for Familial Disease Clusters
October 17, 2014 at 4:00 pm in Petty 219
Refreshments at 3:30 pm in Petty 116

Hoon Hong (North Carolina State University)
Root Separation Bounds
February 4, 2015 at 4:00pm, TBA
Refreshments at 3:30 in Petty 116

Jerrold R. Griggs (University of South Carolina)
Poset-free Families and Poset Packing in the Boolean Lattice
February 20, 2015 at 4:00 pm, TBA
Refreshments at 3:30 in Petty 116

Michael Dorff (Brigham Young University)
How Mathematics is Making Hollywood Movies Better
March 5, 2015 at 4:00 pm, TBA
Refreshments at 3:30 pm in Petty 116

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

For abstracts and further information see http://www.uncg.edu/math/talks.

THE UNIVERSITY *of* NORTH CAROLINA
GREENSBORO
Department of Mathematics & Statistics

Helen Barton Lecture Series in Mathematical Sciences

Dr. Suzanne Lenhart

Professor of Mathematics
University of Tennessee

The Power of Optimal Control in Biological Models

Lecture 1: Introduction to Optimal Control of Ordinary Differential Equations

Monday, April 13, 2015
Reception: Lounge, Petty 116, 3:30-4:00 PM
Lecture: Petty 150, 4:00 PM

This talk will present the basic ideas underlying optimal control of ordinary differential equations. Source terms or rate coefficients in the differential equations are taken as control functions to be adjusted to achieve a specified goal. Following a simple case from Pontryagin's Maximum Principle, the technique for finding 'an optimal control' will be presented. Some illustrative examples will be shown.

Lecture 2: Optimal Control of Systems of ODEs for Biological Systems

Tuesday, April 14, 2015
Reception: Lounge, Petty 116, 3:30-4:00 PM
Lecture: Petty 150, 4:00 PM

This talk extends the introduction of optimal control to systems of ODEs. Cases with the linear and nonlinear dependence on the controls will be compared. Examples of management strategies in infectious disease models will be shown.

Lecture 3: The Power of Optimal Control in Discrete Models: from Confining Rabies to Improving CPR

Wednesday, April 15, 2015
Reception: Lounge, Petty 116, 3:30-4:00 PM
Lecture: Petty 150, 4:00 PM

This talk will present optimal control of discrete time models with two main examples. The first example involves difference equations that model cardiopulmonary resuscitation. The goal is to design an external chest and abdomen pressure pattern to improve the blood flow in the heart in standard CPR procedure. The second example is an epidemic model for rabies in raccoons on a spatial grid. The goal is to find the optimal distribution pattern for vaccine baits to slow the spread of the disease.

Suzanne Lenhart is a Chancellor's Professor of Mathematics the University of Tennessee, Knoxville, and is the Associate Director for Education and Outreach at the National Institute for Mathematical and Biological Synthesis (NIMBioS, funded by the National Science Foundation). She is currently also a Faculty Fellow of the University of Tennessee Center for Business and Economic Research and a member of the UT Center for Wildlife Health. She was a part-time member of the research staff at Oak Ridge National Laboratory for 22 years.

Dr. Lenhart is an applied mathematician working in partial differential equations, ordinary differential equations and optimal control. Her current research focuses on population models with applications in infectious diseases, invasive species, and natural resources.

She has authored more than 140 journal articles, as well as 3 books, including *Optimal Control applied to Biological Models* and *Mathematics for the Life Sciences*. She was elected to the Board of Trustees of the Society for Industrial and Applied Mathematics (SIAM) in 2004 and again in 2007. She is a fellow of the American Mathematical Society, the American Association for the Advancement of Science and SIAM.

Dr. Lenhart has extensive education and outreach experience. She directed the Research Experiences for Undergraduates program in the Department of Mathematics for 15 years and now directs such a program at NIMBioS since 2009. She was President of the Association for Women in Mathematics (AWM) in 2001-2003. She has worked with the Bearden High School Math Club since 2002.

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

11.2 Colloquia

Peter Zvengrowski	University of Calgary, Canada	9/15/2014	Quadratic Residues, Hadamard Matrices, and Avalanches in the Lake Louise Area
Henry Adams	Duke University	10/20/2014	Introduction to Persistent Homology and the Vietoris-Rips Complex of the Circle
Lalitha Venkataramanan	Schlumberger-Doll Research	10/29/2014	Some Applied Math Problems of Interest at Schlumberger-Doll
J. David Harris	Laboratory for Analytic Sciences	2/11/2015	The Laboratory for Analytic Sciences: Reflect. Observe. Imagine.
John Adam	Old Dominion University	2/23/2015	Rays, Waves and Rainbows: A brief tour through mathematical physics!
Tom Trotter	Georgia Tech	2/25/2015	Graphs and Posets: Analogies and Contrasts
Pankaj Joshi	Tata Institute of Fundamental Research, India	4/20/2015	Predictions of General Relativity: Big Bang, Black Holes, and Naked Singularities

11.3 External Seminar Speakers

Mauricio Rivas	Wake Forest University	9/22/2014	Linear Elliptic Eigenproblems and Observing Infinite-dimensional Dynamics
Yuh-Lang Lin	North Carolina A&T	9/23/2014	Recent Advances and Future Challenges in Hurricane Prediction

Harish Chintakunta	North Carolina State University	9/24/2014	Some applications of Toplogy
Lakshmi Shankar	University of West Bohemia, Czech Republic	9/29/2014	Infinite semipositone problems on unbounded domains
Sarath Sasi	University of West Bohemia, Czech Republic	10/6/2014	On the radial asymmetry of the second eigenfunctions of the p-Laplacian on a ball
Anoop Veetil	University of West Bohemia, Czech Republic	11/3/2014	On the Fredholm alternative for the p-Laplacian
Haluk Sengun	University of Sheffield, United Kingdom	11/10/2014	Modular Forms and Elliptic Curves over Number Fields
Cody Lorton	Wake Forest University	11/10/2014	An Efficient Numerical Method for Acoustic Wave Scattering in Random Media
Maurizio Monge	Universitade Federal do Rio de Janerio, Brazil	11/12/2014	Extensions of degree p^2 and p^3 of p-adic fields
Louis Fan	University of North Carolina Chapel Hill	1/26/2015	Reflected diffusions with partial annihilations on a membrane
Jonathan Sands	University of Vermont	2/9/2015	Quaternion Algebras and Zeta Functions
Emily Griffith	North Carolina State University	3/4/2015	Adventures in Quality Control: Assessing System Suitability in Liquid Chromatography-Tandem Mass Spectrometry
Bevin Maultsby	University of Minnesota	3/18/2014	1:2 Resonance in Langmuir Circulation
Rodrigo Hernández-Gutiérrez	University of North Carolina Charlotte	3/20/2015	The proximal game for topological spaces

Paul Gunnells	University of Massachusetts Amherst	4/17/2015	Galois representations, automorphic forms, and cohomology
Liping Liu	North Carolina A&T	4/27/2015	Mathematical Analysis for CO-Mediated Sickle Cell De-Polymerization

11.4 UNCG Seminar Speakers

Lance Everhart	UNCG	9/10/2014	SL_2(O_K)
Jonathan Milstead	UNCG	10/1/2014	G-relative H-invariant
David Barron	UNCG	10/8/2014	ECM (Elliptic Curve Method)
James Rudzinski	UNCG	10/15/2014	Pilesize Dynamic One-pile Nim
Ricky Farr, James Rudzinski, Brian Sinclair	UNCG	11/5/2014	3 short talks (Ricky Farr: On Non-integer Stieltjes Constants and Fractional Differentiation; James Rudzinski: Pilesize Dynamic One-Pile Nim and Beatty's Theorem; Brian Sinclair: Enumerating Extensions of p-adic Fields with Given Invariants)
Lance Everhart	UNCG	11/19/2014	Generators of Hilbert Modular Groups and Cusps
Brian Sinclair	UNCG	3/4/2015	Enumerating Invariants and Extensions of Local Fields
Quinn Morris	UNCG	3/16/2015	An Introduction to Variational Methods
Talia Fernos	UNCG	3/25/2015	CAT (0) cube complexes are cool

Susan Walcott	UNCG	4/8/2015	Statistics Seminar
Xiaoli Gao	UNCG	4/22/2015	Statistics Seminar

11.5 Research Visitors

Research Visitor	Institution	Dates Visited	Host
Lakshmi Sankar	University of West Bohemia, Czech Republic	9/10-11/10/2014	Ratnasingham Shivaji
Sarath Sasi	University of West Bohemia, Czech Republic	9/10-11/10/2014	Ratnasingham Shivaji
Anoop Veetil	University of West Bohemia, Czech Republic	9/10-11/10/2014	Ratnasingham Shivaji
Pavel Drabek	University of West Bohemia, Czech Republic	10/31-11/10/2014; 4/26-5/3/2015	Ratnasingham Shivaji & Maya Chhetri
Jerome Goddard	Auburn University of Montgomery	9/28-9/29/2014; 2/19-2/20/2015	Ratnasingham Shivaji
Eunkyung Ko	Seoul National University, South Korea	10/14-10/22/2014	Ratnasingham Shivaji
Inbo Sim	University of Ulsan, South Korea	10/17-10/22/2014	Ratnasingham Shivaji
Haluk Sengun	University of Sheffield, United Kingdom	11/8-11/13/2014	Dan Yasaki
Paul Gunnells	University of Massachusetts	4/15-4/19/2015	Dan Yasaki
Jonathan Sands	University of Vermont	1/19-5/15/2015	Brett Tangedal
David Ford	Concordia University, Montreal, Canada	3/16-3/20/2015	Sebastian Pauli
Frederick Johansson	INRIA Bordeaux-Sud Ouest, Bordeaux, France	5/23-5/29/2015	Sebastian Pauli
Peter Girg	University of West Bohemia, Czech Republic	6/4-7/6/2015; 12/6-12/21/2014; 6/11-7/2/2014	Maya Chhetri
Mark Broom	City University London, United Kingdom	4/19-4/25/2015	Jan Rychtář

Michal Johanis	Charles University Prague, Czech Republic	7/27/14-8/7/2014	Jan Rychtář
Chunfeng Huang	Indiana University, Bloomington	5/30-6/3/2015; 11/21-24/2014; 7/26-7/30/2014	Haimeng Zhang
Tom Trotter	Georgia Tech	2/24-2/28/2015	Clifford Smyth
Jerrold Griggs	University of South Carolina	2/19-2/21/2015	Clifford Smyth

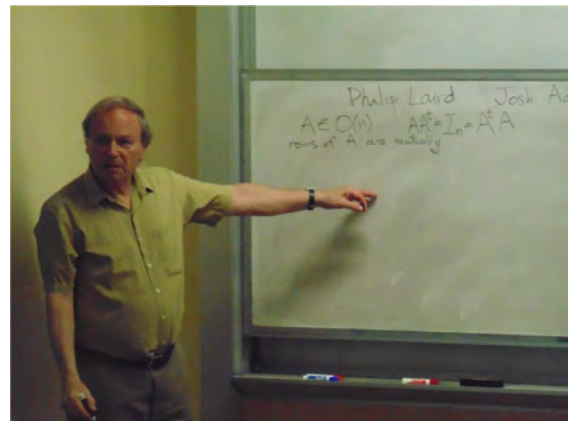## Some research visitors from the 2014–2015 academic year

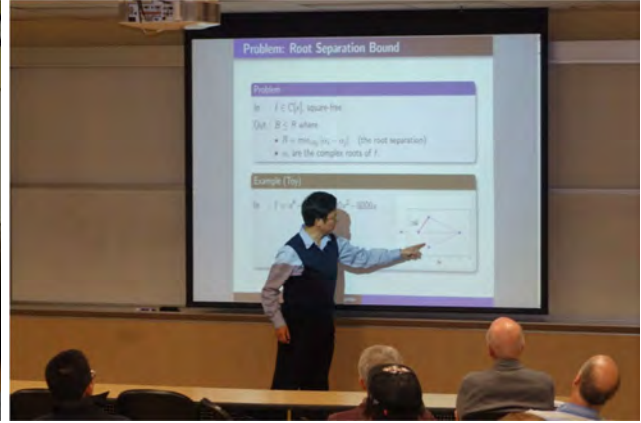**Dan Zelterman, Yale University**

Jerrold Griggs, University of South Carolina

Suzanne Lenhart, University of Tennessee

Peter Zvengrowski, University of Calgary, Canada

**Lalitha Venkataramanan,
Schlumberger Doll Research, Boston**

Hoon Hong, North Carolina State University
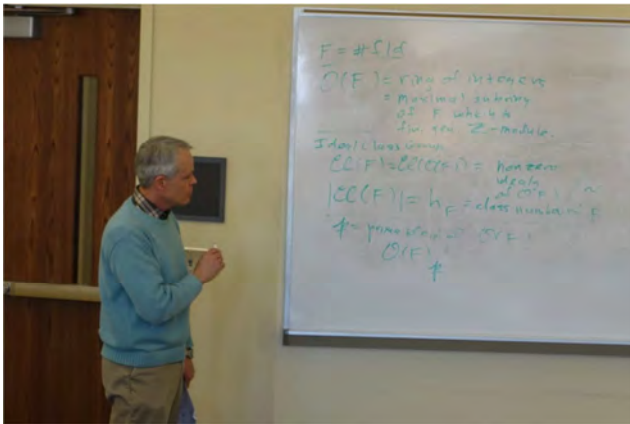
Jonathan Sands, University of Vermont

John Adam, Old Dominion University

Tom Trotter, Georgia Institute of Technology

**Pavel Drabek, University of West Bohemia
Czech Republic**

11.6 Carolina Topology Seminar

The Carolina Topology Seminar is a research seminar devoted to topics in topology and its applications that are 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 at other universities and colleges 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 participants are posted on http://www.uncg.edu/~vaughanj/topseminar.html

12. Service Profile

12.1 Math Help Center Services

Math Help Center

Math Help Center, located in Curry 210, provides services to UNCG students enrolled in 100-level MAT and STA courses as well as MAT 253, 292, 293, 310, 311, 390, 394 and STA 271/290. This is a free and walk-in service open Monday/Wednesday 9am-3pm and 5pm-7pm, Tuesday/Thursday 9am-7pm and Friday 9am-1pm. In addition to this tutoring service, MHC also arranges **Review Sessions** for 100-level courses upon the request of course coordinators.

**Maya Chhetri,
Director of Math
Help Center**

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 2014	**Spring 2015**
1. 11 Graduate Teaching Assistants tutored in Math Help Center and some of them conducted review sessions before mid-term exams.	1. 12 GTAs tutored in Math Help Center and some of them conducted either weekly review sessions or before mid-term exams.
2. 1156 student visits were recorded in MHC.	2. 1381 student visits were recorded in MHC.
3. 13 undergraduate students helped instructors in their classes.	3. 12 undergraduate students helped instructors in their classes.

12.2 Math Emporium Report

Math Emporium

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 white-boards), a Prometheum ActivBoard (an interactive whiteboard) and a Prometheum ActivExpression response system (a student response system that produces real-time

Maya Chhetri, Director of Math Emporium

results). (Taken from UNCG IT news). Math Emporium courses (WLL marker) get the priority for lab reservation even though it is open for all. Students in this 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 2014 – 159 students in MAT 115 (WLL), 91 students in MAT 150 (WLL) and 93 students in MAT 151 (WLL) took the final exam

Spring 2015 – 176 students in MAT 115 (WLL), 82 students in MAT 150 (WLL) and 75 students in MAT 151 (WLL) took the final exam.

12.3 Statistical Consulting Center

Highlights

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

Scott Richter, Director of Statistical Consulting Center

- 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 and student consultants assisted researchers from many disciplines across campus, including: Biology, Chemistry and Biochemistry, Communication Sciences and Disorders, Computer Science, Education, Educational Research Methodology, Genetic Counseling, Human Development and Family Studies, Marketing, N

Sat Gupta with students in the Consulting Center

utrition, Psychology, Public Health Education and Sociology.
- Faculty and student consultants assisted researchers affiliated with several off-campus entities, including Division of Medical Assistance (NC), Moses-Cone Health System, Alamance Regional Medical Center, Apex Analytics, University of Sunshine Coast, and LPL Financial.
- 11 students enrolled in STA 667 and worked with faculty consultants to complete graduate research projects.
- Eight manuscripts appeared in 2013-14 stemming from SCC collaborations, and three others were submitted.

Quantitative Methodology Series
Summer 2015 - May 19 & 21

Co-Sponsored by: Statistical Consulting Center, Department of Mathematics and Statistics; Office of Assessment, Evaluation and Research Services, Department of Educational Research Methodology

Tuesday, May 19th
9:00 AM - 12:30 PM, Petty 219
Data Cleansing and Manipulation

This workshop will cover techniques for finding erroneously entered raw data and recoding/reformatting data so it can be used in statistical procedures. Instruction will include advanced use of Microsoft Excel and introductions to using SAS and SPSS for these tasks.

Prerequisites: Familiarity with Microsoft Excel or a similar spreadsheet application.

Instructor: Mark Dixon,
UNCG Information Technology Services

1:30 PM - 5:00 PM, Petty 219
Introduction to R for Data Analysis

Hands on introduction to using the R language for statistical analysis for those with little or no experience.

Prerequisites: No previous experience using R is required. Participants must have a laptop with wireless internet acesss, able to install and run the R program.

Instructor: Scott Richter,
UNCG Statistical Consulting Center

Thursday, May 21st
9:00 AM - 5:00 PM, Petty 219
Regression Analysis

Designed to deepen and expand understanding of linear regression modeling. The workshop will cover basics of simple and multiple linear regression, with emphasis on topics commonly encountered in research. Emphasis will be on practical issues to help researchers better apply regression analysis to address their research questions and better understand and report their results.

Prerequisites: Familiarity with material typically covered in an introductory statistics course, including graphical displays, mean and standard deviation, normal distributions, t-tests and confidence intervals and simple linear regression.

Instructor: Scott Richter
UNCG Statistical Consulting Center

For more information and to register, go to: https://workshops.uncg.edu

- Faculty consultants were involved as co-investigators in three interdisciplinary grant submissions to the National Institutes of Health, as well as on two continuing projects, including the NIH-funded 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.
- The Quantitative Methodology Series (QMS), a joint effort between the SCC and the Office of Assessment, Evaluation and Research Services in the School of Education, was created. Three workshops were created and offered to the UNCG campus community, and work on developing additional workshops was begun.

**Scott Richter with students
in the Consulting Center**

Goals for 2015-16
In addition to continuing active collaborations with researchers and UNCG and beyond, the SCC plans to continue developing offering regular QMS workshops. 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.

12.4 State Math Contest

State Math Contest Winners April 2015

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.

State Math Contest Winners April 2015

On Thursday, April 30, 2015, the Department of Mathematics and Statistics hosted the Central Region State Mathematics Contest Finals. Fifty-nine students from middle schools and high schools participated in one of three levels. Sixteen students competed in Level 1, 21 students competed in Level 2, and 22 students completed in Level 3. 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.

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State Math Contest Winners April 2015

13. Collaboration with the Institute for Mathematics and its Applications (IMA)

IMA participation- UNCG is a participating institution member of the Institute for Mathematics and its Applications (IMA: http://www.ima.umn.edu/) at Minnesota since January 2012. 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. Our faculty and students have greatly benefited in participating in IMA events.
For more information, see the website http://www.ima.umn.edu

Descriptions of faculty and students who have participated in IMA events this academic year.

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.
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

Greg Bell at IMA

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.

In 2015 Greg also attended the IMA Special Workshop: Careers and Opportunities in Industry for Mathematical Scientists in April of 2015. This workshop was aimed at graduate students and post-doctoral students in the mathematical sciences with an interest in exploring careers in industry. Faculty were also invited to learn how to improve their students' success in finding careers in industry. Throughout the three-day workshop, industrial representatives from Boeing, Schlumberger-Doll, ExxonMobil, Boston Scientific, Target, and others shared their experiences and anecdotes about working in industry. Additionally, student participants were advised on resume preparation and networking. Faculty at the workshop met with a panel of faculty who have been successful in placing students and postdocs in internships and careers.

Clifford Smyth, Associate Professor, Department of Mathematics & Statistics
Clifford Smyth attended a Probabilistic and Extremal Combinatorics workshop at the IMA and was able to make and renew a dozen mathematical contacts. Through networking he was able to gain very valuable directions and cues for his research that he would not have been able to get any other way.

Xiaoli Gao, Associate Professor, Department of Mathematics & Statistics
Thanks to the sponsorship by IMA, Xiaoli Gao had a chance to attend the Big Data workshop organized by IMA and The Hong Kong University of Science and Technology (HKUST) from January 5 to 16, 2015. The program brought together a number of prominent researchers in Statistics, Computer Science, and Applied Mathematics with interests in big data from all over the world.

Byungjae Son, PhD Student, Department of Mathematics & Statistics
Byungjae participated in the 6th symposium on Analysis and PDEs at the IMA in 2015. One of main topics was free boundary problems. It was a great opportunity for Byungjae to learn and interact with PDE researchers and students from other IMA institutions.
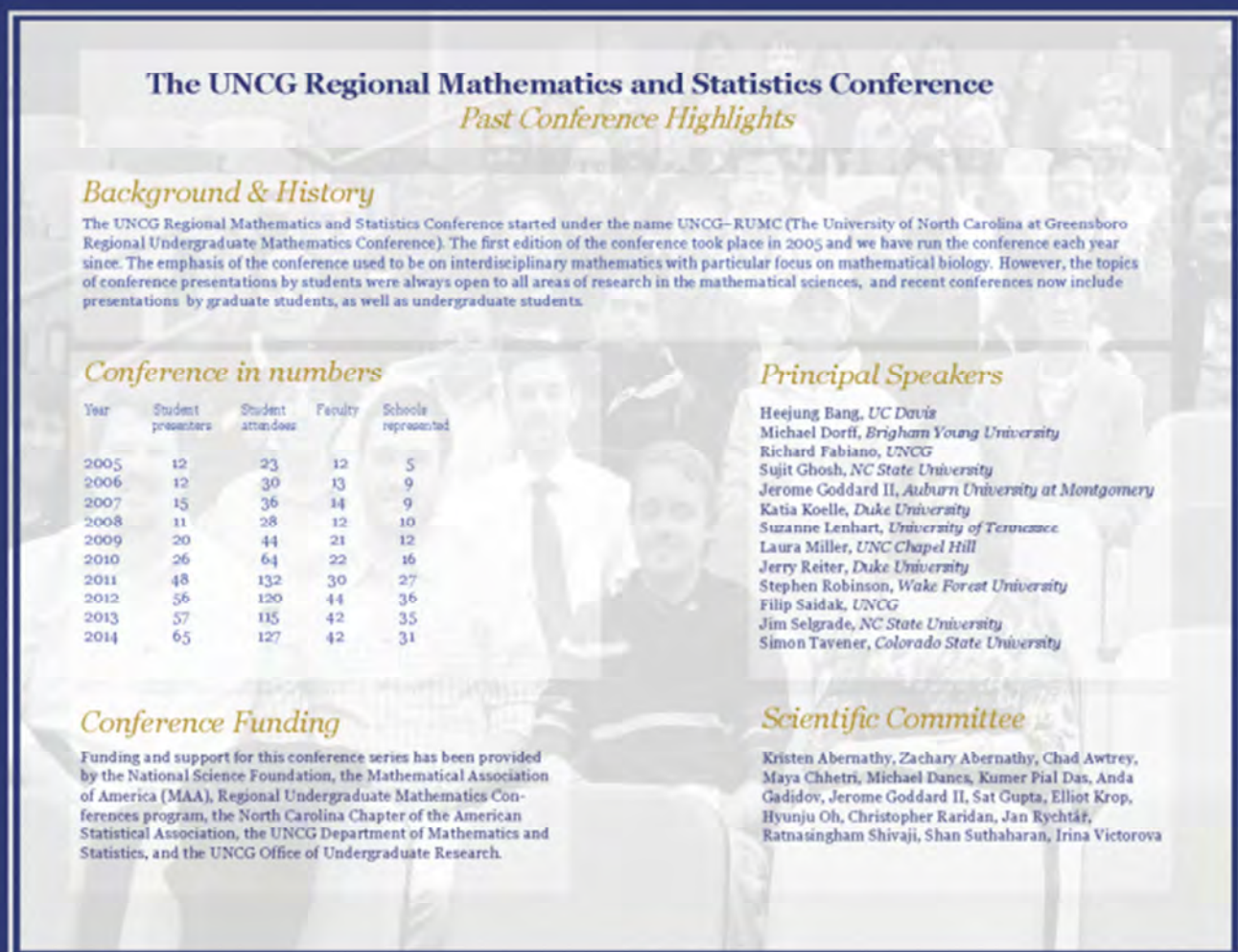

James Rudzinski, PhD Student, Department of Mathematics & Statistics
James Rudzinski attended the IMA Special Workshop on Careers and Opportunities in Industry for Mathematical Scientists from April 20-22, 2015. The workshop provided insights into the current mathematical needs in various industrial sectors. James attended talks by mathematicians employed at major industry leaders including ExxonMobil, Boeing, and Merck. After the first portion of the workshop there were additional sessions about preparing resumes, interviewing, and communicating research. James was very fortunate to have the opportunity to explore diverse mathematical careers. Learning about important applications and the types of mathematics that are important in the corporate world was especially enlightening.
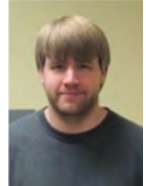
14. UNCG Math/Stat Conferences

14.1 UNCG Regional Mathematics and Statistics Conference

The UNCG Regional Mathematics and Statistics Conference
Past Conference Highlights

Background & History

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 presentations by students were always open to all areas of research in the mathematical sciences, and recent conferences now include presentations by graduate students, as well as undergraduate students.

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
2014	65	127	42	31

Principal Speakers

Heejung Bang, *UC Davis*
Michael Dorff, *Brigham Young University*
Richard Fabiano, *UNCG*
Sujit Ghosh, *NC State University*
Jerome Goddard II, *Auburn University at Montgomery*
Katia Koelle, *Duke University*
Suzanne Lenhart, *University of Tennessee*
Laura Miller, *UNC Chapel Hill*
Jerry Reiter, *Duke University*
Stephen Robinson, *Wake Forest University*
Filip Saidak, *UNCG*
Jim Selgrade, *NC State University*
Simon Tavener, *Colorado State University*

Conference Funding

Funding and support for this conference series has been provided by the National Science Foundation, the Mathematical Association of America (MAA), Regional Undergraduate Mathematics Conferences program, the North Carolina Chapter of the American Statistical Association, the UNCG Department of Mathematics and Statistics, and the UNCG Office of Undergraduate Research.

Scientific Committee

Kristen Abernathy, Zachary Abernathy, Chad Awtrey, Maya Chhetri, Michael Danes, Kumer Pial Das, Anda Gadidov, Jerome Goddard II, Sat Gupta, Elliot Krop, Hyunju Oh, Christopher Raridan, Jan Rychtář, Ratnasingham Shivaji, Shan Suthaharan, Irina Victorova

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

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 10th Annual UNCG RMSC 2014

2014 UNCG RMSC Participants

UNCG-RMSC is an annual one day conference promoting student research in mathematics, statistics, and their applications in various fields. The 2014 conference was held on Saturday, November 1, 2014. Jan Rychtář served as conference chair and Sat Gupta, Maya Chhetri, and Ratnasingham Shivaji were co-organizers. The conference featured a plenary presentation by an invited speaker:

Jerome Goddard II, Auburn University, Montgomery: How small is too small? Modelling the effect of habitat fragmentation via reaction diffusion equations

The conference was attended by 169 participants (127 students: 1 high-school, 85 undergraduate, 41 graduate students, and 42 faculty) from a total of 31 schools attended conference. The participants came from groups underrepresented in STEM disciplines (47 female students, 16 female faculty; and also 19 African American, and 9 Hispanic).

The students delivered a total of 65 presentations. 41 presentations were delivered by undergraduate students, 24 by graduate 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 University
- Noah Hughes, Appalachian State University
- Jia Zhao, University of South Carolina

Undergraduate student category
- John Cruickshank, University of North Carolina at Chapel Hill
- Saniita FaSenntao and Kaleigh Mulkey, Kennesaw State University
- Nicole Soltz, Elon University

All UNCG RMSC presenters were invited to submit papers to the refereed electronic journal The North Carolina Journal of Mathematics and Statistics.

14.2 UNCG Summer School in Computational Number Theory - 2015

Zeta Functions – New Theory and Computations

From May 18–22, 2015 the University of North Carolina at Greensboro hosted a summer school entitled Zeta Functions – New Theory and Computations. The organizers were S. Pauli, F. Saidak, B. Tangedal, and D. Yasaki. There were 29 participants, including 19 graduate students (6 UNCG and 13 external), including 5 women.

The summer school in computational number theory fills a gap in the education of many graduate students. Most graduate courses in number theory take a mainly theoretic approach with very little emphasis on the computational aspects of the subject. The goal of the UNCG Summer School in Computational Number Theory is to complement this with a constructive- algorithmic approach. Many of the algorithms used for number theoretic computations are non-trivial, which makes it difficult to cover them in a standard course.

The subjects covered this year include: A historic approach to the Riemann Zeta function; the distribution of the zeros of zeta functions and their and their derivatives; horizontal cuts of the critical strip; pair correlation between zeros; efficient evaluation of zeta functions and their derivatives; related functions; gaps between primes; and twin primes.

The main lectures in the summer school were given by Fredrik Johansson (INRIA Bordeaux-Sud-Ouest); Yuri Matiyasevich (Steklov Institute of Mathematics, St. Petersburg); Filip Saidak (UNCG); Cem Yıldırım (Bogaziçi University, Istanbul); Peter Zvengrowski (University of Calgary); An additional talk was given by Ricky Farr (UNCG).
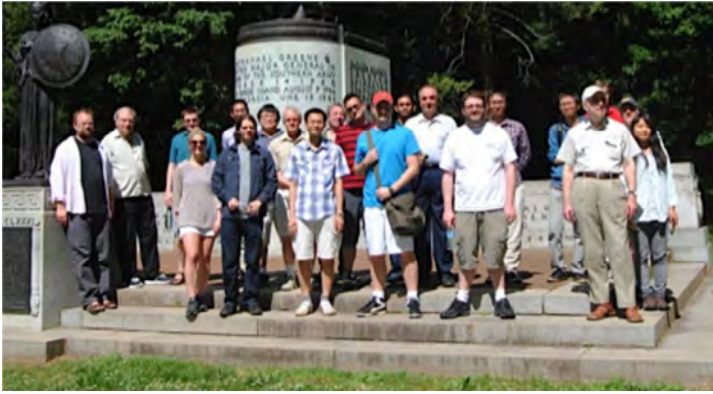
UNCG Summer School in Computational Number Theory 2015 participants

On a typical day, the talks were given, and in the afternoon students worked in groups to solve problems related to this material. The schedule can be found below. The talks early in the week introduced the students to the subject. 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.

This project is supported by UNCG and the NSF (DMS-1303565). Additional information, including links, slides, and notes from some of the lectures, and problem sets can be found on the website
www.uncg.edu/math/numbertheory/summerschool/2015.html

14.3 International Conference on Advances in Interdisciplinary Statistics and Combinatorics

The latest edition of the AISC conference series was hosted by the department during October 10-12, 2014. Professor Sat Gupta served as the conference Chair. The conference is held every other year and is co-sponsored by the North Carolina Chapter of the American Statistical Association. Like the previous AISC conferences, AISC 2014 was also supported by ASA, NSF, NC-ASA, and Taylor and Francis, in addition to several other sponsors.

The conference featured 161 talks including 30 talks by students and 22 by very senior plenary speakers. The plenary speakers included C. S. Cheng and Lexin Li (Berkeley); David Dunson, Jerry Reiter and Mike West (Duke); Richard Smith (SAMSI and UNC Chapel Hill); Marie Davidian, Anastasios Tsiatis and Alun Lloyd (NC State); John Stufken (Arizona State); Dan Zelterman (Yale); Alan Karr (RTI); Ben Kedem (Maryland); Sudipto Guha (U Penn); Ming Yuan (Wisconsin - Madison); Ejaz Ahmed (Brock Uiversity); Mike Broom (City University London); Vlastimil Kivan (University of South Bohemia, Czech Republic); Mike Mesterton-Gibbons (Florida State); Ross Cressman (Wilfrid Laurier University, Canada); Benjamin Allen (Emanuel College); and Dmitri Zaykin (National Institute of Environmental Health Sciences).

Two workshops were arranged, largely for young researchers - one on Big Data/Machine Learning and the other on Mathematical Biology/Game Theory. There were more than 200 participants with many coming from abroad. The NSF grant allowed us to support 26 young researchers, including 10 women. Four of the young researchers were recognized for outstanding presentations. These were Nicole Dalzell (Duke), Gina - Maria Pomann (N C State), Geeta Kalucha (University of Delhi) and David Sykes (UNC Greensboro). Four of the senior NC Statisticians were honored with the NC- ASA Chapter Distinguished Service awards. These were Mike West (Duke), Richard Smith (SAMSI and UNC Chapel Hill), Anastasios Tsiatis (N C State), and Sat Gupta (UNC Greensboro). Selected papers from the conference will appear in the *Journal of Statistical Theory and Practice*. Additional conference details are available at the conference website http://www.uncg.edu/mat/aisc/2014/index.html

14.4 AMS Fall Sectional Meeting

Greg Bell at the AMS meeting at UNCG

The American Mathematical Society is the largest mathematical society in the United States. Founded in 1888, it boasts over 30,000 members. Each year, the society hosts eight sectional conferences. In November 2014, UNCG hosted the 2014 Fall Southeast Regional AMS conference at the School of Education Building. Greg Bell and R. Shivaji served as local organizers. Haley Childers, Alyssa Holster, Chelsea Burden, Vee Galloway, and Qi Zhang helped with registration. Christopher Vanlangenberg drove a hotel shuttle and Richard Cheek provided IT support.

Over 420 mathematicians attended this conference, which featured 344 session talks, three invited addresses and a special Maclaurin lecture. Additionally, the Department of Mathematics and Statistics sponsored a evening reception for all participants on the first night of the conference. The participants came to UNCG from 38 states and 15 different countries representing North and South America, Europe, Asia, Africa, and Oceania.

Invited Addresses

The conference featured three large invited addresses and a special AMS-NZMS Maclaurin Lecture.

- Susanne C. Brenner, Louisiana State University, Novel finite element methods for optimal control problems with PDE constraints.
- Skip Garibaldi, Emory University, E_8 and other exceptional groups.
- Stavros Garoufalidis, Georgia Institute of Technology, Knots and q-series.
- James Sneyd, University of Auckland, The dynamics of calcium: Oscillations, waves, theories, and experiments. (AMS-NZMS Maclaurin Lecture)

Special Sessions

Cliff Smyth presenting a lecture at the AMS meeting at UNCG

Nine UNCG Faculty members organized or co-organized Special Sessions, which feature cutting-edge research talks in a very narrowly defined research area.

- Sebastian Pauli was an organizer of the *Special Session on Algorithms for Local Fields*.
- Dan Yasaki was an organizer of the *Special Session on Automorphic Forms and Related Topics*.
- Jonathan Rowell and Jan Rychtář organized the *Special Session on Movement in Mathematical Biology*.

- Thomas Lewis was an organizer of the *Special Session on Discontinuous Galerkin Finite Element Methods.*
- Maya Chhetri was an organizer of the *Special Session on Nonlinear Boundary Value Problems*.
- Clifford Smyth was an organizer of the *Special Session on Recent Developments in Graph Theory and Hypergraph Theory*.
- Jerry Vaughan was an organizer of the *Special Session on Set Theoretic Topology*.

Jerry Vaughan presenting a lecture at the AMS meeting at UNCG

UNCG Faculty, Student, and Alumni Presentations

Four faculty members delivered invited talks, five UNCG graduate students gave invited talks, and one UNCG Computational Mathematics PhD alumnus gave an invited talk.

- Abraham Abebe (PhD 2014, UNCG) "Positive solutions for a class of multiparameter elliptic systems."
- Ricky Farr (PhD Student of Sebastian Pauli) "On Non-Integer Stieltjes Constants and Fractional Differentiation."
- Catherine Payne (PhD Student of Richard Fabiano) "Continuous functions on psi-spaces."
- Jonathan Rowell (Assistant Professor of Mathematics UNCG) "Harvesting Ideally

Abraham Abebe presenting a lecture at the AMS meeting at UNCG

Motivated Populations: Ecological and Evolutionary Implications."

- James Rudzinski (PhD Student of Clifford Smyth) "Pilesize Dynamic One-Pile Nim and Beatty's Theorem."
- Jan Rychtář (Professor of Mathematics UNCG) "Habitat selection game in structured populations."
- Brian Sinclair (PhD Student of Sebastian Pauli) "Enumerating Extensions of p-adic Fields with Given Invariants."
- Byungjae Son (PhD Student of R. Shivaji) "Bifurcation and Multiplicity results for classes of p Laplacian equations."
- Clifford Smyth (Associate Professor of Mathematics) "Revolutionaries and Spies."

Catherine Payne presenting a lecture at the AMS meeting at UNCG

- Jerry Vaughan (Professor of Mathematics) "Psi spaces on an uncountable cardinal kappa with a MAD family of cardinality kappa."

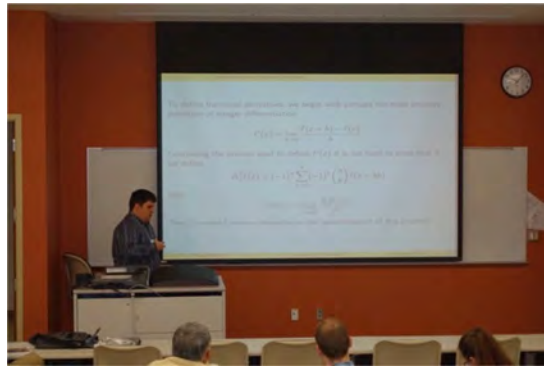**Participants at the AMS meeting at UNCG**

Brian Sinclair presenting a lecture at the AMS meeting at UNCG

Ricky Farr presenting a lecture at the AMS meeting at UNCG

15.   Student Clubs and Organizations

15.1 Alpha Student Chapter of NCCTM

NCCTM student affiliate groups are student-led organizations at NC colleges and universities and are designed to support those who are interested in or planning to become mathematics educators. The Council supports these organizations through scholarships to attend the state conference each fall and by granting funds for special projects.

**Tracey Howell,
Faculty Advisor**

Alpha Students

15.2 UNCG Student Chapter of the Association for Women in Mathematics

Suzanne Lenhart with AWM

**Talia Fernós,
Faculty Advisor**

The AWM encourages women toward mathematical careers and promotes equal treatment of women and other underrepresented minorities in mathematical sciences.

Part of the purpose of AWM is to encourage women toward mathematical careers. We share information about resources, such as scholarships, mentoring, and workshops   available to us as women in mathematics through AWM and other organizations. The other part is to promote equal treatment of women and other underrepresented minorities in mathematical sciences, and to discuss some of the subtle ways that inequality may appear in academia and other professional careers. In the future, we plan to ask visiting mathematicians to share their perspective and

advice for us as we move toward professional careers, as well as programmatic meetings to discuss issues pertaining to women and minorities in mathematics.

This is the third year of the AWM student chapter at UNCG. There were 6 meetings over the course of the 2014-2015 academic year. Several of these were "meet and greets" with successful women in the STEM disciplines.

Our guests included Lydia Fritz (CS department at UNCG), Deepshikha Shukla (physics department at UNCG), and Suzanne Lenhart (math department at University of Tennessee, Knoxville). We were very happy to have Suzanne Lenhart, who was the president of the AWM between 2001-2003. Another success was in recruiting some students from computer science, thanks to the meet and greet with Lydia Fritz. We are also very happy to have AbaGayle Younts as president. She is very organized, an outstanding student, and most importantly, early in her undergraduate career, meaning that this student chapter will go far under her leadership.

President: AbaGayle Younts

Vice-president: Sims Osborne

Secretary: Renee Moore

Treasurer: Catherine Payne

From left to right: Sims Osbourne, Lydia Fritz, Talia Fernos, AbaGayle Younts, Renee Moore, Vee Galloway, Catherine Payne, Tanja Zatezalo, Maya Chettri
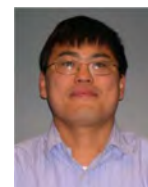
15.3 UNCG Math Club

The 2014-2015 academic year was the fourth year of the UNCG Math Club, whose goal is to create a community for math enthusiasts. There were six meetings this year, including two presentations from graduate students

- Austin Lawson (UNCG): *Persistent Homology*
- Aida Briceno (UNCG): *Dynamics of Social Media Networks*

and a presentation by Dr. Park and Dr. Davis from North Carolina A&T on Industrial Engineering. Other meetings included the traditional meet & greet and fierce (but friendly) competition in a variety of math and science related games.

President: Vee Galloway

Dan Yasaki, Faculty Advisor

UNCG Math Club Members

15.4 Pi Mu Epsilon

Pi Mu Epsilon is a national honorary mathematics society that was founded in 1914. It is a nonsecret organization whose purpose is the promotion of scholarly activity in mathematics. There are academic requirements for undergraduates to be invited to join.

Richard Fabiano, Faculty Advisor

Pi Mu Epsilon is dedicated to the promotion of mathematics and recognition of students who successfully pursue mathematical understanding. To promote mathematics, the National Pi Mu Epsilon Council sponsors an annual conference in conjunction with the Mathematics Association of America's (MAA) annual MathFest.

In its quest to promote mathematics, Pi Mu Epsilon also sponsors a journal devoted to topics in mathematics accessible to undergraduate students. Papers from students and faculty appear in this refereed forum. The journal also presents a Problem section where a reader can find challenging mathematical problems. Solutions to those problems appear in subsequent editions.

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: Caitlin Adam, Daniel Donovan, Xinyu Feng, and Mingyan Li.

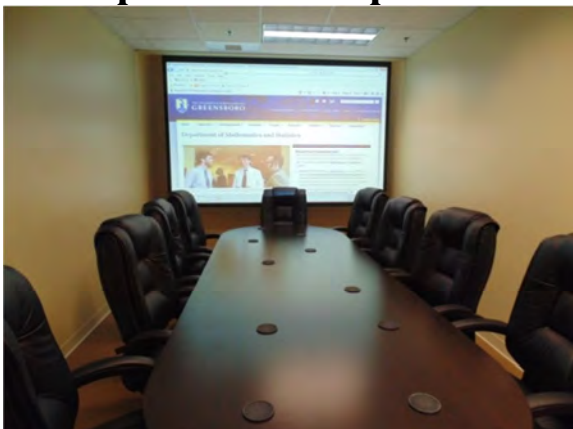We held an induction banquet to honor these students on April 28, 2015, at the Saigon Vietnamese Restaurant. The banquet was attended by new inductees and their guests, and several faculty members.

Faculty and students at the Pi Mu Epsilon Dinner

Inductees Caitlin Adam and Mingyan Li

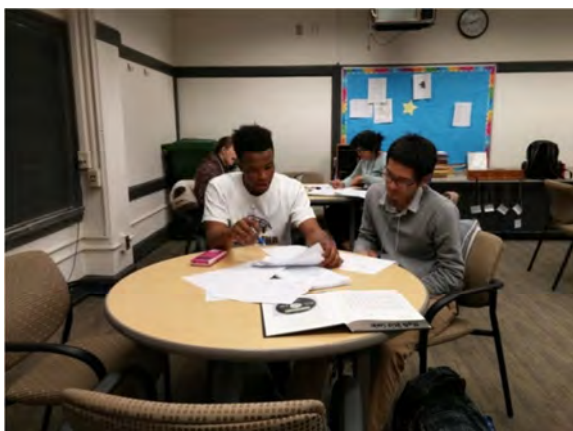# 16. Departmental Spaces

Jerry and Theresa Vaughan Conference Room in Petty 146.

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

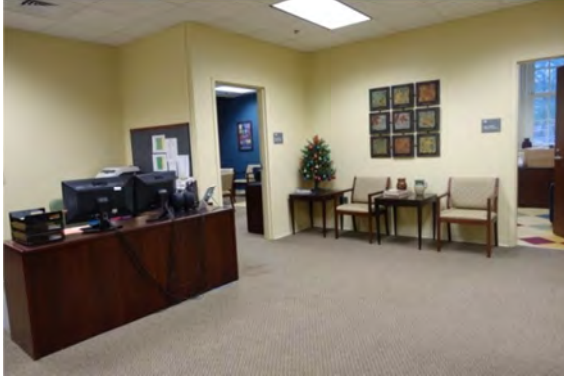The **Math Help Center** is located in Curry 210.

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.

The **Statistical Consulting Center** is located in Petty 209.