NC State Undergraduate Mathematics

Fall 2018

Newsletter

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SUM CLUB
NC STATE

Applied Dance + Inspired Mathematics

Not everyone enjoys scribbling down notes in a classroom trying to decipher the jumble of letters and symbols on a whiteboard that has come to be what everyone thinks of when it comes to higher mathematics. On September 22 and 23, Dr. Tye Lidman, a professor researching Topology here at NC State and Michelle Pearson of the Black Box Dance Theatre took it to the dance floor. Geneva Collins, a junior in mathematics and dancer in the performance, talks about her experience:

"What does that even mean?" This is the most common response I received when telling people that I was in a "math dance." The performance that came of the unique collaboration between the abstract world of mathematics and the artistic world of dance took us all on a journey through the dimensions of our world and ourselves. Identifying primarily as a math student, rather than a dancer, I found the art aspect really incredible. I knew a bit of the basics of topology going in, like the whole "a donut is the same as a coffee mug" idea, but relating those concepts to dance and the human experience was really eye-opening. It was also amazing seeing other people relate to and get excited about mathematics like I do! I think that this collaboration between math and dance created a unity between the performers and the audience in really unique way, and I hope to continue to bring math into the community.

SUM Club

The Society for Undergraduate Mathematics (SUM Club) is a student organization for students with a passion for or professional future in mathematics. We connect math undergrads and provide students with academic and professional development, leadership, and service opportunities. This is accomplished through social and outreach activities, presentations at meetings, career events, and other college- and university-wide involvement. Open to any student, math major or otherwise, we meet on the first Thursday of every month to get to know one another, do math puzzles, play games, learn together, and plan outreach. The club hosts undergraduates, graduate students, and professionals to share their experiences and knowledge, so that we can learn. SUM Club supports the Raleigh community through participation in programs like Service Raleigh and Washington Elementary Math and Science Night. We hope to continue to create a strong undergraduate mathematics community. We would love to have more people involved! Email us at ncsusumclub@ncsu.edu with question or to be added to our email list.

Sports Analytics Club

The Sports Analytics Club at NC State is a student-run, student-driven club which brings together undergraduates, grad students, and faculty who are interested in the quantitative analysis of sports. We enable members to work on individual and group research projects under the guidance of grad students and our faculty advisors. In addition, we play fantasy sports and prediction contests together. We meet approximately bi-weekly on Mondays at 7:00pm in SAS Hall 2235. Email sportsanalytics@ncsu.edu if you would like to join our email list.

AI Club

Our mission is to inform, bring together, and educate the NC State community about artificial intelligence and its opportunities and threats, and to create a platform for learning and innovation in the field. We host general meetings, as well as workshops and speakers. The club is multidisciplinary and open to everyone, regardless of skill level or department. Find out more at our website, https://aiclub.wordpress.ncsu.edu/

MIC Club

The Mathematical Insights Club (MIC) aims to foster an environment where undergraduate students can delve deeper into the field of mathematics. We will discuss undergraduate research, interesting papers, and math history. MIC is a platform for students to share their math interests. Each month two students give a short informal presentation on something they have found interesting, whether it is their own research, a published article, a fun problem, or math history. Come to MIC and advance your ability to discuss mathematics and give your CV a boost! We meet every third Thursday of the month! We hope to see you there! Email MIC.ncstate@gmail.com to join.

Stat Club

If you are interested in statistics and related professions or just want to meet and socialize with other statistics lovers, come join Stat Club every other Thursday from 6-7pm in SAS 5270. The purpose of the club is to expose people to the endless applications of statistics and what a career in statistics really looks like by bringing in guest speakers from industry and academia. This is also a great way for members to network with industry professionals, NCSU faculty, and other statistics majors. Our next meeting will be October 18th where representatives from SAS will be coming to talk about #Data4Good as well as the internship and full-time opportunities they offer. We hope to see you there!

Internship in Germany: Meredith Bain

Tell us a little about what you did during your internship

This summer I interned for the municipal government of Ingolstadt, Germany, where I developed a computer-based greenhouse gas emissions monitoring system to track progress on the city government's carbon neutrality plan. My majors are math and German studies, and I do a lot of environmental and climate change work at NC State and in Raleigh, so it was a perfect fit for me! I designed a computer-based model for estimating the greenhouse gas emissions occurring within the boundaries of the city. I used this model to generate annual emissions inventories dating back to 2014, and then I submitted policy proposals for decreasing the city's carbon emissions to zero tonnes by the end of 2050. Aside from that, I assisted with drafting international project proposals for a series of connected national parks along the Danube River, and I also helped with an exchange visit from one of Ingolstadt's sister cities.

How did you find this internship?

I got the internship with the help of my German adviser. I applied to a program run by a nonprofit called Cultural Vistas, where you submit a resume and a bunch of writing about your career aspirations and level of foreign language competency, and then the staff finds a relevant position for you. They're great at what they do and they run similar programs all around the world, so go ahead and check out Cultural Vistas if you're feeling adventurous next summer.

Going into this internship, what were you most excited about?

I was most excited to have the opportunity to spend my summer dedicated only to environmental work, whereas during the school year my attention tends to be distracted by math homework and other extracurricular obligations. Also, I was excited to meet people whose full-time jobs are protecting and improving the environment!

Were you anxious or nervous about anything?

My German skills are really not that great, so I was worried that I wouldn't be able to keep up with the pace of work. However, I improved a lot, and I learned that a rudimentary grasp of German is all that's necessary to be a competent worker anyway. It's pretty arrogant to assume that everyone will speak English all the time, but a basic knowledge of your target language will suffice.

Internship in Germany: Meredith Bain cont.

Of all the lessons you learned during this internship, which one had the most profound impact?

I learned that it's ok to throw away old work and give up on ideas that are not functional. The final version of the emissions monitoring program is the eleventh iteration of my third idea of what the system would look like, so needless to say a lot of my work was thrown away. It was always terrifying to give up on a program that had taken so much time to develop, especially as the deadline got closer, but I noticed that every time I started over I was a faster and more efficient worker. All of the failed and messy attempts helped me improve the math and layout of the next iteration, so it ended up not being a disaster every time I had to start over.

If you are visiting Germany, you need to see or experience…

Go on a bike ride!! Germany has a very well-developed infrastructure for bicycles, and it's perfectly feasible to bike between small towns. I've been on several day trips along the Danube exploring the villages in the area, and in my opinion it's just as fun as going to big cities like Munich and Berlin. The rural areas are so scenic, especially on the river, and if you're lucky you might even get to see an enormous German rabbit along the way. Also, Germans have this drink called Eiskaffee, which is basically a cup of coffee with a massive helping of ice cream scooped into it. You should definitely try Eiskaffee!

Puzzles!

1) A transposition of a vector is created by switching exactly two entries of the vector. For example, (1, 5, 3, 4, 2, 6, 7) is a transposition of (1, 2, 3, 4, 5, 6, 7) by switching entries 2 and 5. Find the vector v if w = (0, 0, 1, 1, 0, 1, 1), x = (0, 0, 1, 1, 1, 1, 0), y = (1, 0, 1, 0, 1, 1, 0), and z = (1, 1, 0, 1, 0, 1, 0) are all transpositions of v. Explain the method you use to find v. (Credits to Lewis and Clark College, Department of Mathematical Sciences)

2) Imagine there are 100 people in line to board a plane that seats 100. The first person in line realizes he lost his boarding pass so when he boards he decides to take a random seat instead. Every person that boards the plane after him will either take their "proper" seat, or if that seat is taken, a random seat instead. What is the probability that the last person that boards will end up in his/her proper seat?

Entrepreneurship in Mathematics

Chandra Manivannan, a third year student majoring in Computer Science and Applied Mathematics won the Judges' Choice Award at NCSU's Entrepalooza, for her venture Math Mundo, a multilingual math education platform!

From a very competitive audition process, 15 founders were selected to pitch their venture in 1 minute or less, in the annual "Minute to Pitch It" competition on September 20. Chandra won the Judges' Choice Award for best pitch and venture, and was awarded $2500 to help fund her organization!

She is currently in the ideation stage, and is so excited to continue growing her business! She is especially grateful for the support she received from the Entrepreneurship Initiative at NC State!

Mathematical Contest in Modeling

The Mathematical Contest in Modeling (MCM) is a five-day, international math competition that challenges undergraduate students in teams of three to apply their mathematical knowledge to real world problems. Past questions have included modeling the government of a Martian colony and assessing potential damage from an asteroid striking Antarctica. NC State has been very successful in the past, winning the top prize Outstanding designation in 2017 and winning multiple Meritorious designations every year.

Jaye Sudweeks, a senior in applied math, and Graham Pash, also a senior in mechanical engineering and applied math, participated in MCM last year. "Despite the incredible challenge, the reward is well worth it, as Graham describes, "You spend 5 days working around the clock and absorbing all of the material that you can on the topic that you chose, so it's extremely rewarding to see it all culminate in this nice paper that you feel proud of and can show off." Jaye says: "... [T]he most important thing that I've learned about myself by participating in MCM is that I can do difficult things - there's so much power in being able to say that. I also learned that I can be creative and innovative, and those skills are not reserved for other people."

Both Graham and Jaye intend on competing in the MCM again this year, and the Math Department is interested in sponsoring more teams for the contest this coming Spring (dates TBA). Interested students should contact Jaye (jcsudwee@ncsu.edu) or Graham (gtpash@ncsu.edu).

Advanced Mathematics Courses

MA 565 Graph Theory

1:30 pm - 2:45pm TH
Instructor: Dr. Blair Sullivan
Introduction to graph theory. Starting from the fundamentals, this course will cover essential theorems and algorithms from across the field of graph theory. Topics will include Connectivity, Matchings, Planar Graphs, Coloring, Directed Graphs, Extremal Problems, Ramsey Theory, Random Graphs, and (time permitting), Structural Graph Theory. Where relevant, applications and algorithmic considerations, including data structures, will be highlighted. Students should be comfortable with formal proofs; some exposure to algorithm complexity (big-O notation) will be helpful, but is not essential coming in.

MA 518 Geometry of Curves and Surfaces

12:50 pm - 1:40 pm MWF
Instructor: Dr. Andrew Cooper
Curves and surfaces in 3-dimensional space are fun to study because they are easy to visualize and you can understand quite a bit of the formal theory using only the tools of multivariable calculus and some linear algebra. This is foundational for applications involving 3D movement and modeling, such as mechanics, computer imaging, robotics, aerodynamics, astronomy, etc. On a more abstract level, the techniques address modern research questions in advanced differential geometry, algebraic geometry, and theoretical physics subjects like general relativity and gauge theory. This class is essential for fans of shapes and motion.

MA 591 Introduction to Mathematical Cryptography

4:30 pm - 5:45 pm TH
Instructor: Dr. Ernest Stitzinger
The course will include public key cryptography based on factoring (RSA) and discrete logs (El-Gamal) and the numerous attacks. Elliptic curve cryptography, ciphers and attacks. Lattice based cryptography including GGH, NTRU, Learning with errors (LWE) and ring LWE and attacks: LLL for the shortest vector and closest vector problems. UNDERGRADUATES ARE ENCOURAGED TO SIGN UP You will need MA 405, 407. The needed algebraic number theory will be developed.

MA 544 Computer Experiments in Mathematical Probability

11:45 am - 1:00 pm TH
Instructor: TBA
The intent of the course is to reveal to the student the virtues of using the computer to gain insight into mathematical behavior. Examples will be chosen from topics in probability theory which are either not typically covered in courses, or do not have a complete mathematical treatment at the present time. For futher details go to www.math.ncsu.edu/~jack/ma544.html
This course satisfies the writing and modeling requirements.

MA 451 Methods of Applied Mathematics II

1:30 pm - 2:45 pm TH
Instructor: Dr. Mansoor Haider
Applied mathematics relies on techniques that apply to many aspects of science and engineering. In this class, and the companion MA 450, students learn and use a variety of methods in the context of fluid mechanics and elasticity. The text by Mark Holmes can be downloaded from the library or can be purchased from the bookstore. The class uses material from the prerequisites: MA 242 and MA 341.

Math Honors Program

Currently we have 30 students participating in the Math Honors Program and we will extend our invitation to more students in the future. Lately a little less than 20% of math graduates complete the Math Honors Program and about 90% of those students go on to excellent graduate schools or find great jobs. Schools they have attended include Berkeley, Princeton, Stanford, MIT, Cornell, NYU and UCLA. Math honors students have received 25 NSF Fellowships AND 3 DoD Fellowships for graduate school as well as 9 Goldwater Scholarships, 1 Churchill Scholarship and 3 Gates Fellowships. Besides taking a number of challenging advanced Mathematics courses, Math Honors students also do research either at NC State or in a summer REU Program (Research Experience for Undergraduates) nationwide. More than 30 students have completed a study abroad program focusing on Mathematics, either at the BSM Program (Budapest Semesters in Mathematics) or the MiM Program (Math in Moscow Program).
Participation in REUs, BSM, MiM and doing undergraduate research in mathematics has helped greatly the success of honors students getting accepted into numerous excellent graduate schools. Dr. Min Kang is happy to talk to any student interested in undergraduate research opportunity in Mathematics – stop by her office in SAS 4114 or email her at kang@math.ncsu.edufor an appointment. More information about the program can be found on the Math Honors website at http://www.math.ncsu.edu/honors

Welcome to the Math Honors Program!

Emily Esterline
Thomas Lee
Noah Jabusch
Claire Steffen
Samuel Herring
Ryan Li
Geneva Collins
Ana Iglesias
Yuxuan Tao
Robert van der Drift
Ethan Dudley
Zachary Lowenberger
Neil Dey

Graduates of the Math Honors Program!

Falastein Alie
Andrew Hensley
Gautam Nagaraj
Walker Powell
Bevelry Setzer
Matthew Simpson
Olivia Trogdon
Christopher Cardullo
Madgleidys Figueroa
Marvin Newlin
William Reese
Jean-Claude Shore
Brandon Summers

Puzzle Solutions

1) u=(1, 0, 1, 1, 0, 1, 0) found by summing the 4 vectors and then keeping the 1's and 0's that showed up at least 3 times. The last 2 slots can be found because if one way is chosen you get back vector x, otherwise you get the answer u.

2) ½ Suppose whenever someone finds their seat taken, they evict the squatter and take their seat. In this case, the first passenger keeps getting evicted (and choosing a new random seat) until, by the time everyone else has boarded, he has been forced by a process of elimination into his correct seat.
This process is the same as the original process except for the identities of the people in the seats, so the probability of the last boarder finding their seat occupied is the same.
When the last boarder boards, the first boarder is either in his own seat or in the last boarder's seat, which have both looked exactly the same (i.e. empty) to the first boarder up to now, so there is no way the poor first boarder could be more likely to choose one than the other.
This answer also gives an intuitive explanation for the nice result: When the kth passenger reaches the plane, there are n−(k−1) empty seats. If the first passenger stands up, he will see that he is in an arbitrary one of n−k+2 seats, all of which have looked the same to him so far. So there is a 1/(n−k+2) chance that, when seated, he is occupying the kth passenger's seat.