The Nebraska Southeast South Dakota Spring 2018 Section Meeting

April 20-21, 2018, University of Nebraska at Omaha

Schedule with Abstracts

Friday, April 20

11:30 – 1:00 Board meeting, Durham Science Center 208

Room: Durham Science Center 115-116

12:30 – 1:30 **Registration (until 5:30PM) and Welcome**

1:30 – 1:50 Steven R. Dunbar, University of Nebraska at Lincoln: *Graph Theory of Redistricting.*

Abstract: Political redistricting is a highly constrained problem in graph theory. This talk will sketch some of the challenges and open questions in the graph theory of redistricting.

1:50 – 2:10 Xiaoyue Cheng, University of Nebraska at Omaha: *Becoming a better instructor: experience from a junior faculty.*

Abstract: As an international junior faculty in the UNO math department, I'll talk about my experience on improve teaching, including the challenges, consulting, and new trials.

2:10 – 2:30 Muhammad Inam, Alabama A&M University: *The word problem for one relation Adian inverse semigroups.*

Abstract: The word problem is decidable for some classes of one relation Adian inverse semigroups.

2:30 – 2:45 **Break**

Room: Durham Science Center 115 (parallel sessions, students)

2:45 – 3:05 Christopher Chapin (grad), University of Nebraska at Omaha: *Solutions to $x^4-p^2y^4=z^4$ in quadratic extensions of the Rationals.*

Abstract: Consider the Diophantine equation $x^4-p^2y^4=z^4$, where p is a prime with p=3 mod 8, a family of equations shown to have no non-trivial rational solutions by H.C. Pocklington in 1914. In 1968, L.J. Mordell offered a simple method utilizing elliptic curves to find solutions in quadratic and cubic extensions of certain Diophantine equations. By applying the same techniques to this family of equations we prove that no non-trivial solutions in any quadratic extension exist.

3:05 – 3:25 Bronson Wacker (grad), Dora Matache, University of Nebraska at Omaha: *Network Topologies and the Determinative Power.*

Abstract: An examination of network topologies and topological aspects on the quantity known as the determinative power.

3:25 – 3:45 Matthew Eller (undergrad), Mahboub Baccouch, University of Nebraska at Omaha: *Fourier series expansion methods for the heat and wave equations in two and three dimensions.*

Abstract: The Fourier series expansion method is an invaluable approach to solving partial differential equations, including the heat and wave equations. For homogeneous heat and wave equations, the solution can readily be found through separation of variables and then expansion of the solution in terms of the eigenfunctions. However, solutions to inhomogeneous heat and wave equations through Fourier series expansion methods are not readily available in the literature for two- and three-dimensional cases. I shall present my research for solving such equations using Fourier series expansion methods.

3:45 – 4:00 **Break**

Room: Durham Science Center 116 (parallel sessions, students)

2:45 – 3:05 Andrew Oberg (undergrad), Danielle Melnar, (undergrad), University of Nebraska at Omaha: *NOYCE Connecting Faculty-Students-Community.*

Abstract: Two undergraduate Noyce Scholars representing UNO will present how the benefits of the Noyce Scholarship have connected them closer to faculty, community, and peers.

3:05 – 3:25 Nadia Missak (undergrad), Courtney Swift (undergrad), University of Nebraska at Omaha: *ESCAPE UNO.*

3:25 – 3:45 Brian Detweiler (grad), University of Nebraska at Omaha: *Complex Survey Design and the Nationwide Inpatient Sample.*

Abstract: When surveying a population as complex as the United States healthcare system, a simple random sample is not suitable. To reduce costs, minimize standard error, and account for small and hard to sample sub-populations such as rural hospitals, the Agency for Healthcare Research and Quality (AHRQ) have conducted a remarkably well-documented and consistent survey of inpatient admissions since 1988, known as the Nationwide Inpatient Survey (NIS). This is a rich dataset for cross-sectional and

longitudinal studies. Analysts must account for nuances such as missing data, stratification, clustering, weighting, and survey design changes over the years.

3:45 – 4:00 **Break**

Room: Durham Science Center 115 (parallel sessions, students)

4:00 – 4:20 Brad Horner (undergrad), University of Nebraska at Omaha: *Adventures in S^3.*

Abstract: Expository talk for a general audience on how to visualize the three-sphere S^3 sitting inside four dimensions R^4. Exhibits standard algebraic topology constructions - like gluing, joins, bundles and smash products - in picturesque R^3 under stereographic projection. Connects to many topics in topology and physics - the major keywords being: Bloch sphere, Riemann sphere, quaternions (3D and 4D rotations), quantum spin, homotopy groups of spheres.

4:20 – 4:40 Nicholas Britten (grad), University of South Dakota: *Addition property of Algebraic Entropy: some noncommutative cases.*

4:40 – 5:00 Andrea Lopez (undergrad), University of Nebraska at Omaha: *Fibonacci in the Real World.*

Abstract: Fibonacci found in the real world.

5:00 – 5:15 **Break**

Room: Durham Science Center 116 (parallel sessions, students)

4:00 – 4:20 Trevor Pentzien, (undergrad), Dora Matache, University of Nebraska at Omaha: *Node power and centrality in Boolean networks.*

Abstract: In recent years Boolean networks have become an important modeling technique for biology. The networks that were used in this study were logical representations of several cellular signal transduction networks, such as protein networks, and were taken from the cell collective, a free online database (www.thecellcollective.org). In past work, the determinative power (DP) of the nodes, which quantifies the information gain for each node, was found for approximately 30 networks. Of these 30 networks, 4 were used to explore topological properties of the network, such as in-degree, out-degree, in-closeness, out-closeness, and betweenness. It was found that none of the calculated properties were linearly related to DP.

4:20 – 4:40 Paul D. P. Blum (undergrad), Victor Winter, Betty Love, Michelle Friend, and Michael Matthews, University of Nebraska at Omaha: *Setting the Foundation for Bricklayer; Functional Programing in the Classroom.*

There is a continuing and growing trend to combine mathematics with the other Science, Technology, and Engineering disciplines, to show the applications of mathematics. Dr. Victor Winter, developed a program in the SML programming language to help his students learn coding. Dr. Winter, with the aid of other professor have created a class that proposes to offer an alternative to the lower level math courses at UNOmaha. The Brick Layer software is also being used in over 75 local public and private schools in the greater Omaha metro area. Paul Blum will present the progressive interface and basics of BL. Dr. Michael Matthews, then presents the current research results from the implementation of Bricklayer.

4:40 – 5:00 Christopher Johnson (undergrad), Dr. Donald Rowen, University of Nebraska at Omaha: *Using interpretable neural network models of Pseudomonas aeruginosa gene expression to reveal potential functions of an unstudied transcription factor.*

Abstract: There is an urgent need for alternatives to traditional antibiotics due to the proliferation of drug-resistant strains of pathogenic bacteria. Antimicrobial peptides (AMPs) are an intriguing alternative to currently available antibiotic therapies. DASamP2, an AMP developed by the Wang lab at UNMC, is highly effective against the pathogens Pseudomonas aeruginosa, and Staphylococcus aureus, but the mechanism of action is not currently understood. To characterize the genetic factors affecting susceptibility to this AMP, our lab created mutant strains of P. aeruginosa that demonstrated increased resistance to DASamP2. Analysis of one of our most resistant mutants revealed that increased expression of the transcription factor PA5189 is somehow responsible for a more than eight-fold increase in resistance. This transcription factor has not been studied previously, but we can extract biologically meaningful insights about its potential function from public gene expression datasets using recently developed neural network techniques. By training denoising autoencoders or disentangled variational autoencoders on all available gene expression data for this organism, we can construct a compressed representation which captures complex relationships between genes. Interpreting what the neural network learns allows us to connect raw expression data to higher-level biological features. This is possible despite enormous differences between the experiments generating the gene expression data, which make many traditional statistical approaches difficult. Intriguingly, early results from this approach suggest that many of the genes most strongly associated with PA5189 are also unstudied, potentially indicating that PA5189 acts to regulate a novel subset of genes affecting antibiotic resistance.

5:00 – 5:15 **Break**

5:15 – 6:15 **Guest speaker: *Michael Dorff,*** Brigham Young University, Next president of the MAA: ***The best jobs this century? – mathematician/STEM careers!***

Abstract: A 2014 ranking from CareerCast.com, a job search website, recently named mathematician the best job of 2014. “Mathematicians pull in a midlevel income of $101,360, according to CareerCast.com, and the field is expected to grow 23% in the next eight years,” states the Wall Street Journal blog post. Many students and professors think that teaching is the main (or only) career option for someone who studies mathematics. But there are hundreds of jobs for math students. However, just graduating with a math degree is not enough to guarantee getting one of these jobs. In this talk, we will talk about some of the exciting things mathematicians in business, industry, and government are doing in their careers. Also, we talk about the national PIC Math program that prepares students for nonacademic careers. Finally, we will reveal the three things that recruiters say every math student should do to get a job.

7:00- Banquet: Scott Conference Center, 6450 Pine St, Omaha, NE 68106

Saturday, April 21

Room: Durham Science Center 115-116

8:00 – 8:30 **Registration (until 9:00AM)**

8:30 – 8:50 Laura McCauley, Peru State College: *Spot It! with Combinatorics.*

8:50 – 9:10 Margaret Adams, South Georgia State College: *Proposed Theoretical Model of Understanding Piecewise Functions.*

Abstract: Patterns of misconceptions among pre-calculus students are revealed for piecewise functions with jump and point discontinuities. Initial research on what students know about limits prompted this more in-depth investigation, to explain the unique altered perceptions of limits of piecewise functions exhibited by students in Calculus I and III courses. Student evidence is categorized into themes and presented in the context of a theoretical model of understanding functions.

9:10 – 9:30 Jeff Solheim: *Refuting a Conjecture of Goldbach.*

9:30 – 9:50 Peggy Hart, Doane University: *An Intro to the Mathematics Major Course.*

Abstract: First-year students are often exposed to mathematics solely via calculus courses, and therefore have little exposure of the realities of choosing this major. Doane University's 1-credit-hour Introduction to the Mathematics Major course exposes interested students to strategies, interesting and fun mathematical ideas, faculty members, academic planning and careers associated with the mathematics major.

9:50 – 10:00 **Break**

10:00 – 11:00 Guest speaker: *Michael Dorff,* Brigham Young University, Next president of the MAA: ***How mathematics is making Hollywood movies better*.**

Abstract: What's your favorite movie? *Star Wars? Avatar? The Avengers? Frozen*? What do these and all the highest earning Hollywood movies since 2000 have in common? Mathematics! You probably didn't think about it while watching these movies, but math was used to help make them. In this presentation, we will discuss how math is being used to create better and more realistic movies. Along the way we will discuss some specific movies and the mathematics behind them. We will include examples from Disney's 2013 movie *Frozen* (how to use math to create realistic looking snow) to Pixar's 2004 movie *The Incredibles* (how to use math to make an animated character move faster). Come and join us and get a better appreciation of mathematics and movies.

11:00 – 11:15 **Concluding remarks and Break**

11:15 – 12:15 Business Meeting