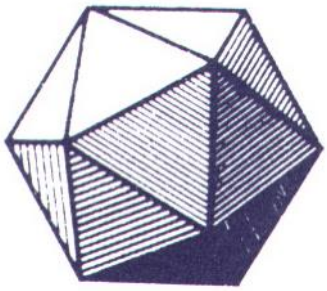
North Central Section

Mathematical Association of America



Fall Meeting • October 18-19, 2019
Concordia College
Moorhead, Minnesota

Friday, October 18, 2019

7:00 – 8:30 **Registration** – Grant Center, Barry Auditorium Lobby
$25 (Free for Students and Invited Speakers)

7:00 – 8:00 **Book Display**, Grant Center 032

Internet access: wireless access throughout campus via ConcordiaGuest network (no password necessary)

Contributed Session – Grant Center 114, Presiding: Nathan Axvig

7:00 – 7:20 **Jeremiah Bartz, University of North Dakota**
Playing Farkle with n-sided Dice

7:25 – 7:45 **Christopher Ennis, Normandale Community College** (Retired)
Between the Cracks: Filling Space with Polygonal Shapes

Invited Lecture – Grant Center, Barry Auditorium, Presiding: Jonathan Rogness

7:55 – 8:05 **Welcome**: Drew Rutherford, Division Chair of Sciences and Mathematics

8:05 – 9:00 **James Sellers, Secretary, MAA, University of Minnesota-Duluth**
Revisiting what Euler and the Bernoullis Knew About Convergent Infinite Series

9:00 – 10:00 **Reception** – Grant Center, Barry Auditorium Lobby

Saturday, October 19, 2019

8:30 – 11:00 **Registration** – Grant Center, Barry Auditorium Lobby

8:30 – 11:00,
12:00 – 2:00 **Book Display** – Grant Center 032

Invited Lecture – Grant Center, Barry Auditorium, Presiding: Julia Walk

9:00 – 9:05 **Welcome**

9:05 – 9:55 **Jessica Striker, North Dakota State University**
Mind-boggling Toggling

Morning Concurrent Session I – Grant Center 014, Presiding: Dan Biebighauser

10:05 – 10:55 **Section NExT Panel**
Moderator: Namyong Lee, Minnesota State University-Mankato
Dan Kemp, South Dakota State University, John Zobitz, Augsburg University, Timothy Prescott, University of North Dakota, Shawn Chiappetta, University of Sioux Falls, Aaron Wangberg, Winona State University
Starting or Leading a Math Club

Morning Concurrent Session II – Grant Center 114, Presiding: Mark Causapin

10:05 – 10:25 **Nathan Axvig, Concordia College**
Computing the Insphere of a Polyhedral Cone

10:30 – 10:50 **Karlee Westrem** (Graduate)
Groups of Units Modulo $f(x)$

Invited Lecture – Grant Center, Barry Auditorium, Presiding: Doug Anderson

11:00 – 11:50 **Aaron Wangberg, Winona State University**
2019 MAA-NCS Distinguished Teaching Award Recipient
Rethinking the Role of 'Math' in the Mathematics Classroom

12:00 – 1:15 **Lunch** – Knutson Campus Center, Anderson Commons

1:15 – 2:00 **Business Meeting** – Grant Center, Barry Auditorium, Presiding: Jonathan Rogness, Section President

Afternoon Concurrent Session I – Grant Center 114, Presiding: Sarah Seger

2:10 – 2:30 **Bismark Akoto** (Graduate)**, University of Minnesota**
Defining and Measuring Procedural Flexibility and Sense-making in Community College Algebra

2:35 – 2:55 **Sarah Jahn, Concordia University (St. Paul)**
Quantitative Reasoning for Nursing

2:55 – 3:10 Break

3:10 – 3:30 **Mark Causapin, Concordia College**
The Math Department's Profound Role in Training Highly Successful Elementary Teachers

3:35 – 3:55 **Mahrud Sayrafi** (Graduate)
One Year of Directed Reading at UMN

Afternoon Concurrent Session II – Grant Center 014, Presiding: Greg Tanner

2:10 – 2:30 **Rob Thompson, Carelton College**
Simulating Liquid Lenses

2:35 – 2:55 **Jie Min** (Graduate)**, University of Minnesota**
Graphs, Divisors and Symplectic Capping

2:55 – 3:10 Break

3:10 – 3:30 **Noah Wong** (Graduate)**, University of Minnesota-Duluth**
Newton's Method for 2 Dimensional Functions

3:35 – 3:55 **Bret Benesh, College of Saint Benedict and Saint John's University,**
A Determinant Game

Local Organizing Committee:
Doug Anderson, Dan Biebighauser, Julia Walk (chair)

Abstracts

Invited Addresses

James Sellers, Secretary, MAA, University of Minnesota-Duluth,
Revisiting what Euler and the Bernoullis Knew About Convergent Infinite Series

All too often in first-year calculus classes, conversations about infinite series stop with discussions about convergence or divergence. Such interactions are, unfortunately, not often illuminating or intriguing. Interestingly enough, Jacob and Johann Bernoulli and Leonhard Euler (and their contemporaries in the early 18th century) knew quite a bit about how to find the **exact** values of numerous families of convergent infinite series. In this talk, I will show two sets of **exact** results in this vein. The talk will be accessible to anyone interested in mathematics.

Jessica Striker, North Dakota State University,
Mind-boggling Toggling

The toggle group is a simply presented permutation group generated by certain involutions, called toggles. Despite its simple description, the toggle group turns out to be a powerful gadget for finding surprising connections between various objects, discovering intriguing dynamical phenomena, and proving results related to statistical physics. In this talk, we give a tour of the toggle group, with connections to algebra, geometry, combinatorics, and physics.

Aaron Wangberg, Winona State University,
Rethinking the Role of 'Math' in the Mathematics Classroom

Math instructors, just like students, evolve in their thoughts about the role of math and instruction in the mathematics classroom. Like many of my colleagues, what I valued as a student (lecture!) shifted (active engagement!) as I progressed through graduate school and into my early teaching career. But, as students and Raising Calculus adopters will attest, something went…. awry. In this talk, I'll share how three 'collisions' in the physics classroom so impacted my view on who does, owns, and voices mathematics in the classroom that it even re-directed my understanding of what it means to teach 'math'.

Section NExT Panel

Dan Kemp, South Dakota State University, John Zobitz, Augsburg University, Timothy Prescott, University of North Dakota, Shawn Chiappetta, University of Sioux Falls, Namyong Lee, Minnesota State University
Starting or Leading a Math Club

One of the ways in which new faculty can have an immediate impact on their department and students is to start or participate in leadership of a Math Club. However, with busy schedules (both faculty and students), this is not always an easy undertaking. Everyone is invited to this session which will provide ideas for how to start a group and how to motivate students to participate in a new or already established club. Panelists will share their experiences related to this, along with ideas for great activities that draw students and faculty in!

Contributed Talks

Bismark Akoto (Graduate)**, University of Minnesota,** Dexter Lim, University of Minnesota,
Defining and Measuring Procedural Flexibility and Sense-making in Community College Algebra

The Algebra Instruction at Community Colleges project investigates the instructional quality in algebra lessons at community colleges. Supporting Procedural Flexibility and Instructors Making Sense of Mathematics are two of the codes used in our EQIPM protocol to evaluate the instructional qualities of algebra instruction. Procedural flexibility measures the degree to which instructors present mathematics in a way that allows students to develop flexibility in solving a problem. Making sense of mathematics involves the development in the understanding of a problem by connecting it to prior knowledge. This session will discuss how flexibility and sense-making play out in community colleges.

Nathan Axvig, Concordia College,
Computing the Insphere of a Polyhedral Cone

The insphere of a polyhedral cone is the sphere of maximum radius taken from all spheres contained within the cone whose centers lie on the unit ball. A result of Henrion and Seeger implies that the insphere of a full-dimensional polyhedral cone exists and is unique, but their work is silent on how to compute such an insphere. In this talk we present an iterative method that can compute the insphere to within any degree of accuracy. Applications to error-control coding theory will also be discussed.

Jeremiah Bartz, University of North Dakota, Karlee Westrem, University of Minnesota-Duluth,
Playing Farkle with n-sided Dice

Farkle is a popular greedy-type dice game involving six 6-sided dice. Using various combinatorial techniques, we make gameplay observations and explore game strategies for the standard game of Farkle and a Farkle-like games involving n-sided dice. In particular, we are interested in changes as n varies. This work stems from the second author's undergraduate research project at the University of North Dakota.

Bret Benesh, College of Saint Benedict and Saint John's University (CSBSJU), Bardia Bijani Aval, CSBSJU, Mitchell Hansen, CSBSJU, Eddy MacDonald, CSBSJU, Emily Twardy, CSBSJU,
A Determinant Game

We study a game played by two players on a square matrix. Each turn, a player enters a real number into one of the matrix elements. At the end of the game, the determinant of the matrix is computed. The player who goes first wins if the determinant is nonzero, and the second player wins otherwise. We discuss winning strategies for various square matrices, as well as a variation of the game.

Mark Causapin, Concordia College,
The Math Department's Profound Role in Training Highly Successful Elementary Teachers

Math and education faculty typically share the responsibility of training prospective elementary teachers to teach mathematics. In most cases, mathematics content courses are offered by the math department, while education pedagogy courses are offered by the education department. The key assumption in this model is that prospective teachers can master mathematics and the "how-to's" of teaching mathematics separately, and somehow connect the two once they start teaching. This assumption is problematic. This presentation is about the "specialized mathematics knowledge" elementary teachers are not acquiring, and how the delivery of mathematics courses for elementary teachers can have far-reaching effects in future elementary teachers' and their students' success.

Christopher Ennis, Normandale Community College (Retired),
Between the Cracks: Filling Space with Polygonal Shapes

I'll present some background and an update on recent progress toward proving a conjecture of John Shier concerning his algorithm for the disjoint, but otherwise random placement of successively smaller copies of an arbitrary shape within a bounded region whose area is the infinite sum of all the shape areas. A proof for circular discs was given in MAA *Math Horizons*, February 2016. The conjecture has now been proved for all convex polygonal shapes and certain non-convex polygonal shapes that satisfy a geometric condition I've called *double containment*. The new result has been accepted for publication in MAA *Mathematical Monthly*.

Sarah Jahn, Concordia University (St. Paul),
Quantitative Reasoning for Nursing

Should your institution have a special math course specifically designed for nursing majors? If so, should this course be taught by the nursing faculty or the mathematics faculty? At Concordia University in St. Paul, we created a Quantitative Reasoning for Nursing Course taught by the math department in Fall, 2017. This presentation will include a discussion of the topics covered in the course, the challenges we encountered in creating the course and a summary of what we learned in the process.

Jie Min (Graduate)**, University of Minnesota,** Tian-Jun Li, University of Minnesota,
Graphs, Divisors and Symplectic Capping

A symplectic manifold is a smooth manifold with a closed, nondegenerate two form. A symplectic filling/cap is a symplectic manifold with certain restriction on its nonempty boundary. A filling and a cap can be glued together to form a closed symplectic manifold, so their topologies are intimately related. We use a certain type of symplectic caps which arise from configurations of surfaces and use them to study the topology of the corresponding filling. We also give simple combinatorial criterions on when such configurations can be useful.

Mahrud Sayrafi (Graduate)**, University of Minnesota-Twin Cities,**
One Year of Directed Reading at UMN

The Directed Reading Program (DRP) is a graduate student-run program that matches undergraduates with mathematics graduate students in independent reading projects. The original DRP started by graduate students at the University of Chicago over a decade ago, and has since spread to many other math departments. The graduate student mentor will be able to highlight subtle points and explain how things fit into the "big picture". This model lends itself to broadening participation in math by providing an inclusive and stress-free way to learn advanced mathematics.

In this talk, I will recount lessons learned in the first year of DRP@UMN.

Rob Thompson, Carelton College, Zack Johnson, Carleton College,
Simulating Liquid Lenses

Put a tiny droplet of oil on water. It will form a small lens-like shape. What is this shape, exactly? In this talk we discuss the equations that determine the shape of a fluid lens formed by depositing droplets of one fluid onto another. Reduction of the governing physical equation (the Young-Laplace equation) to a set of ordinary differential equations for the lens shape will be discussed along with methods for numerical solution of these equations. We'll also share the success (and failure) of these simulated lens shapes at predicting the shapes of actual polymer lenses produced in the research lab of Prof. Martha-Elizabeth Baylor at Carleton College. This work is done in collaboration with Prof. Baylor and '19 Carleton graduates Emily Schwartz and Sam Stevenson.

Karlee Westrem (Graduate)**, University of Minnesota-Duluth,**
Groups of Units Modulo $f(x)$

For a prime p and an irreducible polynomial $f(x)$ over Z_p, the ring of polynomials over Z_p modulo $f(x)$ denoted $Z_{p[x]}/< f(x) >$ is a finite field and the set of nonzero elements is a cyclic group under multiplication. We investigate the structure of the group of units of $Z_{p[x]}/< f(x) >$ when $f(x)$ is reducible over Z_p.

Noah Wong (Graduate)**, University of Minnesota-Duluth,**
Newton's Method for 2 Dimensional Functions

The dynamics of Newton's method for the complex function $z^2 - 1$ is well known. We explore the dynamics of Newton's method for a related function: $z^2 - 1 + A\bar{z}$, where A is a complex perturbation parameter. Since $\bar{z}$ is not complex analytic, Newton's method is a dynamical system on the real plane, rather than on the complex plane. The computer-generated pictures of the basins of attraction yield some surprises. We give a partial explanation of the resulting dynamics and bifurcations.