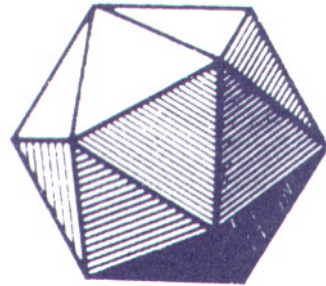


North Central Section

Mathematical Association of America



Spring Meeting • April 1-2, 2022
Metropolitan State University
Saint Paul, Minnesota

Friday, April 1, 2022 (7PM-10PM)

7:00 – 8:30 **Registration** – Science Education Center (SEC) Atrium
\$25 (Free for Students and Invited Speakers)

Internet access:

1. Open Wifi on your device.
2. Select Metro_Guest wireless SSID
3. Open a web browser
4. Agree to the Acceptable Use Policy

Contributed Session – SEC 115

7:30 – 7:50 **Tom Sibley, St. John's University and College of St. Benedict,**
Measuring "Dents-ity"

Invited Lecture – SEC 115, Presiding: Megan Breit-Goodwin, Section President

7:55 – 8:05 **Welcome:** Kyle Swanson, Dean of College of Sciences, Metropolitan State University

8:05 – 9:00 **Susan Crook, Loras College**
Inquiry-Based Learning: Emphasis on the Inquiry

8:05 – 9:00 **Student Activity** – SEC 308, Presider: Sarah Jahn, Concordia University, St. Paul

9:00 – 10:00 **Reception** – SEC Atrium

Saturday, April 2, 2022 (8:30AM-1:50PM)

8:30 – 11:00 **Registration and Breakfast** – Founders Hall Reception Area

Concurrent Session Ia – SEC 308, Presiding: David Jacobson, Metro State University

9:00 – 9:20 **Jodin Morey (Grad), University of Minnesota,**
Relative Equilibria of Dumbbells Orbiting in a Planar Newtonian Gravitational System

9:30 – 9:50 **Eva Airoidi (UG), Carleton College, Oliver Calder (UG), Carleton College, Antonia Ritter (UG), Carleton College, Rebekah Stein (UG), Carleton College, Tom Patterson (UG), Carleton College,**
Applications of Ensemble Analysis to Gerrymandering in Minnesota and Texas

Concurrent Session Ib – SEC 311, Presiding: Michael Green, Metro State University

9:00 – 9:20 **James Sellers, University of Minnesota – Duluth,**
Garden of Eden Partitions for Bulgarian and Austrian Solitaire

9:30 – 9:50 **Adam Shultze, St. Olaf College,**
Introduction to Crystal Graphs

Concurrent Session IIa – SEC 308, Presiding: Craig Calcaterra, Metro State University

10:00 – 10:20 **Nikhil Jain (HS in PSEO Program), University of Minnesota,** Alexis Johnson,
University of Minnesota
Fantasy Football Machine Learning Algorithm

10:30 – 10:50 **Anders Nielsen (UG), Winona State University, Megan Lee (UG), Winona State University, Parker Leipnitz, (UG), Winona State University,**
Jacob Duncan, Winona State University
Assessing the Connectivity of Bicycle Infrastructure with Graph Theory

Concurrent Session IIb – SEC 311, Moderator: Rebecca Glover, University of St. Thomas

10:00 – 10:20 **MITN Lightning Talk Session I**
Jeff Ford, Gustavus Adolphus College,
You all do this for fun too, right?
Kristen Sellke, Saint Mary's University of Minnesota,
Grading Reform aka The Calculus Panic of Spring 2021
Namyong Lee, Minnesota State University, Mankato,
Does IBL Work Online?
Aaron Wangberg, Winona State University,
Oops, We Over-fit It Again!

- 10:30 – 10:50 **MITN Lightning Talk Session II**
Anne Sinko, College of Saint Benedict and Saint John's University,
"You Lie!": State of the Unions in the Monty Hall Problem
Megan Breit-Goodwin, Anoka-Ramsey Community College,
A Moment of Sheer Panic in Introductory Statistics Class
Melissa Hanzsek-Brill, St. Cloud State University,
Correcting and Reflecting: A First Time Ungrading Fail
- 11:00 – 12:00 **Business Meeting** – Founders Hall Auditorium, Presiding: Megan Breit-Goodwin,
Section President
- 12:00 – 1:00 **Lunch** – New Main – Great Hall
- Invited Lecture** – FH Auditorium, Presiding: Megan Breit-Goodwin, Section President
- 1:00 – 1:50 **Haydee Lindo, Harvey Mudd College,**
TBD

A thanks to all Metropolitan State Volunteers (*Organization Chairs, **Student):
Max Blochowiak**, Craig Calcaterra, Marisa Eftefield**, Claire Evans**, Jason Evans, Mike
Green, David Jacobson, Katherine Johnson, Natalie Klang**, Cindy Kaus, Casey Volante**,
Rikki Wagstrom*, Wei Wei*

Abstracts

Invited Addresses

Susan Crook, Loras College,
Inquiry-Based Learning: Emphasis on the Inquiry

“I hope you never lose your sense of wonder

You get your fill to eat, but always keep that hunger”

I can't confirm that Lee Ann Womack was thinking about an inquiry-based learning approach to mathematics when she sang her 2000 hit “I Hope You Dance,” but it fits so well that I can't imagine she wasn't. Too often, people leave school equating mathematics and arithmetic. Inquiry-based learning (IBL) is a tool to engage students and friends in mathematics in an authentic manner – a tool to help others see what it is about mathematics that we love. In this interactive talk, we'll consider IBL approaches and activities from both a student and a teacher viewpoint. We'll discuss how to find that sweet spot between giving enough information and leaving enough material to discover and how to adapt as it changes.

Haydee Lindo, Harvey Mudd College,
TBD

TBD

MITN Lightning Talk Sessions

In inquiry-based classes, we ask our students to struggle and make mistakes but frequently do not allow the same for ourselves. In this session, IBL practitioners will tell a story about a teaching failure or struggle. They will share what they learned from that experience as an instructor and perhaps did something different the next time.

Speakers (Part I):

Jeff Ford, Gustavus Adolphus College,

You all do this for fun too, right?

Kristen Sellke, Saint Mary's University of Minnesota,

Grading Reform aka The Calculus Panic of Spring 2021

Namyong Lee, Minnesota State University, Mankato,

Does IBL Work Online?

Aaron Wangberg, Winona State University,

Oops, We Over-fit It Again!

Speakers (Part II):

Anne Sinko, College of Saint Benedict and Saint John's University,

"You Lie!": State of the Unions in the Monty Hall Problem

Megan Breit-Goodwin, Anoka-Ramsey Community College,

A Moment of Sheer Panic in Introductory Statistics Class

Melissa Hanzsek-Brill, St. Cloud State University,

Correcting and Reflecting: A First Time Ungrading Fail

Contributed Talks

**Eva Airoidi (UG), Carleton College, Oliver Calder (UG), Carleton College, Antonia Ritter (UG),
Carleton College, Rebekah Stein (UG), Carleton College, Tom Patterson (UG),
Carleton College,**

Applications of Ensemble Analysis to Gerrymandering in Minnesota and Texas

We utilize the existing framework of ensemble analysis with some modifications to quantify and contextualize the level of gerrymandering in Minnesota and Texas maps. By generating a representative sample of all legal districting plans for the given state, we identify whether the real plan is an outlier on a number of physical, demographic, and partisan metrics of gerrymandering. We found that typical metric scores varied in bias towards a particular party across states, likely because of different geography and population distributions. This implies that evaluating gerrymandering requires the comparison of metrics within the context of a state. Using this method, we found a typical, legal Texas map is more likely to favor the Republican party than one in Minnesota. Additionally, the 2010, 2020, and proposed 2020 maps in Minnesota do not show unusual amounts of bias, while the 2010 map in Texas shows strong evidence that racial and political gerrymandering could be present.

Nikhil Jain (in PSEO Program), University of Minnesota, Alexis Johnson, University of Minnesota
Fantasy Football Machine Learning Algorithm

For the past four years, I had missed the playoffs in my fantasy football league. I wanted to find a way to use my new knowledge of coding to remedy this cycle of losses. After reading about the creation of WalterPicks, an app that provides sports insights using machine learning and AI, I was inspired to create my own machine learning algorithm to predict fantasy football scores using data from previous seasons. In this talk, I will discuss how we automated the data collection process, the details of feature selection, the model used, and how we trained, tested, and tuned the model. For the 148 players overall, the model overprojected points per game by an average of 2.4225. Thanks to the software I created (and maybe a little bit of luck), I ended up winning my fantasy football league.

Anders Nielsen (UG), Winona State University, Megan Lee (UG), Winona State University, Parker Leipnitz (UG), Winona State University, Jacob Duncan, Winona State University
Assessing the Connectivity of Bicycle Infrastructure with Graph Theory

The efficiency of bicycle infrastructure plays an important role in promoting sustainable transport. One way to assess the efficiency of a bikeway system is to analyze the connectivity of the network of bike trails, lanes, and other bike routes that connect various points in the city. In this talk, we develop and employ a variety of graph connectivity measures to quantify the connectivity of bicycle infrastructure in a particular city. With the aid of community input and a city bicycle map, we construct a graph model of a bikeway system using vertices to represent specific geographical locations in the city. Edges are defined between vertices if there is a direct bike route (bike lanes, paths, designated shoulders, etc.) connecting the two corresponding locations. Connectivity of the system is then measured using the concepts of vertex degree, edge connectivity, maximum flow, and distance. This connectivity assessment process can be used to inform city planners in improving the connectivity of the bikeway system, hence promoting healthy living, pollution and climate change mitigation, and a safer, more sustainable transportation system.

Jodin Morey (Grad), University of Minnesota,
Relative Equilibria of Dumbbells Orbiting in a Planar Newtonian Gravitational System

In the cosmos, any two bodies share gravitational attraction. When in proximity, their motions are modeled by Newtonian gravity. Newton found orbits when these bodies are infinitely small, the two-body problem. The situation of varying body shapes and sizes, called the full two-body problem, remains open. We find relative equilibria and their stability when each body is restricted to a plane and consists of two point-masses connected by a massless rod, a dumbbell. In particular, we find symmetric RE in which the bodies are arranged colinearly, perpendicularly, or trapezoidally.

James Sellers, University of Minnesota – Duluth,
Garden of Eden Partitions for Bulgarian and Austrian Solitaire

In the early 1980s, Martin Gardner popularized the game called Bulgarian Solitaire through his writings in Scientific American. After a brief introduction to the game, we will discuss a few results proven about Bulgarian Solitaire around the time of the appearance of Gardner's article and then quickly turn to the question of finding an exact formula for the number of Garden of Eden partitions that arise in this game. I will then introduce a related game known as Austrian Solitaire and consider a similar question about the Garden of Eden states that appear. The talk will be completely self-contained and should be accessible to a wide ranging audience. This is joint work with Brian Hopkins and Robson da Silva.

Adam Shultze, St. Olaf College,
Introduction to Crystal Graphs

Crystal bases are combinatorial objects that coincide with representations of Lie algebras. They are directed graphs whose vertices can be described by certain fillings of Young diagrams and whose edges are procured via a simple bracketing procedure. In this talk, we build these graphs in a purely combinatorial manner and note how they can be made available to undergraduates from a variety of academic backgrounds. We finish by exploring a recent application of crystal graphs in efforts to solve a long standing problem of extending the Lascoux-Schutzenberger charge, a statistic on words of partition content, to all classical Lie types.

Tom Sibley, St. John's University and College of St. Benedict,
Measuring "Dents-ity"

Unlike horseshoes and hand grenades, close doesn't count with convexity: a geometric set is either convex or it isn't. Yet we can intuitively think some non-convex sets come closer to convex than others. Some computer scientists working on visual pattern recognition and some political scientists studying gerrymandering have come up with what they call measures of convexity. I propose a way of comparing these measures and a couple that I think are my own. I don't think any of these measures is a "winner" but I'll let you be the judge.

NCS MAA Fall 2022 Meeting University of North Dakota

Safety Guidance

Your health and safety, as well as that of other meeting attendees, Metropolitan State University employees, and students, is important to us. This is a shared responsibility, which is why we ask that you stay at home if:

- you are sick or not feeling well,
- you test positive for COVID-19,
- you are awaiting results from a COVID-19 test, or
- you are not fully vaccinated and you have been exposed to someone who has tested positive for COVID-19 within the last 14 days.

Face masks (Updated March 3, 2022):

Masks are welcome, but not required at the MAA-NCS spring meetings.

Water Bottles:

We ask that attendees bring their own labeled water bottles to the meeting. Drinking fountains are available to use and water flow is regularly checked. We recommend that the use of the fountains be for refilling bottles. Please don't touch your mouth to the fixture. Drinking fountains are cleaned once a day by janitorial staff. Metropolitan State University will have a limited supply of recyclable water bottles available for attendees that forget.

MAA Meetings Safety Requirements:

All meeting attendees will sign an MAA Meeting Safety Requirements statement. The MAA requires that all attendees acknowledge and accept the risks and requirements associated with participation in MAA Section meetings. Attendees must agree to abide by the host university's protocols in accordance with CDC guidance.

Visit <https://www.metrostate.edu/notices/covid-19> to learn more about Metropolitan State University and MinnState policies regarding COVID safety measures.