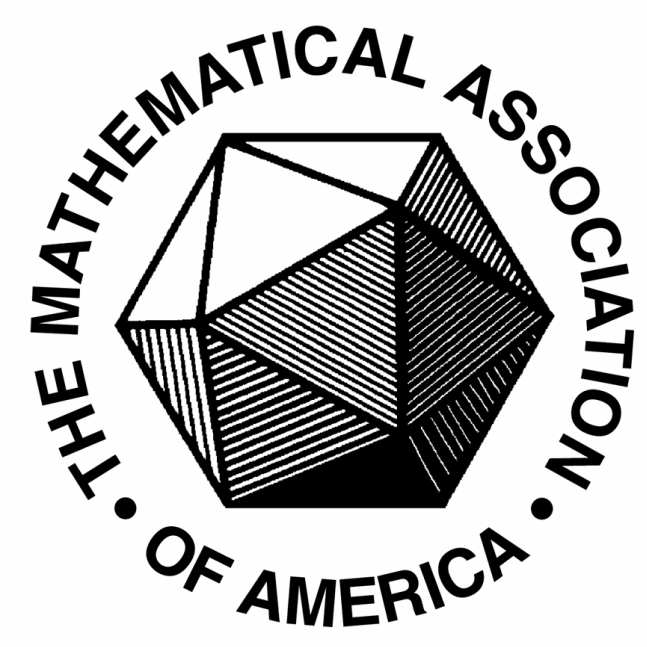
Annual Meeting
of the
Pacific Northwest Section
of the
Mathematical Association of America



University of Washington Tacoma
Tacoma, Washington

April 25-26, 2025

Annual Meeting
of the
Pacific Northwest Section
of the
Mathematical Association of America

Hosted by the University of Washington Tacoma
School of Interdiscplinary Arts and Sciences
Sciences and Mathematics Division
Tacoma, Washington
April 25-26, 2025

Friday, April 25

<table>
<tr><td>8:00

2:45</td><td colspan="2">PNW Section NExT Meeting
Tioga Library Building (TLB), Room 109</td></tr>
<tr><td>3:00

5:30</td><td colspan="2">Minicourse: Transforming Textbook Problems into Engaging Student Activities [1]
Tioga Library Building (TLB), Room 109</td></tr>
<tr><td>6:00</td><td>Student Registration[1]
& Pizza Reception
Dawg House Student Lounge, Mattress Factory (MAT) building</td><td>General Registration[1]
William W. Philip Hall (WPH), Atrium</td></tr>
<tr><td>7:30</td><td colspan="2">Welcome Address: Maureen Kennedy
Chair of the Division of Sciences & Mathematics
University of Washington Tacoma

Invited Address: Hortensia Soto
Creating and Sharing Linear Algebra Metaphors as an Assessment for Engaging Students Beyond the Cognitive Domain [2]
William W. Philip Hall (WPH)</td></tr>
<tr><td>8:40

9:30</td><td colspan="2">Dessert Reception
William W. Philip Hall (WPH)</td></tr>
</table>

[1]Participants who registered online prior to the meeting may check-in to pick up badges and programs. There is limited on-site registration. Payments must be made electronically, by credit card.

Saturday, April 26

<table>
<tr><td>7:30</td><td colspan="2">Executive Committee Meeting
Russell T. Joy building (JOY),
Room 207</td></tr>
<tr><td>8:00</td><td>General Registration Begins[2]
William Philip
Hall (WPH), Atrium</td><td></td></tr>
<tr><td>9:00</td><td colspan="2">Introductory Remarks: Allison Henrich
Professor of Mathematics, Seattle University

INVITED ADDRESS: STEVEN KLEE
What Are You Going To Do With a Math Degree? [3]
William W. Philip Hall (WPH)</td></tr>
<tr><td>10:20

12:25</td><td colspan="2">Simultaneous Sessions
Russell T. Joy building (JOY),
Rooms 109, 113, 206, 207, 210</td></tr>
<tr><td>12:30</td><td>Lunch pick-up
Russell T. Joy (JOY) building, Atrium</td><td rowspan="2">Movie Showing: CountedOut
Hosted by the UW Tacoma Math Club

Russell T. Joy building (JOY),
Room 117</td></tr>
<tr><td>1:20

2:00</td><td>Section Business Meeting
William W. Philip Hall (WPH)</td></tr>
<tr><td>2:10

3:10</td><td colspan="2">Panel Discussion: Careers and How To Catch One
Panelists: Hortensia Soto, Steven Klee, Marion LaRocque
William W. Philip Hall (WPH)</td></tr>
<tr><td>3:20

5:25</td><td colspan="2">Simultaneous Sessions
Russell T. Joy building (JOY),
Rooms 109, 113, 206, 207, 210</td></tr>
<tr><td>5:30</td><td colspan="2">Social Hour & Hors d’Oeuvres Reception
Sponsored by Transform Learning
William W. Philip Hall (WPH)</td></tr>
<tr><td>6:30</td><td colspan="2">Section Awards
William W. Philip Hall (WPH)</td></tr>
<tr><td>6:45

8:00</td><td colspan="2">Introductory Remarks: Natalie Eschenbaum
Dean of the School of Interdisciplinary Arts & Sciences,
University of Washington Tacoma

INVITED ADDRESS: CANDICE PRICE
Can We Make Grace the Norm in Our Classrooms? [5]
William W. Philip Hall (WPH)</td></tr>
</table>

[2]On Saturday, general registration will run from 8:00am to 12:30pm in the WPH Atrium.

Program of Contributed Papers

The program of contributed papers appears on the following pages. In some cases, titles or other information are abbreviated for due to space constraints; please see the full abstract for more information.

A dagger (†) indicates which contributor(s) will present when multiple contributors are listed and fewer are presenting the work. An asterisk (*) indicates the contributor is a graduate student. Double asterisks (**) or triple asterisks (***) indicate the contributor is an undergraduate student or a high school student, respectively.

Session Organizers

Please contact the session organizer with any questions about a session.

- *Applied Mathematics*: Kelsey Marcinko, Whitworth University
- *Building a Collaborative Community in the PNW Section*: Charles Camacho, University of Washington, and Aaron Wooton, University of Portland
- *Keep Calm and Puzzle On*: University of Washington Tacoma Math Club
- *Removing Hurdles for Students in Mathematics Courses*: Ksenjia Simic-Mueller, Pacific Lutheran University, and Ekaterina Yurasovskaya, Seattle University

Moderators: Please start each talk on time, but **not** early. Meeting participants often move between sessions and will want to be there when the talk is scheduled to begin.

Conference Sponsors

UNIVERSITY of WASHINGTON
SCHOOL OF INTERDISCIPLINARY ARTS & SCIENCES
SCHOOL OF EDUCATION

Transform Learning

everylearner everywhere

FlatWorld
The Textbook Good Guys

SEATTLE UNIVERSITY | COLLEGE OF SCIENCE AND ENGINEERING

Pearson

Contributed Talks – Saturday Morning

	Contributed Paper Session	Special Session in Applied Mathematics 1	Special Session in Building a Collaborative Community in the PNW Section
	JOY 207	*JOY 109*	*JOY 113*
10:20–10:40	*Exploring the Possibilities of Quantum Computing* [28] **Malaya Jove** and Yimesgen Buruk**, UWT**	*Quantitative Modeling of Molecular Shape Recognition* [17] **Noah Dunham and Shay Perlot, Whitworth**	*Lessons From 100 Collaborations* [25] **Allison Henrich, SU**
10:45–11:05	*Performing Topological Data Analysis in Python with Mapper* [44] **David Walker**, UWT**	*Modelling Inductive Pulsed Plasma Thrusters* [42] **Jenea Mei Trousil**, Whitworth**	*Mathematics Education for Peace* [12] **Candice Carter, Independent Scholar**
11:10–11:30	*Fabric Origami: An Exploration of Mathematical Crafting* [26] **Holley Jones** and Kieran O'Callaghan**, UWT**	*The Mathematics of Virtual X-ray Imaging* [46] **Matthew B. P. Wong**, Gonzaga**	*Data Labs for Calculus* [47] **Aaron Wootton, UP**
11:35–11:55	*Knot in a Box* [16] **Mary Deng**, Sean Kawano** , SU**	*Applying Virtual X-Rays to Practical Examples* [14] **Sean J. A. Cowan**, Gonzaga**	*Math Teaching Collaborations to Address Current Challenges Across PNW* [11] **Alexandra Nichifor, UWS**
12:00–12:20	*Cospectral Constructions for the Generalized Distance Matrix* [34] **Kate Lorenzen†, Ori Friesen, Cecily Kolko, Sarah Zaske, Amy Zeidler, Nick Layman, Linfield**	*Dispersion Reduction Schemes for the 3D Acoustic Wave Equation* [19] **Mia Escobar**† and Yajun An, UWT**	*Session Conversation*

Contributed Talks – Saturday Morning		
	Contributed Paper Session	**Education & Social Science**
	JOY 206	*JOY 210*
10:20–10:40	*Responding to the Need for Data Scientists in the South Puget Sound* [30] **Zaher Kmail, UWT**	*Meaningful Math: Trade Based Quantitative Literacy* [21] **Mark Fitch, UAA**
10:45–11:05	*Data Literacy and Visualization: Improving Undergraduate STEM Education Through Service Learning* [31] **Zaher Kmail, UWT**	*Into (and Out of) the Woods: Modeling Students' Use of Online Resources to Study Mathematics* [18] **Ander Erickson, UWT and Tramon Jones, UWS**
	Special Session in Removing Hurdles For Students in Mathematics Courses 1	
	JOY 206	
11:10–11:30	*Creating an Accessible Environment in the Mathematics Classroom* [38] **Cameron Raber, PLU**	*Evidence-Based Teaching Practices and Ideas for Implementing them with Digital Tools* [32] **Christine Latulippe, Linfield**
11:35–11:55	*Effective Group Learning through Critical Roles* [23] **Corban Harwood, George Fox**	*Subsidizing Inclusive Insurance to Reduce Poverty* [33] **Sooie-Hoe Loke**, CWU**
12:00–12:20	*Redesigning Precalculus Using a Modular and Self-paced Structure* [13] **Christine Cole, Dylan Helliwell, and Angela Siple, SU**	*Analyzing Salary Compression with Multiple Models* [10] **Jeremiah Brown** and Izabela Lacki**, UWT**

Contributed Talks – Saturday Afternoon

	Algebra and Combinatorics	Special Session in Applied Mathematics 2	Keep Calm and Puzzle On
	JOY 207	*JOY 109*	*JOY 113*
3:20–3:40	*On the Atomicity of One-dimensional Monoid Algebras* [37] **Ishan Panpaliya**, SU**	*The Hare, the Tortoise, and the Separation of Time Scales That Makes Wildfire Complex* [29] **Maureen C. Kennedy, UWT**	
		Contributed Paper Session *JOY 109*	
3:45–4:05	*Investigating Qualitative Properties of the Third Smallest Eigenvalue of the Graph Laplacian* [36] **Henry Pallette**, CWU**	*Computing and Estimating Distortion Risk Measures: How to Handle Analytically Intractable Cases?* [43] **Sahadeb Upretee, CWU**	*Puzzle Session* **UWT Math Club**
4:10–4:30	*How Much Information is in a Matrix Anyway?* [9] **James Bisgard, CWU**	*My Experiences Interning at UWT and Finding Complexity Measurements of STEM Majors* [41] **Ngoc Tran***, Highline Big Picture High School**	
4:35–4:55	*The Process and Play in Solving Star Sums* [24] **Matthew Helmer**, PLU**	*Using Statistical Methods to Optimize an Open Range Breakout Trading Strategy* [20] **Lahiru Fernando, UWS**	
5:00–5:20	*Helping Students See the Forest Rather Than the Fallen Trees When Using Row Operations* [40] **Jeffrey Stuart, PLU**	*Determining Influential Factors in Social Networks: A Comparative Analysis of Centrality Measures* [27] **Holley Jones** and Luke Sterquell**, UWT**	

Contributed Talks – Saturday Afternoon		
	Special Session in Removing Hurdles For Students in Mathematics Courses 2	**Contributed Paper Session**
	JOY 206	*JOY 210*
3:20–3:40	*Stretch Calculus: A Way to Increase Student Completion of Calculus I* [22] **Emily Gismervig and Nicole Hoover, UWB**	*Book Embeddings and Abstract Data Structures* [35] **Thomas McKenzie, Gonzaga**
3:45–4:05	*Developing Students' Autonomy in Calculus Courses Through the Lens of South Asian Moral Philosophy* [8] **Alexandre Barchechat, UWB**	*Geometric Model Construction: A Hands-On Learning Experience* [6] **Rudolfo Luna Acosta**, UWT**
4:10–4:30	*Making Ourselves Learners So We Can Better Support Our Students (My Spring with PingPong AI and TBIL)* [45] **Brandy Wiegers, CI**	*Network Analysis of Collaboration in Mathematics Research* [39] **Anna Singley**, UP**
4:35–4:55	*Co-requisite Course Improves Student Performance in Intro to Proof* [48] **Ekaterina Yurasovskaya, SU**	*Hexagons are the Bestagons* [7] **Carter Alanis**, Roland Allen** , Gonzaga**
5:00–5:20	*Session Conversation*	*A Mathematical Analysis of the Visual Appeal of PopMart Blind Box Figurines* [15] **Patricia Dao**, UWS**

Social Events

Thursday PNW Section NExT Gathering
7:00-9:00pm at The KOI – 1552 Commerce St #100, Tacoma, WA 98402

Friday PNW Section NExT Dinner
5:00-7:00pm at 7 Seas Brewery and Taproom – 2101 Jefferson Ave, Tacoma, WA 98402

Friday Student Reception
Hosted by the UW Tacoma Math Club
6:00-7:30pm at the Dawg House Student Lounge – Mattress Factory (MAT) building

Friday Evening Invited Address: Hortensia Soto
Creating and Sharing Linear Algebra Metaphors as an Assessment for Engaging Students Beyond the Cognitive Domain [2]
7:30pm at William W. Philip Hall (WPH)

Friday Dessert Reception
8:40pm at William W. Philip Hall (WPH)

Saturday Morning Invited Address: Steven Klee
What Are You Going To Do With a Math Degree? [3]
9:00am at William W. Philip Hall (WPH)

Saturday Lunch (pick up)
12:25pm at Russell T. Joy (JOY) building atrium

Saturday Movie Showing: *CountedOut*
Hosted by the UW Tacoma Math Club
12:30pm at the Russell T. Joy building (JOY), Room 117

Saturday Afternoon Discussion Panel
Careers and How to Catch One
2:10pm at William W. Philip Hall (WPH)

Saturday Social Hour & Hors d'Oeuvres Reception
Sponsored by Transform Learning
5:30pm at William W. Philip Hall (WPH)

Section Awards Ceremony
6:30pm at William W. Philip Hall (WPH)

Saturday Evening Invited Address: Candice Price
Can We Make Grace the Norm in Our Classrooms? [5]
6:45pm at William W. Philip Hall (WPH)

Minicourse Descriptions

Friday, April 25

1 *Transforming Textbook Problems into Engaging Student Activities*

Chris Black, Central Washington University,
Natalie Naehrig, University of Washington, and
Katharine Shultis, Gonzaga University

Active learning and student engagement in the classroom have been proven repeatedly to be the most effective approach to foster learning. In this mini course we will transform standard textbook problems to active learning exercises based on the four pillars of active learning, identified by S. Laursen and colleagues: deep student engagement with rich mathematics, collaboration in making sense of mathematical ideas, instructor inquiry into student thinking, and equity in design and facilitation choices. Participants will walk away with tools, ideas, and strategies that can be used to create their own engaging problems for any course.

Abstracts of Invited Addresses

(in chronological order)

2 *Creating and Sharing Linear Algebra Metaphors as an Assessment for Engaging Students Beyond the Cognitive Domain*

Hortensia Soto, Colorado State University

In this presentation I will take the audience on a journey of an introductory linear algebra class designed to help students develop a geometric understanding of basic linear algebra concepts. I will share some embodied activities that I implemented in the course and then share metaphors that the students created for basic linear algebra concepts. Preliminary findings of this work suggest that the embodied activities, linguistics, and students' identities informed the metaphors that they created. Moreover, I will showcase how this assessment illustrated students' cognitive understanding of the concepts as well as their behavioral and affective domains. The students expressed all three of these domains (cognitive, behavioral, and affective) via embodiment including gestures, body posture, facial expressions, and tone of voice. In conclusion, I will share the value and challenges of such assessments.

3 *What Are You Going To Do With a Math Degree?*

Steven Klee, Amazon Web Services

In this talk I will share some of my story as a mathematician who has worked both as a professor and in industry. We'll learn about some of the basic mathematics behind machine learning and I'll share a sampling of how I have used those and other mathematical ideas in some of my recent projects at Amazon. At the end, I'll share some thoughts about why we need more mathematicians in industry, and offer some tips on how you can plan your studies if this career path sounds interesting to you (and even if it doesn't).

4 *Panel: Careers and How to Catch One*

Hortensia Soto, Steven Klee, Marion LaRocque

The panelists will share the stories of their various career pathways, path-lengths, and experiences across academia, industry, and government. In addition to exploring the panelists' myriad career pathways, significant time will be devoted to audience questions. We invite students who are curious about interview processes, faculty interested in transitioning to industry, or anyone looking for information about building or moving careers!

5 *Can We Make Grace the Norm in Our Classrooms?*

Candice Price, Smith College

For much of my life, I was always confused about the way that people perceived the relationship between students and instructors in the classroom, especially in mathematics. There is such an adversarial relationship that even sharing my career choice with strangers leads to groans and stories of trauma. I believe this is what happens in a classroom without grace. So when we add grace the opposite should happen, right? During our time together, I hope to discuss with you the ways that I incorporate grace in my classroom and why many people think it is radical. I invite everyone to come and reflect on ways they can make grace the norm in their classrooms and spaces.

Abstracts of Contributed Talks

(in alphabetical order, by presenter)

6 *Geometric Model Construction: A Hands-on Learning Experience*
Rudolfo Luna Acosta, University of Washington Tacoma**

In this presentation, we explore the diverse learning opportunities that arise from a project in a junior-level geometry course. This project challenged students to construct a 3D model with mathematical significance, providing hands-on experience in geometric concepts, collaboration, and the process of creating a complex structure as a team.

7 *Hexagons Are the Bestagons*
Carter Alanis, Gonzaga University**
Roland Allen, Gonzaga University**

Many types of tiles can be used to represent projections of knots onto small grids, namely mosaic (square) tiles and hexagonal tiles. We aim to show that there is a relationship between the tile numbers on these grids. Efficiency can sometimes be improved using simple shifts of crossings.

8 *Developing Students' Autonomy in Calculus Courses Through the Lens of South Asian Moral Philosophy*
Alexandre Barchechat, University of Washington Bothell

After giving a non-western definition of knowledge, I will discuss different activities I have implemented, in and out of the classroom, to develop students' deontic authority and autonomy. I will then share qualitative data about how students perceive this increase in freedom and responsibility. If time permits, I will wrap up my presentation by noting similarities between self-determination theory and South Asian philosophy.

9 *How Much Information is in a Matrix Anyway?*
James Bisgard, Central Washington University

Matrices are nice data structures, since we can use them to encode information about relationships between "things." For example, a matrix could encode the relationship between users and their ratings of software, movies, etc. A relevant question then is "how much information does that matrix contain?" We discuss two useful linear algebraic tools and how they can help give a meaningful answer.

10 *Analyzing Salary Compression with Multiple Models*
Jeremiah Brown, University of Washington Tacoma**
Izabela Lacki, University of Washington Tacoma**

Salary compression, in the context of universities, refers to the phenomenon of small salary differentials between the junior and senior faculty. We utilize and assess multiple measures of salary compression and apply them to a set of salary data. All methods (linear regression, exponential, and average percentage difference modeling) are analyzed individually using quantitative/categorical variables of data, as well as statistical measurements such as residual values. Furthermore, compression metrics are applied to analyze each model as well as a pool of results across the models.

11 *Math Teaching Collaborations to Address Current Challenges Across PNW*
Alexandra Nichifor, University of Washington Seattle

With the proliferation of AI technologies in math education, and increased isolation and wider gaps in foundational knowledge among college math students, how do we best engage students and bring the human element into our math classes? I am interested in starting collaborations with faculty who are interested in both finding commonalities in the challenges we currently face as higher ed math teachers as well as designing and implementing tangible solutions. The talk will touch on observations from our undergraduate math courses at the University of Washington, Seattle by myself and my colleagues.

12 *Mathematics Education for Peace*
Candice Carter, International Peace Research Association

She seeks collaboration to address the need for information about mathematics-based peace education and research on it. As time permits in this special session, Candice will share goals of peace education and theoretical frameworks in which it has been researched.

13 *Redesigning Precalculus Using a Modular and Self-paced Structure*
Christine Cole, Seattle University
Dylan Helliwell, Seattle University
Angela Siple, Seattle University

It is well known that mathematics courses serve as a significant barrier to progress, and therefore retention, at colleges and universities across the country. To address some of the systemic challenges, we have developed a new way to teach mathematics below the calculus level that is flipped, modular, self-paced, and standards-based. Early results indicate that our new structure is serving to improve students' experience and success.

14 *Applying Virtual X-Rays to Practical Examples*
Sean J. A. Cowan, Gonzaga University

In this presentation, we expand upon the mathematical development introduced in the previous talk to demonstrate how virtual X-ray techniques can be applied to generate reconstructions from actual electrode measurements. By mathematically unbending the paths of electrical current, we create images similar to those produced by X-ray CT scanners, enabling the use of standard CT reconstruction algorithms. We will present images reconstructed from both real-world tank data and numerically simulated data, highlighting our progress toward applying the methods to human data. This talk will showcase some of the world's first-ever virtual X-ray images, which illustrate the method's potential for advancing the field of medical imaging.

15 *A Mathematical Analysis of the Visual Appeal of PopMart Blind Box Figurines*
Patricia Dao, University of Washington Seattle**

The Chinese toy company, PopMart, has gained international popularity within recent years, largely attributed to aesthetical design of its figurines and notably the adoption of the blind box. The blind box sales method allows the consumer to purchase a box containing a randomized figurine from a specific character series. This study explores the design elements of PopMart's blind box figures to uncover underlying design principles that contribute to consumer satisfaction. By examining the proportional relationships between the figures' features to classical aesthetic principles, such as the Golden Ratio and the Silver Ratio, this study evaluates their influence on visual appeal and therefore modern design.

16 *Knot in a Box*
Mary Deng, Seattle University, and**
Sean Kawano, Seattle University**

Tame knots, which are equivalent to a polygonal knot with a finite number of sides, have well-studied invariants; conversely, wild knots that exhibit infinite and pathological behavior are difficult to study and classify. Knot mosaics, introduced by Lomanoco and Kauffman, are an example of a complete invariant for tame knots. Our project aims to expand the existing formal system of knot mosaics to develop an invariant for wild knots. We define n-singular mosaic tangles, the mosaic analog of tangle insertions in pseudoknots and singular knots, and we formalize a system of infinite insertion that generates a wild mosaic to represent certain wild knots. We also intend to define wild mosaic equivalence moves to capture the notion of wild knot equivalence in the mosaic setting. This gives insight to many wild knots explored in existing literature and provides methods to generate and classify new examples.

17 *Quantitative Modeling of Molecular Shape Recognition*
Noah Dunham, Whitworth University**
Shay Perlot, Whitworth University**

Crystal formation is an essential area of study in materials science. Crystals also have useful electrical and optical properties. However, predicting when molecules will form a crystal structure is challenging. This study compared pairs of quasienantiomers, mirrored molecules that differ by one functional group, by quantifying the differences in molecular shape to provide a diagnostic tool to predict crystal formation. We developed a tool that uses several methods to approximate variations in molecular volume by analyzing the effect of changing functional groups within a crystal structure. We also present preliminary results of this tool's application to crystal data.

18 *Into (and Out of) the Woods: Modeling Students' Use of Online Resources to Study Mathematics*
Ander Erickson, University of Washington Tacoma
Tramon Jones, University of Washington Seattle

We present a theoretical model of undergraduate students' use of online resources to study mathematics. This model was developed through the analysis of large-scale survey responses in tandem with a series of semi-structured follow-up interviews. We look at reasons why students employ certain commonly-used resources, like Google, YouTube, and Chegg, over others, and what triggers them to begin using such resources in the first place. This model will also provide a framework for a short discussion of ways that students can be supported to make more productive use of available resources while avoiding counterproductive practices.

19 *Dispersion Reduction Schemes for the 3D Acoustic Wave Equation*
Mia Escobar, University of Washington Tacoma**

Finite-difference (FD) methods for the wave equation are flexible, robust and easy to implement. However, they in general suffer from numerical dispersion. FD methods based on accuracy give good dispersion at low frequencies, but waves tend to disperse for higher wavenumbers. Moreover, waves in higher dimensions also suffer from dispersion errors in all propagation angles. In this work, we will give a unified methodology to derive dispersion reduction FD schemes for the three-dimensional acoustic wave equation. This new methodology would generate schemes that give the theoretical minimum dispersion error in the uniform norm. Stability criteria is given, and stability analysis is done for each generated scheme.

20 *Using Statistical Methods to Optimize an Open Range Breakout Trading Strategy*
Lahiru Fernando, University of Washington Seattle

The Open Range Breakout (ORB) strategy is based on the early minutes price movement to be predictive of setting trends in later times. We establish key parameters, and indicators to optimize the algorithm such that it maximizes return, sharpe, and minimizes drawdown. Optimization is done in both a probabilistic and grid search manner. We also implement unsupervised learning to establish regimes (clusters) in which certain hyperparameters of the algorithm will change based on historical performance. The process of optimization combines both mathematical rigor and qualitative market insight to come up with a robust algorithmic trading strategy.

21 *Meaningful Math: Trade Based Quantitative Literacy*
Mark Fitch, University of Alaska Anchorage

This is the story of a course and the development of a matching textbook designed both to meet the quantitative needs of students in UAA's certificate and associate trade programs and to satisfy UAA's Quantitative Literacy (baccalaureate) requirement. We will present how being application driven affected the choice of outcomes, topics, and pedagogy. We will also present the difficulty of fitting QL, with its focus on developing an effective, mathematical thought process and curiosity, smoothly into this trades centric course.

22 *Stretch Calculus: A Way to Increase Student Completion of Calculus I*
Emily Gismervig, University of Washington Bothell
Nicole Hoover, University of Washington Bothell

Many students struggle to complete Calculus I, even when they have previously completed precalculus with a good grade. This prevents many STEM-intending students from progressing into their majors of choice. Students often take precalculus when they matriculate, which duplicates their coursework from previous institutions. To address these issues, we developed and taught a two-quarter stretch Calculus I course where Calculus I is taught over two quarters with intentional just-in-time review built into the course throughout the sequence. The design of this course meets the needs of students with a variety of backgrounds without requiring them to duplicate prior coursework. This course was taught for the first time in the fall and winter of AY 2024-25. Students did quite well, with nearly 80% of students earning high enough grades to proceed to Calculus II. In our talk, we will discuss our course design, lessons learned, future plans and data on student outcomes.

23 *Effective Group Learning through Critical Roles*
Corban Harwood, George Fox University

What roles can students take in the learning process? In an active learning environment, we seek to move them from audience to participant or even teacher. The role students see themselves in shapes how they approach the subject matter, how they interact with their classmates, and how deep they understand the concepts. In this talk, we will discuss ideas for defining roles for students which are critical in the learning process, fit well with a modeling-driven and project-based pedagogy, and allow every student to see the many perspectives of success. Alongside these roles, we will explore how modeling matters in both problem context and motivation, balancing content delivery vs discovery, providing alternative pathways for assessment, providing outlets for individual expression, and evaluation of the impact on

student efficacy and learning. Student roles can be defined through historical context, problem narratives, individual objectives/strengths, or general collaborative group positions. We will discuss published project ideas adaptable for courses in differential equations, numerical methods, and calculus.

24 *The Process and Play in Solving Star Sums*
Matthew Helmer, Pacific Lutheran University**

Problem 455 from the Playground column in the undergraduate math magazine Math Horizons asks solvers to find the minimal set of 21 distinct positive integers that can be arranged in a certain symmetric star graph such that each of 14 rows of 3 have the same sum. It turns out that there are at least 71 ways (up to rotation and reflection) to arrange the integers 1 through 21 satisfying these constraints. This talk will discuss the play that was involved in lowering the bounds for the maximum integer, the techniques used in finding the arrangements of the integers 1 through 21 in the graph, and magic and semi-magic squares and their parameterizations. This talk will also describe opportunities for undergraduate students to solve other open and interesting math problems.

25 *Lessons From 100 Collaborations*
Allison Henrich, Seattle University

Collaboration has defined my academic journey, transforming my research, teaching, and service into deeply enriching experiences. From co-organizing conferences to partnering in team-teaching and writing books, I have found that working with others builds community, amplifies creativity, and is just plain fun! While not every collaborative project unfolds perfectly, each has provided invaluable lessons and lasting connections. Drawing on insights and stories from over 100 of my own collaborations in a variety of professional contexts, this talk will highlight practical strategies for successful teamwork, emphasizing how collaboration can lead not only to better outcomes but also to personal and professional growth.

26 *Fabric Origami: An Exploration of Mathematical Crafting*
Holley Jones, University of Washington Tacoma, and**
Kieran O'Callaghan, University of Washington Tacoma**

We invite you to join us in observing the beauty of Fabric Origami through our gallery of handcrafted projects! This presentation will explore geometric properties that are involved in a craft called Fabric Origami and explain the process as described in The Artistry and Algorithms in Fabric Origami Tessellations by Jiangmei Wu. Through this, we hope to highlight specific geometric properties, such as perpendicularity, parallelism, angle measure, and isometries, to show how "simple" crafts can help facilitate learning and intuitive understanding of mathematical concepts and relationships without a formal framework through object manipulation.

27 *Determining Influential Factors in Social Networks: A Comparative Analysis of Centrality Measures*
Holley Jones, University of Washington Tacoma**
Luke Sterquell, University of Washington Tacoma**

Have you ever wondered how diseases spread? Or why sustainable practices are not easily implemented? What about how people become marginalized or the effects of social engagement on communities? Then studying social systems might be right up your alley! Social

systems are characterized by the connections and relationships between individuals, groups, or institutions. Through the use of networks, we are able to see how elements of a social system connect to each other. Information from those networks can be used to construct matrices that we can analyze using centrality measures to pinpoint influential nodes. By knowing the influential nodes in a social network, we are able to suggest changes to the system in order drive it to our desired state. This presentation aims to introduce the structure and background information of social networks, present information on different centrality measures, and perform a comparative analysis between measures to evaluate their ability to determine influential factors in a social system.

28 *Exploring the Possibilities of Quantum Computing*
Malaya Jove, University of Washington Tacoma**
Buruk Yimesgen, University of Washington Tacoma**

Quantum computing is a developing technology that has the potential to change several aspects of computing as we know it. We introduce several essential components of quantum computing such as qubits, superposition, and entanglement. In addition, we discuss an example of quantum computing: quantum teleportation. Our coverage of quantum teleportation provides an example of a property of quantum computing that is impossible using classical computing. Our findings underscore the significant potential of quantum computing in solving complex problems more efficiently than classical methods. This talk aims to be a concise resource for understanding foundational quantum computing concepts and the basics of quantum teleportation.

29 *The Hare, the Tortoise, and the Separation of Time Scales That Makes Wildfire Complex*
Maureen C. Kennedy, University of Washington Tacoma

Aesop's fable of the Hare and Tortoise provides an apt metaphor for the emergent complex behavior of wildfire systems. In the fable, the swift and overconfident Hare challenges the slow but steady Tortoise to a race. When the Hare obtained a large lead, he took a nap, allowing the Tortoise to continue plodding along and eventually overtaking the Hare and winning the race. This tale describes a separation of time scales, with the tortoise operating slow-but-steadily and more or less continuously. The activity of the hare is rapid and discontinuous, episodically entering and leaving the race. In wildfire, the activity of the tortoise is akin to the slow-but-steady accumulation of fuels through vegetation productivity, or the conversion of the electromagnetic energy of the sun to potential energy in the form of molecular bonds in plant carbohydrates. The hare the Hare is wildfire itself–episodically and swiftly causing disruption to the slow and steady accumulation of fuels and representing the conversion of organic potential energy back to electromagnetic energy (heat and light). In the wildfire system, the race is ongoing as the hare overtakes the tortoise, takes a nap, then awakes again. In statistical physics, the separation of time scales between the rate of energy accumulation (p) and dissipation/release (f: $f \ll p$) explains emergent critical behavior in a variety of systems, including wildfire. In this talk I will present two simple cellular automata models of wildfire that result in critical system behavior. Self-organized criticality (SOC) directly simulates the separation of time scales by randomly dropping fuel onto a grid, then sparking a fire every f iterations. SOC forest fire models have been shown to derive fire size distributions like those observed in vegetated systems. Dynamic percolation (DP) models, in contrast, apply a mean-field probability of fire spread on a grid, which integrates bottom-up controls on fire spread (such as fuel and topography). Critical system behavior emerges at the percolation threshold and the DP model better accommodates variation in spatial patterns of fire spread.

That multiple models can both show emergent critical behavior demonstrates the difficulty in studying complex system dynamics.

30 *Responding to the Need for Data Scientists in the South Puget Sound*
Zaher Kmail, University of Washington Tacoma

The need for increased degree production in statistics and data science has been widely documented in recent years. Industries across sectors rely heavily on data analytics and our community partners have communicated their need for data scientists who have a strong foundation in theoretical statistics as well as applied skills working with real data and algorithms. The proposed Bachelor of Science (B.S.) degree program in Statistics and Data Science at the University of Washington Tacoma (UWT) will help to fill a clearly needed gap in statistics and data science degree programs in the South Puget Sound. Housed in UWT's School of Interdisciplinary Arts and Sciences, this new program provides a strong foundation in the theory and application of statistics and data science. It will provide students with fundamental knowledge and skills related to probability, mathematical statistics, experimental design, data analysis, data management, and statistical computing, including machine learning and Bayesian statistics. Through a combination of coursework and consulting experiences, students will develop the skills to design experiments, analyze real-world data, communicate results with stakeholders and, most importantly, develop the critical and theoretical framework to understand the logic underpinning those designs. Equipped with this theoretical and practical knowledge, graduates will be well-positioned for careers in industry as well as to continue with graduate degree programs. Curriculum offerings and program pathways will be presented, with a focus on how UWT's B.S. in Statistics and Data Science will support transfer students from local institutions.

31 *Data Literacy and Visualization: Improving Undergraduate STEM Education Through Service Learning*
Zaher Kmail, University of Washington Tacoma

In Fall 2020, the University of Nebraska at Omaha (UNO) successfully introduced a general education quantitative literacy course fusing workforce-critical data science skills with service learning. Seeking to build on UNO's existing success, the University of Washington Tacoma (UWT) created their own version of the course for Spring 2024, where researchers collaborated to revise, implement, and assess it in both environments. At both institutions, the learning model contributed to increased data literacy among participants from a broad variety of majors by helping them develop fundamental mathematical, quantitative, and data literacy competencies in ways that are accessible and engaging, while increasing the capacity of local non-profit organizations to use data to answer meaningful questions to further their missions. We found an increase in positive perceptions of mathematics and data science, particularly for non-STEM affiliated students who typically have lower interest and self-efficacy in mathematics and are often from groups underrepresented in STEM. In this presentation, analysis of data collected at both institutions will be discussed, as will the future of the course at UWT including building capacity to help additional community partners and creating a new iteration of the course to support UWT's proposed Bachelor of Statistics and Data Science degree program.

32 *Evidence-Based Teaching Practices and Ideas for Implementing Them with Digital Tools*
Christine Latulippe, Linfield University

This talk reviews eight Evidence-Based Teaching Practices or "EBTs": Active Learning; Assessing and Activating Prior Knowledge; Data-Informed Instruction; Formative Assessment

and Practice; Fostering a Sense of Belonging Through an Inclusive Learning Environment; Instructional Transparency; Metacognition and Self-Regulated Learning; and Peer Collaboration. Regardless of the modality in which we teach, we can all be more mindful of EBTs and consider ways to implement them to support student learning and engagement in our mathematics classes. Special consideration will be given to using digital tools to engage all students and improve the student learning experience in post-secondary mathematics.

33 *Subsidizing Inclusive Insurance to Reduce Poverty*
Sooie-Hoe Loke, Central Washington University

In this talk, we assess the benefits of coordination and partnerships between governments and private insurers and provide further evidence for microinsurance products as powerful and cost-effective tools for achieving poverty reduction. To explore these ideas, we model the capital of a household from a ruin-theoretic perspective to measure the impact of microinsurance on poverty dynamics and the governmental cost of social protection. We analyze the model under four frameworks: uninsured, insured without subsidies, insured with subsidized constant premiums, and insured with subsidized flexible premiums. Although unsubsidized insurance alone may not be sufficient to reduce the likelihood of falling into the area of poverty for specific groups of households, our analysis suggests that subsidized schemes can provide maximum social benefits while reducing governmental costs.

34 *Cospectral Constructions for the Generalized Distance Matrix*
Kate Lorenzen†, Linfield University
Ori Friesen, Linfield University
Cecily Kolko, Linfield University
Nick Layman, Linfield University
Sarah Zaske, Linfield University
Amy Zeidler, Linfield University

The generalized distance matrix of a graph is a matrix in which every entry is function of the distance between the vertices. With special choices of function, the generalized distance matrix family includes the adjacency matrix and distance matrix. Surprisingly, some pairs of graph matrices have the same set of eigenvalues, or are cospectral, independent of the choice of function. We present a construction that builds on Godsil-McKay Switching to produce cospectral pairs for the generalized distance matrix connecting cospectral constructions for many different graph matrices. This work is supported by the National Science Foundation.

35 *Book Embeddings and Abstract Data Structures*
Tom McKenzie, Gonzaga University

A book is formed by joining half-planes together at a common line, called the spine. In a book embedding of a graph, the vertices are ordered along the spine and edges are embedded on the pages of the book so that no two edges cross each other or the spine. Book embeddings correspond to an abstract data structure called a stack. If we replace the half planes in the book with cylinders joined at a common spine, we get a cylinder book, and this corresponds to an abstract data structure called a queue. We begin by explaining these correspondences. Then we define torus, Möbius band, and Klein bottle book embeddings, and describe the data structures to which they correspond.

36 *Investigating Qualitative Properties of the Third Smallest Eigenvalue of the Graph Laplacian*
Henry Pallette, Central Washington University**

In the field of spectral graph theory, the second smallest eigenvalue of the graph Laplacian matrix can provide information into the structure of a given graph. In our research, we look to find what – if anything – the third smallest eigenvalue of a graph Laplacian tells us about a given graph. We find that the third smallest eigenvalue can provide insight into the algebraic connectivity of the subgraphs given by partitioning a graph. This result opens the door for further questions into spectral partitioning and characterizing graphs based on their spectra.

37 *On the Atomicity of One-dimensional Monoid Algebras*
Ishan Panpaliya, Seattle University**

In 2017, Gotti conjectured that for every q in the set $S := ((0,1) \cap \mathbb{Q}) \setminus \mathbb{N}_{>1}^{-1}$, atomicity ascends from the cyclic Puiseux monoid M_q to its monoid algebra over the field of rationals. If this conjecture were true, it would provide a broad class of atomic domains of dimension that do not satisfy the ACCP. Bu et al. recently proved that the algebra $\mathbb{Q}\left[M_{3/4}\right]$ is atomic, marking the first progress towards settling this conjecture. We strengthen this result and prove the atomicity of $\mathbb{Q}[M_q]$ for all $q \in S$ having an odd denominator.

38 *Creating an Accessible Environment in the Mathematics Classroom*
Cameron Raber, Pacific Lutheran University

Universal Design for Learning (UDL) is an approach to teaching and learning that aims to give all students equal opportunity to succeed. It provides a framework to make education more inclusive, flexible, and effective. In this talk we will explore the core guidelines of UDL and demonstrate practical ways to implement them in a college mathematics course. We'll see how embracing UDL, even in small, easily manageable ways, can help break down barriers and create a more equitable learning environment.

39 *Network Analysis of Collaboration in Mathematics Research*
Anna Singley, University of Portland**

Complex networks can be used to explore a plethora of biological, social, and ecological systems. Visualization of complex data with a network allows for more intuitive analysis and identification of underlying structure in a dataset. Tools from network topology and graph theory allow for a more thorough study of the evolution of a network over time. Using a repository of open access journal articles organized by math subject code (MSC), we can visualize the evolution of a field over with the use of networks. Further, we can utilize methods from spectral graph theory to identify key actors and tipping points in coauthorship and citation networks – helping us to visualize the evolution of a mathematical subfield. Using historical examples from the past century, we will examine the evolution of fields in mathematics via analysis of coauthorship networks.

40 *Helping Students See the Forest Rather Than the Fallen Trees When Using Row Operations*
Jeffrey Stuart, Pacific Lutheran University

The Gauss-Jordan algorithm, based on row operations, is a central tool in introductory linear algebra. Many students seize upon the row operation computations as a lifeline in a sea

of scary definitions, theorems and proofs. Unfortunately, when doing so, students focus their attention on the aspect of linear algebra most easily and most accurately performed by software. Further, in their focus on individual row operations, students lose sight of why they are doing row operations. Carefully selected questions can force students to lift their eyes from the individual rows to the overall result of the row reduction process: the reduced row echelon form of a matrix.

As anyone who has carefully crafted an exam problem knows, one small numerical error in a messy row operation can defeat the intended purposes of the problem - identifying rank, constructing a basis for a row or column space, and constructing a basis for the solution space to a homogeneous equation. We will discuss how to pose row reduction problems involving one or two parameters that require only a few, low error-rate row operations for their solution. These problems enable students to understand how different choices for the parameter values lead to different conclusions to the questions of interest.

41 *My Experiences Interning at UWT and Finding Complexity Measurements of STEM Majors*

Ngoc Tran*, Highline Big Picture High School**

As a Highline Big Picture High School student, I am interning at the University of Washington Tacoma (UWT), and this presentation describes my experience. I will narrate work done thus far, including skills I've learned, and share the complexity measurements of UWT STEM majors found. The project revolves around a specific complexity measure applied to curriculums to help quantify the academic and scheduling challenges faced by students in STEM disciplines. The session will include results from the data collected on the complexity levels in majors such as computer science, engineering, and biomedical sciences. This work is in collaboration with an NSF-funded grant through Virginia Tech, and with Dr. EC Cline, Dr. Heather Dillon, and Dr. Ruth Vanderpool.

42 *Modelling Inductive Pulsed Plasma Thrusters*

Jenea Mei Trousil, Whitworth University**

Inductive pulsed plasma thrusters (IPPTs) are a type of electric spacecraft propulsion device that offer higher efficiency and a longer device lifetime. A set of differential equations can model the electro-mechanical circuit, the ionization of the propellant, its inductive acceleration, and other internal plasma processes in IPPTs. In this presentation, I will explain the previously established mathematical model that reflects the physical IPPT system. In addition, I will share the results from numerical analysis of the mathematical model and future directions of this research.

43 *Computing and Estimating Distortion Risk Measures: How to Handle Analytically Intractable Cases?*

Sahadeb Upretee, Central Washington University

In insurance data analytics and actuarial practice, distortion risk measures are used to capture the riskiness of the distribution tail. Point and interval estimates of the risk measures are then employed to price extreme events, to develop reserves, to design risk transfer strategies, and to allocate capital. Often the computation of those estimates relies on Monte Carlo simulations which depending upon the complexity of the problem, can be very costly in terms of required expertise and computational time. In this paper, we study analytic and numerical evaluation of distortion risk measures, with the expectation that the proposed formulas or inequalities will

reduce the computational burden. Specifically, we consider several distortion risk measures – value-at-risk (VaR), conditional tail expectation (CTE), proportional hazards transform (PHT), Wang transform (WT), and Gini shortfall (GS) – and evaluate them when loss severity variable follows shifted exponential, Pareto I, and shifted lognormal distributions (all chosen to have the same support), which exhibit common distributional shapes of insurance losses. For these choices of risk measures and loss models, only the VaR and CTE measures always possess explicit formulas. For PHT, WT, and GS, there are cases when the analytic treatment of the measure is not feasible. In the latter situations, conditions under which the measure is finite are studied rigorously. In particular, we prove several theorems that specify two-sided bounds for the analytically intractable cases. The quality of the bounds is further investigated by comparing them with numerically evaluated risk measures. Finally, a simulation study involving application of those bounds in statistical estimation of the risk measures is also provided.

44 *Performing Topological Data Analysis in Python with Mapper*
David Walker, University of Washington Tacoma**

This talk will give an overview of the topological data analysis method known as Mapper and its uses in exploratory analysis. We will discuss some of the mathematical background and Mapper's requirements and parameters using a simple example, then follow with a more advanced use case and see what results can be found. Each of these will be done in Python using the KMapper library, with focus on the details of usage and choice of inputs.

45 *Making Ourselves Learners So We Can Better Support Our Students (My Spring with PingPong AI and TBIL)*
Brandy Wiegers, College of Idaho

Sometimes trying new approaches to courses can be the most humanizing way to reconnect with where our students currently are. Honestly, I don't remember what it's like to learn about matrices, it's just part of my vocabulary. However this semester I'm teaching a one-off course while my colleague is on sabbatical. To keep consistency between each of the courses I'm using his planned inquiry and standards based structure. So I'm having to learn whys and hows and having to think through linear algebra from a whole new perspective. This talk will be discussing what I've learned when forced to be the learner, with a focus discussion on PingPong AI and Team-Based Inquiry Learning (TBIL).

46 *The Mathematics of Virtual X-ray Imaging*
Matthew B. P. Wong, Gonzaga University

In this talk, we discuss recent advancements made in electrical impedance tomography (EIT), a type of medical imaging. Through a new process that integrates techniques found in parallel-beam imaging modalities (e.g. X-ray CT scanners), the voltage distribution measured on the domain boundary after an application of electrical current can be transformed into a sinogram. This virtual projection image has the same geometry as that produced by straight-line X-ray tomography and, as a result, offers new insights into the target's internal structure as compared to standard EIT reconstructions. In addition to discussing the steps of this new process, we also demonstrate that the nonlinearity and ill-posedness of the EIT inverse problem, which were formerly thought to be inseparable, can actually be uncoupled as a consequence of this process.

47 *Data Labs for Calculus*
Aaron Wootton, University of Portland

The ability to work with large data sets is a hot commodity for graduating students, and math courses are well-positioned to expose students to data. Unfortunately, there are limited resources for instructors to incorporate data into their courses unless they already have some exposure to programming, an essential component to analysis of large data. I am currently working with a small group of people who are creating Python Labs written for a standard calculus course. These labs are designed to be an easy introduction to working with data and programming while also help students learn mathematics. The labs are designed to be easy to use, even for those with no experience and require no software installation, so ideal for both students and faculty with limited or no exposure to programming and data. Come learn about these labs and, if interested, how you can help in the next steps!

48 *Co-requisite course improves student performance in Intro to Proof*
Ekaterina Yurasovskaya, Seattle University

How can we help undergraduates succeed in the traditional Introduction to Proofs course and build a supportive cohort? To address these challenges, the Mathematics Department at Seattle University developed a co-requisite, problem-solving, lecture-free course that significantly improved student outcomes in the Intro to Proof. The percentage of students identified for additional support who earned grades between B- and A increased by more than 50%, while the proportion of non-passing grades (F through C-) in the same group decreased by over 50%. Students in the co-requisite course reported overwhelmingly positive experiences. This presentation describes the course and offers insights from our experience for those interested in developing such a course at other institutions.

Parking Information & Campus Map

Those who've purchased a parking permit can use the Cragle, Tioga, or TPS lots.

Permit Pick-Up: To ensure efficient parking and registration, please follow these steps.

1. Park your vehicle in your desired lot.
2. Proceed to the registration table to receive your parking permit.
3. **Display the parking permit clearly on your dashboard.**

Alternatively, free parking (for up to 24 hours) is available at the Tacoma Dome Station, with easy access to campus via the T Line light rail.

Campus Information

Internet Access: Please follow these steps to access WI-FI on the UW-Tacoma campus.

- To login to UW Wi-Fi, please ensure Wi-Fi is turned on via your device settings and select the University of Washington as the Wi-Fi network.
- Open your internet browser and view a webpage outside the UW to bring up the authentication page.
- You will then be automatically prompted to enter the following information:
  - UW NetID: `event0375`
  - Password: `39jm;33hy;86hc`
- Once you have successfully logged in (authenticated) you will be able to use services outside the UW for up to 12 hours without having to re-authenticate.

UWT Public Safety and Security Information:

All emergency situations: 911

Campus Safety: 253-692-4416

Portions of South 21st St. will be under construction during the conference. Please check this site for details and updates: https://tinyurl.com/uwtconstruction

Local Attractions

Restaurants, Cafes, & Bars within walking distance: https://tinyurl.com/uwtrestaurants

Local Events & Activities: https://www.visitpiercecounty.com/

The **South Sound Sustainability Expo** is also happening on UW Tacoma on Saturday:

Date: Saturday, April 26, 2025
Time: 10 AM – 3 PM
Location: University of Washington Tacoma Campus Prairie Line Trail (1900 Commerce St.) & Tollefson Plaza (1548 Commerce St.)
Cost: Free admission!
More information: https://tinyurl.com/SouthSoundSustainabilityExpo

Acknowledgments

Events of this size never come together without a community of support. We are especially grateful to many student and faculty volunteers who helped this event run smoothly.

In particular, we extend our deepest gratitude to the organizers who dedicated countless hours to planning and execution: the MAA-PNW Section officers, the UW Tacoma local organizing committee, the special session and mini-course organizers, and the UW Tacoma Math club for arranging the student reception and a student puzzle session.

The smooth running of the event would not have been possible without our wonderful UW Tacoma student, staff and faculty volunteers – thank you for your energy and assistance throughout the conference! We also wish to thank the SIAS administration and staff for providing essential logistical support.

We gratefully acknowledge the generous contributions of our sponsors, whose support was vital: The University of Washington Tacoma Chancellor's Office and School of Interdisciplinary Arts and Sciences (SIAS), The SIAS Science and Mathematics Division, The UWT School of Education, FlatWorld Knowledge, Transform Learning, Pearson, and Seattle University's Master of Science in Data Science Program.

We are indebted to all our speakers for sharing their knowledge, research, and insights, which formed the intellectual heart of our meeting.

Finally, thank you to all attendees. Your participation, engagement, and enthusiasm created a vibrant and collaborative atmosphere of learning and sharing. Thank you all for making MAA-PNW 2025 at UW Tacoma a success!

Thank you,

Erik Tou	Rita Than
Program Chair	Local Arrangements Chair