2020 PME Conference Schedule

9:00–10:00: Registration & Breakfast - Williamson 3422/3423

10:00–10:15: Welcome & Introduction - Williamson 3422/3423

President Tressel, Youngstown State University
Dr. Wim Steelant, Dean, College of STEM
Anthony Dickson, YSU PME Chapter President

	Williamson 2201	Williamson 2202	Williamson 2203	Williamson 2204
10:20-10:35	Justin Richter	Simon Richard	Bikash Thapa, Rabin Thapa, and Tyler Leibengood	COMAP-MCM Esteban Garcia
10:40-10:55	Tessa Moseley	Jessica Harness-Koehnle	Benjamin Mudrak	COMAP-MCM
11:00-11:15	Stephanie Heusey	Alex Schroeder	Trevor MacKenzie	COMAP MCM
11:20-11:35	Matt Wilson	Owen Meilander	Thomas Galvin	COMAP MCM
11:40-11:55	Montana Ferita	Kevin Lannoch	Nikitas Missos, Derek Miller, James Lagese, and Morgan Weinreber	Isabella Lusk

11:55–12:50: Lunch - St. John's Episcopal Church Hall

	Williamson 2201	Williamson 2202	Williamson 2203
12:50-1:05	Niksa Praljak	Olivia Bindas	Gabrielle Majetic
1:10-1:25	Ryan Cecil	Michael Zirpoli	Patrick Cone
1:30-1:45	EmilyAnn Moenich	Stefan Solarski	Brooke Fincham

1:50: Closing Remarks - Williamson 3422/3423

Youngstown State has partnered with AT&T to deliver visitor wireless Internet access on campus through the "attwifi" wireless network. This is an unsecure wireless network and is not protected by any of the University's cyber-related safeguards. The code for access is: WPE6-g6UV-DN. The AT&T wireless network is supported directly by AT&T.

Morning Session 10:20-10:35

10:20-10:35 | **Justin Richter** | **Williamson 2201**

The Median Concurrence Theorem

Edinboro University of Pennsylvania

Advised by: Dr. Rick White

The three medians of any triangle are congruent, that is, if triangle ABC is a triangle and D, E, F are the midpoints of the sides opposite A, B, C respectively: then segment AD, BE, and CF all intersect in a common point G. Moreover, $AG = 2GD$, $BG = 2GE$, and $CG = 2GF$.

10:20-10:35 | **Simon Richard** | **Williamson 2202**

Continuous Random Walks

Lakeland Community College/iSTEM

Advised by: Dr. Paul Zachlin and Ms. Moriah Wright

Normal, discrete random walks are fun enough. But what if we try to make it continuous? This presentation will explore a definition of a continuous random walk based off of continuous random variables and limits.

10:20-10:35 | **Bikash Thapa, Rabin Thapa, and Tyler Leibengood** | **Williamson 2203**

The Hipster Effect: Modeling of Group Affinity and Fashion Sense

Youngstown State University

Advised by: Dr. Jozsi Jalics

Our research is about the social dynamics (interactions of individuals, change of trends, etc.) within and between two opposing groups: hipsters and mainstreams in society, and how the transition and information exchange occur between the two groups. In our work, we have considered fashion sense (although our model can be applied to any trends), which differs among individuals and groups, to be the major factor. Based on that, individuals can roughly be categorized into two distinct subgroups: hipsters and mainstreams. Hipsters, by definition, try to do what is not common. So, when it comes to fashion, they try to dress uniquely. This is in sharp contrast with the mainstreams who follow the common trends. As a new trend kicks in, waves of information reach people through interpersonal connections. Our model simulates the social behaviors among people (within and outside their subgroups) and social environmental variables to predict how individuals change their appearance and mentality with time. Mathematical model was built using the differential equations, and the results were analyzed using MATLAB.

10:20-10:35 | **Esteban Garcia** | **Williamson 2204**

COMAP Modelling Ocean Temperatures for Predicting Fish Habitats

Indiana University of Pennsylvania

Advised by: Dr. John Chrispell

In the COMAP Mathematical Contest in Modelling we were tasked to model the migration of Herring and Mackerel and advise a small fishing company from Scotland how, where, and when to find and catch these fish. We used data from the NOAA Earth System Resources Laboratory (NOAA ESRL) to find the surface sea temperatures per month from 1982 to 2019 with respect to Latitudes (46.5N,69.5N) and Longitudes (10.5W,10.5E) in intervals of 0.5. By finding a best fit line, we were able to predict the temperatures for the next fifty years for one square, and consequentially for the whole grid. We then showed where and when the fish could potentially be located. From this, we could advise the company how and when to catch the Herring and/or Mackerel. This project was in collaboration with Dafni Pratt.

Morning Session 10:40-10:55

10:40-10:55 | **Tessa Moseley** | **Williamson 2201**

A Proof of the Median Concurrence Theorem

Edinboro University of Pennsylvania
Advised by: Dr. Rick White

We will use Ceva's Theorem to prove the Median Concurrence Theorem

10:40-10:55 | **Jessica Harness-Koehnle** | **Williamson 2202**

Modeling the Spread of Disease

Lakeland Community College/iSTEM
Advised by: Ms. Moriah Wright

Illness affects people all over the world. The average adult in the United States becomes infected with two to four common colds each year. This talk explores a basic model of the common cold and how it spreads through a given population. To start, a survey was administered twice in two separate school years to an entire high school gathering data on how the common cold spread through that school. From this data set, a model was constructed and data was analyzed to find the attack rate, incubation period, and length of contagion. The model was then used to predict the spread of an outbreak of the common cold given certain parameters in a hypothetical population.

10:40-10:55 | **Benjamin Mudrak** | **Williamson 2203**

The Commuting and Non-Commuting Graphs of Non-Abelian Groups

Kent State University
Advised by: Dr. Laura Smithies

An interesting object in group theory is the commuting graph of a group. Essentially, the commuting graph of a group, G, is the graph whose vertices are the elements of G with the property that two vertices are adjacent if and only if they commute in G. Similarly, the non-commuting graph of a group, G, is defined to be the graph whose vertices are the elements of G with the property that two vertices are adjacent if and only if they do not commute in G. In this presentation, we discuss some interesting results relating to the commuting and non-commuting graphs of finite non-abelian groups.

10:40-10:55 | **COMAP Modeling Discussion** | **Williamson 2204**

All are welcome to discuss this year's COMAP problems and potential solutions. This informal session is meant to share ideas and strategies for the approach to the problems, which are provided on Page 11 of this abstract book.

Morning Session 11:00-11:15

11:00-11:15 | **Stephanie Heusey** | **Williamson 2201**

The Altitudes of a Triangle are Concurrent
Edinboro University of Pennsylvania
Advised by: Dr. Rick White

We will be showing the three altitudes of a triangle are concurrent by proving the perpendicular bisectors are concurrent, the point of concurrency is equidistant from the vertices of a triangle, that a triangle ABC is a medial triangle for $A'B'C'$, and that the perpendicular bisectors of a side of $A'B'C'$ is the altitude for the medial triangle.

11:00-11:15 | **Alex Schroeder** | **Williamson 2202**

Generalizations on Incomplete Rulers of Length n
Lakeland Community College/iSTEM
Advised by: Ms. Moriah Wright

A 12-inch ruler can measure every integer distance up to 12 inches because every one-inch increment is marked. However, if you took away some of the markings to make an incomplete ruler, you can still measure every distance from 1 to 12 inches (though not always starting at the 0-inch mark). But what is the minimum number of markings necessary in order to be able to measure every distance? And how many arrangements of these markings are possible so that every distance can still be measured? In this presentation, we'll explore the generalizations of these questions for any theoretical ruler of length n.

11:00-11:15 | **Trevor MacKenzie** | **Williamson 2203**

Tiling with Trominoes
Chatham University
Advised by: Dr. Aaron Trout

There are so many games out there today that deal with fitting set shapes into a specific area. In these proofs we take a freely rotated L-shaped tromino, and see if we can fill grids with copies of this shape. The twist is that we want one grid space left empty after tiling in the trominoes. Showing when this can be done is achieved through looking at area sizes, modular arithmetic, and straight-up trial and error. End of the day, we create a bidirectional proof for what grid sizes will fit our goal.

11:00-11:15 | **COMAP Modeling Discussion** | **Williamson 2204**

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Morning Session 11:20-11:35

11:20-11:35 **Matt Wilson** **Williamson 2201**

A Relationship Between an Isosceles Triangle and its Medians

Edinboro University of Pennsylvania

Advised by: Dr. Rick White

We prove that a triangle is isosceles if and only if two medians are congruent.

11:20-11:35 **Owen Meilander** **Williamson 2202**

The $3n + 1$ conjecture...except the 3 and the 1 are 2's

Westminster College

Advised by: Dr. Natacha Fontes-Merz

The $3n + 1$ conjecture, also called the Collatz conjecture, is a set of simple rules placed on any positive integer in order to create a sequence of numbers. The rules are as follows: if the number is even, divide by two. If it is odd, multiply it by three and add one. Mathematicians have long studied this conjecture in the hopes of proving or disproving that the sequence of numbers resulting from any starting number will always include the number one. This talk will focus on variations of this conjecture, including a $2n + 2$ and $3n + 3$ case, that can be explored to a greater extent.

11:20-11:35 **Thomas Galvin** **Williamson 2203**

Calculating Hom and Ext of Two $\mathbb{Z}$-modules

Penn State Behrend

Advised by: Dr. Amos Ong

In this talk, we will go through an example of the calculations of the Hom and Ext functors of two Z-modules, $\mathbb{Z}/n\mathbb{Z}$ and $\mathbb{Z}/\mathbb{Z}$ with n and m both positive integers. These two functors commonly arise in the field of homological algebra in the process of measuring "how far" a module is from being injective or projective, both of which are commonly desired properties of modules.

11:20-11:35 **COMAP Modeling Discussion** **Williamson 2204**

All are welcome to discuss this year's COMAP problems and potential solutions. This informal session is meant to share ideas and strategies for the approach to the problems, which are provided on Page 11 of this abstract book.

Morning Session 11:40-11:55

11:40-11:55 | **Williamson 2201**

Montana Ferita
An Agent-based Model of Pollen Competition in Arabidopsis thaliana
Westminster College
Advised by: Dr. Capaldi (Valparaiso University)

In 2016, Swanson et al. showed that when an Arabidopsis thaliana stigma is pollinated with equal amounts of pollen by two accessions, Columbia and Landsberg, Columbia pollen sire disproportionately more seeds. This phenomenon is known as nonrandom mating. Previous experiments have investigated nonrandom mating by examining how pollen performance traits such as proportion of pollen germinated, time to germination, and pollen tube growth rates differ between these two accessions. In addition, bioenergetics, such as the energy supplied to pollen tubes from the pistil during fertilization, likely also magnify competition. While plant fertilization is well-studied, the exact mechanics of pollen competition remain unknown. Using an agent-based model, we aim to identify the traits that cause pollen from one accession to sire more offspring than pollen from another accession and to what extent these traits contribute to this process. We calibrate our model against a number of parameters from empirical data to observe the output of seed siring proportions from mixed pollinations; we compare these values to those found in the literature. Our model can also be extended to predict seed siring proportions for other accessions of Arabidopsis thaliana given data on their pollen performance traits.

11:40-11:55 | **Williamson 2202**

Kevin Lannoch
Exploring Equilibrium in Supply and Demand
Cleveland State University
Advised by: Dr. Shawn Ryan

The premise of basic economic theory is centered around the interaction of supply and demand. Since the revelation of Adam Smith and his theory on the 'invisible hand', the idea of equilibrium, in which the demands of consumers and the supply of the producers are in agreeance of price and quantity, has been a focus of the economic discipline. We will explore a simple economic model on supply and demand presented in G. Gandolfo's *Economic Dynamics: Methods and Model.* We will also provide an extension on the existing model to determine the effect of individual supply and demand shocks on the behavior and location of the equilibrium.

11:40-11:55 | **Williamson 2203**

Nikitas Missos, Derek Miller, James Lagese, and Morgan Weinreber
Baby Boomer Generation
Youngstown State University
Advised by: Dr. Moon Nguyen

This study is focused on the effects of the Baby Boomer Generation on the economy. A random sample of 1500 death records was taken over two years in order to create an accurate prediction of when the Baby Boomer Generation will die out. We used multiple mathematical models to complete this and then used this information to predict the ramifications on the economy of such a large generation entering retirement.

11:40-11:55 **Williamson 2204**

Isabella Lusk

The Gracefulness of $K4$ Snake Graphs

Duquesne University
Advised by: Dr. Anna Haensch and Dr. Karl Wimmer

The discovery of Graph Theory originated from The Seven Bridges of Königsburg problem in which Euler attempted to find a path through the city that would cross each bridge exactly once. A complete graph is a graph in which all of the adjacent vertices of the graph are connected by a unique edge. A $K4$ graph is the base case of a $K4$ snake graph. Larger $K4$ snakes are obtained when sequential $K4$ graphs share a vertex with the previous $K4$ graph with no more than two shared vertices for each $K4$ graph in the snake. A weighted graph is a graph in which the weights of the edges are obtained by the absolute value of the difference of the corresponding vertices. A graph with m vertices that are weighted with any combination of the values $0, 1, 2, \ldots, m$ with no repetition such that the weights of the edges produce exactly $1, 2, 3, \ldots, m$, is a graceful graph. My research has shown that not all $K4$ snake graphs may be gracefully labeled.

Afternoon Session 12:50-1:05

12:50-1:05 **Williamson 2201**

Niksa Praljak

Pulsatile Flow Through Idealized Renal Tubules: Fluid-Structure Interaction and Dynamic Pathologies

Cleveland State University
Advised by: Dr. Shawn Ryan and Dr. Andrew Resnick

Kidney tubules are lined with flow-sensing structures, yet information about the flow itself is not easily obtained. We aim to generate a multiscale biomechanical model for analyzing fluid flow and fluid-structure interactions within an elastic kidney tubule when the driving pressure is pulsatile. We developed a two-dimensional macroscopic mathematical model of a single fluid-filled tubule and determined both flow dynamics and wall strains over a range of driving frequencies and wall compliances using finite-element analysis. The results presented here demonstrate good agreement with available analytical solutions and form a foundation for future inclusion of elastohydrodynamic coupling by neighboring tubules. Overall, we are interested in exploring the idea of dynamic pathology to better understand the progression of chronic kidney diseases such as Polycystic Kidney Disease.

12:50-1:05 **Williamson 2202**

Olivia Bindas

Not Your Grandma's Sudoku: An Exploration of Latin Squares

Youngstown State University
Advised by: Dr. Alexis Byers

A Latin Square is an $n \times n$ matrix, with the entries being the positive integers 1 through n, where each number appears exactly once in each row and each column. A Sudoku puzzle is a 9×9 Latin Square with the property that each of the nine 3×3 blocks contain all of the integers, 1 through 9. Using this information, we are going to apply matrix operations to work with Latin Squares and produce Sudoku-like properties within them.

12:50-1:05 **Williamson 2203**

Gabrielle Majetic

An Agent-Based Model of Cell-Type Specific and Pain-Related Neural Activity in the Amygdala During Neuropathic Pain

Duquesne University
Advised by: Dr. Rachael Miller Neilan and Dr. Benedict Kolber

Injury changes the excitability of pain-related neurons within the central nucleus of the amygdala (CeA). An agent-based computational model was created in NetLogo to simulate neural behavior over time and in response to injury. Each agent represents one neuron in the CeA and is characterized by its location (left or right hemisphere of the CeA), protein-expression type (somatostatin or protein kinase C-delta) and spiking frequency (regular or late). Connectivity of neurons is achieved through agent links and used to send inhibitory signals between connected neurons. During each time step, neurons' firing rates (Hz) are stochastically updated using probability distributions estimated from data collected in laboratory experiments using a neuropathic pain model. A damage accumulation sub-model tracks the damage accumulated by each neuron during injury as the neurons transition from an unsensitized to a sensitized state. Cumulative firing rates of somatostatin and protein kinase C-delta neurons are used to calculate emergent levels of pain attributed to injury. Results demonstrate the model's ability to predict acute and chronic pain along with neurons' contribution to pain.

Afternoon Session 1:10-1:25

1:10-1:25 | **Lincoln 2201**

Ryan Cecil
PDE Based Deep Learning for Geometric Image Data
Duquesne University
Advised by: Dr. Stacey Levine

Image restoration is the process of estimating uncorrupted images from observations that have undergone degradations such as noise or blur. Recently, image restoration models have been proposed using the deep learning framework of convolutional neural networks (CNN). Furthermore, previous results have shown that denoising image geometry, such as level line curvature data, and then reconstructing an image with the denoised curvature data yields more accurate results than denoising the image directly. In this work, we propose a new CNN whose architecture mimics that of a nonlinear partial differential equation for learning new higher order geometrically motivated image features, as well as corresponding convolution filters and activation functions that can be used for image restoration, such as denoising and deblurring. To realize this model, we have analytically computed the gradients of a convex loss function and initial numerical results for denoising are promising. The ultimate goal of this work is to use these learned features, filters, and nonlinear activation functions to formulate mathematically sound partial differential equation based models for image restoration.

1:10-1:25 | **Williamson 2202**

Michael Zirpoli
Problem 846–Pentagon
Slippery Rock University
Advised by: Dr. Nicholas Hurl

I will present my solution to Problem 846 from the *Pentagon*, an undergraduate journal published by Kappa Mu Epsilon. This problem involved solving an improper integral using numerous u-substitutions, trigonometric identities, and logarithm techniques to evaluate it.

1:10-1:25 | **Williamson 2203**

Patrick Cone
Climbing the Branches of the Graceful Tree Conjecture
Indiana University of Pennsylvania
Advised by: Dr. Rachelle Bouchat

This joint work with Dr. Rachelle Bouchat at Indiana University of Pennsylvania focuses on the Graceful Tree Conjecture. This unsolved problem of graph theory was first posed by Kotzig, Ringel, and Rosa in 1967 and states that every tree has a graceful labeling. Moreover, a graceful labeling is an assignment of the integers 0 to n to the vertices of the graph so that the edges, when labeled by the absolute value of the difference of the integers placed on the end vertices, are labeled by the integers 1 to n. This research project continues the progress we have made using patterns present in the graphs' adjacency diagrams. In particular, we focus on the possible labelings of the vertices as they relate to the positions in the associated adjacency diagram. Using these diagrams, we are able to construct several classes of graceful trees.

Afternoon Session 1:30-1:45

1:30-1:45 **EmilyAnn Moenich** **Williamson 2201**

Lotka-Volterra Models with Disease Affecting Predator and Prey

Cleveland State University

Advised by: Dr. Shawn Ryan

The Lotka-Volterra model for predator and prey, along with the Kermack and McKendrick disease model, can be used to create a predator-prey model that includes an infectious disease. We will discuss a model of three differential equations to analyze the populations of prey, susceptible predator, and infected predator. Along with reviewing this model and its steady states, we will create and examine a model for a similar scenario where there is an infectious disease in the prey population.

1:30-1:45 **Stefan Solarski** **Williamson 2202**

Persistent Homology: Making better photos of your Pets

Kent State University

Advised by: Dr. De La Cruz Cabrera

Data of various kinds is being produced at an extraordinary pace. Out of all that data only 0.5% is being processed. One of the reasons is that the data gathered is often high-dimensional which restricts our ability to visualize and understand it. Obtained data is also much noisier than in the past and often has missing information. This is especially so in biological data and computer vision. We will discuss Topological Data Analysis with focus on Persistent Homology and how it can be applied to improve today's methods of visualizing and understanding data. The presentation will include short introduction in Algebraic Topology, Simplicial Homology and Betti Numbers.

1:30-1:45 **Brooke Fincham** **Williamson 2203**

What is a Fractional Difference?

Fairmont State University

Advised by: Dr. Thomas Cuchta

In 1695, Guiallaume de l'Hôpital, who was corresponding with Gottfried Leibniz, proposed the question: "What does it mean to take the one-half derivative?" Since then, this idea has been expanded upon by Joseph Liouville in the 1830s, and many more authors in recent times. Difference equations is a theory similar to that of differential equations with one fundamental distinction–we use the simple difference operator instead of the derivative operator. Discrete fractional calculus extends the differences and sums of functions to the υ-th difference and sum of a function, where $N-1 < \upsilon \leq N$. In this presentation, we will introduce key functions and operators of fractional difference equations and their properties.

2020 MCM / ICM - COMAP Modeling Problems

Continuous Modeling (Problem A)
Moving North

Global ocean temperatures affect the quality of habitats for certain ocean-dwelling species. When temperature changes are too great for their continued thriving, these species move to seek other habitats better suited to their present and future living and reproductive success. One example of this is seen in the lobster population of Maine, USA that is slowly migrating north to Canada where the lower ocean temperatures provide a more suitable habitat. This geographic population shift can significantly disrupt the livelihood of companies who depend on the stability of ocean-dwelling species.

Your team has been hired as consultants by a Scottish North Atlantic fishery management consortium. The consortium wants to gain a better understanding of issues related to the potential migration of Scottish herring and mackerel from their current habitats near Scotland if and when global ocean temperatures increase. These two fish species represent a significant economic contribution to the Scottish fishing industry. Changes in population locations of herring and mackerel could make it economically impractical for smaller Scotland-based fishing companies, who use fishing vessels without on-board refrigeration, to harvest and deliver fresh fish to markets in Scotland fishing ports.

1. Build a mathematical model to identify the most likely locations for these two fish species over the next 50 years, assuming that water temperatures are going to change enough to cause the populations to move.

2. Based upon how rapidly the ocean water temperature change occurs, use your model to predict best case, worst case, and most likely elapsed time(s) until these populations will be too far away for small fishing companies to harvest if the small fishing companies continue to operate out of their current locations.

3. In light of your predictive analysis, should these small fishing companies make changes to their operations?

   (a) If yes, use your model to identify and assess practical and economically attractive strategies for small fishing companies. Your strategies should consider, but not be limited to, realistic options that include:

   - Relocating some or all of a fishing company's assets from a current location in a Scottish port to closer to where both fish populations are moving;
   - Using some proportion of small fishing vessels capable of operating without land-based support for a period of time while still ensuring the freshness and high quality of the catch.
   - Other options that your team may identify and model.

   (b) If your team rejects the need for any changes, justify reasons for your rejection based on your modeling results as they relate to the assumptions your team has made.

4. Use your model to address how your proposal is affected if some proportion of the fishery move into the territorial waters (sea) of another country.

5. In addition to your technical report, prepare a one to two page article for *Hook, Line, and Sinker* magazine to help fishermen understand the seriousness of the problem and how your proposed solution(s) will improve their future business prospects.

Interdisciplinary Modeling (Problem E)
Drowning in Plastic

Since the 1950s, the manufacturing of plastics has grown exponentially because of its variety of uses, such as food packaging, consumer products, medical devices, and construction. While there are significant benefits, the negative implications associated with increased production of plastics are concerning. Plastic products do not readily break down, are difficult to dispose of, and only about 9% of plastics are recycled. Effects can be seen by the approximately 4-12 million tons of plastic waste that enter the oceans each year. Plastic waste has severe environmental consequences and it is predicted that if our current trends continue, the oceans will be filled with more plastic than fish by 2050. The effect on marine life has been studied, but the effects on human health are not yet completely understood. The rise of single-use and disposable plastic products results in entire industries dedicated to creating plastic waste. It also suggests that the amount of time the product is useful is significantly shorter than the time it takes to properly mitigate the plastic waste. Consequently, to solve the plastic waste problem, we need to slow down the flow of plastic production and improve how we manage plastic waste.

Your team has been hired by the International Council of Plastic Waste Management (ICM) to address this escalating environmental crisis. You must develop a plan to significantly reduce, if not eliminate, single-use and disposable plastic product waste.

- Develop a model to estimate the maximum levels of single-use or disposable plastic product waste that can safely be mitigated without further environmental damage. You may need to consider, among many factors, the source of this waste, the extent of the current waste problem, and the availability of resources to process the waste.

- Discuss to what extent plastic waste can be reduced to reach an environmentally safe level. This may involve considering factors impacting the levels of plastic waste to include, but not limited to, sources and uses of single-use or disposable plastics, the availability of alternatives to plastics, the impact on the lives of citizens, or policies of cities, regions, countries, and continents to decrease single-use or disposable plastic and the effectiveness of such policies. These can vary between regions, so considering regional-specific constraints may make some policies more effective than others.

- Using your model and discussion, set a target for the minimal achievable level of global waste of single-use or disposable plastic products and discuss the impacts for achieving such levels. You may consider ways in which human life is altered, the environmental impacts, or the effects on the multi-trillion-dollar plastic industry.

- While this is a global problem, the causes and effects are not equally distributed across nations or regions. Discuss the equity issues that arise from the global crisis and your intended solutions. How do you suggest ICM address these issues?

- Write a two-page memo to the ICM describing a realistic global target minimum achievable level of global single-use or disposable plastic product waste, a timeline to reach this level, and any circumstances that may accelerate or hinder the achievement of your target and timeline.

2020 MCM-COMAP Participants from YSU

Bishal Lamichhane Pradip Rimal Yogesh Sapkota	Gyaneshwar Agrahari Subham Singh Luke Hetzel	Kathryn Chludzinski John Gula Dominick Daloni
Reece Wilson Riley Hilton Sean Livingston	Oluwatumininu Adeeko Troy Tyson Leah Bookser	Victoria Messuri Tanner Tsvetkoff Kyle Gamble

2020 PME National Meeting at MAA MathFest

Please join us at this year's meeting to be held July 29 through August 1, 2020, in Philadelphia, PA. Students are invited to give fifteen minute talks on any mathematical topic or application in areas such as statistics, computing, or operations research. Topics including expository research, interesting applications, problems, etc. are also welcome. Transportation reimbursement is also available to those who qualify. Visit the National Pi Mu Epsilon website at `http://www.math-pme.org` for more details.

Ohio Section of MAA Spring Meeting at Bowling Green State University

The Ohio Section of the Mathematical Association of America will hold its annual spring meeting at The University of Akron on Friday, April 3 and Saturday, April 4, 2020. The meeting consists of talks by mathematics faculty, graduate students, and undergraduates from around the state. The Section especially welcomes talks and participation by undergraduate students. In addition to student talks, there is an undergraduate problem solving competition with cash prizes, and a pizza party. We encourage you to give a talk at the meeting or participate in the competition or pizza party.

If you are participating in the problem solving competition, we ask that you register at:

`http://constum.ohiomaa.org/`

If you have any questions, please do not hesitate to contact Tom Wakefield by phone 330-941-3302 or by email `tpwakefield@ysu.edu`.

A Warm Welcome to the Participating Schools:

- Case Western Reserve University
- Chatham University
- Clarion University of Pennsylvania
- Cleveland State University
- Cork Elementary School
- Duquesne University
- Edinboro University of Pennsylvania
- Fairmont State University
- Indiana University of Pennsylvania
- iSTEM Geauga Early College High School
- Kent State University
- Lakeland Community College
- Penn State Erie, The Behrend College
- Slippery Rock University
- University of Mount Union
- Westminster College
- Youngstown State University

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Dr. Thomas Madsen

Dr. Thomas Wakefield

Dr. George Yates

Funding for this conference is provided by the YSU Student Government Association and National Pi Mu Epsilon Honor Society.

Special thanks to National PME, YSU President Tressel, Dr. Wim Steelant, YSU Student Government, the College of STEM, the Department of Mathematics and Statistics, and the Center for Undergraduate Research in Mathematics (CURMath) at Youngstown State University.