

Abstracts of Student Talks
Mathematical Association of America
Allegheny Mountain Section Meeting
Shepherd University
Friday, April 5, 2019

7:15 - 7:30 p.m.

Samuel Hockenberry, Westminster College, Stutzman-Slonaker 201

Investigation of Ohio Adjudicated Youth Through Cluster Analysis

The Allegheny County Court System keeps records on all juvenile court cases, referrals, and accusations within Allegheny County. While the initial goals of this research were to identify common characteristics of dependent and adjudicated children within Allegheny County, the data requested from the Allegheny County Court System was denied. This denial led into another interest - focusing on arrested and rearrested youth. In 2009, the University of Cincinnati Corrections Institute published a report on a new tool called the Ohio Youth Assessment System (OYAS) that identifies the needs and risks of juvenile offenders. This report describes five tools that make up the OYAS and their initial results on arrested and rearrested youth. This project uses the results of this report as a base to recreate representative data and discover new findings. Through cluster analysis we hope to identify common characteristics of arrested and rearrested youth to allow for more informed decisions concerning the health and safety of adjudicated youth.

Kristina Daniels and Sydney Maibach, Fairmont State University, Stutzman-Slonaker 202

Optimizing Low-Income Home Loans

Mon Valley Habitat for Humanity provides home solutions for the people of north-central West Virginia. In addition to building homes for low-income families, they also provide no-interest home loans for high-risk borrowers. In order to maximize the number of families they are able to help, they must minimize the number of loan defaults. In order to facilitate Habitat for Humanity's borrower selection process, our goal as student researchers in the Fairmont State PIC Math program was to build a predictive model for loan defaults using current and past loan holder data. Our talk will cover the methods we used and a preliminary model.

Zheping Lu, University of Pittsburgh, Stutzman-Slonaker 207

Nonsplit Module Extensions over the One-sided Inverse of $k[x]$

Let R be the associative k -algebra generated by two elements x and y with defining relation $yx = 1$. A complete description of simple modules over R is obtained by the results of Irving and Gerritzen. We examine the short exact sequence $0 \rightarrow U \rightarrow E \rightarrow V \rightarrow 0$, where U and V are simple R -modules. It shows that nonsplit extension only occurs when both U and V are 1-dimensional, or, under certain condition, U is infinite-dimensional and V is 1-dimensional.

7:35 - 7:50 p.m.

Jamie Thompson, Westminster College, Stutzman-Slonaker 201

An Investigation of Adjudicated Ohio Youth through Logistic Regression

In 2009, the University of Cincinnati Corrections Institute published a report on a new tool called the Ohio Youth Assessment System (OYAS) that identifies the needs/risks of juvenile offenders. This report describes five tools that make up the OYAS and their initial results on arrested and rearrested youth. Our project uses the results of this report as a base to recreate representative data and discover our own findings. Through logistic regression we hope to identify common characteristics of arrested and rearrested youth to allow for more informed decisions concerning the health and safety of juvenile youth.

Sydney Maibach and Kristina Daniels, Fairmont State University, Stutzman-Slonaker 202

The Human Error in Cyber Security

Email phishing is a serious issue for large institutions, especially those handling sensitive or classified information. Our research under a NASA Software Assurance Research Program (SARP) grant is focused on quantifying the human risk factors associated with phishing. Our talk will discuss our experiment designs and findings.

Stephen Cha and Tyra Pitts, University of Pittsburgh, Stutzman-Slonaker 207

Natural Language Processing for Smart Baseball Scouting

In baseball, players are rated on a 20-80 scale by professional scouts with 20 being the lowest score and 80 being the highest. Scouts use these ratings to determine how good the player is expected to be for recruiting purposes. Text data from scouts involves various ability attributes about individual players that can increase or decrease a player's score. Using the text data, a model is created to forecast future predictions of the player scores. Thus, we are verifying if an accurate rating on the 20-80 scale can be given to a baseball player based on a string of text about that player and his associated commentator. This is joint work with a Major League Baseball organization.

7:55 - 8:10 p.m.

Colleen Dougherty, Slippery Rock University of Pennsylvania, Stutzman-Slonaker 201

Finding Pythagorean Triples Using Gnomons

Ancient Greeks did not have access to the type of algebra we use today to solve equations. Their kind of algebra was in the form of geometry. Using gnomons within square figurate numbers is possibly a way ancient Greeks found Pythagorean triples. This talk explores how this process may have developed, along with some examples and historical background.

Brooke Fincham and Zachary Linger, Fairmont State University, Stutzman-Slonaker 202

A Mathematical Model for Proactive Bank Hiring

First United Bank & Trust is moving from a staffing method that hires new employees based off historical success to a mathematical model that can predict the number of full-time equivalencies (FTEs) needed at a branch based on various data related to the bank's income and expenses. Our PIC

math group at Fairmont State University was tasked with developing a predictive model that would allow First United to proactively hire new employees. Our preliminary model can use the anticipated income and expense values of a branch to determine the employment needed at that time. We will discuss the difficulties we faced in the project and our preliminary solution.

Claire Hickey and Valeri Natole, University of Pittsburgh, Stutzman-Slonaker 207
Flight Scheduling: ‘Shirley’ You can’t be Serious!

Currently, our goal in this problem is to compose an efficient model in flight scheduling for Republic Airlines. We are tasked with minimizing ‘deadheading’, when an airline has to fly aircrew to their bases in a passenger’s seat. Other important factors we are required to consider are 9/11 scheduling regulations, rest requirements for air crew, and maintenance/weather delays. The Coloring method is our main approach, where we combine both the pilot’s bidding process for flight selection and the flight routings so that each flight has a captain and first officer.

Patrick Cone, Indiana University of Pennsylvania, Stutzman-Slonaker 209
Graceful Tree Conjecture

In graph theory, a graph is just a collection of vertices (dots) and edges (line segments connecting the dots). My project focuses on the Graceful Tree Conjecture. This conjecture was posed by Alexander Rosa in a 1967 paper on graph theory. The Graceful Tree Conjecture states that every tree, which is a certain class of graphs, 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 . It should be noted that the Graceful Tree Conjecture remains an unsolved problem in mathematics, although there are several classes of graphs where the conjecture has been proven true. Since the beginning of my research, I have worked to understand the problem, generate many examples, and make a few conjectures regarding generalized labeling equations that should produce graceful labelings for specific classes of graphs. In this research, we have also been working to define when two graceful labelings of tree graphs can be modified to form a graceful labeling of the larger tree graph formed by combining the two smaller graphs together.

8:15 - 8:30 p.m.

Jacob Daugherty, Slippery Rock University of Pennsylvania, Stutzman-Slonaker 201

On Round Robin Tournaments and Integer Sequences

A round-robin tournament is a tournament where each contestant plays each other contestant one time. Natural questions include asking the total number of matches that are played and how many rounds are required to schedule the tournament. To answer these and other questions, a directed graph can be used to represent the outcome of a tournament. For our main result, we associate an integer sequence with the outcome of a round robin tournament and provide necessary conditions for when such a sequence represents a tournament outcome.

Cori Timney, Juniata College, Stutzman-Slonaker 202

The Fairness of Freaky Four-sided Die

Serving as pseudo-random number generators, dice have been a staple of gaming, gambling, and fortune telling. We explore the fairness of the “crystal” four-sided die, a modern adaption of the ancient four-sided long die. These dice challenge our assumptions about what fair dice should look like, perhaps for very good reasons. Unlike a tetrahedron, this die has no regular faces. We test the fairness of this die

by treating it as a random number generator and testing its roll sequences.

Joel Valentino, University of Pittsburgh, Stutzman-Slonaker 207

Optimization of Sensors for Robotic Inspections

Gecko Robotics is a company based in Pittsburgh, PA which utilizes robotics to perform industrial infrastructure inspections. Their Robots consist of an array of 8 sensors which collect their data. They have tasked our team with finding an optimal amount of sensors to place on their robots. In this peculiar case, we explore the options of placing an upper bound on sensors, as an upper bound is not directly apparent. In this, we outline our practical maximization equation as a function of time, and explore other counter intuitive variables through an exercise in machine learning.

Xueying Li, University of Pittsburgh at Johnstown, Stutzman-Slonaker 209

The Trend of Temperature of Philadelphia from 2007 to 2017

The project aims to use the raw data of temperatures of Philadelphia of the last one decade to analyze the trend of the average daily temperatures and the relationships between the highest daily temperatures, the lowest daily temperatures and the average temperatures. The core tool I used in this project is the linear regression model, which helps to analyze the relationships between the three variables by using SPSS and Excel. I found out that the relationships between average temperatures and the highest(lowest) temperatures are positive correlated.

8:35 - 8:50 p.m.

Jacob Lindey, Slippery Rock University of Pennsylvania, Stutzman-Slonaker 201

An Algorithm for Triangulating 3-Manifolds Given by an Infinite Family of Face Pairings

A 3-manifold is a topological space that locally looks like a Euclidean 3-dimensional space. One way to generate 3-manifolds is through face pairing schemas. Here we consider a family of manifolds generated in this manner, that was studied in search of manifolds with hyperbolic geometries among other properties. Python scripting was used to create triangulation schemas for objects in this family and Regina, a low dimensional topology software package, was used to analyze the triangulations produced by the script.

Michael Madden, Juniata College, Stutzman-Slonaker 202

A New Slant: Trigonometry in the Iso-taxi Metric

In cities where the streets are laid out in a grid pattern, one cannot simply drive directly from point A to point B, but must drive strictly north/south and east/west. Here, the metric between A and B is different than the Euclidean metric where we could just go in a diagonal. In my talk we will explore a metric that looks similar to a city with the streets creating a triangular lattice, and we will define angles and trigonometric functions.

Donald Falk, Andrew Klang, and Jason Miller, University of Pittsburgh, Stutzman-Slonaker 207

Machine Learning Applied to Pitching and Batting in Baseball

As a baseball hitter, the ability to know what pitch is coming puts you at a huge advantage. In our project, techniques for predicting pitches are explained and implemented using a variety of methods including Markov chains, random forests, and neural networks. By using our algorithm, we help put the Erie Evil Geniuses' baseball team at a favorable position over their competition.