ABSTRACTS OF TALKS PRESENTED TO THE INDIANA SECTION OF THE MAA

1. Introduction

The Spring 2015 meeting of the Indiana Section of the Mathematical Association of America is at Taylor University, in Upland, March 13–14. The abstracts appearing here are based on text electronically submitted by the presenters. Contributed talks are listed in alphabetical order by presenter.

2. Invited Talks

Presenter: Francis Su, Harvey Mudd College, and MAA President-Elect

My Favorite Math Fun Facts

For many years, I have been collecting "Math Fun Facts", cool ideas that can be presented quickly, from any area of math, meant to arouse my students' curiosity and show that math is full of beautiful ideas, patterns, and ways of thinking. In this talk, I will present my favorite Math Fun Facts. Will they be your favorites? You decide.

All about Cubes on Super π Day

Just like circles, cubes are one of the simplest geometric objects. Or are they? I will ask some basic questions that show how cubes are connected to many other mathematical ideas. Including π? Some are recent discoveries by undergraduates.

Presenter: Jenna Carpenter, Louisiana Tech University, and MAA 1^{st} Vice President

Top Secret: Women's Contributions to the History of Computing

Did you know that the first computers were humans, not machines? Did you know that these computers were women, not men? Did you know that these women were in their late teens and early 20s, not PhDs? We will learn about the central role that a group of mathematically-talented young women, called the Top Secret Rosies, played during the transition to the computer era in World War II.

3. Indiana Project NExT Panel Discussion

Panelists:

- Justin Gash, Franklin
- Edray Goins, Purdue
- Vincenzo Isaia, Rose-Hulman
- Francis Su, Harvey Mudd

Engaging Students in Extracurricular Math Activities

A valuable aspect of being a math major is getting involved in activities outside of the classroom. In this session, the panelists will share their experiences in getting students involved in extracurricular activities such as math competitions, student organizations like Pi Mu Epsilon and math clubs, and conference programs. Plenty of time will be allotted for questions from the audience.

4. Student Workshop

Presenter: Stacy Hoehn, Franklin College

Lattices, Limits, and Lines, Oh My! A Pi Day Exploration

In honor of Pi Day, we will use hands-on exploration and experimentation to investigate some straightforward questions whose answers surprisingly involve the number π. These interactive explorations will take us through the fantastic nature of falling needles, into the probabilities of randomly finding relative primes, and around the average number of ways a whole number can be written as the sum of two squares. No circles will be harmed in this workshop (and relatively few will be needed).

5. Contributed Talks

Presenter: Keith Bauson, Taylor University undergraduate student

Modeling decisions in RoboCup soccer

The proper positioning of players on the field is a core principle in soccer. Players should be able to take in the field and adjust on the fly so that as a team they are in an optimal position to help achieve the objectives of getting the ball into the opponent team's goal and keeping the ball away from their own goal and out of the possession of their opponents. Last summer, a research team at Taylor University focused on coming up with a flexible way to instruct autonomous agents (artificial intelligence-based players) on how they should position themselves on the field. We produced a model which assigned priorities to potential positions based on various factors, with players moving towards the position with the highest priority. Additionally, we were able to plot these priorities in real-time on a 3D graph, allowing us in a sense see how the players were making decisions.

Presenter: Levi Boxell, Taylor University undergraduate student

Missing data in spatial econometrics

Missing data poses a problem for most applied research in economics. Two typical approaches among applied researchers are listwise deletion and mean imputation. These methods are standard in most statistical packages. However, they make an implicit assumption about the nature of the missing data. Using the terminology set forth by Rubin (1976), listwise deletion and mean imputation assumes the data are missing completely at random (MCAR). However, the spatial component of spatial econometric models makes estimates after listwise deletion and mean imputation biased, even for MCAR data. Despite this fact and the prevalence of missing data in applied work, there has been little research on missing data methods in spatial econometric models. I propose a general method for handling missing data in a broad class of spatial econometric models using an expectation-maximization (EM) algorithm along with multiple imputations via chained equations. I demonstrate the unbiased nature of this method via Monte Carlo simulations and then use it to examine the spatial dependency of HIV prevalence in sub-Sahara Africa. Results suggest a positive and statistically significant level of spatial dependency.

Presenters: Adam Coffman, IPFW, and Andy Rich, Manchester University

π/τ debate

Which is better, $\pi = \frac{\tau}{2} \approx 3.14$ or $\tau = 2\pi \approx 6.28$? Are you a pi-rate or a tau-ist? This debate might help you decide.

Presenter: José Contreras, Ball State University

GeoGebra as a tool to solve and model mathematical problems: The treasure problem

GeoGebra, and Interactive Geometry Software, is a powerful cognitive tool to model mathematical problems. It often provides valuable insights about their solution that can then be justified using mathematical arguments. In this talk I describe some of the approaches that my college students (prospective secondary mathematics teachers) have used to model and solve the classical problem involving a buried treasure with the help of GeoGebra.

Presenter: Patricia Erickson, Taylor University

Using fun in the statistics classroom: An exploratory study of college instructors' hesitations and motivations

This study examines statistics instructors' use of fun as well as their motivations, hesitations, and awareness of resources. In 2011, a survey was administered to attendees at a national statistics education conference, and follow-up qualitative interviews were conducted with 16 of those ($N = 249$) surveyed to provide further context for interpreting the quantitative results. Motivations were similar for men and women, but female instructors admitted more hesitations in many areas. While many instructors are using or are open to using fun in the statistics classroom, the findings suggest that not having available resources at hand and not being aware of resources such as the CAUSEweb collection are major hesitations.

Presenter: Kristin Farwell, Grace College

Fantasy football and a knapsack

In this talk we will be presenting an integer programming problem formulation of a Salary Cap Fantasy Sports game. Most websites that run a Salary Cap Fantasy game will post the best team for the week, which are typically suboptimal. We will show the optimal solution and compare some heuristic solutions.

Presenter: Amanda Harsy, Lewis University, Illinois

Oral and mastery based testing in a real analysis course

In this talk we will discuss oral and mastery-based testing in an undergraduate Real Analysis course. The main goals of these alternate assessment methods are to decrease test anxiety and increase full understanding of the concepts of Analysis. In mastery-based testing, students are given problems in which they can only receive full credit on the problem after they demonstrate mastery of the concept being tested. Each test includes similar questions over the same concepts from previous tests which allows students who have not mastered an idea to retest and fully comprehend old concepts. Once a student receives full credit for a question, they need never attempt the question again. Students also met with the instructor to present proofs as an oral exam. This allowed the instructor to ask questions to determine whether a student fully understood the step by step process of the proof. It also provided students who were stuck a chance to be given a hint from the instructor and continue from that point. Both testing methods are designed so that test anxiety decreases since one bad exam grade or getting stuck on a proof will not necessarily tank their overall grade. This talk will discuss the benefits, shortcomings, and challenges of implementing these alternate assessment techniques.

Presenter: Sarah Hinkel, Grace College undergraduate student

Faculty Advisor: Kristin Farwell, Grace College

Expected worth of properties from two different perspectives for Panic on Wall Street

My advisor and I analyzed *Panic on Wall Street*, a board game where the objective is to accrue the most money. This game involves probability and economic theory. The players are divided into two groups: managers and investors. The investors negotiate a price to pay the managers for a company share. The roll of the dice determines the return on investment for each share. In this report, we find the worth of a property from the investor and manager's perspective and recommend decisions given a point in the game.

Presenter: Edna Jones, Rose-Hulman Institute of Technology undergraduate student

Faculty Advisors: Matthew Young, Texas A&M; John Rickert, Rose-Hulman

Representations by ternary quadratic forms

How can you represent integers by ternary quadratic forms? For example, can the integer 2015 be represented as a sum of a square plus three times a square plus five times a square? A few kinds of representations over the integers (such as global representation and local representation) will be discussed. To better understand these representations, we count how many solutions there are to congruences involving ternary quadratic forms using quadratic Gauss sums and Hensel's Lemma.

Presenter: Joshua Kiers, Taylor University undergraduate student

A peculiar polarity: Invariants and extensions of a particular geometric projection

One of the primary concerns of projective geometry is the duality of points and lines in the plane. This duality can arise from inversion across conics. A particular parabolic inversion lends itself to extensions to higher dimensions and to parametric functions. Several properties of these extensions, such as invariants and dual spaces, are explored with examples.

Presenter: Daniel Kiteck, Indiana Wesleyan University

Numberphile: *Episodes from* 2012

Numberphile is a YouTube series focusing on interesting math aimed at a general audience. I will give highlights from the first year of *Numberphile*, which are primarily episodes from 2012. I just finished these (around 100 episodes around $5 - 10$ minutes each), and I will continue to watch them. Topics include Heegner numbers, a special modern magic square, Brown numbers, and more.

Presenter: Tiffany Kolba, Valparaiso University

When and how can randomness have a stabilizing effect?

Noise-induced stabilization is the phenomenon where the addition of randomness (i.e. noise) stabilizes an unstable deterministic system. This is quite a surprising and intriguing phenomenon because one's first intuition is often that randomness will destabilize, rather than stabilize, a system. This talk will focus on two seemingly similar unstable deterministic systems and show that the first can be stabilized by the addition of randomness into the system, while the second cannot. We will explore how to perturb the second unstable deterministic system in order to allow for the addition of randomness to have a stabilizing effect.

Presenter: Phil Mummert, Butler University

Joint work with: Anna Durham, Sarah Stoops, and Paije Smith, Butler University undergraduate students

MSC 2010: 37F10

A symbolic algorithm for periodic points

Iteration of a polynomial rapidly increases the degree, making it a challenge to find all points of fixed period. For example, there are over one million points that equal their twentieth iterate under a fixed quadratic function. In some cases, by changing coordinates and importing symbolic dynamics, we can track each periodic point while perturbing parameters. Implementing this method also results in a natural correspondence between loops in parameter space and elements of the group of automorphisms of the symbolic shift space.

Presenter: Mark Panaggio, Rose-Hulman Institute of Technology
Joint work with: Steve J. Bacinski and Timothy J. Pennings, Davenport University

Elvis Lives: An exploration of greedy and global path optimization in a game of fetch

Elvis, the Welsh corgi who "knew" calculus, became famous when he found the quickest route down the beach and through the water to his ball. It was later discovered that Salsa, the Labrador, could achieve the same result by using a "greedy" approach — moving toward the ball as quickly as possible at each instant in time. Why would these two disparate strategies yield identical results? In this talk, we consider a generalized game of fetch in which the dogs' speeds depend on their position. We will demonstrate that when speed is continuous the greedy path is always a beeline straight to the ball, while the optimal path seldom is. Only when the speed is discontinuous along the shoreline does Salsa's short term thinking result in her taking the optimal path.

Presenter: Brandon Reppert, Taylor University undergraduate student
MSC 2010: 68-04

Satellite telemetry compression: Using delta compression to shrink packet size

The goal of this research was to find optimal methods of compression for telemetry data. ELEO-Sat specifically, a Taylor University satellite, will benefit from having an efficient compression and packetization algorithm due to the high costs associated with sending data to and from space using the Globalstar network. Not only cost, but also representational constraints and responses to potentially faulty mechanisms require careful algorithmic solutions that strike a proper balance between the competing ends of savings and redundancy. Due to the nature of the data, a variety of delta compression methods will be explored in order to accomplish optimal rates. Simulations and implementations will be tested and discussed, with the result being successful compression rates that hedge against the inevitability of dropped packets.

Presenter: Derek Thompson, Taylor University

Desmos demonstration

This talk will give an overview of the online graphing calculator tool, Desmos, and ways that you can use it in the classroom as well as save time on projects/homework/etc. Desmos is free and also has a free iPad app.

Presenter: Carolyn Yarnall, Wabash College

Product societies: Voting orthogonally

Approval voting is a voting method in which each voter can cast a vote for every candidate they approve of. The candidate approved by the most voters wins the election. In this talk we will provide basic definitions in the context of approval voting and note already known bounds for the agreement number, or number of votes a winning candidate will receive, in certain societies. Then we will consider voting societies that may be constructed as products of other societies and state new results regarding the agreement number of such societies.