



**GEORGIA
COLLEGE**

GEORGIA'S PUBLIC LIBERAL ARTS UNIVERSITY

3rd ANNUAL

CAPSTONE DAY

Department of Mathematics

Georgia College

November 22, 2014

8:00 AM - 2:15 PM

Health Sciences Building

Department of Mathematics Georgia College

Earning a college degree is a significant achievement and requires dedication and tremendous effort by each student. Several programs have been developed to help students majoring in Mathematics to succeed. The First Year Academic Seminar provides an introduction to department faculty, departmental and University expectations, policies, resources, and opportunities following graduation. The department conducts informal social activities and presentations by faculty and guest speakers to encourage faculty and student interaction. The department newsletter, Sum News, serves to inform, acknowledge and encourage student majors to become involved in activities related to the major such as mathematics competitions and professional meetings. The academic honor society Kappa Mu Epsilon has been organized to encourage and provide a supporting network for the student body.

Professional schools, businesses, government, and industry recognize that mathematics majors are problem solvers and are highly skilled in the use of logic and reasoning. A degree in Mathematics opens many careers that are closed to those without quantitative skills. Actuarial Science stands as one major example. Moreover, the demand for mathematics in education-especially in secondary schools-is tremendous. In fact, the chronic nation-wide shortage of mathematics teachers is due in part to the demand in so many other areas for talented mathematics majors.

2014 Capstone Day Schedule

8:00 – 8:40 Registration and Breakfast	HSB Student Lounge (3rd Floor)
8:40 – 9:00 Opening Remarks	HSB 300
9:00 – 10:10 Session I	HSB 300
9:00-9:20 <i>A Matrix Extension of the RSA Cryptosystem</i> , Andrew Pangia	
9:25-9:45 <i>Linear Algebra of Pascal Matrices</i> , Lindsay Yates	
9:50-10:10 <i>Various Properties of the Fibonacci Number Sequence</i> , Moriah Gibson	
10:10-10:25 Break	HSB Student Lounge
10:30-11:40 Parallel Session II	HSB 300
10:30-10:50 <i>Using Groebner Bases to Find Nash Equilibria</i> , Wayne Cook	
10:55-11:15 <i>Generalizations of the Postage Stamp Problem</i> , Suzanne Frank	
11:20-11:40 <i>Regression and Tree Based Models: Georgia Unemployment</i> , Matthew Heath	
10:30-11:40 Parallel Session III	HSB 304
10:30-10:50 <i>Student's Perception of Interactive Teaching Aids in the Core Mathematics Classroom</i> , Taylor Smoak	
10:55-11:15 <i>Comparing Perspectives of Mathematics and Special Education</i> , Lauren Stephansen	
11:20-11:40 <i>Creatively Disrupting the Mathematics Classroom with the Humanities</i> , Madii Davis	
11:40-12:40 Lunch	HSB 314
12:45-1:55 Parallel Session IV	HSB 300
12:45-1:05 <i>Introducing Students to the Projective Plane Using the Dynamic Geometry Software Sam</i> , Joel Rapkin	
1:10-1:30 <i>Forecasting Median Home Price Using Regression Analysis</i> , Marcie McBride	
1:35-1:55 <i>Modeling Student Achievement using Linear and Nonlinear Models</i> , Ryan Lawson	
12:45-1:55 Parallel Session V	HSB 304
12:45-1:05 <i>The Principle of Mathematical Induction: A Viable Proof Technique for High School Students</i> , Alex Reid	
1:10-1:30 <i>Mathematics Taking the Stage</i> , Emily Harper	
1:35-1:55 <i>Culturally Responsive Mathematics Teaching</i> , Katie Hodgson	
2:00-2:15 Closing Remarks	HSB 300

2014 Capstone Day Abstracts

Wayne Cook

Using Groebner Bases to Find Nash Equilibria

Game theory is a field of study that has many applications in economics. In this talk we discuss how to apply algebraic geometry techniques to problems in game theory. In particular, we use Groebner bases to determine equilibrium points of specific types of games. We explain how to solve a given system of polynomial equations and show how these arise in game theory. We give specific examples of these techniques in small games.

Madii Davis

Creatively Disrupting the Mathematics Classroom with the Humanities

This paper will discuss the importance of incorporating the humanities within a mathematics classroom. An experience was designed for a calculus II class in order to analyze such effects. Students observed a presentation influenced by the history of limits, answered concrete and thought-provoking questions, and shared additional thoughts by writing a journal entry. The primary purpose of this paper is to analyze what the calculus II students gain after being exposed to this experience. It will also provide one with possible methods that can be incorporated into the classroom.

Suzanne Frank

Generalizations of the Postage Stamp Problem

The postage stamp problem and its variations are classical problems in elementary number theory. This problem involves finding the largest value that cannot be expressed as a nonnegative linear combination of two relatively prime integers m and p . It turns out that this value can be defined as a function of m and p . An original proof of this fact is the first major goal of this paper. Moreover, this paper will explore the connections between the Euclidean Algorithm and linear Diophantine equations. Further applications of the problem such as the number of representations that these integers have are also investigated.

Moriah Gibson

Various Properties of the Fibonacci Number Sequence

The Fibonacci number sequence is famous for its connection to the Golden Ratio and its appearance within natural objects. However, there do exist Fibonacci-like sequences that share the same recursive definition as the Fibonacci sequence without possessing its same connection to the Golden Ratio. We will explain a method for constructing such Fibonacci-like sequences, and then examine the relationship between the Golden Ratio and the Fibonacci number sequence through the appearance of Fibonacci numbers within a sunflower.

Emily Harper

Mathematics Taking the Stage

Students having difficulties learning mathematics is not a new story, but involving mathematics with theatre might seem to be. Theatre in the classroom can be seen as involving movement and play, or as my study suggests, kinesthetics and manipulatives. Today people are usually categorized as left or right brained, and it is seen as unusual for someone to enjoy aspects of both. What effect would it have if we started to integrate more theatrical and creative endeavors into the mathematics classroom? Would these aspects make it so that students find the classroom more enjoyable? What effect would it have on math anxiety in students? This capstone looks into the studies done by educators working with new forms of play paired with my own studies with students at Georgia College.

Matthew Heath

Regression and Tree Based Models: Georgia Unemployment

Regression analysis and tree based models are a widely used statistical methodology for fitting data and making a prediction. This capstone project is about studying factors affecting Georgia unemployment. The factors we considered are national unemployment, if there is a war going on, if there is a presidential election, if the president, house, or senate has a republican or democratic majority, the end of the year value for both the Dow and S&P 500. We fit regression and tree-based models. Then, we compared the prediction accuracy of these models using mean square error of the test data set.

Katie Hodgson

Culturally Responsive Mathematics Teaching

This research project examines effective strategies for teaching students of different cultures in the mathematics classroom. As the number of students with multiple cultural backgrounds grows every year, the teacher's need to understand this and respond to it is crucial. In the literature teaching strategies that are culturally responsive are suggested to motivate and improve students' critical thinking and allow students to better solve problems. In my paper the main focus is to give the reader a better understanding of what culturally responsive mathematics teaching is, examples of how it could inform a mathematics lesson, and how the lack of these practices can limit students' learning in mathematics.

Ryan Lawson

Modeling Student Achievement using Linear and Nonlinear Models

Linear regression models are widely used to make predictions based on data. In this paper, we use linear as well as nonlinear models to fit and predict standardized test results of various high schools in Georgia, using the average teacher salary, student-to-classroom ratio, and student-to-computer ratio as predictors. We develop and test predictor models using polynomial, spline, stepwise, ridge, and LASSO regression methods. We compared the performance of these models with respect to mean square error of test data for each standardized test. We find that stepwise regression works quite well for most of the subject tests, but in the case of 9th Grade Literature & Composition, the nonlinear LASSO model gives us less overall mean square error on test data set.

Marcie McBride

Forecasting Median Home Price Using Regression Analysis.

Home prices are affected by many economic indicators such as economic growth, unemployment, consumer confidence, mortgage availability, etc. In this work, we use the gross domestic product, the inflation rates and the unemployment rate to analyze the median home prices in U.S. We use regression analysis to study the effect of each variable on the median home prices.

Andrew Pangia

A Matrix Extension of the RSA Cryptosystem

We propose a variation on the RSA Cryptosystem: namely, an extension of the RSA encryption and decryption methods to matrix values in addition to scalars. We first explore the mathematics behind the RSA Cryptosystem, after which, we investigate the theory of the proposed variation to the system.

Joel Rapkin

Introducing Students to the Projective Plane Using the Dynamic Geometry Software Sam

Projective geometry originated in the context of art, but evolved into a much more mathematical research field as more and more mathematicians started questioning the uniqueness of the very popular Euclidean geometry. In this talk we will introduce the real projective plane and explore it using the Dynamic Geometry Software Sam. With its “swap finite & infinite points” function, students will be able to see connected geometrical figures and explore some theorems from the Euclidean plane in the projective plane.

Alex Reid

The Principle of Mathematical Induction: A Viable Proof Technique for High School Students

This paper discusses the examination and study of the principle of mathematical induction. Specifically, we are interested in the idea of teaching the principle of mathematical induction to high school students as a viable proof method. Our goal for the project was to have the students learn how to write a correct mathematical proof as well as transition from the computational realm of mathematics to the theoretical realm. To gather information, a lesson plan was developed and taught to a class of high school students. We found that the principle of mathematical induction is a proof method that high school students can learn and understand given enough time and the proper approach to teaching the topic.

Lauren Stephansen

Comparing Perspectives of Mathematics and Special Education

There exists several different learning theories that have developed over the years as an attempt to determine how students learn. This paper outlines the learning theories presented by Jean Piaget, B.F. Skinner, John Dewey and Lev Vygotsky and discusses several different educational belief systems proposed by Costa and Garmston. It focuses on comparing mathematics educators and special educators beliefs about the teaching and learning of mathematics.

Taylor Smoak

Student's Perception of Interactive Teaching Aids in the Core Mathematics Classroom

Research suggests that manipulatives are an important part of the learning process in the mathematics classroom. These hands-on engagements allow greater creativity and a deeper understanding of mathematical topics while increasing student interaction. The purpose of this project is to see how Georgia College students in an undergraduate mathematics classroom perceive the use of manipulatives, or lack of, in the modern day mathematics classroom. This paper explores the thoughts of individual students in their respective teaching aid group, and analyzes their knowledge and understanding about the unit circle.

Lindsay Yates

Linear Algebra of Pascal Matrices

The famous Pascal's triangle appears in many areas of mathematics, such as number theory, combinatorics and algebra. Pascal matrices are derived from this triangle of binomial coefficients, which create simplistic matrices with interesting properties. We explore properties of these matrices and the inverse of the Pascal matrix plus the identity matrix times any positive integer.



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