GEORGIA COLLEGE

GEORGIA'S PUBLIC LIBERAL ARTS UNIVERSITY

FOURTH ANNUAL

CAPSTONE DAY

Department of Mathematics

Georgia College

November 21, 2015

8 a.m. - 2:15 p.m.

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.

2015 Capstone Day Schedule

8 – 8:40 a.m. Registration and Breakfast **HSB Student Lounge (3ʳᵈ Floor)**

8:40 – 9 a.m. Opening Remarks **HSB 300**

9 – 10:10 a.m. Session I **HSB 300**

    9 - 9:20 a.m. ***Sequences of Soddy Circles,*** Keri Spetzer

    9:25 - 9:45 a.m. ***Multi-Way Contingency Tables in Baseball: An Application of Algebraic Statistics,*** Brian Minter

    9:50 - 10:10 a.m. ***Effectiveness of a Supplemental Instruction Program in a Statistics Classroom,*** Emily Baum

10:10 - 10:25 a.m. Break **HSB Student Lounge**

10:30 - 11:40 a.m. Session II **HSB 300**

    10:30 - 10:50 a.m. ***On the Rank of a Kronecker Sum of Similar Matrices,*** Kirsten Morris

    10:55 - 11:15 a.m. ***Fractional Calculus Fundamentals and Applications in Economic Modeling***, Austin McTier

    11:20 - 11:40 a.m. ***Discovering Discovery Learning,*** Kendall Brown

11:40 a.m. - 12:40 p.m. Lunch **HSB 314**

12:45 - 1:55 p.m. Parallel Session III **HSB 300**

    12:45 - 1:05 p.m. ***Modeling the Game Plinko with Random Walks,*** Dylan Hogan

    1:10 - 1:30 p.m. ***Models Involving Interactions between Predator and Prey Populations,*** Matthew Mitchell

    1:35 - 1:55 p.m. ***How Conceptual Understanding Can Improve Mathematical Intuition***, Jordan Orlandini

12:45 - 1:55 p.m. Parallel Session IV **HSB 304**

    12:45 - 1:05 p.m. ***Children's Understanding of the Equal Sign,*** Sue Prestwood

    1:10 - 1:30 p.m. ***Investigating the Content Knowledge Teachers Need to be an Effective Mathematics Teacher,*** Elijah Jordan

    1:35 - 1:55 p.m. ***The Mystery of Mixed Number Addition and Subtraction***, Misty Kent

2-2:15 p.m. Closing Remarks **HSB 300**

2015 Capstone Day Abstracts

Emily Baum
Effectiveness of a Supplemental Instruction Program in a Statistics Classroom

At most universities, an introductory statistics course is required for the majority of the students before they begin their specific major classes. Roughly 25% of undergraduate students at a given university will take a statistics class during a single academic year. Of these students, several will fail to retain the information, making future classes more difficult, or fail to successfully pass the course, increasing the likelihood a student will not graduate on time. Providing academic support through the implementation of a Supplemental Instruction (SI) Program gives students the opportunity to receive free, out-of-class help focused on student achievement in this course. Lead by a SI Leader, students are able to attend sessions to receive conceptual help while reviewing class material, developing study strategies, and collaborating with classmates. We will be focusing on the effects SI can have on student achievement in a statistics classroom. Since statistics is a necessary and important course in several disciplines, proper academic help is crucial for the success of the students. We will share our data analysis for using SI in a statistics course over a 4-year period, providing participants the opportunity to identify the positive effects SI has on student success.

Kendall Brown
Discovering Discovery Learning

Research suggests controversy exists in the way that students best understand mathematical concepts. A traditional classroom tends to keep the teacher as the center, however; becoming more popular in the educational realm is a shift where the students become the center of the learning process, building their own understanding. One way the students become the center is by engaging in a Discovery Learning Activity. The purpose of the project is to see which method of teaching increases two of the five aspects of mathematical proficiency: conceptual understanding and procedural fluency of Georgia College undergraduate Pre-calculus students. This paper will compare and contrast the benefits of a student-centered classroom with a teacher-centered one.

Misty Kent
The Mystery of Mixed Number Addition and Subtraction

It has long been acknowledged that fractions tend to be a major hurdle for students. After seeing my own high school students struggle with fractions, I began to wonder where was the disconnect? The Mystery of Mixed Number Addition and Subtraction is a study on preservice teachers currently at Georgia College in Dr. Abney's MATH 2008 class. The purpose of my research was to study a possible connection between a person's personal mathematical relationship and their type of understanding of mixed number addition and subtraction, specifically conceptual verses procedural.

Dylan Hogan
Modeling the Game Plinko with Random Walks

In this talk we model the popular The Price is Right game Plinko. We introduce a simple random walk and illustrate with a variation of Plinko. Further, we give a table of the probabilities of landing in specific slots that depends on starting position by using a random walk with reflecting barriers. We also investigate the effects of other Plinko boundaries and modify the length of the Plinko board.

Elijah Jordan
Investigating the Content Knowledge Teachers Need to be an Effective Mathematics Teacher

There is a major reform movement happening in the world of mathematics education. Not only does this change require teachers to do more than lecture at the front of the classroom, but it also requires teachers to know and understand mathematics more deeply. Through a survey given to high school mathematics teachers identified as effective, I looked for themes that may help to identify what teachers need to know in order to teach mathematics effectively. I will present findings on how these teachers draw on previously taken college courses as well as their own teaching experiences to inform their practice.

Austin McTier
Fractional Calculus Fundamentals and Applications in Economic Modeling

A relatively untapped branch of calculus, Fractional Calculus deals with integral and differential operators of non-integer order, as well as resolving differential equations consisting of said operators. This paper examines certain properties, definitions and examples of fractional integrals, Riemann-Liouville fractional derivatives, Caputo fractional derivatives and differential equations, along with various methods in order to solve them. In addition, this paper applies a fractional order approach to modeling the economic growth of the United States. Based on previous research, we expect to find that the implemented fractional model will have a stronger performance than traditional methods of measuring economic growth.

Brian Minter
Multi-Way Contingency Tables in Baseball: An Application of Algebraic Statistics

Algebraic statistics is a relatively new field of mathematics that combines methods from algebraic geometry and commutative algebra to develop new techniques of statistical inference. Although there are already methods to test for independence such as Pearson's Chi-Square Test and Fisher's Exact Test, methods from algebraic statistics have shown to be useful when evaluating multi-way and sparse tables. In this presentation, we seek to duplicate these results by using Markov Chain Monte Carlo Methods, in particular the Metropolis Hastings Algorithm, to sample multi-dimensional distributions of baseball data to test for independence.

Matthew Mitchell
Models Involving Interactions between Predator and Prey Populations

Predator-prey models are used to show the intricate interactions between predator and prey populations. In this project, we will show how these different interactions between the predator and prey populations are possible based on the choice of functional response we make. In general, a Functional Response is the relationship between the average number of prey eaten by each predator per unit of time versus the density of the prey population. Our choice of functional responses is motivated by the observations of the predator and prey interactions in nature.

Kirsten Morris
On the Rank of a Kronecker Sum of Similar Matrices

Sylvester equations of the form $AX + X(-B) = C$, where A, B and C are given matrices and the matrix X needs to be determined, play an important role in control theory and stability theory. Using the Kronecker sum of matrices and the vectorization operator we can rewrite this equation as the linear equation $(I \otimes A + (-B^T) \otimes I) \text{vec}(X) = \text{vec}(C)$, where I is the identity matrix. We present a result regarding the rank of the Kronecker sum $(I \otimes A + (-B^T) \otimes I)$, where A and B are similar matrices.

Jordan Orlandini
How Conceptual Understanding Can Improve Mathematical Intuition

This is a study that was conducted on 61 high school sophomore and juniors to see if training their conceptual understanding of exponential growth and decay improves their intuition of the concept. The students were given an anonymous short four question pre-test followed by a lecture followed by an identical post-test. The students were not allowed to use calculators or refer to their first test when taking the second. The lecture trained students on the behavior of exponential growth and decay. Statistical analysis indicates that there was improvement from the pre-test to the post-test. Other research indicates that training intuition is critical for improving mathematical understanding.

Sue Prestwood
Children's Understanding of the Equal Sign

Researchers have analyzed students who struggle with the transition from arithmetic to algebra and have found one of the causes to be a misunderstanding of the meaning of the equal symbol. An earlier study revealed an alarmingly high number of elementary and young middle school students who possessed this misconception (Falkner, Levi, and Carpenter, 1999). My research was conducted to identify possible improvements in students' conceptions of the equal sign. The methods and results of my study will be presented.

Keri Spetzer
Sequences of Soddy Circles

Given three externally tangent circles, there exists a fourth circle that is externally tangent to the three. This fourth circle is called the inner Soddy circle. In this presentation we construct a sequence of inner Soddy circles. We recursively define the inner Soddy radius and examine the convergence of the sequence of the Soddy radii and their ratios. We also explore the geometric relationship among the centers of the circles in the sequence and give a characterization of the the curve that passes through the Soddy centers.

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