NINTH ANNUAL CAPSTONE DAY

Department of Mathematics
Georgia College

November 13, 2020
2 pm – 4:35 pm
Virtual

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 webpage 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 nationwide shortage of mathematics teachers is due in part to the demand in so many other areas for talented mathematics majors.

2020 Capstone Day Schedule

2 – 2:05 pm Opening Remarks **Zoom**

2:05 – 3:05 pm Session I **Zoom**

Resampling Techniques in Inferential Statistics**,** Stephen Mosley

What Determines War in Baseball**,** Sam Eichel

Deepening Understanding of Quadratics Through Bruner's Theory of Representation, Caroline Drummond

3:05 – 3:10 pm Break

3:10 – 4:30 pm Session II **Zoom**

Lie-derivations of 3-dimensional non-Lie Leibniz Algebras**,** Emily Howe

Comparing Virtual and Concrete Manipulatives Effect on Conceptual Understanding of the FOIL Method**,** Kristen Hartley

The Evolution of Cryptography Through Number Theory**,** Dawson Shores

The Effectiveness of Middle and High School Mathematics Inclusion Classes, Justin Hockey

4:30 – 4:35 pm Closing Remarks **Zoom**

2020 Capstone Day Abstracts

Caroline Drummond
Deepening Understanding of Quadratics Through Bruner's Theory of Representation

Bruner's Theory of Representation is typically applied in early childhood education, but it can also be beneficial in secondary education as well. In Bruner's Theory learners go from a tangible, action-oriented stage of learning to a symbolic and abstract stage of learning. By using this theory, learners can build new knowledge upon knowledge they've previously learned. This can lead to a better understanding of what students are learning. A way to apply this in an upper level math class is through manipulatives. The purpose of my study is to show how successful Bruner's Theory is in increasing understanding and creating connections in mathematics when applied to secondary and upper level math classes. Students from the Special Education Cohort at Georgia College were given a lesson on completing the square using Algebra Tiles and given a pre and post assessment to assess their learning and understanding. Through this project we will see the impact of applying Bruner's Theory in the classroom.

Sam Eichel
What Determines War in Baseball

2020 has been a very weird year. The 2020 Baseball season was no different. Instead of the normal 162 game season, it was a very short season of 60 games. In this research, we will use variable selection to determine what predictors have the highest effect on War (Wins Above Replacement). We will also use multiple regression analysis to find the best fit for War.

Kristen Hartley
Comparing Virtual and Concrete Manipulatives Effect on Conceptual Understanding of the FOIL Method

Defined as "an object that can be handled by an individual in a sensory manner during which conscious and unconscious mathematical thinking will be fostered," (2010, p. 14) manipulatives are used in mathematics classrooms all across the United States and other countries. Stein and Bovalino state that manipulatives provide a concrete way to link abstract information to already established knowledge thus giving new concepts a deeper meaning (2001). The purpose of this study is to compare concrete and virtual manipulatives to see if one fosters a deeper conceptual understanding of the FOIL Method. Students in a Middle Grades Cohort at Georgia College were given both a pre and post assessment to assess their level of understanding of the FOIL Method after a lesson using either virtual or concrete manipulatives. They then were taught using the other type of manipulative to assess whether students prefer virtual or concrete manipulatives.

Justin Hockey
The Effectiveness of Middle and High School Mathematics Inclusion Classes

An inclusion class is a class containing both general education students and students with learning disabilities. They typically consist of two teachers, one who is a general education teacher who specializes in a particular academic subject and the other who specializes in teaching students with learning disabilities, such as a special education teacher or a paraprofessional. So far, there is a considerably small pool of research which addresses math inclusion classes. For this study, a survey was conducted for teachers who have taught in a middle or high school math inclusion class. The goal of the survey was to figure out whether or not teachers feel students are best taught math in an inclusion class, whether or not teachers are properly equipped to facilitate a math inclusion class, and which teaching strategies work best in math inclusion classes.

Emily Howe
Lie-derivations of 3-dimensional non-Lie Leibniz Algebras

The concept of Lie-derivation was recently introduced as a generalization of the notion of derivations for non-Lie Leibniz algebras. In this project, we determine the Lie algebras of Lie-derivations of all three-dimensional non-Lie Leibniz algebras. As a result of our calculations, we make conjectures on the basis of the Lie algebra of derivations of Lie-solvable non-Lie Leibniz algebras.

Stephen Mosley
Resampling Techniques in Inferential Statistics

Before the age of computers, inferential statistics required heavy levels of formula-based computation to get estimations and the accuracy of those estimations from even small sets of data. But now, methods have been introduced that cut down the computation with the use of iterative resampling from samples in any distribution. Resampling is the method of taking a sample and creating different samples from that sample with their own distribution using any method of resampling the statistician deems fit. Two such methods of resampling are the Jackknife and Bootstrap methods. In this presentation, we'll be taking a look at what these methods are, how they work, and assessing the pros and cons of their methodology in certain situations.

Dawson Shores
The Evolution of Cryptography Through Number Theory

Cryptography, the science of disguising messages in order to increase the security of the message, has been in practice for thousands of years. The ability to send messages in secret has been influential throughout history. Another influence in history is cryptanalysis, the technique of uncovering encrypted messages without knowing the decryption key. What started as simply wrapping paper around a stick has evolved into complex internet encryption using mathematics. The ciphers that were used thousands of years ago, while adequate for their time, would necessarily be replaced by more secure ciphers. As more advanced ciphers would be broken, new ones would need to be created. As a result, cryptography is always changing. One key element of this change is the inclusion and progression of mathematics. From simpler arithmetic such as addition and multiplication, to the use of more advanced techniques such as matrix operations, modular arithmetic, and discrete logarithms, a wide variety of mathematics is incorporated into cryptography. A specific field of mathematics that is essential to cryptography is number theory. While there are various ciphers that use number theory, public key ciphers are one of the most important in today's society. Public key ciphers are essential in modern day security for the internet and credit card transactions. This paper describes some of the earlier ciphers that use number theory, and then focuses on different types of public key ciphers such as RSA and ElGamal, as well as the Diffie-Hellman Key Exchange.

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