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<http://sections.maa.org/southeastern/maase/conference2015/>

Undergraduate Poster Session Abstracts

UP.1	<i>Motif-based clustering of directed networks</i>	
Thomas Reith	Davidson College	Laurie J. Heyer, Davidson College
<p>The study of networks has become increasingly relevant in a variety of scientific fields, including biology, sociology, and computing. It has been shown that many real networks divide naturally into clusters, or communities, of related vertices. A large amount of research has focused on the detection of such clusters in undirected networks; their detection in directed networks, however, is a less well-studied problem. Here we introduce a novel clustering algorithm for directed graphs based on the concept of network motifs—recurrent, statistically significant subgraphs found at higher frequencies in real networks than ones that are randomly generated.</p>		

UP.2	<i>Derived Sequences</i>	
Sarah Myers	Berry College	Adam Cronan-Berry College
<p>Given a function d from the natural numbers to the positive integers such that $d(1) = 0$, $d(x) = 1$ when x is prime, and $d(x) = a \cdot d(b) + b \cdot d(a)$ if $x = ab$ is composite, we determine methods for calculating $d(x)$ based on the prime factorization of x and look at the behavior of the function as it is iterated. Then we extend d to be defined on other sets of numbers including the integers and the rationals. We notice when determining methods of calculating $d(x)$ that d acts as a numerical derivative, so we consider the existence of a numerical antiderivative.</p>		

UP.3	<i>An Introduction to Phylogenetics and Tree Space</i>	
Amber Holmes	LaGrange College	Mercedes Coleman - Lamar University Cody FitzGerald - University of New Hampshire Emily Smith - Kenyon University
<p>As part of the North Carolina State University Research Experience for Undergraduates program in the Department of Mathematics, we explored a variety of means in tree space. Tree space is a subset of Euclidean space in which every point represents a tree. In this space, there exist numerous metrics, each of which lead to a different notion of a mean tree. We have implemented the algorithm for the $(1,1)$, $(2,2)$ and $(1,\infty)$-mean in MATLAB. The $(1,1)$-mean is a weighted majority rule consensus tree, the $(2,2)$ mean is generated using Sturm's algorithm. Unlike the $(1,1)$ and $(2,2)$-mean, the $(1,\infty)$ mean is not as well studied. The $(1,\infty)$-mean algorithm we propose incorporates traversing the L_2 geodesic using the L_1 midpoint as a mechanism for obtaining the mean tree's orthant. Once the orthant has been found, the mean tree can be optimized using linear programming.</p>		

UP.4	<i>Power-Conserving Selective-Range Multilateration for Wireless Sensor Network Localization</i>	
Graham Gordon	Auburn University	
<p>The Network Localization Problem (NLP) is the problem of determining the positions of all sensors in a wireless sensor network (WSN) given (i) the positions of only some of the sensors and (ii) the distance between only some of the pairs of sensors. WSNs can be viewed as graphs, with vertices acting as sensors and edges acting as communications. Using results from Random Graph Theory, Eren et al. showed that there exists a sufficient uniform communication radius for all sensors to guarantee a solution to the NLP. Using multilateration to successively determine the sensor positions motivates the Discrete Vertex Ordering Problem (DVOP). Solving the DVOP produces a solution to the NLP. We investigate a sufficient bound on the number of neighboring sensors each sensor communicates with to guarantee a solution to the DVOP. Numerical evidence suggests the bound depends only on the dimension of the space in which the sensors are embedded.</p>		

UP.5	<i>The optimum turning angle after aircraft engine failure at a</i>	
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	<i>low altitude</i>	
Xinyue Dai	Sewanee: the University of the south	Dr Catherine Cavagnaro, Math and Cs Department, Sewanee: the university of the south
<p>Engine failure in a single aircraft at a low altitude right after takeoff demands immediate reaction. The FAA recommend procedure pilot to land straight ahead, but it not work effectively when the failure altitude is 300-1000 feet. The purpose of this study is evaluate the possibility and feasibility of turning back after engine failure during the takeoff phase of flight in a single engine aircraft by building analytical model with Mathematica. Then, matching the result to the analytical result done by Rogers at 1994 . By examining the influence of engine failure altitude, wind direction and velocity, and bank angle on the required runway length of single aircraft, the model shows that the optimum flight turning angle is 45° bank angle at constant velocity during the turn.</p>		

UP.6	<i>Optimization of Water Delivery for Optimal Fire Flow Capabilities</i>	
Ben Eavenson	Emmanuel College	Dr. Bruce E. Scranton, Emmanuel College
<p>Depending on the size of a structure, fire involvement, and water availability, what means of water delivery would provide the most efficient means of continuous fire suppression? At what percentage of fire involvement should the incident commander recognize that amount of involvement exceeds the water availability? By integrating mathematical models for different aspects of the firefighting problem, we seek to answer both tactical problems and strategic infrastructure planning questions. This poster presents the problems, discusses key aspects of the solutions, obstacles encountered, and illustrates results.</p>		

UP.7	<i>Combinatorics of Linked Systems of Quartet Trees</i>	
Emili Moan	Winthrop University	Dr. Joseph Rusinko, Winthrop University
<p>We apply classical quartet techniques to the problem of phylogenetic decisiveness and find a value k such that all collections of at least k quartets are decisive. Moreover, we prove that this bound is optimal and give a lower-bound on the probability that a collection of quartets is decisive.</p>		

UP.8	<i>A Hat Game</i>	
Biraj Dahal	Coastal Carolina University	
<p>We will define a particular hat game and provide optimal strategies for special cases.</p>		

UP.9	<i>Lunar Rhythms and the 17 Year Cicada</i>	
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Shuler Hopkins	King University	
<p>It is well known the the moon has a natural 19 year cycle. We also know that the moon is receding from the earth currently at a rate of about 3 cm/year. By applying Kepler's law, we can estimate when the moon had a 17 year cycle. We then investigate whether the 17 year lunar cycle during this time had an influence in determining the life cycle of the 17 year cicada.</p>		

UP.10	<i>Mathematical Modeling of Crypt-Villus Cell Population Dynamics in the Intestine</i>	
Saif Alimohamed	me	
<p>Crypt-villus cells are fast-dividing cells that are targets of chemotherapeutic agents. Crypt cells differentiate into stem cells. Our goal was to model crypt and villus cell populations in the intestine under various conditions. We formulated a one-crypt and one-villus compartment model. We also developed a mechanical and chemical feedback model for two-crypt and two-villus compartments. Each of these models was characterized using phase-plane and steady state analysis. The one-crypt and one-villus compartment model was shown to undergo a Hopf bifurcation as the feedback term “m” became higher than $2p_0/(2p_0-1)$.</p>		

UP.11	<i>Forms of Carmichael Numbers</i>	
Alex Boutwell	Wofford College	
<p>Carmichael numbers are composite numbers which satisfy Fermat's Little Theorem: $a^n \equiv a \pmod{n}$. In this paper we will show that certain factorizations of Carmichael numbers are not possible, thus narrowing down the potential forms that Carmichael numbers can take. In particular, after assuming a common conjecture about Fermat primes, we found that Carmichael numbers of the form $\lambda(m) = 2^k * P^2$ do not exist for $P = 7, 43, 127, \text{ or } 19661$ and there are a limited number of such Carmichael numbers for $P = 3$ and 5.</p>		

UP.12	<i>Cliffhanger and the Price is Right</i>	
Scott Scruggs	Francis Marion University	Jeremiah Bartz-Francis Marion University
<p>“The Price is Right” has been one of the most popular game shows on television for over forty years with a plethora of games players compete in. However, can future players “hack” into some games to increase their profit? The CNN article “Win on ‘The Price is Right’—with Math!” states that there exist optimal strategies for players to exploit. This looks at the game Cliffhanger and determines whether or not the claims made on this article are true.</p>		

UP.13	<i>Oscillatory Integrals of the First Kind</i>	
Jurgen Xhafaj	Newberry College	
<p>Oscillatory integrals in one form or another have been an essential part of harmonic analysis. In this poster we will investigate the asymptotic behavior of integrals of Laplace type.</p>		

UP.14	<i>Questionnaire Refinement in Neuropsychological Assessments</i>	
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William Smith	UNCW Mathematics and Statistics Department	
<p>The 100 item Trauma Symptom Inventory (TSI) diagnoses and assesses the activity of posttraumatic stress disorder (PTSD) and other psychological disorders. Over the past few years the TSI has been administered to thousands of veterans and active marines stationed in Camp Lejeune, a base in Jacksonville, North Carolina, who were referred by military neurologists. In utilizing Item Response Theory (IRT) on these test results, multiple statistical analyses provided insight into the underlying characteristics of the TSI: item difficulty, item discrimination, and local dependency. The TSI is time consuming, therefore a shorter test with tailored assessments is needed. From the IRT model, the selected subset of items will provide an equally as informative test as the longer version, while still maximizing precision along all segments. According to psychologists, “poor effort” constitutes up to 50% of the difference in cognitive testing performance, which may stem from the length of the TSI.</p>		

UP.15	<i>A Random Walk with the Dead</i>	
Emily Deborde	Coastal Carolina University	
<p>The Walking Dead is a television show broadcasted on the AMC Network that depicts the “eminent” zombie apocalypse. Data was collected from each episode to examine potential trends of the show over time. The variables observed were the number of zombies killed, the episode rating, and the number of viewers for each episode over the first four seasons. Time series plots were constructed for each of these variables and then evaluated to find if they exhibited stationary or non-stationary characteristics. Based on these characteristics, forecasting models were selected to make predictions for the fifth season of the show.</p>		

