Abstracts of Student Talks

Mathematical Association of America
Allegheny Mountain Section Meeting
Clarion University,
Friday April 8th, 2011

6:30-6:45

Mary Welter, Washington and Jefferson College, STC 123
An Analytical Proof of Pascal's Theorem
After a brief background of Pascal's life and how the theorem came to be, I shall present John Casey's analytical proof followed by an example to illustrate the proof.

Kent Uber & Rip Straessley, Slippery Rock University, STC 125
Touchdowns, Safeties, and Probability
On November 16, 2008, the Pittsburgh Steelers defeated the San Diego Chargers by a score of 11-10. This was the first time in the history of the NFL that a game had been decided by that exact score. This led us to wonder what other scores had never occurred, what was the most common score, and was it unlikely that a game had never before been decided by that score. Data was gathered on every regular season game in the NFL since the merger in 1970. The total number of games, total touchdowns scored, total field goals kicked, and total safeties scored were gathered. This data allowed us to determine the mean number of touchdowns, field goals, and safeties per game. In addition, the likelihood of a team going for a point after touchdown and the probability of the extra point being converted was found based on statistics given by the National Football League. The same method was used to calculate how likely a team was to forgo the PAT and attempt a two point conversion instead and the likelihood of success for a two point conversion. In this talk, we will look at the probability of an 11-10 score and whether having only one game in the history of the NFL with this outcome is unlikely, the probability of the most common score in the NFL—20-17, and the probability of a 4-2 score, which has never occurred in the NFL.

Shawn O'Shea, Slippery Rock University, STC 134
The Fifteen Puzzle
The Fifteen Puzzle is a sliding block puzzle that has captivated many people for almost a hundred years. In some formations, this puzzle can be impossible to solve. In this talk, we will discuss the best strategy for solving the puzzle, reveal how to tell if a formation of the puzzle is solvable or unsolvable (before finding out the hard way), and show the relation of inversions to the determinant of a matrix.

Josh Koslosky, Duquesne University, STC 136
The Image Fusion Problem and Sparsity
Recent research in image processing has shown that sparse and redundant representations of image patches can be used to perform various techniques such as denoising and deblurring of images. These representations can be formed using dictionaries that are either fixed using the Discrete Cosine Transform and Pre-constructed Image Databases or they can be learned from the noisy data. Elad and Aaron proposed the K-SVD model (a modification of the Singular Value Decomposition inspired by K-means) for learning the dictionary from the data. Finding the best

patch representation leads to a constrained optimization problem which, depending on its formulation, can be nonconvex. In this talk we analyze their algorithm and propose modifications in order to tailor the dictionaries for denoising and deblurring in an effort to achieve better image representation.

Amanda Mannerberg, University of Pittsburgh at Greensburg, STC 138
Extension of the Predator-Prey Model
We will discuss ecological background to predator-prey relationships, including the theory and evolution of the Lotka-Volterra approach. We will offer an extension to the model which we will simulate numerically.

Jon Boyd, Nichole Lemke, & Hoyt Mihalak, Edinboro University of Pennsylvania, STC 120
Exploring Limits; Some Interesting Examples
In our Introduction to Analysis class, we found ourselves enjoying the connection between convergent sequences and function limits. In this expository talk, we explain some examples suggested by our textbook, Introduction to Analysis by Edward D. Gaughan, which show this connection. We begin with a "shuffling" of two convergent sequences, examine an everywhere discontinuous function, and finally develop the notion of right and left hand limits of a function at an accumulation point of its domain.

Kelli Lafferty, University of Pittsburgh, STC 140
Multiple Attractors in Discrete Models of Neuronal Networks
We study discrete dynamical systems models of neuronal networks. These models use the structure of directed graphs to represent communication between neurons. Previous work has established the conditions under which attractors form in such networks. We build on this work by exploring the conditions under which certain classes of attractors, particularly multiple co-existent attractors, will occur. Through combinatorial and direct analysis we find structural classes of graphs that facilitate the formation of these multiple co-existent attractors, and count the attainable number of attractors in such graphs.

6:50-7:05

Bradley Weaver, Grove City College, STC 123
Minkowski Length of Polyhedra
The Minkowski sum of two polytopes P and Q is defined as follows: P + Q = {p + q : p in P; q in Q}. Given this defintion, the full Minkowski length L(P) of a convex lattice polytope P is defined to be the largest k such that there exist convex lattice polytopes P_1, P_2, ... , P_k whose Minkoswki sum is a subset of P. Moreover, the summation P_1 + P_2 + ... + P_k is denoted a maximal decomposition of P. Certain problems concerning the full Minkowski length of polytopes have significant applications in coding theory. During this talk two such problems will be considered in the context of three-dimensional polytopes; i.e., polyhedra: the existence, for every convex lattice polyhedron P, of a maximal decomposition of P which is AGL(3,Z)-equivalent to one of two reasonably nice, related forms and an upper bound on the number of interior points in the polytopes of any maximal decomposition of a convex lattice polyhedron P.

Stephen Timko, Duquesne University, STC 125
An Investigation of the Agreement Among Hypothesis Tests for 2x2 Tables
In this talk, we consider three statistical procedures for making inference on sample data that can be represented in a 2x2 table. We explore similarities and differences among these procedures (or

hypothesis tests) via simulation techniques. These simulations suggest discrepancies among these tests behave in a predictable way; this behavior is then confirmed via computational proof.

Kristy Lester, Albert Harrison, & Bill Noel, Indiana University of Pennsylvania, STC 134
Developing Efficient Airplane Boarding Strategies
Minimizing airplane turnaround time is an important objective of airline companies since it is used as a measure of airline efficiency. Passenger boarding time is an important factor for determining turnaround time. This is the factor for which airlines have the least control. The focus of our study is to determine a way to decrease passenger boarding times by expanding upon past studies [1]. Using similar methods as the authors of [1], passenger and aisle interferences during airplane boarding were studied. It was determined that an outside-inside boarding strategy is the most efficient way to board the airplane. This differs from the results determined by [1], which suggests a reverse pyramid strategy. The difference in these results was attributed in part to the different usage of aisle interference penalties in the model. [1] van den Briel, M. L., Villalobos, J. R., Hogg, G. L., Lindemann, T., & Mule, A. V. (2005). America West Airlines Develops Efficient Boarding Strategies. Interfaces, 35(3), 191-201.

Tanya Riston, Penn State Erie – The Behrend College, STC 136
On Modifying a Finite Difference Method for a Class of Nonlocal Problems
Authors Cannon and Galiffa have recently published papers on a class of nonlinear, nonlocal, elliptic boundary value problems, which were integro-differential equations. Their most recent paper is entitled "On a Numerical Method for a homogenous, nonlinear, nonlocal elliptic boundary value problem." The boundary value problem in this work consists of a coefficient that is dependent upon an integral of the solution ranging over the domain of the solution. In the corresponding numerical procedure used in this work, the integral was approximated by the Trapezoid Rule. Recently, theoretical and experimental evidence suggested that the accuracy of this numerical procedure can be improved by utilizing Simpson's Rule as opposed to the Trapezoid Rule and appropriately modifying the procedure. In this talk, we discuss on the details of the aforementioned numerical procedure, address how Simpson's Rule will be utilized and conclude with supplementary numerical examples.

Jaime Jeke & Victoria Lang, University of Pittsburgh, STC 138
Accounting for Extinction: Population Dynamics of Stochastic Modeling of Predator-Prey Systems
While many are familiar with the standard Lotka-Volterra equations governing predator-prey interactions, such models do not account for extinction through stochastic birth and death dynamics. We employed the Doob-Gillespie algorithm to create statistically accurate population trajectories within a predator-prey system. This system exhibited clear extinction behavior, where either the prey or predator population went to zero dynamics. We explored the relationship between initial states of populations and the resulting probability of extinction. Finally, separate genotypes within the prey group were introduced and subsequent interactions, extinctions, and possibilities for overall stability were examined, in both deterministic and stochastic frameworks.

Lindsay Brush & Jennifer Kelly, Slippery Rock University, STC 120
Baccarat Gambling and Multisets
Baccarat is a high stakes casino game that compares two hands where gamblers bet on the outcome of the two hands. In our talk, we will discuss the possible outcomes of one hand of Baccarat using a single deck of cards. From there, we will discuss probabilities of individual scores of a hand. We will then expand this to six and eight decks of cards, which are commonly used in casinos, by using multisets to account for repetition in individual cards.

Kaska Adoteye, University of Pittsburgh, STC 140

Single Attractors In Discrete Models Of Neuronal Networks

The dynamics of neuronal networks can be represented and analyzed in terms of discrete dynamics on a digraph, in which the neurons correspond to nodes and the connections between neurons correspond to edges. We used combinatorial probability, graph theoretical approaches, and numerical simulations to investigate the conditions that lead to both multiple and single attractors, and the characteristics of those attractors, in such a model. In particular, analyzing long-term dynamics resulting from random initial conditions in networks of 100 nodes, we found that, under certain conditions, there is a transitional connection probability at which convergence properties abruptly change. Above this transition point the network almost always converges to an attractor and there are many different possible attractors, below this transition the network almost never converges to an attractor, and at this transition the network is likely to converge to a single attractor. We also found that there are other very specific conditions that must be satisfied in order for the network to always converge to a single attractor if it converges to any.

7:10-7:25

Jennifer Magee, Washington & Jefferson, STC 123

e as a Transcendental Number

A real number is algebraic if it is the solution of an equation of the form $a_n x^n + ... + a_1 x + a_0 = 0$, where the coefficients a_i are integers and a_n is nonzero. If a real number does not satisfy an equation of this form, it is said to be transcendental. Little was known about transcendental numbers until 1851 when Liouville proved their existence. In this talk we will describe Liouville's construction of a class of transcendental numbers. These transcendental numbers were the only known ones until Hermite proved the transcendence of e in 1873. We present Hilbert's simpler proof of Hermite's work and conclude with Cantor's argument that the set of transcendental numbers is uncountable.

Kristy Snyder & Amanda Eplett, Slippery Rock University, STC 125

Heads or Tails?

You and your friend are taking a bet on who is going to buy dinner tonight. You decide to stand a coin up on its edge and hit the table so that it falls over. You have a 50/50 chance of winning the bet, right? With different images on the front and back of a typical coin, how unbiased can a coin really be? Inspired by the article, “Penny Bias,” written by Ivars Peterson, we sampled Lincoln Memorial and Union Shield pennies along with the Jefferson and the newly remodeled Jefferson nickels. The basis of this study was to determine whether there is a greater tendency for the pennies and nickels to fall onto a certain side when the coins are placed upright on their edge. The question is: Heads or Tails?

Li Kou, Juniata College, STC 134

Analyzing admission data

By examining Juniata College admission data, we answer two questions: 1) Which groups of prospective students have a higher yield? 2) How can we predict the size of the incoming freshman class? The data include numbers of inquiries, applications, acceptances, and net deposits from 2007 to 2010 in two-week intervals as well as historical data from 1996 to 2010 of actual freshman class size, total applications and total acceptances.

Katie Heaps, Duquesne University, STC 136
Denoising Images Using Total Variation
Total variation has been used in the image processing community for decades as a way to denoise images while preserving important information such as edges and smooth regions. In this talk, we will examine the total variation method first introduced in an influential paper by Rudin, et al. and look at several extensions of their original scheme, including a dual formulation that yields a differentiable problem (unlike the original) and an upwind scheme that better preserves isotropic features. We will observe the effects of these algorithms on a variety of images.

Pete Lund, University of Pittsburgh, STC 138
Influence of Predation on Genetic Variability in Prey
The classical Hardy-Weinberg law of genetics determines the allele and genotype frequencies in a population under the assumption of no mutations, genetic shift, or drift. Depending on the selective pressure, one of the alleles can become extinct or both can survive, but in either case the system approaches equilibrium. We study how such an equilibrium in prey species is perturbed by the influence of a predator. Using an ODE framework we formulate a population genetic model with three prey genotypes (two homozygous and one heterozygous) and one predator in which the fecundities of the prey and the predation rates depend on the genotype. We observe that there are parameter choices for which the steady state becomes unstable through a Hopf bifurcation. We also find that there are mechanisms by which mutation can increase prey population size, and situations in which a predator's presence may promote genetic diversity in the prey.

Rex Edmonds, Slippery Rock University, STC 120
Pythagorean triples of the form (Tn, Sn, Pn) where Tn, Sn, and Pn are triangular, square, and pentagonal numbers
In this talk we will consider Pythagorean triples along with triangular, square, and pentagonal numbers. Furthermore, we will answer the question of which natural numbers n provide Pythagorean triples of the form (Tn, Sn, Pn) when Tn, Sn, and Pn are triangular, square, and pentagonal numbers, respectively.

Suren Jayasuriya, University of Pittsburgh, STC 140
Dynamics of a Neural Competition Model Driven by Intermittent Stimuli
We develop a nonlinear ODE model for perceptual rivalry involving two neural populations corresponding to different inputs in competition with one another having self-excitatory and cross-inhibitory connections. Switches in dominance are implemented by a slow adaptive process. The strength of input stimuli is varied over time, which generates solutions that feature mixed-mode oscillations involving switch mechanisms of release and escape. Using a fast-slow timescale analysis, we derive dominance times and parameter constraints based on the dynamics of the adaptation variable for each population. These constraints predict the appearance of a certain mode of oscillation, which is confirmed in numerical simulations. These different modes of oscillation could help explain the complex perceptual states that occur during rivalry when the stimulus strength is varied.

7:30-7:45

Richard Ligo, Westminster College, STC 123

The Subgraph Summability Number of a Graph

Given a simple, non-directed graph G and its set of vertices a vertex labeling of G is a mapping to a natural number, assigning a positive integer value to each vertex. Consider the set of connected induced subgraphs of G and the vertex set of a connected induced subgraph. With this we can consider vertex labels of the induced subgraphs for every subset of the vertices of G. The subgraph summability number of a connected graph G is the largest integer sigma so that the label sums of connected induced subgraphs cover the integers 1 through sigma. The question of graph labeling is intimately related to ideas in number theory and combinatorics. In order to learn more about the subgraph summability number for a family of graphs, algorithms to count the number of connected induced subgraphs are developed. Additionally, in cases where the subgraph summability number is difficult to determine, lower bounds for sigma are provided. For specific graphs or families of graphs, a special type of labeling called sharp may be possible; proofs regarding the sharpness or lack of sharpness are explained. We investigate summability labelings for cycles, centipede graphs, circulant graphs, and multipartite graphs and generalize their subgraph summability numbers, number of connected induced subgraphs, and sharpness. We also provide an overview of areas for continued exploration and unsolved conjectures within this problem.

Andrew Mayle & Stephanie Ihrig, Slippery Rock University, STC 125

Two-Faced Monty Hall: A Variation of Host Behavior

Consider a game show in which a contestant is given three doors to choose from. Behind one door is a car and behind the other two are goats. After the contestant picks a door, the host opens a different one and shows a goat. The player must decide whether he or she wants to switch to the remaining door. This is called the Monty Hall problem. We will analyze this scenario, along with several variations including: different host behaviors, multiple plays, and assigning different probabilities to switch or stay. In each different game, we determine the behavior of the contestant and the host that will result in favorable odds.

Joseph Garcia & Brian Sullivan, Slippery Rock University, STC 134

A Perfect Bracket – The Impossible Dream

Every March, hundreds of thousands of sports fans go crazy trying to predict a perfect bracket for the Men's NCAA Division I basketball championship involving 64 teams and 6 rounds of games. Since it is impractical to predict a perfect bracket, we strive to predict results after the first round of 32 games. We developed a statistical model using historical data to examine what key components successful teams possess and what makes them a championship caliber team. We then proceed to use our model to compare this year's and the previous year's tournament results against the suggested results of our model. In addition, we will talk about interesting scenarios that could arise in March Madness and the probabilities associated with them.

Jonathan Lowden, California University of Pennsylvania, STC 136

Mathematical modeling, simulation, sensitivity analysis and outbreak risk of vancomycin – resistant enterococci

Antibiotic resistant bacterial infections pose a major health concern. We developed and analyzed a new mathematical model of a Vancomycin-Resistant Enterococci (VRE) infested intensive care unit (ICU). This model consists of a system of five non-linear differential equations with five variables based on stages of VRE infection: susceptible, colonized, colonized with preventative care, infected, and infected undergoing treatment. We investigated the dynamics between those five infection stages as well as the interplay of nineteen independent parameters involved in the transitions. The parameters include colonization rate, fitness cost, plasmid transfer, antibiotics use, preventive care, treatment schedule and infection factors. Realistic parameters values were determined using data from research journals, as well as from national and professional health institutions, and vary within specific ranges to account for any ICU scenario.

Adam Burch, University of Pittsburgh, STC 138
Population Firing Rate Dynamics of Perfect Integrate-and-Fire Neurons
The integrate-and-fire neuron model is widely utilized in neuroscience for its simplicity and success in capturing physiological phenomena. We study a single population of perfect integrate-and-fire neurons with noisy input. Using Monte-Carlo simulations, we study the firing rate statistics of populations of neurons. In addition, we develop numerical methods to simulate the associated Fokker-Planck equation, as well as using analytic methods to characterize the statistics of the firing rate. We extend the model to two populations coupled via synapses and carry out a similar analysis. Analysis reveals that steady-state solutions do not always exist. Furthermore, we perform a linear stability analysis of the steady-state solution when it does exist.

Joey Cortez, Slippery Rock University, STC 120
Examining Roots of Rational Numbers
Starting with the classic proof that the square root of two is irrational, we show that all prime numbers have irrational square roots. We then generalize the argument to examine the square roots of composite integers and non-integer rational numbers. Finally, we inquire whether an integer can be obtained by raising a non-integer rational number to an integer power.

Tyler McLaughlin, University of Pittsburgh, STC 140
The Geometry of Up and Down States
Networks of neurons in the cerebral cortex alternate spontaneously between an Up state, a noisy period with higher potential and a Down state, a relatively quiescent period at lower potential. From experimental data, an external stimulus of sufficient strength can cause the network to transition from the Down state to the Up state. A stronger stimulus can kick the network to the Up state transiently before returning to the Down state. The same stimulus can switch a neuron from the Up to the Down state. The propagation of the Up state has been observed to move in traveling waves. We construct a Wilson-Cowan model network that explains this recurrent behavior, and determine conditions necessary for bistability. Coupled populations of excitatory and inhibitory neurons are examined via numerical phase-plane analyses with different levels of inhibition. We use the Gillespie algorithm to add stochasticity to the populations. Our model shows that the variance in the Up state is greater than in the Down state. The model also captures the stimulus dependent behavior described above, and transitions from the Down state to the Up state occur in traveling waves. These findings are in accord with experimental data. Developing a spatiotemporal extension of this model, we determine the conditions necessary for stability of the Up state in space and demonstrate that spontaneous pattern formation is possible only in the Up state.

7:50-8:05

Mackenzie Harding, D'Youville College, STC 123
Order of U(n)
Discovering how to calculate the order of U(n), the group of units in the ring of integers modulo n, using the inclusion-exclusion principle.

Hallie Doi & Kristen Leya, Slippery Rock University, STC 125
Generalizations of the Birthday Problem
The birthday problem is one of the most well-known problems in probability. The most common form of this problem is: given n people, what is the probability that two people share the same birthday. This classic generalization has led us to modify the problem in accordance with the discoveries made through random classroom samplings.

Zachary Hopkins & Jamie Gordon, Slippery Rock University, STC 134
The Best Running Back of All Time
Who is considered to be the best running back in the history of the National Football League? Jerome Bettis? Walter Payton? Jim Brown? After analyzing several categories that make up the "complete running back," we determined the necessary variables to create a rating system for running backs based upon weighting the categories. To determine the credibility of the model, it was then tested against ESPN's list of their top ten running backs of all time.

Alex Harshberger, University of Pittsburgh, STC 136
Predicting Bacteria-Immune Dynamics in Necrotizing Enterocolitis: A Model Comparison
Necrotizing enterocolitis (NEC) is a severe disease of the gastrointestinal tract that primarily affects premature infants. The disease is characterized by injury to the intestinal lining which leads to flux of bacteria from the intestine to the surrounding blood and tissue. An ordinary and a partial differential equation model of NEC have been developed to predict conditions under which the health of an infant may be compromised due to an overwhelming inflammatory response and an inability to heal intestinal wounds. Here, the fundamental assumptions and parameters governing the two models are compared, and the overall model predictions are shown to be consistent with each other. Differences in some of the models' components are examined and interpreted physiologically. Additional methods of extending and blending the two models are discussed.

Grace Lindsay, University of Pittsburgh, STC 138
Tuning Curve Quality and Its Effect on Population Coding
Tuning curves are widely modeled as identical and uniformly-distributed Gaussians. However, electrophysiological recordings show that real tuning curves exhibit much variety in both shape and distribution. To investigate the impact this variety has on the ability of a population of disparity-tuned cells (recorded from primate V1) to encode stimulus information, a probabilistic population code was used to estimate the information content in this population of cells. To test the impact that cells with either traditionally-defined 'good' or 'bad' tuning curves have on the ability of the population to encode stimulus information, cells were strategically (based on several ranking methods) removed from the probabilistic population code calculations. The ability of the resulting subpopulations to accurately encode stimulus information was then calculated and compared. The results indicate that a small group of well-tuned cells can encode stimulus information as accurately, if not more so, than the entire population.

Greg Clark, Westminster College, STC 120
Tessellations: Properties and Periodicity
A plane figure A tessellates the plane by translation if the plane can be covered by translated copies of A with no gaps or overlaps. In this talk, we investigate tiles that are subsets of the rectangular grid. We will present a proof that a certain type of tile tessellates in a periodic fashion, and give additional information on the periodicity of the tiling.

Jen Kokoska, Bucknell University, STC 140
Spatial Metrics for Characterizing Networks of Seismic Receivers
Monitoring the compliance of the Comprehensive Test Ban Treaty requires an external means of assessing the accuracy of located suspected banned nuclear testing sites. Several criteria based on the placement of seismic receiving stations have been proposed (Bondár, 2004; Bondár and McLaughlin, 2009, Boomer et al 2010). In this talk we explore several spatial metrics for characterizing the coverage of a station network with the idea that more uniform coverage will yield a more accurate event location. One metric has been used in existing criteria and the other three offer the potential to better assess event location uncertainty.

8:10-8:25

Amanda Goodrick, Slippery Rock University, STC 123
Mathematics Magazine Problem 1851: A Generalization of the Perrin Sequence
Let a be an integer. Consider the sequence defined by $u_0=4$, $u_1=0$, $u_2=2$, $u_3=3$, and $u_n=u_{n-2}+u_{n-3}+a*u_{n-4}$ whenever $n>3$. Note that when $a=0$, (u_n) is the Perrin sequence (apart from the value of u_0). In the October 2010 issue of Mathematics Magazine, Eric Pite proposed the problem of showing that if p is a prime number, then p divides u_p. We solve Pite's problem by amending the classic proof that the Perrin sequence has this property.

James Bichler & Krista Scott, Slippery Rock University, STC 125
We Are Not Trying to Reinvent the Wheel: We Are Just Trying to Beat It
Casinos are filled with enticing games, all of which have odds stacked against you. Many who frequent a casino have the hope of getting rich quickly; most fail to realize it. We, however, have found a method in which you may enter a casino, play with our strategy, and leave with significantly more money than you arrived. Getting rich is certainly not a guarantee, but it certainly becomes a possibility.

Jung Y. Colen & Yong S. Colen, Indiana University of Pennsylvania, STC 134
Discrete Mathematics in the Elementary Grades
The presenters will share an experience in teaching map coloring to a second-grade student and will explore ways to incorporate discrete mathematics at the elementary level.

David Stiffey, University of Pittsburgh at Johnstown, STC 136
Oligopolistic Competition
Our goal is to analyze, using Calculus techniques, an oligopoly of more than two firms with identical production costs. We thus generalize the Cournot Model for a duopoly with no production costs presented in the UMAP 518 (by Donald R. Sherbert).

Noemi Borsay, West Virginia University, STC 138
Behind Phenotype Transfer: Simulation and analysis of "drivers" within a gene network
Five years ago, scientists in Japan were able to alter the phenotype of a mammalian cell by identifying four critical transcription factors and introducing them into the target cell. Perfecting a

procedure like this could help circumvent one set of ethical issues involved in using actual embryonic cells while still providing the benefits of growing new tissues or organs that maintain the original genomic complement of the host's own cells. For wider applicability of this approach, it is necessary to identify the correct transcription factors for a cell. Identifying the relevant transcription factors within a simulated gene network is the focus of this project. We define a synthetic network of genes which includes two types of genes, which we call "drivers" and "passengers". The expression level of these two genes defines the phenotype of the cell. The system is modeled using ordinary differential equations which describe the state of the genes and the concentration of the messenger RNA (mRNA) and proteins within the cell. Kinetic parameters are chosen in such a way that the switching behavior is ensured. The phenotypic switching experiments are simulated numerically. The predicted mRNA levels are sampled with noise added to mimic experimentally obtained microarray data. Analysis is conducted using principal component analysis (PCA), a procedure which uses singular value decomposition (SVD) of the time courses. We then evaluate the performance of various scoring schemes aimed at identifying the original drivers.

Brad Dinardo, Juniata College, STC 140
Examining the Effects of Initial Atmospheric Conditions on Tornadogenesis
The process of tornadogenesis, which is the formation of tornadoes from a thunderstorm, is not fully understood. This analysis looks at examining tornadogenesis and the influence of initial atmospheric conditions on the process. Ultimately, the mechanics of tornadoes are described by a set of differential equations the govern properties such as horizontal and vertical wind speed, pressure, and the tangential wind speed of the tornado. An axisymmetric model was utilized to approximate solutions to these equations for specific initial conditions of updraft forcing, tangential inflow, and drag. Contour plots displaying information on various wind speeds, velocities, temperatures, and viscosities were generated with the aim to get a firm foundation on how initial atmospheric conditions present in a supercell thunderstorm alter the process of tornadogenesis. A startling and counterintuitive result was detected, showing that increasing tangential inflow to the tornado actually dampens the cyclonic activity and an increase in drag actually increases the wind velocity of the tornado.