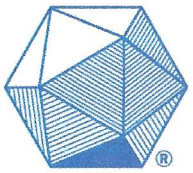

Mathematical Association of America
Northern California, Nevada and Hawaii Section
Saturday, February 28, 2015
Foothill College
STUDENT POSTER SESSION ABSTRACTS

Title: *Distribution of Crime Types in Realignment*
Authors: Wenjia Bai, Jake Hasse, and John Spalluzzi; Saint Mary's College of California
Faculty Sponsors: Dr. Christopher Jones and Dr. Ellen Veomett; Saint Mary's College of California
Abstract: The study examined the distribution of population among different types of crimes for the Marin County Jail and the State of California. The investigation was done upon the types of crimes that are committed by each individual and the relationship with the individual's characteristic like age, gender, race, etc. By recategorizing the penal code into types crimes and looking at the linear correlation and χ^2 goodness of fit between one's characteristic and the type of crime he or she committed, the results suggested that the population does not evenly distribute among different types of crimes, and certain characteristic of an individual do affect the type of crime he or she committed.

Title: *Bounding the Tree Cover Number and the Positive Semidefinite Zero Forcing Number*
Author: Sofia Burille; Saint Mary's College of California
Faculty Sponsor: Dr. Michael Nathanson; Saint Mary's College of California
Abstract: Given a graph, G, with a set of vertices, v, and edges, various properties can be calculated. Two of these properties, or graph parameters, are the tree cover number and the positive semidefinite zero forcing numbers, $T(G)$ and $Z_+(G)$ respectively. Methods of easily bounding $T(G)$ and $Z_+(G)$ are presented. The general procedure is to break a graph G, into multiple smaller subgraphs G_i at specific vertices, separating vertices. Tree cover number of smaller graphs are easier to calculate, so $T(G_i)$ for each subgraph is calculated and combined to estimate the tree cover number of $T(G)$. These estimations and bounds can be more or less accurate depending of the structure of the graph. Different cases are examined to conclude results specific to certain kind of graphs. The same process is applied to positive semidefinite zero forcing, $Z_+(G)$.

Title: *Multiple Climate Model Comparison of the Mid Pleistocene Transition using Ensemble Empirical Mode Decomposition*
Authors: Drew Gallatin and Ryan Smith; Cal Poly San Luis Obispo
Faculty Sponsor: Dr. Charles D. Camp; Cal Poly San Luis Obispo
Abstract: Conceptual climate models are useful for testing hypotheses regarding the processes underlying observations; however, their high degree of simplification dictates that they generally can only qualitatively match the empirical records. Because models based on substantially different physics may have comparable correlations to the data records, we must use more robust model validation procedures to analyze and compare these models. The Mid-Pleistocene Transition (MPT) is an ideal test case for the development of such procedures because the character and cause of the transition from a 41 kyr cycle in the early Pleistocene to a dominant 100 kyr cycle in the late Pleistocene is poorly understood. In order to extract and compare subtler features which provide insight into the validation of these conceptual models, we analyze two conceptual models with differing physical hypotheses for the MPT with ensemble empirical mode decomposition (EEMD) and other modern time series analysis techniques.

Title: *Comparison of Bayesian Credible Intervals to Frequentist Confidence Intervals*
Author: Antonio Silveti-Falls; California State University at Chico
Faculty Sponsor: Dr. Kathy Gray, California State University at Chico
Abstract: In frequentist statistics, if a population is not normally distributed the distribution of the sample means can still be approximated as normally distributed using the central limit theorem given a large enough sample size. It is useful to know how Bayesian statistics compares to frequentist statistics in terms of interval

estimation and it is also of interest to know how large a sample must be taken in order to approximate the posterior distribution of a parameter with a normal distribution. To investigate this we compared frequentist confidence intervals with Bayesian credible intervals under a variety of scenarios to determine when Bayesian credible intervals outperform frequentist confidence intervals.

Title: *Classification of Conics Up to Projective Equivalence*
Authors: Anthony Kling and Zachary Straus; Cal Poly San Luis Obispo
Faculty Sponsor: Dr. Eric Brussel, Cal Poly San Luis Obispo
Abstract: Our main goal is to classify conics, up to some developed notion of equivalence, over different types of fields, culminating over $\mathbb{Q}$. We begin by formally defining what a conic precisely is, especially over a non-algebraically closed field, investigating potential issues that motivate the geometric definition. Projective equivalence is introduced as our way of identifying conics. Accordingly, we adopt the philosophy that two conics should be the same if they simply differ by a change of coordinates.
The classification of conics over $\mathbb{C}$ and $\mathbb{R}$ is straight forward due to the "nice" arithmetic of these fields. However, over $\mathbb{Q}$, the classification is not as immediate. This leads to a short introduction of the field of p-adic numbers, $\mathbb{Q}_p$, as a tool used to understand $\mathbb{Q}$ locally. The nice arithmetic of $\mathbb{Q}_p$ results in a nice classification of conics over the p-adics. With this, we prove certain features of conics over $\mathbb{Q}$ and completely classify them over $\mathbb{Q}$.

Title: *Modeling the Eradication of Ebola*
Authors: Maureen N. Smith, Anthony Bardessono, and Donna L. Martin; Cal Poly San Luis Obispo
Faculty Sponsor: Dr. Charles D. Camp, Cal Poly San Luis Obispo
Abstract: We construct a modified SEIR epidemic model to track the spread of a disease through a population while also looking at the influence of vaccination, treatment, and other medical care options. Applying this model to Ebola reveals not only how many people may become infected and die as a result of this fatal disease in the event of an outbreak, but also how many people can be saved as a result of preventative and reactive measures given that they are executed in a timely manner. We use our SEIR model to estimate how quickly drugs and vaccines need to be manufactured and distributed in order to best respond to an outbreak. We find that the introduction of a cure is significantly more effective in accelerating the eradication of Ebola than the introduction of a vaccine. We then test our model against real data from the most recent Ebola outbreak in West Africa to determine what further refinements are needed. We find that our model predicts the previous outbreak's progression to a reasonable degree. This Model was made for the Mathematical Competition in Modeling for 2015.

Title: *Optimal Debris-Informed Search for a Lost Plane*
Authors: Joseph L. Marsili, Emily S. Nunn, and N. A. Sutton-Smolin; Cal Poly San Luis Obispo
Faculty Sponsor: Dr. Charles D. Camp, Cal Poly San Luis Obispo
Abstract: A model for optimal discrete-effort search for a plane lost in open ocean is presented. A pre-existing ocean current model is assumed to generate probability distributions for both debris and the plane body in the search area. The search region is split into smaller cells. An aerial search for debris is then executed. The probability distribution for the location of the plane body on the seafloor is then modified by the ocean current model using a statistical transformation on the data. Searches underwater are then optimized with respect to chance of discovery and search cost. Two search cost functions are compared. Both searches are generalized with respect to the search technology used. A measure of the efficiency of search technologies is referenced and assumed to be given by other research. In this way, the model is generalized so that any search technology may be used. Results of test runs demonstrate a logarithmic relationship between percent success, quantity of search vehicles, and quantity of searches. The computational cost of the model is estimated at $O(n)$ with respect to both quantity of search iterations and quantity of search vehicles. Additionally, a comparison is made between a simulation that optimizes cost as a function of distance and one that does not optimize cost. This comparison reveals that optimizing the travel distance may reduce total distance traveled by up to a factor of 38 while only marginally sacrificing total search effectiveness. This paper was submitted to the Mathematical Contest in Modeling, 2015.