**Student Speaker Abstracts; Listed according to Rooms and Presentation Times**

**Friday, 3:00 – 3:50 p.m.**

**Room G-219, Crapo Hall**

**3:00 – 3:20 p.m.**
***Mathematics, It's Almost Like Cheating***
**Tim Blaharski, Sienna Heights**

***Abstract***: This presentation will analyze impartial gaming theory using a game called Nim. Moreover, any impartial game can be related to a Nim game. Two additional games, Kayles and Chomp, will be analyzed using the Nim strategies.

**3:30 – 3:50 p.m.**
***Knots In Chemistry***
**Jasmine Spady, Hillsdale College**

***Abstract***: Although the average human being does not understand the meaning of the word "chiral", almost every human being is born with a pair of chiral objects, their hands. Even their DNA is chiral. In fact, many biomolecular structures are chiral. In today's world of bioengineered drugs, determining chirality is extremely important. In the human body, one form of a chiral drug can cure while the other can kill. My talk will discuss some of the elementary aspects of knot theory and how they apply to chemistry and determining the chirality of different structures.

**Room G-221, Crapo Hall**

**3:00 – 3:20 p.m.**
***A Markov Analysis of the Pathfinder Game***
**Matthew Spensor, Evansville**

***Abstract***: We construct a mathematical model of the Pathfinder game on The Price is Right. Specifically, we use the theory of absorbing Markov chains to approximate the probability of winning a game of Pathfinder. We conclude by comparing the theoretical value obtained with values computed using statistics compiled from recent games. Furthermore, we discuss likely causes of discrepancies between these values.

**3:30 – 3:50 p.m.**
***Breaking the MD5***
**Brandon Borkholder, RHIT**

***Abstract***: The MD5 hash function and its family are security algorithms that have been used world-wide for nearly a decade. Just a few years after creation there were hints of weakness and now there are algorithms to crack it efficiently. How do these algorithms work? Is the MD5 completely broken? How can a potential hacker exploit this weakness to undermine the trust of those who use it?

**Friday 4:10 – 5:00 p.m.**

**Room G-219, Crapo Hall**

**4:10 – 4:30 p.m.**
***Ideal-Divisor Graphs of Commutative Rings***
**J.D. McKeel, U. Evansville**

***Abstract***: Recall that a zero-divisor of a ring R is an element such that there exists an element b giving ab=0. For a commutative ring R we can form the zero-divisor graph of R whose vertices are nonzero zero-divisors. We recognize {0} simply as an ideal of R and begin to construct ideal-divisor graphs of R with respect to an arbitrary ideal I. We find and compare the diameters of zero-divisor and ideal-divisor graphs of direct products of commutative rings.

**4:40 – 5:00 p.m.**
***GPS Navigation Solution- An Alternative Way to Solve for User Position Using GPS***
**Mathew Cosgrove, Miami University (OH)**

***Abstract***: This talk will deal with the various new methods of solving for pseudo-ranges by using closed form solutions, iterative techniques based on linearization and Taylor series expansion in three variables followed by a brief discussion of Kalman filtering. Most of the talk will focus on the iterative techniques and the use of matrices to solve sets of linear equations as well as the use of a basic least-squares solution. The applications of this new technique allow for compensation of various forms of error in positioning such as Ionospheric error, and clock bias.

**Room G-221, Crapo Hall**

**4:10 – 4:30 p.m.**
***Using Mathematical Modeling to Develop an Optimal Inventory Strategy for Perishable Products***
**Candice Ohm, Sienna Heights University**

***Abstract***: This presentation will address the creation of an optimal inventory strategy for the ordering and storing of perishable products. Inventory records were tracked at a local restaurant for several perishable products. The data was used in two different types of models and the results were compared. The first model is analytical and discrete. It is a network flow model that results in a dynamic programming algorithm which solves for the minimum inventory cost. The other is theoretical and continuous. Calculus was used to determine an optimal replenishment cycle number to minimize inventory cost.

**4:40 – 5:00 p.m.**
***Benford and Winning Streaks***
**Lee McDaniel, Rose-Hulman Institute of Technology**

***Abstract*:** Benford's law describes the distribution of the first significant digit of a surprisingly large number of naturally occurring (e.g., river lengths, mountain heights, populations) data sets. The law was first discovered during a seemingly unrelated scientific study by American astronomer Simon Newcomb while skimming the pages of a logarithm book. Today Benford's law has been used to detect fake coin toss data, and more seriously, tax fraud. What exactly is Benford's law? What data sets conform to this law and what are their common characteristics? Can Benford's law be applied to other data sets (naturally and man-made) occurring in the world around us everyday?

**Saturday, Room G-219, Crapo Hall**

**10:10 – 10:30 a.m.**
***A Mathematical Look into Kaleidoscopes***
**Leonie VanderHoff, Siena Heights University**

***Abstract***: Using mirrors and mirror systems to produce attractive images has led to the study of this topic. This presentation will address an open two-mirror system and a closed two-mirror system (the traditional toy kaleidoscope). Along with the geometry of the placement of the mirrors, the mathematics of kaleidoscopes involves linear algebra, group theory and a bit of graph theory. The study of these systems will reveal a relationship to dihedral groups and wallpaper groups.

**10:40 – 11:00 a.m.**
***Do Dogs Really Know Calculus?***
**Eric Reyes, Rose-Hulman Institute of Technology**

***Abstract***: Least squares is a regression technique frequently used by engineers and scientists to gain insight into data generating processes. In 2003, Timothy Pennings of Hope College asked the question: "Do Dogs Know Calculus?" In an effort to determine if his dog minimized the retrieval time during a game of fetch, Pennings collected data. We take a second look at the data he acquired and the statistical analyses. We show how a simple-looking problem can require an intricate analysis. We use modern methods to detect and compensate for violations in the standard least squares assumptions. And, we seek to answer the question: Do Dogs Really Know Calculus?

**11:10 – 11:30 a.m.**
***Thermal Imaging of Circular Inclusions.***
**Donald Brown, University of Cincinnati**

***Abstract***: This talk will describe some results from the 2005 Rose-Hulman REU Inverse Problems group. We consider the inverse problem of recovering a circular defect (inclusion) from some arbitrary 2-dimensional Domain knowing only thermal data on the boundary. By applying the Laplace Transform to the time-dependent Heat Equations we may obtain information about the position and size of such a defect knowing only this thermal boundary data of D and approximations to the solution. The main mathematical tool utilized to carry out these calculations is known as the Reciprocity Gap Functional (closely related to Green's Theorem).

**11:40 – 12:00 p.m.**
***Investigating the Shape of a Cookie***
**Hari Ravindran, Rose-Hulman Institute of Technology**

***Abstract:*** This is a continuation of the previous two talks on the Shape of a Cookie. The goal of the investigation is the establishment of an asymptotic expansion for the shape of a cookie with an elliptical base domain. The talk summarizes the work towards this goal over the past summer and during this academic year. This research was funded in part by a Joseph B. and Reba A. Weaver Undergraduate Research Award.