Department of Mathematics and Statistics Colloquia

Student Research Presentations

(Monday, April 25 at 3:45 pm in Roop 103, refreshments at 3:30)

Title: Population Projection and Habitat Preference Modeling of the Endangered James Spinymussel (*Pleurobema collina*)

Speaker: Marisa Draper (Faculty Advisor: Anthony Tongen)

Abstract: The James Spinymussel (*Pleurobema collina*) is an endangered mussel species at the top of Virginia's conservation list. The James Spinymussel plays a critical role in the environment by filtering and cleaning stream water while providing shelter and food for macroinvertebrates; however, conservation efforts are complicated by the mussels' burrowing behavior, camouflage, and complex life cycle. The goals of the research conducted were to estimate detection probabilities that could be used to predict species presence and facilitate field work, and to track individually marked mussels to test for habitat preferences. Using existing literature and mark-recapture field data, these goals were accomplished by evaluating matrix population models, odds of detection based on environmental factors, dispersion type, and clustering trends. These results serve as the foundation of mathematical models used to aid in the recovery of the James Spinymussel and other cryptic species with sparse populations.

Title: Evolutionary Models of Transposable Elements Using a Maximum Likelihood Approach

Speakers: Channing Parker and Katie Voss (Faculty Advisor: Brian Walton)

Abstract: The freshwater zooplankton *Mesocyclops edax* exhibits the trait of chromatin diminution, in which it deletes 80% of its DNA in somatic cells. Genome-wide comparison of the somatic genome (3 Gb) with the germline genome (15 Gb) shows that much of the deleted DNA comes from transposable elements. Transposable elements are regions of DNA that replicate themselves within the genome leaving multiple copies of the original sequence. Modern DNA sequencing methods produces millions of short reads of the DNA sequence randomly distributed across the genome. We use a Maximum Likelihood method to find the most likely alignments of these transposable elements. This information can then be used to gain knowledge on the evolutionary history of each transposable element.

Title: Second Order Pendulum with Interesting Tangential Force

Speakers: Brock Crook, Alex Karp, Tanner Naughton, and Galen Richards
(Faculty Advisor: Jim Sochacki)

Abstract: A pendulum, which consists of a mass attached to rod which rotates about a fixed point, illustrates strange behavior with certain forcing functions. We will explore this with both analytical and numerical methods using auxiliary variables. We will use various graphics and animations to correlate the findings with the physical system.

Title: A Computational Investigation of Large Gaps in Contingency Tables.

Speaker: Noah Watson (Faculty Advisor: Edwin O'Shea)

Abstract: Integer programming can be used to find upper and lower bounds on the cells of a multi-dimensional contingency table using the information from the released margins. The linear relaxation of these programs also provides bounds and the discrepancy between these bounds, the integer programming gap, can be large. While the more notable examples of large gaps have been shown to be rare. Here we provide some results on the rarity of large gaps on small tables.

Title: Unstoppable Force Meets Immovable Object: A Look at the Spring Equation Under Various Forcing Terms

Speakers: Ben Dulaney, Aidan Gordon, and Zev Woodstock (Faculty Advisor: Jim Sochacki)

Abstract: In this talk, we discuss some surprising results surrounding the spring equation. We will present a new method for approximating constants of motion for the non-homogeneous spring equation and display trajectories along a parabolic surface for these conserved quantities. We also present a system in which an infinite force results in finite motion (i.e. the unstoppable force loses the battle).