POSTER PRESENTATIONS
Milne Library, First Floor Common Area

Biomathematics

1 • Fractal Dimension Metrics across a Vegetational Chronosequence

Kevin Aagaard

Faculty Sponsors: Gregg Hartvigsen, Biology, and Chris Leary, Mathematics

We used fractal geometry to examine how the structure of a forest changes over time. Data were collected from three sites near Geneseo, NY (old field, shrub land, young forest, old forest). We found, that when measuring using the same scale, the fractal dimension (D) across communities exhibited an asymptotic relationship ($p<0.05$). However, on the scale of the dominant vegetation at a particular site, the D was constant ($p = 0.3341$). The use of fractal dimension to analyze forest organization will further our understanding of the space filling structure of plants in a forest stand as they compete for natural resources.

2 • A Model of Cooperation

Joseph Kane

Faculty Sponsors: Gregg Hartvigsen, Biology, Chris Leary, Mathematics

Computer models can help us to better understand the conditions under which cooperation may emerge. In this model, individuals occupy the elements of a toroidal lattice and are assigned a probability (P) of interacting with surrounding individuals. During an iteration each individual i gets one chance to play. If a random number is < P(i) then it plays and evaluates the P(j) values of a variable number of neighbors. Individual i then attempts to cooperate with the neighbor with the highest P(j) within this set of neighbors. If neighbor j cooperates then the original individual increases its probability of cooperating by epsilon [P(i) = P(i) + epsilon] and decreases if j defects [P(i) = P(i) – epsilon]. When a set of only one neighbor is evaluated the system goes to either all cooperation or all defection. However, if a set of more than one neighbor is evaluated then coexistence of cooperators and defectors is possible. Furthermore, the system can become stable with fewer cooperators than defectors. This result suggests that when we ask more than one person for help then we are more likely to have cooperators in the system even if the majority of people are defectors.

3 • The Structure of Student Association Networks at SUNY Geneseo

Chris Lonnen

Faculty Sponsor: Gregg Hartvigsen, Biology

Network analysis is useful for describing the interactions of complex systems. As access to high quality data has opened up, epidemiologists have found networks representing human interactions particularly useful. We investigate the structure of student association networks at SUNY Geneseo. We construct networks using course enrollment data from the spring and fall 2008 semesters at SUNY Geneseo for each weekday in each semester. Two students are connected to each other on a given day for every class they have together. We show that the mean distance between students grows logarithmically with the number of students in the network, correlating strongly with the growth expected by the Watts and Strogatz model "small world" network. These results provide insight into the nature of student interactions and establish a basis for future characterization of student association networks.

4 • Slavemakers Don't Make Good Neighbors: Spatial Patterns of *Formica* Ants in the Arboretum

Dillon Meier

Faculty Sponsors: Jennifer Apple, Biology, Gregg Hartvigsen, Biology, and Chris Leary, Mathematics

Certain species of ants within the genus *Formica* are known for their social parasitism. These species parasitize other species by capturing them as larvae and pupae during large raids. These "slaves" become the workforce of the "slavemaker" colony and raise the slavemaker offspring. The slavemaker workers generally only leave the nest to scout and raid. This summer we discovered that in our own Arboretum the slavemaker *Formica cf. subnuda* was exploiting the slave *Formica cf. glacialis* by frequently raiding the slave nests and obtaining workers for their own colony. The slavemakers compete with one another for a limited resource (i.e., the host species brood). We predicted that the spatial pattern of the *F.cf. subnuda* nests may follow a non-random pattern because of competition between colonies for *F. cf. glacialis* workers. GPS coordinates of eighty-seven host nests and ten slavemaker nests were recorded from June 2008 – October 2008 using Trimble equipment. These data are being manipulated in ArcView software for spatial analyses.

5 • The Behavior of the Basic Reproductive Ratio (Ro) in Morbillivirus Epizootics

Caitlin Ryan

Faculty Sponsors: Gregg Hartvigsen, Biology, and Chris Leary, Mathematics

Dolphin morbillivirus (DMV) has been responsible for recurrent mass strandings and deaths within many cetaceans, including the striped dolphin (*Stenella coeruleoalba*) population in the Mediterranean Sea. We simulate the DMV epidemic in the striped dolphin population using an individual-based network model. In the model, we use the basic reproductive ratio (Ro) equal to 2.0, where Ro is the average number of secondary infections caused by an infectious individual in a fully susceptible

population. However, as the epidemic progresses, the actual number of secondary infections (rRo) does not remain constant. Since striped dolphins have complex and dynamic social interactions, we tested the rates of decline of rRo across different networks ranging from regular to approximately random. We found that as the epizootic progresses rRo decreases. However, the rate of decrease is dependent on the duration of the epizootic and network structure (P). The change in rRo, assessed during the epizootic peak, suggests that when dolphins are relatively social (high levels of mixing) DMV spreads rapidly while the rate of actual secondary infections (rRo) decreases rapidly. This work suggests the importance of rRo as a tool for understanding the dynamics of epizootic.

6 • Changes in the Geneseo Student Network and its Effect on the Likelihood of Influenza Spreading

Stephen Verdini

Faculty Sponsors: Gregg Hartvigsen, Biology, and Chris Leary, Mathematics

The Centers for Disease Control and Prevention reports that every year in the United States an average of 5% to 20% of the population gets the influenza virus, leading to more than 200,000 hospitalizations. Using a computer model of the Geneseo network, which factors in class schedules and residence, the spread of influenza was simulated using data from the fall 2007 semester and again using data from the spring 2008 semester. The network data showed that the Geneseo student body was more connected through class schedule and residence in the fall of 2007 than they were in the spring of 2008. As a result influenza had a higher probability of spreading in the simulations using the fall data than in the simulations using the spring data. It is important to be able to track how the Geneseo network changes per semester as well as how potential administration decisions would affect the network, because the Geneseo campus could become more prone to the spread of influenza as well as other viruses.

7 • Average Distance between Points on Fractals

Dennis Ruppe

Faculty Sponsors: Chris Leary, Mathematics, and Gregg Hartvigsen, Biology

Fractal geometry provides many quantitative descriptions of objects that have been useful in a range of scientific disciplines, from biology to physics. One such measure is lacunarity, which measures how a shape fills space and how clustered it is. We discuss some examples in which lacunarity fails to distinguish between sets that appear to cluster differently. We define a measure of the average distance between points in a set. We calculate the average distance for many variations of the Cantor set. We find that our measure can provide new insight into the structure of a fractal.

Chemistry

8 • Solid Phase Microextraction - High Performance Liquid Chromatography to Extract and Separate *Trans*-resveratrol from Red Wine Samples

Megan Ralbovsky

Faculty Sponsor: James Boiani, Chemistry

Trans-resveratrol is a phenolic compound found in red wines. It is an antioxidant believed to reduce the risk of cardiovascular disease. Due to the potential health benefits of this compound, it is critical to develop successful and reproducible ways to extract and separate this compound from other complex molecules found in red wines in order to quantify it and better study its properties. One such way is by solid phase microextraction (SPME) coupled with high-performance liquid chromatography (HPLC). Typically with HPLC, there is a pre-extraction cleanup step in order to isolate the desired compound from the rest of the components in a mixture. In this research, SPME was used to extract *trans*-resveratrol from various red wine samples on a carbowax fiber. Methanol was used to transfer the *trans*-resveratrol from the fiber to the HPLC. Reversed-phase HPLC was then used to separate the *trans*-resveratrol and confirm that this compound was in fact isolated by using a solvent of acetonitrile and water along with a 0.01 M phosphate buffer (pH 6). A standard addition was carried out in order to create a calibration curve to determine the concentration of *trans*-resveratrol in each red wine sample.

9 • Identification of a Halogenase Gene in *Anaphalis margaritacea* by PCR

Wanda Lam and Eunwoo Shim

Faculty Sponsor: Eric Helms, Chemistry

Naturally occurring halogenated compounds have been isolated, for the most part, from marine organisms and microorganisms. However, only a few halogenated organic compounds have been isolated from higher plants. Interest in these compounds stems from their considerable biological activity. Since most of the sequenced halogenase genes or enzymes come from bacteria, little is known about halogenases in higher terrestrial plants. The roots of *Anaphalis margaritacea* (pearly everlasting), which were used by the Iroquois to treat diarrhea and dysentery, produce a thirteen-carbon, chlorinated polyacetylene. Biosynthetic investigations of this plant will shed light on the molecule's biosynthesis, function, and conditions in which it is produced by the plant. The goals of this project are to locate the halogenase-coding gene in the plant's genome by PCR, purify the amplified piece of DNA, and finally sequence the gene. Four primers were designed around highly conserved protein domains from known sequences of halogenases enzymes found in various bacteria. This work can serve as a model for further studies of halogenase enzymes in other terrestrial plants.

153 • High-Speed RaPToRS

William Becker and Robert Henchen

Faculty Sponsors: Ed Pogozelski, Physics & Astronomy, and Stephen Padalino, Physics & Astronomy

The High-Speed Rapid Pneumatic Transport of Radioactive Samples (HS-RaPToRS) system, designed to quickly and safely move radioactive materials, was assembled and tested at the Mercury facility of the Naval Research Laboratory (NRL) in Washington D.C. A sample, which is placed inside a four-inch-diameter carrier, is activated before being transported through a PVC tube via airflow. The carrier travels from the reaction chamber to the end station where it pneumatically brakes prior to the gate. A magnetic latch releases the gate when the carrier arrives and comes to rest. The airflow, optical carrier-monitoring devices, and end gate are controlled manually or automatically with LabView software. The installation and testing of the RaPToRS system at NRL was successfully completed with transport times of less than 3 seconds. The speed of the carrier averaged 16 m/s. Prospective facilities for similar systems include the Laboratory for Laser Energetics and the National Ignition Facility.

154 • WIYN Open Cluster Study: UBVRI CCD Photometry of the Open Cluster NGC 6716

Alex James, Sarah Muller, and Ryan Rickert

Faculty Sponsor: Aaron Steinhauer, Physics & Astronomy

We present UBVRI CCD photometry of open star cluster NGC 6716. Calculated cluster parameters include reddening, metallicity, distance and age. In addition star temperature and mass were inferred. This is part of an ongoing photometric survey of this cluster and our work provides independent results aimed at reducing systematic errors in the cluster parameters.

155 • The Distribution of Matter in the Universe

Ching Man Wong

Faculty Sponsor: Aaron Steinhauer, Physics & Astronomy, and Gregg Hartvigsen, Biology

The Hubble Deep Field and Hubble Ultra Deep Field are the most detailed views of the early universe and also provide a glimpse of the distribution of matter over large distances. Current theories of the universe suggest the distribution of galaxies over large scales to be homogeneous. We explore the galactic distribution in both images from our local neighborhood to the most distant, visible objects. Our results from the raw data for the distribution of matter are consistent with homogeneity up to 5500 megaparsecs but the density of the galaxies appears to fall off beyond that.

Psychology

156 • Terror Management Theory and Environmentalism

Marisa Garber, Kristy Bowers, Matt Lauster, Melissa Steenburgh, Kelly Ludovici, and Rich Atkins

Faculty Sponsor: James Allen, Psychology

Terror management theory (TMT) predicts that reminders of mortality cause increases in existential anxiety. Furthermore, research and theory in TMT indicates that individuals cope with this anxiety by firmly defending a cultural worldview that gives a sense of permanence and meaning to their lives. However, researchers have not investigated environmentalism as a possible cultural worldview that might respond to TMT pressure. Consistent with the TMT predictions, reminders of mortality caused pro-environmental protection participants to derogate a target who violated an important environmental norm. However, and also consistent with TMT, reminders of mortality caused anti-environmental protection participants to be more positive toward the target who violated the environmental norm.

157 • Energy Efficiencies May Not Reduce Energy Consumption: A Test of the Jevons Paradox

Kelly Ludovici, Kristy Bowers, Marisa Garber, Matt Lauster, Melissa Steenburgh, Rich Atkins, Christina Piccarillo, and Dan Bach

Faculty Sponsor: James Allen, Psychology

The Jevons' paradox describes a common observation that energy efficiencies are often associated with increases in total energy consumption rather than decreases in energy consumption. Macro level studies of countries and industries have often confirmed this phenomenon. However, few if any studies have investigated the Jevons' paradox on an individual or psychological level. Based on the Jevons' paradox, we hypothesized that individuals who are in command of energy efficient technologies, such as fuel efficient automobiles, will engage in more energy consumptive behaviors than do individuals commanding less efficient technologies.

158 • Death, Mindfulness, and Being Mindful of Death

Hideaki Imai

Faculty Sponsor: James Allen, Psychology

This study investigated the relation between attitudes toward death and overall well-being and mindfulness. Currently, the dominant theory in the death-psychology is Terror Management Theory (TMT). TMT states that reminders of mortality cause unbearable increases in existential anxiety. According to TMT, individuals deal with this anxiety by engaging in various death

CONCURRENT PRESENTATIONS
SESSION 1 • 9:40-10:55

Session 1-A • Biomathematics — Newton 214
Modeling Biological Systems: Studies in Epidemiology
Session Chair and Faculty Sponsor: Gregg Hartvigsen, Biology
Faculty Sponsor: Chris Leary, Mathematics

Multi-Drug Resistant Tuberculosis in Ethiopia
Aline Heffernan, Jennifer Prizzi, and Kevin Tuttle
Multi-drug resistant tuberculosis (MDR-TB) is an emerging form of tuberculosis (TB). Multi-drug resistant tuberculosis is a bacterial infection that does not respond to the two front line drugs used to treat TB, isoniazid and rifampicin. Tuberculosis and MDR-TB are increasing in prevalence all over the world and are a growing problem in Ethiopia. The World Health Organization has a global goal of reducing the prevalence of TB and MDR-TB in half by the year 2015. Using a set of differential equations along with a compartment model we predict how prevalent MDR-TB will be in Ethiopia in the near future based on current trends. According to existing data, our model indicates that TB and MDR-TB in Ethiopia will continue to increase in prevalence. Although it is possible that the prevalence of the infection might be cut in half by 2015, it is unlikely unless treatment is improved.

The Transmission of Rabies in New York State Raccoon Populations
Chris Lonnen, Kevin Aagaard, D.J. Wayland, and David Peck
Epizootic transmission of rabies in raccoon host populations has shown to be a salient issue throughout New York State. Raccoon rabies was first detected in the state in the early 1990s during a northward moving wave of transmission from an outbreak in West Virginia in the 1970s. Raccoon rabies has since become periodically epizootic in New York State. We model the surges of raccoon rabies transmission, making use of a coupled-lattice SI (susceptible-infectious) model to simulate raccoon sub-population interactions. Results are consistent with the observed wave-like pattern of rabies spread in New York. Results also suggest that rabies transmission through the state may be most dependent upon the degree of spatial interactions (rho) between counties. More knowledge of the transmission of rabies can lead to more efficient prevention strategies in the future.

Modeling HPV Vaccination Strategies in a College Population
Anna Plichta, Nicole Briglio, and Vincent Andolina
Human papillomavirus (HPV) is a sexually transmitted disease that infects approximately 80% of females by age 50. The prevalence of HPV is greatest among individuals between the ages of 20 and 24. High risk strains (16/18) are known to cause cervical cancer in women, and low risk strains (6/11) account for approximately 90% of genital warts in both males and females. The quadrivalent vaccine, Gardasil, protects against strains 6, 11, 16, and 18. An SIR model was developed to show the possible paths of infection and recovery from the high and low risk strains of HPV. The data from this model was used to investigate vaccine effectiveness in a constant college population comprised of individuals ages 18 to 24. Our model suggests that certain vaccination strategies could be used to decrease the prevalence of this infection. A strategy involving routine vaccination of students entering college significantly had a greater effect the incidence of HPV than the current protocol of random vaccination. In addition, it was more effective to vaccinate both females and males starting at age 18, rather than just vaccinating females.

Methicillin-Resistant Staphylococcus aureus Dynamics in Hospitals Sensitive to Patient Turnover Rates
Stephen Verdini, Sean Bardenett, Joseph Mort, Esther Yoon, and Sam Carnicelli
The Centers for Disease Control and Prevention reports Methicillin-resistant Staphylococcus aureus (MRSA) infections occur in 94,000 persons each year, along with 19,000 associated deaths; of these infections, 86% are hospital-associated. Using a model, which takes vulnerability and disease virulence into account by classifying the hospital population into those who are susceptible, infectious, carrier, or recovered, the spread of MRSA was simulated in hospitals with different turnover rates (μ), which is the rate at which patients are admitted and discharged daily. We find that hospitals with large turnover rates, corresponding to a higher μ value, are at a lower risk of MRSA prevalence than hospitals with lower turnover rates, resulting in a lower μ value. A lower μ value resulted in an increase in the basic reproductive ratio (Ro), or the number or secondary cases caused by a single infectious individual, causing the disease to become endemic after rapidly spreading through the hospital. Our model suggests that the turnover rate of a hospital can predict the patterns and infectivity of MRSA. This information on the risk of MRSA transmission can be very helpful towards reducing the risk of outbreaks.

Modeling morbillivirus in Mediterranean striped dolphins (Stenella coeruleoalba)
Joseph Kane, Ryan Cait, Vrooman Scott, and Dumas Adam
Dolphin morbillivirus (DMV) is highly virulent, resulting in many fatalities and mass strandings of many cetacean species. Since 1990 there have been three DMV epizootics in the Mediterranean striped dolphin (Stenella coeruleoalba) population. There

essay will examine how the elite-driven initiative for a sophisticated court system may present hope for a more democratic future in China. An improving judicial system may compel the CCP to relent some of its control over Chinese society, establish a deeper respect for rule of law, and instill social expectations that may move China towards democratization. My essay will seek to present a fair view of the court system's effects, highlighting its flaws, benefits, and realistic prospects for the future.

Session 4-H • Mathematics and Biomathematics — South Hall 338

Session Chair: Caroline Haddad, Mathematics

Generating and Breaking Simple CAPTCHAs Using MATLAB

Nicole Kingsley

Faculty Sponsor: Caroline Haddad, Mathematics

Have you ever visited a website where you were prompted with an image, most likely including a block of letters or a sequence of words, from which you were asked to decipher the text and enter it back in order to proceed? Most likely, you have. These images are called CAPTCHAs, or Completely Automated Public Turing tests to tell Computers and Humans Apart, and are common attempts at preventing computerized hacking and spam attacks on popular websites. We will generate some simple CAPTCHAs using MATLAB, and focus on an algorithm that has proven successful in decoding these basic CAPTCHAs.

Break it Down: Using Wavelets to Analyze Handwritten Letters

Katy Nowak

Faculty Sponsor: Caroline Haddad, Mathematics* and *Dante DeBlassie, Texas A&M University

212 billion pieces of mail are processed by our postal system annually. The post office uses machines to decrease the time and man power required to sort the mail. I explored the techniques used by these machines to recognize the addresses. The goal of my project was to construct an algorithm using wavelets to distinguish different handwriting samples.

Modeling Celiac Disease using Differential Equations

Michael Hausberger and Hannah Miller

Faculty Sponsors: Gregg Hartvigsen, Biology and Chris Leary, Mathematics

Celiac Disease, an auto-immune disease of the small intestine, is widely under-diagnosed and occurs in approximately 1% of the US population. Individuals with the disease have an auto-immune response to gluten, a component of wheat. This auto-immune response occurs in the small intestine where the gluten is destroyed by the immune system. Consequently, this action also destroys the small intestine's villi, which are responsible for nutrient absorption. The destruction of villi results in malnutrition, which leads to a plethora of problems and eventually death. Differential equations, which are mathematical equations that track rates of change, are ideal for modeling this disease, because the disease progresses as various rates of change. We present a differential equation model of the disease to explore the effects of the disease on various individuals. First, we examine our conceptual model, which links six key factors of the disease. Then, we write six equations; one for each disease factor. Finally, we show that eliminating gluten from the diet halts the progress of the disease, leads to villi recovery, and returns nutrient absorption to normal levels.

Session 4-I • Political Science & International Relations — Welles 134

State Responses to Terrorism

Session Chair and Faculty Sponsor: Victoria Farmer, Political Science & International Relations

POWs in the War on Terror

Andrew Petracca

The mistreatment of prisoners in U.S. custody between September 11, 2001, and January 2009, including indefinite detentions, unfair trials, the use of interrogation techniques amounting to torture, and the deportation of prisoners to other countries for the purpose of torture, constitute violations of international law. Contrary to what the Bush administration and its supporters have argued, these policies are illegal and have not been more effective at protecting the United States than legal methods. In fact, by reducing the moral standing of the country and alienating individuals throughout the world, especially Muslims, they have strengthened anti-American extremism and increased the danger of terrorist attacks against the United States.

Imposing Democracy: State Building and the War on Terror

James Maxwell Duhe

The terrorist attacks of September 11, 2001 fundamentally reprioritized US foreign policy. In this environment, the Bush administration crafted what came to be known as the "Bush Doctrine." Though a precise definition of the Bush Doctrine remains contested, definitions typically include the idea that the US may preemptively attack countries harboring terrorists and that the US should support the spread of democracy. But, after eight years, the United States is still not safe. This paper analyzes democratization as an element of the Bush Doctrine through case studies of Iraq and Afghanistan. US attempts to democratize these countries have angered local inhabitants, locked the United States into situations where withdrawal is difficult, and damaged relations between the United States and other countries. Overall, the Bush administration's efforts to impose democracy in these countries have been ineffectual and counterproductive at combating terrorism. I conclude with policy