FACULTY CONTRIBUTED PAPER SESSIONS

Temple University
24 March 2018

Locations: Anderson 23, 24, 25, & 26

Rodrigo Carraminana, Delaware County Community College

Time: 1:05pm   Anderson 26

Title: *The Oldest Optimization Problem in the History of Mathematics*

Abstract: This talk is based on Richard Tapia's multiples talks about the mathematical solution of the Isoperimetric Problem. My presentation will focus on the historical part of the problem with emphasis on the Queen Dido promotion. In addition, I will talk about the necessary and sufficient conditions for the Solution of the problem, including Euler's contribution to its solution.

Melanie Butler, Mount St. Mary's University

Time: 1:05pm   Anderson 25

Title: *Learning to read mathematics: A pre reading heuristic*

Abstract: This talk is for mathematics faculty, mathematics students, and pre-service teachers. We will introduce a heuristic which students can use to prepare to and begin to read mathematics. Practical advice and techniques will be shared from education research. Faculty can put these strategies in place in their classrooms right away and students can use the strategies to become better at reading mathematics on their own.

Shelby Stanhope, Temple University

Time: 1:05pm   Anderson 23

Title: *Mathematical Models of the Immune System's Response to Bacterial Infection on the Surface of an Implant Device*

Abstract: The occurrence of biofilms on the surface of implant devices is a problem of great concern in the medical community. In this study, we use mathematical modeling in conjunction with data collected in laboratory studies, to model the immune response to bacterial infection on the surface of implant devices. Focusing on the initiation of infection, we aim to understand which factors determine the elimination of infection and which eventually lead to the development of a biofilm on the device. Some of the first responders in the body's innate immune response are neutrophils, white blood cells that follow chemical signals to locate and phagocytose bacteria. Using partial differential equations and stochastic differential equations, we model the growth of bacterial populations, their release of chemoattractants (the chemical signals), and the chemotactic movement of neutrophils to the sites of infection. By varying the amount of bacteria present in the initial infection and the strength of the immune response, we observe cases where the infection is completely eradicated and others where the infection persists.

Asif Mahmood, Penn State York

Time: 1:23pm Anderson 26

Title: *Statistical emulation of Geophysical Mass Flows*

Abstract: Rare natural hazards such as large volcanic eruptions can cause loss of life and damage to property. With sufficient information, those charged with public safety may issue warnings of impending hazards to mitigate the hazard impact. Recent developments in modeling and simulating large geophysical mass flows can provide useful information in assessing hazard risk. In particular, computer simulations of a model system of PDEs, which determines flow depth and runout, are expensive to run. On the other hand, analysis based on only a few simulations is not sufficiently accurate for hazard analysis. Computational costs can be reduced by constructing a statistical emulator - an approximate response surface for selected output variables derived from several full simulator runs. Whenever the result from a simulation is required in an analysis, the emulator can be queried quickly. A key feature of the emulator is that an estimate of the prediction uncertainty is defined together with the regression estimate. A popular emulator is the Gaussian Separable Process emulator, or GaSP, which is constructed as the mean of a Bayesian posterior distribution over outputs. In this work, we propose an alternative procedure for constructing emulators, one that uses knowledge about the model physics. We model the mass flow as an Ornstein-Uhlenbeck (OU) process for sliding blocks over the topography. We demonstrate how the OU results can be used to predict simulator results. By calibrating certain input parameters, a fit to the OU process is made, together with an error approximation, by classical statistical techniques, to provide an emulator of the runout computed by the computer simulator.

Jessica Babcock, Temple University

Time: 1:23pm Anderson 25

Title: *Integrating Active Learning in a Traditional Undergraduate Course*

Abstract: As part of a University-wide initiative, two instructors took part in a project to redesign Precalculus in line with active learning research and principles. These instructors taught eight pilot sections over the 2016-2017 academic year. Course materials, content, and major assessments were all standardized by the Math Department, so modifications were limited to teaching methods, in-class activities, and minor assessments. This talk will discuss how, through the creation of classroom activities, discussion-based lessons, and select alternative assessments, we found that not only can this be an effective way of teaching traditional material, but also that the classroom atmosphere can be more exciting and enjoyable for both students and the instructor. The percentage of students earning A/A- grades in the pilot sections was higher than those in the traditional sections (14.03% vs. 8.84%), and the pilot sections had a significantly lower DFW rate (35.61% vs. 50.12%).

Brooks Emerick, Kutztown University

Brooks Emerick, Kutztown University

Time: 1:23pm Anderson 23

Title: *Semi-Discrete Modeling for Host-Parasitoid Population Dynamics*

Abstract: Extensive work has been done on analyzing host-parasitoid interactions using discrete-time models. Our research focuses on a semi-discrete framework in which the host-parasitoid interactions are characterized by a continuous-time model. The continuous dynamic allows us to incorporate intricate behaviors of the host-parasitoid interaction such as host-feeding, egg load capacity, or migration. This talk focuses on migration of parasitoids between two locations. We find that in the simplest case, when the migration rates are constant, the model is unstable yielding diverging oscillations. When we consider one-way migration, coexistence between hosts and parasitoids occurs. A similar stability region arises when we consider an instant transportation of parasitoids between the two locations. We present analytic and numerical results that describe the region in parameter space in which coexistence among the two species is possible.

Jocelyn Quaintance, University of Pennsylvania

Time: 1:23pm Anderson 24

Title: *A New Method for Encryption Utilizing Power Product Expansions*

Abstract: Given the numerous security breaches that have occurred in recent years, it is of paramount importance to develop new approaches to cryptography. This talk discusses an innovative cryptosystem based on the one-to-one correspondence between a finite integer power product expansion, $\prod_{i=1}^{N}(1+g_i x^i)^{r_i}$, and its associated power series representation $1+\sum_{i=1}^{M} a_i x^i$. The cryptosystem takes the product representation, converts it into series format, and transmits a set of N coefficients. Decryption amounts to solving a finite number of nonlinear Diophantine equations which transforms the $\{a_{i_j}\}_{j=1}^{N}$ into the $\{g_i\}_{i=1}^{N}$. Numerous detailed examples ensures this talk will be accessible to an undergraduate audience.

Eugene Boman, Penn State Harrisburg

Time: 1:41pm Anderson 25

Title: *Limits Belong at the End of Differential Calculus, Not in the Beginning*

Abstract: The typical first semester Calculus course begins with the formal definition of the limit, which is then used to develop the familiar rules for differentiation. Logically, this makes perfect sense. Historically, it is backwards. The limit concept was first stated, rigorously, after the ideas and techniques of Calculus had been fruitfully exploited for 200 years. It is a solution of the problem, "Why does Calculus work?" When we teach limits first we are giving our students the solution of this problem, without first stating the problem. I will discuss the practicality of reordering the topics in a first semester calculus course to reflect this fact.

Gillian Queisser, Temple University

Time: 1:41pm Anderson 23

Title: *Mathematical Neuroscience: How cellular architecture can control biochemical signals*

Abstract: Brain cells come in many shapes and forms and continuously process electrical and biochemical signals. In order to understand the brain's multi-scale machinery multi-disciplinary research is required, often comprised of mathematics, physics, computer science, biology, and medical research. One of the hypotheses regarding cellular signal processing is that cell shape and intracellular organization is tightly coupled to cellular function. Studying such structure-function interplay is content of this talk. We will focus on calcium signaling, since calcium plays a most prominent role in cell signaling and is implicated in numerous neurodegenerative diseases, such as Alzheimer's and Parkinson's disease. Using mathematical modeling and simulation, guided by experimental data, we demonstrate how the intracellular architecture can control cellular calcium signals that are important for cell survival, learning, and plasticity. Mathematical methods, ranging from image processing to solving complex systems of differential equations will be part of this talk.

Harry Gingold, West Virginia University

Time: 1:41pm Anderson 24

Title: *Enigma with Power Product Expansions*

Abstract: The conversion of a power series into an infinite product creates an enigma. I will discuss this enigma and other related issues to these types of conversions. The talk will be accessible to graduate students.