Mathematical Association of America
MD-DC-VA Section, November 6 & 7, 2015
Saint Mary's College of Maryland
Abstracts

Abstracts for the workshop and invited addresses are listed first, in chronological order, followed by faculty abstracts alphabetized by submitting presenter's last name. Graduate student presentation abstracts and undergraduate student presentation abstracts follow (all alphabetized the same way).

Invited Addresses

FRIDAY WORKSHOP

Edwin O'Shea, James Madison University

Euclid's Elements Across the Modern Curriculum

4:00 PM, 117 Goodpaster Hall

Euclid's Elements is the foundational text of our discipline. Until recently, it was considered part of the bedrock of every liberal arts education worth its salt. Many commentators claim Elements' influence on western thought is second only to the Bible. Like the Bible, it may be that famous text that you know but have not read! The goal of this workshop is to provide a hands-on introduction to Euclid. This tour will be complemented by suggestions on incorporating Elements across the undergraduate curriculum in ways that are coherent with the CUPM recommendations. Special emphasis will be placed on guiding liberal arts students through Euclid, one that emphasizes the singular potency of the axiomatic method and that features star turns by Plato, Aristotle, Thomas Jefferson, and Abraham Lincoln.

BANQUET ADDRESS

Robert (Bob) Bosch, Oberlin College

Opt Art

8:00 PM, Daugherty-Palmer Commons

Optimization is concerned with optimal performance—finding the best way to complete a task. It has been put to good use in a great number of diverse disciplines: advertising, agriculture, biology, business, economics, engineering, manufacturing, medicine, telecommunications, and transportation (to name but a few). In this lecture, we will showcase its amazing utility by demonstrating its applicability in the area of visual art, which at first glance would seem to have no use for it whatsoever! We will begin by describing how to use integer programming to construct a portrait out of complete sets of double nine dominoes. We will then describe how high quality solutions to certain large-scale traveling salesman problems can lead to beautiful continuous line drawings. We will conclude by presenting other examples of Opt Art—art constructed with the assistance of optimization techniques.

SATURDAY INVITED ADDRESSES

Talitha Washington, Howard University

The Ubiquity of Mathematical Biology

9:45 AM, Cole Cinema, Campus Center

What comes to mind when you hear the phrase "mathematical biology"? Perhaps you begin to think of biological processes and mathematical equations. Perhaps you think of differential equations and exponential growth of bacteria. Perhaps even you think of modeling cancer growth in animals. In this talk, we will take a tour of the concept of "mathematical biology".

Heidi Hulsizer, Hampden-Sydney College

A 'Mod'ern Mathematical Adventure in Call of Duty: Black Ops

2:05 PM, Cole Cinema, Campus Center

Call of Duty: Black Ops is a popular video game that was released in 2010. Interestingly, one can use mathematics to solve an interesting problem that appears in the game. The problem involves turning dials to reach a desired solution, however when a player turns one dial he simultaneously turns others in a special configuration. Two perspectives on the solution will be presented; one involves solving a system of equations modulo ten and the other involves converting a directed

graph with four vertices into a matrix equation. This example provides an affirmative answer to the question: “Will I ever use math in real life?” This talk will be accessible to undergraduates.

Contributed Papers by Author (non-student)

Abdinur Ali, Norfolk State University
Chung-Chu (George) Hsieh, Norfolk State University
Mushtaq Khan, Norfolk State University
Performance Metrics for Machine Learning Algorithms
11:30 AM, 186 Goodpaster Hall
The emails and the other personnel computer accounts for non-governmental and governmental agencies are continuously under threat. In addition, the signature based detection techniques are not sufficient to catch new attacks. Therefore, machine learning algorithms which detect new attack classes are continuously being developed to keep up with these new computer attacks. These algorithms use training data sets which have different probability distributions from the testing data sets. In this paper, we used WEKA which is open source software to simulate the prediction of ten different classification algorithms for unknown attack classes. The results from the simulations are compared and analyzed for numerous performance metrics. This material is based on research sponsored by the Office of the Assistant Secretary of Defense for Research and Engineering (OASD(R&E)) under agreement number FAB750-15-2-0120.

Brian Bradie, Christopher Newport University
Population Ecology: A Linear Algebra Supplement
4:05 PM, 109 Goodpaster Hall
Population ecology uses many tools from linear algebra, from matrix representation of data to matrix multiplication, from the inner product to linear transformations, from the matrix inverse to eigenvalues and eigenvectors. A collection of modules that introduce the relevant population ecology concepts and demonstrate the application of a particular area of linear algebra is described. The modules could be used as supplementary material in any first course in linear algebra.

Bud Brown, Virginia Tech
The nonnegative integers are ... a field??
3:15 PM, 184 Goodpaster Hall
Roughly speaking, a field is an algebraic system, such as the real numbers, where one can add, subtract, multiply, and divide (except by zero). Under the usual addition and multiplication of numbers, the set N = {0,1,2, ...} of nonnegative integers is not a field. There is a way, using some unusual operations, to make N into a field, and this talk is about it's done.

Ray Cheng, Old Dominion University
An Extension of the Pythagorean Theorem
11:05 AM, 184 Goodpaster Hall
We'll start by reviewing what the Pythagorean Theorem means for Euclidean space, and more generally for vector spaces with an inner product. We'll then explore what the Pythagorean Theorem might look like for a vector space that doesn't have an inner product. What would "orthogonality" mean in that situation? Our investigation leads us to define the Weak Parallelogram Laws for normed spaces. These properties have interesting consequences and examples. From them we extract generalized Pythagorean theorems, which take the form of a family of inequalities.

David Clark, Randolph-Macon College
Geometry in 18th Century Japan: Exploring and Creating Sangaku
9:15 AM, 117 Goodpaster Hall
During the Edo Period (1603-1868), Japan was almost completely isolated from the West, including the products of the Western revolutions in math and science. At the same time, the Japanese witnessed a cultural renaissance in the visual and performing arts, music, fashion, ceremony -- and mathematics. Geometry intersected with religious tradition to

create a unique genre of folk art known as sangaku. In this talk, after introducing Edo Period mathematics, we'll follow a group of undergraduates traveling to Japan to learn about the fascinating cultural history of sangaku.

Donna Dietz, American University
Sonobe Origami for enriching understanding of geometric concepts in three dimensions
3:15 PM, 109 Goodpaster Hall
"Programs that take advantage of paper folding to teach mathematics are thriving in many parts of the world," according to the organizers of the MAA origami-themed Contributed Paper Session to be held at the JMM in January 2016. But, K-12 should not be having all the fun! In this talk, I will show some ways of stimulating student engagement using sonobe origami. These activities can be used in General Education mathematics "appreciation" courses or for Non-Euclidean Geometry for mathematics majors. Specifically, the goals are enriching student understanding of surface curvatures and helping them understand the duality of the regular polyhedra using these folded paper objects.

Ming Fang, Norfolk State University
Binary numbers and its issues in implementation
11:05 AM, 186 Goodpaster Hall
In this presentation, we first use MATLAB to demonstrate some issues in a computer. Then we will use IEEE floating point standard, which is implemented in almost all computers. Finally we will demonstrate how subnormal numbers allows a calculation to lose precision gradually when the result is around 0.

Susan Goldstine, St. Mary's College of Maryland
Knitting branches out: a geometric exploration in fiber
4:05 PM, 186 Goodpaster Hall
Another designer's knit shawl with an unusual stitch pattern inspired me to explore knit meshes that branch in systematic ways. In this talk, I will show two knitted artworks that I entered into the upcoming Joint Mathematics Meetings Exhibition of Mathematical Art and explain their loose connection to the well-practiced art of hyperbolic crochet.

Brian Heinold, Mount St. Mary's University
Smalltalk: A Student-Faculty Colloquium
8:50 AM, 184 Goodpaster Hall
Smalltalk is our department's colloquium. Its unique features are that talks are limited to 30 minutes and are given by both students and faculty. This talk will cover the ins and outs of running the colloquium, how it has worked out, and PD Points -- our system for ensuring attendance at Smalltalk and other department events.

Randall Helmstutler, University of Mary Washington
First-Year Seminar in Mathematics, part 2
11:30 AM, 109 Goodpaster Hall
One of the first-year seminars developed at Mary Washington focuses on the area of Cryptology. In this portion of the 2-part presentation, we look at some of the nuts and bolts of this course. In addition to a discussion of content and course design, we explain how the mathematical content was integrated into the broader student learning outcomes developed as part of the university's reaccreditation efforts. Concrete ideas on how to develop freshmen-level seminar courses will be discussed in the context of this course.

Ilhan M. Izmirli, George Mason University
A Passage through Brobdingnag: René Descartes and the Differential Calculus
3:15 PM, 186 Goodpaster Hall
On page 416 of volume I of The Correspondence of Isaac Newton edited by H. W. Turnbull et al, there appears a letter from Isaac Newton (1642-1726) to Robert Hooke (1635-1703) dated February 5, 1675 with a rather inconspicuous line, only to become one of the most often quoted statements in the history of mathematics:
If I have seen further it is by standing on ye shoulders of Giants.

It was indeed the works of these giants – François Viète (1540-1603), William Oughtred (1575-1660), René Descartes (1596-1650), John Wallis (1616-1703), and Isaac Barrow (1630-1677), to name a few – that helped Newton attain the mathematical maturity that would culminate in the complete development of the Fundamental Theorem of Calculus.
In this paper we will look into the work of one of these giants – the "calculus" of Descartes, and see how it pertains to Newtonian calculus.

Mitchel T. Keller, Washington and Lee University
IBL Introduction to Proofs in Four Weeks: A Survivor's Tale
3:15 PM, 117 Goodpaster Hall
Washington and Lee University, as part of its SACS Quality Enhancement Plan, has been working to redevelop its spring term. Part of this was to move from six weeks to four weeks for the spring term a few years ago. (Fall and winter terms are 12 weeks apiece.) Each student takes a single four-credit class during spring term. While many departments offer nontraditional courses such as "The Politics of Mad Men", most of the Department of Mathematics spring term teaching is in our introduction to proofs course. In this talk, I will discuss my inquiry-based learning approach to this whirlwind course, including the structure of class time, assignment and grading strategies, and student feedback. Many of the things I learned and will share in the talk can be translated to more traditional, full-semester IBL classes.

Phong Le, Goucher College
An Inquiry-Based Crash Course in Proofs
8:50 AM, 117 Goodpaster Hall
The Math major at Goucher has recently been restructured. As part of this restructuring, a one credit Proofs course is being offered in tandem with another proofs based 300 level course. This semester it is Complex Analysis. I'll discuss the logic behind the change as well as preliminary reflections and student feedback on the experience of inquiry based learning in an abbreviated format.

Nicholas Martin, Shepherd University
Using identities to solve equations
9:15 AM, 184 Goodpaster Hall
The paper begins with a well known identity, in three variables and uses it to solve the general cubic equation (in "depressed" form). Then, by analogy, an identity is developed for solving the quartic, in four variables, it is shown how to use this to solve the "depressed" quartic, and then another identity is developed for solving some special cases of the quintic, e.g. De Moivre's quintic is one of the examples.

Keith Mellinger, University of Mary Washington
First-Year Seminar in Mathematics, part 1
11:05 AM, 109 Goodpaster Hall
As part of a major overhaul of the first-year experience at Mary Washington (part of the Quality Enhancement Plan required for our reaccreditation efforts), there has been significant emphasis on the development of the first-year seminar program. In this short talk, I'll discuss some of the ways UMW has improved the first-year experience through a very intentional program to build academic survival skills among our first-year students. Moreover, we'll look at how the Department of Mathematics has contributed to the program by developing several new seminar courses in mathematics, but requiring no university-level prerequisite.

Jessica OShaughnessy, Shenandoah University
Mastery Based Assessment in Calculus
11:30 AM, 117 Goodpaster Hall
A common trend in my calculus classes is that many students perform poorly on the first exam, only to understand the early material well by the end of the course. In an effort to acknowledge the material mastered by the end of the calculus courses, I have implemented mastery based testing by which students are able to reattempt main concepts in the course with the goal of mastering them by the end of the semester. The main goals of this technique have been to relieve test anxiety in students, give students more opportunity to learn the material, and remind students to review old concepts

that they do not yet fully understand. In this talk, I will reflect on using mastery based testing in calculus courses over the past three semesters including benefits and limitations.

Alice Petillo, Marymount University
Investigating the impact of out-of-classroom events on undergraduate students
4:05 PM, 117 Goodpaster Hall
Out-of-class special events provide unique interdisciplinary links between mathematics and other disciplines. This research study based on undergraduate students attending the National Math Festival 2015 in Washington DC has implications for college faculty as they plan informal learning experiences particularly for pre-service teachers. Would you like to have some helpful questions to encourage student meta-cognition and provide you with valuable qualitative data? Alice Petillo will share pre-reflection and post-reflections surveys along with data.

Dylan Poulsen, Washington College
Can an Unstable Control System Be Stabilized By Timing Noise?
9:15 AM, 186 Goodpaster Hall
We consider the scalar, linear time invariant control system $\dot{x} = Ax + Bu$, where the control u is a sample-and-hold state feedback rule which updates at nonuniform time steps. We show that even if the system becomes unstable when updated with the uniform time step τ the system may still be stabilized when updated at non-uniform time steps with an average time step $T > \tau$ if $A < 0$.

Bob Sachs, George Mason University
A Transition to Proof Course (under construction) Centered on Complex Algebra and Analysis
9:15 AM, 109 Goodpaster Hall
In June 2014 a group of faculty met with the goal of revitalizing the undergraduate complex analysis course. One suggestion was to create a version of the transition to proofs course centered on complex topics. This talk will present the bare bones of such a course, the possible advantages, and seek feedback on the main ideas.

Nathaniel Schwartz, Washington College
Involutions of G_2 over fields of characteristic 2
8:50 AM, 186 Goodpaster Hall
Symmetric k-varieties generalize Riemannian symmetric spaces to reductive groups defined over arbitrary fields. For the standard fields, it is known that symmetric k-varieties are in 1:1 correspondence with isomorphism classes of k-involutions. Therefore, we need representatives of each isomorphism class in order to describe the k-varieties. In this presentation, we introduce composition algebras. The exceptional group G_2 is the group of automorphisms of an octonion algebra that fix a quaternion subalgebra. In the case that the fixed quaternion algebra is split, we give representatives for each isomorphy class of k-involutions when k is a field of characteristic 2. Work is ongoing in the case that the fixed quaternion algebra is a division algebra.

Amy Shell-Gellasch, Montgomery College
The Spherometer: Bringing Right Triangles into the Classroom
8:50 AM, 109 Goodpaster Hall
The Spherometer is a small micrometer used to calculate the radius of curvature of an object. Invented in the 17th century for the shaping of eye-glass lenses, it quickly became essential to the grinding of astronomical lenses. The mathematics behind the spherometer is surprising in its simplicity and is a fun way to bring some hands-on history into the classroom.

Katherine Socha, Park School of Baltimore
Shaping learning by doing: teaching topology to accelerated high school students
3:40 PM, 117 Goodpaster Hall
Teaching talented and well-supported high school students is both a delight and a challenge. The advanced mathematics

class at The Park School of Baltimore is made up of fifteen students from every grade in the upper school, ninth grade through twelfth grade. Their formal mathematics knowledge varies widely – some students are essentially ready to start upper division or graduate level work, others have extraordinary mathematical intuition but have never worked with sets or metric spaces, and yet others are able students who have just completed a high school calculus course. This is the story of a `recovering college professor's' work with an extraordinary high school mathematics program focused less on techniques and vocabulary and more on mathematical habits of mind. Illustrations will include student work, challenge problems and questions that guide class work, and comments on how some students have launched an affiliated mathematical modeling competition team.

Eva Strawbridge, James Madison University
Creating an Interdisciplinary Undergraduate Research Lab at the Interface of Math and Biology
3:40 PM, 109 Goodpaster Hall
Math biology, by its very nature, exists at the interface of the two fields and often necessitates the coupling of experiment and theory. In practice this all too often means people who engage in one collaborating with those engaged in the other, leaving undergraduate research students firmly rooted on one side of this divide. As a result, this approach appears to propound the statement: ``Don't look at the man behind the curtain!'' In this talk I will discuss how we have incorporated experiment and mathematical theory together using both mathematical and experimentally driven questions in the JMU WORM Lab as well as some of the successful projects which have come out of this group.

Bruce Torrence, Randolph-Macon College
Left Center Right - An Update
11:30 AM, 184 Goodpaster Hall
Imagine you are one of n players seated around a table playing a game of chance. There is a 100 dollar bill in front of you. At each turn, the bill moves one position to the left or right, each with probability 1/3. And at each turn, there is a 1/3 chance that the game ends and the person who the bill is currently in front of wins and gets to keep it. What are your chances of winning? At the Spring section meeting, I presented on this question. In this talk I will present a simpler expression for the winning probability as a ratio of Fibonacci and Lucas numbers.

Eve Torrence, Randolph-Macon College
The Structure of "Day"
3:40 PM, 186 Goodpaster Hall
I will discuss the geometry behind my sculpture,"Day", which was awarded "Best of Show" in the Bridges 2015 Art Show in Baltimore this summer. I will also discuss the trial and error process that led to the successful rendering of this structure. I will bring this sculpture and a few others to the meeting.

Jill Tysse, Hood College
Sonia Kovalevsky Day at Hood College
11:05 AM, 117 Goodpaster Hall
Sonia Kovalevsky Day (SK Day) is a day-long mathematical workshop for high school girls that is designed to celebrate and encourage these young women in their study of mathematics. The day is named for the first woman to earn a doctorate in mathematics and workshops like ours are held annually at colleges and universities all over the country. Here at Hood College, we have just held our 10th SK Day. I will talk about SK Day at Hood over the years and share specific details about how we manage to fund and organize this event.

Qing Wang, Shepherd University
Zhijun Wang, Shepherd University
David J. Klinke, West Virginia University
A Calibrated Model for an Immuno-Chemotherapy to Treat Colon Cancer
3:15 PM, 198 Goodpaster Hall
In a recent study, a chemotherapy agent Oxaliplatin in combination with interleukin-12 treatment was used to eliminate

colorectal cancer cells in a murine model. To better understand the effects of the combination therapy, we developed a multi-scale mathematical model using a set of impulsive ordinary differential equations to describe the interaction between the immune system and tumor in response to the therapy. Model parameters were calibrated to published experimental data using a genetic algorithm. Stability analysis and its biological relevance were also discussed. Treatment strategies to control tumor growth for the mixed immuno-chemotherapy were also discussed. This research has been supported by the NIGMS of the NIH grant as part of the WV-INBRE (P20GM103434).

Gwyneth Whieldon, Hood College
Combinatorial Games: Open Problems and Computation Approaches
3:40 PM, 184 Goodpaster Hall
Combinatorial games -- two person, perfect information games with no element of chance -- have seen an explosion of interest in the past two decades. Problems in combinatorial game theory make excellent research questions for undergraduates and faculty alike, and the field provides many easy examples and open questions to attack. In this talk, we highlight a few new computation approaches to finding winning strategies in combinatorial games, and showcase a few recent open source software packages that have been developed to assist in elucidating the structure and strategies for such games.

Cassie Williams, James Madison University
Maximizing market share: A real-world example of Lagrange Multipliers
4:05 PM, 184 Goodpaster Hall
In multivariable calculus, we teach our students about gradients, parameterizing paths on surfaces, and the method of Lagrange multipliers to optimize with respect to a constraint. We know there are ``real-world" applications, but most textbooks contain mainly trivial, contrived, or simplified examples. In this talk, I will show how we used multivariable calculus to analyze the solution to a particular Markov model for brand switching. In particular we will be investigating market share, a function of two variables, and we will maximize it with respect to a budget constraint using Lagrange multipliers. This work was recently published in a marketing journal with a marketing professional from a major technology company.

Graduate Student Abstracts by Author

Jonathan Graf, University of Maryland, Baltimore County
Singly Diagonally Implicit Runge-Kutta schemes within the Numerical Solution of Partial Differential Equations
9:15 AM, 198 Goodpaster Hall
Singly Diagonally Implicit Runge-Kutta (SDIRK) are multi-stage methods appropriate for the solution of stiff ODE problems. Implicit methods are necessary to solve stiff problems, but these methods require the computational cost of solving a non-linear system that explicit methods do not. We first verify our method implementation in Matlab with convergence studies for two scalar test problems with both implicit and explicit Runge-Kutta methods. Next, two time-dependent PDE problems are used to present results comparing Matlab's built in ode15s which is a variable order Numerical Differentiation Formula (NDFk) to a third order SDIRK method. The first is a linear PDE and the second is a fully non-linear reaction diffusion system with 2 species. The method of lines is used for the numerical solution of the PDEs. The result of the spatial discretization is a large system of ODEs that must be solved at each time step thus at each time step we apply the ODE method. Adaptive time stepping in which the high order of the method leads to larger time steps and this fewer non-linear systems that need to be solved. Finally, we establish the context of this work within the three dimensional Calcium Induced Calcium Release (CICR) model, a three species non-linear reaction diffusion coupled PDE system.

Ashlee Edwards, Old Dominion University
Oncolytic Virus Dynamics: Analysis of a Mathematical Model of Tumor Growth Using Oncolytic Viruses as Treatment
8:50 AM, 198 Goodpaster Hall
For the past several years therapeutic cancer treatments using oncolytic viruses has become a popular area of study.

How successful is targeting tumor cells with viruses that replicate and eradicate these tumor cells, simultaneously minimizing their effect on normal cells? In an effort to analyze the influence of oncolytic viruses, we formulate and speculate aspects of a mathematical model of a tumor that is injected with a replicating oncolytic virus. The formulation consists of non-linear PDE system in spherical domain with a moving boundary accompanied by relevant initial boundary conditions. In order to conduct stability analysis on the model, we introduce an accompanying ODE endemic model, treating the infected tumor cells as the "disease/infection," and the virus is the cause of the infection.

Yarong Feng, the George Washington University
Degree Profile of Hierarchical Lattice Network
11:05 AM, 198 Goodpaster Hall
We study the degree profile of random hierarchical lattice networks. At every step, each edge is either serialized (with probability p) or parallelized (with probability $1-p$). We establish an asymptotic Gaussian law for the number of nodes of outdegree 1, and show how to extend the derivations to encompass asymptotic limit laws for higher outdegrees.
The asymptotic joint distribution of the number of nodes of outdegree 1 and 2 is shown to be bivariate normal. No phase transition with p is detected in these asymptotic laws.
For the limit laws, we use ideas from the contraction method. The recursive equations which we get involves coefficients and toll terms depending on the recursion variable and thus are not in the standard form of the contraction method. Yet, an adaptation of the contraction method goes through, showing that the method has promise for a wider range of random structures and algorithms.

Cheng Zhang, The George Washington University
Measuring Identification Risk in Microdata Release and Its Control by Post-randomization
11:30 AM, 198 Goodpaster Hall
Many statistical agencies aim to collect and release useful data to help researchers and policy makers to make informed inferences and decisions. But, they also need to keep each survey participant's information confidential for legal reasons and upholding public trust and support. So, agencies often release a perturbed or masked version of the original data. Data masking degrades data quality. Thus, the tradeoff between disclosure risk and data utility is an important consideration in confidentiality protection. However, the basic tasks of defining and measuring disclosure risk and data utility, and determining appropriate disclosure control goals are significant challenges in practical data masking.In this paper, we focus on identity disclosure based on categorical key variables. First, we propose a measure for identification risk and an associated disclosure control goal. Second, we present a method that accomplishes the disclosure control goal which is an application of PRAM (Post-randomization). We also discuss the inference aspect of this method.

Undergraduate Student Abstracts by Author

Evan Clough (Senior), Hood College
The History of the Unsolvability of Hilbert's Tenth Problem
11:30 AM, 111 Schaefer Hall
At the International Congress of Mathematicians in Paris in 1900, David Hilbert posed 23 problems. The tenth problem, a question in number theory, asks to find a finite process that can determine whether or not any given Diophantine equation is solvable. Seventy years later, Yuri Matiyasevich proved that, contrary to Hilbert's expectation, there could not be any such process. Surprisingly, Matiyasevich and the other mathematicians whose work contributed to the solution used mathematical logic instead of number theory to approach the problem. We will discuss the history of this transformation from number theory to logic and the mathematicians involved in it.

Chris Lloyd (Senior), University of Mary Washington
Non-commutative Key Exchange Protocols with Generalized Dihedral Groups
3:40 PM, 198 Goodpaster Hall
Given an arbitrary abelian group A, one can form its dihedralization D(A), which is typically a non-abelian group whose order is twice that of A. As D(A) is usually non-abelian, this makes it a possible candidate for the platform group in certain

non-commutative key exchange protocols. We show that for such groups the Ko-Lee protocol is susceptible to a polynomial-time attack.

Zulfiya Muradova (Senior), Shepherd University
Jessica Poffenberger (Sophomore), Shepherd University
A Calibrated Model and Analysis for Ebola Outbreaks
4:05 PM, 198 Goodpaster Hall

The recent outbreak of Ebola virus disease in West Africa is a tragic case of how quickly an unchecked virus can run through a population. This disease demonstrates the need for strong and rapid measures for containment of possible infection. This project proposed a set of ordinary differential equations based on the well-known SEIR (susceptible, exposed, infectious, treated/recovered) model to describe the spread and transmission of the disease in Liberia, Sierra Leone, and Guinea. The parameters of the model were calibrated to the observations of the outbreaks in the three countries using a genetic algorithm. Local stability results were discussed based on the values of the calibrated parameters. Based on the simulations of the SEIR model, the impact of several methods on control or reduction of the spread of Ebola virus is discussed. The project was supported by the NIGMS of the NIH grant as part of the West Virginia INBRE (P20GM103434).

Jessica Poffenberger (Sophomore), Shepherd University
Zulfiya Muradova (Senior), Shepherd University
Peter Hopkins (Junior), Shepherd University
A Mathematical Model of West Nile Virus
11:05 AM, 111 Schaefer Hall

West Nile Virus (WNV) is a widespread disease mainly transmitted by mosquitoes. While humans are considered dead-end hosts once infected, birds have been documented to produce high enough levels of the virus to spread WNV to mosquitoes. Thus, bird populations produce a significant impact upon the growth of the disease. Approximately 80% of cases in humans show no noticeable symptoms, and the infected recover on their own. Another 20% develop mild symptoms similar to a flu. A serious neurological illness occurs in less than 1% of the infected population. Currently, there is no cure or preventative shot for this disease. Preventative measures, including killing off mosquitoes and minimizing personal exposure to mosquitoes, are the most effective ways to combat WNV. The project proposes a revised ODE model based on the model developed by Bowman et al. (2005) to describe the spread of this virus and the impact of mosquito and bird populations on its outbreaks. Though numerical simulations, the impact of some control methods such as reducing the number of mosquitoes and/or possible human-mosquito contact rate on the WNV transmission outbreaks is discussed. This project was supported by the NIGMS of the NIH grant as part of the West Virginia INBRE (P20GM103434).