Mathematical Association of America
MD-DC-VA Section, November 4 & 5, 2016
Johns Hopkins University
Abstracts

Abstracts for the workshop and invited addresses are listed first, in chronological order, followed by faculty and graduate student abstracts, alphabetized by submitting presenter's last name. Undergraduate student presentation abstracts are next (also alphabetized by submitting presenter's last name).

Invited Addresses

FRIDAY WORKSHOP
Keith Mellinger, University of Mary Washington
Magma Workshop
4:00 PM, Room 213, Hodson Hall
The Magma computational algebra system is a software package designed for computations in algebra, number theory, algebraic geometry and algebraic combinatorics. It provides a mathematically rigorous environment for defining and working with structures such as groups, fields, algebras, graphs, codes and many others. In graduate school I used the system to aid my research, using the package to construct "small" examples that could be analyzed and, with any hope, generalized into families or in other ways that allowed me to write structural theorems. Later I learned to integrate Magma into my undergraduate research projects. In the workshop, we will use Magma to explore topics in abstract algebra and discrete mathematics just as we use similar tools in calculus and numerical analysis.

BANQUET ADDRESS
Caren Diefenderfer, Hollins University
Betty Mayfield, Hood College
Jon Scott, Emeritus, Montgomery College
The MD-DC-VA Section: The First 100 Years
8:00 PM, The Glass Pavilion, Levering Hall
Founded in 1916, the Maryland-District of Columbia-Virginia Section was one of the earliest of the Mathematical Association of America. Thirty-eight people attended our first meeting on March 3, 1917 at Johns Hopkins University. As we return to the site of that first meeting, we celebrate the Centennial of our Section by remembering its history. Join us for a trip down Memory Lane as members of the Section History Committee describe what we have learned from the newsletters, meeting programs and abstracts, minutes and financial reports, annual reports, and correspondence collected by our officers over the years and stored in basements and garages all over the mid-Atlantic. Discover the famous people who have given talks at our meetings, and trends in topics of contributed papers. Track the participation of women, of HBCUs, of undergraduate students. From the Summer Workshops to Section NExT, our Section has a rich and fascinating history. Come learn about our past, present – and future!

SATURDAY INVITED ADDRESSES
Paul Zorn, St Olaf College
Extreme Calculus
9:45 AM, Room 110, Hodson Hall
There is much more to differential and integral calculus than may first meet the eye, especially to those of us who teach it again and again. Well-worn calculus techniques and topics-polynomials, optimization, root-finding, methods of integration, rationality and irrationality, and more-often point to deeper, more general, more interesting, and sometimes surprising mathematical ideas and techniques. I'll illustrate my thesis with figures, examples, and calculation, and give references to MAA publications and resources that can support taking elementary calculus to its extremes.

William Dunham, Bryn Mawr College
Euler in Two Acts
2:05 PM, Room 110, Hodson Hall
Leonhard Euler (1707 – 1783) is one of the towering figures from the history of mathematics. Here we look at two results that show how he acquired his lofty reputation. In 1737, Euler considered the infinite series 1/2 + 1/3 + 1/5 + 1/7 + 1/11 + … – i.e., the sum of reciprocals of the primes – and established that the sum "is infinite." The proof rested upon his famous product-sum formula and required a host of analytic manipulations so typical of Euler's work. The other result addressed 1 + 1/4 + 1/9 + 1/16 … – i.e., the sum of reciprocals of the squares. Euler first evaluated this in 1734, and revisited it in 1741, but here we examine his 1755 argument that used l'Hospital's rule not once, not twice, but thrice! Euler has been described as "analysis incarnate." These two theorems, it is hoped, will leave no doubt that such a characterization is apt.

Contributed Faculty Papers by Author

Abdinur Ali, Norfolk State University
Chung-Chu (George) Hsieh, Norfolk State University
Mushtaq Khan, Norfolk State University
Theoretical Analysis of Code Emulations and Use of Multiple Sandboxes for Cyber Defense
9:15 AM, Room 316, Hodson Hall
Most of the today's computer viruses cannot be detected with hash function analysis of each file or correlation analysis of arbitrary vectors and Euclidean metric techniques. The complexity and the sophistication of new internet viruses are always increasing. At our research group, we are turning to nature as inspiration. Bio-inspired algorithms can be used to stop these new computer viruses. These new computational paradigms can simulate evolution in biological networks, learning, adaptation, alterations in the gene sequences and how immune system controls the spread of disease-producing agents in the body. In this paper we will cover binary encoded algorithms, probabilistic algorithms and how to monitor the functions of self-modifying codes in restricted or emulated environments. 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.
Content Area: applied mathematics

Jathan Austin, Salisbury University
History of Mathematics for Secondary Education
3:40 PM, Room 216, Hodson Hall
In this talk, I will discuss how I incorporate historical perspectives on polynomial equations into a capstone course for secondary education. In particular, I will highlight cubic equations studied by Omar Khayyam.
Content Area: mathematics education

Ezra Brown, Virginia Tech
An Incomplete History of the (7,3,1) Block Design
3:15 PM, Room 311, Hodson Hall
The (7,3,1) block design has appeared in many times and places, frequently disguised as something else. In this talk, we trace the chronology of (7,3,1) from its apparent beginnings in the mid-nineteenth century up to present time. We'll talk about difference sets, tournaments, finite geometries, normed algebras, Hadamard matrices, error-correcting codes, Venn diagrams, and many other matters -- and what is meant by "apparent" beginnings.
Content Area: history of mathematics, combinatorics

Abstracts

James Case
Who Really Proved the Isoperimetric Theorem
4:05 PM, Room 316, Hodson Hall
It was known to Pythagoras more than 2500 years ago that, among all simple closed curves of given arc length, the circle encloses the greatest area. Subsequent authors, including Zenodorus (200 BC – 140 BC), were able to prove uniqueness for "the isoperimetric problem" without proving existence: The maximizing curve, if there is one, can only be the circle. But proof that the circle does indeed solve the problem was apparently lacking until Weierstrass (in or about 1870) used his "sufficiency test" from the calculus of variations to validate the classical result. Accordingly, Weierstrass usually receives credit for completing the proof of the isoperimetric theorem. It will be argued that, although his book On Isoperimetric Figures is lost, Zenodorus almost surely supplied the missing proof.
Content Area: geometry

Chris Castillo, Loyola Blakefield
Permutation Polynomials and Polynomial Generators of a General Linear Group
11:30 AM, Room 203, Hodson Hall
Cayley's Theorem guarantees that any group can be represented as a permutation group. In particular, when we take the set being permuted to be a finite field $\mathbb{F}_{p^n}$ for some prime p, we can use the Lagrange Interpolation Formula to construct a polynomial which represents a given permutation. Such polynomials, whose induced function defines a bijection of $\mathbb{F}_{p^n}$, are called permutation polynomials, and it is a central problem in the theory of finite fields is to discover new classes of permutation polynomials. In this talk, we will describe a technique for constructing groups of permutation polynomials using group actions, which has been used to construct several new families of permutation polynomials. The construction includes a notion of equivalence describing when two groups of permutation polynomials constructed using the method induce essentially the same permutation on the finite field. In the process of determining the equivalence of certain permutation polynomials over $\mathbb{F}_{p^2}$, we discovered an interesting and unexpected result which gives polynomial generators for the general linear group~$GL(p^2)$.
Content Area: finite fields, permutation polynomials, discrete mathematics, representation theory

Ray Cheng, Old Dominion University
Bounds for the Roots of Polynomials
11:05 AM, Room 203, Hodson Hall
We'll review some of the classical bounds for the roots of a polynomial in terms of its coefficients, along with a simple proof. A new approach will be presented, based on generalizing the notion of orthogonality on a normed vector space. These ideas will enable improvements over the classical results.
Content Area: functional analysis

Prince Chidyagwai, Loyola University Maryland
On Finite Element Decoupling Techniques for Coupled Multi-Physics Flows
3:40 PM, Room 313, Hodson Hall
In this talk we consider the coupling of free flow with porous media flow modeled by the Navier-Stokes or Stokes equations coupled with Darcy's law. This coupled model is of interest in various engineering and biological applications in which a free flowing fluid interacts with porous material. Solving the coupled problem is very computationally expensive due to the large size and in some cases non-linearity of the coupled systems resulting from finite element discretization of the coupled problem. I will discuss numerical decoupling techniques for both the steady state and time dependent problems. The decoupling methods result in two relatively smaller sub-problems corresponding to each sub-domain and can be solved more efficiently than the fully coupled problem.
Content Area: numerical analysis

Jerome Dancis, University of Maryland at College park
Guiding Small-Group, Inquiry Learning in the Classroom
4:05 PM, Room 305, Hodson Hall
This talk will describe how to guide small-groups of students to discover much of the Math in standard Math courses such

as Differential Equations. It will include problem sets, which will illustrate, how to write effective and efficient problem sets. Ones, which facilitate inquiry learning both in class and in homework. It will show how to steer the groups away from time-wasting, inefficient as well as dead-end approaches to problems. It will answer the question: What to do when the students are floundering? The talk will be based on the small-group parts of my report, "A Hybrid, Small-Group, Guided-Discovery Method of Instruction // A Rigorous, Non-Extremist Approach", at www.math.umd.edu/~jnd/Discovery.htm
Content Area: mathematics education (inquiry-based learning)

Matt Dellatorre, University of Maryland
Dirichlet Duality and Applications
4:05 PM, Room 203, Hodson Hall
I will sketch the main ideas of the Dirichlet duality theory of Harvey and Lawson and provide some examples of fully nonlinear, geometrically motivated PDEs to which it can be applied.

Beth Dodson, Shenandoah University
I Love Learning Like This… Five Words that Tell Me I am Doing Something Right
3:15 PM, Room 316, Hodson Hall
A great educator once told me that students should be just as tired as I am when they leave my class, if not, my lesson had most likely not been "student-centered". With this in mind, inquiry-based learning is an excellent way to meet the goal of switching the focus within a course. Inquiry-based learning (IBL) is a popular method for encouraging autonomous thinking and allows students to be as active in their learning experience as the teacher. By combining IBL methods with group work founded in immersive content discovery through constructivist activities, we convert the instructor's role from lecturer to coordinator. This allows the educator to provide unobtrusive guidance, manage class time without manipulating a student's thought process, and build a foundation for future in-depth analyses. These guided-inquiry activities provide students the opportunity to help each other through problem manipulation and active contribution to a group, not only to create a sense of teamwork but also to build a strong knowledge base through the proven art of "learning by teaching". I will share our experiences, observations and student reactions to our current set of IBL activities for the introductory statistics class. In addition, I will provide resources for anyone wishing to implement these same student centered activities in their own course.
Content Area: mathematics, statistics

W. Ethan Duckworth, Loyola University Maryland
Ideas and Results from a Summer Bridge Program at Loyola University
9:15 AM, Room 216, Hodson Hall
The Ignatius Scholars Program at Loyola is designed to increase success and retention for incoming students who are first generation college bound, minority, or Pell Grant qualifying. For the last four years I've designed and run the component that covers mathematics preparation. In this talk I'll discuss decisions that were made in this program and results. Big picture issues to consider include: placement, range of student ability, classroom structure, and content. The content that I developed ranges from study skills, to material from algebra, pre-calculus, calculus, as well as topics off the algebra-calculus track.
Content Area: pedagogy

Sam Eastridge, Virginia Tech
First Cohomology of Some Infinitely Generated Groups
3:40 PM, Room 203, Hodson Hall
In this talk I will consider some common results about l^p-cohomology for finitely generated groups, and see which of these results also apply for uncountable groups. Many of the results do not hold even for the countably generated case. In particular, I intend to give some explanation as to the reason why even though the first cohomology group with coefficients in l^p is not even Hausdorff for infinite amenable finitely generated groups, it vanishes for some (and perhaps all) uncountable amenable groups. I also intend to discuss the injectivity of some maps between cohomology groups.
Content Area: group cohomology

Abstracts

Ashlee Edwards, Old Dominion University
Tumor Virotherapy and Lotka Volterra Dynamics
11:30 AM, Room 316, Hodson Hall
For the past several years therapeutic cancer treatments using oncolytic viruses has become increasing popular. How successful is targeting tumor cells with viruses that replicate and eradicate these tumor cells, simultaneously minimizing their effect on normal cells? We will present a model of cancer tumor growth that describes the interaction between an oncolytic virus, tumor cells, and the immune response. In particular, the Lotka –Volterra predator-prey model is a predator-prey relationship model. It is designed to simulate the actions between population growth and decay of the two separate populations. We investigate the predator-prey relationship between the virus (prey) and the immune response (predator) of the model.
Content Area: biomathematics

Didem Egemen, The George Washington University
Fabrizio Ruggeri, CNR IMATI, Milano, Italy
Refik Soyer, The George Washington University
Bayesian Modeling of Virtual Age in Repairable Systems
4:05 PM, Room 313, Hodson Hall
In this study, we are proposing Bayesian analysis of aging of repairable systems, which are subject to minimal, perfect or imperfect repairs upon each failure. Each repair is affecting the age of the system, bringing it back to the initial value (i.e. 0) when a perfect repair is performed, or leaving it as it is for a minimal repair. The imperfect repair will bring the age back to an intermediate value between the ones for perfect and minimal repair. The choice of the repair policy is first modeled through specification of latent random variables at each failure time. Then, as extensions of this model, age reduction and intensity reduction models are presented. For all these models, parameters are estimated using Markov Chain Monte Carlo methods within the Bayesian framework.
Content Area: reliability, Bayesian analysis, repairable systems

Wendy Hageman Smith, Longwood University
A Case-Control Study in a General Education Math Course (Focus on Math Anxiety)
11:05 AM, Room 311, Hodson Hall
Last year, I and another colleague presented about a short reference book for instructors and students, based in my earlier research, for addressing student attitudes towards the study of mathematics (including math anxiety) with best practices for the teaching and learning of mathematics in introductory courses. The result is a brief (2 or 3 lecture) program for integration into courses that are typically a "first experience" for students of college math that orients their attitudes, expectations, and study habits towards getting the most out of their current—and likely future—coursework in mathematics. This "short-course" in the nature and value of college math, in disarming math anxiety, and in establishing sound student skills enhances student optimism and engagement. This presentation is on resulting data from a case control study (Fall 2015) of two Math121 classes (one treatment and one control class) that focuses on Math Anxiety and results of the “brief 2 or 3 lecture program” as inserted into the classroom.
Content Area: mathematics

Spencer Hamblen, McDaniel College
Students Writing for Students
3:40 PM, Room 305, Hodson Hall
In an attempt to improve my upper-level students’ mathematical writing, my recent Number Theory and Abstract Algebra courses have required students to co-write a community document during the semester. This talk will discuss the successes and failures of these assignments, as well as the challenges of implementing similar work in an Intro to Proofs course.
Content Area: pedagogy/inquiry-based learning

Hasan Hamdan, James Madison University
Shenghua Zha, James Madison University
Matt Trybus, James Madison University
Offering Online Peer-Assisted Study Sessions to Help Students Learn in an Undergraduate Statistics Course
3:15 PM, Room 216, Hodson Hall
In the summers of 2015 and 2016, we offered online peer-assisted study sessions (Online PASS) to supplement the formal instruction of an online statistics course. The purpose of the Online PASS was to improve students' understanding and learning in the course. The preliminary results showed that, while controlling for the differences of student groups and bonus points offering in 2015 and 2016 by the variable Year, the number of Online PASS sessions that a student participated predicted their course grades significantly. In this talk, we will present and discuss the results based on the summer online statistics course at James Madison University using data from the last two summers.
Content Area: teaching

Brian Heinold, Mount St. Mary's University
Probability Questions from the Game Pickomino
8:50 AM, Room 311, Hodson Hall
Pickomino is a simple and fun dice game published by Rio Grande Games. It has some similarities with Yahtzee, and nearly every move involves some probability. The game is good for teaching probability. This talk will cover a wealth of interesting problems that arise from Pickomino for all levels of students (and faculty).
Content Area: general

Noble Hetherington III, United States Naval Academy
Justin Allman, United States Naval Academy
Amy Ksir, United States Naval Academy
Megan Selbach-Allen, United States Naval Academy
Inquiry-Based Calculus II at the Naval Academy
11:05 AM, Room 305, Hodson Hall
This semester, the four of us have teamed up to teach, for the first time, an inquiry-based version of Calculus II. In this talk we will describe our motivations, the materials we are using, and share some of what we have seen and learned so far.
Content Area: inquiry-based learning

Dan Kalman, American University
Mystic Secrets of the Yeast: A Cautionary Tale for Teachers of Mathematical Modeling
11:30 AM, Room 311, Hodson Hall
Real life examples showing the applicability of mathematical models are often included in math courses. And the internet provides a wealth of real data. One particular data set has been cited repeatedly as an example of logistic growth. It originated from a 1913 experimental observation of yeast population growth, and a logistic model fits the data almost perfectly. But could that fit be a little too perfect?
Content Area: population growth models

Mitchel T. Keller, Washington & Lee University
My IBL Approach to Theoretical Ideas in First-Semester Calculus
8:50 AM, Room 305, Hodson Hall
This talk will begin by briefly summarizing the context in which I use inquiry-based learning in my first-semester calculus class. I will then discuss a few guided inquiry activities that I have developed to help students explore some of the more theoretical results in calculus such as the limit of sin(x)/x as x approaches 0, the mean value theorem, and obtaining the properties of the natural logarithm using its definition as an integral function.
Content Area: inquiry-based learning

Abstracts

Paul Massell, Mathematical Consulting
Using the Mathematical Sciences to Protect Data
8:50 AM, Room 316, Hodson Hall
Federal statistical agencies and many other organizations are interested in learning about various populations, e.g. of people, households, and companies. They collect data about these populations in various ways, e.g., via surveys (paper or online), or from administrative forms. The goal of the organization is often to create statistical information of use to itself, other organizations, researchers, or the public. In most cases the organization wants to protect the confidentiality of the data; i.e., not disclose individual-level information. This has led to a subject called statistical disclosure control. An interesting aspect of this subject is that it uses techniques from several of the mathematical sciences. For decades, simple ideas from probability and statistics have been used, e.g., in methods such as adding noise to actual data. Noise can be generated with a standard random number generator or by using Markov matrices. Methods from operations research, such as linear and integer programming, are often used for protecting sensitive cells in magnitude data tables. In the past decade, privacy protection has become a 'hot' topic among computer scientists. They have added some sophisticated approaches and methods (ref1: C. Dwork and A. Roth) to those developed by statisticians. Courses on statistical disclosure control are now being developed that discuss all these approaches (ref2: P.B. Massell).
References:
1. www.cis.upenn.edu/~aaroth/Papers/privacybook.pdf
2.
apps.ep.jhu.edu/course-homepages/3494-625.468-statistical-privacy-protection-in-large-datasets-massell
Content Area: using data to release statistical summaries while protecting individual data

Marc Michael, Frostburg State University
Incorporating Inquiry-Based Learning in a Geometry Course for Future Elementary Teachers
11:30 AM, Room 305, Hodson Hall
Exposing prospective teachers to IBL tasks, such as presenting and explaining problems to peers, not only builds understanding of content and critical-thinking attitudes, but also helps these students to develop confidence and communication skills that will undoubtedly provide a foundation for their early teaching experiences. In this talk, I will describe how I used aspects of IBL in a content course for prospective elementary teachers and discuss some of the lessons that I learned as a result of teaching the course a couple of times.
Content Area: mathematics pedagogy

Minah Oh, James Madison University
Effective In-Class Programming Projects for STEM Majors
4:05 PM, Room 311, Hodson Hall
Teaching a lower-level numerical analysis course that involves programming can be challenging, since the students that are taking the course all have different programming experiences. In this talk, I will present some in-class programming projects that kept students of all programming levels engaged and interested. These projects were used in my Computers and Numerical Algorithms class (sophomore-level math-major course) at James Madison University, and they were effective in teaching programming and related mathematical theory.
Content Area: teaching, applied mathematics

Cherng-tiao Perng, Norfolk State University
Euclidean Geometry Revisited
9:15 AM, Room 203, Hodson Hall
This talk concerns the center of mass (centroid) of a polygon. It is shown by simple construction that the center of mass of a polygon can be constructed by ruler and compass. This talk is dedicated to my junior high school mathematics teacher, Tsai-Yuan Chern, who shared a related problem that inspired this construction.
Content Area: Euclidean geometry, calculus

Luca Petrelli, Mount St. Mary's University
A Second Chance for a Game of Chance
9:15 AM, Room 311, Hodson Hall
We take a novel look at a game of chance recently appeared in a Mathematics Magazine paper and generalize the results of the paper. As an unexpected outcome we discover a new Fibonacci and Lucas identity.
Content Area: recreational mathematics, combinatorics

Bob Sachs, George Mason University
Towards Guided Reinvention of Riemann Sums and the Fundamental Theorem of Integral Calculus
9:15 AM, Room 305, Hodson Hall
Student reinvention of the Riemann sum of products and the Fundamental Theorem of Calculus makes for an inspiring climax to first-semester calculus. Presented with distance/velocity, cost and earnings tasks requiring use of average values on subintervals, students create Riemann sums. Some then go on to formulate the Fundamental Theorem of Calculus in its global (fixed endpoint integral) and then local (moving endpoint and derivative thereof) versions. Ongoing refinements of tasks aims to increase the number of successes and productive misses.
Content Area: calculus teaching

Prasad Senesi, The Catholic University of America
The Euclidean Geometry of Linear Voting Theory
8:50 AM, Room 203, Hodson Hall
We will show how the standard inner product of Euclidean space provides a new way to understand and analyze certain voting methods. Using this perspective, along with the action of the symmetric and special orthogonal groups on the vector space of profiles, we extend some natural voting criteria to ballots of arbitrary composition type.
Content Area: voting theory, group theory, combinatorics

Amy Shell-Gellasch, Montgomery College
Object Based Learning: Using the Smithsonian Collections
11:30 AM, Room 216, Hodson Hall
OBL, or Object Based Learning, leverages objects as items of discovery in the classroom. These may be actual physical objects or images. The Smithsonian online collections contain a wealth of material for classroom use, in all areas of study. In this presentation you will be introduced to several mathematics-related object groups at the Smithsonian.
Content Area: pedagogue

Ryan Shifler, Virginia Tech
Equivariant Quantum Cohomology of the Odd Symplectic Grassmannian
3:15 PM, Room 203, Hodson Hall
The odd symplectic Grassmannian IG:=IG(k, 2n+1) parametrizes k dimensional subspaces of C^{2n+1} which are isotropic with respect to a general (necessarily degenerate) symplectic form. The odd symplectic group acts on IG with two orbits, and IG is itself a smooth Schubert variety in the submaximal isotropic Grassmannian IG(k, 2n+2). We use the technique of curve neighborhoods to prove a Chevalley formula in the equivariant quantum cohomology of IG, i.e. a formula to multiply a Schubert class by the Schubert divisor class. This generalizes a formula of Pech in the case k=2, and it gives an algorithm to calculate any quantum multiplication in the equivariant quantum cohomology ring. The current work is joint with L. Mihalcea.
Content Area: algebraic geometry

Martha Siegel, Towson University
The CUPM Curriculum Guide
11:05 AM, Room 216, Hodson Hall
The 2015 Curriculum Guide to Majors in the Mathematical Sciences is the first in about 20 years to focus on the major and

all its variants. As chair of CUPM, I am planning to discuss the basic principles in curriculum design that motivated the committee's recommendations.
Content Area: college curriculum

Joseph Slagel, Virginia Tech
Stochastic Iterative Methods for Large-Scale Least-Square Problems
11:30 AM, Room 313, Hodson Hall
We describe stochastic Newton and stochastic quasi-Newton approaches to efficiently solving large linear least squares problems, for applications where the size of the data exceeds the memory capabilities or for problems with time-dependent data acquisition. Theoretical results for consistency of both the stochastic Newton and stochastic quasi-Newton methods are provided. Numerical results demonstrate the potential benefits of this approach.
Content Area: numerical linear algebra, stochastic approximation methods

Ana Maria Soane, US Naval Academy
Multigrid Preconditioners for Stochastic Optimal Control Problems with Elliptic SPDE Constraints
3:15 PM, Room 313, Hodson Hall
We consider an optimal control problem constrained by an elliptic SPDE, with a stochastic cost functional of tracking type. We use a sparse grid stochastic collocation approach to discretize in the probability space and finite elements to discretize in the physical space. To accelerate the solution process, we propose a deterministic multigrid preconditioner for the stochastic reduced KKT system, similar to the preconditioners introduced by Draganescu and Dupont for the deterministic PDE constrained problem.
Content Area: numerical partial differential equations

Kunbo Wang, Johns Hopkins University
Chen Feng, Johns Hopkins University
Kaining Yang, Johns Hopkins University
Non-Asymptotic Analysis of Iterate Averaging in Stochastic Approximation
11:05 AM, Room 313, Hodson Hall
Consider the stochastic approximation algorithms, where we have noisy measurements of gradients at each iteration. A popular form of stochastic approximation is to average some or all of the iterates in order to reduce the variance of the resulting estimate. Under proper settings for coefficients, the averaged sequence converges to its limit at an optimum rate. In practice, however, the results on iterate averaging are more mixed than the above suggests. Here, we provide a formal analysis under finite iterations, and derive necessary and sufficient conditions under which iterate averaging benefits the algorithm output, in terms of reducing mean-squared error. Simulations and examples support the practical importance of the given conditions.
Content Area: stochastic optimization, non-asymptotic analysis, iterate averaging algorithm

Long Wang, Johns Hopkins University
Identification of Systems with Binary Subsystems: Beyond Reliability
8:50 AM, Room 313, Hodson Hall
Consider a stochastic system composed of multiple subsystems, where each subsystem can generate a binary response. The full system may have a general distribution that depends on multiple parameters (e.g., Gaussian and multinomial). Such systems have a wide range of applications in practice, such as systems reliability testing, sensor networks, target detection, fault diagnosis, and Internet-based systems control. This paper extends the identification of the mean output (reliability) of the full system and the “success” probabilities subsystems to the analysis of all the parameters of the system. Using the maximum likelihood estimation (MLE) approach, we derive the general MLE formulation and give a formal convergence proof of the MLEs to the true full system and subsystem values.
Content Area: convergence analysis, maximum likelihood estimators, system identification

Jonathan Weisbrod, Rowan College ta Burlington County
RGB in IBL: Discovering Set Operations by Light Mixing

3:40 PM, Room 311, Hodson Hall
This is an overview of an Inquiry-Based Learning Activity Appropriate for a non-STEM track Math for Liberal Arts course. In this activity, students discover a real-life application of set operations.
Content Area: inquiry-based-learning

Cassie Williams, James Madison University
The Case for IBL
3:15 PM, Room 305, Hodson Hall
Inquiry based learning is a form of active learning that puts students in the role of creators rather than consumers of mathematics. As with any teaching method, researchers in mathematics education have investigated the effectiveness of IBL on student learning and the its more intangible effects on student perceptions of math and problem solving abilities. In this talk, we give an overview of the current research to address the question "Why IBL?"
Content Area: mathematics education

Undergraduate Student Abstracts by Author

Lydia Hoffman, American University
Effect of Government Type on Terrorist Attack
11:05 AM, Room 316, Hodson Hall
The primary purpose of this study is to test the significance of the relationship between the type of regime of a country and terrorist attacks the country experiences. The thrust of the research stems from information by the Institute for Economics and Peace released every year in their Global Terrorism Index Report. In 2015 the Global Terrorism Index Report labeled the five deadliest terrorist organizations all of which resided in at least one of the five countries that suffered the most deaths due to terrorism. Terrorist data were obtained from the Global Terrorist Database maintained by the University of Maryland. The actions of terrorist organizations were broken down into four categories: attack type, target type, the number of people killed, and source of attack categorized as “domestic” or “international”. A one-way Analysis of Variables (ANOVA) test was run for each of these dependent variables, followed by an independent-sample t-test for the number of people killed in the attack and the origin of the attack. Results showed statistical significance for the number of people killed and for the source of the attack with respect to government type, indicating that government type does affect terrorism. Results also suggest that a state with a fully democratic government is most likely to suffer an attack from an organization not headquartered in that country, whereas the opposite goes for an authoritarian government.

Eric Neyman, Princeton University
Anomalous Primes and the Elliptic Korselt Criterion
9:15 AM, Room 313, Hodson Hall
We define a Bachet anomalous number to be any prime power q such that there is an elliptic curve y^2 = x^3 + B of order q over the field of q elements. We show that, conditional on a special case of the Tijdeman-Zagier conjecture, the Bachet anomalous numbers are exactly the prime powers of the form 3n^2 + 3n + 1. This result has been proven unconditionally for q = p^r where r = 1; we prove the result unconditionally when r is 2 or a multiple of 3. We then examine Type I elliptic Korselt numbers, a class of pseudoprimes introduced in a paper by Joseph Silverman. We generalize a result of Silverman that sets conditions on when a Type I elliptic Korselt number must be a product of anomalous primes. Finally, we establish a probabilistic result that, conditional upon a conjecture, almost all Type I elliptic Korselt numbers that are a product of two distinct primes are a product of anomalous primes.