Abstracts and Descriptions

Fall 2015 Seaway Section Meeting

Rick Cleary, Babson University (Banquet speaker)

What Every Mathematician Should Know About Statistics … and Vice Versa

Abstract:

The first course in statistics is often taught by people whose training is mostly in a different discipline, often mathematics. In this talk we look at some of the ways that mathematics teachers can prepare to teach statistics by adopting some of the essentials of statistical thinking. With a few audience participation examples, we will consider how the statistical thinking approach is sometimes very much at odds with traditional approaches to working on mathematics problems. We will try a few exercises to show how mathematics teachers can use their training to develop fun and effective approaches to teaching statistics. And of course to be fair we will also consider what statisticians can learn from the mathematics community.

Biography:

Rick Cleary is Professor and Chair in the Division of Mathematics and Science at Babson College in Wellesley, MA. He grew up in the Seaway section in Oneida, NY and was an undergraduate at SUNY Oneonta. He has previously taught at Cornell University (where he earned his PhD), Bentley University, Harvard University and Saint Michael's College in Vermont. He enjoys working on applied problems in mathematics and statistics, and has recent jointly authored papers with colleagues on diverse topics including failure times for hip replacements, fraud detection in accounting, assessment of creativity in marketing, and various questions in modeling sports outcomes. He has been a very active member of the Mathematical Association of America, including serving a six year term on the Executive Committee as Associate Treasurer and Chair of the Budget Committee. Professor Cleary's recreational interests are largely sports related. Running, golf, coaching his sons in baseball and rooting for the Red Sox are among his favorite activities.

Erica Flapan, Pomona College (Polya lecturer)

Topological and Geometric Symmetries of Molecular Structures

Abstract:

How does a chemist know that a molecule that he or she has synthesized has the desired form? Most non-biological molecules are too small to see in a microscope or even with the help of an electron micrograph. So chemists need to collect experimental data as evidence that a synthetic molecule has a particular form. One approach to this is to try to match the experimental data about the symmetries of the molecule to the symmetries of a physical model of the desired form. But molecules which are not completely rigid may have symmetries that are absent from the model. In such a case, topology, which is the study of deformations of objects in space, can help interpret the data. In this talk we will explore topological and geometric approaches to studying the symmetries of complex molecular structures.

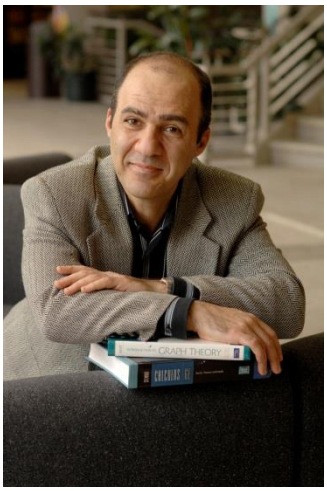
Biography:

Erica Flapan joined the faculty at Pomona College in 1986. Since 2006, she has been the Lingurn H. Burkhead Professor of Mathematics at Pomona College. In addition to teaching at Pomona College, Flapan has been teaching regularly at the Summer Mathematics Program for freshmen and sophomore Women at Carleton College. In 2011, Flapan won the Mathematical Association of America's Haimo award for distinguished college or university teaching of mathematics. Then, in 2012, she was selected as an inaugural fellow of the American Mathematical Society. She is currently a Polya Lecturer for the MAA.

Erica Flapan is one of the pioneers of the study of the topology of graphs embedded in 3-dimensional space, and has published extensively in this area and its applications to chemistry and molecular biology. In addition to her research papers, she has published an article in the College Mathematics Journal entitled "How to be a good teacher is an undecidable problem," as well as three books. Her first book, entitled "When Topology Meets Chemistry" was published jointly by the MAA and Cambridge University Press. Her second book entitled "Applications of Knot Theory," is a collection of articles that Flapan co-edited with Professor Dorothy Buck of Imperial College London. More recently, Flapan co-authored a textbook entitled "Number Theory: A

Lively Introduction with Proofs, Applications, and Stories" with James Pommersheim and Tim Marks. She has just finished writing a new book that is entitled "Knots, Molecules, and the Universe: An Introduction to Topology," which is intended to introduce first year college students to topology. This book is currently in press with the American Mathematical Society, and should be published in time for the Joint Math Meetings in 2016.

Hossein Shahmohamad, Rochester Institute of Technology



Cancellable Numbers, Poisoned Martini & Suspended Bottle

Abstract:

Following the footsteps of mathematical giants like Martin Gardner, Peter Winkler, Sam Loyd and Henry Dudeney, this talk attempts to bring out the beauty of mathematics in a recreational sense. Our goal is to gain appreciation among the non-mathematical groups. In presenting these puzzles, we intend to promote mathematical interest among school children and in general people of all ages and regardless of their academic backgrounds.

Biography:

Hossein Shahmohamad received his PhD from University of Pittsburgh in 2000 and is currently a Professor of Mathematics at RIT. His original interest lay in Graph Theory and coloring problems. He has been the recipient of teaching awards as a graduate student at Pitt, as a faculty member at RIT and as a member of the Seaway Section. His true passion is in teaching and in improving the academic lives of his students. He is a former Chair of Seaway and is currently the Chair of RIT Academic Senate. His first book of puzzles in the Farsi language will be published soon. Since he is interested in collecting more new puzzles, he offers $1 to anyone who shares a new interesting puzzle with him.

Laura Person, SUNY Potsdam (Randolph lecturer)

Clearing Obstacles to Student Success

Abstract:

Recognizing potential for mathematical achievement in students is one of the most valuable gifts we instructors can give our students. Sometimes we have difficulty recognizing potential. Even when we do, for it to do any good, we must convince the students that they have mathematical promise, that the hard work necessary to fulfill that promise is worthwhile, and that they hold the key to their own success. It is all too easy for us to inadvertently put needless obstacles in the way of the mathematical progress of our students. I will discuss some of the obstacles to student success I have found in my own teaching, and steps I have taken to remove them.

Biography:

Laura Person is a Professor of Mathematics at SUNY Potsdam with 26 years of teaching experience. She joined the Potsdam faculty directly after receiving her Ph.D. from the University of California at Santa Barbara. She is co-author with Amy Babich of the bridge course textbook *Write Your Own Proofs*. Her teaching awards include the MAA Seaway Section Clarence Stephens Distinguished Teaching Award in 2008 and the SUNY Chancellor's Award for Excellence in Teaching in 2015.

Friday afternoon

IBL Calculus – An Interactive Workshop (Ted Mahavier, Lamar University)

Description: Whether you want to dip your toes gently into IBL Calculus or dive in head first, we have something for you! From references addressing the efficacy of IBL, to sources for materials, to grading, to developing your own materials, to failed techniques, we will do our best to address it all. We will demonstrate via video what an IBL course might look like in real time. We will try to show the excitement that can come from a successful IBL course and share student comments on IBL courses. We will address the trades in learning outcomes that are made when using IBL over more content-oriented pedagogy. Mostly, we'll just have some fun and think about new way to teach.

Friday evening

TEAM TRIVIA TOURNAMENT (Blair Madore)

Description: Students and faculty from different colleges form teams to answer a series of mathematical trivia challenges. There will be prizes!

Saturday afternoon special sessions

Workshop on Leadership in the Mathematical Sciences (Mihail Barbosu)

Topics: Faculty Annual Report, Evaluation, Plan of Work
Departmental Annual Report
Developing a Departmental Strategic Plan

Using Simulation Methods to Build Conceptual Understanding in Introductory Statistics (Robin Lock, Patti Frazer Lock)

Description: This workshop will give participants hands on experience with activities designed to introduce students to basic ideas of statistical inference using simulation-based methods. These techniques provide an early and intuitive approach to core ideas such as confidence intervals and hypothesis tests that apply to many situations, but don't require a lot of formal algebraic or probabilistic prerequisite knowledge. Participants will use a freely available web package (StatKey) that is designed to give students easy access to these computer-intensive methods on a wide variety of platforms. Examples might address important questions such as "Are mosquitoes more attracted to beer drinkers?" or "Do teams with more malevolent uniforms get more penalties?"

Panel on Undergraduate Mathematics Research Experiences (Elizabeth Wilcox)

Description: Come hear what undergraduates have to say about undergraduate research: the real deal straight from the horse's mouth!

Project NExT Discussion: The Unexpected Parts of an Academic Career (Matt Koetz)

Description: A discussion about things you may not have anticipated when you became a professor, such as choosing a textbook, advising, committee work, and balancing numerous responsibilities.

Saturday Afternoon

Contributed Talks

1. **Anurag Agarwal**, RIT

Special matrices applied to both cryptography and solving polynomial equations.

It is well known that the polynomial equations beyond the fourth degree do not have a general solution (using radicals) but solutions for quadratics, cubics and quartics are well known. These solutions are complicated and the methods seem ad hoc. Is there a unified approach for all equations through degree four?

In cryptography there is a well known problem called the discrete log problem (DLP). The usual groups in which DLP is proposed are the group of units of a finite field and the group of rational points of an elliptic curve over a finite field. Is there a group other than these where we can propose DLP and also implement it securely?

We will answer both the questions posed above by means of a special group of matrices.

2. **Hossein Behforooz**, Utica College

From Melencolia I to Calendarical Magic Squares

In this short talk we will go over from the 500th birth year of Melencolia I masterpiece engraving (from Albrecht Durer, a German renaissance painter, graphic artist and mathematician) to the Yang Hui-Durer magic square with amazing and interesting properties, then from Durer Conjecture to Anti Durer Conjecture. Finally, if time permits, we will finish this talk with the construction of Calendarical Magic Squares by using the Yang Hui-Durer magic square. Some historical notes will be discussed. We know that the magic squares are fun topics of recreational mathematics, so, join us and enjoy and have fun. ☺

3. **David Clark**, SUNY New Paltz

Real Analysis for Preservice Teachers

This talk will describe new guidelines from the CBMS (Conference Board for the Mathematical Sciences) for real analysis courses for preservice teachers. It will then outline an active learning (IBL) text authored by the speaker that was designed to meet those guidelines and is currently available for pilot testing. The CBMS 2012 guidelines differ sharply from the previous CBMS 2001 guidelines on this issue. We quote here the relevant paragraph.

"The Real Number System and Real Analysis."
"It is an often unstated assumption of high school mathematics that the real numbers exist and satisfy the same properties of operations as the rational numbers. Teachers need to know how to prove what is unstated in high school in order to avoid false simplifications and to be able to answer questions from students seeking further understanding. Thus, a construction of the real numbers, a proof that they satisfy the properties of operations (the CCSS term for the field axioms), and a proof that they satisfy the Completeness Axiom are necessary for teachers. A definition of continuity for a function of a real variable and a proof of the Intermediate Value Theorem provide the underpinnings of the graphical methods for solving equations that are taught to high school students. Thus, they are needed ingredients in teachers' backgrounds. A treatment of the real numbers can also include a treatment of their representation as infinite decimals, including an understanding of decimal expansions as an address system on the number line and an analysis of the periods of decimal expansions of rational numbers using modular arithmetic."

The Mathematical Education of Teachers II, CBMS: Issues in Mathematics Education, Volume 17, Chapter 6, page 60, published jointly by the AMS and MAA (2012).

4. **Charlie Jacobson**, Elmira College

A Flipped Statistics Course: Two-Year Report

A 'flipped' instructional model significantly changes the way that students spend their course-related time. Homework consists of listening to lectures, reading relevant text selections, and doing other preparatory activities. Class time is then devoted to problem-solving.

In the fall of 2013, the author flipped all his sections of MAT 2090, Statistical Methods, and continues to utilize this model. The organizational details of the flipped course will be presented, along with several outcomes, including increases in both student exam performance and course engagement, and a much better feedback loop to assist in course improvement.

5. **Keith Jones,** SUNY Oneonta

Routes to Infinity: Asymptotic Behavior in the Lamplighter Group

Imagine a person, a "lamplighter", tasked with patrolling an infinitely long straight road with lamps placed at regular intervals. The lamplighter has two possible actions at a given point in time: step from one lamp to the next in one direction or the other, or toggle a lamp on or off.

Hidden inside this scenario is a group known as the "Lamplighter Group" $L2$, which records all possible (finite) sequences of actions the lamplighter may take. When one sequence of actions is followed by another, they combine to form a third, and this provides a group operation. One way to understand this group is by representing in the form of a graph, called a Cayley graph. In general, a group has many Cayley graphs, but a particularly nice Cayley graph for the Lamplighter Group is known as the Diestel-Leader graph, $DL(2,2)$, an important and beautiful mathematical object in its own right.

My Colleague, Dr. Gregory Kesley of Bellarmine University, KY, and I have studied ways of "finding infinity" in this group. More technically, we've found natural topological spaces associated to this group, called the visual boundary and the horofunction boundary, which provide two different ways of thinking about asymptotic properties of this group.

6. **Nicole Juersivich**, Nazareth University

Inquiry and Technology in Calculus I

Technology is a natural cognitive support for inquiry because it provides students with a tool to guide their experimentation, conjecturing, and communication. After teaching Calculus I for a year using a modified Moore method, I decided to incorporate structured inquiry workshops employing technology into the course as well. Using the National Research Council's components of mathematical proficiency as a standard, I created three workshops addressing common misconceptions in differential calculus. In this presentation, I will discuss the creation, implementation, and informal evaluation of these workshops.

7. **Joseph Kolacinski**, Elmira College

Equilibriums for Approval Voting: A Preliminary Report

Using a one-dimensional model of voter behavior, the Median Voter Theorem tells us that the ideal position of a candidate in a two-candidate election is the position of the median voter.

In 1984, Gary Cox argued, from a set of assumptions about voter behavior, that Approval Voting also has an analogue of the Median Voter Theorem and that the preferred position of any candidate in an AV election is also at the position of the median voter.

Using a different set of assumptions about voter behavior, we develop a broader equilibrium for an approval voting election.

8. **Natasha Komarov**, St. Lawrence University

Cycles in Tournaments

We will discuss a bit of the motivation for and history of the problem of computing the number of k-cycles in tournaments, as well as some new results. Specifically, we will see that while the maximum number of directed 3-cycles in a tournament is asymptotically equal to the expected number, this is not true for 4-cycles. The natural extensions (to the cases where $k > 4$) have largely remained open for decades. We will compute a formula for the number of 5-cycles in any tournament, and use it to show that the number of 5-cycles in a tournament cannot exceed the expected number. Time permitting, we will conclude with a summary of some results that are known for $k > 5$ and some open problems.

9. **Heather Lewis**, Nazareth College

Changing Calculus

In the past three years, our department has made two significant changes to our calculus sequence. The first was reordering the topics in the second and third semester so that students covered differentiation and integration of multivariable functions in Calculus II and series in Calculus III. The second was teaching our entire calculus sequence through inquiry-based learning. This talk will cover the initial decision to reshape our calculus courses, and the challenges and benefits that have arisen as a result.

10. **Benjamin Levy**, University of Tennessee

Modeling Feral Hogs in Great Smoky Mountains National Park to Evaluate Control Efforts and Analyze the Population's Niche.

Feral Hogs (*Sus scrofa)* are an invasive species that have occupied the Great Smoky Mountains National Park since the early 1900s. Recent studies have revitalized interest in the pest and have produced useful data. Two models were created and analyzed using detailed data on vegetation, mast and harvest history. The first model is discrete in time and space and was formulated to represent hog dynamics in the park. The second is a spatial model of the niche of the population that relates known presence locations to environmental predictors. Together these projects asses the importance of the existing control program and predict suitable locations for hog presence in the Park.

11. **Daniel M Look**, St. Lawrence University

Stylometry and the Seldon Crisis: Using Statistics to Categorize Novels in Asimov's Foundation Universe

Stylometric authorship attribution uses statistical methods applied to the written language to add evidence in cases of contested authorship. However, by "authors" we really mean "narrative voices." Hence, stylometry can theoretically be used to distinguish a work written by an author in their 20s from one written by the same author in their 50s. We will introduce the field of stylometric authorship attribution and apply the techniques to the Foundation Universe of Isaac Asimov.

Over the course of almost 60 years, Asimov published a total of 14 books (depending on how you count his earlier serialized works) in his Foundation Universe. These books are separated into three sub-series (Foundation, Empire, Robot), with publication dates for these works primarily in the 1950s and the 1980s, with a break from 1954 until 1982. Due to the multiple narrative voices of Asimov over time and among series, this collection makes for an excellent case study.

12. **James Marengo**, RIT

The Conditional Poisson Process and the Gamma and Negative Binomial Distributions

Consider a counting process which has the property that it's *conditionally* a Poisson process given its rate, and suppose the rate is a random variable which has a gamma distribution. It is shown by way of an easy calculation with the law of total probability that the number of events that have occurred in the process up to a fixed time is *unconditionally* negative binomial. This calculation appears in many books on stochastic processes, but it doesn't explain intuitively just *why* the result should be true. Could we have *guessed* this result without this calculation? It's the purpose of this talk to present an alternative proof which *does* explain just *why* the result works. This proof, which doesn't appear in any text with which the speaker is familiar, uses the memoryless property of the exponential distribution and interchanges the role of the *rate* and the *time* in another Poisson process.

This talk should be accessible to any student who has taken a solid course in probability.

13. **Sam Northshield**, SUNY Plattsburgh

ReReRecounting the rationals

In 1999, Neil Calkin and Herbert Wilf wrote their paper "Recounting the rationals" which gave an explicit bijection between the positive integers and the positive rationals. Their result leads to the following reformulation: For $f(x) := 1 + 1/x - 2\{1/x\}$ where $\{x\}$ denotes the fractional part of x, the sequence $1, f(1), f(f(1)), f(f(f(1))), \ldots$ is a list of all of the positive rationals. I recently discovered the surprising fact that the iterates of $2 + 2/x - 4\{1/x\}$ starting at 2 also cover the positive rationals as do the iterates of $3 + 3/x - 6\{1/x\}$ starting at 3. That is, the iterates of $cf(x)$, starting at c, cover the positive rationals for $c = 1,2,3$. Even more surprisingly, $c = 1,2,3$ are the only numbers such that the iterates of $cf(x)$ cover the positive rationals. I'll try to sketch some of the proofs; they involve, among other things, "negative" continued fractions, Chebyshev polynomials, Euler's totient function, arrangements of circles, and variants of Stern's diatomic sequence.

14. **Mitchell Phillipson**, SUNY Oswego

Counting Foldings in RNA

Everyone is familiar with DNA, the double stranded helix that makes us who we are. However, you may be less familiar with RNA. RNA is the single stranded cousin of DNA, responsible for many actions within cells. Because RNA is single stranded, it tends to fold onto itself; these foldings can potentially change the function of the RNA. Given an RNA sequence, it is possible that the sequence can fold in a variety of ways. An interesting combinatorial question is, how many ways can an RNA sequence fold onto itself? Further, are there RNA sequences that have a unique folding? If so can we classify them? In this talk we'll work to answer these questions in a manner that is accessible to all levels, especially undergraduate.

15. **Gregory Quenell**, SUNY Plattsburgh

Variations on the Birthday Problem

How many students do you need in your introductory probability class in order to have a better-than-even chance that two of them share a birthday? A familiar counting argument tells us that the answer is 23. How many do you need if you're just looking for adjacent birthdays, or birthdays within the same week? What's the probability of finding a 3-way or 4-way coincidence? These variations on the Birthday Problem lead to counting arguments that are slightly less familiar, but still straightforward enough to use in an introductory probability class.

16. **Robert Reams**, SUNY Plattsburgh

Exceptional copositive matrices

I will introduce copositive matrices, and state some facts known about them from a to-be-published paper. Let A be an n-by-n symmetric matrix with real entries, and x a vector with n real entries. A matrix A is said to be copositive if $x^t Ax \geq 0$ (t denotes transpose), for any vector x with real nonnegative entries. If you have an n-by-n positive semidefinite matrix B (in other words, $x^t Bx \geq 0$, for any vector x with real entries), and an n-by-n symmetric nonnegative matrix C (in other words, all entries of C are nonnegative), then it is clear that $B + C$ is copositive. One well-known interesting fact is that there are copositive matrices which are not of the form $B + C$, with B positive semidefinite and C nonnegative, although they only exist for $n \geq 5$. When A is invertible we will give sufficient conditions, based on the entries of the inverse of A, for a matrix A not to be of the form $B + C$, where B is positive semidefinite and C is nonnegative.

17. **Joanne Redden**, Elmira College

Teaching Calculus using Maple labs

At Elmira College many of our Mathematics course require a laboratory component. For our Calculus sequence our students have a lecture component on MWF and a computer lab component on TTh. We use computer algebra system, Maple, to explore calculus in our labs. This model straddles traditional method of classroom lecture with a form of inquiry based learning. In this presentation I will talk about how I balance the lab experience with the classroom and why I love this model for teaching calculus.

18. **Robert Rogers**, SUNY Fredonia and **Eugene Boman**, Penn State Harrisburg

Flipping the Calculus Course (Not the Class)

The teaching of Calculus has been discussed at length for many years with no real consensus having been reached. We suggest that simply changing the order of the topics would be an improvement. We will present one possible reordering that mirrors the historical development of the topic. We believe this will feel more natural to students, but will still cover the same traditional topics by the end of the course.

19. **Tamas Wiandt**, RIT

Are all inequalities created equal?

Inequalities are organic ingredients of some deep analytical results as well as mainstays of elementary problem solving. I give a short survey of the connections among some of the well-known inequalities. We are interested in the question of whether all these inequalities originate from the same basic idea.