Friday night speaker: Allan Taylor, Union College

The mathematics of voting

We will give a quick survey illustrating the kinds of mathematical questions and answers that arise from real-world voting systems. Many of these results assert that certain election-theoretic desiderata are impossible to attain. Examples (cryptically stated) include: a "simple" description of the US federal system, an equally good alternative to majority rule, a fair method of apportionment on which to base the electoral college, and voting systems for three or more alternatives in which honesty is the best policy. Along the way we'll see that sometimes (i) having a vote is just like not having a vote, (ii) a candidate can lose to an opponent that everyone likes less, and (iii) gaining a vote can lead to a loss.

Saturday morning invited speakers:

1. Richard J. Cleary, Bentley College

"Benford's Law, Fraud Detection and Risk Measures in Auditing"

Benford's Law proposes a distribution of first digits in measurements that span many orders of magnitude. Auditors and others with an interest in data integrity have begun using Benford's law as part of fraud detection schemes in a variety of settings. In this presentation we give an overview of Benford's law, discuss some situations in which it is used, and present some ways to incorporate it as a teaching tool in elementary mathematics and statistics courses. We also present a more general framework for the ways in which auditors assess whether a company's financial statements contain 'material misstatements.' (This work is being done jointly with Prof. Jay Thibodeau, Bentley College Department of Accountancy.)

2. Darren A. Narayan, Rochester Institute of Technology

Teaching Mathematical Concepts Using Real World Applications

Traditional curricula seldom offer students examples of cutting-edge applications, especially in higher mathematics. As a result students finish their undergraduate degree asking themselves, "Besides math professors, who uses this material?" This talk will focus on the STEM Real World Applications Modules Project funded by an NSF-CCLI grant. Topics include applications of graph theory to reconstruction of three-dimensional images (*Microsoft Research*), analysis of flight route maps for airlines (*JetBlue Airways*), mathematical analysis of telecommunication networks (*National LambdaRail*), and identification of WWW cyber-communities (*Google*). The goal of the STEM Real World Applications Modules Project is to show students how their lecture material can be used to solve problems in business and industry right now.

3. Randolph Lecture series speaker: Jack Narayan, SUNY Oswego,

Across 50 Years in Teaching

In 1959, high school students in Guyana didn’t need me, their teacher, to provide motivation. They didn’t need laptops, email, or graphing calculators. Armed with only a slate and pencil, motivation came from the poverty surrounding them and the parents who supported them. Education was the path out, and the students were hungry for knowledge. Engaging such students was easy in a time and place where resources were meager, but respect and hard work abounded. Later I left Guyana for Canada and eventually the United States to further my own education. Teaching in North America presented new challenges. Respectful and hard-working students were there, but in many cases it was up to me to spark their interest. Mathematical pedagogy became as important as mathematical content. Cooperative learning came into play, technology advanced, and assessment of students’ leaning was emphasized. Student feedback and formal evaluations became valuable in designing lessons plans. Now at the end of my career, I bring together all of these aspects of teaching in a large smart classroom where the slate and pencil have been replaced laptop computers and Personal Response Systems. But the goal is still the same—assisting students to create their own knowledge.

Contributed talks abstracts

1. Anurag Agarwal, Rochester Institute of Technology

   Generalizing the Chinese Remainder Theorem

   Chinese remainder theorem is one of the most well-known and useful result

   in algebra and number theory. However most versions of this theorem have few constraints, such as: modulii being coprime and being applicable to single variable situations. We will discuss results which will address these constraints and offer possible generalizations.

2. Jon Bannon*, Siena College & Junsheng Fang, University of New Hampshire

   Correspondences and Haagerup's Approximation Property

   A finite von Neumann algebra M with a faithful normal trace τ has Haagerup's approximation property (relative to a von Neumann subalgebra *N*) if there exists a net $(\varphi_\alpha)_{\alpha\in\Lambda}$ of normal, completely positive (N-bimodular) maps from M to M that are subtracial (i.e. $\tau\circ\varphi_\alpha \leq \tau$), the extension operators T $_{\varphi_\alpha}$ are bounded compact operators (in $\langle M, e_N\rangle$), and pointwise approximate the identity in the trace-norm, i.e., $\lim_\alpha \|\varphi_\alpha(x) - x\|_2$ = 0 for all x ∈ M. We prove that the subtraciality condition on the maps φ_α can be removed from the definition and hence provide a description of Haagerup's approximation property in terms of Connes's theory of correspondences. We show that if N ⊆ M is an amenable inclusion of finite von Neumann algebras and N has Haagerup's approximation property, then M also has Haagerup's approximation property.

3. Sandeep Bhargava, University of Windsor, Canada

Easy constructions of Lie algebras with root systems of type BC

If we drop the axiom that the only permissible scalar multiples of a root are plus or minus itself, the resulting root system is said to be nonreduced. In this case, in addition to plus or minus itself, we can also get plus or minus half times the root, and plus or minus two times the root. Up to isomorphism, every irreducible nonreduced root system is of type BC. If we are willing to work over a more general associative algebra than the complex field (and to break the shackles of finite-dimensionality) we see that it is surprisingly easy to provide examples of Lie algebras that possess a root system of type BC.

4. David Biddle, State University of New York at Oneonta

Using paradoxes to reinforce mathematical concepts

Certain paradoxes and contradictions have arisen that have troubled mathematicians from ancient times to the present. Some are false paradoxes: they do not present actual contradictions, and are merely slick logic tricks. Many others have forced mathematicians to completely step back and rethink whole schools of thought. Many of the paradoxes and (fallacies!) can be used in algebra, geometry, and trigonometry to help students master difficult yet pivotal concepts. In this talk I will present several of these (classical) paradoxes and show how one can introduce them into the classroom with various (and surprising) effects.

5. Daniel Birmajer, Nazareth College

The many faces of the zero polynomial

A polynomial with coefficients in a field can be thought both as a purely algebraic construction and as an evaluation function, by plugging-in scalar values for the variables. This dual perspective on the polynomials allow us to ask the natural question: Is it true that two polynomials represent the same function if and only if they are the same polynomial? In this talk we examine this question for polynomials in several variables over different fields.

6. Ryan Gantner, Saint John Fisher College

   Mastery Learning in Calculus II

   Mastery Learning is a grading style and course structure which was introduced in the 1960s. Since then it has received both praise and criticism, but the practices have fallen out of style. In this talk, we'll define what Mastery Learning is and discuss how the presenter adapted the ideas to his Calculus II class. We'll identify some benefits and drawbacks and explore why Calculus II (and math in general) makes for a good fit.

7. Dawn M. Jones, The College at Brockport

   Faculty Learning Communities at Brockport

   This year the College at Brockport has instituted a new Faculty Learning Community Program. Many people have heard of Student Learning Communities but Faculty Learning Communities are still relatively unknown or even if they are known, they do not have wide-spread implementation. I am the facilitator for one of four Faculty Learning Communities that are running on the campus and we are examining Active Learning. In this talk, I will discuss what a Faculty Learning Community is (and is not) and give an early report on what has been a transformative experience thus far.

8. Chulmin Kim, Rochester Institute of Technology

   A modification of OPS: Widely used to measure a baseball batter's performance

   Home runs (HRs), runs batted in (RBIs) and batting average (BA) are the most popular statistics to measure a baseball hitter's performance. Because each of these three statistics holds a great sense and some drawback on a batter's ability, we often see the three together in newspapers or sports journals. Slugging percentage (SLG) and on-base percentage (OBP) have been used as alternatives of the traditional three statistics. SLG measures how often a batter hits and how valuable the hits are and OBP measures how often a batter reaches bases. However SLG doesn't account for walks or hits by pitched ball which are not hits but a batter can reaches bases. A combination of these two is called OPS, the sum of OBP and SLG, which has become widely used. There have been studied by several slightly varied statistics of OPS. One example of those is called gross point average (GPA) introduced by Aaron Gleeman. GPA is obtained by the following: (the sum of SLG and 1.8 times OBP)/4. We study a variation of these statistics on a batter's performance and may use it to model a batter's salary by his contribution to generate runs for his team.

9. Chris Leary, SUNY Geneseo

How Gappy is that Fractal?

The fractal dimension of an object measures, in some sense, how much space the object occupies. In an effort to further differentiate fractal-like images, biologists have been interested in measures of the manner in which the images occupy space. We review a couple of the standard measures and introduce a not-really-all-that-new way to think about gappiness, the average distance between points. We then calculate the average distance for the Cantor set and a couple of its variants.

10. Aaron Luttman, Clarkson University

Using Ideas from Linear Algebra for Astronomical Image Analysis

In linear algebra all students learn that a system of linear equations can have a unique solution, no solution, or infinitely many solutions. The same is true for linear equations designed to process digital images. When a system has infinitely many solutions, it is often useful to choose one "best solution." One possibility is the least-squares solution, which is the solution of smallest norm. In this talk, another method will be presented for choosing one "best solution" to the problem of removing blur from images taken by ground-based telescopes, and example images will be shown to demonstrate the techniques.

11. James Marengo, Rochester Institute of Technology

An Upper Bound for the Expected Range of a Random Sample Chosen from the Unit Interval

We consider the expected range of a random sample of points chosen from the unit interval according to some probability distribution. We then use the notion of convexity to derive an upper bound for this expected range which is valid for all possible choices of this distribution. Finally, we show that there is only one distribution for which this bound is attained.

12. Sam Northshield, SUNY-Plattsburgh

On color-transitivity of graphs

An n-coloring of a graph is the assignment to each vertex one of n colors so that any two adjacent vertices have different colors. A graph is n-color-transitive if it has an n-coloring and for any two such n-colorings, say A and B, there is a sequence of n-colorings A(0), A(1), …, A(n) so that A(0)=A, A(n)=B, and A(k) differs from A(k-1) at only a single vertex. We show: (1) any 3-color-transitive graph is 2-colorable (i.e., bipartite) and (2) there exists a 4-color-transitive graphs that is not 3-colorable.

13. Gabriel Prajitura, Brockport University

Equivalent inequalities

We will show that several classical inequalities are equivalent.

14. Patrick Rault, SUNY Geneseo

On uniform bounds for rational points on rational curves and thin sets

We show that for any positive epsilon the number of rational points of height less than B on the image of a degree 2 map from the projective line to projective n-space, under certain conditions, is at most CB / |RD|^delta + C_epsilon |RD|^epsilon, where the point is that the constants C and delta are independent of the choice of the map. R and D are respectively the resultant and discriminant of the map. In the special case of degree 2 plane curves we prove a bound of CB /|RD|^delta + 4 which improves on a result of Heath-Brown and Browning Heath-Brown by establishing an inverse dependence on the resultant and discriminant. Heath-Brown proved that for any positive delta the number of rational points of height less than B on a degree d plane curve is O_{d,epsilon} (B^(2/d + epsilon)). Browning and Heath-Brown later proved that this result holds with delta = 0 for degree 2 curves. It is known that Heath-Brown's theorem is sharp apart from the epsilon, and in fact Ellenberg and Venkatesh have proven that there is some positive delta (depending only on d) such that the counting function for any plane curve of positive genus is O_d(B^{2/d-delta}). It is an open question whether Heath-Brown's Theorem is true with epsilon = 0.

15. Edwin Rogers* & Nikolai Krylov, Siena College

Dynamics of simple folds in a plane

Take a strip of paper whose two long edges are parallel, and fold in a crease intersecting these edges, creating two angles. Choose one edge and consider the angle between the crease and this edge. Now fold the opposite edge along the crease, creating a new crease that bisects the other angle. Fold again, this time using the newly created crease and the initial edge, creating a new angle along the chosen edge. It is well known that if this process is continued, the constructed angles along the chosen edge will approach a limiting value which is independent of the initial angle. In this talk, we explain why and generalize the result to when the edges are nonlinear or the strip lies in the hyperbolic plane.

16. Lauren Sampson, Clarkson University

IMPETUS - For Career Success. Engaging High School Students Through Roller Coaster Creation

The IMPETUS program was created at Clarkson University for students enrolled in grades 7-12 who have an aptitude and interest in mathematics, science, and technology, and is created around the concept of creating a fun and safe roller coaster. The program consists of a summer camp and an academic year program that focuses on helping the students to become interested in higher learning by teaching them physics, mathematics, and more through the roller coaster formation process. The academic year program and summer camp use model roller coaster tracks, computer programs, and the Max Flight Virtual Roller Coaster, which allows students to design and ride their own virtual roller coasters. The overall goal of the program is to encourage the students to want to pursue careers in STEM (Science, Technology, Engineering and Mathematics) fields, and give them an opportunity to use the Clarkson University faculty, graduate and undergraduate students as a resource for guidance and mentoring throughout the process. Overall, the program has seen much success as many of the students previously enrolled in the program are currently enrolled at colleges and universities throughout the region.

17. Mufutau Akinwande, Clarkson University & Abbas Alhakim, Calrkson university

This talk is about the constructions of combinatorial objects called deBruijn cycles, which are sequences of symbols (for finite alphabets) that include every possible substring of a given length exactly once.

Lempel presents a homomorphism between two binary deBruijn digraphs of consecutive order that is then used backwards to invert one deBruijn cycle of lower order into two complementary cycles of higher order that can be further *cross-joined* into one deBruijn cycle of higher order. We describe an efficient recursive construction of deBruijn cycles in nonbinary alphabets, thus generalizing Annextein's implementation of Lempel's work. Unlike binary, there are many possible homomorphisms that allow this recursive construction and many types of cross-joins. We present a pseudo-code that yields a unique de Bruijn cycle given a few parameters. The code relies on a formula that calculates precisely the location of cross-joins for each recursive step (so no storage is needed). For an alphabet size q, the code can generate $q^n\times\phi(q)^{n+1}$, where ϕ is Euler's totient function and n is the order of the desired de Bruijn cycle.

Statistics Panel: Modern Trends in Teaching Elementary Statistics

Rick Cleary, *Bentley College*

Bernadette Lanciaux , *Rochester Institute of Technology*

Robin Lock, *St. Lawrence University*

Moderated by John Maceli , Ithaca College.

This panel will discuss some of the changes that are occurring in the teaching of elementary statistics at the college level. The presenters will show some "fun" examples that can be used in class along with pointing the audience to the excellent resources (both print and web) that are available. There also will be some discussion about to bring about change in your department's basic statistics course. The panel members will speak 10 minutes each and the rest of the time will be for a group discussion.

A Workshop on Presenting Mathematics

Aaron Luttman, Clarkson University

Every story has a beginning, middle, and end, and the best stories tie the three cohesively together with the fewest extraneous details. A successful mathematics presentation is no different. While there are many resources out there with excellent advice on public speaking and creating slides for a presentation, one of the most difficult tasks in formulating a mathematical talk is crafting the presentation so that it is interesting for the particular audience involved. Given any research project, there are many different angles from which the topic can be approached, and thus the most important question to be answered is “What’s the story?”. Different stories are interesting to different audiences, and the better and more clear the story line, the more successful the presentation. In this w cally at undergraduate students, the participants will engage in hands-on activities aimed at learning to tell different mathematical stories about a single research topic and determining which story is appropriate for a given audience.