ABSTRACTS

MAA SEAWAY FALL MEETING

SUNY Fredonia, 2009

Friday night speakers

Jeff Johannes & Garry Towsley, SUNY Geneseo

An "Outrageously" Concise History of Calculus

A lively overview of over two thousand years of calculus history. Not only who-did- what along the way, but the cultural and sociological causes and effects of the calculus.

Saturday morning speakers

1. **Daniel J. Teague, North Carolina State University**

The Infamous Five Color Theorem

Sure, its kid brother, the Four Color Theorem, gets all the big press, but the Five Color Theorem has its own rich history and is much more fun. This talk will present a few fundamentals of graph theory and then describe the development of the Five Color Theorem and some of its derivatives. We will also take a few excursions into the history of the problem and note some current developments.

2. **Gino Biondini, SUNY Buffalo**

Solitons: from water waves to optical fibers

Soliton theory, which began over forty years ago with Zabusky and Kruskal's discovery that the solitary waves of the Korteweg-deVries (KdV) equation interact elastically, continues to be an active area of research. After briefly reviewing the history of the subject and how KdV solitons arise in the theory of water waves, we will discuss some of the many remarkable properties of the KdV equation. We will then see how such properties are not unique to KdV, but are shared by a class of nonlinear evolution equations. Importantly, many of these soliton equations are also relevant in the applied sciences since they arise as universal models in a

variety of nonlinear physical phenomena. In particular, we will see how another such equation, the nonlinear Schroedinger equation, has been used as a fundamental tool to study the behavior of optical fiber communication systems. Finally, in the last part of the talk we will briefly discuss some recent advances in soliton theory (e.g., soliton behavior in boundary-value problems and in multi-dimensional systems) and we will outline some of the many research problems still open.

3. **Randolph Lecture: Sam Vandervelde, St. Laurence University**

King Solomon on Teaching Math

When it comes to offering an instructive mathematical experience for students, is there really anything new under the sun? While the principles motivating recent pedagogical innovations may be rooted in antiquity, the innovations themselves provide a fresh implementation that can substantially boost the degree to which students actively engage in learning mathematics. We will discuss or even experience firsthand several novel techniques including IF-ATs, Polished Proof Portfolios and Homework Wikis. The goal will be to share such a wide variety of ideas that everyone will discover something new that they are inspired to incorporate into an upcoming course syllabus.

Saturday afternoon speakers

1. **A High School Prom Theorem for Variance**

Charles Jacobson, Elmira College

David Gale's High School Prom Theorem states that for a simple balanced bipartite graph, the means of the degree sequences for either vertex class must agree. It is interesting to speculate on whether similar theorems exist for other statistical measures, such as the variance. By reformulating in terms of compatible integer partitions, the following proposition is obtained: Suppose that L and R are the degree sequences of the vertex classes of a simple balanced bipartite graph with E edges and N vertex pairs. Then Var(M) <= Var(R) <= Var(LC), where M is the minimum variance partition of E into N nonnegative parts, and LC is the partition, conjugate to L, of E into N nonnegative parts. It is also shown that the bounds are sharp.

2. **An alternative expression of the covariance and its inverse of the Antedependence Models**

Chulmin Kim, RIT

The precision matrix specification where parsimonious models are specified for the elements of the inverse of the covariance matrix is widely used for covariance modeling. Antedependence (AD) models, generalization of autoregressive (AR) models that allow the variances and same-lag correlations to vary over time, can be useful for covariance structure for longitudinal data when serial correlation exists among measurements within subject. When measurement times are common across the subjects, the maximum likelihood estimators of the first-order AD model parameters can be obtained explicitly. When measurement times are not common across the subjects, extensive computations are required to obtain the likelihood-based estimation of the parameters numerically. We present how this computation can be reduced to use an alternative expression of the covariance and its inverse of the AD models. An example is illustrated in which the usefulness of the results.

3. **How Close Was It Really? Alternative Voting Methods and the 2008 Minnesota Senate Race**

Joseph F. Kolacinski, Elmira College

When a close or an ambiguous election occurs, it is common for proponents of voting reform to use the election's results to argue for their cause. Had only a particular method been in use, they might claim, we would have a definitive result. It seems unlikely that this should be the case; any election method can produce close results and there is no reason to suppose that, if an election is close under one election method, it would not remain close under others. In this paper we consider these issues in the context of the 2008 Minnesota Senate Race. It is impossible to know how Minnesota voters might have voted had a different system been in use. However, to characterize the kinds of outcomes that might have been possible, we estimate how these voters' second choices might have broken down in two ways. We use estimates based on voters' first choices in the first instance and then make guesses based on polling data of the candidates' approval and disapproval ratings in the second. Each estimate is used to generate a voting profile, for which we generate the representation triangle, the procedure line and the approval voting region. Finally we look at a large number of possible profiles for different configurations of second-choice votes. Looking across all these possible profiles, it seems likely that different voting methods would have led to different outcomes for the election. In the case

of either a Franken or a Coleman victory, it seems likely that the election would have remained close across many different voting methods.

4. **An Upper Bound for the Expected Difference Between Order Statistics**

James Marengo, RIT

Suppose we randomly and independently choose n numbers X1,X2,…,Xn from the interval (0,1) according to some probability distribution. Now let's put these numbers in ascending order and call the results Y1,Y2,…,Yn. If k is less than l, how large can we make Yl-Yk? A moment's reflection reveals that by choosing the X's appropriately, we can make Yl- Yk arbitrarily close to one. But what if we consider the *expected value* of this difference? What is the smallest possible upper bound for this expectation? We will answer this question in this talk.

5. **The Fermi-Pasta-Ulam Problem**

Anthony Mastroberardino, Penn State Erie, The Behrend College

The FPU problem refers to the numerical experiments performed on the Los Alamos MANIAC computer during the 1950's by Enrico Fermi, John Pasta, and Stanislaw Ulam. These experiments, which were a test of a hypothesis of statistical mechanics known as the equipartition of energy, marked the birth of numerical simulation in the study of nonlinear science and, through the work of Zabusky and Kruskal, triggered the development of soliton theory and the inverse scattering theory. In this talk, we will review the physical model that serves as the basis for the experiments and its relation to the kdV equation. We will conclude with a brief discussion of the impact the FPU problem has had on the development of nonlinear science.

6. **Wavelets and Elementary Linear Algebra**

Olympia Nicodemi, SUNY Geneseo

My talk is based on the wonderful paper by Colm Mulcahy that appeared in the *Mathematics Magazine* in 1996, entitled "Plotting and Scheming with Wavelets." I will share some wavelet based activities that I have introduced into my elementary linear algebra class based on that paper, but at an even more elementary level (with some interesting twists). The emphasis will be on the algebra rather than many applications of wavelets.

7. **A short proof of Lagrange's theorem on continued fractions**

Sam Northshield, SUNY-Plattsburgh

Lagrange was the first to prove that every irrational root of a quadratic polynomial with integer coefficients has an eventually repeating continued fraction expansion (e.g., the square root of 3 equals 1+1/(1+1/(2+1/(1 +1/(2+1/(1+1/(2+1/(1+ …)))). We present a short, elementary, and possibly new proof of Lagrange's result. Our proof readily generalizes.

8. **M-Zeroids: Structure and Its Effect on the Additive Operation**

Joshua Palmatier, SUNY Oneonta

An m-zeroid is an algebraic structure with both operations and an inherent order on its elements. If we look at finite, totally-ordered m-zeroids, only the additive operation remains important. In this talk, we will discuss how the structure of the finite, totally-ordered m-zeroid, both algebraic and pictorial, restricts the additive operation table and allows us to generate such m-zeroids with as little work as possible. This talk will be accessible to undergraduates.

9. **The sum of the reciprocal of factorials**

Gabriel Prajitura, SUNY Brockport

We give a new look to an old limit.

10. **An optimization problem from statistics, and a complementary assessment scheme**

Scott Preston, SUNY Oswego

I will describe a task I assign to students that involves an optimization problem in a (somewhat contrived) manufacturing setting. Completion of the task requires the use of the Normal distributions. The task is suitable for students in both applied and mathematical statistics. I assess student work in monetary terms (later converting to grades or scores) that arise somewhat naturally from the problem. I'll discuss some of the issues that have resulted from my attempts to reward students in a fashion parallel to compensation schemes in business and industry.

11. **On the Continuing Story of the Covering Number of Small Alternating Groups**

Joanne L Redden, Elmira College

In an Abstract Algebra course a common exercise is to show that no group is the set theoretic union of two proper subgroups. On the other hand, the Klein 4 group is the union 3 proper subgroups. And life just continues to get more interesting. The minimal number of subgroups needed to cover a group G is called the covering number of G. M.J.Tomkinson found the covering number for certain classes of groups and suggested further investigation of families of finite simple groups. So far, a few results are known, among them some for alternating groups. Using GAP and a little graph theory, we show that the covering number for the alternating group on 7 letters is 31. The covering number for the alternating group on 8 letters is 71. Work continues on the covering number of the alternating group on 9 letters. This is joint work with Luise-Charlotte Kappe of Binghamton University, Binghamton, New York.

12. **Teaching Introductory Analysis Using its Historical Context**

Robert Rogers, SUNY Fredonia

This talk will describe how the author uses history to motivate the definitions and theorems in an introductory real analysis course. In a shameless plug, the author will present sample pages and exercises from the textbook he wrote for the course and describe how he uses them. A pdf of the text (which can be used free of charge) will be sent to anyone requesting it.

13. **Dynamic Visualization Tools for Multivariable Calculus**

Paul Seeburgher, Monroe Community College

A tour of an NSF-funded project that seeks to develop geometric intuition in students of multivariable calculus. This online exploration environment allows students (or instructors) to create and freely rotate graphs of functions of two variables, contour plots, vectors, space curves generated by vector-valued functions, regions of integration, vector fields, etc. A series of assessment/exploration activities has also been designed to help students "play" with the 3D concepts themselves, and to assess improvements in geometric understanding gained from these activities. The results of the first two semesters of this assessment will be shared. The grant project is titled, *Dynamic Visualization Tools for Multivariable Calculus* (NSF-DUE- CCLI #0736968). See http://web.monroecc.edu/calcNSF/.

14. **Dante and the Three Sphere**

Gary Towsley, SUNY Geneseo

Near the end of his *Commedia* the poet Dante Alighieri is given a true view of the whole universe and it turns out to be the three sphere. Though Dante does not use this topological language and probably didn't really have a conception of the fourth dimension, he clearly sees the three sphere. In fact, his vision is a natural extension of Aristotle's vision of the universe.