

# MD-DC-VA Section MAA Spring 2000 Meeting

## Contributed Paper Abstracts

(Alphabetical order by last name of first author)

**Bradford Abbott & Parviz Khalili**

### **How likely is a fifth degree polynomial to be Symmetric about a Point?**

We show that the probability of a fifth degree polynomial, with integer coefficients in the interval of  $[-5, 5]$ , to be symmetric about a point is approximately 1%. Further we show how to extend the result to any interval  $[-n, n]$ .

**Michela Barba**

### **A Random Regression Model Explored**

RCR models are used worldwide in many fields, including financial and agricultural settings. The RCR model can be used in situations where the slope coefficients remain constant over time or cross sections. Specifically, Ordinary Least-Squares (OLS) and Autoregressive-1 (AR-1) are special cases of the RCR model. Moreover, unlike classical regression models, RCR models are more general and can be used to model data with varying coefficients. Results from simulations with fixed coefficient models show that the RCR model accurately estimated the parameters for both fixed coefficient models.

**Ezra Brown**

### **Magic Squares, Finite Geometries and Points of Inflection on Elliptic Curves.**

Searching for an answer to a student's question can sometimes lead you to gold. The question is, "Do finite geometries show up anywhere outside of discrete math courses?" The gold is a surprise encounter with the wonderful world of elliptic curves.

**Stephanie Cawthorne**

### **Using the Washington Post to Teach an Introductory Statistics Course**

Using the Washington Post and other forms of media is an exciting way to interest students in a lower-level statistics class. Students enjoy seeing the concepts they learn used (and abused!) by the media.

**Bashir Dweik**

### **The Hill Estimator and Heavy Tailed Models**

Huge data sets often exhibit nonstandard characteristics such as heavy tails and long range dependence. Parameter estimation methods for tail heaviness such as the Hill estimator and the qq-estimator are reviewed. The behavior of the Hill estimator in the presence of local alternatives is described. Different estimators are then compared with emphasis on the Hill estimator, where consistency and asymptotic normality are established. The problem of bias in the Hill estimator is briefly addressed. Finally, examples are given using the call holding data and inter-arrivals between packet transmissions on a computer network.

**Raymond R. Fletcher III**

### **An Automorphism Theorem for Bipermutational Tournament Square-root Graphs**

A tournament square-root graph (TSR) is a directed graph with the property that each pair of vertices is joined by a unique directed path of length 2. Bifunctional tournament square-root graphs (BTSR) form a highly structured subclass of the TSR graphs. We trace the beginning of BTSR theory from the earlier theory of classical TSR graphs up to important recent developments including Automorphism and Representation Theorems for bipermutational TSR graphs.

**Dawit Haile**

### **Minimal Vertex Separators of Chordal Graphs**

A set  $S$  of vertices of a graph  $G$  is called a vertex separator if there exist vertices  $x, y$  in  $G - S$  such that every  $x$ -to- $y$  path contains a vertex

in  $S$ . A vertex separator is called a minimal vertex separator if none of its proper subsets is a vertex separator. In this talk we give a formula to determine the number of minimal vertex separators of chordal graphs. We also use minimal vertex separators to characterize subclasses of chordal graphs.

**Ilhan M. Izmirlı**  
**Mathematics of C-spaces**

C-spaces (contour spaces) are musical spaces where the only measurement is whether a tone is higher than or lower than (or the same as) another tone (no frequencies, or steps). This space demonstrates some very interesting algebraic properties. The talk will focus on these properties. We will also show that any transformation in this space can be expressed as a combination of two or three canonical transformations.

**Conrad Lotze**  
**Mathematics on the Web**

The presentation will explore some of the myriad of existing math web-sites currently available through the internet. The goal is to make the audience aware of these sites as possible resources for the teaching and learning of mathematics. Click [HERE](#) for a webpage with links to these resources.

**Betty Mayfield**  
**Is there a "right" way to teach girls math? Feminist pedagogy and curricular reform**

I will report on some research that Dr. Strand and I have conducted, examining links between the types of teaching strategies used in high school mathematics courses and students' attitudes and persistence in mathematics in college.

**Keith Mc Carron and Becci Torrey**  
**Continuous Motion of Displaced Coordinate Frames**

This talk discusses moving a 3-dimensional orthonormal coordinate frame back to "standard" position without the use of eigenvalues. We utilize intermediary reference frames to track all vectors in a continuous rotation through 3-dimensions that proceeds two dimensions at a time and preserves orthogonality. Matlab movies will be presented contrasting the motion of several 3-dimensional examples through time using the above method and a congruence method devised by Dan Kalman that uses eigenvectors.

**Terrence Moore**  
**Shrewd Shannon-Type Sampling Via Number Theoretic Trickery.**

Sampling Theory is that branch of mathematics which seeks to reconstruct functions from their values at a discrete set of points. The fundamental result in Sampling Theory, known as Shannon's Sampling Theorem, has many applications to signal processing and communications engineering. We will demonstrate Shannon's result complex interpolation methods. We then use these methods to solve interpolation problems on unions of non-commensurate lattices, which are created via specific number-theoretic guidelines. These interpolations give Shannon-type reconstructions on these lattices.

**Dr. Atma Sahu**  
**Principle Learning and Theorem Building Process of Integrating Polynomials in  $\csc x$  and  $\cot x$ .**

This paper presents a simple example of integrating polynomials in  $\sec x$  and  $\cot x$  demonstrating the process of mathematical rule building in the form of a theorem. Additionally, the issue of low graduation rates in mathematics programs has been discussed and current statistical data have been presented.

**Nirit Sandman**  
**An exploration of a type-B Tamari poset**

In the 1980's, M. Perles asked if the abstract simplicial complex of dissections of a convex  $(n+2)$ -gon could be viewed as the boundary

complex of some convex polytope. C. Lee answered this question in the affirmative by constructing the desired polytope, called the associahedron; he also developed other properties of the associahedron. In 1999, R. Simion constructed a type-B analogue of the associahedron. This talk will explore properties of a poset derived from the 1-skeleton of the dual of the B-associahedron.

**Thaddeus Selden and Neil Bridge**  
**Interfering with Interference**

Submitted by Randolph-Macon's team in the 2000 MCM modelling contest, this paper addresses how to successfully place radio transmitters in a hexagonal grid. Following several constraints put forth by interference issues, a model for the placement of transmitters in the grid is developed. The result also shows interesting relationships between neighboring transmitters and their positions in the grid.

**Thaddeus Selden**  
**If Pascal Had a Computer -- A do-it-yourself guide to the Problem of the Points**

In this presentation I will summarize the correspondence of the summer of 1654 between Pascal and Fermat, in which their independent solutions to the 'Problem of the Points' marked the birth of the theory of probability. Pascal's solution, in particular, involves difference equations and the concept of expectation; as such, his approach lends itself well to study by computer. I will explore some implications of this approach that were beyond his realm by using a computer algebra system.

**Jan Smid**  
**A user model for Internet based intelligent tutoring**

This model is based on probabilistic networks. Implementations issues will be discussed. A software demo will be presented.

**Roman Sznajder**  
**New results on univalent functions and their applications to complementarity theory**

We introduce a new concept of weakly univalent function, that is, continuous and almost uniform limit of univalent functions. Using this idea, we study connectedness properties of inverse images  $f^{-1}(q)$ . In addition, we provide new results on the connectedness of solution sets of parameterized equations and of solution sets in linear complementarity problems.

**William Traves**  
**Fair Cake Cutting After Su**

How are we to divide a cake at a large party so that everyone is happiest with their piece? In a recent paper Su gave a very clever argument establishing the existence of the "cake-cutting problem". His proof leads to a constructive algorithm for locating the "cuts".

**William P. Wardlaw**  
**An elementary school approach to the 16 puzzle**

A really simple-minded proof of the possible positions in the 16 puzzle.