Invited Talks: Abstracts and Biographical Information

Barbara T. Faires, "The Scottish Cafe"

Barbara Faires is a Professor of Mathematics at Westminster College in New Wilmington, PA where she has received both the Henderson Lecture Award and the Distinguished Faculty Award. She received her BS in math and business from East Carolina University and her Ph.D. from Kent State University. She is currently the Secretary of the MAA. Her research interests include vector measures and Banach space theory. She studied computer science while on a sabbatical leave at Carnegie Mellon. She has held visiting positions at Carnegie Mellon. She has been active in the MAA since joining the faculty at Westminster. She began the student puzzle section for the Allegheny Mountain section and initial coordinator of NExT. She has received the section's Meritorious Service and Distinguished Teaching Awards.

Abstract: The Scottish Café, the favored cafe of mathematicians in Lvov, Poland, is now known by many through the notebook of problems produced by those mathematicians. The notebook provides insight into problems posed as well as life in Poland at that time. This talk highlights the history and recent work on some of the problems posed in the Scottish Problem Book as well as some MAA projects..

Gail S. Mackin, "Determining the source of pollutants within river systems"

Gail Mackin is currently Chair of the Department of Mathematics at Northern Kentucky University. She received her BS in math and physics from Keene State University and her Ph.D. from Virginia Tech. She is the recipient of the 2013 Distinguished Teaching Award for the Kentucky Section of

the MAA. Her research interests include material science, PDEs, numerical analysis, and mathematical modeling. Prior to coming to NKU in 2001, she taught at both Georgia Southern and Western Carolina universities. She was a Project NExT Fellow while at Georgia Southern. She has been extremely interested in getting undergraduate students involved in research.

Abstract: The complex processes involved in the erosion, transport and deposition of sediment ultimately result in an alluvial record within the downstream deposit that represents a mixture of material derived from multiple source areas within a watershed. Geochemical tracer research involving mathematical mixing models is applied to this alluvial record of stored contaminants to unravel such things as the timing and history of contaminant influx to rivers, and the dispersal pathways through which contaminants are distributed along the river. These models aid in distinguishing between natural sources of contamination and those resulting from industrial waste or agricultural practices.

Francis E. Su, "Combinatorial Fixed Point Theorems"

Francis Su is the Benediktsson-Karwa Professor of Mathematics at Harvey Mudd College in Claremont, CA. He received his BS in math from the University of Texas at Austin and his Ph.D. from Harvard University. He is currently President-Elect of the MAA. His research interests include geometric combinatorics and its application to the social sciences. He has a passion for teaching and popularizing mathematics. He has co-authored numerous papers with undergraduates. From the MAA, he received the 2001 Hasse Prize for expository writing, the 2004 Alder Award for distinguished teaching by a young faculty member, and the 2013 Haimo Award for distinguished teaching. He maintains the popular Math Fun Facts website and has created an iPhone app. His hobbies include songwriting, gardening, photography, and theology.

Abstract: The Brouwer fixed point theorem and the Borsuk-Ulam theorem are beautiful and well-known theorems of topology that admit combinatorial analogues: Sperner's lemma and Tucker's lemma. In this talk, I will trace recent connections and generalizations of these combinatorial theorems, including applications to the social sciences. Some of this work includes research with undergraduates.

Abstracts of Contributed Talks

(u)=undergraduates, (g)= graduate, (f)= faculty member

Mashael Albaidani (g), Murray State University
A Relation Between Partitions and the Number of Divisors
We introduce a generating function and show the relationships between p(n), the number of unrestricted partitions of n,and the function $\sigma_k(n)$ the sum of the kth powers of divisors of n.

Jared Antrobus (u), Northern Kentucky University
Alignment of JN-25 Enciphered Groups and Additives
In 1939 the Imperial Japanese Navy introduced JN-25, a two-part, five-digit superenciphered code that became the primary "general purpose" cryptographic system for the Japanese fleet. JN-25 became a primary source of intelligence for the Allies. One task undertaken by Navy codebreakers was, when sufficient JN-25 additives had been recovered, to attempt to align intercepted enciphered groups against recovered additives. Using patterns created by the error-detection method built into JN-25, Navy codebreakers designed a machine called Mamba to align messages against additives. This presentation will explore the mathematical foundations of Mamba and, using Navy test messages, will demonstrate how Mamba aligned messages and additives.

Ferhan Atici(f), Western Kentucky University
Linear Forward Fractional Difference Equations
In this talk, we introduce the basics of discrete fractional calculus. We define a convolution and obtain a convolution theorem for the R-transform. We then apply a transform method and obtain a variation of parameters formula for a linear forward fractional difference equation.

Mustafa Atici (f), Western Kentucky University
Efficient algorithm to construct vector space secret sharing scheme
The threshold scheme, the monotone circuit construction, and the vector space construction are some of the well-known secret sharing schemes in cryptography. The threshold and monotone circuit secret sharing schemes are fairly easy to construct for any given access structure Γ.
The construction of a secret sharing scheme realizing a given access structure Γ with Vector Space Construction requires the existence of a function φ from a set of participants into a vector space, that is, φ : P -> Z_p^d . This function φ must satisfy certain conditions. There is no known algorithm to construct such a function φ in general. Constructions are mainly done by trial and error. In this paper, we develop polynomial algorithms to construct φ functions for vector space secret sharing scheme realizing certain types of access structures. Some examples are given to illustrate the algorithms.

Jeremy Bivins (u), Alex Payne(u), Kentucky Wesleyan College
Faster than a Speeding Prime
A basic question in number theory and theoretical computer science is how to find an efficient algorithm to decide whether a given number is prime or not prime. This has important applications in secure transmissions over the internet and techniques like RSA cryptosystems. Of course, the ancient method of Eratosthenes (sieve method) is one such algorithm, albeit a very inefficient one. So, mathematicians and computer scientists have been trying to find a deterministic algorithm which works in polynomial time. Recently, this has been achieved by three scientists form IIT, Kanpur, India. A copy of their work can be found via Google search. The aim of this project is to look at the historical development of prime numbers and to understand the arguments of the computer scientists from IIT, Kanpur, India. The arguments are very elementary and uses only a little bit of algebra and number theory. Additionally, the project will explore the history of the problem of finding an efficient algorithm of prime numbers and the ramifications of now having an efficient algorithm.

Katey Bjurstrom (g), University of Louisville
Generalizing Arrow's Theorem
Arrow's classic theorem proves that any collective choice function satisfying the Pareto property (P) and independence of irrelevant alternatives (IIA) whose range is restricted to weak orders is based on a unique dictator. Researchers in social choice theory have shown that, keeping all other criteria the same, if either (IIA) is replaced by the condition of weak independence (WI), or the range is generalized to allow for acyclic, indifference-transitive relations, the function must only be based on a unique weakly decisive voter. In this talk, we will discuss what happens when both of these criteria are weakened simultaneously; that is, what can be said about collective choice functions satisfying (WI) and (P) whose range is a set of acyclic and indifference-transitive relations?

Christopher Braccini (u), Morehead State University
Environmental Radiation Analysis of a Sample of Soil from Southeastern Kentucky
This is the analysis of radiation emission from a sample of soil from southeastern Kentucky that exhibits radiation in excess of background. The project consisted of using a multichannel analyzer (MCA) to detect gamma ray emissions from the soil in a shielded environment. The data is then subjected to background subtraction and the energy peaks were analyzed to assign probable isotopes. Using an analysis of the full width at half maximum (FWHM), error inherent in the detector as well as the data's standard deviation allowed assessment of the accuracy of isotopes assigned. All isotope determinations were within the data resolution and within 3 standard deviation of the actual value for the isotope. This allowed for high confidence in all isotope determinations for the five newly discovered peaks.

Sutthirut Charoenphon (g), University of Louisville
Green's function of fractional calculus and its application in pharmacokinetic model.
In my talk, I will introduce the discrete fractional calculus. First, I will define the delta operator as the forward difference operator and the falling factorial powers. Next, I will introduce the basic properties of finite fractional difference i.e. the power rule, the product rule. Furthermore, we will calculate Green's functions of some boundary problems of discrete fractional equations. Last, I will demonstrate how my findings generalize the existence results in the literature.

Doug Chatham (f), Morehead State University
The N-Queens Problem with Forbidden Squares
For n = 1 or n > 3, it is well-known that we can place n queens on the squares of an n-by-n chessboard so no two queens are in the same row, column, or diagonal. Suppose r of the chessboard squares are marked as forbidden territories where no queen can be put. How many nonattacking queens can we place on the n-by-n board with r forbidden squares? We reveal some partial results using coloring and boolean integer programming and discuss the extent to which the general problem remains open.

Chris Christensen (f), Northern Kentucky University
Mike, An Early Codebreaking "Computer"
During World War II, US Navy codebreakers – lacking a universal machine – designed a collection of machines to implement various cryptanalytic methods. "Mike" was one of the simplest and most used. Mike counted digraphs (two-letter groups) that appeared on pairs of paper tapes. This presentation will describe how Mike worked and present an example of its use.

John Cliburn (u), Western Kentucky University
Applications of the Banach Fixed Point Theorem
We investigated the application of the Banach fixed-point theorem, especially as it applied to initial value problems in differential equations. Many partial differential equations (PDE's) model biological growth and could be reduced to ordinary differential equations (ODE's) with time delay on a real Banach space. Other PDE's are abstract and non-homogeneous. For any contraction operator on a Banach space, the Banach fixed-point theorem could be used to prove the existence and uniqueness of a solution to these equations.

Bryan Conn (u), Morehead State University
A Model to Reduce Light Pollution on MSU's Campus
In an effort to study light pollution and possibly reduce the negative impacts of light pollution on MSU's campus we created a model of a public area (Bell Tower outside of the Camden-Carroll Library). We modeled Bell Tower because it is a high traffic area which includes three different types of light fixtures. These fixtures are rated as good or bad (as per the standards set by the International Dark Sky Association) with respect to light pollution with two of the three types of fixtures present being classified as bad. We use a Vernier Light Sensor and a digital camera to record light levels as we experiment with different lighting conditions. We examine the effect of reducing the bulb wattage, eliminating certain lamps, and adding shielding to existing fixtures. We found that shielding will allow us to reduce the input voltage by 25% and still allow us to maintain the same level of illumination. We conclude by calculating the energy savings and reduction in carbon footprint by making these changes.

Alex Disibio (u), Jeffrey Hartman (u), Vincent Ware (u), Georgetown College
Traffic and the Keep Right Rule
We created a mathematical model to analyze the effectiveness of the keep right rule in promoting traffic flow and safety. Our method for modeling the right hand rules uses algorithms derived from kinematics, velocity versus time step calculations and conditional analysis for task-choice decisions. Using vehicle velocities and positions, our model was able to successfully determine the path of least resistance for each vehicle on the road in a small time step, ultimately determining the vehicle flow of varying traffic densities across a 500 meter stretch of highway. Our model successfully demonstrates that the keep right rule effectively improves the flow of traffic when compared to roads with no keep right rule by percentage differences of as much as 70 percent. Our model also determined that keep right rules should be relaxed as density approaches the maximum safe vehicle density, due to decreases in flow. We also found that under an automated roadway system, traffic flow can be increased if human choice is not a factor.

Lauren Duffy (u), Morehead State University
Analysis of Nighttime Sky Brightness Data from January to May 2013 in Morehead, KY, and the Effect of Cloud Cover and Lunar Phase on Overall Brightness
Analysis of nighttime sky brightness data from January to May 2013 in Morehead, KY, and the effect of cloud cover and lunar phase on overall brightness.

Marcia Edson (f), Murray State University
The Last Non-zero Digit of n! in a Prime Power Base
Abstract: We consider the base b expansion of n! and the sequence { $l_b(n)$ }, which we define to be the last non-zero digit of n!. Kakutani, in 1967, showed the 5-automaticity of { $l_{10}(n)$ }, and recently Deshouillers and Ruzsa show that { $l_{12}(n)$ } coincides with a 3-automatic sequence on a set of density 1. We show that for $b = p^k$, for p an odd prime, the sequence{ $l_b(n)$ } is p-automatic, and discuss open problems.

Claus Ernst (f), Western Kentucky University
Strategies to unknot a tangled string
There are two different strategies one could use to unknot: Strand-passage and nullification. We show that both of these are employed by nature in the world of tangled DNA."

Bill Fenton (f), Bellarmine University
Gifts in a Cycle

In an exchange of gifts among a large group of people, it is possible but not likely that all gifts will be given in one cycle of presentations. This talk considers the probability of obtaining a single cycle from a random assignment of gift recipients. Although this can be viewed as a graph theory problem, permutations give a more productive approach to calculating the probability of a single cycle.

K. Renee Fister (f), Murray State University
Optimal Control of Age-Structured Cholera Model
We analyze cholera dynamics through a variation on an SIR epidemiological model in which two separate age classes are considered in a population. We discuss R0, estimated using parameters from Bangladesh. We then construct the necessary conditions for an optimal protection control minimizing infected classes and societal costs. Subsequently, we provide some numerical examples for our model with optimal control denoting that a protection control be implemented at the end of the monsoon season.

Erika Foreman (g), University of Louisville
An investigation of some lattice theoretic properties of Res(M3)
The residuated maps on complete lattices (simply the join homomorphisms) form their own lattice, which we denote Res(L). In this talk, we explore the order automorphisms on the lattice Res(M3).

Lucas Hoots (g), University of Louisville
May's Theorem on Hierarchies
In 1952, Kenneth May published a set of necessary and sufficient conditions that characterized simple majority rule in the case of 2 alternatives. We extend May's Theorem beyond the classical setting to the median semilattice of hierarchies.

Heather Hunt (g), University of Louisville
Examples of a Functional Equation Defined on a Group
Let G be an arbitrary group and C the field of complex numbers. We have previously proven that $f : GxG \rightarrow C$ is a solution of the functional equation $f(pr, qs) + f(ps, qr) = 2f(p, q) + 2f(r, s)$ for all p, q, r, s in G if and only if f is of the form $f(p, r) = \theta(p) + \theta(r) + \psi(pr-1, pr-1)$, where $\theta: G \rightarrow C$ is a homomorphism and $\psi: GxG \rightarrow C$ is a symmetric bi-homomorphism. We will look at several examples of such functions.

Daniel King (u), Northern Kentucky University
The Japanese Coral Cipher Machine
During World War II, the US Navy gathered much tactical intelligence from breaking Imperial Japanese Navy fleet and convoy ciphers. Another source of intelligence was enciphered reports sent to Tokyo by Japanese naval attaches in embassies abroad. These long reports often contained useful strategic information. Rather than being transmitted by radio, these enciphered reports were typically sent on commercial cables. Because the naval attaches were working in embassies, they were able to use sophisticated cryptographic machines to encipher their messages. The machine used by Japanese naval attaches was called Coral by the Allies. Coral was in many ways similar to the German Enigma machine; however, in others ways Coral was more sophisticated than Enigma. This presentation will describe how Coral enciphered and deciphered messages and will briefly discuss the nature of the intelligence that was obtained by the Allies' attack on Coral.

Janie Knell (u), Morehead State University
Use of CAM therapies among college students in Eastern Kentucky: Factors that influence amount and frequency of use.
Dietary supplements are pills, capsules, tablets, or liquid products that contain a vitamin, mineral, herb, botanical, amino acid, or other concentrate, metabolite, constituent, or extracts. Although these products are usually marketed using health claims that do not have to be approved or safety-tested by the US FDA, Americans annually spend 20 billion dollars in these therapies without strong evidence of their effectiveness. The literature on the use of dietary supplements has identified gaps in the knowledge associated with the actual cognitive and affective processes that people go through in deciding whether to use them. This gap is especially large for rural populations, people of low socioeconomic status, and young adults. The aim of this project was to understand how college students in Central Appalachia (Eastern Kentucky) become aware of herbal and dietary supplements and what factors might predict an increased use of these therapies. Using a statistical approach to understand why college students might prefer unproven dietary supplement over evidence-based contemporary medicine, can lead to more targeted programs that help Kentuckians make better decisions about their health.

Robert Lamphere (f), Elizabethtown Community and Technical College
Newton and Lambert and the Computing of Elliptical Orbits
Carl F. Gauss [1777-1855] showed how to compute an elliptical orbit of a planet when given two positions of the planet with respect to the Sun at two different times. Gauss' problem can be broken up into a geometric problem and a dynamic problem. Isaac Newton [1643-1727] solved the geometric problem and Johann Lambert [1728-1777] solved the dynamic problem. Combining their solutions gives a simple solution to Gauss' problem. In our talk we will give Newton's solution using analytic geometry, state Lambert's solution in a form suited for calculation, and we will give an example of determine an elliptical orbit.

Ryan Luke (g), University of Louisville
Finding groups among residuated mappings on a lattice L
It is well known that Res(L) forms a monoid for a lattice, L. M.F. Janowitz (Regularity of residuated mappings. Semigroup Forum, (1991) Vol. 42 No. 3, p. 313-332), considered the semigroup properties of this monoid, in particular for what L it would be a regular semigroup. Motivated by this study, we investigate which lattices L ensure that Res(L) has a nontrivial subsemigroup that is a group. This question reduces to a question of bijections on L; results for several common types of lattices as well as their vertical and horizontal sums will be presented.

Kurtis Mann (u), Georgetown College
Predicting Activity via Cell Phone Data
Using video lectures and data provided through a Coursera course (not currently running), an algorithm was developed to predict someone's activity. The data was collected via an accelerometer inside a cell phone given to the study participant who was then asked to perform a number of different activities such as walking, sitting down, laying, walking up and down stairs, etc. The ability to predict was accomplished using RStudio, data analysis/linear regression techniques and machine learning.

Kurtis Mann (u), Eric Mortberg (u), Zac Bettersworth (u), Georgetown College
An Eigenvector Approach to Ranking Network Nodes
We analyze coauthor and article networks populated by authors with an Erdos number of 1, and articles linked by citation respectively. We develop an algorithm to rank the authors in terms of relative influence, taking into account the quality of published works. When the only relationship between authors is coauthorship, only general centrality measures can be readily applied to attempt to distinguish influential network members. Simple models which only consider node degree measures fail to provide a purposeful way to weight links, limiting the detail of the analysis. We present a method to rank coauthors by first constructing an article network composed of articles written by members of the coauthor network. These articles are ranked and these rankings result in weights for the links of the coauthor network. Weighting coauthor links in this manner treats endorsement by a prominent author as more valuable than endorsement by a lesser one. With this furniture in place, a variation of a pagerank algorithm is applied to the coauthor network.

Andy Martin (f), Kentucky State University
Simon Newcomb and Benford's Law
In 1888 the Canadian-American astronomer Simon Newcomb made the odd observation that the earlier pages of a reference book of common logarithms showed significantly greater wear than the later pages, indicating that numbers whose logarithms began with the lower digits (1, 2) were being calculated with more frequently than those whose logarithms began with the larger digits (8,9). He apparently concluded that the probability of a naturally occurring number having d as the first significant digit is about log (1+1/d). Was he right? How could such a result (now called Benford's Law) be established?

Rus May (f), Morehead State University
A video game variant of the soft landing problem
The Atari video game Lunar Lander has players land a spaceship on the surface of the moon. The player must decide on a strategy to burn the thrust fuel during the descent so that the ship lands as softly as possible. This is related to the "soft landing problem", studied by NASA and other space agencies since the 1960's. We use the calculus of variations to determine the optimal landing strategy in this game.

Lan Nguyen (f), Western Kentucky University
Using exponential functions to solve PDEs
An exponential function is a continuous function T(t) with the property: T(0)=1 and T(t+s)=T(t)T(s). Using that formula we define exponential functions in normed spaces such as n-dimensional space or space of functions. We now can use the fact that every exponential function is a solution of a simple linear DE to solve PDEs, from heat equation, wave equation to higher order PDEs.

Ngoc Nguyen (f), Western Kentucky University
Choosing stocks in a bear market
The downward trend of a bear market (identified via stock analytical analyses) normally continues over a period of time following the occurrence of short-term abrupt events such as the Wall Street market crash in 1929, or the stock market panic in 2008. The bear market effect catastrophically produces pessimistic views of investors, which partly drives away a portion of asset from the market. Such negative sentiment feeding on itself accelerates pessimistic circles in the operation of stock market. For stock data accumulated in a bear market, the downward and depressing environment underlying the data invalidates the normal model assumption for the random fluctuation around an unknown mean market return. This necessitates a new method of modeling. One of the advantages of the new model is to select stable stocks in a bear market as a portfolio strategy to minimize the bear market loss. Selecting stable stocks consequently requires the comparisons of stock volatilities in a market. In this paper, we present a simultaneous inference approach to compare more than one stock volatilities and to identify stable stocks (the stock's beta is less than 1) in a bear market.

Allison Perkins (g), University of Louisville
On A Few Functional Equations
We will discuss the solutions to two functional equations related to trigonometric functions.

Tom Richmond (f), Western Kentucky University
Sets: Crisp, Fuzzy, and Rough
If A is a subset of the universal set U, then for a point x in U, classical thought tells us that either x is in A or not in A. That is, either x is 100% in A or 0% in A. This classical approach describes crisp sets. Fuzzy sets, introduced in 1965, allow points to be p% in A for values of p between 0 and 1. Rough set theory, introduced around 1981, classifies points as definitely in A, maybe in A, or definitely not in A. Properties of rough sets will be discussed, including computer graphics considerations which motivate their study.

Rebekah Robinson (f), Georgetown College
Elementary Statistics with RStudio
RStudio is an integrated development environment (IDE) that facilitates the use of the programming environment R. RStudio, in conjunction with the contributed R-package “tigerstats”, is being used to teach undergraduate elementary statistics at Georgetown College to students with no prior background in programming or statistics. This talk will include examples of interactive instructional apps that are used to explain some of the more difficult statistical concepts, how course materials can be managed within RStudio, and how students can learn to create reproducible research using the LateX and Markdown markup languages available through RStudio to create documents such as slideshows, pdf, and html files.

Christine Shannon (f), Centre College
"Flipping" the Real Analysis Classroom
As attention spans have shortened, it has become more challenging to keep the class engaged in a course where most of the work revolves around proofs. To encourage greater student participation in the construction of those proofs, I have developed worksheets which guide the students through a proof by outlining steps and asking pertinent questions along the way. This talk will share some of the things I've tried.

Logan VanWay (u), Western Kentucky University
Loop numbers of knot diagrams
A drawing of a knot on a piece of paper can be thought of as a 4-regular graph. When walking along the knot we keep track of how often we generate a loop in the diagram. This number is called the loop number of a knot diagram. This talk focuses on the calculation of loop numbers of particular families of knots called 4-plat projections. We investigate how properties of a knot affect the loop number.

Sai Sindhuja Veeramachaneni (g), Western Kentucky University
Generating random walks and polygons to investigate features of DNA molecules
DNA is packed very tightly inside the capsid of viruses. In our project, we model packed DNA through random walks (chains of unit-length, freely-jointed segments) and polygons (closed walks) within a sphere of certain radius. An existing mathematically derived random packing mechanism for these walks and polygons is adapted is to add thickness (volume) to the segments in the model. The talk discusses the algorithm we employ to generate walks/polygons within the confinement with thickness. The talk will include some preliminary results comparing features of walks/polygons with and without thickness.

Susan White (u), Georgetown College
Mathematical Theory in Dots-and-Boxes Game Play
The classic game of Dots-and-Boxes has been analyzed by Elwyn Berlekamp, who made the surprising discovery that Sprague-Grundy theory can be used to find winning moves. This talk will investigate the usefulness of “nimber values” in Dots-and-Boxes game play. We close with a brief discussion of related open problems and conjectures.

Homer White (f), Georgetown College
Elementary Statistics with R: Some Useful Contributed Packages
R is a statistical programming language and environment that has been adopted widely among working data analysts. It now ranks as the 15th most popular programming language in the world. Recent work by the NSF-funded Project Mosaic has made it feasible to use R in undergraduate statistics classes. The contributed R-package "tigerstats" (Teach It Gently: Elementary R and Statistics) was developed at Georgetown College in order to facilitate the teaching of elementary statistics with R, to students of average ability who have no prior experience with programming or the command line. This talk introduces the tigerstats package, its integrated suite of basic statistical routines tailored to elementary teaching, and its interactive instructional apps.

Steven Wilkinson (f), Northern Kentucky University
Smart Graphers
To plot the graph $y = f(x)$, one generates x-values, plots the points $(x, f(x))$ and connects the dots. One quickly realizes that for many functions, certain regions of their graphs need more points plotted than other regions to get acceptable resolution. Most graphers now employ adaptive algorithms to do this on the fly. We will discuss some of the mathematics behind how these choices are made.

Di Wu (f), Western Kentucky University
A Statistical Approach to Protein Structure Refinement
Protein structures are often underdetermined due to the limited experimental data. Therefore, applications of these proteins are severely limited. Development of protein structure refinement methods becomes important and urgent to biomedical research and pharmaceutical industry. Through the study of proteins with high quality structures, we can often extract conformational properties with significant statistical distributions and hence they can be applied to improve the structures of proteins. In this presentation, we will show a statistical approach that is developed based on the study of inter-atomic distances and can improve protein structure models.

Bangteng Xu (f), Eastern Kentucky University
Fourier Transforms and Bent Functions on C-algebras
The dual of a (bent) function on a finite abelian group is a natural concept. In this talk we introduce the dual of a (bent) function on a finite nonabelian group. A more general algebraic structure of a C-algebra provides a better and natural context for this purpose. We will present Fourier transforms, bent functions, and dual bent functions on C-algebras. Then as an application, we obtain the properties of dual bent functions on finite nonabelian groups.

Uta Ziegler (f), Western Kentucky University
Generating Polymers in Confinement
A polymer in confinement is represented by an N-segment, unit-length, free-jointed, closed polygon in spherical confinement, P = { X0 , X1, X2, X3, ….. XN = X0}. We present a fast algorithm to generate such polygons randomly. Let ri be the distance of Xi to X0, that is ri =| Xi |. At each step k in the generation process, the k-th segment of the polygon is ideally added based on the cumulative conditional probability density function H(rk | r^{k-1} && m=N-k) that is the probability that Xk‘s distance to X0 is less than or equal to rk, given that the prior point X^{k-1}‘s distance to X0 is r^{k-1} and that the polygon must be closed in m = N-k steps. The runtime for the generation is O(N), although significant time is needed (though only once) to obtain the functions for H.