Abstracts / Speakers

Exploring four-dimensional geometry with Zometool

Mira Bernstein, Wellesley College, Wellesley, MA

Zometool is a mathematical construction set whose ingenious design and versatility make it an ideal tool for exploring many aspects of three-dimensional geometry. However, in this workshop our focus will be on the geometry not of three but of four dimensions. Participants will use Zometool to construct 3D "shadows" (projections) of various four-dimensional "shapes" (polytopes). The centerpiece of the workshop will be a model of the truncated 120-cell - a beautiful, intricate structure about 6 feet in diameter which will be built as a group effort by all workshop participants.
The workshop will run on a drop-in basis: participants are welcome to show up and leave at any time. Everyone is encouraged to come for a little while to experiment with Zometool or to help with the construction of the truncated 120-cell. The geometric ideas underlying the constructions will be discussed throughout the workshop as the building progresses. No prior experience with Zometool or four-dimensional geometry is required.

Mira Bernstein received her BA from Yale University in 1994 and her PhD from Harvard University in 1999, specializing in algebraic geometry. She has taught at the University of California Berkeley and at Stanford before coming to Wellesley in 2002. Most of Mira's experience with Zometool comes from working with students at Canada/USA Mathcamp, a binational summer program for talented high-school students, of which she is the executive director. She has made the truncated 120-cell only once before and looks forward to building it again at this workshop.

All you ever wanted to know about patterns in baseball statistics!

Steven Krevisky, Middlesex Community College, Middletown, CT

In this presentation, we examine patterns in a batter's seasonal home run totals, slugging averages and on base averages. Using such methods as z scores, we will be able to see how such all-time luminaries as Jimmie Foxx, Babe Ruth, Mickey Mantle, Hank Aaron, Willie Mays, Ted Williams and others fared in these measures, especially compared to how the league did. Descriptive statistics will help as well. Are there also patterns regarding when a player had a " career year?" come hear how your favorite batter fits into the pantheon of greats.

Professor Krevisky was President of MATYCONN, 1992-1994 and 1998-2000, and coordinator of Connecticut system -wide math contest for several years. He has been a presenter, presider and delegate to annual meetings of AMATYC for several years and a presenter at NCTM meetings in Laramie, WY. 2001 and Montreal 2002. He has received travel grants to attend and present at the ninth international congress in math education (ICME-9) in Japan in 2000. He has also presented at the international conference on teaching statistics (ICOTS) in South Africa in 2002. He was President of Connecticut System Senate , 2000-2002.

How has this teacher failed? Let me count the ways...

Emma Previato, Boston University

This presentation is offered in gratitude for the MAA/NES 2003 teaching recognition. Through case studies, an illustration will be given of failures of this teacher and successes of her students. From the time I was called to the Dean's office, to the student's feat that (although the BU Bridge isn't The New York Times) Chairman David Rohrlich likened to Andrew Wiles': she put mathematics on the front page of a newspaper!

Emma Previato received her PhD from Harvard University in 1983 from the Fields Medalist David Mumford with a dissertation concerning applications of algebraic geometry to non-linear wave equations and other dynamical systems. In 1983 Emma became an assistant professor at Boston University, where she is now a full professor. She has pursued her research as a visitor, among other places, at the Institute for Advanced Studies (Princeton, NJ); the Mittag-Leffler Institute (Royal Academy of Sweden); the

Bunting Institute (Radcliffe College); and the Mathematical Sciences Research Institute (Berkeley, CA). She is editor and writer of two books, a scientific dictionary, and some 40 technical articles, has supervised two doctoral and several undergraduate dissertations, and is currently nurturing four graduate students, in areas as diverse as classical projective geometry, mathematical physics, and coding theory. As the founder (1993) and advisor of the Boston University Student Chapter of the MAA, Emma has obtained grants (Exxon Foundation, BU's Humanities Foundation and Student Government) to create undergraduate publications, interdisciplinary symposia, Masterclasses series, and fund other student activities, which she avidly partakes in.

Geometry, Topology, and the Entanglement Phase Transition
Greg Buck, Saint Anselm College, Manchester, NH

Filaments occur at every scale, from the molecular to the cosmic. We will introduce a new way to look at the entanglement of filaments that allows us to do four things: 1. Measure the entanglement rate for any filamentary process. 2. Find the relationship between the geometry and the topology of filamentary processes. 3. Identify a universal phase transition for filamentary processes. 4. Find relationships between entanglement rates and total curvature and the bending energy of a filament.
These results have applications wherever physical entanglements arise, in vortex and field lines, in magnetic flux tubes, in polymers and biopolymers, in cables, rope and hair. For example, the theory provides rationales for the supercoiling of DNA and the braiding of hair.

Greg Buck is Professor and Chair of Mathematics at Saint Anselm College. His research is in Applied Topology, Mathematical Molecular Biology, Celestial and other sorts of Mechanics, Models of Evolution, and some other conceptual locations. His writings have appeared in Nature, Science, and other leading mathematics and science journals. He received his Ph.D from Boston University in 1988.

Fractal Dynamics in Health: Changes with Disease and Aging
Ary L. Goldberger, MD, Director, Rey Institute for Nonlinear Dynamics in Medicine, Beth Israel Deaconess Medical Center, Professor at Harvard Medical School and Program Director of the NIH/NCRR Research Resource for Complex Physiologic Signals

According to classical concepts of physiologic control, healthy systems are self -regulated to reduce variability and maintain physiologic constancy. Contrary to the predictions of homeostasis, however, the output of a wide variety of systems, such as the normal human heartbeat, fluctuates in a complex manner, even under resting conditions. Scaling techniques adapted from statistical physics reveal the presence of long-range, power-law correlations, as part of multifractal cascades operating over a wide range of time scales. These properties suggest that the nonlinear regulatory systems are operating far from equilibrium, and that maintaining constancy is not the goal of physiologic control. In contrast, for subjects at high risk of sudden death, fractal organization, along with certain nonlinear interactions, breaks down, associated with a loss of complexity. Application of fractal analysis may provide new approaches to assessing cardiac risk and forecasting sudden cardiac death, as well as to monitoring the aging process. Similar approaches show promise in assessing other regulatory systems, such as human gait control in health and disease. Elucidating the fractal and nonlinear mechanisms involved in physiologic control and complex signaling networks is emerging as a major challenge in the post-genomics era. These problems present exciting opportunities for interdisciplinary research.

Ary L. Goldberger is a graduate of Harvard College and Yale Medical School. He is currently Associate Professor of Medicine at Harvard Medical School and Director of the Margret and H.A. Rey Institute for Nonlinear Dynamics in Physiology and Medicine (http://reylab.bidmc.harvard.edu) at Beth Israel Deaconess Medical Center. He is also the Program Director of the NIH/NCRR Research Resource for Complex Physiologic Signals (http://www.physionet.org). Dr. Goldberger and his colleagues have had a longstanding interest in the application of concepts from nonlinear dynamics to basic physiology and bedside medicine

Christie Lecture: Exploring Uncharted Territory in Forced ODE's: Strange and Counterintuitive Periodic Solutions

Lisa Humphreys, Rhode Island College, Providence, RI

This talk will highlight the easy access and sheer fun of research in applied mathematics. We will detail a research journey examining a differential equation model of the motion of a suspension bridge. The origins began as an eighteen-month long undergraduate honors project and later culminated with unexpected results including a successful numerical scheme. Details of various solution spaces will be shown through the use of bifurcation curves. Different numerical tools will be highlighted, some of which are certainly accessible to undergraduates. Possible undergraduate projects, stemming from this work, will also be presented.

Lisa Humphreys earned her Ph.D. at the University of Connecticut in 1994. She is now an associate professor at Rhode Island College. Her major research interests include the numerical analysis of partial differential equations, mountain pass techniques and the study of nonlinear mechanical models. She has served the Northeastern Section as the prime mover behind the Northeastern Project NExT and as one of the coordinators of the Student Papers sessions at the Sectional meetings. She has directed undergraduate research and has brought students to speak at Sectional meetings.

New Perspectives on the Mathematics of Voting and Elections

Stephen Brams, New York University, New York City, NY

A new framework is proposed for comparing and analyzing voting systems, based on the notion of "voter sovereignty." The idea is that voters should be able not only to vote for as many or as few candidates as they like, but they should also be able to prevent, insofar as possible, the election of unacceptable candidates. "Approval voting," now used by the MAA, AMS, and several other professional societies, maximizes these abilities. It is compared with other voting systems, including the Borda count, the Hare systems of single transferable vote ("instant runoff"), and other voting systems with respect to these abilities and its propensity to yield stable and strongly stable (equilibrium) outcomes.

Steven J. Brams is Professor of Politics at New York University. He is the author or co-author of 14 books that involve applications of game theory and social choice theory to a variety of fields. His most recent books, co-authored with Alan D. Taylor, are *Fair Division: From Cake-Cutting to Dispute Resolution* (Cambridge University Press, 1996) and *The Win-Win Solution: Guaranteeing Fair Shares to Everybody* (W.W. Norton, 1999). He is a Fellow of the American Association for the Advancement of Science, the Public Choice Society, a Guggenheim Fellow, a past present of the Peace Science Society (International), and in 1998-99 was a Visiting Scholar at the Russell Sage Foundation

A Tintinnabulous Introduction to Group Theory: The British Sport of Change Ringing

Lucy Dechene, Fitchburg State College, Fitchburg, MA

About 130 years before the birth of Galois, a poorly educated London printer essentially discovered permutation groups and cosets while attempting to formalize a method for ringing all possible permutations on a set of tower bells. This historical and mathematical talk will discuss the origins of change ringing and Fabian Stedman's discoveries still used today. We will also look at some of the beautiful results of A. T. White and listen to, and do, some change ringing. We will close with the mention of a tie with change ringing, the evening of April 18, 1775 in Boston, and bell founding in America.

Lucy Dechéne is Professor of Mathematics at Fitchburg State College and Graduate Program Chair of the M.A.T. in Mathematics. She received a B.S. in mathematics (with a second major in organ performance) from the University of San Francisco. She studied carillon while finishing her M.S. and Ph.D. in mathematics at the University of California at Riverside. In 1977, she completed the national requirements of the North American equivalent of diploma from a European carillon school. An active composer, organist and carillonneur, she has given carillon recitals in the U.S., Canada and Europe. She has mixed her mathematics with music many times, including giving recitals at the International Congress of Mathematicians at UC Berkeley and the AMS/MAA Summer Meeting in Toronto. As a member of the British and Irish Carillon Society, she knows many change ringers. Alas, she has never done change ringing herself.