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http://www.uncg.edu/mat/rumc
Michael Motyka saw a magnetic pendulum being damped into the exceptional center of a cevian box by Asya Monds. Actually, it was an algebraic center as corrected by Ronald W. Davis II. Joseph Krenicky discovered a romantic relationship between volume and area hidden under the surface of rejection. Christian Sykes interpolated his results among $P$-matrices that evolved in a small world networks of Brian Stadler. Although James Conrad Eubanks found a shortcut through the jungle of differentiation, M. Scott Wells has measurably beaten up a lengthy path for Alex Ford who went global in an arc. Kathryn Sikes found an art in math which was subsequently explored by a sudoku master Yair Goldberg. And we all had a big slice of a pie prepared by Robert Gove.

Math can be a lot of fun.
Conference Schedule

9:30 - 9:55    Registration and refreshments, Bryan 160
9:55 - 10:00  Welcoming remarks, Bryan 160

**Morning session I, Bryan 160**, chair: Jan Rychtář
9:55 - 10:20   Michael Motyka: The Dynamics of a Damped, Magnetic Pendulum
10:20 - 10:40  Asya Monds: The Exceptional Center of a Cevian Box
10:40 - 11:00  Ronald W. Davis II: The Algebraic Center of a Cevian Box
11:00 - 11:10  Coffee break

**Morning session II, Bryan 160**, chair: Robert Buchanan
11:10 - 11:30  Joseph Krenicky: On The Volume-Surface Area Relationship
11:30 - 11:50  Christian Sykes: Interpolation of linear subspaces by $P$-matrices
11:50 - 12:10  Brian Stadler: Evolutionary Dynamics on Small-World Networks
12:10 - 1:20   Lunch Break

**Plenary Lecture, Bryan 160**, chair: Sat Gupta
1:20 - 2:05    Filip Saidak: Prime numbers and their distribution
2:05 - 2:10    Short break

**Afternoon session I, Bryan 160**, chair: Richard Fabiano
2:10 - 2:30    James Conrad Eubanks: Differentiation Shortcuts à la Descartes
2:30 - 2:50    M. Scott Wells: Beating a Measurable Path through the Calculus II Jungle
2:50 - 3:10    Alex Ford: Arc Length Gone Global
3:10 - 3:20    Coffee break

**Afternoon session II, Bryan 160**, chair: Gregory Boudreaux
3:20 - 3:40    Kathryn Sikes: The Art of Math
3:40 - 4:00    Yair Goldberg: An Exploration into the Mathematics of Sudoku
4:00 - 4:20    Robert Gove: A Slice of Pi
4:20 - 4:25    Closing remarks
THE DYNAMICS OF A DAMPED, MAGNETIC PENDULUM

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ABSTRACT. Suppose that a spherical pendulum system is suspended above a plane that parallel to the azimuthal motion. On this plane, three magnets are placed symmetrically around the south pole, or lowest position, of the pendulum. This study examined the energies of the system and the equilibrium points of the pendulum bob. The study focused on initial condition sensitivity when examining the equilibrium points.
THE EXCEPTIONAL CENTER OF A CEVIAN BOX

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Abstract. If two contact triangles in base triangle ABC meet in four points, then one of these is exceptional in the sense that it has a clear view of a base triangle vertex. The contact triangles associated with the vertices of a Cevian box form a collection of exceptional points. We show that these points lie on three concurrent lines.
The Algebraic Center of a Cevian Box

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Abstract. We define the Cevian Algebra on the points in the interior of a base triangle. In terms of this algebra, we define the algebraic center of a Cevian parallelogram, and then show that the base triangle Cevians through the algebraic centers of opposite faces of a Cevian box are concurrent.
On The Volume-Surface Area Relationship

Joseph Krenicky

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Abstract. The volume of a sphere of radius $r$ is given by the standard formula $V = \frac{4}{3} \pi r^3$. Its surface area is given by $S = 4\pi r^2$. Clearly, $S$ is a derivative of $V$. The volume and surface area of a cube of length $a$ is given by $V = a^3$ and $S = 6a^2$, respectively. In this case, $S$ is not a derivative of $V$. The goal of this presentation is to study the volume-surface area relationship. In particular, it will be proven that surface area of an object is always the derivative of its volume. Initially, it appears that the proof is doomed to fail since it was already shown that the case of the cube disproves this hypothesis. The answer lies in the proper set up. It is intended to ultimately prove and give proper mathematical meaning to the statement that, Surface area is a derivative of a volume.
Interpolation of linear subspaces by P-matrices

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Abstract. A P-matrix is a matrix whose principal minors are positive. Let $X, Y$ be $n \times k$ real matrices of rank $k$. We consider the problem of what conditions are necessary and sufficient for the existence of a $P$-matrix $A$ such that $AX = Y$. The analytic properties of a simple necessary condition are explored. This condition is shown to be sufficient in the case $n \leq 3$. 
EVOLUTIONARY DYNAMICS ON SMALL-WORLD NETWORKS

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ABSTRACT. Graphs can represent nearly everything we encounter in life, cites interconnected by highways, the national power grid, ecological structures and even the human population. We can populate these graphs and see how they react in different situations. We introduce a mutant (or simply just a new element) into a specific type of graph to study the probability of the entire graph mutating. Different graph structures and sizes yield greatly varying results and give rise to a struggle between natural selection and a random mutation. We first study graphs with known theoretical solutions to the above problem. We then take these graphs and apply a random permutation to transform them into a more real life like graph, so called small-world networks. We compare the results against the initial graph in an attempt to see if there is any relation or, rather, no relation but completely new results.
Plenary talk

Prime numbers and their distribution

Dr. Filip Saidak

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Abstract. Prime numbers have been studied for over 25 centuries, during which many important and interesting results concerning them have been proved by some of the greatest mathematicians in history. In this talk we try to have a brief look at some highlights of the work that resulted in the proof of the celebrated Prime Number Theorem in 1896, and along the way we also discuss several still unsolved questions related to it, including the notorious Riemann Hypothesis.
DIFFERENTIATION SHORTCUTS À LA DESCARTES

James Conrad Eubanks

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ABSTRACT. In his Geometry, Descartes details an ingenious way of finding the tangent line to a point on an algebraic curve by finding the tangent circle. He is able to accomplish this feat algebraically by describing the intersection of the circle and the curve in terms of a parameter, and then finding the value of the parameter that yields a root of multiplicity two. In a letter shortly thereafter, he offers a simplification which utilizes a line, the curve and a different parameter, which may be recast by the modern reader as the slope of the line. Finding the value of the parameter that yields a “double root” is akin to computing the tangent slope. This second method affords an alternative way to derive the familiar differentiation shortcuts for rational polynomial functions which is both remarkable and completely algebraic. In this talk, the second method will be fully described and used to derive some of these familiar shortcuts.
BEATING A MEASURABLE PATH THROUGH THE CALCULUS II JUNGLE

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ABSTRACT. Topics in a second semester Calculus II course usually include techniques of integration, applications of integration and infinite series. Typically, this material is more loosely organized than its first semester Calculus I counterpart, and more challenging. Finding the slope of a tangent to a curve and the inverse problem of finding the area under a curve, motivate beautifully the first calculus course. In this talk, an unlikely candidate is identified that motivates most of the topics in a second calculus course. Through a series of natural question centered on this motivating concept, a path is beaten through the Calculus II jungle.
Arc Length Gone Global

Alex Ford

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Abstract. The arc length integral allows one to compute the arc length of a function (with a continuous derivative) on a given interval. This may be considered a local technique. The arc length function is used in some textbooks to compute the arc length of a function (with a continuous derivative) on any subinterval of a given interval without the need to re-compute the integral when the subinterval is changed. This is a more global approach. In this talk, the notion of a measuring function is introduced, which globalizes arc length computation even further and allows the function to not have a continuous derivative. A Mathematica notebook, the main focus of this research, will be used to illustrate the theory.
The Art of Math

Kathryn Sikes

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Abstract. Over the years I have noticed that many people consider the subjects of Art and Mathematics as belonging to opposite sides of the brain, with nothing in common aside from the occasional fractal or Esher print. As a student of both however, I am here to tell you of two common grounds shared by Art and Mathematics that are often overlooked. Namely that of the common When am I ever going to use this information? question, and that both fields are heavily utilized in digital art programs, which are popular among students, professionals and hobbyists the world over. In my talk I will discuss how concepts from undergraduate level Mathematics (linear algebra in particular) are applied in these programs both in the creation and alteration of digital artwork.
AN EXPLORATION INTO THE MATHEMATICS OF SUDOKU

Yair Goldberg

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ABSTRACT. We will explore the mathematics of Sudoku, particularly what makes two Sudoku puzzles different, with reference to Sudoku variants.
A SLICE OF PI

Robert Gove

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ABSTRACT. \( \pi \) is one of the longest-studied irrational constants, and although \( \pi \) has been calculated to 1,241,100,000,000 digits it is still unknown if \( \pi \) is normal in any base. We look at possible implications if it were normal, along with some known properties of \( \pi \) and their proofs. \( \pi \) has a long history of varied methods of calculation which are introduced and examined. More recent discoveries include the BPP formula, which may have a connection to the question of normality. We attempt to answer the question of why we need to compute long approximations.