MD-DC-VA Section MAA Spring 2010 Meeting at Virginia State University

Invited Speaker Abstracts

Workshop *Using Lurch in the classroom: A word processor that checks your mathematical reasoning* Nathan Carter Bentley University	If word processors can check your spelling and grammar, why can't they check your math? Although building such a word processor is a tall order, that's exactly the goal of the Lurch project. Lurch is free and open source software whose development began in 2008. It is supported by the National Science Foundation (DUE #0736644) and available at http://lurch.sourceforge.net. This workshop will show the current state of the software, and what you can do with it in several common mathematics courses, from formal logic to basic algebra. We will use several of the math topics that come built into Lurch, but another important goal of the project is to make it easy for mathematicians to add new math topics to Lurch without any computer programming required. Although that goal is still only partially realized, it is enough to experiment with and we will spend some time doing so in the workshop.
Banquet Address *Geometric Gems* Michael Starbird University of Texas	Plain plane (and solid) geometry contains some of the most beautiful proofs ever --- some dating from ancient times and some created by living mathematicians. This talk will include some of my favorites, and the audience can decide which ones to see. Choices include the Dandelin Sphere argument that a plane intersects a cone in an ellipse; a method for computing areas under curves such as the tractrix developed by a living mathematician, Momikan Mnatsakanian; a modern proof by John Conway (refined by me) of Morley's Miracle; Archimedes' use of a lever to deduce the formula for the volume of a sphere; and many more. Geometry provides many treats!
Saturday Morning Address *The Mathematics of Doodling* Ravi Vakil Stanford University	Doodling has many mathematical aspects: patterns, shapes, numbers, and more. Not surprisingly, there is often some sophisticated and fun mathematics buried inside common doodles. I'll begin by doodling, and see where it takes us.
Saturday Afternoon Address *Spinning Heads and Spinning News* Rebecca Goldin George Mason University	News increasingly depends on a careful dissection of numbers. Statistics are everywhere, from how many people are not covered by health insurance to whether Vitamin E is good for you or not. Yet for being so prevalent, statistics are badly understood by the general public. In this talk, I'll illustrate how the press often misuses statistics with examples from recent coverage. Since news sources are the main avenue by which the public understands many public health issues, these misguided representations of science can actually shape public policy, legislation, and individual choices. We will see why it is so important that media writers understand basic concepts from statistics, epidemiology and the scientific method. I will also show how powerful the work can be when the press goes beyond politics and morality to get the science right. These examples come from my experience as the research director for Statistical Assessment Service (STATS), a nonprofit media education and watchdog group affiliated with George Mason University, where I am a professor of mathematics as well. STATS takes critical aim at the poor use of statistics to justify false claims or to back-up ideological agendas, while serving as a resource for journalists and producers who want to engage in high-level responsible reporting that takes into account what the science says, what it doesn't, and what it can't.

Contributed Paper (CP)
Faculty and Graduate Student Abstracts

(Talks marked with a Ψ are not recommended for undergraduates)

Boolean Groebner Bases and Sudoku Elizabeth Arnold James Madison University CP2	Buchberger's algorithm will theoretically compute a Groebner basis for any ideal of a multivariate polynomial ring. However, even with today's computers, many examples still use too much memory to be computed in real time. This is because all computation is done symbolically over the rational numbers. Two main problems occur: the coefficients of the polynomials during the computation can grow very large and also the degrees of the polynomials can grow very large allowing a large number of monomials in each polynomial. If the problem can be re-written as an ideal consisting of Boolean polynomials, then we can take advantage of a special Boolean version of Buchberger's algorithm that avoids these two issues entirely. We will discuss this Boolean algorithm and its applications to Sudoku.
Sources and Sinks: Quantitative and Citizen Literacy through Fundamental Environmental Issues Harel Barzilai Salisbury University CP3	We describe the curricular development of and teaching experience for a 100-level Liberal Arts mathematics course centering on Quantitative Literacy via environmental topics. The course was taught largely with activities, group explorations and short readings (including newspaper articles) rather than a textbook, and touched on some of the major environmental challenges of our day, such as climate destabilization, climate feedbacks, Hubbert peak for oil and other resources, and exponential growth on a finite planet. Curricular materials will be shared which allow authentic quantitative explorations of these issues by students in a General Education course. Related questions for discussion which arise include: how can relevant real-world examples be used to both motivate the study of, and also to deepen student understanding of, mathematical ideas? How can relevant mathematical ideas be included in a General Education course at a level which is accessible while still providing students with powerful lenses and tools through which the complex issues in the world around them can be understood throughout their lives as participating citizens?
Interpolation and remainders: two formulas that are really the same Ezra Brown Virginia Tech CP6	To pass a polynomial through a set of points, use the Lagrange interpolation formula. To construct an integer satisfying a set of congruences, use the Chinese Remainder Theorem. This talk is about how these two classic results are really the same, and how the speaker came to realize this while teaching two back-to-back classes.
Trajectory Controllability of Nonlinear Integro-differential System Dimplekumar N. Chalishajar Virginia Military Institute CP3	Trajectory (T) controllability is the new notion of controllability. We study T-controllability of first and second order systems in finite and infinite dimensional spaces using theory of semigroups, family of cosine operators and monotone operator theory. Examples are provided to illustrate the results.

Common Core Math Standards – Some good, some bad, some importance Jerome Dancis University of Maryland CP4	March 2010 draft is at www.corestandards.org/Files/K12MathStandards.pdf Possible importance: U.S. Dept. of Education's proposed Blueprint for replacing NCLB includes a new utopian goal of 100% minimally college ready by 2010. Many states may choose the Common Core Math Standards as their minimally college ready standards. Sample of GOOD: 1. Grade 8 students will be required to "Solve systems of two linear equations in two variables algebraically, ..." This is far higher than the standards in Maryland, wherein even knowing that $2x + 3x = 5x$ is NOT on the Maryland state HSA on Algebra. 2. Grade 7 students will be required to "understand that ... [it's] "the distributive law, [that leads] to products such as $(-1)(-1) = 1$". This is rigorous mathematics. Sample of BAD. 1. The standards do not include (*) the many connections between topics as well as (*) combinations of topics. Combinations like $1/3 - 1/6 + 1/4$ are omitted. The connections between Measurement and Arithmetic are omitted; like that area diagrams justify the Commutative Rule of Multiplication and the Distributive Rule. 2. Middle school standards on measurement, units, proportions and percents need to be beefed up to provide students with the fluency in these topics needed for rigorous high school chemistry and physics courses. 3. The word, "understand" appears 200+ times; "know from memory" is only for the multiplication and addition tables. Missing: Converting 1/3, 1/20, 1/1000 into decimal notation. Knowing that 50% equals a half. Knowing that a million is a thousand thousands. Deciles.
Perfect Polygons Raymond Fletcher III Virginia State University CP1	Let P be a set of n points in the plane labeled with the integers mod n and such that no 3 are collinear. For each k in Z(mod n) let W(k) denote the set of lines $\{xy : x+y = k\}$. If for each k the lines in W(k) are concurrent, then we call P a perfect polygon. Let X(k) denote the point of concurrence of the lines in W(k). Then we call $\{X(k) : k \text{ in } Z(\text{mod } n)\}$ the set of perspective points of P. In our Main Theorem we show that the vertices and perspective points of a perfect polygon all lie on a cubic curve. In case the vertices of P all lie on a circle, we call P a perfect cyclic polygon. Some properties and constructions of cyclic perfect polygons will be given.
Rethinking Developmental Mathematics Barbara Franklin Prince George's Community College CP5	Every day, I am challenged by my work in developmental mathematics (DVM). The students, the lack of success, and the attitudes of non-developmental education colleagues are some of the challenges. The students have a myriad of educational and support needs; and many students are often discouraged by the need to take non-credit developmental mathematics courses and the stigma associated with taking these courses. Some colleagues think poorly of developmental education and most think developmental education is synonymous with remedial education. These challenges amongst others, have led me to believe that we need to rethink developmental mathematics. Therefore, this paper addresses the importance of/need for DVM, outlines current DVM practices and challenges, and recommends some possible considerations for revamping DVM.

Ψ*A New Paradigm in Collaborative Textbook Writing* Gregory Hartman Virginia Military Institute CP4	In this talk we will discuss the current author/publisher/student textbook paradigm and present an alternative. With software such as LaTeX and affordable online based print-on-demand services, faculty can work together to present their students with inexpensive, yet high quality, textbooks and course books that can be tailored to fit specific needs. We will introduce the APEX (Affordable Print and Electronic teXtbook) Project, a consortium of authors who collaborate to produce open textbooks.
Hidden Patterns in Functions Brian Heinold Mount St. Mary's University CP1	Given a lattice of points $L(a,b)=\{(ma,nb): m,n \text{ integers}\}$ and a function $f(x,y)$, plots of $f(x,y)$ mod 2 on $L(a,b)$ exhibit some intriguing patterns. We will examine the patterns produced for various values of a and b and various functions.
Teaching Lebesgue's Integral in Calculus I Bill Johnston Randolph-Macon College CP2	Study of the Lebesgue integral, so important to an understanding of function spaces and modern function theory, is generally not offered in standard courses at the undergraduate level. A new but little-known approach by Alan J. Weir in the 1970's made this material much more accessible, and his method can be employed to teach the Lebesgue integral (on continuous functions) to Calculus I students. The associated level of complexity is equivalent to that of the Riemann integral for continuous functions. This paper presents the method, providing associated examples and sample exercises.
Generalized Parabolas and Their Directrixes Daniel Joseph Virginia Military Institute CP5	In this talk we examine generalized parabolas, an interesting class of curves which are the locus of points equidistant from a given point (the focus) and a (not necessarily affine) directrix. We then ask the question "What curves can we classify as generalized parabolas?" In other words, given a focus and an arbitrary directrix, what types of curves can we come up with? The surprising answer leads to some beautiful and fascinating curves.
Relatively Prime Gamma Products Chris Kennedy Christopher Newport University CP3	We give an elementary proof for a closed form of $\prod_{(k,n)=1} \Gamma(\frac{k}{n})$ as well as some of its extensions. This result, while not new, does not appear to be widely known.
Ψ*Construction of Einstein Metrics on Quotient Manifolds of S^3 X S^5* Lydia Kennedy Virginia Wesleyan College CP6	We present a concrete construction of an Einstein metric on a class of quotient manifolds of S^3 X S^5.
Ψ*Math + Games = Fun in the Classroom* Alex Meadows St. Mary's College of Maryland CP6	We will (interactively) discuss various ideas for using games in a class for liberal arts students. The main idea is to use games, including combinatorial and tic-tac-toe type games, almost exclusively to introduce mathematical ideas, including the infinitude of primes, modular arithmetic, and higher dimensional geometry.

Unified Approach for the Inversion of Structured Matrices via Newton's Iteration Stephanie Nash Virginia State University CP4	Newton's iteration is a fundamental tool for numerical solutions of equations and systems of equations. The well-known iteration $x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$ converges quadratically to the solution x for an equation $f(x) = 0$ with a given close initial approximation x_0 to x. We will extend this method to the case where x, x_i, and $f(x_i)$ are matrices. In particular, we let $f(X) = M - X^{-1}$ for matrices M and X. In this case the iteration takes the form $X_{i+1} = X_i(2I - AX_i) = 2X_i - X_iAX_i = (2I - X_iA)X_i, i \geq 0$ and rapidly refines a crude initial approximation X_0 to the inverse of a general non-singular matrix A. We will extend and apply this method to a matrix with structures such as Toeplitz and Toeplitz-like. These matrices and some other structured matrices can be represented by their short generators, which allow faster computations based on the displacement operators tool. Besides having strong numerical stability, the iteration is very simple to implement. We compress the computed approximations to the inverse to yield superfast algorithm in the case where the input matrix is a well-conditioned structured matrix bases on two different compression techniques: SVD and substitution. We will analyze the algorithm and estimate the overall number of Newton steps required for convergence, and the algorithm can be applied to more general classes of structured matrices. Finally, we will give some numerical tests with special Toeplitz matrices using Matlab.
Trite Student Comments: Can We Turn Them into Teaching Opportunities? Ed Parker James Madison University CP5	"Will this be on the test?" Comments such as this can test the patience of even the most seasoned teacher. Nevertheless, possibilities exist for leveraging such questions or statements into teaching opportunities. In this talk, working from an active learning perspective, we discuss conversations that can be initiated in response to some of the author's "favorite" trite student comments.
The Coffee Mug Caustic James Parson Hood College CP6	Light shining into a coffee mug reflects off the curved sides and focuses on a distinctive cuspidal curve at the bottom of the mug. I will discuss this curve using Geometer's Sketchpad and using calculus. Exploring this curve would be a nice activity for a College Geometry class.
A new(?) geometric look at diagonalizing symmetric matrices Bob Sachs George Mason University CP1	Diagonalizing symmetric matrices is one of the highlights of a linear algebra course. This talk presents a geometric approach to the fact that the eigenspaces are orthogonal, starting from the case of two dimensions, where it follows from high school trigonometry.
Markov Chain Monte Carlo and Its Applications Dianne Schmidt Montgomery College CP2	Markov Chain Monte Carlo is a well-known technique to solve the Monte Carlo Integration using Markov Chains. Its applications are rapidly expanding into many subjects--Bayesian analysis, Biomedicine, Economics, Computer science, Education, Engineering and so on. The Metropolis Hasting Algorithm is a major algorithm in MCMC. Gibbs Sampler is a popular computer-intensive algorithm in MCMC. Of significance to applications is one that can solve analytically and numerically difficulty problems.

Teaching Cryptography using Technology Neil Sigmon Radford University CP4	Cryptography provides an excellent way to introduce students to important concepts in number theory, linear algebra, and abstract algebra. To implement most historical and modern algorithms in cryptography, some type of technological assistance is needed. This presentation will discuss how Maplets have been successfully integrated and have become an integral part in the teaching of a general education honors course in cryptography at Radford University.
Uniqueness of the isosceles trapezoid central configuration of the planar Newtonian four-body problem Zhifu Xie Virginia State University CP3	The question on the number of central configurations for a given mass vector is one of the challenging problems for 21st century mathematicians. The uniqueness of central configurations with two equal masses in the kite shape has been proved by Leandro in 2003. In this paper, we prove that there is a unique isosceles trapezoid central configuration of the planar Newtonian four-body problem when two pairs of equal masses are located at adjacent vertices of a trapezoid. Such isosceles trapezoid central configurations are exactly one dimensional family. The side with two less equal masses is parallel to and shorter than the side with two larger equal masses.
Krush-Kuhn-Tucker Condition and Second Order Condition in Calculus Bing Yang West Virginia University Institute of Technology CP2	Researches in the area of inequality-constrained nonlinear optimization problems often mention Krush-Kuhn-Tucker first-order necessary condition and second-order sufficient condition in general n-dimensional setting. Students often have difficulties to fully understand these conditions when they see them and cannot relate them to the concepts of optimization that they have been exposed to in calculus. To make these theorems more understandable, the optimization problem in calculus is reformulated to fit the problem statement and Krush-Kuhn-Tucker first-order necessary condition and second-order sufficient condition are carefully analyzed.

Contributed Paper
Student Abstracts

Intersecting Cylinders at Arbitrary Angles Yuri Calustro Faculty Advisor: Phillip Poplin Longwood University CP2	This research serves as an extension of the calculus problem in which the volume of intersecting perpendicular cylinders is calculated. Given that both cylinders are of equal radius and intersect at an arbitrary angle, α, the volume is determined by expressing one cylinder as a series of shifting ellipses. This knowledge is then applied in determining the total volume of a chain of n cylinders in which two cylinders intersect at each joint. The figure created will resemble a regular n-sided polygon, represented by a series of pipes connected at various angles.
Extensions of Van der Waerden numbers to finite gap sets Stephen Hardy Faculty Advisor: Spencer Hamblen McDaniel College CP3	The Van der Waerden number $w(k;r)$ is defined as the least positive integer n such that every r-coloring of $\{1, 2, \ldots, n\}$ yields a monochromatic k-term arithmetic progression. Dr. Bruce Landman introduced an extension of the Van der Waerden numbers to a finite gap set D of positive integers. We let $w_D(k; r)$ denote the least positive integer n (if it exists) such that every r-coloring of $\{1, 2, \ldots, n\}$ contains a monochromatic k-term arithmetic progression with gap $d \in D$. We explore some cases when $w_D(2;3) < \infty$ when $\lvert D\rvert=3$.
Curves on the Unit 2-Sphere with Constant Torsion Demetre Kazaras Faculty Advisor: Ivan Sterling St. Mary's College of Maryland CP4	The abstract classification curves of constant torsion in 3-Space which lie on the unit sphere is over 100 years old; however explicit formulas were unknown. By using a judicious change of variables, Mathematica, and (relatively) new methods for solving differential equations using hypergeometric functions we were able to find explicit formulas.
The Dynamics of Finite Cellular Automata with Null Boundary Conditions Catherine Walsh Faculty Advisor: Michael Bardzell Salisbury University CP5	Cellular Automata (CA), a type of discrete dynamical system, are often studied with periodic boundary conditions over a finite lattice of cells. While there are numerous results about periodic boundary conditions, results can also come from null boundary conditions. Consider CA over finite lattices of cells, where cells take on values from a finite alphabet G. The values of these cells are updated in discrete time steps using a local rule. If G is an abelian group the states of the cellular automaton form a group and the time evolution map often can form a group homomorphism. The kernel of this evolution homomorphism will reveal information about the dynamics of the underlying system, which is represented by a state transition diagram. The nodes of the diagram represent states and the arrows represent time evolution. For example, if the kernel is trivial, then the evolution map is one-to-one and the CA is reversible. Furthermore, the kernel can suggest how long or how many steps until each state within the system will hit a fixed point, or hit a cycle. The state transition diagram's geometry ties in with the kernel of the evolution homomorphism and determines whether the diagram is a collection of rooted trees, cycles, and/or products of cycles with rooted trees. Computations of the kernel are analogous to techniques used in linear algebra. However, care must be taken since these systems are not always defined over finite fields, but over abelian groups.

Undergraduate Poster Descriptions

Your friend and Mine: The Circulant Matrix Cameron Atkins, Melissa Bechard, Alexander Srisuwan Faculty Advisor: Carla Martin James Madison University	Discussion of the eigenvalues, eigenvectors, and determinants of circulant matrices.
Pi: The Constant that Has No Equal...Especially 22/7 Jason Barnes Faculty Advisor: Aprillya Lanz Virginia Military Institute	The value of π has been argued for centuries. Its usefulness has helped build the Great Pyramids of Egypt to helping architects build the city of Rome. We use it today mostly for measuring the circumference and area of a circle, but it also shows up in many different kinds of formulas. For this reason many mathematicians and scientists have researched π to obtain a more approximate value. Using some of these existing methods of approximating π, my advisor, MAJ Lanz, and I researched different algorithms and how accurate they are. After researching these methods, we came up with our own algorithm to approximate the value of π.
Genetics with Abstract Algebra Bali Boule Faculty Advisor: Elizabeth Arnold James Madison University	We will describe how genetics can be represented using concepts from abstract algebra.
Intersecting Cylinders at Arbitrary Angles Yuri Calustro Faculty Advisor: Phillip Poplin Longwood University	This research serves as an extension of the calculus problem in which the volume of intersecting perpendicular cylinders is calculated. Given that both cylinders are of equal radius and intersect at an arbitrary angle, α, the volume is determined by expressing one cylinder as a series of shifting ellipses. This knowledge is then applied in determining the total volume of a chain of n cylinders in which two cylinders intersect at each joint. The figure created will resemble a regular n-sided polygon, represented by a series of pipes connected at various angles.
Stock Market Interpolation Kendall Davis Faculty Advisor: Mohammed Moazzam Salisbury University	Using the 2006, 2007, 2008, and 2009 Stock Market data for Dover Downs Gaming and Entertainment, we sought to find the ideal time to invest, during a given year, in DDE common stock. We sought also to find any pattern suggesting growth or depreciation in the value of the researched DDE common stock. Using Numerical Methods from MATH 471, we have evaluated the stock market growths using Newton's Divided Difference Method to ultimately find various rates over time exponentials, each further difference showing peaks and valleys in stock efficiency. It is our goal that our findings may assist, in a general fashion, in the prediction and thereby the success of investment in future common stock.
Using Matrices to Represent Complex Numbers Reginald Ford Faculty Advisor: Elizabeth Arnold James Madison University	This poster illustrates an isomorphism between the set of complex numbers and a set of 2 by 2 matrices. This can give one an insight into the nature of complex numbers. This topic can serve as a great mental refreshment about rotation matrices, linear algebra, and complex numbers.
Matrix Exponential Steven Hu, Joseph Bae Faculty Advisor: Carla Martin James Madison University	Matrix exponential is useful in different mathematical models such as in biology, economics processes that involve systems of linear, constant coefficient ordinary differential equations. We find different ways to solve these problems using eigenvalue decomposition, power series expansion and computing the Jordan Canonical Block.

How to Simultaneously Diagonalize 2 nxn Matrices Caitlin Johnson Faculty Advisor: Carla Martin James Madison University	We say that a square matrix A is diagonalizable if there exists an invertible P such that $P^{-1}AP$ is diagonal. In this project I look at another type of diagonalization by proving a theorem.
To be, or not to be... Lucky Robert Kelvey Faculty Advisor: Spencer Hamblen McDaniel College	An analysis of the Lucky numbers and their not-so-lucky friends. Lucky numbers are a sequence generated by a sieving process similar to the Sieve of Eratosthenes. We will examine: similarities between prime numbers and Lucky numbers; a proof that there are an infinitely many Lucky numbers; a classification of exactly which numbers are sieved, and a comparison between the Ulam (Prime) Spiral and the Lucky Spiral.
Discrete Dynamical Systems focusing on Predator-Prey Relationships David MacDonald Faculty Advisor: Elizabeth Arnold James Madison University	In order to determine the long term behavior of relationships in nature multiple methods can be used. One such method is Eigenvector Decomposition. In this poster eigenvector decomposition is used to determine the long term growth of the system of predation concerning willows, hares, and lynx. A simulation was run to confirm the results of the mathematics. A piece-wise system concerning these three species explored as well as a system of five species.
Circulating Eigen-values Leslie Mitchell, Umut Onat, and Colleen Hogan Faculty Advisor: Carla Martin James Madison University	This project will examine the eigenvalues of circulant matrices. Circulant matrices have constant diagonals with a vector as its first row and the other rows are shifted permutations of the first row. The project also focuses on the Discrete Fourier Transform matrix applications on solving linear equations with circulant matrices.
Math Model of Salmonella William R. Orndorff III Faculty Advisor: Leah Lanz Virginia Military Institute	In recent news, Salmonella has come to light as a serious problem around the world. It is estimated that there are approximately 12.5 million cases each year. Through the use of differential equations, a model to describe the dynamics of Salmonella was developed based on parameters available in literature. The model is a modified SIRS model. The value of the basic reproduction number and stability analysis will be presented.
Abstract Algebra Application: Public Key Cryptography Caleb Reed & Tom Schneider Faculty Advisor: Elizabeth Arnold James Madison University	With today's broad online market place, protecting personal information is increasingly difficult. Here we demonstrate how encryption methods involving abstract algebra techniques are applied to online transactions to keep your information secure.
Generalized Eigenvalues Alyssa Taylor, Ann Randolph, Jillian Alder Faculty Advisor: Carla Martin James Madison University	This poster will serve as an introduction to generalized eigenvalues by the inclusion of specific examples to then make generalizations of common properties.

COMAP Presentations

A Simple Approach to Geographic Modeling: The Circle-Decay Overlay Model Cameron Auker, Nathan Parr, Douglas Vermilya Faculty Advisor: Marcus Pendergrass Hampden-Sydney College CP1	We developed a hybrid model for predicting the next sequence of crimes. The model combines spatial and temporal analysis of past history to make its predictions.
To the Bat-Swing: An Impulsive Approach Yuri Calustro, Nikole Varhegyi Faculty Advisor: Leigh Lunsford Longwood University CP1	The "sweet spot" of a baseball bat is the point of contact whereupon the force generated by the collision is efficiently conserved such that the ball exit velocity is greatest. As a solution to problem A of the 2010 COMAP competition, our model observes the force generated at the point of contact relative to the force exerted on the batter's hands to model the "sweet spot" for a variety of bat compositions. Using data on the dimensions of a particular 33 inch bat, we interpolate the remaining data using cubic splines. By then creating a two dimensional model of the bat and calculating the volume, mass, moment of inertia, and center of mass; we model the impulse exerted on a batter's hands. This information is calculated and compared between bats composed of ash wood, corked centers, and aluminum.
Silence of the λ's: A Geographical Model of Criminal Behavior Dennis Howell, Sara Miller, Patrick O'Neill Faculty Advisor: Alexei Kolesnikov Towson University CP6	During the 2010 Mathematical Contest in Modeling, our team was tasked with the creation of a model to characterize criminal behavior and assist law enforcement officers in the apprehension of a serial offender. We develop a model which accepts locations and times of past offenses, and generates likelihood estimates of the offender's place of residence over a geographic area, as well as spatial and temporal distributions for future attacks. We embrace the "hit-score method" discussed in Rossmo (2000) and assume that the criminal's likeliness to offend at a given distance from home is constrained by travel time and fear of detection. Given a sequence of crime locations, we employ Bayesian reasoning to estimate the probability of the offender's residence in an area, and suggest techniques for approximating local maxima of the resulting surface and interpreting the strength of these predictions. We also analyze attacks by time of day and time of year, generating a wrapped normal distribution over a 24-hour cycle and parameter estimation for a homogeneous Poisson process, respectively. We evaluate our model on the dataset for Peter Sutcliffe, a British serial murderer. Through computational simulation, we find that from an initial region of approximately 7,500 square kilometers, the model prioritizes a search area centered within 3km of Sutcliffe's residence. We conclude with discussion of applicability, optional heuristic inputs, and directions for further research.