FALL 2004 SIXTY-FIRST SERIES

M*A*T*H COLLOQUIUM

The Mathematics Department of Sonoma State University presents a series of informal talks open to the public.

"Mathematics is the process of turning coffee into theorems" –Paul Erdös

WEDNESDAYS at 4:00 P.M. DARWIN HALL ROOM 108 COFFEE at 3:45 P.M.

SEPT 01 **It's Knot Math. Maria Robinson, Seattle University**
Knot Theory is an exciting area of Mathematics. One of the fundamental questions that mathematicians strive to answer is "Are these the same knots?" We will explore that question during the talk. We will also look into some of the current open questions in Knot Theory.

SEPT 08 **Math & Statistics Anxiety: Their Causes and Treatment. Diane Johnson, Humboldt State University**
Math (or statistics) anxiety is defined as a feeling of tension, apprehension or fear that interferes with math (or statistics) performance. While it is most prevalent in remedial math students, math majors and even math professors may have traces of it. The causes and treatments are individual and often complex, but certain trends seem to stand out. I will discuss recent research findings concerning these trends.

SEPT 15 **The Statistical Paleontology of Charles Lyell and the Coupon Problem. Neil Schwertman, CSU Chico**
Lyell, a founder of the science of geology, used statistical models to describe the changes that had occurred in the earth and its environment. From this model he attempted to establish a time frame for each epoch. We will show that Lyell's model is equivalent to the classic coupon problem included in many probability texts. Furthermore, the time frame deduced by Lyell is inconsistent with the model he was using.

SEPT 22 **A Mathematical Theory of Ecological Traps. Roland Lamberson, Humboldt State University**
Habitat selection theory suggests that individuals should occupy those available habitats that maximize fitness; "ecological traps" result when they do not. Using a differential equations model, we study an ecological system in which patches may differ in fitness and appeal to organisms. Our results indicate that if the order of habitat preference corresponds to the expected fitness (that is, if the individuals know what's good for them!), then there can be at most one stable distribution of population. Multiple stable possibilities can exist only when lower-quality patches are preferred over higher quality patches, as in ecological traps.

SEPT 29 **Hubris, Weird Numbers, a Missing Asterisk, and Paul Erdos. Stan Benkoski, West Valley College**
This is the true story of a young mathematician who, in a fit of hubris, discovered weird numbers and, with the help of a missing asterisk, ended up with an Erdos number of 1.

OCT 06 **How does one see? Joe Latulippe, Montana State University** . . . . . ***Pizza after talk in Darwin 127***
Although we cannot answer this question we can begin to examine how the brain processes visual information, usually light. This talk will explore different cells in the layers which compose the visual system and identify them as "On"-Center, "Off"-Center, or Simple cells based on their receptive fields. We will discuss how we can use mathematics to model these cells, & obtain numerical results to verify this model.

OCT 13 **A Few Surprises from Calculus. Scott Farrand, Sacramento State University**
As calculus students often notice, $\frac{d}{dr}\left(\pi r^2\right) = 2\pi r$ and $\frac{d}{dr}\left(\frac{4}{3}\pi r^3\right) = 4\pi r^2$, but $\frac{d}{dx}\left(x^2\right) \neq 4x$ and $\frac{d}{dx}\left(x^3\right) \neq 6x^2$. So what's the deal with round things? We'll look at an unexpected connection between this and the standard calculus problem about building an open-top box using a rectangular piece of cardboard. One additional surprise from another standard calculus problem should serve as a reminder to anticipate the unexpected, even in a classical subject like calculus.

OCT 20 **A Gentle Introduction to Trigonometric Series. Sheldon Axler, San Francisco State University**
This talk will present an introduction to trigonometric series. Approximating a function by combinations of sines and cosines often leads to useful insights. Questions about the convergence of trigonometric series have led to many crucial concepts in modern mathematics.

OCT 27 **Mathematical Models and Spotted Owl Populations. Dan Munton, Santa Rosa Junior College**
Spotted Owls have inspired strong feelings and have been a source of controversy in California and the Pacific Northwest. We will blend the natural history of the spotted owl with mathematics and statistics to form and explore several mathematical models. We will discuss the assumptions of the models and their sometimes contradictory conclusions.

NOV 03 **Serendipity: Robots, DAGs, and Salmon Biology. Peter Baker, Stillwater Science**
There is something especially satisfying about turning up connections between ostensibly unrelated fields. I will discuss a few occasions on which I was able to make progress on a problem with the help of knowledge acquired more or less accidentally from an unexpected source.

NOV 10 **Phase Locking in Nature. Sunil Tiwari, Sonoma State University** . . . . . ***Pizza after talk in Darwin 127***
Phase locking of oscillators in nature is quite common. When a given oscillator fires, it pulls the other oscillators up by a fixed amount or brings them to the firing threshold. This interaction between the oscillators causes them to lock into mutual synchrony. Examples of oscillators in nature include synchronously flashing fireflies, and crickets that chirp in unison. This talk is about developing a mathematical model to explain this physical phenomenon.

NOV 17 **Unfolding Hyperbolic Polyhedra. Rick Scott, Santa Clara University**
Compact surfaces are classified by their genus (the number of "holes" in the surface) and whether they are orientable or not. Surfaces with genus > 1 turn out to be "hyperbolic,"meaning that one can define a distance between points on the surface in such a way that the curvature at every point is -1. A nice proof of this fact uses regular hyperbolic polygons to "build" the surface. We will begin the talk with a description of this construction then consider an analogous construction in three dimensions.

NOV 24 **THANKSGIVING BREAK**

DEC 01 **Mathematics of Protein Folding. Ben Ford, Sonoma State University**
Proteins are the tools by which DNA does its work; a protein's function is determined largely by its physical shape (and many diseases are caused by misfolding). The folded (least energy) shape of a protein is determined by its coding DNA sequence — but the resulting calculus minimization problem has thousands of variables and is not tractable. Many mathematical techniques can be brought to bear on this "protein folding" problem, including statistical, algorithmic, and dynamical systems approaches.

SONOMA STATE UNIVERSITY

Mathematics Department

(707) 664-2368 (707) 664-3535 FAX www.sonoma.edu/math

Talks may change: Please confirm with the Mathematics Department before a specific talk.

SPRING 2005 62nd SERIES

New Location! Rachel Carson 68

M*A*T*H COLLOQUIUM

Wednesdays 4 p.m.

The Mathematics Department of Sonoma State University presents a series of informal talks open to the public.

Mathematics is the process of turning coffee into theorems. **Paul Erdös**

FEB 09 Observing the Sun & Moon from Different Parts of the World. Helmer Alslaksen, National University of Singapore

We will discuss the motion of the Sun and the Moon from a "hemispherically correct" point of view, with special emphasis on the needs of "latitudinally challenged" observers. What does the orbit of the Moon around the Sun look like? Which day does the Sun rise earliest in San Francisco, Singapore or Sydney? How can we tell the difference between a waxing crescent Moon and a waning crescent Moon in San Francisco, Singapore or Sydney?

FEB 16 Modeling Pollution Problems with Delays. Clement E. Falbo, Sonoma State University

Mixing Problems that assume "well stirred" or "instantaneous distribution" are less realistic than models that assume nonzero delays in mixing. We use Delay Differential Equations (DDEs) to introduce "structured distribution" for mixing and pollution problems. We will show how to solve DDEs with readily available software such as EXCEL or even with MATHEMATICA.

FEB 23 Mathematica Toolkits. Elaine McDonald's Fall 2004 Math 180 Students, Sonoma State University

Joshua Clement, Rob Cunningham, Michelle Jensen, Julie Kellogg, and others will present their class projects on precognitive ability, animated Taylor series, a diagnostic test for diabetes, and constructing staircases. ***Pizza after talk.***

MAR 02 Folding and Unfolding in Computational Geometry. Lynn Stauffer, Sonoma State University

Computational geometry is a field of study that joins mathematical reasoning and computer algorithms. Folding of flat material and unfolding of a surface in 3D are important processes in applications. We will discuss 1D linkages, 2D foldings, and unfolding of polyhedra with applications in protein folding, computational origami, and manufacturing. Open problems will be highlighted.

MAR 09 Using Simulation-Based Optimization Methods to Solve Groundwater Flow Problems. Genetha Anne Gray, Sandia National Labs

Minimizing costs is important for the design of groundwater supply and remediation systems. Such design problems can be posed as optimization problems in which the variables: number of wells, well locations, and well pumping rates. These groundwater applications are significant challenges and serve as an excellent benchmarking tool. In this talk, we will describe a set of groundwater problems and explain how they were used to test and compare several optimization methods. We will focus on one method, APPSPACK, and show how results compare with the solutions from other optimization algorithms.

MAR 16 Graphical Degree Sequences. Tom Roby, California State University, Hayward

Graphs and partitions are well-known fundamental objects in combinatorics. Less well known is the connection between them via the notion of "graphical degree sequence," a list of vertex degrees of a graph. We will examine many natural questions. Which partitions are graphical? When is there a unique graph with a given degree sequence? What special class of graphs corresponds to partitions into distinct parts? We will also mention accessible open problems. ***Pizza after talk.***

MAR 23 An Introduction to Algebraic Curves. Stuart Smith, California State University, Hayward

The theory of algebraic curves is one of the oldest and richest areas in all of mathematics. Starting with the conic sections in ancient times, this fascinating subject has produced some of the most beautiful results in geometry, analysis, and algebra. This talk will give an elementary introduction to the subject with lots of illustrations and some historical background.

MAR 30 SPRING RECESS

APR 06 Probelm Solving. Alan H. Schoenfeld, University of California, Berkeley

What does it take to be a good problem solver? Knowing a lot? That doesn't hurt, of course. But there's lots more: problem solving strategies, metacognition (what's that?), and beliefs play an important role. (Beliefs? In Math?) Does this sound crazy? Well, you can find out.

APR 13 When Topology Meets Chemistry. Erica Flapan, Pomona College

Mirror image symmetry is important in predicting the behavior of molecules. Recently, knots and links and other non-planar molecules have been synthesized. These are so large that they no longer have the rigidity that is characteristic of small molecules. To understand the symmetries of such molecules we need to understand their deformations. Topology is used to analyze how geometric objects can be deformed and which properties of such objects will be preserved by deformations. In this talk we will discuss how topology helps us analyze the symmetries of flexible molecules.

APR 20 ☸ *Math Festival Day* ☸ Biological Sequence Analysis. Terry Speed, The Walter & Eliza Hall Institute, Australia

Biological macromolecules such as nucleic acids and proteins may be regarded as sequences or strings of letters. For DNA, the letters are A, C, G and T; while they are A, C, G and U for RNA; and the 20-letter alphabet for the biological amino acids in the case of proteins. Many chemical features of such molecules of structural or functional importance can be described in statistical terms involving these letters. The human (and other) genome project generates enormous numbers of DNA sequences. A great deal of effort is devoted to identifying functionally and structurally important features. We will illustrate how statistical models and methods play a large role in such annotation. ***Math Festival Dinner after talk.***

APR 27 The "Coin Exchange Problem" of Frobenius. Matthias Beck, San Francisco State University

How many ways are there to change 42 cents? How many ways will there be when all the pennies are gone? How about if nickels were worth four cents? The Frobenius problem asks for the largest integer that cannot be changed, given coins of denominations $a_1, \ldots, a_d$. This famous problem is solved for $d = 2$, somewhat solved for $d = 3$, and wide open for $d > 3$. We will outline some elementary approaches to the Frobenius problem.

MAY 04 Visualization in Mathematics via The Geometer's Sketchpad. Steven Rasmussen, Key Curriculum Press

Visualization tools like The Geometer's Sketchpad have had a profound impact on school mathematics, especially the way students learn geometry. But mathematical visualization via Sketchpad is not limited to the domain of geometry, nor to pre-college mathematics. We will look for new visual insights into mathematics in areas ranging from operations with numbers to complex analysis.

MAY 11 Computer Simulations of the Human Arterial System. Rebecca Honeyfield, University of California, Davis

General discussion of a computational model of blood flow in the human arterial system. Emphasis will be placed on using a one dimensional model in conjunction with a three dimensional model to examine flow behavior of diseased arteries. ***Pizza after talk.***

SONOMA STATE UNIVERSITY **Mathematics Department**

(707) 664-2368 (707) 664-3535 FAX www.sonoma.edu/math

Talks may change: Please confirm with the Mathematics Department before a specific talk.

FALL 2005

M*A*T*H COLLOQUIUM

63rd SERIES

Wednesdays 4p.m. * Rachel Carson Hall 68

THE MATHEMATICS DEPARTMENT OF SONOMA STATE UNIVERSITY PRESENTS A SERIES OF INFORMAL TALKS OPEN TO THE PUBLIC

"Mathematics is the process of turning coffee into theorems" –Paul Erdös

Aug 31 **THE CYCLOID; HELEN OF GEOMETRY.** JOHN MARTIN, SANTA ROSA JUNIOR COLLEGE

The cycloid has been called the Helen of Geometry not only because of its beauty but also because of the quarrels it provoked among 17th century mathematicians. The presenter will examine some of its beautiful properties (one being that the area under one arch of the cycloid is equal to three times the area of the generating circle) and see what caused some of the greatest mathematicians of the Scientific Revolution to get so worked up.

Sep 7 **RSA VERSUS CAYLEY-PURSER; A COMPARISON OF MODERN PUBLIC-KEY CRYPTOSYSTEMS**. STEVE SCHLUCHTER, SAINT MARY'S COLLEGE OF CALIFORNIA [☺ Pizza after talk ☺]

The presenter will explain the RSA encryption algorithm, the math behind it, and how to use it successfully. The mathematics of Cayley-Purser, a faster encryption system developed in mid 1990's, will also be discussed. Further, we will explore the mathematics behind the successful cracking of Cayley-Purser, leaving RSA as the industry standard in public key cryptography.

Sep 14 **AN INTRODUCTION TO ALGEBRAIC CURVES**. STUART SMITH, CALIFORNIA STATE UNIVERSITY, EASTBAY (FORMERLY HAYWARD)

The theory of algebraic curves is one of the oldest and richest areas in all of mathematics. Starting with the conic sections in ancient times, this fascinating subject has produced some of the most beautiful results in geometry, analysis, and algebra. In this talk, an elementary introduction to the subject with many illustrations and some historical background will be presented.

Sep 21 **LOOKING INSIDE AN 8TH GRADE MATH CLASSROOM.** EDITH MENDEZ, SONOMA STATE UNIVERSITY

What are the decisions a teacher needs to make in leading a mathematical discussion? What does a mathematics educator look for in this discussion? What can be learned from research into one classroom? The mathematics, pedagogy, and teacher knowledge will be explored with a video excerpt from an 8th grade class discussion.

Sep 28 **OPPORTUNITIES FOR MATHEMATICIANS IN BUSINESS DECISION ANALYSIS.** JEFFREY L. REICH, CHEVRON TEXACO; SSU ALUMNUS

Decision analysis--the forecasting of profit that would result from a business decision, given uncertainty about the future--is well suited to mathematicians familiar with algorithms, logic, and probability. The presenter will give a survey of mathematical topics with examples that are useful in the real world.

Oct 5 **FALLACIES IN ELEMENTARY STATISTICS.** ANN WATKINS, CALIFORNIA STATE UNIVERSITY, NORTHRIDGE

The presenter will have some fun demolishing several enticing examples that are commonly used in elementary statistics textbooks to illustrate the mean, median, and mode. Some mathematics backed up by a little data show that these concepts are not as intuitive as they appear.

Oct 12 **TEACHING AND LEARNING MATHEMATICS IN THE CENTURY OF DATA**. BILL FINZER, KEY CURRICULUM TECHNOLOGIES

Without computers, data were dry lists of numbers. With computers, data show pictures, music, and ideas. Not only are the ideas of mathematics particularly intertwined with data, but teaching and learning mathematics takes on new relevance in the presence of data. Once attuned to the possibilities, data jump from behind mathematical models and simulations. Lifting the corner of a blanket of data reveals powerful mathematical concepts. Some examples of classroom use of data and their far-reaching implications will be discussed.

Oct 19 **LORE OF THE TRIANGLE; FROM EUCLID TILL YESTERDAY**. RICK LUTTMANN, SONOMA STATE UNIVERSITY. [☺ Pizza after talk ☺]

The presenter will review some well-known properties of triangles and then some more recent results he encountered over 30 years as an Associate Editor of the Problem Section of the American Mathematical Monthly. Topics will include Special Points, the Vantage Point Theorem, the Nine-Point Circle, Steiner's, Ceva's and Desargues' Theorems, Pascal's Magic Hexagons, Nine Surprises, Seven Miracles, and more.

Oct 26 **BLOW-UP PROBLEM IN COMPRESSIBLE GAS DYNAMICS.** TIANHONG LI, STANFORD UNIVERSITY

Euler equations can describe the conservation of mass, momentum and energy of gas dynamics or compressible fluids. It is unknown whether the gas with finite mass blows up in density even with high inward initial velocity. The presenter will discuss some special solutions to the Euler equations. There is blow-up for infinite mass, but no blow-up for finite mass. This problem is a good application of the direction field analysis in ODE (Ordinary Differential Equations).

Nov 2 **GET RESULTS.** TEED ROCKWELL, SONOMA STATE UNIVERSITY

Some people have trouble with mathematics because most of their inner life consists of words, not images. In order to help students develop the visual pattern recognition skills needed for doing proofs in propositional logic, special exercises were designed for them. The result was a dramatic rise in students' performance. The presenter will discuss these exercises and show how these principles can be applied to teaching other branches of mathematics.

Nov 9 **GROUPS AND CRYSTALS.** TATIANA SHUBIN, SAN JOSE STATE UNIVERSITY

There are millions of diverse species of living organisms but only about 4000 different rocks. Yet it is generally much easier to distinguish living creatures, such as cats and dogs, than various rocks. Onyx, jasper, chalcedony, agate, and quartz are made of the same chemical "bricks". Only variant patterns of the bricks make them different. This leads us to mathematics, since classification of patterns is the realm where mathematics reigns supreme. The speaker will show how similar rocks are really different, and how objects as disparate as numbers, equations, and crystals are in fact pretty similar.

Nov 16 **CLUTCHING FOR SURVIVAL: THE CALIFORNIA CONDOR RESTORATION PROJECT.** THOMAS O'NEIL, CALIFORNIA POLYTECHNIC STATE UNIVERSITY, SAN LUIS OBISPO

The presenter will talk about what several groups of Cal Poly mathematics students did to support the California Condor Restoration Project over a four-year period. This will include using condor traits to model and construct a population projection program. The creation of a database containing every condor in captivity or in the wild, living or dead since 1987, will also be discussed.

Nov 23 **THANKSGIVING BREAK**

Nov 30 **AN INTRODUCTION TO BOTH MARKOV CHAINS AND GENETICS**. STEVE BLASBERG, WEST VALLEY COLLEGE [☺ Pizza after talk ☺]

Many well-known problems in genetics can be solved analytically by the use of the mathematical theory of Markov chains. A brief introduction to Markov chains and a demonstration of their applicability to such questions as the Brother-Sister Mating Problem and other scandalous situations will be presented.

SONOMA STATE UNIVERSITY

Mathematics Department

(707) 664-2368 (707) 664-3535 FAX www.sonoma.edu/math

Talks may change: Please confirm with the Mathematics Office before a specific talk

SPRING 2006

M*A*T*H COLLOQUIUM

64th SERIES

Wednesdays 4p.m. Stevenson 1002

THE MATHEMATICS DEPARTMENT OF SONOMA STATE UNIVERSITY PRESENTS A SERIES OF INFORMAL TALKS OPEN TO THE PUBLIC

"Mathematics is the process of turning coffee into theorems" –Paul Erdös

Feb 8 **THE TRIANGLE: GREATEST HITS.** RICK LUTTMANN, DEPARTMENT OF MATHEMATICS, SONOMA STATE UNIVERSITY

The speaker will reprise some of the results (special triangle points, vantage point theorem, nine-point circle, Steiner's, Ceva's and Desargues' theorems, Paschal's magic hexagons) discussed in his Fall 2005 talk and add new ones: orthic lore, theorems of Meyer, Van Lamoen, Wallace, Sachelarie, and Bellot-Rosada, and a new result by the speaker, Chakerian, de Guzman and Romero Marquez.

Feb 15 **SOME CAR PROBLEMS ARE MATHEMATICAL**. RICK POSS, ST. NORBERT COLLEGE, DE PERE, WISCONSIN

Cars are a large part of our lives. In our daily driving experiences, we often encounter mathematical situations. We will discuss a variety of these elementary problems.

Feb 22 **STUDENT PROJECTS.** ELAINE MCDONALD, DEPARTMENT OF MATHEMATICS, SONOMA STATE UNIVERSITY

Students will present projects using Mathematica from the Fall 2005 Math 180 class taught by Prof. McDonald. [☺ Pizza after talk ☺]

Mar 1 **SLICING BAGELS: PLANE SECTIONS OF REAL AND COMPLEX TORI.** DAVID SKLAR, SAN FRANCISCO STATE UNIVERSITY

We first see how a number of familiar curves (along with some surprises) arise as plane sections of an ordinary circular torus. We also try to understand why the graph of a particular cubic equation is a torus. This involves an algebraic closure, a geometric closure and some plane sections from the first part of the talk.

Mar 8 **NEVER UNDERESTIMATE A THEOREM THAT COUNTS SOMETHING.** TYLER EVANS, HUMBOLDT STATE UNIVERSITY

Mathematicians love a good counting argument, especially when applications of it yield a variety of seemingly unrelated results. In this talk, we will generalize a combinatorial lemma to obtain three divisibility theorems for which three classical theorems (Fermat's (little), Wilson's and Lucas') are special cases. The talk is appropriate for all undergraduate mathematics students and those with experience in abstract algebra and number theory are particularly encouraged to attend.

Mar 15 **WHEN QUILTERS AND CARVERS MARRY, STARS AND POLYGONS HAPPEN.** ANN HERBST, SANTA ROSA JUNIOR COLLEGE

To create polygons and stars, folk artists ask, "How do I divide a circle into *n* equal parts?" This question leads to divisibility problems in number theory, as well as various geometric construction methods and approximations.

Mar 22 **THE MATHEMATICS OF COMPLEXITY.** DEBORA HAMMOND, HUTCHINS SCHOOL, SONOMA STATE UNIVERSITY

The speaker will give an overview of cutting-edge work in the field of complexity, focusing on such topics as non-linear dynamics, agent-based modeling, networks and power laws. In addition, she will share results from a collaborative project with other scholars entitled "Can Complexity Studies Advance Sustainability? Scaling in Natural and Social Systems."

Mar 29 **HOW TO UNTIE A KNOT (AND BECOME RULER OF THE WORLD).** THOMAS MATTMAN, CHICO STATE UNIVERSITY

The legend of the Gordian knot held that whoever untied the knot would become the ruler of the world. Alexander the Great fulfilled the prophecy by going on to conquer Persia (in other words, most of the known world) after dealing with the famous knot. We will discuss Alexander's method for untying knots and how recent research connecting mathematics and physics has given new insight into this program. The talk will also feature some square knot dancing.

Apr 5 **A UNIFIED APPROACH TO GRAPHING RATIONAL FUNCTIONS.** STEVE WILSON, DEPARTMENT OF MATHEMATICS, SONOMA STATE UNIVERSITY

Rational functions of the same degrees can have very different looking graphs depending on the location of the roots for the numerator and denominator. However, given degrees for numerator and denominator, it is possible to derive one formula that will cover all cases.

[☺ Pizza after talk ☺]

Apr 12 **A STAR IS BORN.** KEMBLE YATES, SOUTHERN OREGON UNIVERSITY

Stars are born, they live, and then die. But HOW are they born? James Jeans gave us a modern theory of star formation, complete with mathematical and physical analysis, in 1902. The speaker will give a short history of developments since then, including a model of his own and conclude with the state of the star formation theory today

Apr 26 **THE MATH INSTINCT: THE AMAZING MATHEMATICAL ABILITIES OF ANIMALS, BIRDS, INSECTS AND BABIES AND WHAT CAN WE LEARN FROM THEM.** KEITH DEVLIN, EXECUTIVE DIRECTOR, CSLI, STANFORD UNIVERSITY **[MATH FESTIVAL]**

Many people think they do not have mathematical ability. But they are wrong. Numerous studies have shown that practically every one of us has considerable facility with basic math. We just don't know it. Give the average person a math test and they will score poorly. But present them with the very same problems in the form of a real-life activity (which they maybe don't think of as math) and they will score in the 95-100% range. In fact, it's not just ordinary people that have mathematical abilities. So do several species of animals. You don't believe any of this? Then come to the talk.

Apr 19 **SPRING BREAK**

May 3 **MATHEMATICS AND A LIBERAL EDUCATION: STRATEGIES FOR APPRECIATION AND SKILL BUILDING.** MUTOMBO M'PANYA, HUTCHINS SCHOOL, SONOMA STATE UNIVERSITY

For the most part, teaching mathematics to liberal education students has emphasized mathematical skills; there is little effort to foster an appreciation of mathematical culture. The speaker will discuss a different strategy, which is to build both mathematical skills and appreciation through seminar discussion and critical thinking. He will explore the approaches used in his course "Mathematics and Human Imagination" taught in the Hutchins School of Liberal Studies. Students who have been working on these strategies will be part of the discussion.

[☺ Pizza after talk ☺]

SONOMA STATE UNIVERSITY

Mathematics Department

(707) 664-2368 (707) 664-3535 FAX www.sonoma.edu/math

Talks may change: Please confirm with the Mathematics Office before a specific talk

FALL 2006

M*A*T*H COLLOQUIUM

65th SERIES

Wednesdays 4p.m. Darwin 103

THE MATHEMATICS DEPARTMENT OF SONOMA STATE UNIVERSITY PRESENTS A SERIES OF INFORMAL TALKS OPEN TO THE PUBLIC

"Mathematics is the process of turning coffee into theorems" –Paul Erdös

Sep 6 **DESCARTES TANGENT LINES.** BILL BARNIER, SONOMA STATE UNIVERSITY
A tangent line that intersects a given curve exactly once (only at the point of tangency) is called a Descartes Tangent Line. Question: For *n* a positive integer, can you find a curve that admits exactly *n* Descartes Tangent Lines? This talk will be very graphical and should be accessible to any student who has had experience with graphs of functions. [☺ Pizza after talk ☺]

Sep 13 **COOKIES, CARS AND STATISTICAL PROCESS CONTROL.** Susan Herring, Sonoma State University
If you have ever gotten home from shopping to find the item you purchased was defective then this talk will be of interest to you. Find out the difference between quality control, quality assurance and statistical process control. Applications of statistical process control will be discussed in fields as diverse as manufacturing, teaching and baking cookies.

Sep 20 **GEOMETER'S SKETCHPAD® IS YOUR FRIEND.** Sam Brannen, Sonoma State University
The speaker will display the power and beauty of Geometer's Sketchpad® through a series of demonstrations, including the constructions of fractals and tessellations.

Sep 27 **MATHEMATICAL MYSTERIES OF SUDOKU.** Rick Luttmann, Sonoma State University
The speaker will discuss the origins of Sudoku, techniques of solution for both people and computers, how to create puzzles, and some interesting quantitative questions (some answered, some still open) such as how many puzzles are there, how many completed grids are there, and what is the minimum number of clues that will determine a unique solution. [☺ Pizza after talk ☺]

Oct 4 **MATH IN THE MOVIES.** Jeff Clark, Santa Rosa Junior College
Have you ever sat down and watched a movie, heard or seen some mathematics spoken or demonstrated and wondered if it was said or done correctly? In this talk you will be shown clips from movies such as Contact, U571 and Castaway and see if Hollywood got it right.

Oct 11 **CHEMICAL SYNAPSES AND CELL COMMUNICATION - THE HODGKIN-HUXLEY APPROACH.** Sunil Tiwari, Sonoma State University
The speaker will discuss a Nobel prize winning experiment by Hodgkin and Huxley in medicine (1963) and will give a mathematical explanation of cell-to-cell communication involving chemical synapses. Synapses are circuits in which the neurons of the central nervous system interconnect. They are thus crucial to the biological computations that underlie perception and thought.

Oct 18 **THE STATISTICS OF STUDENT SUCCESS.** Cora Neal, Sonoma State University
Learn about the field of Institutional Research as we look at decisions all universities have to make and the problems they face. Several statistical techniques will be used to investigate a data set involving Native Alaskan students at the University of Alaska Anchorage.

Oct 25 **KNOWING MATHEMATICS AND TEACHING MATHEMATICS.** Rick Marks, Sonoma State University
A teacher of mathematics calls upon a specialized knowledge of mathematics that is different from the mathematical knowledge of a layperson, a teacher of other content areas, and even a mathematician. This pedagogical content knowledge has ties to epistemology, learning theory, educational policies and standards, research, and teacher preparation. We will explore this idea from a variety of perspectives, both theoretical and practical.

Nov 1 **TEACHING HIGH SCHOOL MATH – REWARDS & PERILS.** Yolanda Woods, Emily Savinar-Nogue, & Sean Gregory, Napa High School
Three teachers from Napa High will discuss the difficulties and joys of their chosen vocation and how their schooling and experience have contributed to what they know about the science and art of teaching mathematics. Issues such as No Child Left Behind and the emphasis on high stakes achievement tests, quality teaching and the search for "highly qualified" teachers, along with teacher shortage will also be discussed. [☺ Pizza after talk ☺]

Nov 8 **LAWS OF SINES AND COSINES AS TAUGHT BY BARTHOLEMAUS PITICUS (1561-1613).** Clement Falbo, Professor Emeritus, Sonoma State University
In 1595, Bartholemaus Piticus wrote a popular Trigonometry text that went through six editions, over a period of 35 years. We will reconstruct his proofs for the laws of sines and cosines from fragments of his 1612 edition. The derivations are interesting applications of "circle geometry." We will use these laws to prove a theorem invented in 2005.

Nov 15 **MATHEMATICAL ECOLOGY AND LANGUAGE COMPETITION.** Ben Ford, Sonoma State University
Your country's native language (Irish, French, . . .) is threatened by competition from another language (likely English!). If preserving the local language is important, what options do you have? Which of them are most likely to be effective? How much time do you have before the language is effectively dead? We'll look at tools from mathematical ecology that have been adapted to help explore these and other questions from the social sciences.

Nov 22 **THANKSGIVING RECESS**

Nov 29 **MATHEMATICAL MODELS FOR MUSICAL SOUND.** Rick Kavinoky, Santa Rosa Junior College
The wave equation (a differential equation) in one and two dimensions determines the modes of vibration of musical instruments, for example strings (one dimension) and drumheads (two dimensions). Fourier series help to analyze, compress, and reconstruct the sound.

Dec 6 **THE KAUFFMAN-HARARY CONJECTURE FOR TURK'S HEAD BRAIDS.** Nick Dowdall, Sonoma State University
The Kauffman-Harary Conjecture (KHC) is an open conjecture in knot theory concerning "Colorability Of Alternating Knots." This talk will outline a proof that the KHC holds over all Turk's Head Knots. This talk will be accessible for all undergraduate students. [☺ Pizza after talk ☺]

SONOMA STATE UNIVERSITY

MATHEMATICS DEPARTMENT

(707) 664-2368 (707) 664-3535 FAX www.sonoma.edu/math

TO CELEBRATE MOVING BACK INTO DARWIN HALL, ALL PRESENTATIONS WILL BE GIVEN BY PEOPLE WITH TIES TO THE SONOMA STATE DEPARTMENT OF MATHEMATICS.

Talks may change: Please confirm with the Mathematics Office before a specific talk

SPRING 2007

M*A*T*H COLLOQUIUM

66th SERIES

Wednesdays 4 p.m. Darwin 103
Coffee, tea, and cookies at 3:45

The Mathematics Department of Sonoma State University presents a series of informal talks open to the public

"Mathematics is the process of turning coffee into theorems" –Paul Erdös

Feb7 **Thinking In and Out of Context.** Eric Hsu, San Francisco State University
The speaker will discuss different ways that context affects student thinking and behavior, and consider some implications for teaching practice. Problems that are mathematically equivalent, but which are very different in difficulty due to details of their setting, will be examined. How does the strange context of school influence thinking in unexpected ways? [☺ Pizza after talk ☺]

Feb 14 **Some Hot Button Issues in Math Education.** Diane Resek, San Francisco State University
It may seem that there could be nothing very controversial about math education. You just put it out and people learn. However, what 'it' should be, how you 'put it out', and how to test what may have been learned are all very hot issues in the California Math War.

Feb 21 **Expanders and Superconcentrators and Ubiquity.** Prof. George Ledin, Computer Science, Sonoma State University
Graph theory has much to offer to wireless sensor networks. Pervasive computing or smart dust can be modeled as very large random, strongly regular, near perfect, graphs, connected independent dominating sets, and other interesting structures. This talk is an introductory survey of the status of sensor network technology and a quick guided tour to potentially promising graph models which can help understand and formalize the inherent computational security issues.

Feb 28 **The Algebra Textbook of abu Ja'far Mohammed ibn Musa al-Khwarizmi.** Dean Gooch, Santa Rosa Junior College
Who was Mohammed ibn Musa? His text, *Hisab al-jabr w'al-muqabala,* is considered to be the original algebra text. It is in fact the origin of the English word algebra. When, where, and why did he write this book? Did he write other works? Which mathematical traditions affected his ideas? How did his work influence modern mathematics? Some of the answers to these questions will be presented, many of which are surprising.
[☺ Pizza after talk ☺]

March 7 **Geometric Decompositions—Taking Figures Apart and Putting Other Ones Together.** Tom Sallee, University of California, Davis
Some geometric decompositions are easy converting a unit square into a 2 x ½ rectangle—and some are not at all obvious. The speaker will look at both real-world decompositions and some of the paradoxical ones like breaking a solid ball up and rearranging the pieces to get two solid balls the same size.

March 14 **Topological Analysis of Enzymatic Actions.** Mariel Vazquez, San Francisco State University
DNA topology is the study of geometrical (supercoiling) and topological (knotting) properties of DNA loops and circular DNA molecules. Certain enzymes such as DNA topoisomerases change the topology of circular DNA. The speaker will discuss the analysis of such enzymatic actions using knot theory and computational methods

March 21 **Complexity Revealed.** Ned Kahn, Sebastopol
An artist who draws his inspiration from physics, fluid mechanics, atmospheric science and mathematics, will present a series of videos of his kinetic artworks. "Kahn combines science, art and technology to integrate natural, human, and artificial systems, and his specific works emphasize natural elements, such as water, fire, wind and sand; how these behave independently, and how they interact." (From "An Aesthetic of Turbulence: The Works of Ned Kahn" by David Mather in *SARAI Reader 2006 Turbulence.*)

March 28 **Safe Sets and the Algebra of Four-Colorings.** Sean Lloyd, College of Marin
Mathematicians can be kept amused for hours trying to color the pictures in a coloring book with only four crayons. One approach to showing that this is always possible is to build four-colorable pictures from simpler ones by two operations: splitting a boundary edge in two with a new vertex and splitting a region in two with a new edge which joins pre-existing vertices. Of these two operations, it is only obvious that four-colorability is preserved by the first. The speaker will give two large classes of four-colorable maps preserved by the second operation but not necessarily the first. [☺ Pizza after talk ☺]

April 4 **Algebra is Required for High School Graduation—But What Algebra? What is Algebra?** Judy Kysh, San Francisco State University
The speaker will consider examples from school algebra and how it has changed (or not) over the past century, what are the big ideas of algebra, what from school algebra is necessary and useful, what might be more useful, and even of interest to more students? Algebra is often taught using a tell-and-practice approach. An example to illustrate how algebra is most often taught and how it might be taught more effectively will be demonstrated.

April 11 **Spring Break**

April 18 **The Plane Has More Points Than You Might Think.** David Eisenbud, Mathematical Sciences Research Institute (MSRI)
From the right point of view the circle, ellipse, parabola and hyperbola are not just related—they are the same! The speaker will explain some of their relations as sections of a cone, and then talk about how modern geometers have learned to understand them better by adding points of various kinds to the plane. [Math Festival dinner follows.]

April 25 **Some Unsolved Problems for Latin Squares.** Sherman Stein, University of California, Davis
A Latin square of order n is an n by n square consisting of n^2 cells. In each cell is one of the integers from 1 to n. Each row and each column has no duplications. (A Sudoku puzzle is an example of order 9, with extra conditions.) In 1779 Euler asked when you can find n cells, one from each column and from each row, that have different entries. We generalize this question, describe a few results, and invite mathematicians and computer programmers to explore this new area. .

May 2 **Function, Design, and Evolution of Gene Circuitry.** Michael Savageau, University of California, Davis
The physical basis for complex phenotypes is the context-dependent expression of the organism's genome. The regulation of many gene systems has been studied in detail, and the results have revealed an enormous diversity of molecular elements and circuits. The relationship of these variations in design to the phenotype of the organism requires a quantitative systems approach to elucidate these relationships. The first part of the talk treats the mathematical methods for characterizing and comparing the function of gene circuits**.**

May 9 **Is It Knotted?** Abigail Thompson, University of California, Davis
The speaker will describe some coloring problems and their relation to the problem of deciding whether a particular knot is really knotted. The idea of a probabilistic proof of knottedness will also be introduced. ("In mathematics, a knot is defined as a closed, non-self-intersecting curve that is embedded in three dimensions and cannot be untangled to produce a simple loop (i.e., the unknot)." *MathWorld*

May 16 **A Different Type of Approximation.** Bin Lu, California State University, Sacramento
In calculus, it is known that the main idea of Taylor polynomials is to approximate a given function at a particular point by a polynomial. As polynomials are very nice functions, it is not too hard to imagine they cannot approximate "nasty" functions very well. In this talk, a different kind of approximation, which often works better and efficiently, will be discussed. [☺ Pizza after talk ☺]

SONOMA STATE UNIVERSITY

MATHEMATICS DEPARTMENT
(707) 664-2368 (707) 664-3535 FAX www.sonoma.edu/math

Talks may change: Please confirm with the Mathematics Office before a specific talk

FALL 2007

M*A*T*H COLLOQUIUM

67th SERIES

WEDNESDAYS 4 P.M. DARWIN 103

Coffee, tea, and cookies at 3:45

THE MATHEMATICS DEPARTMENT OF SONOMA STATE UNIVERSITY PRESENTS A SERIES OF INFORMAL TALKS OPEN TO THE PUBLIC

"Mathematics is the process of turning coffee into theorems" –Paul Erdös

Aug 29 **INTERLOCKING CHAINS** JULIE GLASS, MATHEMATICS DEPT. CALIFORNIA STATE UNIVERSITY EAST BAY

This talk will introduce the audience to some of the basic ideas used in the study of chains in the area of computational geometry. A *chain* is a collection of rigid bars connected at their vertices (also known as a linkage), which form a simple path (an open chain) or a simple cycle (a closed chain). A *folding* of a chain (or any linkage) is a certain reconfiguration obtained by moving the vertices. A collection of chains are said to be *interlocked* if they cannot be separated by foldings. This talk will explain some standard techniques using geometry and knot theory to address the problem of when linkages are interlocked. Finally, we will answer the question, "Can a 2-chain and a k-chain be interlocked?" This talk will be accessible to a broad audience.

SEPT 5 **THE JEWEL IN THE CROWN QUADRATIC RECIPROCITY** RICK LUTTMANN, MATHEMATICS DEPARTMENT, SONOMA STATE UNIVERSITY

We will discuss the Law of Quadratic Reciprocity, which Gauss famously described as the Jewel in the Crown, Number Theory, on the head of the Queen of the Sciences, Mathematics. The Law arises from the question: Which possible remainder can the perfect squares have when divided by any number *m?*

Pizza after talk

SEPT 12 **YEARNING FOR THE IMPOSSIBLE** JOHN STILLWELL, DEPARTMENT OF MATHEMATICS, UNIVERSITY OF SAN FRANCISCO

Many of the most important concepts in mathematics were once thought to be impossible; for example, irrational and imaginary numbers, infinitesimals, points at infinity, the fourth dimension, and curved space. Thus it seems that yearning for the impossible can be fruitful, but why? Kolmogorov once wrote (in his diary, 14 September, 1943): "At a given moment there is only a fine layer between the 'trivial' and the impossible. Mathematical discoveries are made in this layer." This talk will review some of the close encounters with the impossible on which mathematics thrives, with illustrations of the impossible in the art of Escher, Magritte, and others

SEPT 19 **ONLINE HOMEWORK IN MATHEMATICS COURSES** MICHAEL SCOTT, DEPARTMENT OF MATHEMATICS, CSU MONTEREY BAY

Many universities are supplementing mathematics courses with online homework. The speaker will discuss issues using an online homework system in a mathematics course and student interaction with the system. How data generated by the online system can be used to evaluate student achievement in the course will also be examined.

SEPT 26 **A PIECE OF π** JOHN MARTIN, MATHEMATICS DEPARTMENT, SANTA ROSA JUNIOR COLLEGE

Through the ages the ratio of the circumference of a circle to its diameter, which we call π, has fascinated mathematicians and non-mathematicians alike. In this presentation we will explore the history, mysteries, and the controversies surrounding this famous number **Pizza after talk**

0CT 3 **A PUZZLE OF KEYS AND A PROBLEM IN GRAPH THEORY** SARAH MERZ, UNIVERSITY OF THE PACIFIC

In 1979, Frank Rubin posed the following puzzle in Recreational Mathematics: *Professor X, who is blind, keeps keys on a circular key ring. Suppose there are a variety of handle shapes available that can be distinguished by touch. How many shapes does Professor X need to use in order to keep n keys on the ring and still be able to select the proper key by feel?* Generalized as a graph theory problem, this puzzle has been well studied. We will discuss this problem as viewed in the setting of directed graphs

OCT 10 **SENSORY INPUT PROCESSING IN THE BRAIN** MARTY BANKS AND JOHANNES BURGE, VISUAL SPACE PERCEPTION LABORATORY, UC, BERKELEY

We use several sources of sensory information when estimating properties of the environment. For example, the eyes and hands both provide relevant information concerning an object's shape. The eyes estimate shape using binocular disparity (differences in the images to the two eyes) and pictorial cues (also used by painters). The hands supply shape information by means of tactile and proprioceptive cues. How does the brain combine these inputs to make sense of the environment? We explore this and related questions via experimentation and mathematical models.

OCT 17 **MODELING FOR FISHERIES ENGINEERING** JOEY HOWARD, M.S., P.E. AND BRAD HALL, M.S., P.E., NORTHWEST HYDRAULIC CONSULTANTS

Hydrodynamics, the science of moving fluids, serves as the basis for designing fisheries improvements. Both numerical and physical modeling are used to represent environmental conditions. In numerical modeling, equations governing the fluid flow – velocity and pressure are the key parameters – are solved numerically to find steady-state or time-variant conditions. One-, two-, and three-dimensional models are all useful. In physical modeling, principles of scaling and similitude help establish the relationship between parameters in a physical model and those in the real world. This talk will show examples of each approach and discuss their applicability and limitations.

OCT 24 **THE MATHEMATICS OF RSA ENCRYPTION OVER THE INTERNET** GLENN CAESAR, MATHEMATICS DEPT. SANTA ROSA JUNIOR COLLEGE

How is private information, such as credit card numbers, safely sent over the Internet? We will look at how RSA encryption uses Fermat's Little Theorem, prime numbers and the Chinese Remainder Theorem to protect such information from hackers.

OCT 31 **THE MATHEMATICS OF TRAFFIC JAMS** BEN FORD, MATHEMATICS DEPARTMENT, SONOMA STATE UNIVERSITY

Ever been stuck in traffic and wondered what caused the jam? While some seem to be caused by particular events – accidents, sights along the side of the road, etc. – many appear out of nowhere in otherwise smoothly-flowing traffic. We'll explore various models that are used to model traffic flow, and see if any of them can help you get around faster! **Pizza after talk**

NOV 7 **MATHEMATICS AND POPULAR CULTURE: THE USUAL SUSPECTS** CHRISTOPHER GOFF, MATHEMATICS DEPT. UNIVERSITY OF THE PACIFIC

Mathematics shows up on both the small and large screen, and not just in expected places, like the TV show *NUMB3RS* or the movie *A Beautiful Mind*. We also see unexpected characters with mathematical talent, such as Lindsey Lohan's Cady in *Mean Girls*, or Hex, voiced by Kristen Bell of TV's *Veronica Mars*, in the newly released *Flatland: the Movie*. This talk will discuss various Hollywood representations of mathematically talented individuals as well as the interplay between mathematics and popular culture. And then we'll watch clips from *Flatland*.

NOV 14 **CONTINUED FRACTIONS AND CACTUS** BEN LEVITT, DEPARTMENT OF MATHEMATICS AND STATISTICS, CALIFORNIA STATE UNIVERSITY, CHICO

This talk will provide an introduction to continued fractions and highlight some of the interesting patterns they reveal. We will learn how to write our own continued fraction approximations and see how simple arithmetic can be used to investigate unsolved problems in Number Theory. This will all, somehow, be related to cactus.

NOV 21 **THANKSGIVING –NO TALK**

NOV 28 **DO YOU USE DRUGS? DOES "NO" MEAN "NO"- OR DOES IT MEAN "YES, BUT NOT RIGHT NOW?** DAVID B. NEAL, MANAGER, STATISTICAL ANALYSIS, UNITED BEHAVIORAL HEALTH

Delve into the world of behavioral research and statistical modeling through a look at drug usage patterns for a sample of injection drug users and cocaine smokers not currently in treatment. This discussion will explore various statistical models suited for this type of data. **Pizza after talk**

MATHEMATICS DEPARTMENT

(707) 664-2368 (707) 664-3535 FAX www.sonoma.edu/math

Talks may change: Please confirm with the Mathematics Office before a specific talk

M*A*T*H COLLOQUIUM

Wednesdays 4 p.m. Darwin 103
Coffee, tea, and cookies @ 3:45 p.m.

Sonoma State University Department of Mathematics and Statistics presents a series of informal talks open to the public

"Mathematics is the process of turning coffee into theorems" Paul Erdös

Feb 6	**Fire in Our Midst (A Statistician's Perspective)**	Haiganoush Preisler, Pacific Southwest Research Station, USDA Forest Service
	As a mathematical statistician for the Forest Service I have worked on a variety of data analysis issues concerning wildfires. These range from studies on the effects of evolving climate on probabilities of forest fires to studies on the effects of fires on the quality of the soil under trees and the air above them. We will explore some of the statistical analysis techniques.	
Feb 13	**Predicting Sex of Golden Eagles Using Different Statistical Techniques**	Kathy Gray, California State University, Chico
	How do you tell the sex of a Golden Eagle? Since there are no external distinguishing characteristics, it's not as easy as you might think, and requires a blood test to determine definitively. We will look at three different methods for predicting sex of Golden Eagles, using footpad size and body weight, which are common measurements collected in the field. We will determine which statistical method has the greatest predictive power.	
Feb 20	**Thinking About Symmetry**	Christine Latulippe, Department of Mathematics, California State Polytechnic University, Pomona
	Is geometry about "2-column proofs" or is geometry about seeing the world around you in a different way? This talk is intended to help teachers and others gain insight into symmetry including its mathematical, natural, and cultural significances. Geometry - and especially symmetry - is all around us.	
Feb 27	**Measuring to the Stars: The Apotheosis of Trig**	Rick Luttmann, Department of Mathematics and Statistics, Sonoma State University
	We will describe the series of clever mathematical applications of triangle trigonometry which, along with some physics, allow us to infer distances to increasingly distant objects in the universe, beginning with the measurement of the earth and ending with the most distant galaxies. *Pizza after Talk*	
Mar 5	**The Space Of Evolutionary Trees and Upgma Algorithm**	Serkan Hosten, Mathematics Department, San Francisco State University
	An evolutionary (or phylogenetic) tree is like a family tree for species, showing possible evolutionary relationships between past and current species. There is a classical algorithm (UPGMA) that finds a "good" evolutionary tree given distance data between species (where distance is a measure of how much the DNA of these species differ). We will describe the way in which all possible phylogenetic trees form a geometric space, and show that the UPGMA algorithm performs an orthogonal projection to this space.	
Mar 12	**Population Genetics Model for Autism**	Joe Latulippe, Department of Mathematics, California State Polytechnic University, Pomona
	There are many questions about the prevalence of Autism in today's society. Many researchers consider genes to be involved in the Autistic Spectrum Disorder (ASD). In this talk we will investigate a basic mathematical model for genetic evolution and more specifically how it may relate to autism.	
Mar 19	**Student Projects from the Fall 2007 Math 180 Class**	Bill Barnier, Department of Mathematics and Statistics, Sonoma State University
	Amelia Beede, Karen Gladysz, Greg Morre, Y Vu, and Holly Wright will present Mathematica projects on planning your menu, trig function graphs, the game of war, finding the best size containers, and paying off your loans. *Pizza after Talk*	
Mar 26	**Spring Break–No Talk**	
Apr 2	**The Petersen Graph: The Tale of the Famous Graph**	Izabela Kanaana Department of Mathematics and Statistics, Sonoma State University
	The Petersen Graph is a cubic graph with 10 vertices and 15 edges, which has fascinated mathematicians for many years. It serves as a useful example and counterexample for many problems in graph theory, giving it a unique place in the field. In this talk we will discuss the origins of the Petersen graph and its most interesting properties. *Pizza after Talk*	
Apr 9	**Easy-to-Explain But Hard-to-Solve Problems in Polyhedral Geometry**	Jesus DeLoera, Mathematics Department, University of California, Davis
	Examples of polyhedral sets are cubes and triangles. These are figures that do not have "holes" or "valleys" and flat surfaces. Polyhedra are finding more and more applications in such diverse fields as optimization, statistics, algebra, and computer science. In this talk we will convince the audience that there is life after calculus and that even the most seasoned of mathematicians can't solve easy-to-understand questions about polyhedra	
Apr 16	**Cyclotomic Polynomials and the Length of the Repeated Portion of Decimal Fractions**	Dean Gooch, Mathematics Department, Santa Rosa Junior College
	Why is it that when writing the decimal representation of 1/47 it does not repeat until after the forty-sixth digit? It only takes five digits for the decimal expansion of 1/41 to repeat! A simple method for determining the lengths of the repeated portions of fractions using cyclotomic polynomials will be given. No previous knowledge of cyclotomic polynomials is needed. Only the usual factoring techniques and some knowledge of prime numbers will be assumed.	
Apr 23	**From Flapping Birds to SpaceTelescopes: The Modern Science of Origami**	Mathematics Festival Day
	Robert Lang, Robert J Lang Origami; Editor in Chief, IEEE Journal of Quantum Electronics	
	The last decade of this past century has been witness to a revolution in the development and application of mathematical techniques to *origami*, the centuries-old Japanese art of paper-folding. The techniques used in mathematical origami design range from the abstruse to the highly approachable. In this talk, I will describe how geometric concepts led to the solution of a broad class of origami folding problems – specifically, the problem of efficiently folding a shape with an arbitrary number and arrangement of flaps - and along the way, enabled origami designs of mind-blowing complexity and realism, some of which you'll see, too. As often happens in mathematics, theory originally developed for its own sake has led to some surprising practical applications. The algorithms and theorems of origami design have shed light on long-standing mathematical questions and have solved practical engineering problems. I will discuss examples of how origami has enabled safer airbags, Brobdingnagian space telescopes, and more. (Math Festival Dinner follows)	
Apr 30	**What do Students Learn in Statistics?**	Brian Jersky, Dean of Science, Saint Mary's College of California
	Recent research in statistics education has investigated what students bring to the typical undergraduate introductory statistics class (more than you might think) and what they take away from it (less than you might think). In this talk, I will review the research and show how the results might inform our teaching of the subject.	
May 7	**Investigating Psychic Phenomena with Statistics**	Jessica Utts, Department of Statistics, University of California, Davis
	Anecdotal stories about phenomena such as telepathy (mind to mind communication) and precognition (knowledge of the future) are intriguing and compelling. But they do not constitute solid evidence for these phenomena because in any given case, random events or normal methods of communication can provide alternative explanations. For several decades, scientists have been studying these alleged abilities using well-designed experiments and simple statistical methods. This talk will cover the basics of these experiments and the statistical methods used to analyze them, and speculate on what can be concluded from this research. *Pizza after Talk*	

DEPARTMENT OF MATHEMATICS AND STATISTICS
(707) 664-2368 (707) 664-3535 www.sonoma.edu/math

Talks may change: Please confirm with the Department of Mathematics and Statistics before a specific talk

Fall 2008 **69th Series**

M*A*T*H COLLOQUIUM

Wednesdays 4 p.m. Darwin 103
Coffee, Tea & Cookies @ 3:45 p.m.

Sonoma State University Department of Mathematics and Statistics presents a series of informal talks open to the public

"Mathematics is the process of turning coffee into theorems" Paul Erdös

---

Sep 3 **Taking Symbols Seriously** — Brigitte Lahme, Sonoma State University

Current algebra teaching often emphasizes the idea of a function from multiple viewpoints. In this talk we will focus on the symbolic aspect of algebra, discussing what it means for students to acquire symbolic literacy. We will highlight the algebraic concepts that are essential for procedural fluency and for success in college. Common misconceptions about functions, expressions, equations, and equivalence will give us a window into student thinking. We will look at questions that probe student understanding and at examples that demonstrate why algebra has earned such a large role in the school curriculum.

Sep 10 **Flatland Video**

Flatland: The Movie is an animated film inspired by Edwin A. Abbott's classic novel, Flatland. Set in a world of only two dimensions inhabited by sentient geometrical shapes, the story follows Arthur Square and his ever-curious granddaughter Hex. When a mysterious visitor arrives from Spaceland, Arthur and Hex must come to terms with the truth of the third dimension, risking dire consequences from the evil Circles that have ruled Flatland for a thousand years *[Pizza after talk]*

Sep 17 **Zoology of Convex Bodies** — Ellen Veomett, CSU, East Bay

In this talk, we will study the fascinating creatures called convex bodies, who live in the wilderness which we call vector spaces. As we wander, we will come across the "dragon" of the lot: the cone of positive semidefinite quadratic forms. We will study this creature's form, which can be well understood by anyone with a knowledge of functions and matrices. We will explore some of the seemingly magical powers of this dragon, including a counterexample to Borsuk's conjecture.

Sept 24 **Is there a Function that Generates Prime Numbers?** — Margaret Owens, Chico State Univeristy

Of course there is! Consider the constant function $f(x) = 17$. Hmmm ... do you suppose we can do better than this? Perhaps you already know examples of non-constant polynomial functions that take on prime values for long sequences of consecutive integers. Are there non-constant (and non-annoying!) functions that generate only prime values? Is there a formula for the n^{th} prime? We will explore these and other questions, including the question of what we really mean by an "answer" to our question.

Oct 1 **Partial Computation of Extremely Large Numbers** — Bala Ravikumar, Sonoma State University

Numbers like 2^2^1000 are so large that even if every elementary particle in the universe is used to store one of its digits, it is still not possible to store the number. We address the problem of computing some of the specified digits of such numbers. Some interesting mathematical issues related to such computations will be discussed in this talk. *[Pizza after talk]*

Oct 8 **Visible Numbers** — Raphael Patton, Saint Mary's College

Greek mathematicians seem to have avoided algebra. Why? Not because they weren't modern enough! We will work through some examples of how ancient mathematics dealt with the amazing heronian triangles.

Oct 15 **Pythagorean Triples** — Bill Barnier, Sonoma State University

Any three integers that are equal to the lengths of the sides of a right triangle constitute a Pythagorean triple; the most well-known are (3, 4, 5) and (5, 12, 13). This talk will demonstrate some easily accessible but surprising facts regarding these triples. For example, 5 is always a factor of one of the integers. Why?

Oct 22 (note change) **Where in the world am I?** — Bill Poe, Sonoma State University

Three solutions to the GPS signal produce increasing degrees of accuracy and precision from meters to millimeters. This presentation will focus on the application of these solutions in archaeological research conducted in Central and South America over the last decade.

Oct 29 (note change) **What Does a Statistician Do at Chevron?** — Jim Rutherford Chevron Oronite Company

The talk will begin with a general description of the global statistics function at Chevron. Two examples of projects will be discussed. Chevron joined with ACTransit, Sasol, and Cummins to test cleaner fuels in an urban transit system. Statistics are used in design, monitoring, and analyses from this project that is nearing completion. Sometimes, statistical theory and closed form mathematical equations are not readily available to address complex analytical issues. Simulation can provide a solution if conceived and executed properly. *[Pizza after talk]*

Nov 5 **Secure E-Mail: PGP, Hashes and Digital Signatures** — Michael King, Joseph Muller and Dylan Field, Sonoma State University

Do you ever wonder how the messages you send over the internet are secure? Speakers will give a brief introduction to cryptography using RSA; an overview of PGP and how it is used to secure communication over the internet; and an overview of hash functions (with MD5 algorithm as an example) used for password protection and message integrity. This is a student project from the Fall 2007 Math 485 class (Introduction to Cryptography). *[Pizza after talk]*

Nov 12 **How Many Colors Do I Need To Tell My Keys Apart?** — Cora Neal, Sonoma State University

Do you have several similar looking keys? Have you ever fumbled to find the right key to open your door? Have you ever thought about buying those colorful key identifiers but been too lazy or cheap to do it? This talk will begin by determining the miminum number of different colors you would need to tell your keys apart on a circular keyring. This number, which depends on the number of keys you have, is called the distinguishing chromatic number. Together we will use graph theory to determine the distinguishing chromatic number of a variety of more complex structures. This will be a very interactive talk so come ready to participate.

Nov 19 **Synchrony and the Brain: Phase-Locking in Neuronal Networks** — Tim Lewis, UC Davis

Synchronous oscillatory behavior is a hallmark of electrical activity in neuronal networks. Its presence has been correlated with many higher brain functions, including attention, learning, and memory. Mathematical modeling and analysis is playing an important role in uncovering the mechanisms of synchrony of neuronal networks. The speaker will provide a brief introduction to neuronal networks and discuss a mathematical framework for understanding the mechanisms underlying synchrony.

Nov 26 **No Talk: Thanksgiving Holiday**

Dec 3 **Three-dimensional thrust wedge deformation** — Matty Mookerjee, Sonoma State University

It is a long-standing observation that thrust fault traces have arcuate shapes suggesting that thrust faults are, in general, non-planar. Three-dimensional complexities in thrust surface geometry give rise to three-dimensional variations in the displacement field and therefore the incremental and finite strain distribution. The kinematics of a salient-recess pair along the Moine thrust zone, Northwest Scotland, are examined to gain an understanding of how three-dimensional thrust surface geometry effects the strain distribution within thrust zones. A mathematical model was developed to more fully understand the kinematics of thrust sheets moving over non-planar thrust fault surfaces.

SONOMA STATE UNIVERSITY

DEPARTMENT OF MATHEMATICS AND STATISTICS

❖ phone: (707) 664.2368 ❖ fax: (707) 664.3535 ❖ www.sonoma.edu/math ❖

Talks may change: Please confirm with the Department of Mathematics and Statistics

Spring 2009 70th Series

M*A*T*H COLLOQUIUM

Wednesdays 4 p.m ❖ Darwin 103 ❖ Coffee, Tea & Cookies @ 3:45 p.m.

Sonoma State University Department of Mathematics and Statistics presents a series of informal talks open to the public.

"Mathematics is the process of turning coffee into theorems" Paul Erdös

Feb 4 **Mathematics of X-ray Tomography** ***Charles Hamaker, St. Mary's College***

Medical CT-scanners use x-ray data to produce the internal density profile of a 2 dimensional slice of the body. Mathematically this is equivalent to reconstructing a real-valued function on the plane from its integrals over lines in that plane. This talk will examine the mathematical algorithms developed to solve the reconstruction problem (as well as explaining the critical role played by the Beatles in the development of the scanners).

Feb 11 **Iterated Triangle Partitions** ***Ronald Graham, UC San Diego***

For a given triangle there are many points associated with the triangle that lie in its interior; examples include the incenter (which can be found by the intersection of the angle bisectors) and the centroid (which can be found by the intersection of the medians). Using this point, one can naturally subdivide the triangle into six "daughter" triangles. We can then repeat the same process on each of the six daughter triangles, and then repeat it on each of 36 resulting triangles, and so on. A natural question is to ask what the typical nth generation daughter triangle looks like after some large number of steps. In this talk we examine this problem for both the incenter and the centroid and show that they have very different behavior as n gets large. We will also look at this process for a number of other lesser known points, such as the Gergonne point and the Lemoine point.

Feb 18 **Student Projects From Math 180** ***Bill Barnier, Sonoma State University***

Selected students, including Alex Connor, Brian Lund, Juan Murillo, and Lindsay Rizzo, from the Fall 2008 Math 180 class will present their projects. The medium is *Mathematica®* and the content includes games, gambling, and math.

Feb 25 **What an Actuary Actually Does** ***Nick Franceschine, North Bay Pensions***

Actuaries are business professionals who attempt to forecast the financial consequences of future events. How much should an insurance policy cost? When an employer promises lifetime medical benefits to somebody who retires, what is that promise worth? Just what IS a tontine anyway, and why are they illegal? One of the world's most elite professions will be on display as our speaker opens the "black box" to show you how actuarial mathematics actually works.

Mar 4 **CLiCS: Categorical Logic in Computer Science -- where do we stand now?** ***Valeria de Paiva, Palo Alto Research Center***

This talk is about Categorical Logic, a branch of Category Theory, a newer subfield of Algebra, established in the late forties/early fifties by Eilenberg and MacLane. One of its most exciting applications is to theoretical computer science and I plan to discuss it, from a very personal perspective.

Mar 11 **Why Certain Integrals Are "Impossible"** ***Pete Goetz, CSU Humbolt***

As every elementary calculus student quickly learns, integration is an art. In fact, some integrals seem very hard to solve in elementary terms. In this talk I will explain why certain integrals are "impossible." The proofs rely on a 19th century theorem due to Liouville, and can be phrased in the language of differential Galois theory.

Mar 18 **Student Projects from Math 467** ***Cora Neal, Sonoma State University***

Two different groups of students will be presenting findings from statistical consulting projects. Kristen Roland and Amanda Frazier will be sharing their experience of working with SSU financial aid data to help to determine how limited funds should be distributed. Patrick Midgley and Anna Espitallier will explain how their statistical analysis helped cheese makers at Cowgirl Creamery. These presentations will give you a glimpse of how much fun you could have if you choose to pursue a major or minor in statistics at SSU.

Mar 25 **A Bijection On Core Partitions** ***Brant Jones, UC Davis***

Core partitions are combinatorial objects that appear naturally in the modular representation theory of the symmetric group and the geometry of the affine Grassmannian. At the level of Coxeter groups, cores index minimal length coset representatives for the parabolic quotient of the affine symmetric group by the finite symmetric group. In this talk we give several new interpretations of a bijection between cores that was used recently by Berg and Vazirani, including a geometric description in terms of a root lattice. We also show that the bijection has a natural description in terms of another correspondence due to Lapointe and Morse.

Apr 1 **Projective Geometry from Pappus to Pieri** ***Elena Marchisotto, CSU Northridge***

A theorem of the great mathematician, Pappus of Alexandria (circa 290-350), makes a beautiful connection between algebra and geometry. If we start with a geometric structure and impose certain postulates and theorems to determine an algebraic structure of an abstract coordinate set, we can prove that Pappus' theorem is necessary and sufficient for commutativity of multiplication there. This result is familiar to many mathematicians thanks to various texts and articles. This talk will focus on the significance of Pappus theorem to projective geometry in ways that that are perhaps not so well known, and will include original research findings on the mathematics of Mario Pieri (1860-1913).

Apr 8 **Gold Rush! – Discovering the Golden Ratio** ***John Martin, Santa Rosa Junior College***

Over the years many people have ascribed mystical properties to the number known as the golden ratio. Recently, several authors have taken the opposite view. In this talk, we will explore some of the legend and lore surrounding this number as well as the mathematics behind it.

Apr 22 **Randomized Response, The Power of Simulation, and the Simulation of Power** ***Scott Nickleach, Sonoma State University***

Would you tell the truth if asked a sensitive question such as, "Have you ever cheated on a significant other?" In this talk, we'll examine a technique for estimating the proportion of people who have cheated, and also the proportion of people who lie about it. We'll also incorporate simulations into the results using the statistical software package, R.

Apr 29 **Mathematics, Energy, and Climate Change** **Math Fest** ***Juan Meza, Lawrence Berkeley National Laboratory***

Our use of energy and the resulting effects on the world's climate are tightly interwoven. Global warming effects are already having a clear and visible impact at many levels, including melting polar ice caps, hurricanes and other extreme events. Not surprisingly, the efficient use of all of our energy sources as well as the search for new sources of renewable energy has received increased attention. In this talk, I will discuss the connections between mathematics, the development of new and efficient energy sources and methods for analyzing the effects of climate change.

May 6 **Use of the Gradient Vector in Constructing a Solar Electric System** ***Chad Griffith, Former Sonoma State Student***

Ever wonder when you may use your mathematics in the professional world? We will discuss mathematical applications used by a project manager in the solar industry highlighting specific examples of Calculus, algebra, geometry, and financial mathematics in the job place.

SONOMA STATE UNIVERSITY

DEPARTMENT OF MATHEMATICS AND STATISTICS

❖ phone: (707) 664.2368 ❖ fax: (707) 664.3535 ❖ www.sonoma.edu/math ❖

Talks may change: Please confirm with the Department of Mathematics and Statistics