

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 Erdős

- Aug 28 **An Introduction to Linear Programming: A Hands-On Approach** **Julia Olkin, California State University, East Bay**
 Linear programming refers to optimizing (maximizing or minimizing) a linear objective function subject to linear constraints (equalities and inequalities). Find out how Amazon figures out which warehouse to use to send you your package, and how United Airlines figures out how many planes to schedule from San Francisco to Washington, D.C. on a normal Monday. If you know how to graph linear equations ($ax+by=c$), you'll be able to join us as we get our hands dirty and answer these meaningful, real world questions!
- Sept 4 **Brocard Points, Triangles, and Circles** **Rick Luttmann, Sonoma State University**
 This talk will involve elementary but little-known lore concerning some strange coincidences in constructions around triangles. For any given triangle, We will define "Symmedians," the "Symmedian Point," the "Brocard Circle," the "Steiner Ellipse," and the "Steiner Point." I will then develop the theory of the two "Brocard Points" of a triangle, what they are and how to construct them; the "Brocard Angle;" the first and second "Brocard Triangles;" and some mystical, magical, and miraculous results concerning the relationships of these triangles, the Brocard Circle, and the Steiner Point. The "Vantage Point Theorem" (aka "Inscribed Angle Theorem") will be mentioned along with Desargues's concept of triangles "perspective from a point."
- Sept 11 **What Mathematics Can Tell Us About Big Data** **David Uminsky, University of San Francisco**
 We will generate more bytes of data in the next two days than the entire amount of data created between the beginning of civilization and 2003. This deluge of data is both a huge opportunity and a huge obstacle to scientific and industrial advancement. Examples of well-known big data problems range from genome sequencing to particle physics to understanding human behavior through social networks. In this talk we will explore how we can exploit simple graph theory and linear algebra to see patterns and structure in these huge data sets. We will then discuss how this mathematics can turn into rigorous machine learning methods so that computers can begin to process this data in an intelligent way.
- Sept 18 **Finding Love With Differential Equations** **David Zeigler, California State University, Sacramento**
 Have you ever gotten the cold shoulder from a differential equation and not known WHY? Have you ever gotten shot down by a differential equation only to see them open up with a beaming smile when someone else approaches? Have you ever been stricken by a paralyzing fear that keeps you from approaching a differential equation you would love to meet? We will focus on meeting differential equations; naturally, without pick-up lines, routines, or gimmicks. We will also learn a modern approach to modeling solutions of differential equations. Open (and accessible!) problems in computational differential equations will also be pointed out for students looking for projects.
- Sept 25 **Tropical Geometry** **Florian Block, University of California, Berkeley**
 Say you replace usual addition and multiplication of real numbers by minimum and addition and call this arithmetic "tropical." How do solutions sets of tropical polynomials look like? What does this have to do with G. Bergman's observation from 1971 that, when plotted on a logarithmic scale, solution sets to usual polynomials look piecewise linear? Is there anything preserved under this crude looking tropical deformation? I will give an introduction to tropical geometry, discuss the questions above and some more, and show you a few tropical success stories.
- Oct 2 **What an Actuary Actually Does** **Nick Franceschine, North Bay Pensions and Sonoma State University**
 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
- Oct 9 **Automated Procedure for EEG-Sleep Stage Separation** **Alexandra Piryatinska, San Francisco State University**
 The maturity level of a neonate (newborn) is difficult to assess by direct physical examination. Dysmaturity (a measure of variation in brain development) is known to be directly related to the structure of neonatal sleep as reflected in the temporal patterns of measured EEG signals. In the past, the assessment of sleep EEG structure has often been done manually by an experienced clinician. An automated procedure for the separation of quiet and active sleep stages will be presented.
- Oct 16 **Black Holes, the Big Bang, and the Cosmic Censor** **Jim Isenberg, University of Oregon and MSRI**
 Einstein's theory of general relativity predicts that in universes like ours, breakdowns in the physics (known as singularities) generally develop, both on the cosmological and on the astrophysical scale. What we don't yet know is what the nature of those singularities is likely to be. Generally speaking, the singularities come in two types: the sort that involve everything being crushed in huge gravitational fields, and the sort that involve the breaking down of physical determinism. Which should we expect? Roger Penrose has conjectured that generally, we all get crushed; and that in almost all cases, astrophysical singularities are contained inside black holes. These ideas have been called the Cosmic Censorship conjectures. We present some of the history of these conjectures, and we discuss some of the recent mathematical evidence that the Cosmic Censorship conjectures are true.
- Oct 23 **Sustainability Week: Mathematical Modeling with Stochastic Processes** **Chris Dugaw, Humboldt State University**
 Undergraduate mathematics students often learn about modeling biological and physical processes using deterministic models, i.e. models that have no random component. Exponential growth and decay, or the logistic population growth models are classic examples of such models. Although these models yield valuable insights in some situations, they have limited applicability to small and/or threatened populations where stochasticity (i.e. randomness) plays an important role. We will provide an introduction to Stochastic Processes and give several examples of their use in mathematical modeling.
- Oct 30 **The BS Graph and Other Hidden Images** **Paul Zeitz, University of San Francisco**
 It is never a bad idea to try to visualize mathematics, especially if the problem seems non-geometric. In this talk, I will give four surprising examples of how recasting a problem in a visual form leads either to new insights, or even better, new questions.
- Nov 6 **Hands -On Math: "What good is this?"** **Ann Herbst, Santa Rosa Junior College (Emeritus)**
 Presentation of examples from the fields of construction, finance, health and art that use high school/first year college mathematics. Questions to be answered include: "how does a California city set speed limits?"; "how (and why) does a British Church ring bell patterns?"; and "what does a recent PG&E bill tell you about your energy usage?" Mathematical topics come from calculus, statistics and mathematics appreciation courses.
- Nov 13 **An introduction to Koszul Algebras** **Pete Goetz, Humboldt State University**
 The goal of this talk is introduce the remarkable notion of a Koszul algebra. Koszul algebras find applications in many areas of modern mathematics: algebra, topology, number theory, combinatorics and mathematical physics. The main part of the talk will consist of defining graded algebras, the Ext functor and Koszul algebras. I hope to give lots of interesting examples. Some familiarity with the notion of a vector space will be assumed. Students studying algebra and linear algebra are highly encouraged to attend.
- Nov 20 **Blaise Pascal and His Mystic Hexagram** **John Martin, Santa Rosa Junior College**
 Inventor, mathematician, physicist and theological writer Blaise Pascal has been called, "the greatest might-have-been in the history of mathematics." In this talk, we will examine his life and times and consider one of his most impressive discoveries.
- Nov 27 No Talk– Thanksgiving
- Dec 4 No Talk– Last Week of Instruction



DEPARTMENT OF MATHEMATICS AND STATISTICS

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