FALL 1984

TWENTY-FIRST SERIES

M*A*T*H

COLLOQUIUM

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

Wednesdays at 4:00 p.m. **Darwin Hall, Room 108**

Coffee at 3:30 p.m.
Darwin 108 Lobby

SEPTEMBER 12
C.S.

USING THE MACINTOSH COMPUTER
Professor Robert G. Plantz, Department of Mathematics and Computer and Information Science, Sonoma State University, asks, "Is the desktop/window/mouse environment really a new way to work with a computer? Or is it just a fad?" He will look at the rationale behind the development of this environment and then discuss some of the advantages and disadvantages implemented on Apple's Macintosh computer.

SEPTEMBER 19
C.S.

CAREERS AND DATA PROCESSING
Mr. James Kennedy, Partner, Pyramid Computer Systems, Oakland, will discuss business systems analysis and planning, systems analysis and design, local area networks, and network analysis.

SEPTEMBER 26

WHY ARE MANHOLE COVERS ROUND?
Professor David Barnette, Department of Mathematics, University of California, Davis, states, "A disc has the property that its width measured in every direction is the same. Surprisingly, there are other figures with this property." He will show how to construct some of them and give some unusual applications.

OCTOBER 3

MATHEMATICAL PROBLEMS IN FINANCIAL PLANNING
Rick Luttmann, Ph.D., Certified Financial Planner, Professor of Mathematics, Sonoma State University, recently returned from a three-year leave as Analyst for a financial planning firm in Alaska. He will discuss mathematical problems that arise in financial planning relating to matters such as taxation, risk/reward, estate planning, annuities, inflation, mortgages, present value, and internal rate of return.

OCTOBER 10

FRACTIONAL DERIVATIVES
Leonard Dixon, M.S., Lecturer, Department of Mathematics, Sonoma State University, suggests, "We know what first-, second- and third-order derivatives are, but what is a half-derivative?" This talk will discuss the defining of derivatives with orders not studied in elementary calculus. Some applications will be given, and a bibliography of references will be handed out.

OCTOBER 17
C.S.

THE ROBOT BIOLOGIST: TEACHING COMPUTERS TO WATCH TELEVISION
Dr. John O. B. Greaves, Director of Engineering for a start-up company in Santa Rosa called Motion Analysis Corporation, will talk about synthesizing engineering and biological skills to produce an Early Warning Water Quality System now under development. A television camera watching live organisms in a flow-through aquarium, a video processor, a computer and an artificially intelligent biologist to predict and compare behavior are the ingredients being used to build the system for detecting pollution in drinking or discharge water systems.

OCTOBER 24

SECOND ORDER EXACT DIFFERENTIAL EQUATIONS
Professor Clement E. Falbo, Department of Mathematics, Sonoma State University, will discuss exactness in nth order ordinary differential equations (odes) and introduce the idea of recursive exactness. A method for recognizing when a second order ode is exact or recursively exact will be given, and techniques for solving such equations will be presented. This study unifies several different concepts in higher order odes.

OCTOBER 31

COMPUTER SIMULATION OF FLUID FLOWS USING VORTEX METHODS
Elbridge Gerry Puckett, doctoral candidate at the University of California, Berkeley, will discuss the Random Vortex, one approach to the problem of modeling a fluid flow. The need to model such fluid flows arises in fields as diverse as aircraft design and weather prediction where one needs to determine such characteristics of the flow as its velocity, lift and drag. Several applications will be examined, and photographs taken from laboratory experiments and computer simulations will be compared.

NOVEMBER 7
C.S.

A GUIDED TOUR OF ASSEMBLY LANGUAGE
Professor Michael D. Kudlick, Chairman, Computer Science Department, University of San Francisco, will begin with a discussion of machine language, which is assembly language's very close relative, then he will discuss from a programming standpoint some of the design problems in the IBM 370 and some of the pedagogical as well as programming advantages of assembly language.

NOVEMBER 14
C.S.

LOCAL AREA NETWORKS
Professor Michael Lyle, Department of Mathematics and Computer Science, Sonoma State University, will describe ETHERNET and show why everyone is so excited about it.

NOVEMBER 28

MATHEMATICAL ECONOMICS -- HAVING THE BEST OF BOTH WORLDS
Professor Gerald Egerer, Department of Economics, Sonoma State University, will discuss the interface between mathematics and economics. He will show how this creates problems as well as providing solutions. Problems of economics interpretation, of determining appropriate initial conditions and parametric constraints, and of choosing the manner in which results are to be presented will also be discussed.

DECEMBER 5

BEFORE SETS, THERE STILL IS TOPOLOGY
Dr. David Ballard, Lecturer, Department of Mathematics, Sonoma State University, presents an informal and elementary yet critical look at contemporary mathematics and its relevance for expressing our direct experience of the world. Should be of interest to anyone with moderate (or elaborate) mathematical training who is secretly puzzled.

Sonoma State University

SPRING 1985 TWENTY-SECOND SERIES

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FEBRUARY 13

SUPERCOMPUTING IN AERODYNAMICS RESEARCH
Mr. Victor L. Peterson, Director of Astronautics for NASA at the Ames Research Center, will introduce computational aerodynamics, which is emerging as a powerful new aerospace discipline. Example applications, future requirements for supercomputer speed and memory, and NASA's Numerical Aerodynamic Simulation Program will be discussed.

FEBRUARY 20

STATUS REPORT FROM SILICON VALLEY
Dr. Howard B. Stauffer, Professor of Mathematics at Humboldt State University and formerly Manager of Image Processing at NASA-Ames, will give a description of the historical events and resulting developments in microprocessor and microcomputer technology emanating from Silicon Valley in the 1970's and 1980's.

FEBRUARY 27

CHAOS CONQUERED: METHODS OF DIFFERENTIAL GEOMETRY IN PHYSICS
Mr. Richard Montgomery, SSU mathematics graduate and doctoral candidate at the University of California, Berkeley, will give a feel for the current renaissance in classical mechanics by examining two systems at opposite ends of the dynamical spectrum: the motion of a rigid body in outer space, which is "completely integrable," and the motion of a heavy top, which is "chaotic." He will describe what all this has to do with chaos in the magnetic resonance of superfluid ^{3}He, with quarks, and perhaps with parallel processors.

MARCH 6
Women's History Week

WOMEN IN MATHEMATICS
Ms. Kathleen Ballester, part-time instructor in mathematics and computer science at SSU, will talk about some of the little-known achievements of women in the history of mathematics.

MARCH 13

SOME MATHEMATICAL PROBLEMS IN FISHERIES AND AGRICULTURE
Dr. Marc Mangel, Department Chairman and Professor of Mathematics at the University of California, Davis, will show how some simple and some sophisticated mathematical ideas can be used to provide information about fish abundance and pest population levels.

MARCH 20

DOING THE IMPOSSIBLE
Mr. John Martin, Professor of Mathematics at Santa Rosa Junior College, will argue that the three famous impossible constructions of classical Greek mathematics are not difficult at all, if we just change the rules!

MARCH 27

COMPUTER ANIMATION TECHNIQUES
Mr. Roger Corman, SSU computer science graduate and Director of Software Development for Time Arts Inc., will discuss techniques for creating real-time animation on pixel-based graphics systems, including frame buffer animation, color cycling, "true" animation, in-betweening, and real-time transformations.

APRIL 10

THE USE OF COMPUTERS FOR SYMBOLIC MATHEMATICS
Dr. Robert Hooper, Professor of Mathematics at the University of Nevada at Reno, will report that, whereas at one time computers were used only by scientists and engineers for numerical calculations, now symbolic mathematics packages are available even for microcomputers. He will discuss methods used to do algebra, calculus, and other mathematical arts.

APRIL 17

FIXED POINTS IN AND OUT OF MATHEMATICS
Dr. Richard G. Montgomery, Professor of Mathematics, Southern Oregon State College, will introduce the elementary theory of fixed points. A fixed point for a process P is an object X which the process leaves unchanged: $PX = X$. (The number "one" is a fixed point for cubing because $1^3 = 1$.) Searching for and capturing fixed points can be both engaging and illuminating. Examples -- some mathematical, some applied and some neither -- will be used to fix the idea. (Bring your calculator.)

APRIL 24

MATHEMATICAL MODELS IN INSECT PEST MANAGEMENT
Dr. Richard E. Plant, Department of Mathematics, University of California at Davis, will describe how mathematical models are used when dealing with insect pest management problems. Some of the uses include trapping and eradication of invasive pests such as the medfly, the management of resistance to pesticides, and the decision as to when to apply a pesticide to an agricultural crop.

MAY 1

ANECDOTES FROM THE EARLY HISTORY OF COMPUTING
Dr. Henry S. Tropp, Professor of Mathematics at Humboldt State University, will share some stories about the period 1935 to 1955. The main cast of characters will include George Stibitz, Howard Aiken, John Mauchley, John von Neumann, Pres Eckert, Alan Turing, and Jay Forrester. The machines will include the Bell Labs relay devices, the Harvard Mark I, ENIAC, and the IAS Computer.

MAY 8

MUSICAL SOUND-SYNTHESIS USING DIGITAL COMPUTERS
Mr. Tom Jerse, Research & Development Project Manager at Hewlett-Packard and formerly Professor of Music at Brooklyn College, will present an overview of all major synthesis techniques, with particular attention paid to speech synthesis. Several musical examples will be played to illustrate.

MAY 15

ERROR-CONTROL CODING FOR SATELLITE COMMUNICATIONS
Dr. Melody Duncan, Associate Professor of Computer Science at Chico State University, will discuss the problem that binary data transmitted through space can suffer alteration from random noise in the environment. Algebraic encoding-decoding techniques can minimize or eliminate errors in received data. This talk will develop the Viterbi "trellis" decoding algorithm for convolutional codes. The algorithm proceeds by traversing the best possible path in the decoding graph.

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SEPTEMBER 11

ULTRAMETRIC GEOMETRY AND NUMBER THEORY
Dr. Hugh Edgar, Professor of Mathematics, San Jose State University, will introduce the rudiments of a rather bizarre type of geometry, and draw some conclusions to number theory. He will also lay to rest some popular myths, e.g., that scalene triangles exist, that n! is large when n is, and that $1 + 2 + 2^2 + 2^3 + \ldots 2^k + \ldots$ diverges.

SEPTEMBER 18

MAGIC SQUARES, PROJECTIVE PLANES AND OTHER STRANGE THINGS
Dr. Tatiana Deretsky, Visiting Lecturer in Mathematics, San Jose State University, will show how two parts of mathematics are intricately entwined and interrelated: space and numbers. At times, the "proper" mathematics was believed to consist of geometry only, while numbers and operations with them were merely a convenient language. On the other hand, some other epochs concentrated on the art of reckoning, and geometry was deemed as a sort of amusement. Specifically, she will show how projective geometry was born in the XVIIth century, how it became clear that it is the most general of all geometries, and what are the surprising ways in which it is related to magic squares.

SEPTEMBER 25

ON UNIFORM DISTRIBUTION MODULO 1
Dr. Vladimir Drobot, Professor of Mathematics, University of Santa Clara, will discuss what it means for a sequence of numbers in the unit interval to be "uniformly distributed." Various examples will be given from number theory and other parts of mathematics.

OCTOBER 2

AUDIT SAMPLING
Dr. Geetha Ramachandran, Professor of Mathematics, California State University, Sacramento, will introduce the theory of audit sampling, and point out some of the limitations faced by accountants when applying finite population sampling theory. Illustrative examples will bring out the salient features of audit sampling.

OCTOBER 9

SCHEDULING WITH RELEASE TIMES AND DEADLINES
Dr. Barbara Simons, IBM Almaden Research Center, San Jose, will present a brief survey of some results in scheduling with release times and deadlines, where the release time is the earliest time at which a job can begin running, the deadline is the time by which it must be completed, and interruption of the job is not allowed once it has begun to run. She will also discuss in detail a fast and simple algorithm for scheduling a set of n unit-time jobs on m identical parallel machines when each job has a rational release time and a rational deadline.

OCTOBER 16

ALGEBRAIC EQUATIONS — SOLVABILITY BY RADICALS
Dr. Simon M. Goberstein, Associate Professor of Mathematics, Chico State University, will trace the development of the theory of solving algebraic (polynomial) equations from 1800 B.C. to 1800 A.D., from ancient Babylonia through the Renaissance to Galois.

OCTOBER 23

SEAT-OF-THE-PANTS MATH FOR COMPUTER GRAPHICS
Mr. Mike Higgins, Senior Software Engineer, Time Arts Inc., Santa Rosa, will share some of his favorite sneaky math tricks that allow advanced computer graphics concepts to be explored on microcomputers. The theory of computer graphics often makes elegant use of advanced mathematical techniques like linear algebra, but the practice often devolves into a bag of sneaky tricks and kludges to make graphics run fast enough on the available equipment.

OCTOBER 30

SOAP FILMS: THE AMUSEMENT OF CHILDREN AND MATHEMATICIANS
Dr. A. J. Tromba, Professor of Mathematics, University of California, Santa Cruz, will review the history of optimum principles in mathematics including a discussion of soap films as a beautiful example of nature's tendency to economize.

NOVEMBER 6

TOPOLOGY AND RELATIVITY
Dr. Gregory L. Naber, Professor of Mathematics, Chico State University, will discuss topological results in general relativity: those which do not depend on the specific form of Einstein's field equations, but only on the fact that space-time is modelled by a four-dimensional Lorentz manifold. A very simple example will illustrate how global topological conditions can determine causality relations in such a manifold and thereby be physically significant. Only a familiarity with linear algebra and elementary point-set topology is assumed.

NOVEMBER 13

MATHEMATICIANS, USEFUL AND USELESS, THEN AND NOW
Dr. Paul R. Halmos, Professor of Mathematics, University of Santa Clara, and Editor, The American Mathematical Monthly, will consider questions such as "Is mathematics useful?," "Are mathematicians useful?," and "Just what sort of problems are likely to be either useful or interesting?."

NOVEMBER 20

THE POSSIBLE, THE IMPOSSIBLE AND THE UNPROVABLE
Dr. Martin Flashman, Professor of Mathematics, Humboldt State University, Arcata, discusses how an axiomatic approach to problems leads to the development and application of models. Model theoretic distinctions between syntax and semantics are used to explain some important and unusual results in the foundation of mathematics.

DECEMBER 4

THE CAT SCANNER
Dr. Robert Plantz, Computer Science Department, Sonoma State University, will describe computed tomography ("Cat Scanning") which is a medical imaging method made possible by the modern digital computer. X-ray images from numerous angles can be mathematically combined to provide cross-sectional views of the internal structure of organs within the body. A computer is necessary because of the large number of computations required to produce an image.

Sonoma State University

25 YEARS BUILDING FUTURES

SPRING 1986 TWENTY-FOURTH SERIES

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FEBRUARY 19

TURING MACHINES
Dr. William J. Barnier, Professor of Mathematics, Sonoma State University, and Alan Weinberger, B.S. Computer Science, SSU, will introduce and discuss Turing machines as recognizers. The talk will include a color graphics program, written by Mr. Weinberger, that simulates a Turing machine.

FEBRUARY 26

E 3064 (A QUADRATIC DIOPHANTINE EQUATION)
Dr. Jack Ladwig, Assistant Professor of Mathematics, Chico State University, will discuss a diophantine equation sparked by a recent Mathematical Monthly problem. The equation involves diverse aspects of mathematics from Bhaskara to Lagrange: the characterization of quadratic irrationals in terms of periodic continued fractions, gaussian number rings, and an amusing analogy with solving inhomogeneous ordinary differential equations.

MARCH 5
Women's History Week

HOW TO DETECT MISLEADING STATISTICS
Dr. Jessica Utts, Associate Professor of Statistics, University of California, Davis, feels results of statistical surveys and experiments are often presented as "facts" by the media. Some of these studies are so poorly designed and executed that the results cannot be taken seriously. This talk will focus on some common problems with statistical studies and on how to determine whether or not the "facts" are actually misleading statistics instead.

MARCH 12

WHAT IS A CHARACTERISTIC CLASS
Dr. S.S. Chern, Mathematical Sciences Research Institute, University of California, Berkeley, will introduce the audience to: vector bundles, absolute differentiation, curvature, characteristic classes, and Maxwell and Yang-Mills equations. The talk will be at the "multi-variable calculus" level; a little knowledge of the exterior differential calculus is preferred.

MARCH 19

COMPLEMENTARY SEQUENCES
Dr. Kenneth Rebman, Professor of Mathematics, California State University, Hayward, has selected a gem of a topic from elementary number theory that offers interesting applications, surprising results, and transparent proofs.

APRIL 2

WHAT IS A POLYNOMIAL?
Dr. Evelyn M. Silvia, Professor of Mathematics, University of California, Davis, will explore interesting properties of polynomials related to the location of zeroes, the proximity of the critical numbers to the zeroes, and criteria for one-to-oneness. Deceptively simple-looking polynomials offer a wealth of challenging problems.

APRIL 9

FIXED POINTS IN AND OUT OF MATHEMATICS
Dr. Richard G. Montgomery, Professor of Mathematics, Southern Oregon State College, will introduce the elementary theory of fixed points. A fixed point for a process P is an object X which the process leaves unchanged: $PX = X$. (The number "one" is a fixed point for cubing because $1^3 = 1$.) Searching for and capturing fixed points can be both engaging and illuminating. Examples—some mathematical, some applied, and some neither—will be used to fix the idea. (Bring your calculator.)

APRIL 16

COMPUTER ANIMATION ON RASTER DISPLAYS
Dr. James L. Murphy, Professor of Computer Science, University of California, Santa Cruz, and California State University, Chico, will discuss techniques for achieving real-time computer animation on full-color frame buffers by manipulating the color look-up tables.

APRIL 23

TIMBER HARVEST SCHEDULING: A STUDY IN OPTIMIZATION
Dr. Roland Lambertson, Associate Professor of Mathematics, Humboldt State University, Arcata, will examine the difficulties of optimizing a long-term sequence of timber harvests where prices for timber may vary and there is a risk of catastrophic loss of the crop due to fire or pests.

APRIL 30

SPIN GLASSES AND THE TRAVELING SALESMAN
Dr. Wilfried Wolff, Department of Applied Physics, Stanford University, will describe the connection between the statistical mechanics of disordered and frustrated systems (so called spin glasses) and the problems in combinatorial optimization, e.g., the travelling salesman and the chinese postman problems. Simple physical ideas lead to new methods and algorithms.

MAY 7

MATHEMATICS AND ANIMATION
Mr. Scott Anderson, free-lance programmer and Sonoma State University graduate in physics, will discuss both the mathematics of animation and the applications of animation to teaching mathematics.

MAY 14

IS THE WORLD PERCEIVED OR IS IT CONCEIVED?
Dr. David Ballard, Lecturer in Mathematics, Sonoma State University, will present a new theory of the real numbers in which it is normal that $x = 0$ while $xy \neq$ or that $x = y$ even though $x - y \neq 0$. The talk should be of interest to those who like their mathematics to be philosophically suggestive.

Sonoma State University

25 YEARS BUILDING FUTURES

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SEPTEMBER 10

STAIRCASE SEARCHING
Dr. Maria Klawe, Manager of Mathematics and Related Computer Science, IBM Almaden Research Center, will illustrate how a number of questions about points in the plane can be answered by finding the maximum value in each row of a matrix with special properties, and will give a simple staircase algorithm which efficiently finds all these maxima.

SEPTEMBER 17

THE HISTORICAL DEVELOPMENT OF SYLVESTER'S FOUR-POINT PROBLEM
Dr. Richard Pfiefer, Assistant Professor, Department of Mathematics and Computer Science, San Jose State University, will trace the history of this geometric probability problem, from its proposal in the 1860's through its solution some 60 years later, and conclude by exploring why its 3-dimensional version remains unsolved to this day.

SEPTEMBER 24

THE MATHEMATICAL MODELING OF LINES
Ms. Jane Millar, mathematics instructor, Santa Rosa Junior College, and a part-time economics student at Sonoma State University, asks, "For what kinds of 'straight lines' is the equation $Y = mX + b$ non-descriptive?" She will present an introduction to the theory of queues and (when the theory won't work or becomes too messy or difficult) the "discovery learning" approach to solving line problems.

OCTOBER 1

FIBONACCI NUMBERS, WITH GENERALIZATIONS
Dr. Neville Robbins, Associate Professor of Mathematics, San Francisco State University, will explore some of the properties of Fibonacci numbers, as well as those of generalized linear second order recurrences. About eight centuries ago, Leonardo Pisano (aka Fibonacci) defined the sequence: 1, 1, 2, 3, 5, 8, 13, 21, 34, etc. This sequence, which has a connection with the golden ratio, occurs in nature and has many scientific applications.

OCTOBER 8

IMAGE METHODS AND ROOM ACOUSTICS
Dr. Tom Barnebey, Sound Solutions acoustical consulting services, and Lecturer in the Physics and Astronomy Department, Sonoma State University, will describe some mathematical techniques employing images of sound sources. These techniques are useful for predicting the acoustic properties of auditoriums and other spaces in which the quality of sound is an important consideration.

OCTOBER 15

THE UBIQUITOUS DIGAMMA FUNCTION
Dr. Michael Dixon, Professor of Mathematics, Chico State University, will discuss the basic properties of the digamma function and some of its applications. The computation of definite integrals and the summation of infinite series often leads to closed form expressions involving this important classical function. A related question on the rationality of a simple class of infinite series will be answered with the aid of Alan Baker's Fields Medal work on transcendental number theory.

OCTOBER 22

SOME REMARKABLE NEW PARTITION IDENTITIES
Dr. Henry L. Alder, Professor of Mathematics, University of California, Davis, will demonstrate that students with little mathematical background can discover new mathematics, by presenting some remarkable new partition identities which were all discovered by undergraduate students within the last few years.

OCTOBER 29

A COLLECTION OF GEOMETRIC EXTREMA FOUND WITHOUT CALCULUS
Dr. L.H. Lange, Dean, School of Science, San Jose State University, who wrote a master's thesis under George Polya concerning the finding of maxima and minima with and without calculus, has been collecting such results, and will share some of the interesting ones with us.

NOVEMBER 5

COMPUTER LAW
Dr. George Ledin Jr, Professor of Computer Science, Sonoma State University, will present a brief survey of intellectual property concepts, including copyright, trademark, patent, and trade secret protection, and a quick overview of laws that affect computer use.

NOVEMBER 12

REALISTIC COMPUTER-GENERATED IMAGES
Dr. Richard H. Gordon, Professor of Computer Science, Sonoma State University, will discuss problems associated with the generation of images that look realistic using techniques of computer graphics.

NOVEMBER 19

DBMS TRENDS INTO THE NINETIES
Mrs. Donna Crawford, Computer Science Department, Sonoma State University, will discuss Data Base Management Systems (DBMS). They have undergone many changes since their first conception in the 1960's. The four major predicted trends for the nineties are to relational DBMS, totally integrated software systems, firmware in the form of software on a chip and DBMS's which incorporate distributed data processing (DDP). How will these trends affect the market place?

DECEMBER 3

THE PACKING OF SPHERES
Dr. Jean B. Chan, Professor and Chair of Mathematics, Sonoma State University, will discuss the densest way to pack identical spheres in space. Some applications of packing will be explored.

SONOMA STATE UNIVERSITY

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FEBRUARY 11

PASCAL'S TRIANGLE MOD P
Dr. Richard P. Kubelka, Assistant Professor, Department of Mathematics and Computer Science, San Jose State University, will describe the striking visual patterns which emerge when the familiar Pascal's triangle is viewed modulo a prime p. He will investigate the underlying symmetry and reproductive properties that give rise to these patterns, and look at their generalizations in the plane and in higher dimensions.

FEBRUARY 18

ANCIENT GREEK ASTRONOMY AS A SOURCE OF MATHEMETICS
Brother L. Raphael, FSC, Ph.D., Associate Professor of Mathematics, Saint Mary's College, Moraga, will show how the ancient astronomers used straightforward geometry and trigonometry to develop a very sophisticated theory of celestial motion, which compares quite well with modern theory as a predictor. He contends that anyone can follow the Greek theory comfortably, while hardly anyone can understand the intricacies of the modern version.

FEBRUARY 25

THE CONE OF POSITIVE SEMIDEFINITE MATRICES
Dr. Steven R. Waters, Assistant Professor of Mathematics, Pacific Union College, Angwin, will present a brief survey of the ideas of elementary cone theory as they intuitively apply to geometric examples. He will then show how these ideas apply to the cone of positive semidefinite matrices.

MARCH 4

WHAT IS PROBABILITY?
Dr. Richard W. Hamming, Professor of Computer Science, Naval Postgraduate School, Monterey, will talk about what he believes probability to be. Probability Theory plays a central role in many important decisions, including social decisions. It has been used in applications ranging from atomic bomb design through guided missiles and space flight, telephone exchange design, science and engineering generally. But there is simply no agreement as to the nature of probability, and theorists find that it is easy to omit significant applications of probability that enter into the daily lives of scientists.

MARCH 11

THE CAKE-CUTTING PROBLEM AND THE HAM-SANDWICH THEOREM
Dr. G. T. Sallee, Professor of Mathematics, University of California, Davis, will discuss applications of the Intermediate Value Theorem in a variety of geometric contexts.

MARCH 18

SYMMETRIES OF CULTURE
Dr. Donald W. Crowe, Professor of Mathematics, University of Wisconsin, Madison, will talk about the classification of repeated patterns and the application of this analysis to archaeology. He will offer many specific examples and encourage audience participation. Flowcharts will be handed out for use in identifying the seven strip patterns and 17 periodic patterns. The speaker is the author (jointly with archaeologist Dorothy Washburn) of a book of the same title to appear in 1987.

MARCH 25

STATISTICS IN THE CLASSROOM AND IN THE REAL WORLD
Dr. Lydia Gans, Professor of Mathematics and Statistics, California State Polytechnic University, Pomona, will discuss the dilemma experienced by the statistical theoretician who is aware that research conclusions often are not valid because the practitioner does not have sufficient understanding of the theory; on the other hand, the practitioner finds that statistical theory, while it provides methods for getting valid results, may not be particularly useful for making practical decisions. Statistics is an area of mathematics that has widespread applications in a great many different disciplines.

APRIL 1

DO IT OR DON'T: ACHIEVEMENT AND AVOIDANCE GAMES
Dr. Frank Harary, Professor of Mathematics, New Mexico State University, Las Cruces, and Visiting Professor of Electrical and Computer Engineering, University of Texas, will show that in an achievement game, the first of two players who reaches the goal wins; in an avoidance game, he loses. Mathematical games which are both edifying and entertaining have been developed in the theories of graphs, groups, numbers, and geometry. The talk will be self-contained.

APRIL 8

PUZZLES AND PERMUTATION GROUPS
Dr. T. D. Parsons, Professor of Mathematics, California State University, Chico, will illustrate an approach to solving the "Pyraminx" or "magic tetrahedron" puzzle, and similar harder puzzles. Many puzzles involve combinatorial problems about groups of permutations. Often, the problem is equivalent to describing the states of the puzzle as words in certain generators for the group, and then inverting such words to reduce the state to an initial state corresponding to the identity element of the group. For very complicated puzzles like Rubik's cube, it is usually impractical to deal with complete descriptions of the states; instead, one must focus on certain special properties in an ordered hierarchy, and one accomplishes the inversion by performing transformations which lower the position of the current state in the hierarchy until the initial state at the bottom is reached.

APRIL 15

SPRING RECESS

APRIL 22

STRANGE BILLIARD TABLES
Dr. Don Chakerian, Professor of Mathematics, University of California, Davis, will discuss a variety of geometric extremum problems related to the paths that might be followed by billiard balls traveling inside billiard tables of peculiar shapes (including n-dimensional billiard tables).

APRIL 29

CODING THEORY APPLIED TO PROBLEMS IN COMBINATORICS
Dr. Ivan Niven, Professor of Mathematics, University of Oregon, Eugene, and past president of the Mathematical Association of America, will talk about a well-known elementary problem in combinatorics which requires us to determine an unknown x in the set {1, 2, 3,. . ., 16} by asking seven questions in this setting: One person (the responder) selects the value for x; we can ask questions of the Yes-No type, and the responder is allowed, but not required, to give one incorrect answer. In the general case of this problem, "16" is replaced by "n." We solve the problem by the use of error-correcting codes from computer science. (No mathematics beyond freshman algebra and no background at all from coding theory or combinatorics are needed to understand the talk.)

MAY 6

MATHEMATICAL MODELING OF DETERRENCE AND ESCALATION DYNAMICS
Dr. Jean-Pierre Langlois, Assistant Professor of Mathematics, San Francisco State University, will describe the classical modeling of deterrence, which is mostly based on subjective probabilities and primitive game models. It fails to address the fact that conflict can occur on wide-scale levels of violence, and it does not provide any analysis of the dynamic of escalation. Recent advances in the theory of continuous games allow a much richer and more realistic representation of deterrence and escalation. Crisis stability can be discussed with respect to the design of the threats of retaliations as well as the technical characteristics of the means of violence. Methods for stabilizing the arms race are among the possible applications.

MAY 13

THE ISOPERIMETRIC PROBLEM
Dr. Jane Sangwine-Yager, Chairman, Department of Mathematical Sciences, Saint Mary's College, Moraga, will discuss the fascinating history of the isoperimetric problem, beginning with the founding of the city of Carthage by Queen Dido in the 9th century B.C. Many proofs are known—one will be presented—but many related problems remain unsolved.

MAY 20

BERNOULLI NUMBERS
Dr. Donald Sarason, Professor of Mathematics, University of California, Berkeley, will give an elementary talk on Bernoulli numbers. He will indicate how they originally arose and describe some of their remarkable properties.

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SONOMA STATE UNIVERSITY

FALL 1987 TWENTY-SEVENTH SERIES

M*A*T*H

COLLOQUIUM

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

Wednesdays at 4:00 p.m. **Darwin Hall, Room 108**

Coffee at 3:30 p.m.
Darwin 108 Lobby

SEPTEMBER 16

EUCLID TURNS TO PROBABILITY
Dr. Kurt Kreith, Professor of Mathematics, University of California, Davis, will share a view of the theory of probability from the perspective of the Greek developers of Euclidean geometry. Much of probability theory was accessible to the Greeks, but the concept of independence might have been a troublesome one. Analogies will be drawn between the difficulties posed by parallelism and independence in the formal development of geometry and probability.

SEPTEMBER 23

NON-COMMUTATIVE MULTIPLICATION AND BRAUER GROUPS
Dr. Alfred W. Hales, Professor of Mathematics, University of California, Los Angeles, will discuss division algebras such as Hamilton's quaternions, where multiplication is non-commutative ($i \cdot j \neq j \cdot i$) but for which other familiar laws hold. These algebras can be classified via an abstract mathematical system called the Brauer group, whose structure will be described in special cases.

SEPTEMBER 30

MATHEMATICAL MODELING AND THE NUCLEAR ARMS RACE
Dr. Charles M. Biles, Professor of Mathematics, Humboldt State University, will present the Wier-Giordano model of the nuclear arms race. Based on the model, a variety of currently proposed scenarios for US defense strategy will be analyzed, including the current debate over Star-Wars. No mathematical prerequisite is needed, although an algebra background will be helpful.

OCTOBER 7

PROBABILITY PARADOXES
Dr. Doraiswamy Ramachandran, Professor of Mathematics and Statistics, California State University, Sacramento, will illustrate with real-life examples some unusual paradoxes from Probability and Statistics such as the Simpson's paradox, the Non-transitivity paradox and the clocking paradox. You may not believe the statements you see and hear in this talk, but they prove to be well founded!

OCTOBER 14

HAMILTONIAN CURCUITS — FROM THE FOUR-COLOR PROBLEM TO THE EXPLORATION OF SPACE
Dr. David Barnette, Professor of Mathematics, University of California, Davis, will show how an incorrect solution to the famous four-color problem in the 19th century led to many interesting problems dealing with circuits in graphs. Recently these problems have had applications in unexpected areas such as chemistry and the space program.

OCTOBER 21

PRACTICAL PROBLEMS
Dr. Clement E. Falbo, Professor of Mathematics, Sonoma State University, will review some of the practical mathematics problems that people have telephoned to the SSU Mathematics Department. These problems range from fighting fires to decorating Christmas trees. The Mathematics Department will use this talk to introduce the Free "MATH CLINIC." The general public is invited to bring in mathematics problems for discussion, but not necessarily for an "on-the-spot" solution. Homework problems from classes in progress will not be considered!

OCTOBER 28

EFFICIENT INTEREST RATES
Dr. Richard Rockwell, Professor and Chairman of Mathematics, Pacific Union College, will present a mathematical model which explores the influence of interest rates on economic efficiency and growth.

NOVEMBER 4

BROWNIAN MOTION, RANDOM WALKS, AND COMPUTATIONAL PHYSICS
Dr. E. Gerry Puckett, Postdoctoral Fellow, Lawrence Livermore Laboratory, and SSU Mathematics Department alumnus, will present an overview of the art of using computers to conduct physics experiments. As as example, he will examine Brownian motion and its mathematical relation to random walks, and will describe how this may be exploited to model fluid flows on a computer. This talk may be of particular interest to students in physics, chemistry, and numerical analysis.

NOVEMBER 11

FIRE AND ICE
Dr. Rick Luttmann, Professor of Mathematics, Sonoma State University, will discuss the effect of latitude and season on the collection of sunlight. Elementary vector calculus is employed to analyze and explain why it is warmer in the summer than in the winter, and near the Equator than at the Poles.

NOVEMBER 18

REPRESENTING POSITIVE INTEGERS VIA FIBONACCI NUMBERS
Dr. Margaret Owens, Professor of Mathematics, Chico State University, will examine one of the many interesting properties of the Fibonacci numbers (1, 2, 3, 5, 8, 13, 21, . . .) and some of its possible applications: Just as each positive integer can be expressed as a sum of powers of 2, it can also be expressed as a sum of distinct Fibonacci numbers.

DECEMBER 2

THOMSEN'S EQUATION FOR LINE REFLECTIONS
Dr. James T. Smith, Professor of Mathematics, San Francisco State University, will show that the simplest nontrivial equation that holds among the reflections in the sides of an arbitrary triangle has twenty-two terms. The methods used will include transformational geometry, algebra of complex numbers and polynomials, and combinatorics of paths in a hexagonal plan lattice. The analogous three-dimensional problem is a mystery.

DECEMBER 9

ABSTRACT DATA TYPES — MODERN ALGEBRA IN COMPUTER SCIENCE
Dr. David Butcher, Professor of Computer Science, Sonoma State University, will survey recent research in computing theory which has suggested that the data structures used in computer programs should be treated as abstract algebraic systems of the kind studied in modern algebra. The practical ramifications of this work for computer programming will be discussed. No prior knowledge of modern algebra will be presupposed.

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FEBRUARY 17

POLYGONS AND POLYOMIALS
Dr. James Shilleto, Department of Mathematics, Sonoma State University, will show that plane polygons can be associated with polynomials in a natural way. Factoring such a polynomial corresponds to decomposing the polygon into simpler (more regular) ones. Many theorems of plane geometry can be redone using these concepts.

FEBRUARY 24

BI-EMBEDDINGS OF THE COMPLETE GRAPH
Dr. Sharon Cabaniss, Department of Mathematics, Santa Clara University, will talk about embedding the complete graph on two different surfaces. She will present some infinite families of bi-embeddings as well as some interesting results from a computer search. An unsolved conjecture will also be discussed.

MARCH 2

NEW TRIGONOMETRIC IDENTITIES
Dr. Samih A. Obaid, Department of Mathematics, San Jose State University, will derive some new trigonometric and combinatorial identities, and will also indicate their applications to certain boundary value problems which arise in mechanics.

MARCH 9

MATHEMATICAL MODELS OF EVOLUTIONARY PROCESSES
Dr. Roland Lamberson, Department of Mathematics, Humboldt State University, will talk about mathematical models of life history strategies of plants and animals evolving in hazardous environments.

MARCH 16

RANDOM WALKS AND EQUILIBRIA OF RUBBER BANDS
Dr. Reuben Hersh, Department of Mathematics, University of New Mexico, Albuquerque, suggests that random walks or Brownian motion on the one hand, and equilibrium states of elastic membranes on the other hand, are two entirely unrelated physical problems. Nevertheless, it turns out that their mathematical descriptions are equivalent. Consequently, we can predict the outcome of a random walk by looking at the position of an appropriate rubber band.

MARCH 23

UNANTICIPATED PROBABILITY RESULTS IN NUMBER THEORY AND GEOMETRY
Dr. William Leonard, Department of Mathematics, California State University at Fullerton, will bring you some surprises from the fields of probability, number theory and geometry including a famous unsolved problem or two and the results of some recent personal research in the realm of mathematical expectancy.

MARCH 30

Spring Recess

APRIL 6

STATISTICAL MECHANICS AND KNOTS
Professor Vaughn F. R. Jones, Department of Mathematics, University of California, Berkeley, will explain the meaning of the partition function of a statistical mechanical system. For certain systems defined on pictures of knots in 3-space, the partition function depends only on the knot, i.e., is independent of the picture chosen. This provides interesting "invariants" of knots.

APRIL 13

THE AXIOM OF CHOICE (AND SOME OF ITS WEAK VERSIONS)
Dr. Gary P. Shannon, Department of Mathematics and Statistics, Sacramento State University, will present a brief history of the Axiom of Choice, and will indicate some of the many ways that the Axiom of Choice as well as some of its weak versions appear throughout mathematics.

APRIL 20

THE RIEMANN INTEGRAL AND THE FUNDAMENTAL THEOREM OF CALCULUS
Dr. Washek F. Pfeffer, Department of Mathematics, University of California, Davis, will show that a small change in the classical definition of the Riemann integral leads to a very general fundamental theorem of calculus.

APRIL 27

A PROBLEM ARISING FROM INDUSTRIAL APPLIED MATHEMATICS
Dr. David Ellis, Professor of Mathematics, San Francisco State University, will discuss a problem arising in the operation of long-belt conveyor systems. In such systems, sharp "shock" waves can develop which can impair the system's performance and, in some cases, destroy critical components of the system. Employing conservation laws for mass and momentum, he will develop a mathematical model which governs the propagation of tension.

NATIONAL MATHEMATICS AWARENESS WEEK

MATH FESTIVAL takes place this date. See schedule for other events.

MAY 4

PARTIAL DIFFERENTIAL EQUATIONS, THE COMPUTER, AND INTUITION
Mr. Craig Hildebrand, SSU alumnus and doctoral candidate, University of California, Berkeley, will show how partial differential equations are used to describe and understand the physical world. In order to understand the equations and the mathematics involved, it helps to enhance one's intuition. Through the use of the computer and elementary numerical techniques, one can "see" how the equations behave and improve both mathematical and physical intuition. One can further understand how the computer can be used as an experimental tool in mathematical research.

MAY 11

MATHEMATICS YOU CAN TOUCH
Mr. Stan Isaacs, Computer Programmer Analyst, Hewlett-Packard, Palo Alto, will talk about mechanical puzzles and the relationship between them and mathematics. Mathematics can be used to help understand some puzzles, and other puzzles provide examples of mathematical structures and theorems. A few puzzles will be presented which are still awaiting mathematical analysis.

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SEPTEMBER 14

MATHEMATICAL MODELING IN ECONOMICS WITH AN APPLICATION IN INTERNATIONAL TRADE
Ms. Alison Butler, SSU graduate and doctoral candidate at the University of Oregon in Eugene, will give an overview of the role, difficulties and limitations of mathematical models in economics, and provide a specific example of dynamic modeling in international trade.

SEPTEMBER 21

THE GIBBS PHENOMENON
Dr. Dale Mugler, Department of Mathematics, Santa Clara University, will talk about the convergence of Fourier series and the associated Gibbs Phenomenon. In 1898, Michelson and Stratton made their "harmonic analyser," a machine which could mechanically graph finite Fourier series. The curves could be made to approach sawtooth functions, except for tiny bumps at the edges, which did not seem to go away, even for large n. These tiny bumps were explained by Willard Gibbs in 1899.

SEPTEMBER 28

JAILHOUSE MATHEMATICS
Dr. Hung-ping Tsao, Lecturer of School of Business, San Francisco State University, will talk about some mathematics one might do while idling in a jail cell. For more detail, please come and find out for yourself.

OCTOBER 5

DYNAMIC BRIDGE ANALYSIS SPOKEN IN THE LANGUAGE OF MATHEMATICS
Mr. Brian Maroney, Associate Bridge Engineer, Caltrans, Sacramento, will describe how the structural idealization of preanalysis engineering is translated into mathematical expressions. He will carry the engineering process through the postanalysis procedures of a typical California bridge.

OCTOBER 12

APPLIED NUMBER THEORY
Dr. Newman Fisher, Chair, Department of Mathematics, San Francisco State University, will show how to construct a calendar, play the ancient game of Nim, and transmit secret messages using such basic notions as number bases and congruences.

OCTOBER 19

BEAUTY AND THE BEAST: THE MANDELBROT SET
Dr. Rick Luttmann, Department of Mathematics, Sonoma State University, will present an elementary introduction to Verhulst processes, which are used to study the complex dynamics of non-linear systems in such diverse fields as plasma physics, cardiology, and ecology. The theory leads quickly to questions of order, stability, periodicity, fixed points, chaos, the Feigenbaum constant, Julia sets, Fatou dust, and finally the Mandelbrot set. Computer-generated color graphics depict the amazing and beautiful complex fractal micro-structures at the boundary of this remarkable set.

OCTOBER 26

A NEW LOOK AT AN OLD FRIEND: MR. PYTHAGORAS GOES TO HOLLYWOOD
Professor Elena Anne Marchisotto, Department of Mathematics, California State University, Northridge, will discuss The Pythagorean Theorem. This "old friend" from high school geometry has a rich history and a wealth of proofs and applications. A computer-animated videotape produced at the California Institute of Technology will provide the framework for the discussion.

NOVEMBER 2

THE MATHEMATICS OF JUGGLING
Dr. Phyllis Chinn, Department of Mathematics, Humboldt State University, will present a lecture/demonstration of some mathematical ideas related to juggling, including brief topics from geometry, combinatorics and algorithms.

NOVEMBER 9

THROUGH THE FOURTH DIMENSION AND BEYOND VIA A PICTORIAL PASCAL TRIANGLE
Dr. Dave Logothetti, Department of Mathematics, Santa Clara University, will show some Pólya picture writing as applied to lattice points on cross-sections of cubes in various dimensions, justification for which rests on no more than beginning algebra, but consequences of which lead to solutions of toughish problems in probability.

NOVEMBER 16

THE ROLE OF BEAUTY IN MATHEMATICAL SCIENCE
Dr. Alvin White, Department of Mathematics, Harvey Mudd College, Claremont, will offer a survey, with examples, of the beauty, aesthetic sense, and other "non-mathematical" considerations which have played a central role in the creation of concepts and laws of mathematics and mathematical science.

NOVEMBER 30

WHO INVENTED METRIC SPACES? MAURICE FRÉCHET—THAT'S WHO
Dr. Angus E. Taylor, Professor Emeritus, University of California, Berkeley, will present a *vast* abbreviation of three long papers from "A Study of Maurice Fréchet" in *Archive for History of Exact Sciences.*

DECEMBER 7

MATH FOR FUN BUT NOT FOR PROFIT
Dr. Paul Halmos, Department of Mathematics, Santa Clara University, will consider questions such as "Is mathematics useful?" and "Are mathematicians useful?". He will present some challenging teasers from several different parts of mathematics.

DECEMBER 14

A QUICK LOOK AT LIE GROUPS
Dr. Thomas McCready, Department of Mathematics, Chico State University, will talk about Lie Groups and Lie Algebras. These concepts have proved to be extremely valuable in studying differential equations and other important mathematical areas. The only prerequisites for this talk are some knowledge of differential equations, vector analysis, and groups.

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FEBRUARY 15

MINIMIZING THE NUMBER OF CLASSROOMS NEEDED FOR TEACHING AND OTHER GRAPH THEORY APPLICATIONS
Mr. Dean Gooch, Sonoma State University Masters Graduate, and instructor in mathematics at Santa Rosa Junior College and College of Marin, asks "given a class schedule and a set of available rooms, is it possible to fit these classes into the set of rooms?" The study of perfect graphs has a solution to this problem using a special perfect intersection graph known as the interval graph. Graphs allow an intuitive understanding of the structure of algorithms. This talk should be of interest to computer scientists as well as mathematicians.

FEBRUARY 22

ACTUARIAL APPLICATIONS IN PREDICTING THE FUTURE
Ms. Darlene Tom, Actuary, Fireman's Fund Insurance Companies, Novato, will discuss actuarial problems arising out of the property/casualty insurance industry. The actuary is very often considered the one who 'figures the odds' for insurance companies. Several examples will be presented illustrating some basic concepts commonly encountered in actuarial work and the application of analytical techniques in predicting the future.

MARCH 1

NEWTON AND HIS PLANETS—DID HE USE CALCULUS?
Dr. Sherman Stein, Department of Mathematics, University of California, Davis, will look at Newton's arguments in the *Principia* in detail as Newton considers different possible gravitational laws.

MARCH 8

STATISITICS AND ESP RESEARCH
Dr. Jessica Utts, Division of Statistics, University of California, Davis, asks the question, "Does ESP exist?" There are hundreds of laboratory experiments showing that the answer is yes. But critics often dismiss these experiments by claiming that the statistical methods used were not valid. This talk will trace the history of this controversy, and discuss statistical methods currently used to evaluate ESP experiments.

MARCH 15

THE TRIANGLE TECHNIQUE
Dr. Kenneth Rebman, Dean, School of Natural Sciences, Hayward State University, will show that many of the famous (and not so famous) numbers of combinatorics may be presented in a triangular array generated by recursion. Pascal's Triangle is everyone's favorite example. We will look at some other triangular arrays related to partitions of sets and of numbers. There are surprises lurking there, some still waiting to be discovered.

MARCH 22

THE FOUR COLOR MAP PROBLEM—WHERE HAS IT LED?
Dr. John Mitchem, Department of Mathematics and Computer Science, San Jose State University, will discuss the four color map problem. In 1851, a University of London student, F.Guthrie, asked, "Can every map on a plane be four colored?" In 1976, two mathematicians and three computers finally showed that the answer was "yes." Guthrie's question has led to various practical and beautiful problems, a sample of which will be discussed.

APRIL 5

MATHEMATICAL PROBLEMS THAT NO ONE CAN SOLVE
Dr. Natasa Bozovic, Department of Mathematics and Computer Science, San Jose State University, will introduce you to one of the most surprising discoveries in modern mathematics—problems that can be rigorously *proved* to be algorithmically unsolvable. Godel, Turing and Novikov have envisioned limits that no supercomputer will ever pass.

APRIL 12

SEX, DRUGS, AND MATRICES: MODELING THE AIDS EPIDEMIC
Dr. Rick Luttmann, Department of Mathematics, Sonoma State University, will summarize a paper by Abramson and Rothschild of UCLA regarding mathematical attempts to forecast the future of the AIDS infection. Matrix theory and differential equations are the tools being brought to bear on this deadly serious contemporary problem.

APRIL 19
NATIONAL MATHEMATICS AWARENESS WEEK

EXTENDING THE BINOMIAL COEFFICIENTS TO PRESERVE SYMMETRY AND PATTERN
Professor Jean Pedersen, Department of Mathematics, Santa Clara University, will extend the meaning of the binomial coefficient $\binom{n}{r}$ to include negative integer values of n and r. Then she will look at two natural questions: (1) Is this hexagonal array of numbers *useful* for anything? and (2) Do patterns in the familiar Pascal Triangle (there are many such patterns, but the ones we will look at should be new to most members of audience) also hold in the Pascal Hexagon? In particular, the properties of the Pascal Flower, which persist over the whole of the Pascal Hexagon, give rise to a Generalized Star of David Theorem—and these results are immediately seen to be true for a much broader class of "Pascalian Hexagons," formed from certain special separable functions for which the binomial coefficient is one special case. The treatment will be elementary and no knowledge of advanced mathematics will be assumed. (Don't let the description scare you!)

APRIL 26

SEVERAL PROBLEMS, ONE SOLUTION
Dr. William Barnier, Department of Mathematics, Sonoma State University, will discuss Catalon numbers and several related problems of combinatorics. The talk will be at an elementary level and presumes no knowledge of combinatorics.

MAY 3

GENERALIZING THE CLASSICAL CONCEPTS OF CURVATURE AND TORSION
Dr. Frank A. Farris, Department of Mathematics, Santa Clara University, will review the concepts of curvature and torsion for curves in Euclidean space. Students of calculus will recall that these quantities completely determine a smooth curve up to congruence. When the proof of this fact is recast in terms of Lie groups, generalization to curves in other spaces is possible. The space-time of special relativity is an interesting example.

MAY 10

BUILDING SHORT ROADS AND ENCLOSING LARGE FIELDS
Dr. Tom Sallee, Department of Mathematics, University of California, Davis, will look at some geometric extremum problems solved without calculus.

MAY 17

GEOMETRY AND ILLUSION—PLAYING WITH FOUR-DIMENSIONAL BLOCKS
Mr. Dan Wheeler, Department of Mathematics, College of Notre Dame, Belmont, will present a four-dimensional analog of the familiar impossible triangle illusion.

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