

The Joint Program Committee
gratefully acknowledges
the generous support of the
following individuals and organizations.

University of Southern Colorado
College of Science and Mathematics
Dr. Jack Seilheimer, Dean

University of Southern Colorado
Department of Mathematics
Dr. Paul Chacon, Chair

Casio Calculator Division
Sales Representative:
Mr. Robert Rutledge

Addison Wesley Publishing
Sales Representative:
Mr. Rob Merino

DC Heath Publishing
Sales Representative:
Mr. Martin Lew

Harper Collins Publishing
Sales Representative:
Mr. Larry Sifford

International Thomson Publishing
Sales Representative:
Ms. Karen MacQueen

John Wiley & Sons Publishing
Sales Representatives:
Mr. Tom Demarce & Mr. Ted Scheffler

West Publishing
Sales Representative:
Mr. Dan Rinn

Wm. C. Brown Publishing
Sales Representative:
Mr. Russ Turley

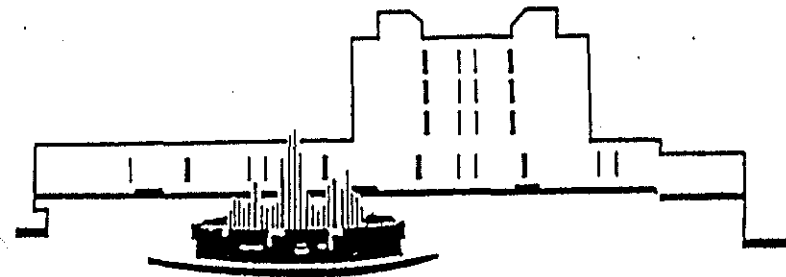
ABSTRACTS BOOKLET

1995 JOINT MEETING
APRIL 21 - APRIL 22

MATHEMATICAL ASSOCIATION OF AMERICA
ROCKY MOUNTAIN SECTION

COLORADO MATHEMATICAL
ASSOCIATION OF TWO YEAR COLLEGES

COLORADO COUNCIL OF
TEACHERS OF MATHEMATICS
SOUTH EAST REGION



UNIVERSITY OF SOUTHERN COLORADO
PUEBLO, COLORADO



was also compared with performance in this course. While some differences were observed, conclusions are difficult to draw from such a limited study. Overall, students in the portfolio section had a significantly poorer history in previous calculus classes than did those in the control section. This section, however, earned a higher percentage of As and Bs, as well as of Ds and Fs, as did the control section. A comparison of the data from the two sections will be presented and the lessons learned from this experience will be discussed.

Abstracts: By Name of Presenter

Listing is alphabetical by last name. Titles of joint presentations are cross-listed by the names of co-presenters, with the abstract appearing under the joint presenter whose name appears first in the alphabetical listing.

STEPHEN TEMPEST ALDRICH, University of Southern Colorado
On Finitely Generated Principal Ideal Domains
Friday, 21 April, 2:55 - 3:10, Room 127

After a short discussion of background material, specific examples and results obtained in the author's senior research project will be presented.

KENNETH AMEND, Metropolitan State College of Denver
Decomposition of Regression Models
(with C. Gutierrez and G. Kulver)
Saturday, 22 April, 10:50 - 11:25, Room 125

A new technique was presented in August 1994 at the International Statistical Meeting in Toronto. This technique can be applied under certain circumstances to regression models and leads to both an understanding of and a graphical representation of the interdependencies of the variables. This technique is discussed and examples are given.

BARRY BALOF, Colorado College
Non-Standard Dice: An Application in Abstract Algebra
Friday, 21 April, 3:45 - 4:00, Room 127

Is there a pair of dice that will yield the same sum probabilities as for the standard pair of six-sided dice? The answer is yes, and surprisingly, it arises out of a topic in Abstract Algebra dealing with cyclotomic polynomials. We will examine the Sicherman dice (a pair of six-sided dice labeled 1,2,2,3,3,4 and 1,3,4,5,6,8, which yield the same probabilities as the standard dice), and a model used to generalize the problem of finding nonstandard dice to n dice of m sides. We will also examine the palindromic nature of such dice as well as those dice which have a prime number of sides.

JEFF BENNETT, University of Colorado-Boulder

*Quantitative Literacy: Mathematics for Citizenship
in the 21st Century (with W. Briggs)*

Friday, 21 April, 2:15 - 2:30, Room 105

As individuals and as a society approaching the 21st century, we face challenges and choices that could affect our survival as a species. Understanding those issues and making informed decisions requires fundamental quantitative skills that all college and university students should possess. From decisions about personal finance and voting issues, to choices of food, lottery tickets and computers; from understanding the federal debt to appreciating the mathematics of pollution and deforestation, we are all called to higher levels of quantitative reasoning if we are to be effective citizens.

The Boulder and Denver campuses of the University of Colorado have developed a precalculus course for liberal arts students based on this theme of quantitative literacy. Supporting material for the course is in the class test phase and will be published by Addison-Wesley. The course and the material provide a broad survey of contemporary mathematics as it applies to the complex and evolving world around us. In this presentation, the authors will talk about the rationale for the course, the special features of the course material, and their experiences (and advice!) in teaching the course.

JEFF BERG, Arapahoe Community College

Some Approaches to Teaching Calculus II (with P. Hauss)

Saturday, 22 April, 10:10 - 10:45, Room 108

No abstract available at time of publication.

WILLIAM L. BRIGGS, University of Colorado-Denver

*Quantitative Literacy: Mathematics for Citizenship
in the 21st Century (with J. Bennett)*

Friday, 21 April, 2:15 - 2:30, Room 105

KIRK BRITAIN, East Central BOCES

Interactive Video in Math Instruction. Now!!

Saturday, 22 April, 2:30 - 3:30, Room 105

No abstract available at time of publication.

it is a critical thinking course. It deals with current social issues, such as whether the range of debate in the mainstream media is too narrow to convey the information citizens need to make informed decisions (about the Denver Airport - for example). How do you know what is true? Simple mathematical techniques (using only arithmetic again) can be used to examine biases in information sources. Prof. Walter also looks at AIDS, decisions in the court room, acid rain and many more topics. His goal is, in fact, to find and compare the "axioms of nature" and the "axioms of society", and see how they can be made compatible.

Environmental Numeracy is an open-ended course. Many questions are raised, which so far have incomplete answers. What students gain is a feeling for some of the actual numbers involved, and the logical structure of environmental subjects. This is what Prof. Walter calls environmental numeracy.

KAREN WHITEHEAD, South Dakota School of Mining Technology

Experiences Using Portfolios in a Calculus III Class

Saturday, 22 April, 10:50 - 11:05, Room 108

In Fall Semester 1994, portfolios were used in a third semester calculus class at the South Dakota School of Mines and Technology. Students were asked to place in their portfolios written summaries of each section studied together with two example problems which they felt best exemplified their mastery of the material. In addition, students were asked to include copies of team assignments done and hour exams taken in the portfolio. They were asked to write corrected versions of any problems missed on either the assignments or the exams. The portfolios were collected periodically to check progress, but were not graded until the end of the semester. A second section of the same course taught by the same instructor was given the same assignments and exams, but used quizzes in place of portfolios. At three times during the semester students in both classes were asked to anonymously fill out surveys which asked them about time spent on various aspects of the course (reading, working problems, reviewing, etc.) as well as about attitude toward the course.

The data gathered was analyzed to determine whether the use of portfolios had a discernible impact on performance or on attitude. The student's performance in previous calculus classes

ing dimension. In this brief overview of topological, similarity, and Hausdorff dimensions, we will discover that dimension need not be integral, and we will calculate the dimension of the Cantor set, the Sierpinski gasket, and the real line.

PATRICIA R. VELICKY, University of Northern Colorado
*Introduction and Use of Rubrics in a University
Mathematics Class (with A. R. Shaw)*
Saturday, 22 April, 11:10 - 11:25, Room 108

PAUL VERCLER, Metropolitan State College of Denver
Application of Gambler's Ruin
Saturday, 22 April, 10:10 - 10:25, Room 125

This talk discusses an application of the Gambler's Ruin problem used by an Atlantic City Casino. In order to recover money won by a Japanese gambler, the Casino hired a mathematician to devise an adequate "freeze-out" (absorbing barrier) to ensure the success of the Casino. This absorbing barrier will be explained along with variations.

CAROL WALKER, Colorado State University
Doing Mathematics with Scientific Workplace (with D. Hardy)
Publishers' Display, Room 116

MARTIN WALTER, University of Colorado - Boulder
MAA MINI-COURSE:
Teaching Environmental Numeracy to Undergraduates
Saturday, 22 April, 2:00 - 4:00, Room 126

The goal of the course *Environmental Numeracy* is to equip students with the mathematical tools they need to understand our increasingly complex environment and thrive in it. It is possible to comprehend many of the environmental problems – and their possible solutions – with arithmetic as the main tool. Using Schwartz charts (which use only elementary addition and multiplication), population modeling can answer some relatively hard questions. If one has the time, more delicate mathematics can be developed, and very interesting topics such as chaos can be studied.

Environmental Numeracy is not just a mathematics course.

JANET BURGOYNE, South Dakota School of Mining Technology
*Denseness of the Generalized Eigenvectors of a Discrete
Operator in a Banach Space*
Friday, 21 April, 3:25 - 3:40, Room 126

Dunford and Schwartz studied conditions under which a linear operator in a Hilbert space had generalized eigenvectors that were dense in the space. They used the notion of singular values of the operator to generate a normed linear space which was central to the development of their result. I have extended their result so that it will apply to linear operators in a Banach space. To do this I work with s -numbers, which are the generalization of singular values to a Banach space. Working without an inner product poses many problems. Foremost among them is the fact that the s -numbers do not generate a normed linear space: the triangle inequality does not hold and hence continuity properties are lost. In this talk I hope to outline how I overcame these challenges to achieve the generalization.

PATTI CAPPS, Montview Elementary School
*Implementing an Elementary School-wide Problem Solving
and Communication Assessment*
Saturday, 22 April, 2:30 - 3:30, Room 109
No abstract available at time of publication.

ERNEST J. CISNEROS, Metropolitan State College of Denver
Teaching L-Grammars in Discrete Mathematics
Friday, 21 April, 2:15 - 2:30, Room 108

Teaching Lindenmayer Grammars in a discrete mathematics course can enhance student understanding by expressing the grammar strings graphically as fractals.

DANA CORTEZ, University of Southern Colorado
Schroder-Bernstein Groups
Friday, 21 April, 3:25 - 3:40, Room 127

The Schroder-Bernstein Theorem in set theory asserts that if there exists a one-to-one mapping from each of two sets into the other, then there exists a one-to-one mapping from either set onto the other. That is, if each of two sets is of the same cardinality as a subset of the other, then the two sets must be of

CARL ROBERT GIBBONS, University of Denver

Explicit formulas for the sums of powers of integers, Bernoulli and Euler Polynomials, and other combinatorial functions

Friday, 21 April, 3:25 - 3:40, Room 105

The closed form polynomial formulas for the sums of powers of integers, $\sum_{j=1}^n j^k = S_k(n)$, and the related Bernoulli and Euler polynomials have been extensively studied. Generally, these polynomials are computed using recurrence relations. Using some tools of elementary linear algebra, it is easy to obtain explicit formulas for the sums of powers of polynomials, the related Bernoulli and Euler polynomials, and many other combinatorial functions. These linear-algebraic methods have two desirable properties: the explicit formulas are relatively convenient to write and compute, and the methods are general, i.e. they apply to a wide range of useful functions.

CHRISTOPHER GUTIERREZ, Metropolitan State College of Denver

Decomposition of Regression Models

(with K. Amend and G. Kulver)

Saturday, 22 April, 10:50 - 11:25, Room 125

DAREL HARDY, Colorado State University

College Algebra in Context: Implementing Algebra Reform at a University (with K. Klopfenstein)

Friday, 21 April, 2:55 - 3:10, Room 105

We are developing a college algebra course that incorporates content, perspective and instructional strategies consistent with current reforms and serves large numbers of university students. Development involves adapting instructional strategies that foster active learning in large classes and writing materials that imbed algebraic topics in contexts and integrate appropriate technology.

DAREL HARDY, Colorado State University

Doing Mathematics with Scientific Workplace (with C. Walker)

Publishers' Display, Room 116

Scientific WorkPlace provides a free-form interface to a computer algebra system that is integrated with a scientific word processor. It accepts mathematical formulas and equations entered

We will then state the classification theorem for any 2-D surface. Visual representations of various surfaces will be displayed in terms of classification theorem. The presentation will discuss which of the surfaces are diffeomorphic to one another.

RHAINNIE SELLMAN, University of Southern Colorado

Super Secret Spy Kit: The Psychic Egg Trick

Saturday, 22 April, 10:30 - 10:45, Room 125

A brief survey of the history of pre-computer cryptology is presented, with demonstrations of classical encoding techniques.

LESLIE E. SHADER, University of Wyoming

Four the Hard Way

Saturday, 22 April, 10:30 - 10:45, Room 126

A proof that a mathematical puzzle has no solutions is extended to the evaluation of a family of infinite series. A special case leads to a new proof of a well-known identity.

A. ROSE SHAW, Education and Business Consultant

Introduction and Use of Rubrics in a University

Mathematics Class (with P. Velicky)

Saturday, 22 April, 11:10 - 11:25, Room 108

Rubrics were introduced in a university's mathematics capstone course. This study provided a hands-on opportunity for the teacher and 16 students, mathematics majors preparing to become secondary teachers, to learn about rubrics. Six modeling projects were scored by the teacher using a rubric scoring procedure and a traditional scoring procedure. Students expressed appreciation for the information rubrics provided, were concerned that rubric scoring resulted in lower scores, and speculated that rubric scoring took more time than traditional scoring. The teacher observed that rubrics fostered a cooperative class atmosphere and that rubric scoring did not take more time than traditional scoring. Correlations between scores for the two procedures were .91 or greater indicating high agreement between the two procedures.

operation form a group. We'll see how the discrete logarithm problem in these cryptosystems compares to its analogue in RSA and why many researchers believe that elliptic curve cryptosystems may be more secure than RSA.

CAROL NACHTIGALL, Pueblo South High School
Integrated Mathematics: Several Working Models
(with D. Cox and P. Mara)
Saturday, 22 April, 10:10 - 11:25, Room 105

CARL POMERANCE, University of Georgia
POLYA LECTURE: *Witnesses for composite numbers*
Friday, 21 April, 4:00 - 5:30, Life Science Auditorium

Given a large number, how quickly can you tell if it is prime or composite? All composite numbers are supplied with plenty of witnesses, that is, numbers by means of which it is possible to quickly tell if the given number is composite. For example, 2 is a witness for 91, since 2 raised to the power 45 is neither 1 nor -1 modulo 91 as Fermat's Little Theorem would assert if 91 were prime. This kind of test is what computer algebra programs often use to check if an input is prime or composite. We shall discuss the validity of this test and give some extreme examples of composite numbers with no small witnesses.

DUANE PORTER, University of Wyoming
DISTINGUISHED TEACHING AWARD INVITED LECTURE:
Slates, Blackboards, Greenboards, Whiteboards, Overheads,
Computers, Multimedia: Can We Possibly Survive in
Such a Changing World?
Friday, 21 April, 1:15 - 2:00, Occhiato Center, Ballroom West

LARA SCHMIDT, University of Northern Colorado
A Visual Representation of the Classification Theorem for
2-D Surfaces (with T. Soto-Johnson)
Saturday, 22 April, 10:10 - 10:25, Room 126

The goal of the presentation is to discuss which 2-D surfaces can be smoothly deformed to look alike and to give examples using computer graphics. We will define a sphere, a torus, and a projective plane, as well as other examples of 2-D surfaces.

in natural notation and is designed to provide the simplest and most direct interface possible to a typesetting system and a symbolic algebra system. By providing an interface with little or no learning cost, Scientific WorkPlace makes symbolic computation as accessible as any Macintosh- or Windows-based word processor, fitting the needs of a wide range of users, from the beginning student to the professional scientist.

DAREL HARDY, Colorado State University
Report of the Inter-Institutional Mathematics Team of the Rocky
Mountain Teacher Education Collaborative (RMTEC)
(with J. Farmer and J. Loats)
Friday, 21 April, 2:00 - 4:00, Room 121
Saturday, 22 April, 10:00 - 12:00, Room 121

PATRICIA HAUSS, Arapahoe Community College
Some Approaches to Teaching Calculus II (with J. Berg)
Saturday, 22 April, 10:10 - 10:45, Room 108

KEN KLOPFENSTEIN, Colorado State University
College Algebra in Context: Implementing Algebra Reform
at a University (with D. Hardy)
Friday, 21 April, 2:55 - 3:10, Room 105

GRETCHEN KULVER, Metropolitan State College of Denver
Decomposition of Regression Models
(with K. Amend and C. Gutierrez)
Saturday, 22 April, 10:50 - 11:25, Room 125

STEVE LETH, University of Northern Colorado
A Simplified Sperner's Theorem
Friday, 21 April, 2:55 - 3:10, Room 108

An induction proof of a simplified version of Sperner's Lemma which is still strong enough to prove the Brouwer Fixed Point Theorem in 2 dimensions will be presented. The proof is suitable for class exploration in either an undergraduate or graduate level Discrete Mathematics course.

JIM LOATS, Metropolitan State College of Denver
Report of the Inter-Institutional Mathematics Team of the Rocky Mountain Teacher Education Collaborative (RMTEC)
(with J. Farmer and D. Hardy)
 Friday, 21 April, 2:00 - 4:00, Room 121
 Saturday, 22 April, 10:00 - 12:00, Room 121

JAMES LOUISELL, University of Southern Colorado
Stability in Nonlinear Delay - Differential Equations
 Friday, 21 April, 2:15 - 2:30, Room 126

The author considers the linear delay-differential system (*) $\dot{x}(t) = A_0x(t) + A_1x(t-h)$. After some introduction, it is shown that there is a velocity functional which, along with its Lie derivative in delay-differential operator theory, is analogous to the velocity Lyapunov function $V(x) = \ll Ax, Ax \gg$, which along with its Lie derivative $x^T(A + A^T)x$ is used in the analysis of the ordinary differential equation $\dot{x}(t) = Ax(t)$. The Lie derivative can be written as $2\langle (A_0 + \sigma A_1)\phi, \phi \rangle$ in a suitable inner product $\langle \cdot, \cdot \rangle$ for C^1 vector functions ϕ given over $[-h, 0]$, where σ signifies the delay operator. Next, considering the nonlinear delay-differential equation (†) $\dot{x}(t) = f(x(t), x(t-h))$, we give a velocity functional having Lie derivative which locally resembles that for the linear system (*). If the linear operator associated with this Lie derivative satisfies a certain stability property, then the nonlinear system (†) will be globally contractive to a unique equilibrium. We give examples in which one can tell precisely where the equilibrium will lie.

BRUCE N. LUNDBERG, University of Southern Colorado
Industrial Problems as a Soul for the Body of Undergraduate Mathematics: Examples from Orbit Transfer Optimization and Medical Imaging
 Friday, 21 April, 2:35 - 2:50, Room 108

Math Majors sometimes complain that they take courses in Calculus, Linear Algebra, Differential Equations, Modern Algebra, Analysis and Topology, but never take a course in MATHEMATICS. Professors are sometimes heard to remark that students forget or fail to apply the mathematics they learn in one course to other courses. In this talk I will illustrate one of sev-

eral ways to try to help students see various parts of the body of mathematics working together as a unified whole rather than lying around dismembered and dying. I will do this by describing two examples of problems from industry in which several areas of undergraduate mathematics come to life and work in concert. Examples will be taken from Orbit Transfer Optimization and Medical Imaging.

BEV LYNDS, University Corporation for Atmospheric Research
Skymath Project
 Saturday, 22 April, 11:00 - 11:25, Room 127
No abstract available at time of publication.

PAT MARA, Pueblo South High School
Integrated Mathematics: Several Working Models
(with D. Cox and C. Nachtigall)
 Saturday, 22 April, 10:10 - 11:25, Room 105

VICTOR MEYERS, University of Southern Colorado
An Investigation Into the Invertibility of a Special Kind of Matrix
 Friday, 21 April, 2:15 - 2:30, Room 127

Conditions under which matrices of the form $\begin{bmatrix} A & B \\ B^T & C \end{bmatrix}$ are invertible are considered, where A is an $n \times n$ matrix, B is an $n \times m$ matrix, and C is an $m \times m$ matrix.

JOE MODICA, Hoehne Middle School
Five Years of Middle School Projects: From Development Through Presentation and Assessment
 Saturday, 22 April, 10:10 - 11:00, Room 127
No abstract available at time of publication.

PETER MORRIS, University of Wyoming
Introduction to Elliptic Curve Cryptography
 Friday, 21 April, 3:45 - 4:00, Room 126

This is a brief introduction of how and why elliptic curves are being used in public key cryptography. We'll look at how an addition operation based upon what's called the chord-tangent method can be defined so that the points on the curve and the