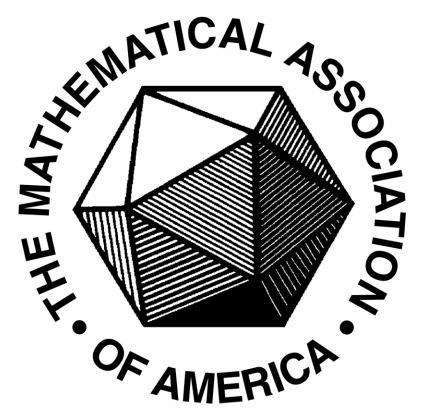
Annual Meeting of the Pacific Northwest Section of the Mathematical Association of America

Carroll College
Helena, Montana
June 19-21, 2008



Annual Meeting
of the
Pacific Northwest Section
of the
Mathematical Association of America

Carroll College
Helena, Montana
June 19-21, 2008

Sponsored by
Mathematical Association of America
Carroll College

Thursday, June 19

8:30 2:30	**Project NExT Meeting** *Simperman Hall 114*	
2:00 2:45	**Early Registration/Packet Pick-up** **(non Project NExT minicourse participants)** *Fortin Center Scola*	
2:45 5:45	**Minicourse** **Classroom Voting** [2] *Simperman 114*	**Minicourse** **Sarah Greenwald** [1] *Simperman 123*
6:30	**Project NExT Dinner** *Riley's Irish Pub*	
7:30 9:00	**Packet Pickup, Early Registration** *Fortin Center Scola*	
7:30	**Ice Cream Social** *Fortin Center Scola*	

Friday, June 20

<table>
<tr><td>7:30</td><td colspan="2"></td><td>Section Executive</td></tr>
<tr><td>8:00</td><td rowspan="5">MAA Book Sale
Fortin Center Scola</td><td rowspan="4">Packet Pickup &
Registration
Fortin Center Scola</td><td>Committee Meeting
Rogers Board Room, Campus Center</td></tr>
<tr><td>8:45</td><td>Welcome: Tom Trebon
Wiegand Amphitheater, SH 101-202</td></tr>
<tr><td>9:00</td><td>Joe Gallian
“Using groups and graphs to create symmetry patterns” [3]
Wiegand Amphitheater, SH 101-202</td></tr>
<tr><td>10:00</td><td>Refreshments
Fortin Center Scola</td></tr>
<tr><td>10:20

12:15</td><td colspan="2">Contributed Talks
Simperman Hall</td></tr>
<tr><td>12:30</td><td colspan="2" rowspan="2">Lunch (Provided)
Campus Center cafeteria</td><td></td></tr>
<tr><td>1:15</td><td>Business
Meeting
Simperman 114</td></tr>
<tr><td>2:15

3:10</td><td colspan="3">Sarah Greenwald
“Good News Everyone! Mathematical Morsels from The Simpsons and Futurama” [4]
Wiegand Amphitheater, SH 101-202</td></tr>
<tr><td>3:10</td><td colspan="2" rowspan="2">MAA Book Sale
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Fortin Center Scola</td></tr>
<tr><td>3:30

5:25</td><td>Contributed Talks
Simperman Hall</td></tr>
<tr><td>5:30

6:30</td><td colspan="3">Social Hour
Campus Center

Banquet and Awards
Campus Center
Ivars Peterson
“Soap Bubbles in Math, Science, and Art” [5]</td></tr>
</table>

Saturday, June 21

<table>
<tr><td>9:00</td><td colspan="2">Ivars Peterson
“A Knotty Tale: From Vortex Atoms to DNA Tangles” [6]
Wiegand Amphitheater, SH 101-202</td></tr>
<tr><td>10:00</td><td rowspan="2">MAA Book Sale
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Fortin Center Scola</td></tr>
<tr><td>10:20
11:55</td><td>Contributed Talks
Simperman Hall</td></tr>
</table>

Social Events

Thursday Project NExT Dinner
Riley’s Irish Pub

Thursday Ice Cream Social
Fortin Center Scola

Friday Lunch
Campus Center cafeteria

Friday Evening Social Hour
Banquet Dinner and Awards Ceremony
Campus Center

Welcome

Recognition of student presenters

Introduction of new Section Project NExT Fellows

Presentation of 25- and 50-year MAA membership certificates

Program of Contributed Papers

The program of contributed papers appears on the following pages. In some cases, titles or other information are abbreviated for reasons of space; please see the full abstract for complete information. An asterisk ($*$) indicates which of the contributers listed is/are make the presentation. A dagger (†) indicates an undergraduate student.

This year's Mathematical Contest in Modeling and Interdisciplinary Contest in Modeling problems were:

- MCM Problem A: *Take a Bath* which asked teams to consider the effects on land from the melting of the North Polar Ice Cap due to the predicted increase in global temperatures.
- MCM Problem B: *Creating Sudoku Puzzles* asked teams to develop an algorithm to construct Sudoku puzzles of varying difficulty.
- ICM Problem C: required teams to understand the issues and finances of health care systems and to build effective metrics to measure and compare health care system quality.

See the COMAP website, http://www.comap.com, for more information.

Session Organizers

- *Action Research in Mathematics Education*: Elizabeth Burroughs and David Yopp, Montana State University
- *Junior Faculty Talks*: Kathryn Temple, Central Washington University
- *Issues and Challenges in Applied Mathematics*: Marie Vanisko and John Scharf, Carroll College
- *Student Papers and Undergraduate Research Projects*: David Scott, University of Puget Sound
- *Outreach Programs for Underrepresented Populations in Mathematics*: Marie Vanisko, Carroll College; Viji Sundar, California State University Stanislaus
- *Talks on Teaching*: Nick Willis and Donna Pierce, Whitworth University
- *General Papers*: Chris Hallstrom, University of Portland; John Thurber, Eastern Oregon University

Contributed Talks — Friday Morning			
	Action Research SH 114	**Student Talks** SH 123	**Junior Faculty** SH 110
10:20– 10:35	*What is action research in mathematics?* [13] **Elizabeth Burroughs, MSU**	*Building Sudoku. (MCM Problem B)* [36] **John Riggs†, Carroll College**	*Singular points of reducible sextic curves.* [48] **Nicholas Willis, Whitworth U.**
10:40– 10:55	*The effect of active learning in remedial mathematics courses.* [17] **Roger Fischer, MSU–Bozeman**	*Creating better health care. (ICM Problem C)* [30] **Ian Lyon†and Cassandra Rapkoch†, Carroll College**	*Singular points of real septic curves.* [16] **Annie Didier†and Kevin Sonnanburg†, Whitworth U.**
11:00– 11:15	*PMET project: a linear and abstract algebra course for middle school mathematics teachers.* [44] **Marie Vanisko, Carroll College**	*Interpolation using radial basis functions.* [18] **Allen Flavell†, Seattle Pacific**	*Numerical analysis for the nonlocal Allen-Cahn equation.* [12] **Sarah Brown, Southern Utah U.**
11:20– 11:35	*A curriculum focus: Interventions effects on students' algebra achievement.* [50] **David Yopp, MSU**	*Mathematically modeling the human knot game.* [23] **Christopher Hardy†, Seattle Pacific**	*Invertible integral operators and subexponential kernel decay.* [10] **Scott Beaver, WOU**
11:40– 11:55		*Tiling mutilated rectangles with tetrominoes.* [15] **Benjamin Coate†, The College of Idaho**	*The calculus of variations is more than minimization.* [11] **Jim Bisgard, CWU**
12:00– 12:15		*Aperiodic tilings: the relationship between spectrum and "Bubbles".* [35] **Ashley Rand†, Minnesota St. U., Mankato**	*What are particle systems, and what are they good for, anyway?* [42] **Kathy Temple, CWU**

Contributed Talks — Friday Afternoon		
	Action Research SH 114	**Outreach** SH 123
3:30–3:45	*Engaging teachers in action research.* [29] **Jennifer Luebeck, MSU**	*Pre-collegiate STEM programs at California State University, Stanislaus.* [41] **Viji Sundar, Cal. St. Stanislaus**
3:50–4:05	*A more balanced assignment: Augmenting a homework assignment to include constructed response questions.* [39] **Kathleen Strauss, MSU-Bozeman**	*Math makes a Splash!* [40] **Kathleen Sullivan, Seattle U.**
4:10–4:25	*Inquiry based teaching vs traditional based teaching.* [8] **Gary Bauman, Townsend School/MSU**	*Reaching students with a live call-in show on PBS.* [14] **Elizabeth Burroughs, MSU**
4:30–4:45	*Using algebra tiles to improve student understanding and attitude.* [38] **Rex Sonsteng, CM Russell High School/MSU**	*Special Issues in Mathematics Facing American Indian Students in Montana.* [25] **Bob Johnke, Montana St. U., Northern**
4:50–5:05		*Carroll College chapter of Engineers Without Borders: working with the Blackfeet in Montana, and orphans in Santa Maria, Mexico.* [32] **John Scharf and Jack Oberweiser, Carroll College**
5:10–5:25		*Discussion: Looking at ways to assist students in the problems they face in transitioning from high school to college mathematics.* [45] **Marie Vanisko, Carroll College**

Contributed Talks — Friday Afternoon		
	General I SH 110	**General II** SH 108
3:30–3:45	*Fun with birthdays.* [27] **Mike Kenyon, Green River Community College**	
3:50–4:05	*A pairing strategy for tic-tac-toe on the integer lattice with numerous directions.* [28] **Klay Kruczek, WOU**	
4:10–4:25	*Weakly peripherally linear mappings between uniform algebras.* [49] **Rebekah Yates and Thomas Tonev, U. of Montana**	*Distribution of zeros of entire functions.* [21] **Michael Gilliam, U. of Montana**
4:30–4:45	*A Cayley type theorem for Boolean rings.* [24] **John Hart, U. of Montana**	*The intermediate value property of derivatives revisited.* [43] **Elena Toneva, Eastern Wash. U.**
4:50–5:05		*Integrals of functions composed with the Cantor function.* [22] **Russell A. Gordon, Whitman College**
5:10–5:25		*Curious connections: rational function extrema and the geometric mean.* [26] **Sally Keely, Clark College and U. of Phoenix Online**

Contributed Talks — Saturday Morning		
	Applied Math SH 114	**Talks on Teaching** SH 123
10:20–10:35	*A modular approach to teaching a course in application-based problem solving.* [20] **Benjamin Galluzzo, U. of Iowa**	*Considerations in developing a special topics course.* [34] **Dr. Donna Pierce, Whitworth U.**
10:40–10:55	*A modular approach to teaching a course in application-based problem solving.* [46] **Dr. Theodore Wendt, U. of Wisconsin - La Crosse**	*Teaching topology to undergraduates during a one month term.* [47] **Nicholas Willis, Whitworth U.**
11:00–11:15	*Using multiple regression to calculate helicopter hover ceilings.* [31] **Terry Mullen, Carroll College**	*Common error patterns in pre-service teachers' attempts at writing fraction word problems.* [9] **Cheryl Beaver, WOU**
11:20–11:35	*Where to put the steel?* [37] **John L. Scharf, Carroll College**	*Epsilon-delta continuity in the first calculus course.* [19] **William Freed, Concordia University College of Alberta**
11:40–11:55	*Mathematical modeling and inquiry in the life, social, informational and behavioral sciences.* [7] **Chris Arney, Army Research Office**	*A Math/CS career prep course.* [33] **Dr. Peter Tucker and Dr. Donna Pierce, Whitworth U.**

Minicourse Descriptions

Thursday, June 19

1 *Math is Not Only a Young Man's Game*
Sarah Greenwald, Appalachian State University

Have you ever had a student who asserted that they do not have the "math gene" or can not do math because they are not a genius? Studies have shown that many people perceive mathematics as a discipline that is done by others rather than people like themselves.

In this interactive minicourse we will look at an overview of recent statistics and research studies on perceptions and success in mathematics, including those related to women mathematicians and mathematicians of African descent. Then we will investigate a variety of ways to utilize these studies to help all of our students connect to mathematics, such as using role models whose style of doing math is identifiable as being similar to the way our students do mathematics. Participants will also have the opportunity to conjecture, throw around ideas, and work on something to take into your own classrooms. There are no prerequisites for this minicourse.

2 *Active Learning Through Classroom Voting and Clickers*
Kelly Cline, Mark Parker, and Holly Zullo, Carroll College

Have you ever wished that you could design a lesson that would interact with each and every one of your students on an individual basis? Classroom voting is a teaching technique, where the instructor poses a multiple-choice question to the class, gives the students a few minutes to think and discuss the question in small groups, then asks all the students to vote on the correct answer, using an electronic "clicker" or by simply holding up a colored index card ($A =$ red, $B = blue$, etc.). In order to vote, every single student in the entire class must play an active role, engaging in the question, forming an opinion, discussing it with their peers, and then participating by voting. After the vote, the instructor can guide the class through a Socratic discussion to help them figure out the correct answer. The results of the vote give instant feedback to the instructor as to the state of the class, and feedback to the students as well when the answer is revealed.

This pedagogy can powerfully transform a classroom into a much more student-centered learning environment. When students who have participated in a voting class are surveyed, we find that strong majorities prefer learning in this way: They think that it is a lot of fun and that it helps them enjoy the class more, they believe that it helps them learn, and if given the choice between two sections of a class, they would choose the one with classroom voting. In this minicourse, we will show you how we have used this technique in our own classes, in calculus, multivariable calculus, linear algebra, differential equations, and other classes. We will demonstrate how we have been able to integrate voting into our daily lesson plans while maintaining the same pace, teaching the same syllabi and giving the same types of exams. We will give you the resources necessary to use voting in your own classes, including libraries of classroom voting questions, and the latest education research that shows you how to use this technique most effectively. (Based on research and materials developed with NSF DUE grant 0536077.)

Abstracts of Invited Talks

(in chronological order)

3 *Using groups and graphs to create symmetry patterns*

Joe Gallian, University of Minnesota, Duluth. MAA President and Director Project NExT.

We use video animations to explain how Hamiltonian paths, spanning trees, cosets in groups, and factor groups can be used to create computer generated symmetry patterns in hyperbolic and Euclidean planes. These methods were used to create the image for the 2003 Mathematics Awareness Month poster.

4 *Good news everyone! Mathematical morsels from The Simpsons and Futurama*

Sarah Greenwald, Appalachian State University

Did you know that *The Simpsons* and *Futurama* contain hundreds of humorous mathematical and scientific references? What curious mathematical object is used as a bottle for beer in the 31st century? What happens when Homer tries to emulate Thomas Edison? What is the significance of the number 1729? The only prerequisite for this talk is an open mind, so come find out!

We'll explore the mathematical content and educational value of some favorite moments along with the motivations and backgrounds of the writers during an interactive talk. Popular culture can reveal, reflect, and even shape how society views mathematics, and with careful consideration of the benefits and challenges, these programs can be an ideal source of fun ways to introduce important concepts and to reduce math anxiety. In the process we'll look at related, recent work in geometry and computational number theory so a calculator and writing utensil will be useful. For more information, check out SimpsonsMath.com and FuturamaMath.com

5 *Soap Bubbles in Math, Science, and Art*

Ivars Peterson, MAA Director of Publications for Journals and Communications

Artworks dating back to the invention of soap illustrate the wonder of soap bubbles and soap films. Soap bubbles have inspired not only art but also important

developments in mathematics and science. Get a fresh perspective on minimal surfaces and their role in art, mathematics, science, and engineering.

6 *A Knotty Tale: From Vortex Atoms to DNA Tangles*
Ivars Peterson, MAA Director of Publications for Journals and Communications

The unexpected discovery more than two decades ago of several new ways to distinguish mathematical knots precipitated a surge of interest in knot theory. Today, intriguing links between knots and physics and illuminating biological applications testify to the new importance of a mathematical pursuit that began in the 19th century with the search for a new atomic theory.

Abstracts of Contributed Talks

(in alphabetical order, by presenter)

7 *Mathematical modeling and inquiry in the life, social, informational and behavioral sciences.*

Chris Arney, Army Research Office

The life, social, informational and behavioral sciences have always been important; yet as we enter the 21st century they have stepped to the forefront of consciousness in our world. In particular, several subjects in these sciences with significant mathematical content (e.g., evolutionary biology, genomics, bioinformatics, intracellular imaging, complex disease modeling, neuroscience, neuroinformatics, artificial intelligence, economics, cultural geography) appear to be involved in many of the capacious social issues and technological needs of our society – such as public health, disease control, biotechnology, robotics, information overflow, network saturation, nanotechnology, and stem cells. The growing infusion of mathematics (modeling and inquiry) into problems in these subjects will transform the life, social, informational, and behavioral sciences and this transformation will have profound effects on the links between mathematics and these sciences in the areas of education and research. This presentation includes the examples of the roles that modeling and inquiry play in these sciences and the types of learning and thinking needed for our future students to succeed.

8 *Inquiry based teaching vs traditional based teaching.*

Gary Bauman, Townsend School / Montana State University

I recently studied inquiry based teaching, and decided to incorporate it into my classroom. I was not fully convinced that inquiry was the only way to teach, but a mixture of inquiry and traditional. I compared the previous years results with this years, and looked for an increase in test scores. In addition, I looked for an overall good attitude, and performance on open ended questions. I found out that there was no significant change in any of the above, but I did realize a increase in social discussions from students that normally would not participate in class discussions. I have evidence of that occurrence on video.

9 *Common error patterns in pre-service teachers' attempts at writing fraction word problems.*
Cheryl Beaver, Western Oregon University

It is important for teachers to have a deep conceptual understanding of the mathematics they are teaching. The learning of fractions can often become rote and turn into a task to be memorized rather than understood. This talk will give preliminary results of a study analyzing error patterns when pre-service teachers were asked to write a word problem for specific fraction operations. The students were given a specific fraction operation, such as $2/3+4/5$, asked to do the calculation, then create a story problem that would have this calculation as the answer to the story problem. Students' work revealed consistent and identifiable error patterns. This talk will discuss the common errors and future work aimed at resolving common misunderstandings.

10 *Invertible integral operators and subexponential kernel decay.*
Scott Beaver, Western Oregon University

It is established that a broad class of involutive Banach $*$-algebras of integral operators, defined by the property that the kernels of the algebra elements possess subexponential off-diagonal decay, is inverse closed in the set of bounded linear operators on $L2(R)$. Symmetry of the algebras is demonstrated en route.

11 *The calculus of variations is more than minimization.*
Jim Bisgard, Central Washington University

The calculus of variations is a useful tool to investigate the existence of special solutions to differential equations. Typically, a solution is found as a minimizer of a functional over an appropriately chosen class of functions. However, there are other variational tools available. In particular, I will discuss the mountain pass theorem and minimax theorems.

12 *Numerical analysis for the nonlocal Allen-Cahn equation.*
Sarah Brown, Southern Utah University

We propose a stable, convergent and linear finite difference scheme to solve numerically the nonlocal Allen-Cahn equation which can model a variety of physical and biological phenomena involving media with properties varying in space.

13 *What is action research in mathematics?*
Elizabeth Burroughs, Montana State University

This talk will give a brief overview of action research in mathematics, describe how it can be used and its importance to the field of mathematics education.

14 *Reaching students with a live call-in show on PBS.*
Elizabeth Burroughs, Montana State University

A PBS affiliate hosted a live call-in show called "Homework Hotline," designed to answer students' questions about mathematics and science. Students from kindergarten through community college level call in with their questions. As a former co-host, I will share some insight about my perception of the benefits of this form of public outreach.

15 *Tiling mutilated rectangles with tetrominoes.*
Benjamin Coate, The College of Idaho

John Conway and J. C. Lagarias' *Tiling with Polyominoes* introduced a group theoretic approach to solving tiling problems not solvable by a coloring argument. Igor Pak has since extended upon their methods, using combinatorial group theoretic techniques to completely classify those rectangular regions tileable by a given set of ribbon tiles. We have applied these group theoretic techniques to pursue a tiling of mutilated rectangles in the integer lattice with ribbon tiles. We have classified the tilings of a family of mutilated rectangles with a set of tiles consisting of four tetrominoes.

16 *Singular points of real septic curves.*
Annie Didier and Kevin Sonnanburg, Whitworth University

Here we attempt to classify individual types of high-multiplicity singular points of septic curves. These classifications are derived by using the computer algebra system Maple. The classification is based on computing just enough of the Puiseux expansion to separate the branches.

17 *The effect of active learning techniques in student achievement in remedial mathematics courses.*
Roger Fischer, Montana State University–Bozeman

This study investigated the effect of specific active learning techniques on course grade and mastery of basic computational skill in undergraduates taking basic algebra. Students who were engaged in active learning mastered basic arithmetic computations in fewer attempts than students who received more traditional instruction. Final course grades were shown to be a superior predictor of final course grade than were college entrance exam scores.

18 *Interpolation using radial basis functions.*
Allen Flavell, Seattle Pacific University

This presentation is an introduction and provides examples of the interpolation problem, radial basis functions, and solutions of the interpolation problem (including multidimensional and scattered data interpolation) using radial basis functions.

19 *Epsilon-delta continuity in the first calculus course.*
William Freed, Concordia University College of Alberta

Why bother? Using an epsilon-delta definition of continuity, coupled with motivations, labs, and careful use of symbols makes rigour accessible to even average students. Then limits are defined in terms of continuity. An extended real arithmetic is used in the evaluation of certain limits.

20 *A modular approach to teaching a course in application-based problem solving.*
Benjamin Galluzzo*, University of Iowa and Dr. Theodore Wendt, University of Wisconsin - La Crosse

Introduction to Applied Mathematics Research, first offered at The University of Iowa during the 2007 fall semester, explores how mathematics is currently being used to interpret and solve real-world problems. The one-semester course is composed of five independent modules, each focused on the development, implementation, critique, and analysis of a model relating to a particular area of current research interest. For example, previous topics covered in one semester were: collisions, subsurface fluid flow, traffic flow, epidemiology, and financial option pricing.

Part 1: A Structural Framework

Despite substantial differences in subject material, each module is approached using the same methodology: several introductory lectures, followed by computer simulation and experimentation, classroom discussion, and ultimately group projects and presentations. In this talk we will discuss the structure of the modular framework using classroom examples to emphasize techniques.

21 *Distribution of zeros of entire functions.*
Michael Gilliam, University of Montana

The Riemann-zeta function is not entire, but if we define the function

$$\xi(s) = \frac{1}{2}s(s-1)\pi^{-s/2}\Gamma\left(\frac{s}{2}\right)\zeta(s)$$

where $\zeta(s)$ is the Riemann-zeta function, then it has been shown that Riemann's hypothesis is equivalent to showing $\xi(1/2+is)$ is an even entire function of genus 1 that is real valued for real s. This can be better formulated by saying $\xi(1/2+is) \in \mathcal{L}-\mathcal{P}$, where $\mathcal{L}-\mathcal{P}$ denotes the Laguerre-Polya class. The Laguerre-Polya class has been the centerpiece of many great research projects in the 20-century. Take a trip with me, gripping tightly on to the coattails of many great mathmeticians such as B. Ja. Levin, G. Csordas, T. Craven, and D. Bleeker, and explore some properties of the Laguerre-Polya class. Since every function in this class has no non-real roots, we will also explore a particular family of linear operators that preserve this property. Let us enjoy this journey with the hope that someday soon, on the shoulders of giants, Riemann's conjecture will no longer be a conjecture.

22 *Integrals of functions composed with the Cantor function.*
Russell A. Gordon, Whitman College

Let c denote the Cantor ternary function and let f be any continuous function defined on $[0,1]$. Seeking a general expression for $\int_0^1 f\circ c$ provides some interesting connections with familiar aspects of elementary real analysis. By selecting specific functions for f, we will obtain several rather intriguing formulas.

23 *Mathematically modeling the human knot game.*
Christopher Hardy, Seattle Pacific University

This presentation investigates the mathematics of the human knot game - a popular icebreaker at camps and other social gatherings.

24 *A Cayley type theorem for Boolean rings.*
John Hart, University of Montana

It is well known that if X is a non-empty set then under symmetric difference and intersection, the power set of X, $P(X)$, is a commutative ring with unit X. In this paper we show that if R is a Boolean ring, possibly non- unit, noncommutative, and X is the set of prime ideals of R then R can be embedded as a subring of $P(X)$.

25 *Special Issues in Mathematics Facing American Indian Students in Montana.*
Bob Johnke, Montana State University, Northern

Standard texts and lecture system are often a poor fit when helping Native American populations. One example is understanding the order of arithmetic and algebra that successful high school students have in their head. Sayings like My

Dear Aunt Sally don't really help those who are out of the loop. I propose to talk about three key math language words of 1) simplify, 2) solve, and 3) evaluate which the math people take for granted and use carelessly are really separate distinct commands. They require reading and thinking from a "question to answer" approach that helps the beginner make sense of an overwhelming variety of inputs including graphs.

26 *Curious connections: rational function extrema and the geometric mean.*
Sally Keely, Clark College and Univ. of Phoenix Online

Rational functions of two quadratics in the form $f(x) = [(x+a)(x+b)]/[(x+c)(x+d)]$ are explored. My collaborator, Larry Larson, discovered a curious connection between the extrema of the function and a geometric mean involving the function's zeros and vertical asymptotes. The result is quite surprising! Together we have been exploring this relationship and are co-authoring a paper planned for publication later this year. I am pleased to present our major finding along with examples.

27 *Fun with birthdays.*
Mike Kenyon, Green River Community College

A colleague celebrated his 80th birthday earlier this year. At his birthday party, we observed something even cooler than merely turning 80 (which is plenty cool on its own). Further investigation revealed interesting solutions, some extensions, at least one generalization, and a purely coincidental Puzzler on Car Talk. Students found the question(s) entertaining and accessible as well.

28 *A pairing strategy for tic-tac-toe on the integer lattice with numerous directions.*
Klay Kruczek, Western Oregon University

We consider a Tic-Tac-Toe game played on the d-dimensional integer lattice. The game we investigate is a Maker-Breaker version of Tic-Tac-Toe. In a Maker-Breaker game, the first player, Maker, only tries to occupy a winning line and the second player, Breaker, only tries to stop Maker from occupying a winning line. We consider the bounded number of directions game, in which we allow n different values for the directions of the winning lines. We show by a simple pairing strategy that Breaker can win this game if the length of each winning line is at least $3n$ where n is the number of different directions. It should be noted that Breaker's winning strategy can be used as a drawing strategy for Player Two in the strong version of this game.

29 *Engaging teachers in action research.*
Jennifer Luebeck, Montana State University

Montana State University offers a masters program for practicing secondary and community college teachers. As a capstone project replacing a formal thesis, teachers complete an action research study in their classrooms or schools. I will describe how teachers identify a need related to mathematics teaching and learning, design and carry out an action research project, and present their findings.

30 *Creating better health care. (ICM Problem C)*
Shawn Andersen, Ian Lyon*, and Cassandra Rapkoch*, Carroll College

Our project goal was to choose several strong indicators of the quality of a national health care system through available statistical data, and to improve an existing health care system based upon these indicators. We developed two distinct models that influenced the indicators when several relevant variables were changed. Our first model demonstrated and implemented the dynamic process of optimizing the distribution of static resources within a health care system, leading to the most positive influence on the indicators. Our second model assumed varying resource availability and showed how increasing or decreasing various resources in a health care system affected the indicators. The two models displayed how various actions a country could take improved its health system; both were versatile, adaptable, and scalable to increasing degrees of intricacy and complexity.

31 *Using multiple regression to calculate helicopter hover ceilings.*
Terry Mullen, Carroll College

The total weight a helicopter can carry depends on the air temperature and altitude. Helicopter pilots must be able to determine their maximum payload at any given time. Manual charts have traditionally been used for this. The Montana Department of Natural Resources (they fight forest fires) asked me to take the data from their charts and come up with a formula that can be put into a computer or calculator. I'll discuss how I did this.

32 *Carroll College chapter of Engineers Without Borders: Working with the Blackfeet in Montana, and orphans in Santa Maria, Mexico.*
Jack Oberweiser and John Scharf, Carroll College

The Carroll College EWB chapter was founded in 2004 by Andrew Stewart and Laura Kohler, engineering students at Carroll. Since then the chapter has been actively involved in projects that benefit underdeveloped countries as well as

projects working with the Blackfeet in Montana. EWB members designed and installed a wastewater treatment system for the Orphanage at Santa Maria del Mexicano near Colon, Mexico. Group members have also made a trip each semester to the De La Salle Blackfeet School in Browning, Montana where they enjoy, with the students, a fun day of science experiments and friendship building.

33 *A Math/CS career prep course.*
Dr. Donna Pierce* and Dr. Peter Tucker, Whitworth University

I like math, I just don't know what I would do with a math degree. Math professors have all heard this statement, and simply pointing the students to career websites and books doesn't seem adequate. A more comprehensive and personal response would encourage students to explore their own strengths and values, to learn what kinds of vocational opportunities are available to students with their skills, and to learn how to prepare for a career consistent with their abilities and values. We want our students to think beyond simply landing the first job. We would rather guide each student to ask more personal, thoughtful questions, such as What do I want my life to look like, and how will my career fit into that? We want them to think more holistically about a career, including work environment, personal values, ethics, contribution to society, personal satisfaction, as well as financial considerations. To this end, the Math/CS Department at Whitworth University developed a 1-credit course entitled, Preparing for a Career in Math and Computer Science. The course targets sophomores interested in majoring in math and/or computer science. Students learn how to assess their skills, interests, and values, and to match these to a possible career. They use readings, interviews and field trips to interact with people in specific careers to see a day in the life view of that career. Students are taught skills to prepare for a career, including pursuing internships, writing cover letters and resumes, and considering future coursework such as graduate school. In order for students to get a holistic view of a discipline, we help the students consider specific ethical and professional issues that can arise in that career. Result? Our students are making more guided career choices. In this talk we describe what we've learned in our four years of teaching this class, including benefits to students and implementation strategies.

34 *Considerations in developing a special topics course.*
Dr. Donna Pierce, Whitworth University

Special topics courses can benefit a math department in several ways from broadening students' awareness of the breadth of mathematics to giving professors a chance to teach in their expertise or research area. Sometimes special topics

courses can be a way of ascertaining student interest and addressing pedagogical issues in anticipation of making the course a regular part of the curriculum. This talk will address some of the issues involved in designing a special topics course including consideration to time frame, audience and departmental goals in choosing a topic. Pedagogical issues such as finding appropriate textbooks, balancing mathematical rigor with broader overviews and determining means of assessment will also be discussed. We will look at a team model for drawing on the strengths and minimizing the difficulties often encountered in a special topics class that attract students with a variety of mathematical backgrounds.

35 *Aperiodic tilings: the relationship between spectrum and"Bubbles".*
Ashley Rand, Minnesota State University, Mankato

An *n*-dimensional tiling is formed by laying tiles, chosen from a finite collection of shapes (prototiles), with their boundaries touching and filling *n*-dimensional euclidean space. This tiling is aperiodic if any sliding (translation) produces a different tiling. Aperiodic tilings appear in physics in the study of quasi-crystals and their spectrum, in biology and computer science in the study of neural networks, and in mathematics in the coding of attractors. Analyzing the structure of aperiodic tilings yields information relevant to these applications.

Given a tiling, we form an associated continuum on which translation is induced. This tiling contains bubbles which combinatorially take the form of translational disagreements and allow us to distinguish between multiple tilings. We also use them to establish a relationship between the geometry of the continuum and the dynamics of the translation operation.

Our research demonstrates a correspondence between "bubbles" and what are know as balanced tiles, expanding on the current research by considering the geometry of the tiles instead of merely their combinatorics. In this way, it is shown that geometrically balanced tiles determine the dynamics and spectral properties of a tiling. In particular, our "bubbles" can lead directly to the x-ray diffraction patterns of the associated quasi-crystals.

36 *Building Sudoku. (MCM Problem B)*
John Riggs, Carroll College

Sudoku, a popular number game, is a constrained version of a Latin Square. Our goal was to develop an algorithm of minimum complexity and maximum efficiency with metrics to create and define Sudoku puzzles of varying difficulty. We developed a technique called Potential Candidate Analysis that assigns constraints to an initially empty grid in order to generate solution paths for a puzzle. Since the various techniques required in the solution path determine the difficulty

of each puzzle in our metric, we can therefore create a puzzle of any predetermined difficulty.

For a desired solution path, each run of our algorithm generates a puzzle with a minimum of 1.2×1012 visually distinct variations. By changing the pattern of initial constraints, our algorithm is able to include any strategy in the solution path of the puzzle. The flexibility and simplicity of Potential Candidate Analysis makes it an ideal algorithm for constructing Sudoku puzzles.

37 *Where to put the steel?*
John L. Scharf, Carroll College

To analyze and design beams for structures, such as buildings, bridges, and towers, structural engineers must be adept at single variable calculus. One problem is to determine where to put the reinforcing steel in reinforced concrete beams. Should it go near the top or near the bottom of the beam. Sometimes it switches from top to bottom or visa versa. Calculus and design codes help the structural engineer in answering these kinds of questions.

38 *Using algebra tiles to improve student understanding and attitude.*
Rex Sonsteng, CM Russell High School and Montana State University

This project focuses on the use of algebra tiles to supplement traditional instruction in the two-period Algebra classes at CM Russell High School. The instructor implemented several activities that used algebra tiles to help students to better understand the objectives of adding and subtracting integers, distributive property, adding and subtracting polynomials, solving equations, multiplying polynomials, and factoring.

39 *A More Balanced Assignment: Augmenting a homework assignment to include constructed response questions.*
Kathleen Strauss, Montana State University, Bozeman

Does augmenting the homework assignment to include constructed response questions improve students' performance on constructed response questions? The treatment group had a balanced assignment whereas the control group assignment was based on the textbook questions. A rubric was also used to grade the assignments.

40 *Math makes a Splash!*
Kathleen Sullivan, Seattle University

Each summer for the past 15 years, Seattle University has welcomed 30 highly motivated, high-achieving middle school girls to its campus for four weeks of

hands-on, collaborative, mathematics and science activities. Splash, as the program is called, is offered free of charge making it possible to attract highly diverse participants. The presentation will describe the program's project-based approach to learning and sources of funding, and give the results of a survey of alumnae and parents done to commemorate the 15th Anniversary of Splash.

41 *Pre-collegiate STEM programs at California State University, Stanislaus.*
Viji Sundar, California State University Stanislaus

California State University, Stanislaus has been offering STEM programs for Pre-Collegiate students since 1989.

In 1992-1994, CSU Stanislaus received a two-year grant from Department of Energy to conduct a math/science academy called PREP (Pre-freshman Enrichment Program) for 48 junior high students. In 1995-1997, the University received a very modest grant from the Tensor Foundation and Mathematical Association of America to conduct a mathematics enrichment program for high school girls in University's service area entitled High School Mathematics Access Program (HiMAP). In 1997-1999 CSU Stanislaus was awarded a two- year grant from the U.S. Department of Education to conduct a math/science academy called (Science and Mathematics Achievement with Right Techniques (SMART) for 48 junior high girls from the Merced County area.

Another summer program for high school girls began in Summer 2005 as an offshoot of HiMAP with a $6,000 grant from the Tensor Foundation. Called Preparing Women for Mathematical Modeling and Robotics (PWMM-R), this program was funded again for the summer of 2006, 2007 and 2008. PWMM-R is a one-week intensive Summer Institute for 24 girls who have completed Algebra II and will be eleventh graders the following fall.

42 *What are particle systems, and what are they good for, anyway?*
Kathy Temple, Central Washington University

Interacting particle systems are a well-developed class of stochastic processes often used as models of physical phenomena. Moreover, particle systems are the building blocks of other types of stochastic processes, including measure-valued processes. I'll talk briefly about some of the standard particle systems and some of the interesting things that are known about them. Then I'll describe how measure-valued processes arise and why particle systems of various types can help us prove theorems about them.

43 *The intermediate value property of derivatives revisited.*
Elena Toneva, Eastern Washington University

The well known Darboux's Theorem claims that each derivative has the intermediate value property. Several proofs will be presented and we will discuss how each one can reinforce different aspects of students' understanding of calculus.

44 *PMET project: developing and teaching a linear and abstract algebra course for middle school mathematics teachers.*
Marie Vanisko, Carroll College

It is common today to see linear and abstract algebra requirements not only for high school mathematics teachers, but also for middle school mathematics teachers. However, since the typical middle school mathematics teacher is not a mathematics major, this could create a major stumbling block. Through a PMET (Preparing Mathematicians to Educate Teachers) grant funded through the MAA, a new course in linear and abstract algebra was created and field tested with middle school teachers in California. The basic structure of the course developed and the results of the study will be shared.

45 *Discussion: Looking at ways to assist students in the problems they face in transitioning from high school to college mathematics.*
Marie Vanisko, Carroll College

46 *A modular approach to teaching a course in application-based problem solving.*
Benjamin Galluzzo, University of Iowa and Dr. Theodore Wendt*, University of Wisconsin - La Crosse

Introduction to Applied Mathematics Research, first offered at The University of Iowa during the 2007 fall semester, explores how mathematics is currently being used to interpret and solve real-world problems. The one-semester course is composed of five independent modules, each focused on the development, implementation, critique, and analysis of a model relating to a particular area of current research interest. For example, previous topics covered in one semester were: collisions, subsurface fluid flow, traffic flow, epidemiology, and financial option pricing.

Part 2: Course Assessment

Throughout the duration of the course we solicited feedback from students through anonymous surveys and open discussion. The course instructors met

and analyzed the feedback frequently, resulting in occasional adaptations to the course material and structure. In this talk we will briefly discuss student feedback, changes implemented during the course's first run, and plans for the course going forward.

47 *Teaching topology to undergraduates during a one month term.*
Nicholas Willis, Whitworth University

Is it possible to teach a course in Topology to undergraduate students with any level of rigor? What do the students gain from such an experience? What are some of the challenges encountered while teaching a Topology course to undergraduates? These are all important questions to any department thinking about adding a Topology course to their curriculum. I will talk about my experiences teaching Topology in a one month January term, what I learned from my experience, and what my students thought of the course.

48 *Singular points of reducible sextic curves*
Nicholas Willis, Whitworth University

There are 106 individual types of singular points for reducible complex sextic curves.

49 *Weakly peripherally linear mappings between uniform algebras.*
Rebekah Yates*and Thomas Tonev, University of Montana

In recent work, Rao, Tonev, and Toneva found sufficient conditions under which a mapping between uniform algebras is an algebraic isomorphism. The first condition relates the peripheral spectrum of the sum of two algebra elements to the peripheral spectrum of the sum of their images under the mapping. The second condition requires the maximum of the sum of the moduli of two algebra elements evaluated on the Shilov boundary to be preserved when the mapping is applied to the elements of the algebra. The proof of this result relies on the construction of a particular mapping τ between the Choquet boundaries of the algebras.

We show that these conditions are more restrictive than necessary. Such a mapping τ between the Choquet boundaries of the algebras can be constructed if the original mapping between the algebras is norm-additive, preserves the peripheral spectrum, and satisfies the maximum modulus condition. This result shows that norm-additive mappings may play a large role in the search for algebraic isomorphisms, a topic of interest to both analysts and algebraists.

50 *A curriculum focus: Interventions' effects on students' algebra achievement, an action research project.*

David Yopp, Montana State University

This paper reports the findings of an action research project that examined the achievement effects of an assessment/feedback/mastery intervention, named Focus Intervention, targeting students enrolled in a community college intermediate algebra course. Students who achieved mastery of the Focus Intervention assessments scored significantly better on a common final than their peers in a comparison group.

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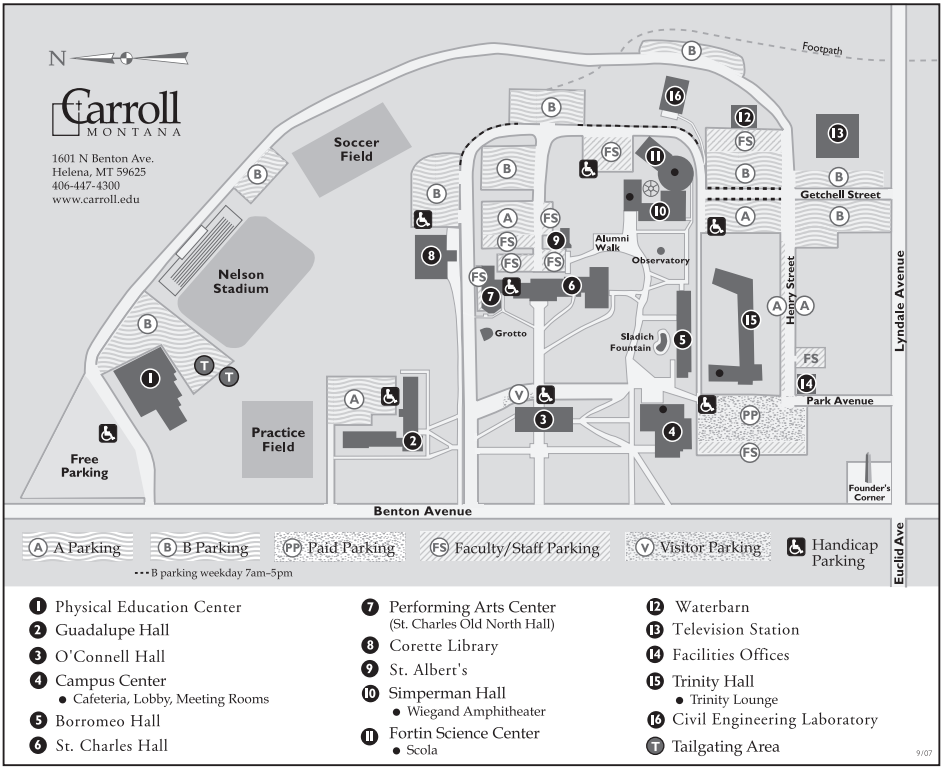
Thank you,

Holly Zullo Local Arrangements Chair



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