



Twenty-Third Annual

Pi Mu Epsilon

Regional Undergraduate Math Conference

November 7 – 8, 2008

Featured Speaker: Eve Torrence

Randolph-Macon College

**This program is an MAA NSF-RUMC sponsored activity, funded by NSF grant
DMS-0536991**

FRIDAY EVENING

STUDENT TALKS

Time	Cofrin 11	Cofrin 15	Cofrin 209
5:30	Dan Hawk , College of the Menominee Nation “Five Clans Rocket Team High-Powered Rocketry”		
6:10	Kristin Bertram , Winona State University “Who's on My Team?”	Tova Lindberg , Bethany Lutheran College “Groups of Automorphisms of Compact Riemann Surfaces”	
6:30	Leah Fehr , Bethany Lutheran College “QTL Mapping in a Complex Outcross of Stickleback Fish”	Hunan Chaudhry , Benedictine University “Regular Conformations of $(2n; 2)$ -Torus Links”	Kathleen Miller , St. Norbert College “Genetic Modeling of the White Buffalo”
6:50	Nicholas Dobes , Benedictine University “Molecular Computing and Graph Theory”	Paul Bruno , Bradley University “Direct Product Subgroups”	Corey Vorland , St. Norbert College “Modeling Diatom Growth in Trout Lake”
7:10	Pinal Shah , Benedictine University “The Dynamics of a One-Predator Two-Prey Model for Integrated Pest Management”	Corey Becker , Loras College “MATLAB: A Brief Introduction to an Invaluable Tool in Mathematics”	Stephanie Schauer , St. Norbert College “Rolling Smoothly on a Saw-Tooth Road”

EVE TORRENCE

7:30 - 8:30 p.m.

Cofrin 11

“Modular Origami and the Dodecahedron”

8:30 – 9:30

Cofrin 11

Face Off! The Mathematics Game Show

Ken Price, Steve Szydlik, John Koker, UW - Oshkosh

9:30 - ?

Pizza in Cofrin Basement Lounge

SATURDAY MORNING

STUDENT TALKS

Time	Cofrin 11	Cofrin 15
9:00	Mark LeRoy , Loras College “Complex Geometry”	Sam Goeben , St. Norbert College “Teaching Math with Pokemon”
9:20	Ryan Kruse , Loras College “Newton vs. Lagrange: Mechanics Smackdown”	Ryan Pavlik , St. Norbert College “Sudoku for the Algorithmically-Minded”
9:40	Steven Anderson , Loras College “The Chaotic Motion of the Double Pendulum”	Sergii S. Bilokhatniuk , St. Norbert College “Mathematics and Its Mystical Meanings”
10:00	Joey Freund , Loras College “Analog to 01100100 01101001 01100111 01101001 01110100 01100001 01101100!”	Nick Gromiuk and Dan Gerber , Carthage College “Adding Applications Can Be Hazardous to your Cyber-Health: A Mathematical Model of Undead Proportions”
10:20	Jim Gonzalez , Loras College “Game Theory and Price Competition”	Dan Monfre , Carthage College “Fibonacci and Base-2 Pseudoprimes: Can Two Wrongs make a Right?”
10:40	Tyler Hyndman , Bradley University “Design Theory and Algorithms”	Rachel Wolf , Carthage College “The Igloo Curtain”

EVE TORRENCE

11:00 - noon

Cofrin 11

“The Lost Art of Condensation”

Friday, November 7

5:00 p.m. Registration, cookies, and soda in Cofrin basement lounge.

5:30 - 7:25 **Student Talks** in Cofrin 11, Cofrin 15, and Cofrin 209

5:30 – 6:00
Cofrin 11 **DAN HAWK, College of the Menominee Nation**
Five Clans Rocket Team High-Powered Rocketry

FCRT competes in college rocket competition. We have competed in the Wisconsin Space Grant Consortium and University Space Launch Initiative. Some of the USLI universities we compete against are: Auburn, Fisk, Harding, Mississippi State, Utah State, North Dakota State, Missouri Rolla, Alabama at Huntsville, Alabama A&M. The presenting rocket is ~14.5' – 7.76" single stage, dual cluster of Animal Motor Works L-1300, ~apogee 7,800'.

6:10 – 6:25
Cofrin 11

KRISTIN BERTRAM, Winona State University
Who's on My Team?

You are enjoying a beautiful sunny day with your friends at the beach when someone says, "Let's play volleyball!" Nominated as one of the "captains" to choose teams, you start to wonder, "What strategy for picking teammates will guarantee my team will win?" A game of volleyball can be modeled with Markov Chains and transition matrices whose components depend upon the ability of the teams' players. We use Markov chains to "play" games of volleyball with two teams whose players were chosen via a number of different drafting strategies. In this talk, we will discuss constructing our model for volleyball as well as our findings of the best drafting strategy.

Cofrin 15

TOVA LINDBERG, Bethany Lutheran College
Groups of Automorphisms of Compact Riemann Surfaces

Group theory and computation enable us to study certain properties of compact Riemann surfaces, a simple example of which is a sphere. Every finite group acts on at least one such surface as a group of automorphisms, moving the surface about while not changing it. For each finite group, we can look for the surface with the smallest number of holes on which the group acts as a group of automorphisms; the genus (number of holes) of this surface is defined as the *strong symmetric genus* of the finite group. We reverse this and look at a surface, asking which groups act on it as a group of automorphisms. In particular, we take all surfaces of a given genus and look for all groups of this strong symmetric genus. We extend the classification of these groups and present an overview of our method.

6:30 - 6:45
Cofrin 11

LEAH FEHR, Bethany Lutheran College
QTL Mapping in a Complex Outcross of Stickleback Fish

Stickleback fish are a valuable model organism for studies of evolution, particularly for the process of speciation. Different stickleback species, living in different environments, show large morphological and behavioral differences. Such quantitative phenotypes are generally affected by multiple genetic loci (often called quantitative trait loci, QTL). We sought to map the QTL contributing to two phenotypes, body size and the number of lateral plates, in a complex outcross of four families derived from two stickleback fish. We developed a new method to analyze the four families jointly rather than individually to increase the power and ability to determine the QTL effects. The new method detected QTL on chromosomes 4, 7, and 21.

Cofrin 15

HUNAN CHAUDHRY, Benedictine University
Regular Conformations of $(2n; 2)$ -Torus Links

An α -regular conformation of a knot (or link) K is a polygonal embedding of K in space such that all edges have the same length and all angles between adjacent edges are equal to α . The α -regular stick number of K is the minimum number of sticks required to construct an α -regular conformation of K . We construct α -regular conformations of $(2n; 2)$ -torus links, here $\alpha = \cos^{-1}(-1/3)$. These conformations provide good upper bounds for α -regular stick numbers and, in some cases, realize α -regular stick numbers.

- Cofrin 209 **KATHLEEN MILLER, St. Norbert College**
Genetic Modeling of the White Buffalo
- In August 1994, a female white buffalo was born in Wisconsin. In this talk, we discuss a mathematical model for predicting the frequency of such an event. The model is built around the theory of genetics, including mutations and albinism. We then attempt to answer: when will it happen again?
- 6:50 – 7:05
Cofrin 11 **NICHOLAS DOBES, Benedictine University**
Molecular Computing and Graph Theory
- DNA computing, also known as molecular computing, is based on the idea of massive parallel computing using DNA molecules. The present day computers use binary codes (involving 0's and 1's) to store and process information. Noticing the fact that DNA molecules are natural information storehouses, and that DNA Polymerase works quite like a Turing Machine, Adleman in 1994 solved a Hamiltonian Path Problem using the techniques of molecular biology. Instead of using the position of electronic switches in microchips, he used the much faster reaction of DNA nucleotides with their complements. In this presentation, we will describe a solution to a particular instance of the Directed Euler path problem using the methods of DNA computing.
- Cofrin 15 **PAUL BRUNO, Bradley University**
Direct Product Subgroups
- I will give a correspondence between the set of subgroups of the direct product of two groups and isomorphisms between subgroup quotients. I will examine and characterize normal subgroups and product subgroups according to these isomorphisms.
- Cofrin 209 **COREY VORLAND, St. Norbert College**
Modeling Diatom Growth in Trout Lake
- Aulacoseira* is a freshwater diatom whose abundance and colony size has been measured at varying depths in Trout Lake in Northern Wisconsin. Its population growth patterns are influenced by temperature, light availability, and nutrients. In this talk, the vertical distribution of *Aulacoseira* is investigated through modeling, which incorporates natural characteristics of the lake as well as effects of the diatom's buoyancy. Predicted outcomes are compared to measure observations. This work is joint with Stephanie Schauer, also a student at St. Norbert College.
- 7:10 - 7:25
Cofrin 11 **PINAL SHAH, Benedictine University**
The Dynamics of a One-Predator Two-Prey Model for Integrated Pest Management
- We present a one-predator two-prey model for integrated pest management. Features of this model include stage structure for the predator species and one of the prey species and a birth pulse (rather than continuous growth) for the stage structured prey species. We demonstrate the existence of total pest eradication solutions and permanent solutions. We also investigate the effects of model parameters through the analysis of bifurcation diagrams.
- Cofrin 15 **COREY BECKER, Loras College**
MATLAB: A Brief Introduction to an Invaluable Tool in Mathematics
- Today, MATLAB's capabilities extend far beyond the original "Matrix Laboratory." MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. I will demonstrate a few basic functions like graphing, matrix manipulation, and simple programming, taking advantage of the built-in Maple kernel. This presentation is designed to spark the interest of individuals interested in applying mathematical instruments such as MATLAB to real life situations.
- Cofrin 209 **STEPHANIE SCHAUER, St. Norbert College**
Rolling Smoothly on a Saw-Tooth Road
- Given a road constructed from a periodic pattern of isosceles triangles, how does one build a wheel that will traverse the road smoothly? Through a change of variables to polar coordinates, a "messy"

problem reveals itself as a simple spiral. In this talk, we discuss the details behind the solution and discuss some interesting discoveries.

7:30 - 8:30
Cofrin 11

Invited Address: **EVE TORRENCE, Randolph-Macon College**

Modular Origami and the Dodecahedron

In this workshop, we will learn how to build beautiful polyhedra using modular origami. We will also see how tools from graph theory can be used to construct nicely colored models and how combinatorics can reveal properties of these solids. Materials and take home instructions will be provided for all participants. No knowledge of origami or advanced mathematics is required.

8:30 – 9:30

Face Off! The Mathematics Game Show in Cofrin 11

9:30 -- ????

Pizza Social in Cofrin Basement Lounge; everyone at the conference is welcome!

Saturday, November 8

8:00 a.m.

Registration, conversation, coffee, juice, fruit, and rolls in Cofrin basement lounge

9:00 - 10:50

Student talks in Cofrin 11 and Cofrin 15

9:00 – 9:15
Cofrin 11

MARK LEROY, Loras College
Complex Geometry

I will introduce the algebra and geometry of the complex plane. I will then describe my investigations into the relation between them. In particular I will discuss a recent article in the *Mathematics Monthly* that looks at the roots of a polygon and the roots of its derivative. This talk will assume no prior knowledge of complex numbers.

Cofrin 15

SAM GOEBEN, St. Norbert College
Teaching Math with Pokemon

Children are living in a media-centered world and teachers are on a constant search for relevant and interesting techniques. One such technique uses a website titled “Pokemon Learning League”. It is an interactive, narrative-based website that uses the well-known cartoons to help teach mathematics to elementary students. Research has shown that this instructional strategy increases the attitude and aptitude in both individual and group case studies, regardless of opinion towards math or Pokemon.

9:20 – 9:35
Cofrin 11

RYAN KRUSE, Loras College
Newton vs. Lagrange: Mechanics Smackdown

In undergraduate physics, we are taught how to use the Newtonian methods for describing the motion of simple dynamical systems. However, these methods have specific limits in certain models. Lagrange discovered a method that is more generalized and simplifies the solving of problems in the cases where the Newtonian methods break down. In this talk, we will look at a double Atwood machine to analyze the difference between the Newtonian and Lagrangian methods.

Cofrin 15

RYAN PAVLIK, St. Norbert College
Sudoku for the Algorithmically-Minded

Whether or not you know about the popular Sudoku logic puzzles, you can enjoy this discussion of basic Sudoku strategy. Given the technically minded audience, we will explore the basic strategies to solve a Sudoku without guessing, and reflect on the algorithmic techniques we are using and learning as we go.

9:40- 9:55
Cofrin 11

STEVEN ANDERSON, Loras College
The Chaotic Motion of the Double Pendulum

The Double Pendulum is a seemingly simple physical construction; however, when analyzed, it exhibits unpredictable chaotic behavior. In this presentation, the general equations of the motion of the double pendulum with any masses, lengths and initial positions will be shown along with their derivation. The angular velocity and position with respect to time of the two pendulums for a given set of masses and lengths will be analyzed. Finally, we will explain the fractal that is generated by assigning particular colors to different lengths of time passed before the first flip of the pendulum.

Cofrin 15

SERGII S. BILOKHATNIUK, St. Norbert College
Mathematics and Its Mystical Meanings

Since the dawn of all known cultures, religions and mysteries, observation of mathematical concepts of natural order, period, proportion and likeness in the motion of celestial bodies, in animal and plants, and in the human body, resulted a mathematics to be considered a reflection of the divine and transcendental. Such speculations are still alive and vibrant in mysticism and religion, while numerical superstitions remain deeply rooted in our modern culture.

10:00 – 10:15
Cofrin 11

JOEY FREUND, Loras College
Analog to 01100100 01101001 01100111 01101001 01110100 01100001 01101100!

No matter how prominent digital systems become, there will always be a need to convert signals between analog and digital. This is because our universe is analog, and therefore continuous, and since many of the signals we use for communication pass through the air as waves, analog will always have utility. This presentation will introduce the mathematics involved with converting between analog & digital. We will look at the process of sampling and its components that include a continuous-to-discrete converter, quantizer, and encoder.

Cofrin 15

NICK GROMIUK and DAN GERBER, Carthage College
Adding Applications Can Be Hazardous to your Cyber-Health: A Mathematical Model of Undead Proportions

When zombies are introduced into a healthy, normal, Web 2.0-based society, many virtual lives are altered. Since the conception of the Zombies application, throngs of Facebook users have joined the burgeoning ranks of the undead. In order to see how this phenomenon will affect future generations of Facebook users, a mathematical model using differential equations was conceived. The validity of the model was then tested against actual Facebook data.

10:20 - 10:35
Cofrin 11

JIME GONZALEZ, Loras College
Game Theory and Price Competition

Game Theory is a branch of Applied Mathematics that examines behavior and strategic choices of parties in competitive scenarios. It is applied in many fields that include military decisions, political science, psychology, and especially economics. Besides common examples, I am going to talk about price competition between McDonalds and Burger King using Game Theory. I have been attempting to model price competition between these two fast food restaurants using knowledge in Economics and Game theory. From my research, I have found interesting results that go along with economic theory.

Cofrin 15

DAN MONFRE, Carthage College
Fibonacci and Base-2 Pseudoprimes: Can Two Wrongs make a Right?

Two tests for determining whether a number is prime are the Fibonacci and the Fermat base-2 tests. Although each test is imperfect in itself, there is no known integer for which both tests give the wrong answer. We shall discuss some results of a search for such an integer.

10:40 – 10:55

Cofrin 11

TYLER HYNDMAN, Bradley University
Design Theory and Algorithms

Choosing an efficient algorithm and reducing redundancy can greatly decrease search time. In this talk I will explore a couple of different approaches to writing a program to solve a golf scheduling problem.

Cofrin 15

RACHEL WOLF, Carthage College
The Igloo Curtain

An Eskimo hangs a curtain in his igloo from floor to ceiling along a circular arc passing through the center of the floor. If the Eskimo wants to maximize the area of the curtain, what should the radius of the curtain be? This presentation discusses how he would go about determining this in any dimension by using the ideas of multiple integrals and line integrals.

11:00 - 12:00

Cofrin 11

Invited Address: **EVE TORRENCE, Randolph-Macon College**

The Lost Art of Condensation

Charles Dodgson, aka Lewis Carroll, is best known as the famous author of *Alice in Wonderland*. But despite his fame, Dodgson never gave up his day job as a mathematics lecturer at Oxford University. Dodgson was as original in his mathematics as he was in his literary pursuits. We will explore a little known method for computing determinants discovered by Dodgson and trace the history of the mathematics behind this method.

Eve Torrence

Eve Torrence earned her PhD in Mathematics in 1991 from the University of Virginia. She was a Clare Bothe Luce professor at Trinity College in Washington D.C. from 1991 to 1994 before joining the faculty at Randolph-Macon College. Her current research interests include the mathematics of Charles Dodgson, origami, and elementary mathematics education. Eve and her husband Bruce Torrence have just published the second edition of their book, "The Student's Introduction to *Mathematica*". Eve and her colleague Adrian Rice were awarded the 2007 MAA Trevor Evans award for their article *Lewis Carroll's Condensation Method for Evaluating Determinants*, in *Math Horizons*, November, 2006. She served as the Chair of the Maryland-DC-Virginia section of the MAA from 2005 to 2007. Eve is currently the President-Elect of PME.

**INVITED SPEAKERS FOR THE
ST. NORBERT COLLEGE PI MU EPSILON
REGIONAL UNDERGRADUATE MATHEMATICS CONFERENCES**

- 1986 Paul Campbell, Beloit College
- 1987 Joseph Gallian, University of Minnesota - Duluth
- 1988 Philip Straffin, Beloit College
- 1989 J. Sutherland Frame, Michigan State University
- 1990 Jeanne LaDuke, De Paul University
- 1991 J. Douglas Faires, Youngstown State University
- 1992 James Kasum, Cardinal Stritch College
- 1993 Mark Krusemeyer, Carleton College
- 1994 Robert S. Smith, Miami University
- 1995 Norbert J. Kuenzi, UW - Oshkosh
- 1996 Donald Saari, Northwestern University
- 1997 Paul J. Humke, St. Olaf College
- 1998 I. Martin Isaacs, UW - Madison
- 1999 Lisa Townsley Kulich, Benedictine University
- 2000 S. Brent Morris, National Security Agency
- 2001 Aparna Higgins, University of Dayton
- 2002 Frank Morgan, Williams College
- 2003 Richard A. Brualdi, UW – Madison
- 2004 Erica Flapan, Pomona College
- 2005 Alexander Hahn, The University of Notre Dame
- 2006 Underwood Dudley, Tallahassee, Florida
- 2007 Keith Devlin, Stanford University
- 2008 Eve Torrence, Randolph-Macon College

WINNERS OF THE REV. NICHOLAS E. NIRSCHL SCHOLARSHIPS

- 1996 Dawn Gibson, Jacqueline Gosz, Sarah Nohr, Nicki Schleis, Dennis Schmidt
- 1997 Debbie Giesler, Tina Huss, Mark Meeker
- 1998 Laura Lemke, Jenny Schmidt, Libby Wiebel
- 1999 Renee Jonet, Erica Pagel, Kate Rendall
- 2000 Michelle Budzban, Danielle Delimata, Heather Olm, Rosemary Tomase, Jeremy Vosters
- 2001 Cinnamon Danube, Abby Mroczenski, Laura Weiland
- 2002 Erin M. Bergman
- 2003 Tammy Bastian, Rachel Meulemans, Jill Schmidt
- 2004 Adam Christman, Brian Hahn, John Karls, Monica Spang, Damian Wegner
- 2005 Josh Domina, Christy Ernst, Mike Konicki, Martina Weber, Angie Wille, and AJ Wood
- 2006 Trina Bower, John Moss, Nicole O'Connell, Jackie Van Ryzin
- 2007 Elizabeth Colletti, Mark Krines, Sarah Schultz
- 2008 Francis Beaumier, Kyle Diederich, Jenni Jacobsen, Ryan Pavlik