Greetings! Please enjoy the very first newsletter of the Department of Mathematics and Computer Science. With luck, this will become an annual report. We have had a fabulous year here, with lots of exciting I.S. projects, presentations, and get-togethers. We are saying goodbye to 16 students who graduated with degrees from our department, and we wish them well. The class of 2011 consists of 23 majors in the department, so we will have even more work to present here next year. After our victory over the Physics Department in the annual bowling competition, the slide-rule is back on the third floor of Taylor, so all is well here. We hope that this newsletter will inspire some alumni to send in their news—we’ll be waiting!

Pamela Pierce
Professor and Chair
Faculty/Staff

**John Ramsay** was on sabbatical during the 2009-10 academic year. This past summer he initiated research into Knot Theory and was awarded a GLCA New Directions grant to pursue such research. He is Co-Pi on an NSF sub-grant with OSU-OARDC. He spent much of his leave writing new projects for calculus and operations research courses. He is also the proud papa of nine Goldendoodle puppies, all of whom have now found homes, and he traveled to Kenya to visit his daughter Colleen and son-in-law who work in an orphanage there. Daughter Adrienne was married in July and he managed to “not hinder” any of the planning.

**Pam Pierce** received a grant of $15,770 to assist her in coordinating the 34th Summer Symposium in Real Analysis that was hosted by The College of Wooster in July. Dr. Pierce published (with **John Ramsay** and several students*) the two articles listed below. The paper in Math Horizons recently won the Trevor Evans Award from the MAA as the best paper to appear in that journal this year. Dr. Pierce serves on the Financial Advisory Committee at the College, and she gave a “Faculty at Large” lecture entitled Circle Squaring and Other Geometric Puzzles.


**Jim Hartman** authored a paper “Computing Definite Integrals using the Definition,” *College Mathematics Journal*, Volume 1, January 2010, pp. 58-60. Dr. Hartman continues his involvement in College Board activities in the area of Advanced Placement (AP). He serves as both the director and an instructor for Wooster’s AP Summer Institute, an endorsed consultant for the College Board, and as the Calculus BC Exam Leader. He serves on the Teaching Staff and Tenure Committee of the College. In addition, he is writing an SPSS manual as an ancillary publication for the elementary statistics text, *Introductory Statistics*, by Stephen Kokoska. Dr. Hartman attended the AP National Conference and the National AMS/MAA Joint Meeting, where he served as a judge at the undergraduate poster session.
Faculty/Staff

**Sofia Visa**

Sofia Visa’s research interests are in the area of machine learning, and she recently expanded her interests when she began a four-year collaboration with Dr. Esther van der Knaap from OSU-OARDC in modeling networks of genes that influence size and shape in tomato fruits. This research is funded by the National Science Foundation and Dr. Visa is co-principal investigator. She developed and taught a new course, Bioinformatics, with Bill Morgan of the Biology Department. Dr. Visa published “A Probability Based Fuzzy Similarity Measure” in *Proceedings of the Information Processing and Management of Uncertainty in Knowledge-Based Systems Conference*, Dortmund, Germany.

**Drew Pasteur** continued his focus on mathematical biology and mathematical ranking methodology. He co-authored a paper entitled “A Model for Hormonal Control of the Human Menstrual Cycle: Structural Consistency but Sensitivity with Regard to Data” in the *Journal of Theoretical Biology*. He is first author on a chapter in an edited book *Understanding the Dynamics of Biological Systems: Lessons from Integrative Systems Biology*. Dr. Pasteur has two manuscripts appearing as chapters in an upcoming Mathematical Association of America book, stemming from the 2010 Math Awareness Month, on the topic of math and sports. The articles are entitled “When Perfect Isn’t Good Enough: Retrodictive Rankings in College Football” and “Extending the Colley Method to Generate Predictive Football Rankings.” A Raleigh, NC newspaper published a column about one of Dr. Pasteur’s ranking methods. This article, *FAIR system developed for seeding high school football playoffs*, ran in the sports section of the September 15, 2009 edition of *The News and Observer*. Fox Sports Ohio interviewed Dr. Pasteur last fall about high school football playoff predictions which led to his appearance on a FSO regional broadcast. Dr. Pasteur, his wife Heather and their son Daniel are celebrating the birth of a new family member, Nathan Drew Pasteur, born July 29.

**Jon Breitenbucher** continued his dual role as adjunct professor and instructional technology specialist. One of his duties is to help students learn how to create e-portfolios. He is also responsible for administering the College’s course management software packages.

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**Sofia Visa**

**Assistant Professor of Computer Science**

- BS Univ of Lucian Blaga, Romania 1998
- MS Univ of Cincinnati 2002
- PhD Univ of Cincinnati 2007

**Courses Taught 2009-10:**
- Computer Programming I (2 sections)
- Intro to Bioinformatics
- Calculus for Social Sciences

**Drew Pasteur**

**Assistant Professor of Mathematics**

- BS, M.ED. Florida 1996, 1997
- MS, PhD North Carolina State 2004, 2008

**Courses Taught 2009-10:**
- Calculus II (2 sections)
- Calculus with Algebra B (2 sections)
- Mathematical Modeling

**Jon Breitenbucher**

**Adjunct Teaching Staff & Instructional Technology Specialist**

- BA Wooster 1992
- PhD Ohio State 2001

**Courses Taught 2009-10:**
- Combinatorics & Graph Theory
- Math in Contemporary Society
Denise Byrnes is developing a CS 199 course: Connecting Art and Computer Science—Animations, Computer Games and 3-D Virtual World. This course will be taught in the fall of 2010. Developing this new introductory course is the starting process for curriculum redesign for the department’s ten-year curricular review in 2010–2011. Dr. Byrnes’ research focus is preliminary investigation of the Fluid in Cell (fliC) method for solving the Navier Stokes equations when used to model fluid flows. The goal is the application of fliC for cloth or gas modeling in independent study projects. Last fall, Dr. Byrnes attended a workshop on “Engaging First Courses” at Georgia Tech and she also served as the Goldwater Scholarship representative.

Jennifer Roche became Jennifer Bowen this past spring when she married Jason Bowen of Wooster. Dr. Roche continues her research interests in nonassociative algebras and matrix rings while also exploring effective methods for teaching and retaining under-represented undergraduate populations in mathematics (both inside and outside the classroom). She published “On Jordan Ideals and Matrix Rings” in Linear Algebra and its Applications. She serves on the College’s Educational Policy Committee. Dr. Roche received a Hewlett Mellon grant for a faculty working group in Quantitative Literacy and attended both sectional and national meetings of the MAA. She served as a faculty adviser during the four sessions of this summer’s newly instituted ARCH program (Academic Registration and Creative Horizons) for incoming First Year students.

Jaymie Strecker tried some innovative teaching methods in her courses this year. She used felt boards to teach data structures so that students could work in groups to “act out” programs and concepts. Dr. Strecker also integrated a barrage of approaches to teach recursion, a notoriously difficult topic, in CS152. Approaches included: using the debugger to trace a recursive function, motivating recursion with fractals, illustrating recursion with songs and poems, having students physically act out a recursive Fibonacci function, and having students compare correct and incorrect solutions to a problem modeling the spread of flu. Dr. Strecker is leaving Wooster to gain professional experience as a software engineer and eventually plans to return to teaching.
John David and his wife Jenny are celebrating the birth of their daughter Madeline on July 6. John is also proud that he completed a half and a full marathon this past year. On the professional side, Dr. David had a paper published in the International Journal of Pure and Applied Mathematics entitled “HIV Model Analysis Under Optimal Control Based Treatment Strategies”. He also applied for a patent: “Electron Gun for a Multiple Beam Klystron with Magnetic Compression of the Electron Beams”. Dr. David is serving as a statistics tutor for a biology faculty’s GLCA New Direction Proposal “Tutorial in Genomics-related Statistical Analysis”.

Mary Jo Kreuzman
Visiting Assistant Professor of Mathematics
BS Xavier 1980
MA, PhD Notre Dame 1982, 1985
Courses taught 2009-10:
- Calculus I (3 sections)

Linda Barbu
Coordinator of the Math Center
BS The University of Findlay 1971
MAT The College of Wooster 1975

Jackie Middleton
Administrative Coordinator since 1989

Scott Meech
Adjunct Teaching Staff
BA Wooster 1995
MS Akron 2001
Courses taught 2009-10:
- Math in Contemporary Society (2 sections)

Mystery Professor
Can you guess the identity of this mystery professor? Look closely! If you’re still having difficulty identifying her (or him), visit:
www3.wooster.edu/math/mysteryprofessor.png
**Yang Tian**, Leshan Sichuan, CHINA  (Double major in Math and Economics)

Advisors: Jennifer Roche and Amyaz Moledina (Economics)

*The Impact of Tariffs on Foreign Direct Investment*

Abstract: This study analyzed the impact of tariffs on Foreign Direct Investment (FDI). Vertical FDI arise due to wage differential between the home and the host country. An increase in tariffs is likely to deter vertical FDI. Horizontal FDI is motivated by tariff-jumping. Higher tariffs set by governments of foreign countries are likely to increase trade costs and motivate a firm to undertake horizontal foreign production to avoid paying tariffs. Thus higher tariffs attract horizontal FDI. The total impact of tariffs on FDI is partially dependent on the relative importance of the two types of FDI. We hypothesize tariffs are negatively related to FDI. We apply industrial data and empirically test the hypothesis. We found tariffs are positively related to FDI, although this result is not significant.

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**John Mullet**, Euclid OH  (Mathematics)

Advisor: Jennifer Roche

*Analyzing Insurgency Situations with an Emphasis on the Effect of Intelligence: An Adaptation of the Lanchester Model*

Abstract: This work examines the possible outcomes of modern insurgency situations. There is a strong focus on the effect of military intelligence in counter-insurgent operations. We will start by focusing on a foundation in the Lanchester model and show how it has been adapted to apply to insurgency situations. This paper will continue by considering all possible results of a government force engaging an insurgency, including the overall conclusion that it is not possible to defeat an insurgency through brute force alone.

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**Max Rafferty**, Rye NH  (Computer Science)

Advisor: Sofia Visa

*BitTorrent-Enhanced Distributed Internet Caching: Applying Peer-to-Peer Protocols to Enhance Performance and Scalability of Browser-Accessible Internet Resources*

Abstract: This research proposes the BitTorrent-Enhanced Distributed Internet Caching (BEDIC) system, which extends the existing BitTorrent file-sharing system to access and distribute URL-accessible content such as HTML files using peer-to-peer methods. Our experiments confirm that our BEDIC implementation is able to match the network performance of current client/server and peer-to-peer file access methods while remaining fully scalable to usage and robust to changing network conditions, unlike any current URL accessible file distribution system.

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**Priscilla Staples**, Stoughton MA  (Mathematics)

Advisor: R. Drew Pasteur

*Optimal Batting Order for The College of Wooster Fighting Scots Softball Team for the 2008 Season*

Abstract: In baseball, teams are faced with a difficult dilemma every day: given a set of nine players, find the optimal sequence in which they should bat. An optimal batting order is that which produces the most runs and/or greatest number of wins. In this study, the optimal batting order the 2008 Fight Scots softball team was calculated and analyzed using statistical analysis and computer simulation.

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**Kristine Mann**, Fairmont WV  (Mathematics)

Advisors: Pamela Pierce and Matthew Broda (Education)

*A Case Study Investigating Practices in Middle School Mathematics*

Abstract: In order to find out what makes an effective teacher, there are many different skills and practices that need to be examined. One of the goals of this study is to observe and analyze the best practices used in the classrooms by examining past research and observing in an actual classroom. Another goal is to ultimately gain knowledge and insight into how a teacher can effectively use these best practices in a classroom. The results of this research can make an impact and set an example of how teachers can ensure a positive learning environment in the classroom.
Economic Benefits of Foot-Voting: Game Theoretic Approach

Abstract: As developed nations alter their immigration policies to attract high-skill workers from abroad, the rate of human capital movement across borders—especially from the developing world—has surged in the recent past. However, increased high-skill emigration has more complex economic implications for a developing country than the obvious brain drain. This paper develops a game theoretic model based on Albert Hirschman's Exit-Voice-Loyalty (EVL) concept and the Tiebout hypothesis to explain a citizen's emigration decision. The outcomes of the game are applied to the human capital augmented Solow growth model to explore the effects of emigration on the source country's economic growth. Theoretical results show that, under certain circumstances outlined by the EVL game, emigration can lead to increased human capital accumulation in a developing country in two ways. First, the prospect of emigration generates extra incentive for individuals to invest in education. Second, return migration triggered by the government's reaction to foot-voting costs brings technological knowledge from the developed countries.

Analysis of Automotive Valve Train Springs

Abstract: Within the field of applied mathematics, it is often the case that a general solution to a particular problem can be used to find its own initial parameter values. The application of this problem-solving technique ranges from simple first order differential equations to systems of multi-dimensional partial differential equations. This thesis gradually progresses from the former to the latter, with an emphasis on automotive engine functionality. Ultimately, an initial physical understanding of the internal combustion engine is enhanced by employing the equations of motion for automotive valve train springs. Through the use of mathematical programming software, it becomes possible to solve such equations and even model various behaviors of these helical rods.

Differential Gene Expression of H. Bacteriophora TTO1 in Response to Heat Stress

Abstract: *Heterorhabditis bacteriophora* is an entomopathogenic nematode whose use as a biocontrol agent against insects with agriculture is currently deficient due to significant nematode mortality during high stress storage. In this study, we investigated the differential regulation by *H. bacteriophora* during heat stress using the Illumina Genome Analyzer, a next generation sequencing technology. With respect to the mathematical investigation, we used the Estimation Maximization (EM) algorithm to model our data on a Poisson mixture model. This type of analysis has been shown to predict transcriptomic data significantly better than simpler models.

Music Genre Recognition: Developing a Tool to Identify Genre Specific Characteristics of a Musical Piece

Abstract: Pattern recognition is the field of study concerned with assigning an object or an event to a category. Each category is defined by a set of features that emphasize the similarities among the objects or the events in the category. It is the occurrence of these features across different object and event samples that create the patterns identified in pattern recognition. These patterns are then classified in a procedure known as pattern classification, which assigns a label to the patterns. This thesis explores the application of pattern recognition to MIDI music files and classifies the patterns identified by assigning a genre label to the music file. The complete software development seeks to highlight the significance of pattern recognition through its application to music classification by genre, and to aid those who value a deeper and richer understanding of music analysis.
Let's See Who Takes Home the Cup this Year, 2010: Mathematical Sports Ranking

Abstract: Each year, billions of dollars are spent on the Fédération International de Football Association (FIFA) World Cup tournament. Most of the money is devoted to the ranking of FIFA teams. There have been several models that have been published on sports ranking, but this thesis shows two in particular: the Thomas Jech's model and the Perron-Frobenius Theorem. The use of these models will not absolutely predict the champion of the 2010 FIFA World Cup soccer tournament, but the mathematics gives better and more accurate ways of ranking teams and determining an ultimate winner before the tournament.

Investigation of the Kinetics of Aqueous Dicarboxylic Acids Under Tropospheric Light Conditions and the Application of Systems of Ordinary Differential Equations to Model Chemical Kinetics

Abstract: Aerosol formation and destruction are fairly well understood processes, but the aging process or the active lifetime of many aerosols is still widely debated or merely unknown. Simple systems consisting of one isomerizable dicarboxylic acid, either fumaric or maleic acid, photochemistry were investigated using a 450 W Xe arc lamp. The arc lamp's output was reduced to a range of 280-400 nm. The acids were reacted in open systems at ambient pressure and temperature. The rate constants for isomerization were determined by solving the system of differential equations using the ode45 solver in MATLAB. A mathematical model was designed to model the degradation pathway of acetone.

NO MORE RED LIGHTS! A Cellular Automaton Solution for City Traffic

Abstract: This thesis explores the applied mathematics behind vehicular movement in a city grid. It uses cellular automata, a discrete mathematical model, to evaluate traffic patterns and adjust traffic signals so that a vehicle entering a city grid will make a minimum number of stops at red lights. The model presented is a four-directional model where vehicles travel either north, south, east or west and all lights are synchronized, implying that the lights all turn green together or red together. The ChSch model only supports two directions, where vehicles can only travel north or east, but the four-directional model’s behavior mimics the ChSch model for traffic in terms of which traffic light cycle lengths produce the most amount of flow. Because of this similarity, we conclude traffic signals can be optimized for the 4-D traffic model.
David Mar, Burr Ridge IL (Computer Science)
Advisor: Sofia Visa
Exploring the Capabilities of the Scribbler Robot as a Teaching Tool for Introductory CS Classes
Abstract: This thesis focuses on assessing the advantages and disadvantages of the Scribbler robot as a teaching tool in an introductory computer science course. This is achieved by collecting data on motor and sensor behavior through repeated testing, using the robot to interpret environmental data, and implementing more advanced algorithms for maze navigation and light following behaviors.

Rebecca Ross, Lexington KY (Mathematics)
Advisors: Pamela Pierce and Matthew Broda (Education)
Flow Experiences in Experiential Mathematics
Abstract: This study seeks to determine whether or not flow can be induced through experiential mathematics. Gaining this knowledge will be invaluable to secondary mathematics educators, as they may be able to design experiential mathematics lessons that would induce flow experiences in their students, ultimately engaging them in and exciting them about mathematics. The data needed to accomplish this purpose is both quantitative and qualitative in nature. Not only is the extent of flow experienced by the participants important, but the distinct characteristics of the participants’ flow experiences are important as well. To accomplish the collection of both sets of data, a mixed method research model, using phenomenological and statistical methodologies was employed.

Mary Rhollans, Sylvania OH (Mathematics)
Advisor: R. Drew Pasteur
An Introduction to Disease Modeling, with a Focus on Malaria
Abstract: This thesis begins with an introduction to some of the classic epidemiological models. Several models are outlined, with the relevant differences highlighted as a means by which diseases of various characteristics can be resembled. A flow chart illustrating the human states is shown for each model, along with the set of differential equations used to construct the models and a summary of the parameters utilized in the equations. The second chapter describes the uses and methods of calculating equilibria and bifurcations of such models, and the third chapter describes the construction of a model used to represent malaria in Uganda. The biology of the disease is discussed in depth, in order to exhibit the method by which the states and parameters in the model were chosen. Research on the parameter values was then presented, and the model was used to create a bifurcation. The thesis concludes with a discourse on the model’s validity and potential uses.
We had 41 participants from ten high schools in the finals of the 2010 College of Wooster High School Mathematics Contest on Saturday, April 24. Trophies were awarded to the top three teams, while the top five individuals received plaques and cash prizes.

Congratulations to

**Western Reserve Academy**
of Hudson OH, who won 1st place in the team competition.

2nd Place: Revere High School, Richfield OH
3rd Place: North Ridgeville High School, N. Ridgeville OH

Individual Winners
1st Place: S. Kuo, Revere High School
2nd Place: C. Ahlborg, Revere High School
3rd Place: J. Woo, Western Reserve Academy
4th Place: E. Cho, Western Reserve Academy
5th Place: J. Byrd, Revere High School
FALL SEMESTER

Thursday, November 12
What do your professors do?
by Dr. Jennifer Roche, Dr. Sofia Visa, and Dr. Drew Pasteur, College of Wooster Department of Mathematics and Computer Science

Tuesday, October 13
CyberEthics: The good, the bad, and the electronic
by Joan Krone, Professor of Computer Science, Denison University

Thursday, September 24
Summer Internship/Research Experiences
by Wenyuan Wu ’11, Xiaorui Bao ’11, Elena Fiocca ’10

SPRING SEMESTER

Thursday, April 15
GEOMETREKS
by Ivars Peterson, Director of Publications and Communications, Mathematical Association of America

Thursday, April 8
Mathematics and the Neptune Controversy: The Best Joke of the 19th Century?
by Deborah Kent, Assistant Professor of Mathematics, Hillsdale College

Monday, March 29
Matrices, Eigenvalues, and the Size of a Linear Transformation
by Christopher Hammond, Associate Professor of Mathematics, Connecticut College

Tuesday, March 2
Algorithmic Methods in Modular Representation Theory
by Dr. Selin Kalaycioglu, Visiting Assistant Professor of Mathematics, Kenyon College

Tuesday, January 26
Counting Curves: Tales from the Enumerative Crypt
by Dr. Susan Colley, Professor of Mathematics, Oberlin College

Award winning mathematics writer Ivars Peterson provided an entertaining look at the role of numbers and shapes in everyday life when he presented "Geometreks" at The College of Wooster on Thursday, April 15.
Honors and Awards

LATIN HONORS

Summa cum laude
- Mary Danielle Rhollans
- Rebecca Marie Ross

Cum laude
- Aung Maw Myo Lwin
- Yang Tian

DEPARTMENTAL & PROGRAM PRIZES

The William Edgar Hoffman, Jr. Prize in Education
- Rebecca Marie Ross

The William H. Wilson Prize in Mathematics
- Mary Danielle Rhollans

The Vivian Chan Prize in Interdisciplinary Sciences
- Marc Christian

The Foster Prize in Mathematics
- Marc Christian

The Elizabeth Sidwell Wagner Prize in Mathematics and Computer Science
- Rebecca Marie Ross

MAA AWARD

A paper by Professor Pamela Pierce, Professor John Ramsay and four of their students has been selected by the MAA for the Trevor Evans Award:


The Trevor Evans Awards, established by the Board of Governors in 1992 and first awarded in 1996, are presented by the Mathematical Association of America to authors of exceptional articles that are accessible to undergraduates and published in Math Horizons. The Awards are named for Trevor Evans, a distinguished mathematician, teacher and writer at Emory University.

PRESIDENTIAL AWARD FOR EXCELLENCE

Karen Hyers (Cow Math '89) has been selected by President Barack Obama as a National Finalist for the Presidential Award for Excellence in Mathematics and Science Teaching. Karen will be invited to Washington DC to attend an award ceremony and receive a citation signed by the President. An educator for 20 years, Karen teaches Advanced Placement Calculus and Accelerated Geometry/Algebra 2 at Tartan High School in Oakdale, MN, where she has worked since 1997. She has also taught for Minneapolis Public Schools and the University of Minnesota Talented Youth Math Program.
The Wooster Applied Mathematics Research Experience (AMRE) is an eight-week summer research program which joins student teams and a faculty advisor from The College of Wooster with a local business, industry or government agency (client) in order to apply a mathematical science perspective to problems found in a "real world" setting. AMRE began in the summer of 1994 with two projects and has continued in each subsequent summer, oftentimes with six or seven projects. Despite suffering through several weeks of nonexistent air conditioning and offices without windows, the 2010 AMRE program completed 10 projects and employed 23 students.

It was a hot but productive summer for AMRE...

MELISSA VENECEK ’12, PAM WALES ’11
KEMAR REID ’12, ANDREW LICKING ’12, YANLONG HU ’12
ITAI NJANJI ’11, ATTICUS JACK, ’12, JOSH THOMAS ’11
DUC CHU ’12, SHILADITYA CHAUDHURI ’11, MAAZ KHAN ’11
NORMAN ISRAEL ’12, HANNAH DAUBER ’12, ROBERT TAYLOR ’11
EVAR RADKOFF ’12, LOGAN GARRITY ’11
SADAF ASRAR ’11
MICHAEL JANNING ’13, SAIF AHMAD ’12
CHRISS MILLER ’11, MICAH CAUNTER ’12
LOUISA CATALANO ’11, DAVID FREUND ’13
Modeling the tan Delta Spectrum
Student Participants: Hannah Dauber, Norman Israel, Robert Taylor
Faculty Advisor: John David (Mathematics)
In rubber, the Tan Delta spectrum is the ratio between loss and storage modulus which contains information about the mechanical properties of rubber. In 1986, K.H Nordsiek found that various parts of the tan Delta spectrum were diagnostic of various tire performance features related to the tread compound. He believed that ideal tread compound performance could be realized through mixtures of rubbers.

The AMRE research team developed a model to predict the tan Delta spectrum from the experimental data on the tire ingredients. The team used Neural Networks to do this, repeatedly creating and training various networks to get better prediction each time, finally creating an optimal predictive model. The team was also able to use the networks to identify the important tire ingredients for tan Delta value.

This research is important to Goodyear because it improves on previous approaches they used for modeling the spectrum. This can reduce the amount of time they spend on testing. The work done by this research team also provides valuable information to guide future research done by Goodyear (such as with the ranking of the ingredients according to importance). The work on confidence bands for the prediction also offers Goodyear new predictive ability.

Surface Competition of Selected Cure Chemicals, Antioxidants, Silanes and Water onto Model Carbon Black, Zinc Oxide and Amorphous Silica Surfaces
Student Participants: Melissa Venecek and Pam Wales
Faculty Advisor: Sarah Schmidtke (Chemistry)
This project was developed as a computational chemistry project to compute the relative sorption energies and model the structures of selected rubber chemicals on filler surfaces. The compounds are used in the vulcanization process for producing tires. The main goal was to use free energy of sorption as a measure of the surface competition by each rubber chemical. The chemicals have an effect on the rubber crosslink density, filler surface and aging characteristics of the rubbers. Each of these rubber compounds sorbs onto a filler, but unfortunately there is not much knowledge as to how the rubber chemicals interact with the fillers. Throughout this research there were four specific milestones: obtaining the lowest energy geometry of the chemicals sorbed onto filler surfaces, computation of relative solvation energies of rubber chemicals, finding a successful computational method for obtaining sorption energies and obtaining the relative energies of absorption for each rubber chemical on each filler surface. All of the calculations in this study were performed using the Gaussian 03 computational chemistry program.

Analysis of Cross-section Geometry of Complex Steel Cords
Student Participants: Kemar Reid, Andrew Licking, Yanlong Hu
Faculty Advisors: John Ramsay and R. Drew Pasteur (Mathematics)
The purpose of our project was to model geometrically the steel cords used by the Goodyear Tire and Rubber Company. Our clients at Goodyear wanted us to deliver a model (using MATLAB) that could display 2-D cross-sections of any specified steel cord design, anywhere along its length, in order to analyze the construction. These steel cords for tire reinforcement are created by taking series of filaments and wrapping them together in a helix. After construction, steel cords are placed upon a layer of rubber, while another is laid on top of it in the tire assembly process. The rubber then molds into the gaps in the steel cord, allowing for greater strength in the tire structure. However, when there is overlap in the structure, namely when two filaments try to occupy the same space, they will push out or rotate or in some other way cause an unaccounted for structural deformity, which will then lead to weakness in the tire designs as well. Our model will be used by Goodyear to view, analyze and interpret steel cord constructions used in tire reinforcement.
**Knot Theory**  
**Student Participants:** Louisa Catalano and David Freund  
**Faculty Advisors:** John Ramsay and Jennifer Roche (Mathematics)

This project, funded by the GLCA, HHMI, and Sophomore Research Program, developed the foundation for a research program into the field of knot theory. In laying the groundwork for future research in this field, specific areas of knot theory were investigated as potential directions for research; these areas include the arc presentation of knot, tricolorability, virtual knots, and satellite knots. The arc index of a knot was found to be promising, and most of the current research in this area was reviewed. Also, the idea of a Klein bottle knot was invented and preliminary drawings were created.

**Monitoring & Evaluation Framework for Adivasi Development Network**  
**Student Participant:** Sadaf Asrar  
**Faculty Advisor:** Jim Burnell (Economics)

The purpose of this project was to create a Monitoring and Evaluation (M&E) Framework for Adivasi Development Network (A.D.N.), a Non-Profit Organization which works with the indigenous people in Eastern India on basic development issues through collaboration with Adivasi non-profits and leaders in Eastern India for the advancement of the Adivasi, the indigenous people of India. The M&E Framework is created using the Logical Framework Approach employing Logframe Matrices and M&E Matrices to provide a step-by-step guideline on how to conduct M&E of multidimensional development projects.

**NFL Prediction Using Neural Networks**  
**Student Participants:** Michael Janning and Saif Ahmad  
**Faculty Advisors:** R. Drew Pasteur and John David (Mathematics)

Our research analyzes the ability of a neural network model to predict the outcome of regular season NFL games. This model uses only readily available statistics, such as passing yards, rushing yards, and fumbles lost. A key component of this model is the use of differentials where, for example, the passing yards of one team are compared to the defensive passing yards of the other team. By using principal component analysis and derivative based analysis, we determined which statistics influence our model the most. We assessed the performance of the model by comparing its predictions to those of media members and the Las Vegas odds makers. We also consider the absolute error in predicting the margin of each game. In both total wins correctly predicted and point spread error, our model performs similarly to the Las Vegas line. Using the second half of the season for our predictions, we obtained an average accuracy prediction of 65.8% for 2006, 72.2% for 2007, 75.8% for 2008, and 68.2% for 2009 over 10 different realizations of the model. The standard deviation for each year was less than 1%.
**2010 AMRE Projects**

**OSU-OARDC**

**Tomato Analyzer**

Student Participants: Itai Njanji, Atticus Jack, Joshua Thomas
Faculty Advisor: Jaymie Strecker (Computer Science)

The purpose of our project was to improve Tomato Analyzer, an application that measures shape and color attributes of fruits. Tomato Analyzer is part of the Tomato Fruit Morphology Project, which seeks to understand how genes and molecular networks control fruit morphology. We added several features to Tomato Analyzer. These features include an area that allows the user to add “notes” to the images being analyzed and updates to the Color Analysis feature. Color Analysis was streamlined and given an expanded interface to make the feature more user-friendly. To accomplish this the user now must only deal with an in program popup window to calibrate the color; this process is much simpler than the previous method that involved exporting values to Excel and running a regression algorithm on them. The program was made more stable and was made to run faster due to the bug fixes made by the team as well. The team also worked on enhancing the boundary detection of the program to allow for more accurate measurements. For more information visit "http://oardc.osu.edu/vanderknaap/tomato_analyzer.htm"

**CoW BUSINESS OFFICE**

**Evaluating Accounts Payable Policies and Procedures**

Student Participants: Shiladitya Roy Chaudhuri, Maaz Khan, Duc Chu
Faculty Advisor: Lisa Verdon (Economics)

The team worked with the College's Accounts Payable (AP) department. The project was created to increase the efficiency of day to day to operational activities of the AP department through the use of process map. By analyzing the process map the team was able to provide recommendations and suggestions that would help the AP department to reduce process cycle time, decrease defects, reduce costs, reduce non-value-added steps, and increase productivity.

**CENTER FOR ENTREPRENEURSHIP, CoW**

**Analyzing Mobile Banking in Microfinance and Developing an SMS Based Program to Facilitate Microfinance Institutions using Mobile Banking with their Clients**

Student Participants: Chris Miller and Micah Caunter
Faculty Advisor: Jim Burnell (Economics)

The purpose of our research was 1) to examine and analyze the market opportunity associated with implementing Mobile Banking in Microfinance 2) to develop and implement an SMS-based mobile banking program that MFIs can use to conduct mobile-based interactions with their clients. Specifically, our team examined the current practices of Microfinance and Mobile Banking by financial institutions across Africa and Latin America. The market research also entailed researching the potential of developing mobile software that would be able to better serve the “unbankable” population in developing countries. Accordingly, we developed an aspect of a larger mobile banking specification that aims at using mobile technology to consolidate financial services. The software will allow MFIs to manage the messages that are transmitted between their clients.

**MATH RESEARCH**

**Polygon Dissection**

Student Participants: Evan Radkoff and Logan Garrity
Faculty Advisor: Pam Pierce (Mathematics) and Denise Byrnes (Computer Science)

Our project, Circle Squaring 2010, is a continuation of work done by AMRE and HHMI researchers in the past. Our work involved polygon dissections. This was a result of trying to approximate a 1990 paper by Laczkovich on the subject of circle to square decompositions. The past summers saw major results arise including an algorithm to dissect a polygon of any given even number of sides and form a square with the pieces. This summer, the task fell to us to write up the results and create an animation visually explaining our algorithm. The goal was to submit a website with our research findings to the MAA’s online journal, LOCI.
The National Science Foundation, the Real Analysis Exchange, and The College of Wooster hosted the Summer Symposium in Real Analysis XXXIV. Real analysts from all over the world descended on Wooster on July 13-17 for the symposium. Guests traveled from Canada, Russia, Czech Republic, Brazil, Japan, Mexico, London, Poland, Germany, Botswana, India and many areas of the U.S. Pam Pierce served as the local host and spent many hours organizing the conference. Conference attendees were treated to a trip to Amish country, narrated by Wooster anthropology professor David McConnell, and a meal in an Amish home in Millersburg, OH. Attendees also enjoyed several performances of the Ohio Light Opera. Invited speakers were Steven Krantz of Washington University in St. Louis (author of 64 books on real analysis and other mathematics topics) and Marianna Csornyei of University College, London, a Hungarian mathematician who proved the equivalence of the zero measure notions of infinite dimensional Banach spaces.

Summer Symposium in Real Analysis
“The Buckeye Symposium”

A SAMPLING OF TALKS

<typename:A Feynman-Kac Solution to a Random Impulsive Equation of Schrödinger Type – Everaldo de Mello Bonatto, Univ de Sao Paulo, Brazil

<typename>New Smoothness Conditions on Riesz Space with Applications to Riesz Space-Valued Non-Additive Measures and their Choquet Integrals – Jun Kawabe, Shinshu University, Japan

<typename>Baaire One, Gibson and Weakly Gibson Real Functions of Several Real Variables – Michael Evans, Washington and Lee University, VA

<typename>On Lusin-Type Approximately Continuous Integrals – Piotr Sworowski, Instytut Matematyki, Poland
Each fall, The College of Wooster sponsors several computer science teams in the ACM Regional Programming Contest. Students who are interested in competing are required to enroll in Computer Science 279 Problem Seminar in the fall semester. The contest is held at the regional site on the first Saturday of November. Six Wooster computer science students on two teams competed in the 2009 ACM-ICPC East Central North America Regional Programming Contest in Youngstown, Ohio. There were 115 teams from 60 colleges in the competition. Although larger universities took most of the top spots, among liberal arts colleges, the two Wooster teams placed 8th and 16th. Congratulations to Tristan Vrolijk ’12, Robert Taylor ’11, Wenyuan Wu ’11, Trisha Fultz ’12, Evan Radkoff ’12 and Daniel Norris ’10.

**SAMPLE PROBLEM: The Flood**

Global warming has us all thinking of rising oceans—well, maybe only those of us who live near the ocean. The small island nation of Gonnasinka has employed you to answer some questions for them. In particular they want to know how high the water has to get before their island becomes two islands (or more). Given a grid of integers giving the altitudes of the island, how high must the ocean rise before the land splits into pieces?

**Input**

Each test case begins with a line containing two positive integers \( n \) and \( m \) giving the dimensions of the grid, then \( n \) lines each containing \( m \) positive integers. The integers indicate the original altitude of the grid elements. Grid elements are considered to be adjacent only if they share a horizontal or vertical edge. Values of zero (0) along the perimeter, and all zero cells connected to these, are ocean at its initial level. Cells of 0 not connected to the perimeter (that is, surrounded by higher land) are simply sea level elevations. Furthermore, assume the ocean initially surrounds the given grid. The island is initially connected. Neither \( n \) nor \( m \) will exceed 100 and heights will never exceed 1000. A line with 0 0 follows the last test case.

**Output**

For each test case output one of the two following lines.

Case \( n \): Island splits when ocean rises \( f \) feet.

Case \( n \): Island never splits.

Our convention here is if your answer is, say, 5 feet, you more accurately mean “5 feet plus a little more.” That is, at least a little water will be flowing over the originally 5 foot high portion of land.

**Sample Input**

```
5 5
3 4 3 0 0
5 5 4 3
2 5 4 3
1 3 0 0
1 2 1 0
5 5
5 5 5 5
4 1 1 4
4 1 2 3
7 1 0 4
7 3 4 4
0 0
```

**Sample Output**

```
Case 1: Island never splits.
Case 2: Island splits when ocean rises 3 feet.
```