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Department of

MATHEMATICS & STATISTICS NEWSLETTER

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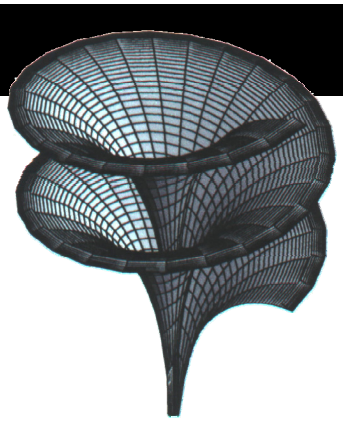


THE DEPARTMENTAL FIVE YEAR PLAN

Under a new administration and with renewed vigor, the faculty of the department have developed and adopted a bold and visionary Five Year Plan that will guide its life in the foreseeable future. In part, the plan re-emphasizes and reinforces some of the strengths for which the department has been known. The Plan identifies five overarching goals, each comprising one or more objectives. A careful analysis reveals that there is a strong and extensive synergy among the goals in that success in any one of them depends on the success of at least one of the remaining four.

1. Offer Excellent Mathematics and Statistics Education for All of RIT

While it re-emphasizes the instructional excellence for which the department has been known all along, the Plan, among other things, proposes to increase the effort and the rewards for innovative teaching methodologies, to update the mathematics and statistics curricula in response to the changing needs of our students, to offer honors courses, and to establish a robust undergraduate research program.

2. Offer Strong Dynamic Undergraduate Programs

The quality and reputation of our undergraduate programs, at least as measured by the professional success of our graduates, are outstanding. But, as the demands and the expectations of the "marketplace" change with the times, we are determined to respond by making the necessary adjustments in our curricula as frequently as necessary. Some of the means to that end are strong minor programs, honors programs, dual BS/MS degree programs, as well as the initiation of a new program in Actuarial Statistics. Through the implementation of this plan we aspire to make our department the focal point for undergraduate mathematics and statistics of the Rochester area.

3. Establish a Strong Departmental Research Program

This goal emanates from the fundamental belief that out-of-class professional activity on the part of the faculty is a necessity if excellence in teaching is to be attained and maintained. Complete absence of professional activity beyond teaching will lead to stagnation and, regardless of how dedicated a teacher may be, this stagnation will, eventually, affect teaching and learning negatively. It is expected that different faculty will engage in different types of professional activity that will range from educational research, to consulting, to new courses responding to changing programmatic needs, to the development of new or enhancement of existing curricula, to pure research, to publications, to participation in or presentations at conferences, etc. The faculty considers it to be self-evident that all of these forms of endeavor will be beneficial not only to the practitioner but also, and as importantly, to her/his students.

4. Offer Strong Dynamic Graduate Programs

It is axiomatic that implementation of such programs will enhance the chances for interdisciplinary collaboration both within and outside RIT. Graduate programs will add new dimensions to Goal #3, creating opportunities for student participation in research projects and in the pursuit of "hybrid" BS/MS programs. Moreover, in view of the intensifying efforts at RIT toward new Ph.D. programs whose foundations rely extensively upon mathematics, our department must be ready to respond appropriately through the resources of a graduate program.

5. Develop Effective Public Relations

This is an obvious *sine qua non* if the foregoing goals and objectives are to be attained. Some of the component objectives of this goal include: the recruitment of outstanding students and faculty whose quality will match and, if possible, surpass that of both at the present time; the promotion of awareness of careers in mathematics and statistics; and the identification and cultivation of consulting opportunities for our faculty.

UPDATE ON THE CALCULUS PROJECT

At a January faculty meeting, Prof. Sophia Maggelakis presented the fall quarter results of the ongoing calculus project. She began by reviewing the project goals: improve students' success rates, make better use of students' active learning skills, instill in students a better foundation of core skills, increase students' appreciation of the usefulness and beauty of mathematics, and link calculus concepts to interesting real world applications. The elements of the pilot program are diagnostic testing of first-year students, a new

precalculus course, a revised calculus 241, a revised calculus 251, and a common final exam.

Prof. Maggelakis reviewed the criteria for placement in the various courses and summarized the numbers of students placed in each of the courses, including the numbers of students who did not follow the recommended placements. The percentage of students who completed recommended courses successfully by earning A's, B's, or C's was significantly improved from the previous year's results. In fact, a large percentage of those students who did not successfully complete the courses in which they enrolled did not follow the recommended placements.

One of the important segments of the revised calculus 251 course is a mandatory two hour workshop. Prof. Maggelakis summarized the results of the workshop evaluations. Students may not be happy about the extra two hours a week, but they seem to like the workshop format and group learning. Most of the students felt that they had learned from others in their groups and that they in turn had helped other students.

All of the faculty members who participated in the project during the fall quarter were acknowledged. This included faculty who taught precalculus, calculus 241 or calculus 251, as well as the members of the Pilot Assessment Committee and faculty members who volunteered their time as tutors in the College of Science Study Center. The Teaching Assistants who helped with the workshops and spent time tutoring in the Study Center were also thanked.

MATHEMATICAL MODELING

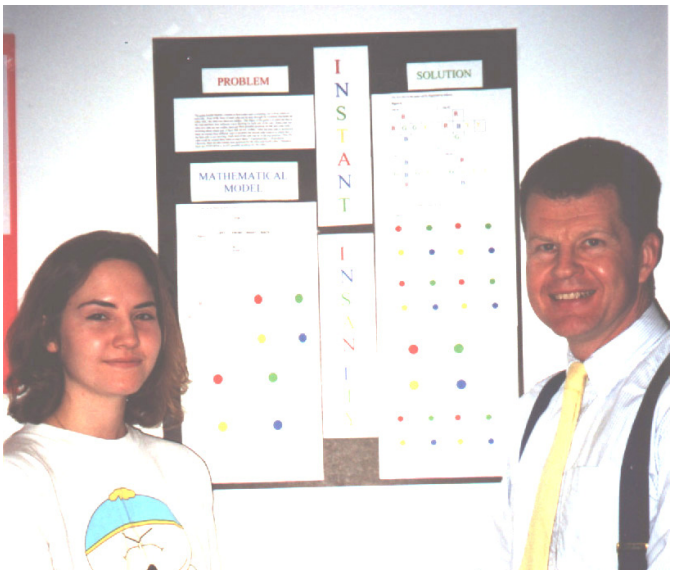
Students who take the mathematics modeling class learn to give a definitive answer to the eternal question of reluctant mathematics students: "What am I ever going to use this for?" This year they learned to use the techniques they've mastered in their calculus, linear algebra, and differential equations courses to solve problems in business, biology, photographic science, vehicular traffic engineering, chemistry, optics, microelectronic engineering, children's games and humor.

The class covered several traditional applications of mathematics. They used linear programming methods to advise two young entrepreneurs on how to maximize profits; they used rational functions to optimize a chemical test for Vitamin C; and they used differential equations to find the trajectories of an ink drop in a printing system. But the most popular topics were less traditional ones: ecology, ants, and jokes.

The class developed a mathematical model of the evolution of plant populations. The model uses demographic data taken and classified by field biologists to project the growth of a plant population and the evolution of its structure. The model was based on simple linear algebraic concepts and on methods of graph theory. David Hagen extended the model, as his final project, to study the sensitivity of the gray squirrel population in North America to changes in its environment.

In his informal autobiography *Surely You're Joking*, physicist Richard Feynman describes his experiments with ants. He noted that when an ant finds a food source it follows the random path it had taken from the food source back to the ant hole. Other ants then follow him, and a parade of scavenging ants ensues. Slowly, as the parade back and forth continues, the ant path straightens out, so that it becomes a straight line between the ant hole and the food source. The students devised many different models to explain this phenomenon. Several built on these models for their final projects, providing computer simulations and proofs of properties of the various models.

In his essay *Public-Spirited Citizens Such as You*, the humorist Dave Barry describes his experimental investigation into the spread of jokes. Students used versions of the logistic equation, most well-known as the basis of models of epidemics, to describe the transmission of jokes. Jennifer Baldwin built on the joke model for her final project, incorporating spatial effects.



Melissa Matthews and Prof. David Ross

The class held a poster session at the end of the term to describe their final projects to friends and members of the faculty. Many of the projects were good, solid, traditional scientific models: Sangeeta Nangia's model of gelation, Pranita Kulkarni's model of polymer spherulites, David Tysiac's model of the permeability of red blood cells, and a project by Vikram Bhole and Ronia Chaar on silver halide crystallization. Several interesting biological models were presented, including one of the growth of a quail population in New Zealand by Jin Song, and one of oscillating predator-prey populations in Canada by Beth Hesley. Two of the quirkiest models were also among the most interesting: Melissa Matthews' graph theoretic model of the game Instant Insanity, and Jennifer Goodenow's analysis of water clocks.

SOPHIA MAGGELAKIS, AN INVITED SPEAKER

Prof. Sophia Maggelakis was an invited speaker at the *In Silico Biology International Symposium*, which took place at the Medical University of South Carolina last December. This initiative was sponsored by the SC EPSCoR and SC BRIN programs to promote inter-institutional collaboration in the application of mathematical principles to biological problems.

Prof. Maggelakis presented a talk entitled "Mathematical Models of Tumor-related Angiogenesis: A Review." The focus of the talk was on the usefulness of mathematical modeling in describing and understanding the complex

biological mechanisms of tumor angiogenesis which takes place during tumor growth.

The talk was very well received by the medical researchers, mathematicians and engineers who participated at this symposium. "I found that the interest among the medical professionals to collaborate with mathematicians has increased since I started to work in the area of mathematical biology, ten years ago," says Prof. Maggelakis. "This is very exciting and challenging! I came back from this symposium encouraged and energized to develop more sophisticated mathematical models that will provide useful insight into understanding various complex biological phenomena."

MARCIA BIRKEN PARTICIPATES IN CONFERENCE

Prof. Marcia Birken, Department of Mathematics and Statistics, and Prof. Anne C. Coon, Department of Language and Literature, participated in the October 2001 conference *The Shape of Discovery: Exploring the Chaos and Complex Systems of Creative Writing and Science,* sponsored by Nimrod International Journal. The conference, which took place in Tulsa, Oklahoma, was part of the weekend activities celebrating the 23rd Nimrod/Hardman Writing Awards for poetry and fiction.

Profs. Coon and Birken were members of a panel discussion on the interlocking themes of science, poetry and fiction, where they presented the talk *Of Sestinas and Tessellations: The Interplay Between Fixed Form and Creativity*. Additionally, they were invited to teach a Master Class in writing poetry and fiction about the natural sciences.

Profs. Coon and Birken began collaborating seventeen years ago when they planned and team-taught an interdisciplinary problem-solving course for students in the College Restoration Program. They have continued to do research and to publish in a number of areas related to combining literature and mathematics. In spring 2001 they team-taught the interdisciplinary course: *Analogy, Mathematics and Poetry* that was developed under a Provost's Grant for 2000-2001.

DAVID ROSS SPEAKS IN MICHIGAN

Prof. David Ross delivered several talks in his capacity as a SIAM Visiting Lecturer. SIAM endeavors to bring industrial and practical applied mathematics talks to universities.

In October, at Western Michigan University in Kalamazoo, Prof. Ross gave three talks. One was for a research colloquium entitled *Temperature-Dependent Vibrations of Bi-layer Microbeams*. Along with collaborators at Kodak, he has been investigating the nature of simple bi-layer beams as thermal microactuators—tiny machines built on computer chips. Mathematically, this particular work is a model based on a nonlinear version of the fourth-order beam equation with some unusual boundary conditions.

The second talk was one of Prof. Ross' SIAM talks, *Mathematics in Photography*. It was the invited lecture of the Pi Mu Epsilon induction ceremonies at Western Michigan University. Pi Mu Epsilon is a national mathematics honor society. The talk was a survey of mathematical methods and models in photographic science.

Prof. Ross was also the after-dinner speaker at the Pi Mu Epsilon induction ceremony. He commented on life as a mathematician and then presented a version of the *Bad Jokes and Cheap Tricks* that he and Dr. John Hamilton do for school children here in the Rochester area. This consists of demos of mathematical and scientific principles dressed up as magic tricks, mind-reading scams, etc.

In September, Prof. Ross gave talks at Northern Michigan University in Marquette. At NMU he presented *Mathematics in Photography*. He also gave a talk, *A Mathematical Model of a Crystallizer*, based on research work that Prof. Ross did with Drs. Ken Hellyar and Jong Wey, both chemical engineers, on the distribution of crystal sizes that result from a certain batch crystallization process.

MEETINGS OF THE MAA

The regional Seaway Section meetings of the Mathematical Association of America provide a good opportunity for the faculty and students of the Department of Mathematics and Statistics here at RIT to interact with their colleagues from other colleges and universities in upstate New York and Ontario, Canada.

The meetings consist of invited talks by prominent speakers in the mathematical community, contributed talks by faculty and students, workshops, and book sales. These meetings occur every April and November. They take place on a Friday evening and most of the day Saturday and are held at different colleges and universities throughout the section.

The most recent meeting was held on November 3 and 4, 2001 at Brock University in St. Catherines, Ontario. In attendance from RIT were Profs. Edwin Hoefer, Carl Lutzer, Munir Mahmood, James Marengo, Michael Radin, and Hossein Shahmohamad. These faculty presented the following professional talks: *External Curves of a Rotating Ellipse* by Prof. Lutzer, *Bounds for Factorial Moments of Discrete Distributions* by Prof. Mahmood, *A Geometric Interpretation of Conditional Expectation* by Prof. Marengo, *Boundedness and Periodicity Character of Solutions of a Max Type Difference Equation* by Prof. Radin, and *Chromatic Polynomial and Chromatically Equivalent Homeomorphs* by Prof. Shahmohamad.

All students and faculty are encouraged to attend future Seaway Section meetings. The next one will take place at SUNY Brockport on April 19 and 20, 2002.

NATIONAL MATHEMATICS MEETINGS IN SAN DIEGO

Several RIT faculty attended the Joint Mathematics Meetings of the American Mathematical Society (AMS) and the Mathematical Association of America (MAA) held in January in San Diego, California.

Profs. Carl Lutzer and Darren Narayan were organizers of the AMS Special Session on Research in Mathematics by Undergraduates. This two-day session was sponsored by the AMS, Texas Instruments, Palm Inc., and Makichan Software. It included twenty-six of the nation's best and brightest students and was well attended by both students and faculty.

Prof. Marcia Birken was a co-organizer of an MAA session on *Innovative Uses of the World Wide Web in Teaching Mathematics*. In addition, several of our faculty gave talks:

On the Global Character of $y_{n+1} = \frac{py_{n-1} + y_{n-2k}}{q + y_{n-2k}}$ *Where p and q are Real Numbers and k is a Nonnegative Integer* by Prof. Michael Radin

Cantor Sets Which are Minimal Sets by Prof. Bill Basener

An Upper Bound for Representatives of Graphs Modulo n by Prof. Darren Narayan

Developing the Interdisciplinary Course: "Analogy, Mathematics, and Poetry" by Profs. Marcia Birken and Anne Coon

A Project to Teach Parametric Equations Using Star Wars: Episode I by Prof. Carl Lutzer

Profs. Rebecca Hill, Paul Wilson, and Marvin Gruber also attended the meetings.

The national meetings provided an excellent opportunity to help faculty stay professionally active. They also provided an enjoyable way for our faculty to meet, share ideas, and socialize with mathematics faculty from throughout the United States and beyond.

MATHEMATICS & STATISTICS COLLOQUIA

Our series of colloquia has continued with a wide variety of topics.

(1) Review of Engineering Applications

On November 13, we were privileged to have as our colloquium speaker Dr. Edward Hensel, who is Head of the RIT Mechanical Engineering Department. He reviewed various areas of study in which he has participated over the past two decades in the broad field of inverse theory and remote sensing.

His primary objective was to give a broad overview of interest areas, in an effort to identify potential areas for collaboration with RIT faculty. Topics included the nature of ill-conditioning and inaccuracy in this class of problems, logistical challenges of data management, and a summary of algorithms used in analysis.

The primary focus was the review of engineering applications, such as re-entry vehicle instrumentation, high-energy device instrumentation, real time thermal control, aerospace test and evaluation systems, and hazardous and nuclear waste site characterization and remediation.

(2) Snap-Through vs. Buckling

The problem of buckling is of significant practical importance, either to prevent it from happening in structures like buildings and bridges, or to use it as a way of storing energy to release suddenly, as in an oilcan.

On December 4, Dr. Antonio Cabal, from the Integrated Microstructures Laboratory in the Eastman Kodak Company, gave a colloquium talk on this topic. He described their theoretical investigations of snap-through bilayer microbeams by contrasting them with a thermally induced buckling microbeam of similar design.

(3) Domination in Dot-Critical Graphs

On December 18, Dr. Tamara A. Burton, from the Armstrong Atlantic State University, gave a talk consisting of a preview of her talk to be given at the Joint Mathematics Meetings in San Diego, CA.

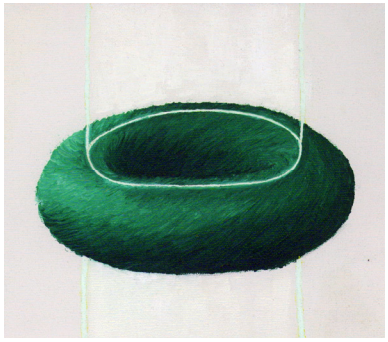
To set the stage for her talk, Dr. Burton stated the following definitions. A set S is a ***dominating set*** for a graph G if every vertex not in S is adjacent to some vertex of S. The ***domination number*** of G is the smallest cardinality of a dominating set for G. A graph G is ***dot-critical*** with respect to the domination number if the identification of the vertices comprising any edge results in a graph with a smaller domination number. The concept extends the previously studied concepts of edge-critical and vertex-critical graphs.

In her talk, Dr. Burton showed that dot-critical graphs include essentially both of these classes. In addition, she presented several examples and properties of dot-critical graphs, such as characterizations of 2-dot-critical graphs and dot-critical trees.

(4) From Zermelo to von Neumann to Nash

On January 31, Prof. Richard Orr provided a succinct history of the mathematical theory of games from Zermelo to von Neumann to Nash. He included an explanation of the Nash equilibrium.

John Forbes Nash, Jr. is the protagonist in the new movie ***A Beautiful Mind***. The moviemakers were interested in a study of the schizophrenia that struck this productive mathematician and disabled him for 30 years. Their interest was strengthened by a happy ending, a recovery sufficient to convince an award committee that they could, without fear of embarrassment, award a Nobel Prize in economics to John Nash. Sad to say, the moviemakers were less interested in Nash's mathematics.



A MATHEMATICS-INSPIRED PAINTING

The picture above represents the collision manifold for Kepler's 2-Body Problem. In the differential equations for the 2-body problem, there is a division by zero at the collision point, which is the point where the distance between the planets is zero.

There is a change of coordinates (called McGehee Coordinates, discovered by Richard McGehee in the 1970's) that replaces the collision point with a manifold and these new equations define a vector field on the manifold. This manifold, called the collision manifold, is a torus in the 2-body problem. There is a circle of fixed points on the top (shown in white) and a circle of fixed points on the bottom. Solutions to the vector field start near the circle on the bottom and travel up to

the circle on the top making a rotation of 2π (or -2π, depending on which side of the bottom circle the solution begins.)

The collision manifold helps us understand how solutions to the 2-body problem behave close to a collision. There is a similar manifold for the 3-body problem which helps us understand what happens near collision in the 3-body problem. There is still much about the 3-body problem which is unknown.

EQUIVALENCES

Prof. Hossein Shahmohamad presented a paper *On the Equivalences of the Wheel W5, the Prism P, and the Bipyramid B5* at the fifteenth Mid-West Conference on Combinatorics, Cryptography and Computing which was held in October 2001 at the University of Nevada.

The main results of this work were the discovery of infinite families of flow equivalent pairs of amallamorphs of the Bipyramid B5 and the wheel W5, and infinite families of chromatically equivalent pairs of homeomorphs of the Prism P and the wheel W5. Two conjectures were made on a class of thirteen graphs having no equivalences. Also a conjecture was made on what properties guarantee the existence of flow or chromatic equivalences among a graph's amallamorphs or homeomorphs, respectively. This original work is being refereed for the precedings of the conference.

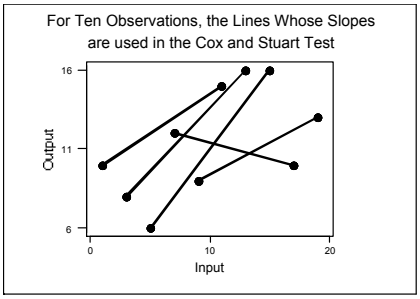
COX AND STUART TEST

For many years, Prof. David Farnsworth has been teaching Nonparametric Statistics. One topic is the Cox and Stuart test in which the slopes of lines between widely separated observations are used to make a decision about trend.

Prof. Farnsworth noticed that his students sometimes reached very different conclusions depending upon which variable they took to be the predictor (or input) variable. He constructed artificial data sets and found many real data sets that illustrated this phenomena.

His methodology and insights are contained in his article *A Cautionary Note Concerning the Cox and Stuart Test* in the Autumn 2001 issue of Teaching Statistics. The journal is sponsored by the British Royal Statistical Society, of which Prof. Farnsworth is a Fellow.

In his paper, Prof. Farnsworth stresses the many excellent features of the Cox and Stuart test and positively recommends its use. Also, he points out that care should be taken because of the ambiguities of the procedure that are demonstrated there.



CURIOSITY SEMINAR

In January Prof. Marvin Gruber gave a talk on the Generalized Riemann integral for the curiosity seminar. The generalized Riemann integral was defined. It was shown how the integral could be used to represent infinite series and applied to probability. Opinions were offered on the suitability of this integral in place of the usual Riemann integral for undergraduate analysis courses.

MATHEMATICS & STATISTICS CLUB ACTIVITIES

In early December, Monica Gladziszewski (an alumna) and Jason Meade gave a talk "What is an Actuary?" based on their experiences while working at Cigna.

In January, Jennifer Strausser (an alumna) spoke about the experiences she had while working for the Bureau of Labor Statistics.

In February, Prof. David Ross and Dr. John Hamilton gave a talk entitled "Bad Jokes and Cheap Tricks; Modern Mathematics at its Essence."

ALUMNI NEWS

Kiley Fennell (SMAM '00) is working as a process controls analyst. She has oversight responsibility for monitoring and maintaining all transactional control activities relative to invoicing, flat file creation, and client payment receipt.

Amy (Novotny) Huebeler (SMAS '01) began working for the Bureau of Labor Statistics in Washington, DC this past summer. Amy is a mathematical statistician in the Office of Employment and Unemployment Statistics. She works on surveys such as the Occupational Employment Statistics survey and the Hours at Work survey.

Michelle Jarzyniecki (SMAM '96) recently started a new job at Citibank in Rochester. Michelle is a programming manager in the Technology Division of the Student Loan Corporation. This group developed and maintains various web sites that support student loan servicing for internal and external organizations, as well as applications regarding Citibank Student Loans.

Christopher Kurz (SMAM '95) is working as an adjunct assistant professor at Johnson County Community College, while pursuing full-time doctoral studies in the Department of Teaching and Leadership at the University of Kansas. He is also a busy father of two young boys.

Mark Marini (SMAM '85) is manager of regulatory affairs in Rochester Gas & Electric Corporation. He spends the vast majority of his spare time with his four children, ranging in age from 7 to 14.

Theresa Rusin (SMAM '93) is a science teacher at Douglas County High School. She is also a US Army Reserve Captain.

Robert Stroup (SMAM '98) is a system analyst at Northrop Grumman Information Technology. He recently married his college friend Laura Lamb.

Laura Till (SMAM '89) is president of The Tamarind Group in Colorado.

Allon Yomtov (SMAM '96) is an actuarial associate with Prudential Financial in Newark, NY.

ANNOUNCEMENTS

The Department of Mathematics and Statistics will be hosting the Monroe County Math League. This is a mathematics competition which will take place on March 7. Approximately 525 high school students and approximately 70 high school teachers from the Monroe County area are going to be on campus for a day-long event.

In a memorandum issued by Steve West, Chair, Educational Policies Committee during the Fall 2001 Extended Executive Committee meeting, there appeared a recent NCTM position statement entitled *Essential Areas of Focus for all Entering College Students*.

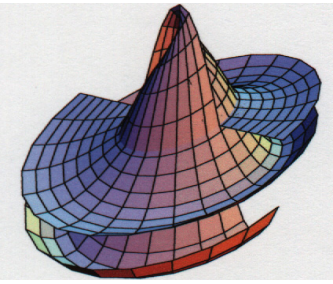
> [High School] Students should take calculus only if they have demonstrated mastery of algebra, geometry, trigonometry, and coordinate geometry. Their calculus course should be treated as a college level course and should prepare them to take one of the College board's Advanced Placement Examinations.

Prof. Michael Radin will be organizing a Special Session on Dynamical Systems for the Summer 2002 CMS meeting that will be held in Quebec City from June 15 to 17.

The American Mathematics Competition program of the MAA is sponsoring a Mathematics Olympiad Program in Nebraska, from June 18 to July 13, 2002.

STEINBACH SCREW

The Steinbach Screw using *Mathematica* and parametric equations:
x = u cos v
y = 2 u sin v
z = v cos u



HONORARY MEMBERSHIPS

The Department of Mathematics and Statistics is very pleased to announce our majors who have been selected to receive the 2001 Mathematical Association of America Honorary Student Membership.

Jennifer Lynn Baldwin	SMAC
Brett Michael Billings	SMAC
Donald A. Butler	SMAC
Kari Hanson Clark	SMAS
Thomas Prevendoski	SMAM
Jin Hua Song	SMAM

The Department is also pleased to announce our majors who have been selected to receive the Association for Women in Mathematics Honorary Student Membership.

Sara Gruetze	SMAM
Melissa Matthews	SMAC
Jennifer Richter	SMAS

These very prestigious honors are awarded based on the overall academic achievement and performance of our majors. These outstanding students fully deserve our hearty congratulations!

PROBLEM CORNER

Let $f(x)$ be a polynomial with integer coefficients. Define a sequence $a_0, a_1, \ldots$ of integers such that $a_0 = 0$ and $a_{n+1} = f(a_n)$ for all $n \geq 0$. Prove that if there exists a positive integer m for which $a_m = 0$, then either $a_1 = 0$ or $a_2 = 0$.

FALL DEAN'S LIST

Jennifer Baldwin	Victor Kostyuk*
Brett Billings*	William Kronholm*
Neil Brenner	Bryan Lenker
Donald Butler*	Stephanie Maksymiw
Tonya Campbell	Melissa Matthews
Ronia Chaar	Patricia Miller
Kari Clark	Jennifer Richter *
Darryl Cooney	Marissa Robertson*
Shana Dagel	Mark Schindlbeck
Gregory Dufore	Victoria Shults*
Calvin Farmer	Jin Song*
Nicolas Germain	Robert St.Pierre
Jennifer Goodenow	Tiffany Swasta
Nicolas Greene*	James Urick
Brian Grundy	Michael Voelkel
David Hagen*	Pamela Winn
Jason Hills*	Benjamin Zindle
Stephanie Jones	

Congratulations to all!
(denotes 4.0 GPA)*

Mathematics and Statistics Newsletter

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