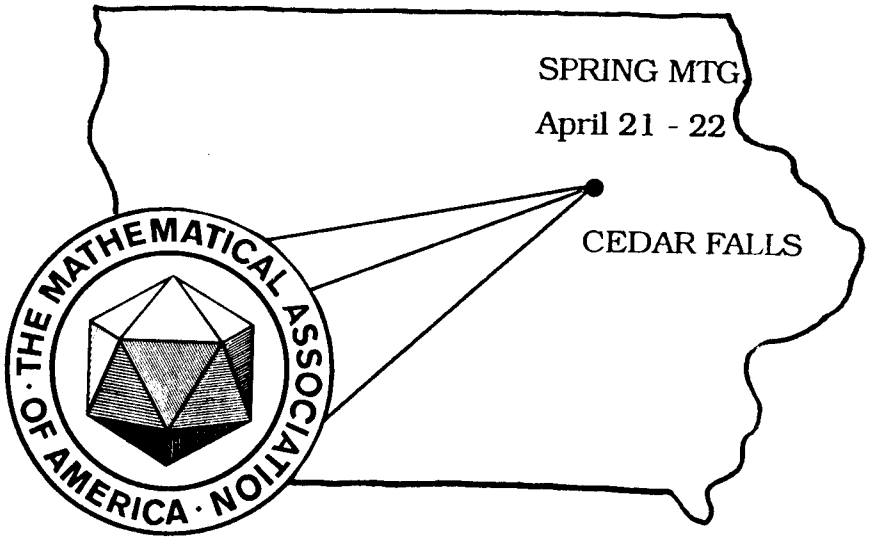
# IOWA SECTION NEWSLETTER




**SPRING 1995**

Department of Mathematics and Computer Science
Central College
Pella, IA 50219

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**IOWA SECTION** **SECTION OFFICER LIST**


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VOLUME XI NO. 2 April 1995


## SPRING SECTION MEETING

at

University of Northern Iowa

Friday and Saturday

April 21-22, 1995

A Note from the Program Chair, Gregory Dotseth

The University of Northern Iowa is pleased to host the 1995 Annual Joint Meetings of the Iowa MAA and IMATYC. Thanks to the efforts of several people in these organizations, I look forward to an interesting program. I am very pleased with the number of student participants we have this year and would like to thank the faculty that have given these students the guidance and encouragement that makes their presentations possible. And of course, we thank the faculty presenters for their time and effort.

During the business meeting, we will be pleased to be awarding for the first time a trophy to the school of the winning team in the Iowa Intercollegiate Math Competition which took place on Saturday, April 1, 1995, at the University of Iowa.

In this newsletter you will find a map of the University of Northern Iowa. Stop by the Visitor Information Center at the Main Entrance (off University) to pick up a parking permit. You will also find a list of motels and eating establishments.

## NATIONAL SUMMER MEETING

BURLINGTON, VERMONT, AUGUST 6-8, 1995

## GOVERNOR'S REPORT
## LYNN J. OLSON

In January I attended my last meeting as the Iowa Section representative on the Board of Governors.

Don Kreider finished his two year term as President and Ken Ross is the new President for the next two years. Incidentally Ken remembers speaking at the Iowa Section meeting when it was at Wartburg about 10 years ago. From all indications he will be a very able and dynamic leader.

The financial status of the organization seems to be solid. There is a contingency of about $100,000 in a $4 million dollar budget. (This doesn't seem to be enough.) The final results indicated that we would end '94 with a $38,000 surplus. The association will be debt free in '98 and as the Executive Director, Marcia Sward, noted the new headquarters is "a beautiful programmatic engine." I came away from my three years on the board with a high degree of confidence in the leadership to monitor costs and creatively gain alternate sources of income. It seems that Gerald Porter, as Treasurer, deserves a great deal of credit for the solid financial status and the clarity of the reporting.

The publications continue to be a highlight of the organization's efforts. I think there are eleven new books. I am sure you will have a chance to purchase these at the spring meeting at UNI.

There are 21,000 subscribers to "Math Horizons" and the number is growing. Don Alpers was very thankful for your support and was happy to announce that there would be no increase in costs for next year.

The MAA is undertaking a major campaign to increase its endowment. The main thrust is to develop a program of planned giving. Board members were asked to include the MAA in their estate plan and/or volunteer to contact members who indicated they might consider a planned gift.

The item that caused the most discussion had to do with the future status of summer meetings. There had been an extensive email discussion group prior to the meeting so many of the key points were familiar to everyone. The major problem is low participation (under 800 last summer) and large cost overruns. It amounted to about $100 per person last year. Obviously the winter meetings subsidize the summer meetings to a large extent. The board approved the continuation of summer meetings if they could be organized to be self sufficient. There was great reluctance to terminate these meetings but also the realization that we could not continue in the current mode. It is complicated by the cooperative agreement with AMS and the use of their organization for the registration and the bookings for the meetings.

In the course of our email discussion of summer meetings, it was asked how many mathematicians in our colleges belong to MAA only, MAA and AMS, AMS only, or a host of other combinations. A worry is that not enough of the professional teaching faculty see membership in MAA as desirable or necessary. It will be interesting to see where this discussion leads.

This past year I have been on a task force studying ways in which to make section governors more "effective." We are now putting together a document which will in some ways expand the duties of the governors but hopefully



lead to better results and more satisfaction. If you have any ideas in this regard please pass them on.

Finally I would like to thank the members of the section for this great opportunity. I tried to represent you in a conscientious way. Looking back I see things that I should have or could have done. The best I can do now is pass these ideas on to the next governor. I am coming away from the experience with much appreciation for the programming "punch" of our national office and the role the organization plays in forming the national agenda on mathematics education. I wish you all could have this experience.

## TREASURER'S REPORT
## STEVE NIMMO

| | Credits | Debits | Balance |
|---|---|---|---|
| Starting Balance (3-1-94) | | | $1,208.45 |
| MAA Dues Rebate | $500.00 | | 1,708.45 |
| 1994 Spring Meeting | | | |
| Registrations (56 @ $5) | 280.00 | | 1,988.45 |
| Iowa State Statistics Department | 100.00 | | 2,088.45 |
| University of Iowa Statistics Dept. | 100.00 | | 2,188.45 |
| Buffet Lunch (cash collected) | 108.50 | | 2,296.95 |
| Vendor Registration | 50.00 | | 2,346.95 |
| Book Sales | 356.00 | | 2,702.95 |
| Refreshments | | $305.15 | 2,397.80 |
| Buffet Lunch | | 110.00 | 2,287.80 |
| 1994 Meeting Expenses | | 28.27 | 2,259.53 |
| 1994 Spring Newsletter | | 193.91 | 2,065.62 |
| 1994 MAA Books | | 357.00 | 1,708.62 |
| 1994 Book Sale Commission | 18.90 | | 1,727.52 |
| 1994 Fall Newsletter | | 208.08 | 1,519.44 |
| 1994 Spring Call for Papers | | 143.98 | 1,375.46 |
| Interest | 21.43 | | 1,396.89 |
| Ending Balance (3-1-95) | | | $1,396.89 |

## NOMINEES FOR CHAIR ELECT

The nominations committee is pleased to submit the following persons for the position of Chair Elect: Jim Freeman from Cornell College, and Al Hibbard from Central College. A brief biographical sketch of each of these candidates follows.

Jim Freeman is a 1976 AB from Grinnell College (Phi Beta Kappa) and a 1980 Ph.D. from Notre Dame in classical group theory. He has taught at Notre Dame, Ripon College, and Cornell College since 1985. He is currently an associate professor of mathematics at Cornell. At Cornell, he teaches mathematics, non-calculus based statistics, and some computer science courses.

He has been an officer in the local sections of Phi Beta Kappa at both Rippon and Cornell. Much of his professional development has been in the area of computers. He managed the computer science network of Apollo workstations, and has served as Chair of the Math department. Currently he is working on distribution of information via the World Wide Web, both for Cornell and the League of Women Voters of Iowa. In addition, he has set up sites for storage and distribution of software for Differential Equations Courses.

Al Hibbard received his Ph.D. from the University of Notre Dame in group theory in 1989 and has been at Central College since. He has been active in incorporating computer-based exercises in a variety of courses over the last six years. As part of the Interactive Mathematics Text Project, he is currently writing labs and packages in Mathematica for use in an abstract algebra course. He is also the Mathematica and Interactive Texts moderator for the Mathematics Archives (archives.math.utk.edu by sopher or WWW).

Editorial note: We, the Iowa Section Members, express our thanks to the members of the nominating committee for putting the slate together, and to Professors Freeman and Hibbard for their willingness to serve. It is very much appreciated!!



## JOINT MEETING OF THE IOWA MAA AND IMATYC

UNIVERSITY OF NORTHERN IOWA, CEDAR FALLS, IOWA
APRIL 21 and 22, 1995

**FRIDAY, APRIL 21**

| | | |
|---|---|---|
| 1:00-4:00 | Registration | Wright Hall |
| 1:00-5:00 | Student papers | WRT 109 and WRT 205 |
| 4:00 | Registration, book exhibit | |
| 5:00-7:00 | Films | WRT 217 |
| 5:30-7:30 | Dinner on your own | |
| 7:30-8:30 | Speaker - Professor Izaak Wirszup *NSF Surveys of East European Mathematical Literature at the University of Chicago: Recognition of the U.S. Education Crisis and Fight for Reform* | SAB 102 (7:00-8:30) |
| 8:30-10:30 | Informal Reception (Sponsored by: D.C. Health and John Wiley & Sons) | Georgian Lounge, Commons |

**SATURDAY, APRIL 22**

| | | |
|---|---|---|
| 8:00 a.m. | Registration, book exhibit | |
| 9:00-10:00 | Speaker - Professor Izaak Wirszup *University of Chicago School Mathematics Project (UCSMP): Toward World-Class Standards in Mathematics Education* | SAB 102 (8:30-noon) |
| 10:15-10:20 | Welcome | SAB 102 |
| 10:20-11:20 | Speaker - Professor Barbara Faires, MAA Representative, Westminister College, New Wilmington, PA | |
| 11:20-11:50 | Iowa MAA business meeting | SAB 102 |
| 11:30-1:20 | Films | WRT 217 |
| 11:50-1:15 | Lunch on your own<br>IMATYC lunch and Business Meeting | WRT 117 |
| 1:00-1:00 | Concurrent Sessions | WRT 7, 119, 217 |

## Friday afternoon Sessions (Student papers)

**WRT 109**

1:00-1:25 Angela Wilken, Buena Vista College
*Categorical Independent Variables in Logistic Regression*

1:30-1:55 Andrew J. Schafer, University of Northern Iowa
*Fundamental Applications of Hill Ciphers*

2:00-2:25 Yijia Xu, Mount Mercy College
*Solving Linear Programming Using Simplex Method*

2:30-2:55 Dan Hayes, Luther College
*Helmholtz's Theorem via Geometric Calculus*

3:00-3:25 Matthew Buckley and Quentin J. Wade
Central Academy and Drake University
*How Curved are Dragon Curves?*

3:30-3:55 Lealand Vettleson, Drake University
*The Physics of Windmills*

4:00-4:25 Kartik Chandra Parija, Drake University
*Algorithm for Finding Select Eigenpairs for Large Symmetric Real Matrices*

4:30-4:55 Laura K. Peterson, Drake University
*Difference Matrices: A Probabilistic Approach*

**WRT 119**

1:00-1:25 Giovanni Santostasi, Maharishi International University
*What do Lie Groups Look Like?*

1:30-1:55 Carla Wafel, Drake University
*Unusual Random Walks Revisited*

2:00-2:25 Leta Steffen, Andrea Lichtenberger and Huong Do
Central Academy and Drake University
*Superposition Graphs*

2:30-2:55 Jennifer Wagner, Grinnell College
*Integer Hexahedra*

3:00-3:25 Domen Prasnikar, Maharishi International University
*Option Pricing Formulas and Their Accuracy*

3:30-3:55 Renee F. Bourgeois, Grinnell College
*Counting Tours*

## Saturday afternoon Concurrent Sessions

**WRT 217**

1:00 A. M. Fink, Iowa State University
*A Non Scientific Approach to Graduation Rates*

1:30 Cathy Gorini, Maharishi International University
*Sending Secret Messages with Mathematics*



2:00 Douglas A. Swan, Morningside College
*Projects in chaos using Derive for a calculus class*

2:30 Robin A. Pennington, Wartburg College
*Energizing Calculus with Classroom Activities*

3:00 Eric W. Hart, Maharishi International University
*The Core Plus Mathematics Project: A New Integrated High School Mathematics Curriculum*

3:30 Russell B. Campbell, University of Northern Iowa
*Mathematics Awareness Week -- What We Can Do, and Why*

**WRT 7**

1:00 Milan Randić, Larry Naylor, and Xiaofeng Guo,
Drake University
*Wiener Matrix Revisited*

1:30 Dan Alexander, Drake University
*A Survey of the Historical Background to Montel's Theory of Normal Families*

2:00 Douglas Mupasiri, University of Northern Iowa
*Complex Convexity in Lebesgue-Bochner Function Spaces*

2:30 Jack Engstrom, Maharishi International University
*2 D Stick Arithmetic*

3:00 Charles H. Jepsen, Grinnell College
*Dissections of p:q rectangles*

3:30 James A. Ralston, Wartburg College
*The Three and Four Line Locus Problem or the Problem of Pappus*

**WRT 119**

1:00 Charles Ashbacher, Decisionmark, Cedar Rapids, Iowa
*An Implementation of the Shortest Path Algorithm For Weighted Graphs*

1:30 Al Hibbard, Central College
*Exploring Abstract Algebra with Mathematica*

2:00 John Price, Maharishi International University
*Looking at Taylor Polynomials with Mathematica*

2:30 Ruediger Jakob-Chien, University of Northern Iowa
*Fast Multipole Algorithms for Spherical Filters*

3:00 Ruth Berger, Luther College
*An Implementation of the $D_5$ Check Digit Scheme*

3:30 Luz DeAlba, Drake University
*Stability, Eigenvalues and Interval Matrices*

## Friday Afternoon

| | WRT 109 | WRT 119 |
|---|---|---|
| 1:00-1:25 | Wilken | Santostasi |
| 1:30-1:55 | Schafer | Wafel |
| 2:00-2:25 | Xu | Steffen, Lichtenberger, Do |
| 2:30-2:55 | Hayes | Wagner |
| 3:00-3:25 | Buckley, Wade | Prasnikar |
| 3:30-3:55 | Vettleson | Bourgeois |
| 4:00-4:25 | Parija | |
| 4:30-4:55 | Peterson | |

## Saturday Afternoon

| | WRT 217 | WRT 7 | WRT 119 |
|---|---|---|---|
| 1:00 | A.M. Fink | Milan Randic<br>Larry Naylor<br>Xiaofeng Guo | Charles Ashbacher |
| 1:30 | Cathy Gorini | Dan Alexander | Al Hibbard |
| 2:00 | Douglas A. Swan | Douglas Mupasiri | John Price |
| 2:30 | Robin A. Pennington | Jack Engstrom | Ruediger Jakob-Chien |
| 3:00 | Eric W. Hart | Charles H. Jepson | Ruth Berger |
| 3:30 | Russell B. Campbell | James A. Ralston | Luz DeAlba |



# INVITED TALKS

### NSF Surveys of East European Mathematical Literature at the University of Chicago: Recognition of the U. S. Education Crisis and Fight for Reform

Izaak Wirszup
Department of Mathematics
The University of Chicago

This presentation will trace many of the international developments in mathematics and science education from the post-Sputnik years to the present, together with their influence on American teaching and policies. Specific attention will be directed to the translation of pivotal education research and other mathematics books from the Soviet Union and their impact on American school mathematics. The role of the NSF in the reform of American school mathematics will be addressed.

### University of Chicago School Mathematics Project (UCSMP): Toward World-Class Standards in Mathematics Education

Izaak Wirszup
Department of Mathematics
The University of Chicago

This presentation will review the problems in U. S. mathematics teaching which prompted the development of the UCSMP, and will examine the bases used in developing this program. Particular attention will be directed to the international setting in which this program and mathematics education reform in general functions.

### Mathematical Puzzles (With a Glimpse at MAA Project)

Barbara Faires
(MAA Representative)

This will be an analysis of puzzles and names from a historical perspective. I will also talk briefly about some MAA projects but will minimize the time devoted to these projects. The talk will be quite appropriate for students and, indeed, was developed for a student session.

## STUDENT PAPERS

### Categorical Independent Variables in Logistic Regression

Angela Wilken
Buena Vista College

Regression is a topic discussed in statistics courses. I will expand briefly upon what regression is, as well as what a categorical variable is in regression equations. The main points of the talk will include a specific type of regression, titled Logistic Regression, and categorical variables in Logistic Regression. In addition, I will discuss the tests used with these regression models.

### Fundamental Applications of Hill Ciphers

Andrew J. Schafer
University of Northern Iowa

The purpose of this presentation is to familiarize the audience with the process of encrypting messages with 2-dimensional Hill Ciphers. Included in this presentation is an overview of basic encryption techniques, followed by an overview of Hill Ciphers, with particular emphasis on 2-dimensional Hill Ciphers. This overview is best demonstrated by encrypting and decrypting messages themselves, rather than try to explain the matrix algebra involved in general. Therefore, the next portion of the presentation involves going through the process of:

1) Encrypting a word with a normal (linear) encryption technique.
2) Encrypting a word with a sample Hill-2 cipher.
3) Decrypting a word with a sample Hill-2 cipher.

The final portion of the presentation involves comparing and contrasting these methods, and providing the audience with an insight as to the advantages of encrypting with Hill Ciphers rather than encrypting with other methods. The remaining portion of the presentation is allotted for questions and comments.

### Solving Linear Programming Using Simplex Method

Yijia Xu
Mount Mercy College

I will begin by giving a brief history of linear programming followed by an introduction of some basic terminologies of linear Programming. Several methods for solving LP have been developed the past few decades. They are: the simplex method (George B. Dantzig, 1947), the ellipsoid method (Khachijan, 1979) and the interior point method (Narenda Karmarkar, 1984). This talk will be focused on the algorithm and implementation of simplex method only.



### Helmholtz's Theorem via Geometric Calculus

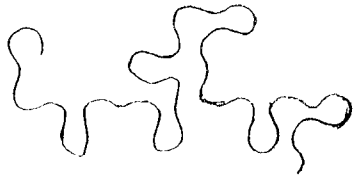
Dan Hayes
Luther College

Geometric algebra and geometric calculus are powerful formalisms encompassing vector algebra and calculus, differential forms, spinors, etc. We use geometric calculus to give a short and lucid proof of Helmholtz's theorem, an important theorem of vector calculus.

### How Curved are Dragon Curves?

Matthew Buckley and Quentin J. Wade
Central Academy and Drake University

Dragon curves originated with John E. Heighway, a NASA physicist. They can be defined by a binary sequence or by a stepwise geometrical construction that we will outline. They appear highly curved as illustrated below on a smaller dragon curve:



We are interested in trying to measure the degree of folding or bending of such fractal-like curves. We followed M. Randić, A. F. Kleiner and Luz DeAlba in using the leading eigenvalue of a D/D matrix as the measure of the folding of a path-like structure. The (i,j) element of the D/D matrix is obtained as the ratio of the geometrical Euclidean distance between points i and j and the topological-graph theoretical distance between the same points. We will report the folding index for smaller dragon curves and compare the results with folding indices for several other geometrical objects. All calculations were made using MATLAB package.

### The Physics of Windmills

Lealand Vettleson
Drake University

With the coming of the end of the fossil fuel era, new methods of getting energy are needed. There are many sources of power that include solar, geothermal, and nuclear power. The idea of harnessing the wind has been existent for a very long time in the form of sailing ships and windmills.

Windmills come in various shapes and sizes. They range in size from large, many bladed machines for pumping water to smaller, two/three bladed windmills that are for personal use. There are currently windmill fields in states such as California. These fields help reduce the need for energy in these states.

Strangely enough, not much information is known about the basic physics behind the air flow through a moving windmill. Most designs depend on the data received from operating smaller-sized windmills. Therefore, it would save much time and effort if a simple mathematical model could be created.

### Algorithm for Finding Select Eigenpairs for Large Symmetric Real Matrices

Kartik Chandra Parija
Drake University

A basic iterative algorithm for finding the highest or lowest eigenvalue and associated eigenvector of a large, real, symmetric matrix is presented. An improvement of this program to determine a selected number of extreme eigenpairs is discussed and its performance on well known test cases are assessed. Several ideas to improve the efficiency and computation time of this method have been implemented and results have been obtained. This technique finds application in multidimensional problems in quantum physics.

### Difference Matrices: A Probabilistic Approach

Laura K. Peterson
Drake University

Consider a k by n array A with entries from $Q = \{0,1,\ldots,q-1\}$ and columns $c_1, c_2,\ldots,c_n$. Such an array is said to form a *difference matrix* if the vector difference (mod q) $c_i - c_j$ of any two columns of A contains each element of Q at least once. Such matricial arrays have been considered by Colbourn and Kreher (1994). Difference matrices are related to orthogonal arrays.

We define and consider a generalization of this notion: A $\lambda q$ by n array forms a t-wise sign-balanced matrix of order $\lambda$ if for each choice of t columns and for each choice $\varepsilon_1,\ldots,\varepsilon_t$ of signs, the linear combination $\sum_{i=1}^{t} \varepsilon_i c_i$ (mod q) contains each entry of Q at least $\lambda$ times.

Motivated by the work of Sloane (1992) and Godbole, Skipper and Sunley (1994), we consider the following extremal problem: Given a k by n matrix A, how large does the number k of rows have to be so that A is a t-wise sign-balanced matrix of order $\lambda$?

We use probabilistic methods, in particular the Lovász local lemma (Alon and Spencer (1992)) and the Stein-Chen method of Poisson approximation (Barbour, Holst and Janson (1992)) to prove several results.

This research was conducted at the Research Experiences for Undergraduates site at Michigan Technological University during the summer of 1994 with Anant Godbole and Erik Sandquist. It is currently being prepared for submission to *Designs, Codes and Cryptography.*



### What do Lie Groups Look Like?

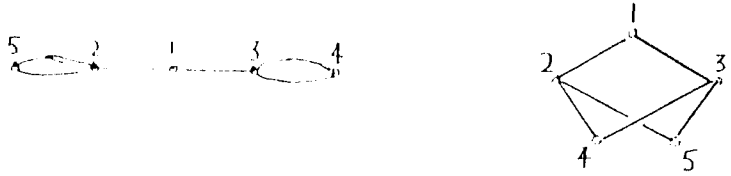
Giovanni Santostasi
Maharishi International University

The theory of Lie groups is one of the most important areas of mathematics with applications ranging from differential equations to particle physics. This article takes some of the main Lie groups and shows how they can be viewed in 2 dimensions. For example, SL(2,r) is a 3 dimensional object in 4-space. I show how to view it and its subgroups in 2-space.

### Unusual Random Walks Revisited

Carla Wafel
Drake University

For a vertex in a graph one can enumerate random walks and self-returning random walks of different length by raising the adjacency matrix to n-th power. It is very unusual for two vertices in different graphs to have the counts of all their self-returning walks equal, except for isospectral graphs. The unusual random walks have been previously reported for several cubic graphs on 10 vertices. In all instances the origin of coincidence in the count of self returning walks was traced to the presence of such walks in the pair of graphs:




We investigated cubic graphs having 12 vertices. In a number of instances we could also trace coincidence in the count of self returning walks to the same pair of graphs on five vertices. However, we came across cubic graphs the connectivity of which could not be reduced to small five-vertex graphs. We will discuss our efforts to reduce these larger graphs and yet preserve the coincidence in the count of random walks. All calculations were made using MATLAB package.

### Superposition Graphs

Leta Steffen, Andrea Lichtenberger and Huong Do
Central Academy and Drake University

By superposition of adjacency matrices of two or more graphs one obtains a superposition graph. Such graphs on four vertices, derived from combining three matrices at a time from 10 symmetrical 4 X 4 matrices, have been introduced in the literature by Randic, Woodworth, Kleiner and Hosoya in their study of symmetry properties of larger graphs. We consider here superposition graphs derived by combining three symmetrical 5 X 5 trivalent matrices that are not

superposition graphs. The number of different superposition graphs increases with the size of the symmetric matrices used in their construction. Hence, efficient schemes for their generation are essential if we are to extend the search for larger super-graphs. We will outline our own approach for deriving super-graphs as well as for deriving regular trivalent graphs that are not superposition graphs.

### Integer Hexahedra

Jennifer Wagner
Grinnell College

Peterson and Jordan give an example of each of the seven classes of hexahedra in which the distance between any two vertices is an integer. We find two examples of the class with four quadrilaterals and two triangles that are smaller than their example. We also find a smaller example of the class with one pentagon, two quadrilaterals and three triangles.

### Option Pricing Formulas and Their Accuracy

Domen Prasnikar
Maharishi International University

Options are one of the most important instruments in risk management because they enable secure money transactions and minimize financial risk. They therefore act as an insurance policy. The search for exact pricing methods yield many formulas that differ in accuracy and speed of calculation. My interest was to compare the Black-Scholes and the binomial formulas looking for patterns of accuracy. It is surprising to see that the accuracy of the binomial formula follows a saw-tooth pattern as the grid-width decreases. This means that in some cases better accuracy is obtained for 25 steps than for 100 or more.

### Counting Tours

Renee F. Bourgeois
Grinnell College

We consider the following problem: a tour on a M X N board is a closed loop which travels through each square on the board exactly once. The tour travels from square to square either horizontally or vertically, but never diagonally. Denote by T(M,N) the number of different tours on an M X N board, up to rotation and reflection. This paper finds formulas for T(M,N) for all N when $M \leq 5$, as well as the solution for T(6,6). For M = 3, we get an explicit formula in terms of N. For M = 4 and 5, we get recursion formulas. Finally, we compute T(6,6) = 149.



## CONTRIBUTED PAPERS

### A Non Scientific Approach to Graduation Rates

A. M. Fink
Iowa State University

We look at a model for graduation rates given in a text as an application of markov chains, which I used as an application of matrix arithmetic in my linear algebra class. The question arose whether one could model ISU's data this way. I can prove that you cannot, but there is a modification that does. I arrive at this result in a non-scientific way. I am interested in the general problem of what graduation rates are possible in the sense of determining the sequence of numbers which are the graduation rates after 4, 5, 6, ... years. (Or more generally for Markov chains.)

### Sending Secret Messages with Mathematica

Cathy Gorini
Maharishi International University

Students in MIU's core course in mathematics study modular arithmetic and its applications. As part of the lesson on the RSA cryptosystem, students encode, send, and decode messages using Mathematica. This paper will describe the Mathematica notebook used by the students.

### Projects in chaos using Derive for a calculus class

Douglas A. Swan
Morningside College

These projects illustrate how to use some programming techniques in Derive to display iterative graphs. [The key programming ideas are from Kay Weiss of Kansas City, Kansas, Junior College.] The objective of the projects is to introduce the chaotic behavior of Newton iteration processes to calculus students by directing them to explore several related problems while watching the sketching of the graphs with different seed points. Other concepts explored are repelling and attracting points and chaos in Newton's iteration in functions of two unknowns.

### Energizing Calculus with Classroom Activities

Robin A. Pennington
Wartburg College

Is it an effective use of time to spend half a class period discussing a chemical reaction model involving mass-action dynamics? The trade-offs of using this type of class activity include diminished time for discussing the difficult concepts and finer details, leading to an increased reliance on the student. Strategies for introducing mathematical models, team activities and computer-aided solutions into a calculus course will be presented.

**The Core-Plus Mathematics Project:**
**A New Integrated High School Mathematics Curriculum**

Eric W. Hart
Western Michigan University
(Adjunct: Maharishi International University)

The Core-Plus Mathematics Project (CPMP) began in late 1992 with a 5-year grant from the National Science Foundation. Our goal is to research, develop, evaluate, and, in cooperation with a publisher, nationally disseminate an innovative, integrated mathematical sciences curriculum for high schools. The project is based at Western Michigan University and involves a collaboration among WMU, University of Iowa, University of Michigan, University of Maryland, University of Wisconsin-Madison, and California State University-Northridge.

The CPMP curriculum consists of four year-long courses, each of which weaves together four strands: algebra/functions, geometry/trigonometry, statistics/probability, and discrete mathematics. Courses are organized in connected units, each comprised of several multi-day lessons in which major ideas are developed through investigations of rich applied problems. The curriculum emphasizes mathematical modeling and student investigation, and features appropriate, integrated use of TI-82 graphics calculators. The CPMP curriculum is in the same spirit as many of the new reformed calculus projects. CPMP Courses 1 and 2 are currently being field-tested in about 50 high schools around the country, including one in Iowa.

This talk will present an overview of the Core-Plus Mathematics Project, including samples from the first two courses and preliminary results from the field test.

**Mathematics Awareness Week -- What We Can Do, and Why**

Russell B. Campbell
University of Northern Iowa

Mathematics Awareness Week can be used to build community among students and faculty within mathematics, as well as bring the role of mathematics in society to the attention of the general population. I shall discuss some activities we have undertaken to achieve these goals.

**Wiener Matrix Revisited**

Milan Randic, Larry Naylor and Xiaofeng Guo*
Drake University

Wiener matrix for a tree was recently introduced as an additional source of graph invariants. The element (i,j) of W-matrix enumerates all the paths in the graph that contain the path from i to j (or j to i). For adjacent vertices Wij is the contribution of bond i, j to the Wiener number W. In order to extend the study of the properties of such



matrices we constructed a program (written in Pascal) which derives W matrix, the row sums for W matrix and the overall sum of all elements of W, designated as WW. Regularities in the row sums and the WW have been investigated. In particular, we consider occurrence of the same row sums in different graphs that is not uncommon. The regularities found in row sums were used to predict the form of larger graphs that should exhibit common vertex row sums. In addition, we investigated the occurrence of the same WW in different graphs, which is not common. Such graphs are not likely to be found at random, but have to be constructed based on relevant properties of Wiener matrices.

* On leave from Xinjiang University, Wulumuqi, Xinjiang, P.R. China

**A Survey of the Historical Background to Montel's Theory of Normal Families**

Dan Alexander
Drake University

Montel developed and articulated his theory of normal families during the first two decades of the twentieth century. While interesting in its own right, the theory of normal families was very powerful and had an immediate impact to a wide variety of subjects, including Picard theory (a body of work stemming from the so-called Big Picard and Little Picard theorems), the iteration of complex functions, the theory of series and sequences and the Riemann mapping theorem. I will not delve very far into the particular details of any of these applications, but instead will attempt to indicate the impact of Montel's theory of normal families on the development of complex analysis.

NOTE: Although I will define Montel's theory of normal families and state some of the results mentioned above, this talk will not be very technical. It should, therefore, be accessible to mathematically mature advanced undergraduates.

**Complex Convexity in Lebesgue-Bochner Function Spaces***

Douglas Mupasiri
University of Northern Iowa

We will introduce extensions of complex geometric properties to continuously quasi-normed spaces and discuss the relationship of these properties to their analogues in real Banach spaces. We will show that the properties lift from a continuously quasi-normed space X to the space of equivalence classes of Lebesgue-Bochner X-valued p-integrable functions, for $0 < p <$ infinity. We will also discuss local versions of these properties and the results connected to them.

* This work was done in collaboration with P.N. Dowling and Zhibao Hu, both of Miami University, Oxford, Ohio.

### 2-D Stick Arithmetic

Jack Engstrom
Maharishi International University

A new understanding of natural numbers is presented which unifies previously independent concepts and is based on a vision of wholeness. We start with stick arithmetic (usually used for tallying) and introduce an extra dimension to the sticks, making them boxes. These boxes suffice to represent numbers, operations, and parentheses. A cancellation postulate together with a single form of distributivity suffice for all calculations. This system, based in G. Spencer-Brown's Laws of Form, axiomatically generates and models the six standard relations between addition, multiplication, and exponentiation in a most elegant and surprising way, and sheds new light on the intimate connection between operations and operands.

### Dissections of p : q rectangles

Charles H. Jepsen
Grinnell College

We consider the problem of dissecting a p : q rectangle into pieces that are p : rectangles of different sizes. (The classical problem of squaring the square is the special case where p = q = 1.) What ratios p : q are possible? What numbers of pieces are possible? A theorem in linear algebra provides conditions for such a dissection to exist. A Maple program then generates the dissections. In this way, we determine all dissections into at most 12 pieces.

### The Three and Four Line Locus Problem or the Problem of Pappus

James A. Ralston
Wartburg College

I will discuss the importance of locus problems in the development of Greek and sixteenth century mathematics. Some background on the structure of the proofs and a discussion of sources will be given. The main body of my talk will be a detailed presentation of the analytic half of the four line locus proof. This theorem states: there exists a curve such that, if it exhibits the four line locus property, then it is a conic section.

### An Implementation of the Shortest Path Algorithm For Weighted Graphs

Charles Ashbacher
Decisionmark, Cedar Rapids, Iowa

The algorithm to determine the shortest path in a weighted graph is well-known. At Decisionmark, we have road data in the form of nodes for the entire United States in files separated on a county-by-county basis. One of our goals was to create a program where the user could enter a start and destination node and the program would compute the shortest path between those nodes. By judicious initial pruning



and reducing data transfers by creating intertwined data structures, the program executes in real time for "small" data sets. The computation is a two-step process:

a) Reading in the nodes for all relevant counties and constructing the data structures. This includes the creation of the links across county borders as well as the computation of the "distances" between nodes.

b) Execution of the algorithm and writing the solution to a file.

The largest data set that could be run without exceeding the on-board RAM was on the order of 71,000 nodes. Two nodes that were nearly the farthest possible distance apart were chosen and the total execution time to determine the shortest path was approximately 5 minutes and 10 seconds on a Pentium running at 66 MHz. Of that time, step (a) took approximately 1 minute and 5 seconds. Similar runs on a 486 running at 66 Mhz took approximately 9 minutes and 20 seconds.

There is no hard-coded specificity in the program, so if one were to specify the "distance" values in the node file, it could be used on any weighted graph. The purpose of this presentation is to describe some of the techniques used to achieve this speed of execution.

### Exploring Abstract Algebra with Mathematica

Al Hibbard
Central College

This session will illustrate a work in progress on developing Mathematica packages and labs to accompany an abstract algebra course. The focus of the underlying package is to provide a graphical/visual component, in addition to a computational one, for many concepts which occur in abstract algebra. Some examples where visualization adds some insights: looking at the subgroup generated by an element; looking at graphs of inverses for two groups of the same order; visualizing a subgroup via a reordering of a Cayley Table.

### Looking at Taylor Polynomials with Mathematica

John Price
Maharishi International University

Approximating functions by using Taylor polynomials is an important part of most upper division calculus courses. Mathematica is an ideal computer package to visualize how this approximation takes place for different classes of functions. In this talk I describe a Mathematica Notebook developed at MIU as the basis of laboratory experiments to study Taylor polynomials. Reactions of the students to this approach will also be described. (Copies of this and other MIU Mathematica Notebooks will be available.)

### Fast Multipole Algorithms for Spherical Filters

Ruediger Jakob-Chien
University of Northern Iowa

The Fast Multipole Method is a fast approximate method for evaluating multipole expansions at many points. The method is used in a fast numerical algorithm for filtering high wavenumber components of scalar quantities on the surface of a sphere. This filter is needed to prevent nonlinear instabilities during the solution of time-dependent PDEs on the sphere. Convergence, accuracy and performance results of a Fortran implementation of the algorithm are presented.

### An Implementation of the $D_5$ Check Digit Scheme

Ruth Berger
Luther College

In CML Vol. 22 No. 3, Gallian presents a check digit scheme that utilizes the Dihedral group of order 10. This is better than the ISBN check digit scheme, because it does not resort to utilizing an 11-th character. The $D_5$ cheme has, in fact, been implemented in the new German bank notes, the details will be presented in this talk. You will want to include this neat application of group theory into your next Abstract Algebra class.

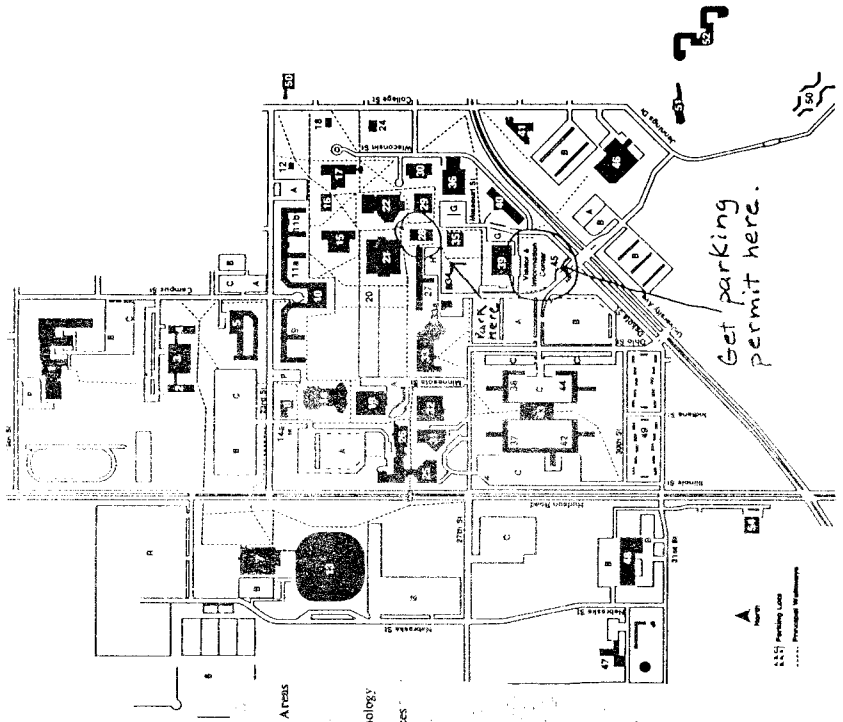
### Stability, Eigenvalues and Interval Matrices

Luz DeAlba
Drake University

In the study of dynamical systems we are interested in the ways in which these systems adjust to perturbations from the outside. This is known as the study of stability of a dynamical system. Many dynamical systems, and in particular some arising in economics and in ecology, can be described by means of matrices. Properties of the dynamical system, such as stability, can be determined by properties of matrices.

Interval matrices arise in the study of dynamical systems and are defined as matrices whose entries are intervals of real numbers. The concept of stability is generalized to interval matrices. In this presentation we define D-stability of a matrix and describe the generalization to interval matrices.



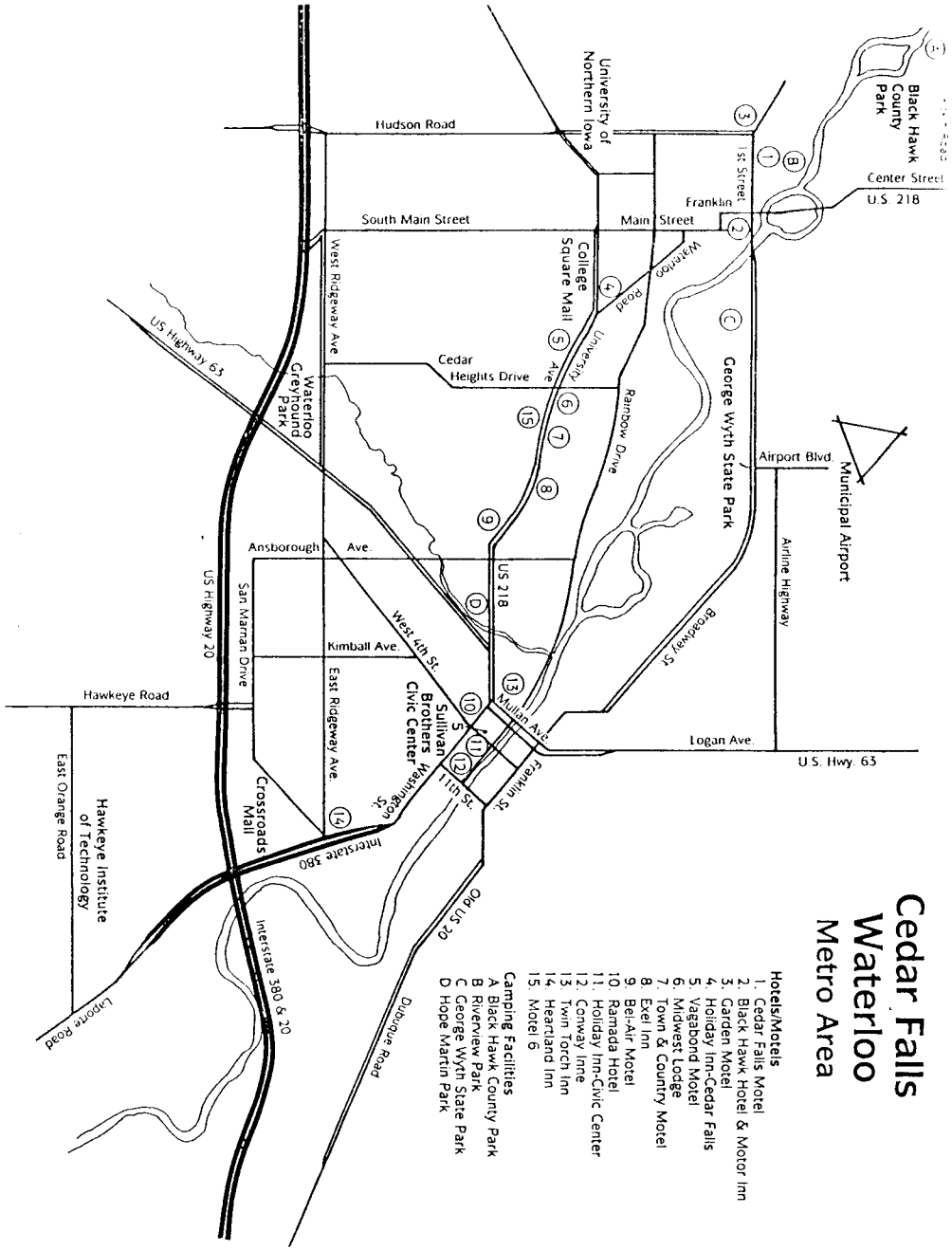



**CAMPUS MAP DIRECTORY** (Building numbers begin at the north end of campus and continue to the south)

**Academic and Activity Areas**
6. Athletic Fields
17. Auditorium Building
27. Baker Hall
41. Biology Research Complex
33. Business Building
51. Center for Energy and Environmental Education
26. Communication Arts Center
15. East Gymnasium & Pool
46. Industrial Technology Center
25. Kamerick Art Building
40. Latham Hall
36. McCollum Science Hall
7. Physical Education Center
16. Physics Building
1. Price Laboratory School
34. Psychology No. 1
32. Russell Hall
29. Sabin Hall
14. Schindler Education Center
30. Seerley Hall
31. Strayer-Wood Theatre
19. West Gymnasium
28. Wright Hall

**Residence and Dining Areas**
11a. Bartlett Hall
2. Bender Hall
5. Campbell Hall
49. College Courts
10. Commons Dining Center
4. Dancer Hall
37. Hagemann Hall
53. Hillside Courts
9. Lawther Hall
42. Noehren Hall
24. President's Home
43. Redeker Center
52. Residence on the Hill (R.O.T.H.)
38. Rider Hall
44. Shull Hall
3. Towers Dining Center

**Administration and Institutional Areas**
33a. Art U
11b. Bartlett Hall-Student Services Center
20. Campanile
50. Center for Educational Technology
10. Commons
55. Conferences & Visitor Services
21. Donald O. Rod Library
18. Ethnic Minorities Cultural & Educational Center
39. Gilchrist Hall
35. Greenhouse
14a. Marshall Center School
22. Maucker University Union
54. Museum
12. Office of Development
48. Physical Plant
47. Power Plant
8. Student Health Center
13. UNI-Dome
45. Visitor & Information Center






## Restaurants in the Cedar Falls Area

**Applebee's**
6301 University Avenue

**The Broom Factory**
115 West Mill
(1st and Main)

**The Brown Bottle**
1111 Center Street

**Danny's Diner**
1525 West 1st Street

**Diamond Dave's**
College Square Mall

**Granny Annie's**
1724 West 31st Street

**Happy Chef**
1409 West 1st Street

**Holiday Inn Greenstreets**
5826 University Avenue
(Located in Holiday Inn)

**Maid-Rite Shop**
116 E 4th Street

**Mainly Lous**
118 Main Street

**McDonald's**
2515 Main Street

**The Other Place**
2214 College Street

**Peppers Grill and Sports Pub**
620 E 18th Street

**Pour Richard's Deli & Pub**
2209 College Street

**Red Lobster**
Black Hawk Village

**Shakey's Pizza**
4728 University Avenue

**Sub City**
1003 West 23rd Street

**SubWay**
6822 University Avenue

**Taco Bell**
6023 University

**Taco John's**
6210 University

**Village Inn Pancake House**
6301 University

**Wendy's Old Fashioned Hamburgers**
Black Hawk Village

## MOTELS IN THE CEDAR FALLS AREA

**Best Western Midwest Lodge**
4410 University Avenue
Cedar Falls, IA 50613
(319)277-1550
1-800-728-9819

**Cedar Falls Motel**
1315 West 1st Street
Cedar Falls, IA 50613
(319)277-1256

**Comfort Inn of Waterloo**
1945 LaPorte Road
Waterloo, IA 50702
(319)234-7411
1-800-228-5150

**Econo Lodge**
4117 University Avenue
Cedar Falls, IA 50613
(319)277-6931

**Excel Inn**
3350 University Avenue
Waterloo, IA 50701
(319)235-2165
1-800-356-8013

**Holiday Inn**
5816 University Avenue
Cedar Falls, IA 50613
(319)277-2230
1-800-HOLIDAY

**Marquis Inn**
4711 University Avenue
Cedar Falls, IA 50613
(319)277-1412

**Town & Country Motel**
4116 University Avenue
Cedar Falls, IA 50613
(319)277-1177



## IN MEMORY

### Basil E. Gillam

Basil E. Gillam, Professor Emeritus of Mathematics at Drake University and long time member of the Iowa Section of Mathematical Association of America, died last November 22.

Basil earned his B.A., M.A., and Ph.D. in mathematics from the University of Missouri in 1935, 1936, and 1940, writing his dissertation in geometry under the direction of Leonard Blumenthal.

He taught mathematics at Drake University from 1944 to 1984. As long-time chair of the department (1944-72), Basil was committed to mathematics, guiding the department in its growth from a one man unit to its present size of ten full time faculty. He actively supported the Kappa Mu Epsilon chapter, started the process leading to the establishment of the computer science major and founded the freshman mathematics contest which now bears his name

Basil served as Chair of the Iowa Section in 1949-50 and as Secretary from 1967-78. In 1987, he received the MAA's Distinguished Service Award—the first Iowa Section honoree. Four other Drake faculty members hired (and trained) by Basil have also served as section Chair. For many years he supported Drake's institutional membership in the Association.

Wayne Woodworth, department chair when Basil retired in 1984, stated that his "actions and attitudes have always been to promote the welfare of the student, his discipline and the University."

## ANNOUNCEMENTS

### Mathematics Awareness Week 1995
**"Mathematics and Symmetry"**
**April 23 - 29 1995**

Mark your calendars now and plan to observe Mathematics Awareness Week in your area, institution, or organization. With the theme of MATHEMATICS AND SYMMETRY, MAW (Mathematics Awareness Week) provides an excellent opportunity to celebrate the beauty and complexity of the mathematical sciences. Please do your part to promote public awareness of mathematics from Sunday, April 23 to Saturday, April 29, 1995.

**********

### The North Central Section of the MAA
### Tenth Biennial Summer Seminar:
**Geometry Across All Dimensions**

| | |
|---|---|
| Featuring: | Professor Tom Banchoff<br>Brown University |
| Dates: | July 31 - August 4, 1995 |
| Location: | The University of St. Thomas<br>Minneapolis Campus |
| Organizer: | Professor Jeff McLean<br>Department of Mathematics<br>University of St. Thomas<br>Box 4304<br>St. Paul, MN 55105 |
| e-mail: | jtmclean@stthomas.edu |
| Phone: | 612-962-5531 |



### Annual Ohio Section Summer Short Course
### Symmetry and Group Theory

**Presented by Doris Schattschneider, Moravian College**
**June 15-17, 1995**
**Held at the University of Dayton in Dayton, Ohio**

This short course will emphasize a visual, hands-on approach to understanding the symmetry groups of two-and three-dimensional objects through the use of computer software, patterns and tilings, polyhedral models, and videotapes. Many abstract concepts encountered in a first course in group theory can be illustrated in a graphic manner using this approach.

Registration fee: $100. Air conditioned dormitory suites consisting of a living room, bath, and 2 bedrooms with 2 single beds in each bedroom are available with a price per night of: $20 (half a double), $40 (single), $80 (suite). A Thursday evening banquet is available for $16; other meals may be purchased in the student union. Registration open until fourty $50 deposits are received, or May 15, whichever is earlier.

For more information, or to register, contact Tom Gantner, Department of Mathematics, University of Dayton, Dayton, Ohio 45469-2316. Phone: 513-229-2511. FAX: 513-229-2566. E-mail: gantner@udavxb.oca.udayton.edu.

**********

### ELEVENTH ANNUAL ALLEGHENY MOUNTAIN SECTION SUMMER SHORT COURSE

The course will be held June 26-30, 1995, and will be given by Fernando Gouvea of Colby College. The following is a description of the course provided by the presenter.

This five-day workshop examines the background work necessary to understand the basic mathematics behind the current work in the proof of Fermat's Last Theorem.

Topics include:

- Modular forms, the easy part (definition, Hecke operators, eigenforms, L-functions)
- Elliptic curves, the easy part definition, minimal Weierstrass form, invariants, group structure, reduction mod p, L-functions
- Elliptic curves, the fancy part (torsion points, Galois representations)
- Modular forms, the fancy part (functional equation for the L-function, the Hecke algebra, Galois representations, the Taniyama conjecture)
- Ribet and Wiles: the Frey curve and its Galois representation, deformation theory and Wiles' theorem

The course will once again be held at Allegheny College. Course registration will be $120 and room and board will be $140 for a total of $260.

For further information and an application, contact:

George Bradley
Department of Mathematics and Computer Science
Duquesne University
Pittsburgh, PA 15282
412-396-5115
BRADLEY@DUQ3.CC.DUQ.EDU

## JOIN THE MATHEMATICAL ASSOCIATION OF AMERICA NOW

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Highest Earned Degree _____ Year Degree Earned _____

Institution Awarding Degree _____

Day/Month/Year of Birth _____

Email address _____

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**Find** the column for your desired combination of MAA journals in the table below. All members receive FOCUS. **Select** the row appropriate for your initial membership period (1 year or 1.5 years) and your status (student or regular). **Circle** your dues in the table. **Write** the amount on the form below.

Journal codes used in the columns of the dues table are:
THE AMERICAN MATHEMATICAL MONTHLY = **M**
MATHEMATICS MAGAZINE = **G**
THE COLLEGE MATHEMATICS JOURNAL = **J**

| **Student Membership** | **M** | **G** | **J** | **M + G** | **M + J** | **G + J** | **M + G + J** |
|---|---|---|---|---|---|---|---|
| 1 year (Jan.-Dec. 1994) | $ 39.00 | $34.00 | $34.00 | $ 47.00 | $ 47.00 | $ 42.00 | $ 55.00 |
| 1.5 years (July 1993-Dec. 1994) | $ 58.00 | $50.00 | $50.50 | $ 69.50 | $ 70.00 | $ 62.00 | $ 81.50 |
| **Regular Membership** | | | | | | | |
| 1 year (Jan.-Dec. 1994) | $ 78.00 | $67.00 | $67.00 | $ 98.00 | $ 98.00 | $ 87.00 | $118.00 |
| 1.5 years (July 1993-Dec. 1994) | $116.00 | $98.50 | $99.50 | $144.50 | $145.50 | $128.00 | $174.00 |

These are **specially discounted rates for new members** provided to help **MAA** reach a wider audience. They are not available to those who have been members for two years. **Student membership** is available to high school and undergraduate students and to students regularly enrolled in graduate study at least half time. Student rates apply to unemployed persons who are seeking employment. **Annual dues include subscription prices as follows:** Regular Member $31 **M**, $20 **J**, $20 **G**, $10 **Focus**. Student members $13 **M**, $8 **J**, $8 **G**, $5 **Focus**. These rates are guaranteed for the indicated periods only.

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