NORTHEASTERN SECTION
OF THE
MATHEMATICAL ASSOCIATION OF AMERICA

Fall 2002 Meeting

November 22 – 23, 2002

FRAMINGHAM STATE COLLEGE
Framingham, MA

Program Chair – Sarah Mabrouk

Local Arrangements Coordinator – Sarah Mabrouk

Local Arrangements Committee – **Michelle Capozzoli, Joyce Cutler, Walter Czarnec, Anita Goldner, Thomas Koshy, Eileen Lee, Sarah Mabrouk, Kenneth Preskenis, Mohammad Salmassi**

About Framingham State College

Framingham State College was founded by Horace Mann in 1839 as the first state-supported institution of public higher education in the United States for the training of teachers. Located in Framingham, Massachusetts, a community 20 miles west of Boston, the College assists in fulfilling the workforce needs of the Commonwealth with an emphasis on the rapidly growing high technology and service region known as MetroWest. The College integrates liberal arts and science programs with a variety of professional programs at the Baccalaureate and Master's levels.

The College offers distinctive programs in:

- Teacher Education and Preparation – Programs to prepare teachers at all levels of Pre-Kindergarten through Grade 12 education.

- Nutrition, Dietetics, Food Technology, Chemistry and Biology – Unique professional programs integrated with foundation sciences.

- Business and its Applications Across the Disciplines – Programs with special preparation for the new technological economy.

- Advanced Technology – Programs infusing information technology throughout the curriculum.

Framingham State College draws the majority of its students from within Massachusetts and the New England region. Traditional college-age students, as well as non-traditional students seeking higher education on either a full- or part-time basis, are served and are accorded opportunities to participate in campus life through a variety of co-curricular programs and activities and to develop the necessary knowledge and skills to compete in a global and technological society.

The Inaugural Northeastern Section NExT
Friday, November 22, 2002
10:00 am - 2:00 pm
Framingham State College
Framingham, MA

The Northeastern Section is inaugurating a Section NExT program for new and relatively new colleagues at this year's fall Section meeting. By providing talks and workshops on issues of interest, opportunities to meet and share ideas with other new colleagues, and an introduction into Section activities, we hope to assist new faculty in their transition from graduate school to professional academic life. We welcome all untenured full time faculty, both those who have and have not been National NExT fellows.

Registration and all sessions will take place in the Fireplace Lounge on the Third Floor (street level) of the D. Justin McCarthy College Center. Lunch will be served in McCarthy's on the Second Floor of the D. Justin McCarthy College Center.

10:00 -10:30 Registration of prospective Section NExT fellows and preliminary information.

10:30-11:30 *Trials and Errors*, by Prof. Charles Vinsonhaler of The University of Connecticut. Prof. Vinsonhaler, who is a former NES/MAA Distinguished Teacher recipient, will share several classroom projects from calculus that worked and some that didn't work, under the hypothesis that we learn more from our failures than from our successes.

11:30-12:00 Discussion of future plans for NES Section NExT.

12:00 -1:00 Lunch

1:00 - 2:00 *Profound Understanding of Fundamental Statistics*, by Prof. Mary Sullivan of Rhode Island College. Prof Sullivan is the chair of SIGMAA in Statistics Education. She will demonstrate hands on activities that explore concepts typically found in a first course in statistics. Participants are encouraged to bring a TI-83+.

3:00 Section Meeting begins.

Registration for the Fall Meeting will take place in the Lobby (street level) of the Athletic and Recreation Center next to Dwight Hall.

Saturday morning
8:00 am New Colleague's Sessions.

The New Colleague's Talks will take place in the Auditorium of Dwight Hall.

If you are interested, please contact Lisa Humphreys of Rhode Island College at LHumphreys@ric.edu. You should also register for the Section meeting by completing the registration form in the Section Newsletter and check off that you will be participating in the Section NExT program. (If you did not receive a Newsletter, indicate that to Lisa.) Note that the Section NExT activities are free.

We also invite all new colleagues to the Section to give a talk during the New Colleague's Sessions on Saturday morning. For more information consult the Section Newsletter or the meeting website http://www.frc.mass.edu/smabrouk/NES_MAA/Fall_2002/program/index.htm. (You can also access this through the MAA website, clicking on Sections and then Northeastern.)

The Changing Face of Mathematics – A Mathematics Sampler

Friday, November 22, 2002

2:30 – 6:00 p.m. Registration/Help Desk . Lobby of Athletic and Recreation Center next to Dwight Hall

2:30 – 3:30 p.m. Executive Committee Meeting . . . . VIP Room, D. Justin McCarthy College Center

3:00 – 5: 00 p.m. Welcome Refreshments . Lobby of Athletic and Recreation Center next to Dwight Hall
Sponsored by the McAuliffe/Challenger Center, Framingham State College

3:00 – 3:50 p.m. Ray Griffin, Framingham State College . Forum, D. Justin McCarthy College Center
"*Mission Mathematics*: Linking Aerospace and the NCTM Standards"

4:00 – 4:50 p.m. Laura L. Kelleher, Massachusetts Maritime Academy . . . . . Dwight Auditorium
2002 NES/MAA Distinguished Teacher Award Winner
"Discrete Mathematics in the Schools"

5:00 – 5:50 p.m.

- Open-House/Tour of McAuliffe/Challenger Center
- Student Papers . . . . . Hemenway Hall 212, 305, 307
- Michelle Hopkins Capozzoli, Framingham State College . . Hemenway Hall G01
  Workshop*: **"Using the Power of JMP to Teach Statistics"**
- Jeff A. Libby, United States Military Academy. . . . . Hemenway Hall 208
  Bart D. Stewart, United States Military Academy
  Workshop*: **"Promoting Visual Cues with '*EXCEL*'lent Tools"**

6:00 – 6:40 p.m. Reception with cash bar and hors d'oeuvres
Hosted by the Development and Alumni Relations Office, Framingham State College
McCarthy's, D. Justin McCarthy College Center

6:45 – 8:00 p.m. Banquet . . . . . Forum, D. Justin McCarthy College Center

8:00 – 8:10 p.m. Opening Remarks. . . . . Dwight Auditorium

8:10 – 9:00 p.m. **Christie Lecture**: Carl Pomerance, Bell Laboratories . . . . . Dwight Auditorium
"Primal Screens"

9:00 – 9:30 p.m. Coffee and Dessert Reception . . . . . 42 Adams Road
Hosted by The Independent Alumni Association

STUDENT PAPER SESSIONS
Friday, November 22, 2002

Session I – Hemenway Hall 212

5:00 - 5:10 p.m. **Relating Cellular Automata to Determining Patterns in Brain Functions**
Lisa Balducci, Framingham State College

Can brain functions be transposed to the computational model of cellular automata? The fundamental concept of CAs has been used to predict weather patterns; to explain the Game of Life, which captures life, birth, growth, evolution, and death; and in the Ant program, which displays the simulation of an ant to analyze the varied patterns marked out by its wanderings. This paper will present these examples, relate them to brain functions, and briefly survey the history of cellular automata.

5:15 - 5:25 p.m. **Speech Recognition: Theory and Design**
George Mechael and Azmy Sukkoor, Framingham State College

Speech recognition is a process of converting an acoustic signal to text. The knowledge-driven model requires word and syntax level knowledge to identify a word from the sound. An alternative approach is based on auditory perception and modeled after humans' tendency to automatically categorize speech sounds. Unlike knowledge driven systems, phonetic recognition is user independent. This paper will discuss speech input, prefiltering, feature extraction, comparison and matching techniques, and the basic concepts in probability theory used in speech recognition.

5:30 - 5:40 p.m. **Neural Networks and Parallel Computing**
Amuche Onyemelukwe, Framingham State College

Bottom-up theorists in artificial intelligence seek to build electronic replicas of the human brain's complex networks of neurons. This paper explains that approach and relates the workings of the human mind to Boolean logic. It discusses artificial neural networks as computational prototypes that implement simplified models of their biological counterparts. Three levels of such network units are presented, along with the notion of learning as the alteration of the effectiveness of synapses that join neurons, and the calculation of error derivatives by the backpropagation algorithm. A review of the contributions of McCulloch and Pitts to neural-network theory, using earlier theoretical work by George Boole, is included.

5:45 - 5:55 p.m. **Taylor, Maclaurin, and Polynomial Approximations**
John Meany, Framingham State College

Taylor and Maclaurin made contributions to mathematics beyond those of series and function approximations. I will present a brief history of their contributions to mathematics as well as a discussion of those who contributed to the development of polynomial approximations.

Session II – Hemenway Hall 307

5:00 - 5:10 p.m. **Maximizing Products of Partitions**
Brian Bayerle, Providence College

For any positive integer k, we define a partition of k to be a set of positive integers whose sum equals k. We define the product of a partition to be the product of the elements of the set. A maximized partition is the partition of k whose product is maximal among all partitions of k. This project investigates properties of products of partitions, including maximized products, and maximized products with respect to the size of their partition. General rules, equations, and algorithms will be discussed. Results include partitions extended to the rational and real positive numbers.

5:15 - 5:25 p.m. **The Babylonians Had It First**
Mike Lopez, Bates College

This paper will focus on the Babylonian culture's derivation of floating point arithmetic in ancient history. I will discuss the basics of sexagesimal notation and how the Babylonians came up with one of the world's most important and fascinating number systems. I will conclude with how this culture found a close approximation to the square root of two, something that more "civilized" cultures down the road struggled to do.

5:30 - 5:40 p.m. **Complex Numbers and Geometry**
Rebecca Keleher, Eastern Connecticut State University

The topic of my senior honors thesis is complex numbers, specifically, their use in proving geometric theorems. This method, one that is not typically used in the United States, is useful in creating simple, yet elegant, proofs. I intend to present the portion of my thesis that involves areas of figures and rotation of vectors. The purpose of my thesis is to bring attention to this technique as a supplemental method of geometric proof that can be taught at both high schools and universities. Technology can also be used a s a method of instruction with this approach.

Session III – Hemenway Hall 305

5:00 - 5:10 p.m. **Periodic Doubling Bifurcations of a Periodically Forced Biological Oscillator**
Jason White, Bates College

According to Glass, et al. (1984), there is convincing evidence that certain types of arrhythmias exhibit chaotic dynamics. Using techniques including finite difference equations, Fourier transforms and Poincare maps, the heartbeats can be modeled and problems can be predicted. When someone with a heart problem exercises the heart rate normally hastens, however occasionally the heart starts beating at abnormal intervals, and chaos has set in. Experimental results have been successful in obtaining results that fit known complicated mappings such as Poincare maps. In this paper I explore the mathematics behind chaotic cardiac rhythms and discuss how the mathematics can aid doctors and researchers in their study of the heart.

5:15 - 5:25 p.m. **Nonlinear Problems Inspired by the Millennium Suspension Bridge**
Ron Pepino, University of Connecticut

In the beginning of the year 2000, a new pedestrian suspension bridge was opened in England in order to celebrate the millennium. There was a large party held on the bridge for its opening. The bridge started to exhibit rather alarming oscillations in the horizontal plane. This puzzled many, and the bridge was shut down two days after its opening. In this talk I will present the work of Joe McKenna, Cory Merow, and myself on just how such an occurrence could have happened and why the possibility of the episode might have been overlooked. The result of running several numerical experiments showed that the peculiar geometry of the system might be the cause of unpredictable nonlinear phenomena such as solution-dependent initial conditions, which (along with a coupling of the degrees of freedom) might have been overlooked in the engineer's models. The method for extracting information from our derived nonlinear system that represents the Millennium Bridge will be explained and the data from the numerical experiments will be presented to support our claim.

5:30 - 5:40 p.m. **New Variables in the Coupon Collector's Problem**
Erin LeDell, Trinity College

The Stein-Chen Method is a valuable and powerful technique for approximating the distribution of a random variable. Using this method, one can establish an upper bound for the error. This error defines the accuracy of the approximation.
We have devised suitable "couplings" which allow us to apply the Stein-Chen Method to several random variables defined in the Coupon Collector's Problem. Further, our results have shown that the distribution of these variables is approximately Poisson.

The Changing Face of Mathematics – A Mathematics Sampler

Saturday, November 23, 2002

8:00 a.m. – 5:30 p.m.	Registration/Help Desk . Lobby of Athletic and Recreation Center next to Dwight Hall
8:00 – 8:50 a.m.	New Colleagues Talks . . . . . Hemenway Hall 305, 307
9:00 – 9:50 a.m.	Dorothy Wallace, Dartmouth College . . . . . Dwight Auditorium **"Sharing Uncommon Ground: How Will The Case For Numeracy Affect The Mathematics Community"**
9:00 – 10:30 a.m.	♦ Mary Ann Connors, Westfield State College. . . . . Hemenway Hall 307 Workshop*: **"Statistics With The TI-83 Plus (TI-83 Plus Silver Edition)"**
	♦ Tom Lee, Waterloo Maple Inc. . . . . Hemenway Hall 208 Workshop*: **"Maple In The Academic Environment: A Practical Introduction To Mathematical Technology"**
10:00 – 10:30 a.m.	Break . . . . . Lobby of Athletic and Recreation Center next to Dwight Hall
10:30 – 11:20 a.m.	Emma Previato, Institute For Advanced Study . . . . . Dwight Auditorium **"Algebra, Geometry And Physics: The Dynamics Of Adding And Multiplying"**
11:30 – 12:00 p.m.	Business Meeting . . . . . Dwight Auditorium
12:00 – 1:00 p.m.	Lunch. . . . . Forum, D. Justin McCarthy College Center
1:00 – 1:50 p.m.	Thomas Koshy, Framingham State College . . . . . Dwight Auditorium **"Fibonacci, Lucas, and Graphs"**
2:00 – 2:50 p.m.	Gilbert Strang, Massachusetts Institute of Technology . . . . . Dwight Auditorium **"Pascal Matrices"**
2:50 – 5:30 p.m.	Refreshments . . . . . Lobby of Athletic and Recreation Center next to Dwight Hall Sponsored by the Office of Career Services, Framingham State College

Please help yourselves before you go to your choice of workshop or panel discussion.

Note: The technology workshops and the panel discussions will be held in Hemenway Hall.

3:00 – 3:40 p.m. Panel Discussion . . . . . Hemenway Hall 212
"What Can I Do With A Mathematics Major?"
Organizer/Moderator – Sarah Mabrouk, Framingham State College
Panelists – Jonathan DeVicarius, Student, Framingham State College
Emily Blood, Dana Farber
Michelle Capozzoli, Framingham State College
Cathy Dufresne, The Segal Company
Paul Dufresne, Quincy Medical Center
Aaron Gong, Natick Labs
Earl Hopkins, ValSource, Inc.

3:45 – 4:30 p.m. Panel Discussion . . . . . Hemenway Hall 212
"Why Should I Go To Graduate School?"
Organizer/Moderator – Sarah Mabrouk, Framingham State College
Panelists – Emily Blood, Dana Farber
Michelle Capozzoli, Framingham State College
Cathy Dufresne, The Segal Company
Paul Dufresne, Quincy Medical Center
Suzanne Szwarc, Graduate Student, Harvard School of Public Health

3:00 – 4:30 p.m.

- Bonnie Gold, Monmouth University . . . . . Dwight Auditorium
  Workshop: **"Assessment Of Student Learning In Undergraduate Mathematics"**

- Mary Ann Connors, Westfield State College. . . . . Hemenway Hall 307
  Workshop*: **"Calculus With The TI-89/TI-92 Plus/Voyage 200"**

- John Lutts, University of Massachusetts – Boston .. .. Hemenway Hall 208
  Workshop*: **"*The Geometer's SketchPad (GSP4)*: A Tool For Exploration, Conjecture and Experiment in High School Geometry"**

4:30 – 5:30 p.m. Contributed Papers. . . . . Hemenway Hall 115, 101A, 101B, 305, 307

* Enrollment for technology workshops is limited, in general, to 25. Please check at the Registration/Help Desk to determine if space is available.

New Colleagues Sessions
Saturday, November 23, 2002

Session I – Hemenway Hall 307

8:00 – 8:25 a.m. **An Introduction to Remotely Projective Planes**
Barbara Leasher, Roger Williams University

Abstract: Projective remoteness planes and their alternative coordinate systems will be introduced in the context of other Barbilian planes and the classical real projective plane.

8:30 – 8:55 a.m. **A Radical Structure for Some Rings with Partial Identities**
Karen Stanish, Keene State College

Abstract: I will introduce the idea of rings with partial identities, define some specific rings, and show that these rings have a radical structure.

Session II – Hemenway Hall 305

8:00 – 8:25 a.m. **Searching for Synergy**
Michelle H. Capozzoli, Framingham State College

Abstract: In 1990, Greco introduced the Universal Response Surface Approach (URSA) to assess drug interactions. This presentation will introduce and demonstrate URSA.

8:30 – 8:55 a.m. **Saving Satellites**
Meredith L. Greer, Bates College

Abstract: Space shuttles and active satellites prefer not to hit other items in space. An exciting connection between ellipsoids and eigenvalues helps to prevent such collisions.

CONTRIBUTED PAPER SESSIONS
Saturday, November 23, 2002

Session I – Hemenway Hall 115

4:30 – 4:45 p.m. **Attitudes Toward Statistics and Course Achievement Among Japanese and American College Students**
Philip P. Amato and Eiki Satake, Emerson College

This study investigated the relationship between attitudes toward statistics (ATS) and course achievement (CA) among Japanese and American college students majoring in communications studies. Seventy-two students participated in the study. The Japanese sample consisted of 20 male and 20 female students from a small liberal college in Tokyo. The American sample included 9 males and 23 females from a small, Northeastern college specializing in communication arts and sciences.

Statistics attitudes was measured using Wise's (1985), Attitudes Toward Statistics (ATS), consisting of twenty-nine, 5-point, Likert-type scales (strongly agree to strongly disagree); a Japanese version was developed by the authors. The instrument was administered at the outset and at the conclusion of the course. The final course grade of the participants, using a 9-point scale (A = 9, A- = 8, B+ = 7, ... F = 0) served as the measure of achievement. Data analyses include factor analysis and reliability estimates for the ATS and independent t tests and correlation analyses of pre-posttest measures.

4:50 – 5:05 p.m. **Introducing Statistical Concepts Using Interactive Excel Worksheets**
Laura McSweeney , Fairfield University

In statistics education, the trend has moved to using technology to help students develop a deeper conceptual understanding of statistics. In this presentation I share how Microsoft Excel can be used as more than a computational tool by creating interactive statistical worksheets that students can use for exploratory learning. Students can also use these dynamic worksheets to make and test conjectures, which again brings learning to a higher level. Examples of interactive Excel worksheets and sample lessons will be presented. The topics include:
· Comparing descriptive statistics and seeing the affects of outliers and skewness on the measure of central tendency
· Exploring the binomial, normal and t-distributions
· Exploring linear regression and the affects of outliers.

5:10 – 5:25 p.m. **Interactive Course Syllabi**
Ronald W. DeGray, Saint Joseph College

Course syllabi became popular during the 1970s. From the beginning, their usefulness has been rather limited and often have had unfulfilled objectives. Because of technology and the Internet we can now evolve course syllabi to higher practical levels. I will demonstrate an interactive working syllabus for courses in probability and statistics. For an example interactive syllabus, refer to http://www.sjc.edu/rdegray/Math251F02/WkSylindex.html

Session II – Hemenway Hall 101B

4:30 – 4:45 p.m. **Learning Disabled Students and Math Word Proble**ms
Janet M. Pfeiffer of Upper Arlington High School (Ohio), and
Kenneth J. Preskenis of Framingham State College

This presentation describes the use of elementary math word problems with high school special education students. Each Friday is designated "Word Problem Day", and (just as last year) during this second year, the participants readily exclaim to their peers that it is not just Friday, but it is "Fun Friday". The unexpected success of this program not only confirms the charm of word problems for many people, but also conjures up a new look at the richness contained in word problems and makes one wonder how this richness can be dispersed. The talk will explain how students become labeled as "learning disabled" and will suggest reasons why such students find solving word problems an enjoyable and pleasantly challenging experience.

4:50 – 5:05 p.m. **The Long Exact $(\overline{\pi}, Ext_{\Lambda})$ -Sequence in the Second Variable and the Long Exact $(\overline{\pi}, Ext_{\Lambda})$ -Sequence of a Triple**
C. Joanna Su, Providence College

In this talk, we will address the work that has been done either by Professor Peter Hilton or by myself, in the homotopy theory of modules, and what might be pursued in the future.

5:10 – 5:25 p.m. **The Helmholtz Classification of Vector Fields and the Maxwell Equations**
Domina Eberle Spencer, University of Connecticut, and
Uma Shama, Bridgewater State College

Helmholtz has shown that vector fields can be fitted into four classes depending on whether or not the divergence and the curl of the vector field vanishes. The thermal field, the gravitational field, the electric field, the magnetic field and the hydrodynamic field all fit nicely into this classification scheme. However, the electromagnetic field does not fit into this scheme. Instead, it is characterized by the four Maxwell equations. It will be pointed out that two of the Maxwell equations are vector identities. It will be shown that the electromagnetic field can alternatively be characterized by a single force field which fits into the Helmholtz classification scheme quite perfectly.

Session III **– Hemenway Hall 101A**

4:30 – 4:45 p.m. **"Mathematics and War": a First Year Seminar**
Bonnie Shulman, Bates College

I will give a brief overview of a course I designed for first year students that is writing-intensive, satisfies the quantitative requirement, and integrates STS (science, technology and society) issues. Here is the course description from the catalog: "From Archimedes, who designed ingenious devices to help defend Syracuse against a siege by the Romans in the 3rd century B.C.E., to John von

Neumann and many others who worked on the Manhattan Project in World War II, mathematicians have played an important role in supporting their country's war effort. In this course we explore what happens when we apply mathematical thinking to situations of conflict. Can mathematical understanding help us to fight wars more effectively? Could mathematical models help us prevent wars? We investigate and critically assess the power and the limitations of applying mathematical techniques to study war and peace." The mathematical content includes Game Theory and Finite Difference Equations. I am happy to share materials (syllabus, reading list, assignments) with anyone who is interested.

4:50 – 5:05 p.m. **Are we far enough offshore to pass this headland safely?**
A mathematician's look at a 'quick and dirty' navigational trick.
Joel S Silverberg, Roger Williams University

In a brief article prepared for boaters by BoatUS, Don Casey describes how to use a hand-bearing compass to determine how far offshore you are.[How-To Tip #911027, BoatUS. Also online at http://www.boatus.com/boattech/casey/27.htm]

Take the time (in minutes) that it takes a compass bearing on a shoreline feature to change by the same number of degrees as your boat speed is in knots (nautical miles per hour). This time (in minutes) is the same as the distance to the offshore feature (in nautical miles).

Say what? Angles in degrees, not radians, giving me information about distances? Speed in miles per HOUR and time in MINUTES, giving me distance in MILES? What a bizarre collection of units! Can this method possibly work at all?

The mariner asks, "Can I use this method safely?" The mathematician answers, " It depends." A mathematical analysis of the geometry of the situation and the algorithm described reveals that the method can not possibly be correct under all conditions. In fact it is not precisely correct under any conditions, but it can provide a useful approximation under certain conditions. Since the safety of a vessel and the people onboard depends upon an accurate estimate of the distance offshore, the mariner should be very interested in knowing under what conditions and to what extent he or she can rely on the method described.

5:10 – 5:25 p.m. **Pattern Recognition and Sequences of Natural Numbers**
Christopher Aubuchon, Johnson State College

Quite often in the teaching of abstract mathematics (particularly number theory) we instruct our students to: (1) List empirical evidence, (2) identify a pattern and generate a hypothesis, and (3) prove this hypothesis true in the general case. While recently teaching an undergraduate course in number theory, I discovered that the above outline under-emphasizes the importance of not only identifying the pattern, but being able to communicate it in mathematical terms. This talk will highlight two examples (stemming from sequences of natural numbers) that challenge the student to produce a careful mathematical formulation of patterns that seem obvious to the naked eye, and yet elude immediate precise description.

Session IV – Hemenway Hall 307

4:30 – 4:45 p.m. **Notes on the Structure of $P\Sigma_n$ - Part I**
Vince Ferlini, Keene State College

The pure symmetric automorphsim group $P\Sigma_n$ consists of those automorphisms of the free group on n generators that map each standard generator to a conjugate of itself. We can interpret $P\Sigma_n$ as a group of motions of n unknotted unlinked circles in R^3 . This talk will provide the background information about group presentations, free groups, and automorphisms to understand $P\Sigma_n$.

4:50 – 5:05 p.m. **Notes on the Structure of $P\Sigma_n$ - Part 2**
Erin Corman, Keene State College

This talk is based on a research project done by KSC student Erin Corman as part of an REU experience at James Madison University during the summer of 2002.

This project involved the derivation of presentations for kernels of homomorphisms $\theta : P\Sigma_n \rightarrow < t >$ (where $< t >$ is the infinite cyclic group) in which each generator is mapped into the identity or t . These kernels necessarily contain the commutator subgroup of $P\Sigma_n$. When the kernel is finitely generated, a generating set is derived. These ideas are then studied in the context of the graph of groups associated with $P\Sigma_n$.

5:10 – 5:25 p.m. **Generalized Metric Spaces via Neighborhoods**
Mike Cullinane, Keene State College

Neighborhood assignments and weak neighborhood assignments will be employed to characterize certain topological spaces that can be generated by distance functions that do not necessarily satisfy the triangle inequality.

Session V – Hemenway Hall 305

4:30 – 4:45 p.m. **A Revision to Michael Prasse and Peter Rittgen's "Interactive Protocol"**
Jonathan Brinker, Framingham State College

Interactive Automata can already be proven to be more powerful than the Turing machine in a sense of computability. According to Peter Wegner, the Interactive Model can be expressed by a set of infinite number of processes. On the other hand Turing machines can only be described by sets of finite size thus limiting its power of computation. There is however a way to allow a system of two Turing machines to behave in an interactive sense. Michael Prasse and Peter Rittgen have introduced an "Interactive Protocol" which describes a system of two Interactive Turing machines that can be modeled exactly the same as Interactive Automata. However valid their protocol may seem, a better model can be conceived by replacing the two Interactive Turing machines within the protocol with basic Turing machines. By doing this, a more efficient, simpler, and

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comprehensible model can be realized to help show that a system of Turing Machines have equal power of computation to Interactive Automata.

4:50 – 5:05 p.m. **Minimization of Interactive Transition Systems**
David Keil, Framingham State College and University of Connecticut, and
Dina Q Goldin of University of Connecticut

This work introduces notions of minimality for the models of sequential interactive computing known as interactive transition systems (ITSs) and persistent Turing machines (PTMs). We extend the Myhill-Nerode Theorem to deterministic versions of these models. In doing so, we show that equivalence and minimality hierarchies of interactive machines collapse, to different degrees, under conditions of determinism, nonredundancy, and amnesia. Furthermore, we produce some computability results for the minimality functions described.

5:10 – 5:25 p.m. **Monte Carlo Queuing Simulation Implementation as Turing Machines and Finite State Automata**
William F Heess Jr., Marlborough MA

The "Standard Model" for Monte Carlo simulations of queuing systems requires placing arrivals on a queue. Since the number of arrivals to the system is, in general, unknown, the number of items in the queue is, in theory, unbounded. This requires unbounded storage for the queue. Since the First In First Out nature of the queue precludes use of a Push Down Automaton, the equivalent of a Turing Machine is needed.

This paper presents a scheme to perform Monte Carlo simulations, and obtain time data without using a queue, which permits it to be implemented as a finite state machine. It discusses limitations introduced by this scheme, which include the loss of queue length information and an alternative scheme that obtains queue lengths, at the price of losing timing data. Finally I address the question of whether running these two schemes with identical pseudo-random number sequences, obtains identical or different sequences of events.

Michelle Hopkins Capozzoli
Framingham State College

Workshop: Using the Power of JMP to Teach Statistics

Abstract: SAS-JMP is a statistical software package produced by SAS. With its flexibility and easy interface, it can be a powerful teaching tool in the classroom. This workshop will give an introduction to the software, as well as how it can be used to further advance the teaching and learning of statistics. Specific examples will be presented.

Bio: Dr. Capozzoli is an assistant professor at Framingham State College. After receiving her Ph.D. from the University of New Hampshire, she worked at Bristol-Myers Squibb as a Biostatistician in their Non-Clinical Department. As a member of the Connecticut Chapter of the American Statistical Association, she has given presentations at several seminars for teaching AP statistics. Dr. Capozzoli has also published articles in the areas of interrater agreement, accelerated life testing, and Bayesian analysis.

Mary Ann Connors
Westfield State College

Workshop: Statistics with the TI-83 Plus (TI-83 Plus Silver Edition)

Abstract: The purpose of this workshop is to present several examples that illustrate how the use of a handheld TI-83 Plus can enrich and enhance the teaching and learning of statistics. Some of these examples will provide the opportunity for student active learning.

Workshop: Calculus with the TI-89/ TI-92 Plus/ Voyage 200

Abstract: The purpose of this workshop is to present several examples that illustrate how the use of a handheld computer algebra system (TI-89/ TI-92 Plus/ Voyage 200) can enrich and enhance the teaching and learning of calculus. Some of these examples will provide the opportunity for student active learning.

Bio: Mary Ann Connors is a faculty member in the Department of Mathematics and Program Director of Secondary Mathematics Certification at Westfield State College http://www.wsc.ma.edu/math/faculty/connors/mconnors.asp. She is a former member of the Department of Mathematical Sciences at the United States Military Academy at West Point.

She is a faculty consultant for the College Board and Educational Testing
Service and a Texas Instruments College Short Course Instructor. She served as a member of the AP Calculus Development and Test Writing Committee. She is a member of the Phi Delta Kappa Fraternity in Education and several national, regional and local mathematical organizations. She is a member of the Editorial Panel of the 2005 Yearbook of the National Council of Teachers of Mathematics, *Technology-Supported Mathematics Learning Environments* (http://www.nctm.org/publications/yearbook.htm).

Dr. Connors has presented Advanced Placement (AP) Calculus Calculator Workshops, National Science Foundation Funded workshops on Calculus Reform using appropriate technology, and the Texas Instruments/Ohio State Technology Short Courses. She has also presented workshops on fractals at national and international meetings. Her publications include numerous articles, papers, and a fractal project on the World Wide Web (http://www.math.umass.edu/~mconnors/fractal/fractal.html). She was

the guest on the call-in talk radio show *Math Medley* entitled "Using Technology to Teach Mathematics" (http://www.csam.montclair.edu/~kenschaft/WALEsched.html).

Dr. Connors is married to Edward Connors, Professor Emeritus of Mathematics at the University of Massachusetts Amherst. They have two children.

Bonnie Gold
Monmouth University

Title: Assessment of Student Learning in Undergraduate Mathematics

Abstract: The SAUM Project ("Supporting Assessment in Undergraduate Mathematics"), sponsored jointly by the NSF and the MAA, has as its goal the improvement of student learning in mathematics through an increased understanding and use of effective assessment methods. This session will introduce you to the SAUM project, give an overview of assessment, share some assessment activities departments in the section are engaging in, and give you a chance to ask questions you have about assessment, as well as to share with others what you are doing.

Bio: Bonnie Gold is chair of the Mathematics Department at Monmouth University in New Jersey. She has helped the two departments she has been part of develop their assessment programs, and is the editor, with Sandra Keith and William Marion, of Assessment Practices in Undergraduate Mathematics, MAA Notes # 49. She has helped run several workshops on assessment. More generally, she has been involved with the MAA's efforts to improve teaching at the college level in a variety of ways, including chairing the Committee on the Teaching of Undergraduate Mathematics and editing MAA Online's Innovative Teaching Exchange.

Ray Griffin
Framingham State College

Title: *Mission Mathematics:* Linking Aerospace and the NCTM Standards

Abstract: Mission Mathematics is a collaborative project of the National Aeronautics and Space Administration and the National Council Teachers of Mathematics. The project links the science of aeronautics to the standards NCTM has developed for all aspects of mathematics education. The mathematics in the different activities in this K to 12 program does not represent the entirety of an elementary, middle school or high mathematics program. Rather, the program involves strategically selected aerospace topics that illustrate how this important science context can develop mathematical thinking using instruction based upon the NCTM Standards documents: *Curriculum Mathematics, Professional Standards for Teaching Mathematics,* and *Assessment Standards for School Mathematics.*

The *Mission Mathematics* presentation will provide participants with an overview of this program with selected examples from each of the three grade division: elementary, middle school and high school.

Bio: Ray Griffin is the Director of the *Christa Corrigan McAuliffe Center for Education and Teaching Excellence.* Prior to Framingham State College, Ray taught mathematics in Massachusetts, the Philippine Islands and the United Kingdom. Ray's career also includes employment at System Engineering Laboratories and Digital Equipment Corporation as a mathematics software application Senior Product Manager.

Laura L. Kelleher
Massachusetts Maritime Academy

Title: Discrete Mathematics In The Schools

Abstract: In *Principles and Standards for School Mathematics* the National Council of Teachers of Mathematics recommends including combinatorics, iteration and recursion, and vertex-edge graphs as an integral part of the school mathematics curriculum. Many teachers of school mathematics have not previously studied these topics or have not considered ways of presenting this material to students in K-12 classrooms. Examples from *The Leadership Program in Discrete Mathematics* will be used to demonstrate ways of reformulating these topics to instill in both teachers and their students an understanding of concepts and applications of discrete mathematics.

Bio: Laura Kelleher is the recipient of the *Award for Distinguished College or University Teaching of Mathematics* from the NES/MAA for 2002. She received her Ph.D. in mathematics from Northeastern University, writing her dissertation in the field of graph Theory. She teaches mathematics and chairs the Department of Science and Mathematics at Massachusetts Maritime Academy where she received the Academy's first *Award for Teaching Excellence*. She served as Chairperson and as Secretary/Treasurer for the Northeastern Section of the MAA and has been a member of several national MAA committees. In 1997 she was a co-recipient of the *Certificate for Meritorious Service* from the NES/MAA. She enjoys exploring applications of graph theory and combinatorics with K-8 teachers through Rutgers University's *Leadership Program in Discrete Mathematics*.

Thomas Koshy
Framingham State College

Title: Fibonacci, Lucas, and Graphs

Abstract: The palindromic year 2002 marks the 800th anniversary of the well-known rabbit problem by Fibonacci. Closely related to Fibonacci numbers, which occur in such diverse areas as art, architecture, biology, chemistry, electrical engineering, geometry, graph theory, music, origami, poetry, physics, physiology, psychology, and neurophysiology, are the Lucas numbers. Fibonacci and Lucas numbers are a source of great fun and excitement; they stimulate intellectual curiosity and sharpen mathematical skills, such as pattern recognition, conjecturing, proof techniques, and problem-solving; and they continue to be a fertile ground for creative amateurs and mathematicians alike.

This talk presents a few delightful applications of Fibonacci and Lucas numbers to combinatorics and graph theory. A minimal exposure to graph theory would be helpful, but not required.

Bio: Thomas Koshy received his B.Sc. in Mathematics and Physics and his M.Sc. in Mathematics from the University of Kerala, India and his Ph.D. with specialization in Algebraic Coding Theory at Boston University under the direction of Edwin Weiss. Tom has written numerous journal and newspaper articles and five textbooks. His most recent textbooks are *Elementary Number Theory With Applications* published by Academic Press and *Fibonacci And Lucas Numbers With Applications* published by John Wiley & Sons. Tom is a frequent invited speaker for the National Council of Teachers of Mathematics (NCTM) and the New England Mathematical Association of Two Year Colleges (NEMATYC). He has given numerous presentations to high schools, colleges, and universities in the United States and in India. Tom has taught at Framingham State College for thirty years, serving on a variety of committees as well as serving as Chair of the Mathematics Department. His honors and awards include the College's Distinguished Service Award and the College Citation for Meritorious Service Award. Tom has been an active volunteer at the Salvation Army Miracle Kitchen in Framingham for sixteen years, done the Walk For Hunger in Boston for seventeen years, and volunteered for the WGBH Phonathon for five years.

Tom Lee Ph.D.
Vice President, Waterloo Maple Inc.

Workshop: Maple In The Academic Environment: A Practical Introduction To Mathematical Technology

Abstract: The Maple software system has been an integral element of college mathematics education and research for over a decade. It's unique hybrid character as an educational tool and a general productivity tool has generated an immense user base that spans the world and many disciplines. Ironically, it is these qualities that sometimes pose challenges for new users in their attempts to introduce the software to their classroom or workplace. This workshop offers a hands-on introduction to the basic techniques and applications of the Maple system in the academic environment. Specific topics include:

Part I - Education (one hour)

- general introduction to the Maple environment
- resources for the teacher
- the pedagogy of the Maple-based curriculum

Part 2 - General (30 minutes)

- Maple as a productivity tool
- future directions for Maple products

Bio: Dr. Tom Lee is Vice President of Marketing, and Executive Product Director for Waterloo Maple Inc. He directs the company's product and corporate marketing activities and also is a leading influence in the design and evolution of the Maple product line. Dr. Lee has been with Waterloo Maple since 1989. He earned a Ph.D. in Mechanical Engineering, an M.A.Sc. and B.A.Sc. in Systems Design Engineering, from the University of Waterloo. His past research interests include application of technology in engineering education, system simulation, and computer aided design. Dr. Lee also serves on the Board of Directors of Renison College in Waterloo, Canada.

John A. Lutts
University of Massachusetts – Boston

Title: *The Geometer's SketchPad (GSP4)*: A Tool for Exploration, Conjecture and Experiment in High School Geometry

Abstract: NCTM in the several versions of its *Standards* has repeatedly called for changes in the way geometry is taught in high school. It has asked for a decreased emphasis on the presentation of geometry as a complete deductive system and an increase in fostering both open exploration and conjecturing and an increase in attention to transformation geometry. The *Geometer's SketchPad* is an ideal tool to use in pursuing such interests. In this presentation I shall introduce the basics of GSP4 and outline several explorations on which students could embark and invite the audience to try the software out for themselves and/or to share their own experiences with it. (If there is time, I shall also hint as to how this software might be used at the college level.)

Bio: John Lutts received his BS in mathematics from Spring Hill College, Mobile , Alabama in 1957, his MA in mathematics from the University of Pennsylvania in 1959 and his PhD in mathematics from the University of Pennsylvania in 1961. He was a lecturer in mathematics at Loyola College, Baltimore, Maryland from 1964 to1966. He was an Asst. Prof. in mathematics at the University of Massachusetts at Boston from 1966 to 1970. Since 1970, he have been an Assoc. Prof. in mathematics at the University of Massachusetts at Boston. He has been a member of MAA since 1957. His fields of interest are:

approximation theory, Lie Groups, history of mathematics, and the training of future high school teachers in mathematics.

His interest in *The Geometer's SketchPad* came about while working on sabbatical in Fall 2001 with the mathematics faculty at Dorchester High School, an inner city high school in Boston. While there, he was asked to provide a series of workshops on the use of this software as part of the professional development efforts of that faculty.

Jeff A. Libby
United States Military Academy

Bart D. Stewart
United States Military Academy

Workshop: Promoting Visual Cues with "*EXCEL*"lent Tools

Abstract: With modern advances, technology continues to weave itself within our classrooms. Such advances, while certainly able to enhance a student's ability to learn objectives and concepts, come with an associated cost – specifically, the responsibility of learning some non-user friendly computer software. In an effort to reduce the software learning curve, it is possible to create a totally interactive environment that rivals some popular Java Applets in mere minutes using nothing more than Microsoft Office. In this talk, we intend to share the interactive tool building process and its effect in and outside the classroom.

Why an interactive environment? Our main reason was the fact that students learn through repetition, taking notes, and audio and visual cues. The challenge for us, as instructors, was to prepare lessons that incorporate each of these methods. Rather than observing static charts/graphs and listening to the instructor, students can enter a dynamic environment that promotes opportunity for self-exploration and discovery. The exploration fosters a deeper understanding of material rather than simply resting on the periphery.

With the "point and click" technology, our students are able to investigate a myriad of Discrete Dynamical System behaviors, both linear and nonlinear, through observing the effect of varying parameters in a numerical and graphical fashion simultaneously. Add-ins also exist for analytic solutions as well. Creating this type of environment not only adds new dimension to students' focus, creativity, and willingness to explore, but it also presents an easy, adaptable tool for all of us that remains only a "point and click" away.

You may view samples at http://www.dean.usma.edu/math/people/stewart/interactive_tools.htm.

Bios: Captain Bart Stewart teaches undergraduate courses in discrete dynamical systems, freshman calculus, and introduction to differential equations. He is a junior faculty member of the Department of Mathematics Sciences at the United States Military Academy. He served for nine years as a personnel officer in the United States Army. He holds a Bachelor of Science degree in Mathematics from the United States Military academy, and a masters in Management, Troy State university, and Applied Mathematics, Naval Postgraduate School. His research interests include applied numerical methods, chaos, math modeling, and applications of innovative technology to education.

Major Jeff Libby teaches undergraduate courses in advanced discrete dynamical systems, freshman calculus, introduction to differential equations, and will be teaching the advanced sections next year. He is a junior faculty member of the Department of Mathematics Sciences at the United States Military Academy. He served for eleven years as an aviation officer in the United States Army. He holds a Bachelor of Science degree in civil engineering from the United States Military academy, and a masters in

Applied Mathematics from the Naval postgraduate School. His research interests include finite element modeling and applications of innovative technology to education.

Carl Pomerance
Bell Laboratories

Title: Primal Screens

Abstract: In August of this year a sensational paper appeared out of India giving a fast test for determining if a given number is prime or composite. This test of Manindra Agrawal and his two students, Neeraj Kayal and Nitin Saxena, has caught the imagination of a far wider public than is usually the case in mathematics. Articles have appeared in newspapers all over the world, as well as news magazines such as US News and World Report, and the major scientific magazines. Come and find out what all the excitement is about.

Bio: Carl Pomerance received his B.A. from Brown University in 1966 and his Ph.D. from Harvard University in 1972 under the direction of John Tate. During the period 1972—99 he was a professor at the University of Georgia, with visiting positions at the University of Illinois at Urbana-Champaign, the University of Limoges, Bell Communications Research, and the Institute for Advanced Study. Currently, he is a Member of Technical Staff at Bell Laboratories and a Research Professor Emeritus at the University of Georgia.

A number theorist, Pomerance specializes in analytic, combinatorial, and computational number theory. He considers the late Paul Erdos as his greatest influence.

Pomerance was an invited speaker at the 1994 International Congress of Mathematicians, the Mathematical Association of America Polya Lecturer in 1993--95, and the MAA Hedrick Lecturer in 1999. He has won the Chauvenet Prize (1985), the Haimo Award for Distinguished Teaching in the USA (1997), and the Conant Prize (2001). In addition he is the co-author with Richard Crandall of the new book, Prime Numbers: A Computational Perspective.

Emma Previato
Institute For Advanced Study

Title: Algebra, Geometry and Physics: The Dynamics of Adding and Multiplying

Abstract: The nature of algebraic objects, curves and moduli, turned out to have important physical meaning, at least since the times of Fermat. In the latest third of the twentieth century, this connection soared to infinite dimensions. At present, mathematicians and physicists together are exploring the properties of the dynamical solutions attached to special loci in moduli spaces. This talk will focus on examples such as billiards and bundles over elliptic and hyperelliptic curves.

Bio: Emma Previato received her PhD from Harvard University in 1983. Her advisor, David Mumford, was awarded a Fields Medal for his advancement of modern Algebraic Geometry; Emma's dissertation concerned applications of algebraic geometry to non-linear wave equations and other dynamical systems. In 1983 Emma became an assistant professor at Boston University, where she is now a full professor having left her post at times to pursue her research as a visitor, among other places, at the Institute for Advanced Studies (Princeton, NJ); the Mittag-Leffler Institute (Royal Academy of Sweden); the Bunting Institute (Radcliffe College); the Mathematical Sciences Research Institute (Berkeley, CA). She is editor and writer of two books and some 40 technical articles. Emma supervised two doctoral and several

undergraduate dissertations and is currently nurturing four graduate students, in areas as diverse as classical projective geometry and coding theory.

Gilbert Strang
Massachusetts Institute of Technology

Title: Pascal Matrices

Abstract: This is joint work with Alan Edelman at MIT and a little bit with Pascal. They had all the ideas.

Put the famous Pascal triangle into a matrix. It could go into a lower triangular L or its transpose L' or a symmetric matrix S:

$$L = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & 2 & 1 & 0 \\ 1 & 3 & 3 & 1 \end{bmatrix} \qquad L' = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 0 & 1 & 2 & 3 \\ 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix} \qquad S = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 2 & 3 & 4 \\ 1 & 3 & 6 & 10 \\ 1 & 4 & 10 & 20 \end{bmatrix}$$

These binomial numbers come from a recursion, or from the formula for i choose j, or functionally from the coefficients of $(1+x)^i$.

The amazing thing is that L times L' equals S. (OK for 4 by 4) It follows that S has determinant 1. The matrices have other unexpected properties too, that give beautiful examples in teaching linear algebra. The proof of $LL' = S$ comes 3 ways, I don't know which you will prefer:

1. By induction using the recursion formula for the matrix entries.
2. By an identity for the coefficients $i + j$ choose j in S.
3. By applying both sides to the column vector $\begin{bmatrix} 1 & x & x^2 & x^3 & \dots \end{bmatrix}'$.

The third way also gives a proof that $S^3 = -I$ but we doubt that result.

Bio: Gilbert Strang was an undergraduate at MIT and a Rhodes Scholar at Balliol College, Oxford. His doctorate was from UCLA and since then he has taught at MIT. He has been a Sloan Fellow and a Fairchild Scholar and is a Fellow of the American Academy of Arts and Sciences. He is a Professor of Mathematics at MIT and an Honorary Fellow of Balliol College.

Professor Strang has published a monograph with George Fix, "An Analysis of the Finite Element Method", and six textbooks:

Introduction to Linear Algebra (1993, 1998, 2003 to come)
Linear Algebra and Its Applications (1976, 1980, 1988)
Introduction to Applied Mathematics (1986)
Calculus (1991)
Wavelets and Filter Banks, with Truong Nguyen (1996)
Linear Algebra, Geodesy, and GPS, with Kai Borre (1997)

He served as President of SIAM during 1999 and 2000. His home page is http://math.mit.edu/~gs.

Dorothy Wallace
Dartmouth College

Title: Sharing Uncommon Ground: How Will The Case For Numeracy Affect The Mathematics Community

Abstract: The volume "Mathematics and Democracy" has sparked a one sided debate about the undebatable value of a quantitatively literate population. In this talk we will outline how the call for numeracy overlaps with the goals of mathematics education and how various institutions have approached the issue. We will touch on both large scale issues and also particular interventions in mathematics education that target goals of numeracy. We will open a conversation on how to improve the numeracy of students at our institutions without sacrificing the mission of traditional mathematics education.

Bio: Professor Wallace grew up in San Mateo, California. She received her Bachelor of Science from Yale University and her Ph.D. in Mathematics from the University of California at San Diego. Before coming to Dartmouth 15 years ago she held positions at Florida International University, the University of California at Berkeley and Stanford University. She works primarily in number theory, although she has also published papers in applied mathematics and mathematics education as well. Her work with the Math Across the Curriculum project at Dartmouth included the development of several interdisciplinary courses in mathematics and art and literature. She was designated CASE New Hampshire Professor of the Year for 2000.

Student Panel Discussion: What Can I Do With A Mathematics Major?

Abstract: Mathematics is fun and intellectually stimulating to study. Studying mathematics helps one to develop skills that will be beneficial in the workplace. Join area college graduates and college students for a panel discussion of the benefits of a mathematics major workplace.

Organizer/Moderator – Sarah Mabrouk, Framingham State College
Panelists – Jonathan DeVicarius, Student, Framingham State College
Emily Blood, Dana Farber
Michelle Capazzoli, Framingham State College
Cathy Dufresne, The Segal Company
Paul Dufresne, Quincy Medical Center
Aaron Gong, Natick Labs
Earl Hopkins, ValSource, Inc.

Student Panel Discussion: Why Should I Go To Graduate School?

Abstract: Graduating from college and you cannot decide if you want to work or if you want to go to graduate school? Join area graduate students and those who have earned Masters and Doctoral degrees for a discussion of the benefits of graduate study. Find out what it is like to go to graduate school to pursue a Master's degree or a Doctorate.

Organizer/Moderator – Sarah Mabrouk, Framingham State College
Panelists – Emily Blood, Dana Farber
Michelle Capazzoli, Framingham State College
Cathy Dufresne, The Segal Company
Paul Dufresne, Quincy Medical Center
Suzanne Szwarc, Graduate Student, Harvard School of Public Health

In Memoriam

Dr. Arthur Doyle, Vice President of Academic Affairs
Without the invaluable help and support of Dr. Doyle, this Meeting would not have taken place.

We would like to thank the following offices and people for their help with the Local Arrangements for the Meeting:

- President Helen Heineman
- Mary Lynch, Executive Assistant to the President
- Dr. Judy Klaas, Vice President, Academic Affairs
- Dr. Philip Dooher, Vice President, Enrollment Management and Dean of Admissions
- Dr. Dale Hamel, Vice President, Administration and Finance
- Dr. Walter Czarnec, Chair, Mathematics Department
- Ray Griffin, Director, McAuliffe/Challenger
- Tom Kelley, Director, Athletic and Recreation Center
- Mark Greenfield, Facility Manager, Athletic and Recreation Center
- Cliff Brigham, Ralph Massa, and Betty Sullivan, Print Services
- James Sweeney, Open Lab Support, Center for Academic Technology
- Rachel Lucking, Director of Student Involvement and Leadership
- Jessica Frost, Reservation Assistant for Student Involvement and Campus Events
- Andrea Pickles, Director, Center for Academic Technology
- Teresa Pagliuca, Multimedia Coordinator, Center for Academic Technology
- Robert Armour, Technical Coordinator, Center for Academic Technology
- Patrick LaFore, Catering Manager, Food Services
- Keith McKittrick, Director, Development and Alumni Relations
- Carol Spector, Director, Career Services
- Lt. Pamela Curtis, Public Safety and Police Services
- Lisa Holland, Director, Independent Alumni Association
- Margaret Storch, Director, College Publications
- Sandy Mellen, Office of the Registrar
- Food Services
- The Office of Admissions
- McAuliffe/Challenger Center
- Independent Alumni Association
- Facilities
- And the numerous other individuals who gave of their time, suggestions, and patience that are not listed here.

Thank you very much.

Book/Technology Displays and Raffle Donations

The following companies will have Book/Technology displays during the Meeting.

- A.K. Peters
- Academic Press
- Addison-Wesley Benjamin-Cummings
- Brooks-Cole
- John Wiley & Sons
- Key College
- MAA
- Maple
- Prentice Hall
- Texas Instruments

The following companies will have information about their products available during the Meeting.

- MathSoft
- The MathWorks
- SAS-JMP

Springer-Verlag will provide catalogs and offer a 20% discount.

We are grateful to the following companies for donations that they have made for raffles to be held during the Meeting.

- A. K. Peters has donated *The Honors Class: Hilbert's Problems and Their Solvers* by Ben Yandell and *Drawbridge Up*.

- Academic Press has donated two copies of Thomas Koshy's book *Elementary Number Theory*, two copies of Zwillinger's *Handbook of Differential Equations*, two copies of Jeffrey's *Handbook of Mathematical Formulas and Integrals*, and two copies of Johnson's *Encyclopedia of the Solar System*.

- Addison-Wesley Benjamin-Cummings has donated a prize basket to contain a variety of books and goodies.

- Brooks-Cole had donated two books.

- John Wiley and Sons has donated five copies of Thomas Koshy's book *Fibonacci and Lucas Numbers with Applications.*

- Key College has donated one copy of each of its software packages Geometer's Sketchpad 4.0 and Fathom.

- Maple has donated two student versions of its popular software package Maple 8.

- The MathWorks has donated four copies of the student version of its popular software MATLAB 6 with Simulink 4 as well as six MATLAB t-shirts.

- McGraw-Hill contributed support of refreshments during the meeting.

- Prentice-Hall has donated two books.

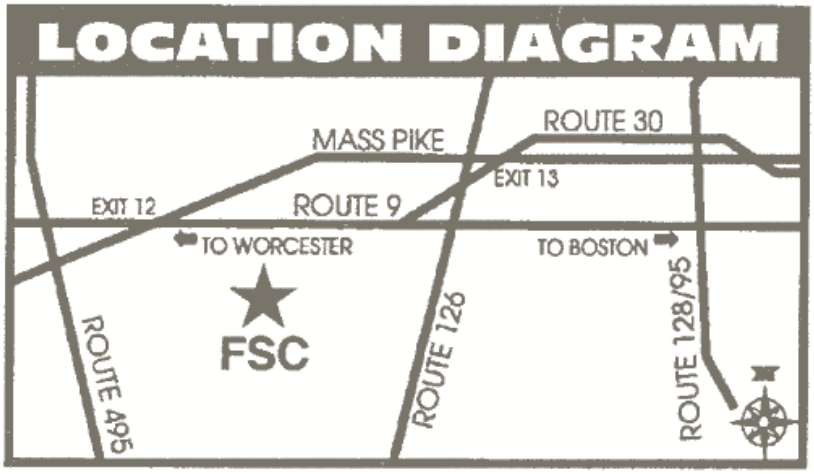
- Quant Systems has donated some books and software.

- SAS-JMP has donated mugs, tri-color highlighters, and “the monitor” computer monitor aids.

- Springer-Verlag has donated one copy of *The Book of Numbers* by John H. Conway and Richard K. Guy, two copies of *Prime Numbers: A Computational Perspective* by Richard Crandall and Carl Pomerance, and one copy of *Mathematical Considerations: Selections From the Mathematical Intelligencer* compiled by Rolun Wilson and Jeremy Gray.

- Texas Instruments has donated a TI-83 Plus Silver Edition calculator.

Directions to Framingham State College Campus



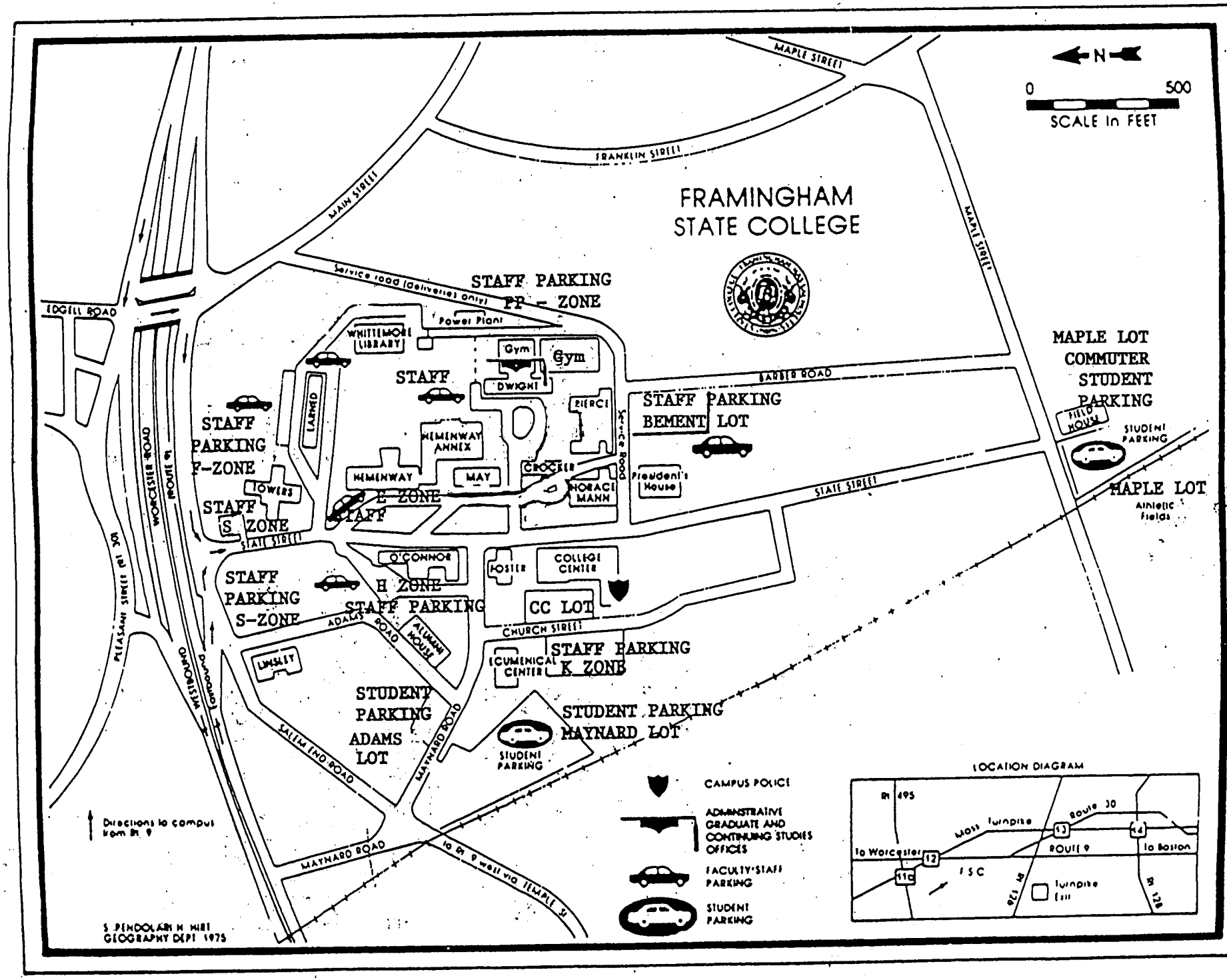
- **From the Massachusetts Turnpike (I-90):**
  Take Exit 12, follow Rt. 9 East two miles to the Edgell Rd.-Main St., Framingham Exit; Take your first right onto State Street and the Framingham State Campus.

- **From I-95 (Route 128):**
  Take Exit 25 to the Massachusetts Turnpike (I-90) West, and follow the directions above.

- **From Route 495:**
  Take Exit 22 to the Massachusetts Turnpike (I-90) East, and follow the directions above.

- **From Route 9 East**
  Take the Edgell Road/Main Street, Framingham Exit; take your first right onto State Street and the Framingham State College Campus.

- **From Route 9 West**
  Take Framingham Center/Edgell Road exit (stay in the middle lane), turn left at intersection/lights to cross the Rte 9 overpass (stay in the right-hand lane), take first right onto High Street, take the first left onto State Street and the Framingham State College Campus.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HEMENWAY
MAY
CROCKER
HORACE MANN
President's House
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STATE STREET
MAPLE LOT
Athletic Fields
O'CONNOR
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ADAMS ROAD
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CHURCH STREET
LINDLEY
ECUMENICAL CENTER
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to Rt 9 west via TEMPLE St
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Mass Turnpike
Route 30
to Worcester
ROUTE 9
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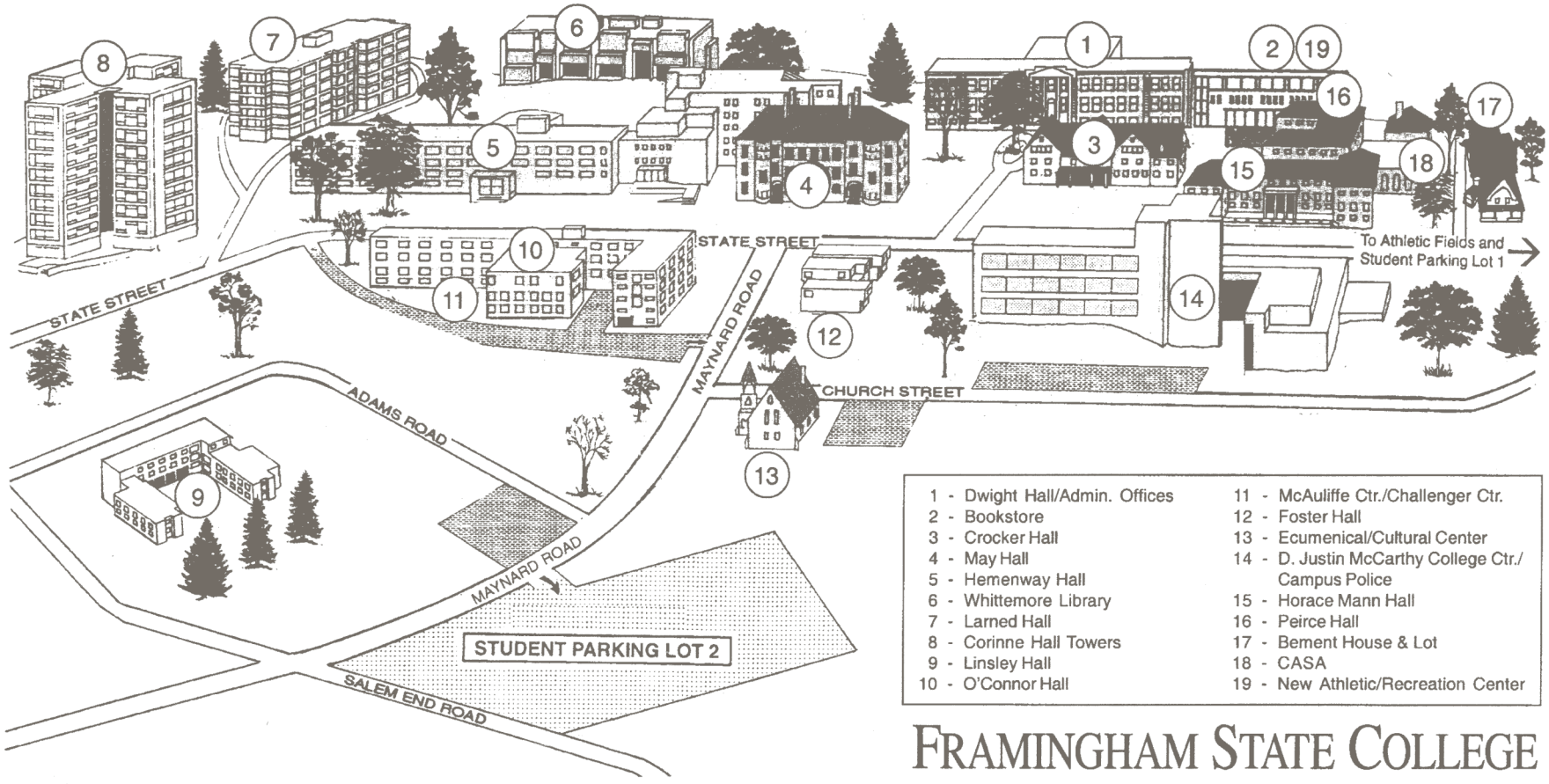
GEOGRAPHY DEPT 1975

Original perspective drawing by Howard Hirt.



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5 - Hemenway Hall
6 - Whittemore Library
7 - Larned Hall
8 - Corinne Hall Towers
9 - Linsley Hall
10 - O'Connor Hall
11 - McAuliffe Ctr./Challenger Ctr.
12 - Foster Hall
13 - Ecumenical/Cultural Center
14 - D. Justin McCarthy College Ctr./ Campus Police
15 - Horace Mann Hall
16 - Peirce Hall
17 - Bement House & Lot
18 - CASA
19 - New Athletic/Recreation Center

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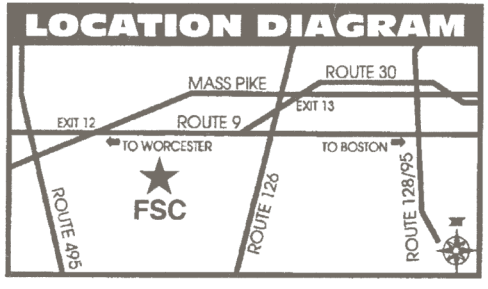

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Take Exit 12. Follow Route 9 East two miles to the Edgell Rd.-Main St., Framingham exit. Take your first right onto State Street and the Framingham State College campus.

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From Route 495: Take Exit 22 to Massachusetts Turnpike (I-90) East, and follow the above directions.