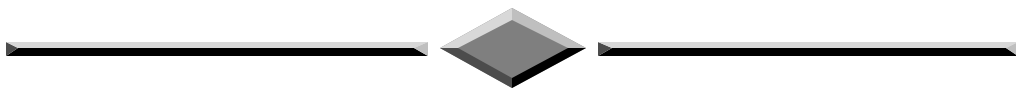


The North Carolina School of  
Science and Mathematics

# Teaching Contemporary Mathematics Conference

February 7 & 8, 2003



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## AGENDA

### Friday, February 7

<u>Time</u>		<u>Place</u>
7:15-8:00	Shuttle from the Durham Marriott to NCSSM	
7:45-8:15	Registration	ETC Lobby
7:45-8:15	Coffee	ETC Student Center
8:15-8:45	Welcome and Overview of Conference Jo Ann Lutz, NCSSM	ETC Auditorium

**Concurrent Sessions - Most talks are offered twice during the conference.**

9:00-9:50

#### Session 1 - Choose One

##### **Modeling is a Two-Way Street**

*Jim Sandefur, Georgetown University, Washington DC*

In this presentation, we will discuss two directions of the modeling street. One direction is to make assumptions about a situation, use those assumptions to develop a mathematical model, and use the model to predict what will happen. The other direction is to collect data (see what happened), fit a model to the data, and use the model to make assumptions about the situation. These two directions will be contrasted, using an understanding of linear and exponential functions. Particular examples considered will relate to how balls bounce, how bicycle gears are designed, and how the box office receipts of movies change. Data will be collected and analyzed during the presentation. Graphing calculators will be extensively used.

*(Also Friday 1:25)*

**Lecture Hall**

##### **Torture the Data and They Will Confess**

*Marty Romero, Woodrow Wilson High School, Los Angeles, CA*

Data collection and Internet projects for the Algebra 2 through Calculus classroom will be shared. Topics include sleep requirements, Starbucks, Dunkin' Donuts, sports ticket prices, sinusoidal functions, and much more.

*(Also Friday 2:30)*

**Watts 301**

##### **$e^{ix}$ and Taylor Series for the Precalculus Class**

*Joe Siddiqui, Maine School of Science and Mathematics, Limestone, ME*

The focus of this workshop is a Precalculus discovery project which gives students a solid introduction to the notion of a Taylor Series while giving them justification for the definition of  $e^{ix}$ . This project not only serves as a review of a spectrum of Precalculus topics, including polynomials, graphing, exponentials, trigonometry, and series, it also paves the way for an easy understanding of the difficult calculus topics of Taylor Series and radius of convergence.

*(Also Saturday 10:10)*

**Hill 7**

<b>Continued... 9:00-9:50</b>	<p><b>Nash Equilibria: A Short Introduction to Game Theory</b>  <i>Dan Teague, NCSSM, Durham, NC</i>  The movie and book "A Beautiful Mind" have made students aware of Nash Equilibria and Game Theory. This talk will give an introduction to game theory and will help you answer student questions about Nash Equilibria. The mathematics requires only a basic understanding of probability (no computations) and familiarity with systems of linear equations.  <i>(Also Friday 10:25)</i></p>	<b>Hill 10</b>
	<p><b>Probability and Statistics Through Game Shows (A)</b>  <i>Mary Mortlock &amp; Matthew Carlton, Cal Poly State University, San Luis Obispo, CA</i>  Once a teacher exhausts the standard probability examples (coins, dice, cards), where can he or she turn? Students can learn –and enjoy learning—major concepts in probability and statistics through current game shows. Bring your TI-83 calculators and find out how!  <i>Note: Two different, non-sequential sessions (A and B) will be offered. The topics and game show activities will be different in each session. (This session will not be repeated.)</i></p>	<b>Watts 306</b>
<b>9:50-10:20</b>	<b>CONTINENTAL BREAKFAST</b>	<b>ETC Student Center</b>
<b>10:25-11:15</b>	<b><u>Session 2 - Choose One</u></b>	
	<p><b>How Many Taxis?</b>  <i>Julie Graves, NCSSM, Durham, NC</i>  We will explore a problem that is appropriate for an introductory class in statistics or mathematical modeling. Imagine that you are standing in the rain trying to hail a cab in a large city. While you are waiting, seven cabs pass by that already have a passenger. You note the cabs' numbers, and wonder whether you could use these numbers to estimate the number of taxis in the city. If you know that the city's taxis are numbered consecutively from 1 to N, how can you use the seven observed numbers to estimate N, the total number of taxis in the city? To answer this problem we will investigate the spread and the bias of various estimators.  <i>(Also Saturday 10:10)</i></p>	<b>Hill 7</b>
	<p><b>The Midge Problem: From Algebra 2 to Mathematical Modeling</b>  <i>Dot Doyle, NCSSM, Durham, NC</i>  Midges are small biting insects that can be either helpful pollinators or carriers of a debilitating illness. In this session we begin with data for the wing length and antenna length for the two kinds of midges. From that information we are to determine a method for classifying an unknown midge. Although this problem originally appeared as a problem for the annual Mathematical Contest in Modeling, I have successfully used it in my algebra and precalculus classes. I will share the rich variety of solutions that the students have generated. In algebra this problem permits students to use their understanding of lines in creative ways. In other classes, students can provide more sophisticated solutions that include additional mathematics.  <i>(Also Friday 11:30 )</i></p>	<b>Lecture Hall</b>

Continued...  
10:25-11:15

**Algebra II: NCSSM Distance Learning and North Carolina Schools**  
*Donita Robinson, NCSSM, Durham, NC*

Watts 301

The curriculum and the teaching of the Algebra II course based on the North Carolina standard course of study are instrumental in leading students on a path of more advanced study in mathematics. A set of 27 lessons designed for the 90-minute block Algebra II class has been developed for NCSSM Distance Learning collaborations with several North Carolina teachers. Each lesson directly addresses goals of the North Carolina Curriculum, is rich in technology-based activities, and focuses on mathematical modeling in the real world. These lessons can be found at [www.dlt.ncssm.edu/algebra](http://www.dlt.ncssm.edu/algebra). In this session we will look at the web site and discuss the overall structure of the lessons. We will also look at one of the lessons in more detail.

*(Also Saturday 11:15)*

**Nash Equilibria: A Short Introduction to Game Theory**

Hill 10

*Dan Teague, NCSSM, Durham, NC*

The movie and book "A Beautiful Mind" have made students aware of Nash Equilibria and Game Theory. This talk will give an introduction to game theory and will help you answer student questions about Nash Equilibria. The mathematics requires only a basic understanding of probability (no computations) and familiarity with systems of linear equations.

*(Also Friday 9:00)*

**Designing Test Questions when Students are using Calculators with a Computer Algebra System (CAS)**

Watts 306

*Ken Collins, Charlotte Latin School, Charlotte, NC*

The TI-89 has a CAS and is legal on both SAT and AP exams. What guidelines should we use to construct tests and exams? This session will offer some suggestions based on recent studies and provide handouts with examples.

*(Also Saturday 8:45)*

11:30-12:20

**Session 3 - Choose One**

**The Midge Problem: From Algebra 2 to Mathematical Modeling**

Lecture Hall

*Dot Doyle, NCSSM, Durham, NC*

Midges are small biting insects that can be either helpful pollinators or carriers of a debilitating illness. In this session we begin with data for the wing length and antenna length for the two kinds of midges. From that information we are to determine a method for classifying an unknown midge. Although this problem originally appeared as a problem for the annual Mathematical Contest in Modeling, I have successfully used it in my algebra and precalculus classes. I will share the rich variety of solutions that the students have generated. In algebra this problem permits students to use their understanding of lines in creative ways. In other classes, students can provide more sophisticated solutions that include additional mathematics.

*(Also Friday 10:25)*

**$R^2$  and  $r^2$  What are They? What Information do They Provide?**

Watts 301

*Gloria Barrett, NCSSM, Durham, NC*

If you use a TI-83 or TI-89 with the Stat App to fit lines and curves to data, you have observed that a value of  $R^2$  or  $r^2$  is calculated whenever a regression equation is computed. In this session we will discuss how to interpret these measures. Some knowledge of residuals and re-expression techniques to straighten curved data will be assumed.

*(This session will not be repeated.)*

<b>Continued... 11:30-12:20</b>	<b>It's a Radical World</b> <i>Allan Bellman, The University of California, Davis, CA</i> Data from slow running clocks, line of sight from a balloon, and accident investigation all lead to situations modeled by the square root function. We will collect data from two of these situations and then work with the square root function. Geometry will help us verify the reasonableness of our models. <i>(Also Saturday 11:15)</i>	<b>Watts 306</b>
	<b>Using Finite and Infinite Sums to Develop Algorithmic Thinking</b> <i>John Morrison, NCSSM, Durham, NC</i> I will present several useful techniques for calculating finite and infinite sums. This will include a method for deriving the formulae for geometric progressions, $\sum_{k=1}^n k^r$ and for $\sum_{k=1}^n R(k)$ for certain rational functions $R$ . These sums can be applied to the analysis of simple searching and sorting algorithms. Examples of these algorithms will be presented and the techniques we discuss will be applied to them. What I aim to do is to invite students to "think algorithmically," and to add new tools to their stable of problem-solving techniques. What we do will be accessible to an ambitious precalculus student. <i>(Also Friday 1:25)</i>	<b>Hill 7</b>
	<b>Let's Play Mathematics</b> <i>Paul Myers, Woodward Academy, College Park, GA</i> Playing and analyzing Monopoly, Scrabble, Cootie, Hi Ho Cherry O, and other board games make mathematical concepts come alive. Featured mathematical topics are data analysis, simulation, expectation and Markov chains. <i>(Also Friday 1:25)</i>	<b>Hill 10</b>
<b>12:20-1:20</b>	<b>LUNCH</b>	<b>NCSSM Cafeteria</b>
<b>1:25-2:15</b>	<b><u>Session 4 - Choose One</u></b>	
	<b>Modeling is a Two-Way Street</b> <i>Jim Sandefur, Georgetown University, Washington DC</i> In this presentation, we will discuss two directions of the modeling street. One direction is to make assumptions about a situation, use those assumptions to develop a mathematical model, and use the model to predict what will happen. The other direction is to collect data (see what happened), fit a model to the data, and use the model to make assumptions about the situation. These two directions will be contrasted, using an understanding of linear and exponential functions. Particular examples considered will relate to how balls bounce, how bicycle gears are designed, and how the box office receipts of movies change. Data will be collected and analyzed during the presentation. Graphing calculators will be extensively used. <i>(Also Friday 9:00)</i>	<b>Lecture Hall</b>

Continued...  
1:25-2:15

**Using Finite and Infinite Sums to Develop Algorithmic Thinking**  
*John Morrison, NCSSM, Durham, NC*

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*(Also Friday 11:30)*

**The Power of Parameters**

Watts 306

*Peggy Craft, NCSSM, Durham, NC*

Students often struggle with the question: In an equation, when is a letter a *variable* and when is it a *parameter*? First I'll give some examples that can be used in Algebra to clarify these concepts. Then we'll work an optimization problem at the Precalculus level that uses data analysis to discover interesting relationships that can be stated in terms of parameters. This makes students eager for Calculus, which gives them the ability to solve the parameterized version of the problem.

*(Also Saturday 8:45)*

**Applications of Pre-Calculus Mathematics in Computer Graphics**

Watts 301

*Jon Choate, The Groton School, Groton, MA*

Anyone who has been to the movies lately, played with a PlayStation 2 game machine, or used graphics software such as PhotoShop or Illustrator knows that the field of computer graphics has exploded in the last 10 years. Many of the ideas we teach at the precalculus level are used in interesting ways in the creation of the computer-generated images we see so often now. This talk will show how

- parametric equations play a key role in computer graphics.
- graphics routines draw 3D objects in perspective.
- vectors and the law of cosines are used to tell whether or not an object can be seen or not.
- vectors, parametric equations and recursion are used in drawing programs to make it very easy to draw fancy curves.
- graphics routines find the equation of a line through two points or the intersection of two lines in the fastest way possible using some ideas from projective geometry developed in the 1800's.

*(Also Friday 3:55)*

**Let's Play Mathematics**

Hill 10

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*(Also Friday 11:30)*

**Error Bounds: Statistics within Algebra / Precalculus****Hill 10***Al Coons, Buckingham Browne and Nichols School, Cambridge, MA*

Would you like to integrate statistics and data analysis topics without “sacrificing” present curriculum? Teaching error bounds includes traditional skills such as linear, exponential, and logarithmic functions and their transformations and re-expressions. Two other data analysis topics that strengthen algebraic skills will be discussed if time allows.

*(Also Friday 3:55)***Really Cool Integrated Mathematics and Science Lessons****Watts 301***Margaret Wirth, J H Rose High School, Greenville, NC*

The National Computational Science Leadership Program (NCSLP) funded through an NSF grant created 50 national teams of 4 math and science teachers. Each team created one 2 to 3 week math and science module for secondary school teachers using computational science tools. The modules include student-centered lessons written in a teacher friendly format and are now available on the web. Each module includes teaching standards, a pacing guide, lessons, worksheets, activities, teacher notes, and grading rubrics. A variety of modules will be demonstrated and handouts on the Hurricane (Algebra 1, 2, Honors Precalculus, Earth Science), Human Population (Biology, Algebra II), and Ozone (Chemistry, Statistics, and Environmental Science) modules will be shared.

*(Also Saturday 10:10)***A Trip to Mars****Hill 7***Floyd Bullard, NCSSM, Durham, NC*

One of the problems associated with a trip to Mars is that of timing: a Mars-bound spacecraft and Mars itself must meet simultaneously at the intersection of the spacecraft’s flight path and the planet’s orbit. The return must be just as carefully timed. These constraints dictate the duration of the stay on the surface of Mars, and therefore affect a host of issues associated with life support, energy supplies, *etc.* Precalculus students can combine their knowledge of trigonometry, function transformations, and parametric equations to plan the timing of a Mars trip, then watch it animated on the TI-83 or the TI-89 calculator.

*(Also Saturday 11:15)***Navigations in Statistics and Data Analysis****Lecture Hall***Landy Godbold, The Westminster Schools, Atlanta, GA*

After an overview of the entire NCTM Data Navigations book, participants will complete one chapter’s activities, using univariate and bivariate data to make decisions. Choosing appropriate graphs, simulation, and informal inference procedures will be examined in detail, and possible formal inference methods will be mentioned.

*(Also Saturday 8:45)***Torture the Data and They Will Confess****Watts 306***Marty Romero, Woodrow Wilson High School, Los Angeles, CA*

Data collection and Internet projects for the Algebra 2 through Calculus classroom will be shared. Topics include sleep requirements, Starbucks, Dunkin Donuts, sports ticket prices, sinusoidal functions, and much more.

*(Also Friday 9:00)*

**Probability and Statistics Through Game Shows (B)****Watts 306**

*Mary Mortlock & Matthew Carlton, Cal Poly State University, San Luis Obispo, CA*

Once a teacher exhausts the standard probability examples (coins, dice, cards), where can he or she turn? Students can learn –and enjoy learning—major concepts in probability and statistics through current game shows. Bring your TI-83 calculators and find out how!

*Note: Two different, non-sequential sessions (A and B) will be offered. The topics and game show activities will be different in each session. (This session will not be repeated.)*

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*(Also Friday 1:25)*

**The Elevator Problem: An Introductory Modeling Problem for All Levels** **Lecture Hall**

*Dan Teague, NCSSM, Durham, NC*

The Elevator Problem is the first modeling activity I use both in Precalculus and with more advanced students in Mathematical Modeling. Students at different levels of mathematical backgrounds generate very different solutions, but all can come up with something interesting. The problem requires only a little algebra, some cleverness and a lot of thought. One important aspect of the problem is that most of the initial solutions students come up with can be improved upon, allowing them to see the iterative aspect of model development.

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*(Also Friday 2:30)*

**Continued... From the Numerical to the Theoretical in Calculus**

**3:55-4:45**

***Doug Kuhlmann, Phillips Academy, Andover, MA***

Numerical techniques easily obtained on a TI-83 can be used to investigate and explore theoretical results in calculus. In fact these techniques can motivate students to discover these results. For example, numerical integration can be used to discover the Fundamental Theorem. More examples will be explored.  
*(Also Saturday 11:15)*

**Hill 7**

**5:00-5:30**

**Shuttles from Watts Lobby to the Durham Marriott Hotel**

## **BANQUET AT DURHAM MARRIOTT HOTEL**

**6:00**

**Social Hour (Cash Bar)**

**Durham  
Marriott Hotel**

**7:00**

**DINNER**

**Durham  
Marriott Hotel**



## Saturday, February 8

7:45-8:30 Shuttle from Durham Marriott to NCSSM

8:15-8:45 COFFEE

ETC Student  
Center

8:45-9:35

### Session 7 - Choose One

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*(Also Friday 10:25)*

Hill 7

#### **Bifurcations**

*David Chan, NCSSM, Durham, NC*

Sometimes we forget to give students a chance to play ... with math. A number of software packages allow students to make discoveries about models/equations. One of the more interesting discoveries is how models/equations can dramatically change by looking at small changes in their parameters. These changes are called **bifurcations**. I will share some activities that can be used by Precalculus, Calculus, and more advanced students. Many of these activities involve using a calculator or a software package.

*(This session will not be repeated.)*

Lecture Hall

9:35-10:05 CONTINENTAL BREAKFAST

ETC Student  
Center

**How Many Taxis?****Hill 7***Julie Graves, NCSSM, Durham, NC*

We will explore a problem that is appropriate for an introductory class in statistics or mathematical modeling. Imagine that you are standing in the rain trying to hail a cab in a large city. While you are waiting, seven cabs pass by that already have a passenger. You note the cabs' numbers, and wonder whether you could use these numbers to estimate the number of taxis in the city. If you know that the city's taxis are numbered consecutively from 1 to  $N$ , how can you use the seven observed numbers to estimate  $N$ , the total number of taxis in the city? To answer this problem we will investigate the spread and the bias of various estimators.

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*(Also Friday 11:30)***12:05-1:05****LUNCH****NCSSM  
Cafeteria****1:15-2:15****Closing Address: Leave No Teacher Behind; Who Teaches Advanced Mathematics?***Lee Stiff, North Carolina State University, Raleigh, NC**Past President of the National Council of Teachers of Mathematics***ETC  
Auditorium****2:30****Shuttle from the ETC Lobby to Durham Marriott Hotel****3:00****Shuttle from the Watts Lobby to Durham Marriott Hotel**

