

TCM Conference 2005 Title and Talk Descriptions

Guest Speakers

Math at the Speed of Sound

Nils Ahbel, Deerfield Academy, Deerfield, MA

Have you ever held a tube (like a wrapping paper tube) up to your ear and listened? It hums, but why? At what pitch? At what volume? I will share a hands-on classroom activity that starts with $distance = rate \times time$ and ends up discovering the speed of sound. It involves data collection (measuring the natural frequency of tubes) and curve fitting (using the reciprocal function) appropriate for Algebra II, Precalculus, and Advanced Functions and Modeling classes. Freeware software will be distributed. Caution: Waves in the room will be flying around at 340 m/s.

Parametric Equations and Football

David Bannard, Collegiate School, Richmond, VA

What should the math department advise the school's punter to work on to improve his distance or hang-time? Will greater leg strength or a more consistent kicking angle help the most? We will look at a model rich in a variety of skills and extensions, using parametric equations, trig identities and proof.

Why Are Normal Distributions So Important?

Gloria Barrett, Deerfield Academy, Deerfield, MA

North Carolina's new Advanced Functions and Modeling course includes the following objective: Recognize, define, and use the normal distribution curve. In this session we will look at how normal distributions can be used to model the distribution of real data, to approximate binomial distributions, and to model the distribution of sample means and sample proportions. Examples and exercises appropriate for use in AFM will be shared.

How Good is your Weather Forecaster?

Floyd Bullard, NCSSM and Duke University, Durham, NC

Your channel 5 weather forecaster says there's a 70% chance of rain tomorrow. If it doesn't rain the next day, does that mean her forecast was wrong? The forecaster on channel 17 said there was an 80% chance of rain. Was he more wrong? What does "wrong" mean? How do you judge weather forecasters, anyway? In this session we'll look at ways to judge the efficacy of probabilistic predictive models.

A Software Solution: Function Aerobics and Other Mathematical Exercises

Tamar Castelloe, NCSSM, Durham, NC and Dedra Eatmon, NCSSM, Durham, NC

When preparing to present certain material, have you ever asked yourself, "is there a better way?" We think we may have one! Using interactive mathematical software developed by the Shodor Foundation, we will guide you through methods of presenting material emphasizing transformations of functions. Our talk will focus on practical applications for Algebra 2, Advanced Functions and Modeling, and Precalculus classes.

Integrating 3D Geometry into the Precalculus Curriculum

Jonathan Choate, The Groton School, Groton, MA

This talk will show how a Computer Algebra System (CAS) and much of the vector work now included in many precalculus books can be used to solve a variety of interesting 3D problems. An easy to use 3D construction multi-platform package will also be demonstrated.

New Jersey Turnpike: A Toll Road

Helen Compton, NCSSM, Durham, NC

The tolls on the New Jersey turnpike present an interesting modeling problem for students studying data analysis. Once models are developed, both the philosophy of setting tolls and establishing new exits with tolls are interesting discussions. Both the TI-84 and the Data Flyer Software from the Shodor Foundation will be used in the discussion. (This lesson is included on the NCSSM Advanced Functions and Modeling website.)

Advanced Functions & Modeling - Collaboration & Projects

Anna DeConti, NCSSM, Durham, NC and Rebecca Hewitt, Camden High School, Camden, NC

Using videoconferencing Anna at NCSSM and Rebecca at Camden High School have collaborated on the teaching of Advanced Functions and Modeling. The two teachers meet once a week to discuss curriculum and teaching strategies. Anna works with Rebecca's students as needed. The two teachers will discuss how they developed, implemented, and graded activities and projects. Participants who are currently teaching or have taught AFM will be encouraged to relate their experiences.

Is the Design of the Congressional Districts in Your State Fair?

Dot Doyle, NCSSM, Durham, NC

Following every census, it is the task of the legislature to redraw the boundaries of the congressional districts. If districts are perceived to be unfair, there are often accusations of gerrymandering. In this session we will consider a definition of fair and look at some mathematical models to quantify fairness. The models are ones that have been proposed by my students and they are consistent with those that are offered by experts. The only prerequisite mathematics for this activity is some fundamental geometry concepts.

Differential Equations with the TI-89

Julie Graves, NCSSM, Durham, NC

The AP Calculus syllabus now includes differential equations, slope fields and Euler's method. The TI-89 makes these ideas immediately accessible to Calculus students. During this session we will explore what the TI-89 is capable of in these areas. Please bring your TI-89 and be ready to share anything you know about these calculator features. We will have TI-89s available for you to borrow. I hope we can all leave the session knowing more than when we started!

Differential Equations and Data Analysis

Maria Hernandez, NCSSM, Durham, NC

Calculus techniques can be used to model the population of the U.S. Using difference quotients to approximate the derivative and then solving the resulting differential equations, we will examine three population models. These methods can be applied to other types of data analysis problems in the calculus classroom. Bring your calculators.

Hands-On Help with Interactive Courseware

Bethany Snyder Hudnutt, Project Interactivate Manager of Shodor Foundation

The tools of the interactive Java-based courseware of Project Interactivate are a favorite resource for many teachers as their students explore functions, data, probability, geometry, and numbers. Project Interactivate provides activities, lessons, a dictionary, and tools that encourage exploration and the development of understanding in the learning of mathematics. Bethany Hudnutt will help you to explore the offerings in Project Interactivate in a hands-on session and is interested in your ideas of how these materials will be useful in your classroom. The website address is

<http://www.shodor.org/interactivate/>.

Our First Year Is Done. Now What?

Anna Jackson, Sanderson High School, Raleigh, NC

The first year of teaching Advanced Functions and Modeling (AFM) is drawing to a close. Now we must evaluate our success (or lack of). In this session, we will discuss our successes and failures over this year. We will examine the good and the bad of assessments, labs, projects, teaching styles, and student performance. We will also attempt to address the question: Where do we go from here? Those who have taught or will be teaching AFM are encouraged to attend.

Getting Started with Python

John Morrison, NCSSM, Durham, NC

Python is an open-source object-oriented scripting language that runs on all platforms. It has powerful extensions for graphics, simulating physical systems, and numerical analysis. On the other hand, its syntax is simple, clear and "looks like English". This makes it an excellent language for programming beginners and for math students who wish to do modeling, simulations or numerical computations. Python has a built-in extended precision arithmetic that makes computing things such as binomial coefficients and Stirling numbers simple and straightforward. This workshop will be a hands-on session in which participants will use the program. We will cover the basics of the language and do some interesting computational activities.

Large-Scale Assessment: Just the Facts

Lewis Romagnano, Metropolitan State College of Denver, Denver, CO

Before teachers can judge the value of large-scale assessments, they need the facts on how these tests are designed and scored, how scores are reported and used, the uncertainty inherent in these uses. Mathematics teachers are uniquely positioned to understand these largely statistical issues and to interpret them for their colleagues in other disciplines, for administrators, and for communities.

Large-Scale Assessment: Just the Facts – continued discussion
Lewis Romagnano, Metropolitan State College of Denver, Denver, CO

This session is a follow-up to the plenary session.

Over and Over Again

Marty Romero, Accelerated Charter High School, Los Angeles, CA

Iteration is a numerical technique used to solve problems in all levels of math. Activities and applications to enhance your algebra through pre-calculus classes will be discussed. Systems of linear equations, number chains, and ancient Hindu problems will be highlighted.

The Mantid Problem

Donita Robinson, NCSSM, Durham, NC

A mantid is a small insect that is often used in biological studies because they are the insect version of a sloth, that is, they rarely move. Researchers have been studying the relationship between the distance a mantid will move for food and the amount of food already in the mantid's stomach. In this session we will investigate the eating habits of mantids. This real-world problem can be used as a culminating experience or to reinforce new ideas and is appropriate for students in Advanced Functions and Modeling (a new course in the NC state curriculum) or Precalculus.

Using Genetics to Motivate Calculus and Precalculus

James Sandefur, Georgetown University, Washington DC

In this presentation, I will present 3 genetic models. First, we will model the failed eugenics movement of the early 20th century using probability and rational functions. Next, we will model the malaria/sickle cell anemia relationship which leads to a simple calculus max/min problem. Finally, we see how we can inductively approximate mutation rates for certain genes. These topics are hands-on in nature and involve using computers or calculators to simulate the situations being studied. These topics generate great student interest because they help the students understand some complex social issues.

Data as the World Gives It

Steve Sigur, The Paideia School, Atlanta, GA

A few years ago I looked at books from every topic in the Library of Congress classification system. All subjects, even seemingly non-mathematical ones, present information using data, equations, and graphs, but often our standard methods using regression and statistics are not applicable. This talk gives very general methods to handle information from the world and examples of their use.

Combat Models

Dan Teague, NCSSM, Durham, NC

Many of my students have family members in the military, so they have a keen interest in models of military combat. We will develop differential equations describing classical combat settings such as the Battle of the Alamo, Bunker Hill, and many famous naval battles. We will modify those models to describe the tactics of guerrilla warfare. By solving the differential equations (they are separable), we will see why guerrilla tactics are so unreasonably effective.

A Closer Look at Blocking

Dan Teague, NCSSM, Durham, NC

Every experiment contains three kinds of variation: 1) systematic, planned variation (the kind we want), 2) chance-like, unplanned variation (the kind we base our probability models on), and 3) systematic, unplanned variation (the kind that spells disaster for our experiment). Blocking turns systematic, unplanned variation into systematic, planned variation. This talk will illustrate how blocking accomplishes this task.

Creating an Everywhere Continuous, Nowhere Differentiable Function

Dan Teague, NCSSM, Durham, NC

This is intended as a fun talk. Such functions play an important role in the theory of calculus, but essentially no role in our course (nor will I argue that they should). If you have some particularly curious students, they may get a kick out of seeing this development. We will first create the Peano curve, the first example of a space filling curve and then modify it to create our everywhere continuous, nowhere differentiable function.

The Fibonacci Triangle – Get Out!

Tom Walters, San Marino, CA

The Mathematics Teacher calendar problems frequently contain the seed for a productive student investigation. May 4, 2003 is certainly no exception. The problem

simply says start with 1,1, and let $a_n = \frac{1}{4} a_{n-1} + \frac{1}{3} a_{n-2}$. Now find the sum of the series

$a_1 + a_2 + \dots$. It turns out that for the more general question where $\frac{1}{4}$ and $\frac{1}{3}$ are just

p and q , the series converges to rational values when the values p and q are decimal

lattice points in the triangular region bounded by $(-1, 2)$, $(1, 0)$, and $(-1, -2)$. The

boundary values produce interesting cyclical behavior. The problem offers lots of chance for simple calculator investigations with a home screen program and a nice closed form solution.

Student Projects

Margaret Wirth, East Carolina University, Greenville, NC

I will share projects that can be done by students in classes ranging from Algebra 2 and Geometry to Precalculus and Advanced Mathematics. The projects and some of the mathematics they rely on are Ejection Seats (parabolic paths), Hang Glider Testing (perimeter, surface area and statistics), and Making and Using the Goniometer to Measure Range of Motion.

Walking through a Field of Slopes using Euler as a Guide

Queen Wiggs, NCSSM, Durham, NC

How do we encourage our students to feel comfortable walking through a field of slopes? One way is to think of the slope field as a set of markers directing you through the plane. By asking a series of questions and offering suggestions, we will successfully chart our path and walk through the plane arriving at an Euler estimation destination. This lesson was developed in a lesson study by the NCSSM Mathematics Department.