

An Innovative Modeling Course for Freshman Liberal Arts Majors

Silvia Heubach

California State University Los Angeles

**Mathfest 2000
UCLA, August 3-5**

History

Modeling course at Humboldt State University:

- **No Differential Equations requirement**
- **Use of MacMath (John Hubbard & Beverly West) got students excited, especially those that previously had not participated much**

GE course for non-science majors at CSLA:

- **More than 50% of the (GE) students dislike or hate mathematics and do not think mathematics is relevant to their lives**
- **Usually only one (college level) mathematics course is required, so they never acquire the necessary background for a "regular" modeling course (calculus, differential equations, linear algebra).**

Advances in CAS

- ***Mathematica* , Maple and MathCad can bridge the gap**
- **Graphing calculators have become much more powerful (TI-89, TI-92)**

Received an NSF-CCD course to develop such a course (DUE-965362).

Modeling Course

Goals

- **Introduce students to mathematical models from across various disciplines**
- **Make mathematics relevant**
- **Make students critical “consumers” of mathematical models and their predictions**
- **Understand the modeling process**

Pedagogy

- **CAS used to produce graphics for qualitative analysis and to perform lengthy/advanced computations**
- **Whenever possible, students perform computations initially by hand to help their understanding of the concepts**
- **In addition to *Mathematica* or the TI-89, hands-on activities and the WWW are used**
- **Assignments require students to justify the methods used and to look at results in the context of the problem**
- **Final projects take students through a complete modeling problem; results are presented to class in a short presentation**
- **Primarily discrete models**

Course Content

Introduction: Planetary Motion

- **Model changes over time**
- **Model needs to be compared to data and adjusted if necessary**
- **Model can be based purely on data**
- **Model can be derived from physical principles**

Functions

- **Representations of functions (tables, graphs, expressions)**
- **Properties of specific types of functions (linear, quadratic, cubic, exponential, logistic, sine)**

Fitting Functions to Data

- **Least Squares Fit (Technology enters the picture)**

Model Classification

Discrete Models

- **One and several variables**
- **Linear and non-linear**
- **Equilibrium values, stability**
- **Applications: Finance, Population Growth, Spread of Disease, Genetics, Age Distribution of Populations, Predator-Prey type models**

Continuous Models

Final Projects

Design

- **Combines various aspects of the course**
- **Students work in groups (2-3)**
- **One page summary of problem and results for other students**
- **15-20 minute presentation to class**
- **Different groups work with different data sets and contexts, but underlying structure is similar**

Type I Project Structure

- **Using actual data, various models are derived**
- **Least Squares Fit of an exponential model to smaller data set**
- **Derivation of an analytical model (also exponential)**
- **Least Squares Fit of logistic model to full data set**
- **Comparison of the different models**
- **Sample Projects**
 - **P1 Adoption of Improved Pasture Technology in Uruguay**
 - **P2 Total Horse Power of Prime Movers**
 - **P4 Population of California**

Type II Project Structure

- **Using a model to test out the effects of various policies or parameter values**
- **Sample Project**
 - **P3 Managing a Deer Population**

Course Materials

Course Materials are available at the course web site

www.cine.net/~silvi

or via link (to the above web site) from my faculty web site

www.calstatela.edu/faculty/sheubac

You can contact me with questions and comments at

sheubac@calstatela.edu