

# MATH 442: Mathematical Modeling

Fall 2010

Lecturer: Prof. Wolfgang Bangerth  
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Office hours: Tuesdays, 2:00–4:30pm or by appointment

Lecture: Tuesdays + Thursdays, 8:00–9:15am  
Blocker Bldg., Room 122

## Textbook

Edward A. Bender: *Introduction to Mathematical Modeling*. Dover, 1978.

## Prerequisites

Prerequisites: MATH 304 (Linear Algebra) and MATH 308 (Differential Equations), or consent of instructor. We will be using Maple for many computations, but if you are more comfortable with other programs such as Mathematica or Matlab, you are free to use those.

## Catalog Description

The construction of mathematical models from areas such as economics, game theory, integer programming, mathematical biology and mathematical physics.

## Course Goal and Learning Outcomes

Mathematical modeling is the art of describing the (physical, biological, social, financial, ...) world around us with mathematical concepts and formulas, in order to understand, predict and optimize it. The primary goal of this course is to gain a familiarity with the techniques with which one can transform our mental models of phenomena into concrete mathematical representations. From these, we will derive equations, identify constraints, solve the equations, and interpret results. The perfect outcome would be if you could go somewhere and say “Ah, here’s an X (neutron star, flying saucer, stock market crash, colony of bacteria, roasting turkey in the oven, ...), let’s see whether we can describe its behavior with mathematical formulas!”

Additional objectives are familiarity with symbolic mathematical software such as Maple and the ability to write a comprehensive report on assigned projects

## Course Outline and Schedule

Here is a rough outline and schedule of the course. Actual allocation of weeks may differ slightly:

Week of 8/30	Introduction to Maple and LyX
Week of 9/6	Introduction to Maple and LyX; first examples of modeling
Week of 9/13	First examples of modeling; estimating parameters, curve fitting, regression analysis
Week of 9/20	Dimensional analysis; non-dimensionalization
Week of 9/27	Modeling with ODEs
Week of 10/4	Modeling with ODEs
Week of 10/11	Modeling with ODEs; analysis of ODEs
Week of 10/18	Modeling with ODEs; analysis of ODEs; review; midterm
Week of 10/25	Modeling with probability
Week of 11/1	Modeling with probability
Week of 11/8	Applications
Week of 11/15	Applications
Week of 11/22	Modeling with partial differential equations; thanksgiving
Week of 11/29	Modeling with partial differential equations
Week of 12/6	Modeling with partial differential equations; reading days
Week of 12/13	Final exam

## Webpage

Assignments and other course information will be posted at the course webpage  
<http://www.math.tamu.edu/~bangerth/teaching.html>

## Exams, homework, projects and Grading

I will give homework on most Thursdays during the semester. In addition, I will assign one individual and one group project over the course of the semester in which you will model a system, take measurements as necessary, and produce a write-up of your findings (of which a PDF version is due at the end). There will also be a midterm (Thursday, October 21, 2010) and a comprehensive final exam (Monday, December 13, 2010, 1–3 pm).

Final course grades will be computed using the following weights:

- Homework: 20%
- Individual project: 20%
- Group project: 20%
- Midterm: 15%
- Final: 25%

*Make-up work:* You must make arrangements in advance if you will not be handing in homework on time or will miss an exam. Absences due to recognized University-related activities, religious holidays, verifiable illness, and

family/medical emergencies will be dealt with on an individual basis, but require a written excuse. Please let me know about this as soon as possible, and preferably in advance.

### **Policies**

*Academic integrity:* The usual rules of academic integrity apply. In particular, the Aggie Honor Code “An Aggie does not lie, cheat or steal, or tolerate those who do” should be self-evident, see

<http://www.tamu.edu/aggiehonor.html>

You may, and are encouraged to, work together and discuss homework problems with each other. However, copying work done by others is an act of scholastic dishonesty and will be persecuted to the full extent allowed by University policy.

*Absences:* Let me know if you have to miss a class in the future. If you missed a class without telling, let me know as soon as possible afterwards. In general, Rule 7 of the Texas A&M University Student Rules applies, as do the other rules.

*Disabilities:* The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, in Cain Hall, Room B118, or call 845-1637. For additional information visit <http://disability.tamu.edu>.

For other policies and other information, please read

<http://www.math.tamu.edu/teaching/operationspg.html>