Math 312 **Applied Mathematics: Social Sciences** **Spring 2005**

Course Information

Instructor:	Warren Weckesser	**Office:**	314 McGregory
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Office Hours: Monday and Wednesday, 1:30-3:30 PM
Other times by appointment, or just drop by to see if I'm available.

Text: None. I will hand out notes and other references in class.

Web Page: `http://math.colgate.edu/~wweckesser/math312/`

Prerequisite:

Math 214 - Linear Algebra

Homework:

There will be six homework assignments. Your solutions to the problems should be carefully prepared documents expressing complete ideas, written with complete sentences. They will be challenging, and will require significant effort. Some of the problems will require you to go beyond what has been covered in class, and apply the techniques that you have learned to new problems. You should expect to get stuck now and then, and you may need some help from me or from your classmates.

Collaboration on the problem sets is allowed, and even encouraged. However, *collaboration* means helping each other to understand the problem and how to solve it; it does not mean simply copying someone else's answer. You must write your own solutions in your own words.

Final Project:

You will do a final project on a mathematical modeling problem that you choose, subject to my approval. I'll say more about this project later in the course.

Exams:

There will be two midterm exams and a final exam. The final exam will be self-scheduled. Currently the midterm exams are scheduled for the evening, but I may change these to take-home exams. (I'll let you know at least a week before the exam if either one will be a take-home exam.)

Exam 1	February 23	7 PM
Exam 2	April 6	7 PM
Final Exam	Self-scheduled	

Mandatory Science Colloquium:

On Friday, February 11, Prof. Schult is giving a talk in the Science Colloquium on *Modeling of Disease Spreading in Networks*. The talk is in 209 Lathrop, and it begins at 3:00 PM. Refreshments are served at 2:45 PM. Attendance at this colloquium is required, and a brief written summary must be handed in. See me if you have an unavoidable conflict.

Grading:

Your grade will be based on the following:

Item	*Points*
Class Part. & Sci. Colloq. Summary	5
Homework (25 points each)	150
Final Project	40
Midterm Exam 1	90
Midterm Exam 2	90
Final Exam	125

Your grade for the course will be determined by computing your numerical total and then converting that number to a letter grade. The assignment of letter grades will depend on performance of the the individual and on my overall impression of the class. However, the cutoffs for letter grades will be no higher than these:

100 - 96.7%	A+	86.7 - 89.9%	B+	76.7 - 79.9%	C+	66.7 - 69.9%	D+	0 - 59.9%	F
93.3 - 96.6%	A	83.3 - 86.6%	B	73.3 - 76.6%	C	63.3 - 66.6%	D		
90 - 93.2%	A-	80 - 83.2%	B-	70 - 73.2%	C-	60 - 63.2%	D-		

Topics Covered:

We will learn about mathematical modeling, especially as it applies to modeling behavior in the social sciences. We will also be using many models from the life sciences, as the models and modeling techniques are similar. The emphasis will be on modeling the dynamics of systems that change over time. The goal will be to learn how models can be used to understand why a system behaves the way it does, predict how a system will behave in the future, and in some cases determine how to change a system to create a desired behavior.

The following is a selection of topics to be covered, not necessarily in chronological order.

- Introduction to modeling with differential equations
- Dimensional analysis and scaling
- Solving separable first order differential equations
- Phase plane analysis: vector fields, trajectories, equilibria, nullclines, linearization, stability of equilibria, limit cycles, and more
- Modeling with discrete maps (many properties analogous to differential equations)
- One-dimensional maps and a brief look at chaos
- Higher dimensional maps
- Probabilistic models
- Markov chains
- Coupled systems
- Large coupled systems
- Systems modeled with networks (i.e. graphs)
- "Small worlds" of various kinds

Additional topics may be added if time permits.

During the course, we will discuss models of phenomena such as love, arms races, battle dynamics, spread of epidemics, synchronization of large systems of oscillators, and more.