Department of Mathematics
Pomona College

Math 183. Mathematical Modeling
Course Outline
Spring 2012

Time and Place:	MWF 10:00 am - 10:50 am, Millikan 211
Instructor:	Dr. Adolfo J. Rumbos
Office:	Andrew 259
Phone/e-mail:	ext. 18713 / arumbos@pomona.edu
Course Website:	http://pages.pomona.edu/~ajr04747/
Office Hours:	MWF 11:00 am - 11:50 am; TR 9:00 am – 10:00 am; or by appointment.
Prerequisites:	Linear Algebra and Ordinary Differential Equations

Course Description. The main goal of this course is to provide opportunities for students to construct and analyze mathematical models that arise in the physical, biological and social sciences. Mathematical models are usually created in order to obtain understanding of problems and situations arising in the real world; other times, the main goal is to make predictions or to control certain processes; finally, some models are created in order to aid in decision making.

Construction of a mathematical model consists of translating a real world problem into a mathematical problem involving parameters, variables, functions, equations and/or inequalities. Analysis of the model involves the solution (if possible) of the mathematical problem through logical, algebraic, analytical or computational means, and assessing what the solutions imply about the real situation under study. If an analytical or computational solution is not possible, computer simulations can sometimes be used in order to study various scenarios implied or predicted by the model.

Analysis techniques can be drawn from many areas of mathematics. In this course, it is assumed that students have a good working knowledge of Calculus, Linear Algebra and Ordinary Differential Equations. These areas are adequate for the analysis of some models. However, many modeling situations require the use of some probability theory and linear programming. These mathematical topics will be covered in the course. In calculus and differential equations courses, students have been exposed to some *continuous* models. In this course, we will also introduce students to *discrete* models as well.

Course Structure and Requirements. The course will be structured around a series of case studies that will provide ample opportunity for students to learn about (and to practice) the development and analysis of models raging from the *discrete* to the *continuous,* and from the *deterministic* to the *stochastic* (or probabilistic), and in many cases involving *mixed-type* modeling. Homework problems will be assigned at every meeting and collected on an alternate basis. There will be a midterm. Students will also be required to work in teams of two or three on a modeling project in the last part of the course. The project consists of a term paper describing the construction and analysis of the model. In addition, students will be required to give a formal presentation on a modeling project at the end of the semester.

Grading Policy. Grades will be based solutions to assigned problems, a midterm, the term paper and the modeling project presentation. The overall score will be computed as follows according to the following distribution:

Homework	20%
Exams	50%
Presentations	15%
Modeling term project	15%

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Tentative Schedule of Topics and Presentations

Date		Topic
W	Jan 18	Introduction to the process Mathematical Modeling
F	Jan 20	Case Study: Bacterial Growth in a Chemostat
M	Jan 23	Nondimensionalization
W	Jan 25	Nondimensionalization (continued)
F	Jan 27	Problems
M	Jan 30	Case Study: Modeling Traffic Flows
W	Feb 1	Traffic flow models (continued)
W	Feb 3	Problems
M	Feb 6	Case Study: Queuing Theory
W	Feb 8	Probability and stochastic models
W	Feb 10	Probability and stochastic models (continued)
M	Feb 13	Probability and stochastic models (continued)
W	Feb 15	Probability and stochastic models (continued)
W	Feb 17	Problems
M	Feb 20	Problems
W	Feb 22	Review
W	Feb 24	**Exam 1**
M	Feb 27	Case Study: An Optimization Problem
W	Feb 29	Linear programming
F	Mar 2	Problems
M	Mar 5	Linear programming (continued)
W	Mar 7	Linear programming
F	Mar 9	Problems
M	Mar 12	Spring Recess!
W	Mar 14	Spring Recess!
F	Mar 16	Spring Recess!
M	Mar 19	Case Study: Testing a Model
W	Mar 21	Model fitting and parameter estimation
F	Mar 23	Problems

M	Mar 26	Review
W	Mar 28	**Exam 2**
F	Mar 30	*Cesar Chavez Day (no class)*
M	Apr 2	Modeling Project
W	Apr 4	Modeling Project
F	Apr 6	Modeling Project
M	Apr 9	Modeling Project Presentations
W	Apr 11	Modeling Project Presentations
F	Apr 13	
M	Apr 16	Modeling Project Presentations
W	Apr 18	Modeling Project Presentations
F	Apr 19	Modeling Project Presentations
M	Apr 23	Modeling Project Presentations
W	Apr 25	Modeling Project Presentations
F	Apr 27	
M	Apr 30	Modeling Project Presentations
W	May 2	Modeling Project Presentations