Math 3583, Introduction to Mathematical Modeling

Course Information Fall 2019

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- ▷ Course Times: MWF 2:30–3:45 PM in 445 MSCS.
- ▷ Instructor's office hours: TBA and by appointment.

Prerequisites: Calculus I and II (Math 2144 and 2153) and Linear Algebra (Math 3013) are the prerequisites listed in the catalog. We will talk about modeling with differential and difference equations, so experience with those topics from Math 2233 might be helpful but is not specifically required. We also will use multiple computational tools in the modeling process, so prior computer experience might also be helpful.

Course Objectives: The aim of this course is for students to become proficient in various aspects of the modeling process, which is the application of mathematical and computational techniques to analyze complex, real-world situations in order to make predictions and solve problems. The modeler will

- ▷ analyze the problem and its fundamental questions;
- ▷ design a mathematical model by forming an abstraction of the system we are modeling through gathering data, making simplifying assumptions, and finding mathematical relationships among the variables involved;
- ▷ solve the model, if possible, or apply additional simplifying assumptions;
- ▷ examine the accuracy of the model (verification) to be sure it makes sense and that it solves the original problem (validation) in a usable manner;
- ▷ report on results obtained orally, in a poster, or in a technical report and maintain the model by making corrections, improvements, or enhancements.

Text: We will use portions of various texts which I will provide for you during the semester.

Course Format: This course is an applied math course in mathematical modeling. That means that we survey various mathematical techniques that have applications, and we use them in applied projects from various contexts. We also use computational tools to assist in the modeling effort and a technical word processing system to help prepare our reports. The core work in the course is four projects, which will be written up as technical reports readable by both experts and non-experts. One project will be presented as a poster, with the date to be determined, and one presented orally to the class, currently scheduled during Pre-Finals Week.

Writing Center: OSU has a Writing Center staffed with people who assist anyone on campus with their writing projects, be it fiction or non-fiction, technical or non-technical. A meeting with a staff member of the Writing Center may be highly beneficial as you are learning to write precisely and clearly about technical material.

Course Requirements: Students enrolled in this course will complete the following:

ITEM	DATE	POINTS	WEIGHT
Homework and quizzes	various	100 pts	20%
Project 1	9/16	75 pts	15%
Project 2	10/7	75 pts	15%
Project 3	11/4	100 pts	20%
Project 4	11/25	100 pts	20%
Poster Presentation	TBA	25 pts	5%
Oral Presentation	Dec 2 or 4	25 pts	5%
TOTAL		500 pts	100%

Grading: Preliminary grade cutoffs are that earning 90% of the available points guarantees an A in the course; earning 80% guarantees a B; and earning 70% guarantees a C. There may be a slight curve if circumstances warrant, but it is not guaranteed.

Projects: The core of the work in this course are the four projects, worth 75 or 100 points. I will typically provide a short list of possible topics, though other topics are possible with my approval. Students will create a model for the problem and solve it, and then writing a technical report summarizing the problem, the model, its solution, and any conclusions or applications obtained. Reports will be typed up neatly using a mathematical typesetting system such as LaTeX (preferred) or the equation editor in MS Word.

Homework and Quizzes: There will be occasional homework assignments and quizzes. These will be done individually and will provide practice in the modeling techniques discussed in class, tutorials on computational tools we use, or other topics. Please prepare all written work neatly on 8.5 by 11 inch sheets which are stapled and have no ragged edges. I am not obligated to grade work which is sloppy, illegible, or does not conform to these guidelines. Quizzes may cover material intended to be read out of class or other topics.

421 MSCS Computer Modeling Lab: Students in this class will have access to the computers in our Modeling Lab, 421 MSCS, by swiping your ID card in the door. The room is a very nice collaborative space, and the computers are very powerful. I have requested that the WinEdt editor for LaTeX, our technical typesetting program, be installed on all machines. There is a backlog since only one person is handling Arts and Sciences computer labs at the moment, but this will be done eventually.

Course Policies: The following policies will be followed in this course.

Group Work Projects two and three will be completed by groups of students and may require meeting times outside of class. Groups may benefit by having members with different areas of expertise! Group members will also evaluate each other's contribution to the project. Group members are not guaranteed to each earn the same grade on the project. Students will fill out an information sheet indicating their group member preferences during the first week of class, to facilitate assignment of groups.

ATTENDANCE POLICY Since some group work will take place in class, attendance is required. Three absences are allowed without penalty. Each unexcused absence beyond three will cause a deduction of **3.3% from your final grade average**. Absences may be excused for documentable illness or family emergencies or professional travel but will not be excused for attending job fairs, vacation, or other issues.

CANVAS I will post course information, assignments, exam review problems, and homework solutions on our Canvas page. I may have students submit work electronically using the Assignments feature in Canvas.

EMAIL COMMUNICATION I will use the Class List in Canvas to email students with news about the course, schedule changes, or other items. Group members may also contact each other using the link on the Class list. Please set your email address in the OSU system to one you check *daily*.

MAKEUP QUIZZES Makeup exams will be given without penalty only for serious and unavoidable conflicts. You must notify me before or as soon as possible after a missed quiz.

WITHDRAWAL The last day to drop the course with no fees encumbered and no grade is Monday, August 26. The last day to drop with a partial refund is Friday, August 30. The last day to drop with an automatic grade of W is Friday, November 8. The last day to withdraw from all classes with a grade of W or F is Friday, November 22.

SPECIAL ACCOMMODATIONS If you have a qualified disability and need special accommodations, you should notify me as soon as possible and request verification of eligibility for accommodations from the Office of Student Disability Services.

Technical Typing: Our standard typing system for technical reports is LaTeX. We will discuss the use of LaTeX in class, and there are numerous tutorials available on the web (www.latex-tutorial.com, www.tug.org). In order to use LaTeX, you must prepare a document with your text and which contains embedded formatting commands. You will process the document in LaTeX, preview it on your screen to proofread it and debug, and then either print or save output as a pdf. In order to create documents in LaTeX, you may

- use LaTeX online on the Overleaf web site, www.overleaf.com;
- create documents on one of the computers in our Modeling Lab using the WinEdt editor (once they get the program updated) and process and print them there, saving your files to your local H drive; or
- you may load MikTex onto your own computer (miktex.org) and keep your documents on your own system. The MikTex system is shareware, but it requires a front-end, a text editing program to operate and coordinate the various parts of LaTeX. Miktex comes with a free front-end editing program called texmaker, but you may purchase WinEdt, the one installed in 421, for $20 for a student license on your own machine (www.winedt.com).

Project Reports: This section will discuss the format of a Project Report. We will go over this material closer to the due date for your first project.

- ▷ Each individual or group will submit one Project Report, typed with large margins in a word processing system that handles equations well such as LaTeX (preferred) or Microsoft Word with the equation editor.
- ▷ Write your report to be a complete, stand-alone document, as if you were submitting it to an employer in answer to a question they had posed or submitting it to a conference or journal. Your paper should contain enough detail to satisfy a technical expert with a comparable background to your own, but should also be clear, correct, and attractive enough that your employer could send it on to a client without revision.
- ▷ There is no strict page guideline or limit, but many reports submitted in a previous semester were from 4–7 pages long. Reports should be clear and as long as necessary to include required information without being too wordy.
- ▷ Generally, technical reports are written in the active voice, using the third-person pronoun ("...we will show that...") rather than the passive voice ("...it is shown that...").
- ▷ The components of a Project Report are as follows.

Introduction Start your report with an Introduction that describes the circumstances in which your problem arose, explains the problem, and states the objective of the paper. You should include information contained in the problem description rather than assume that this material is known to your reader.

Model Design Include any underlying or simplifying assumptions that are needed in your model, the definitions of any technical terms, and introduce any variables and constants needed. You should also explain the relationships among variables using algebraic derivations and diagrams as needed.

Analysis and Solution The body of your report should include your solution to the problems posed. It should be well-organized and should be divided into subsections, if needed, to clarify the presentation. It also should include graphs, tables, and figures as needed to illuminate your ideas and make your discussion easier to follow. Highly technical material such as algebraic derivation of equations or the source code of programs used may be placed in appendices, otherwise the body of the report should include full mathematical details as needed for a reader who has a suitable mathematical background (i.e., a background like yours).

Results and Conclusions End your report with a section summarizing your results, interpreting them, and giving your conclusions or recommendations. Use tables or graphs to clarify your conclusions as needed. Feel free to include comments on any limitations in your model or your solution that have become apparent, and any directions for further research.

References Include references to books and other sources consulted, including our textbook and any web pages consulted.

Appendices Appendices containing longer, technical calculations, source code, and other material may be included as needed, but these are optional.

Rubric for project grading: Your project will be graded as an integrated whole by considering how well it meets the guidelines stated above. I will use the following rubric.

95% This report stands alone as a full and correct solution to the problem including the elements contained in a 90% paper, and it includes significant or unexpected extras, such as particularly good motivational or explanatory comments, creative approaches to helping the reader understand the solution, extra work beyond the minimum to generalize the results or give further analysis, and so on.

90% This is the minimal report that stands alone as a full and correct statement of the problem, description of the model, model analysis, and conclusions needed to solve the problem, with only a few minor errors or typos.

85% This report contains the bulk of the correct statement of the problem and description of the model and its solution but has omissions, errors, or places where clarity can be improved. This paper would need minor editing before submission.

80% This is the minimal report containing a mostly correct statement of the problem, the model, and its solution but may contain more significant gaps or errors or need more extensive editing than an 85% paper.

75% This report includes the major report components but with significant omissions, is unclear in one or more respects, or it may contain errors in parts of the derivation. This report would need significant revision.

70% This report includes the required report components but with significant omissions, lack of clarity, and mathematical errors throughout. Your employer would insist on an extensive revision.

65% This report likely contains significant errors and also is incomplete, with significant information or required components that are missing. Your boss might remove you from the project and assign another team to handle completing the work.