AMATH 383
Introduction to Continuous Mathematical Modeling
Autumn 2018

General Information:	**Lecture**:	T/Th 2:30 - 3:50
	Location:	More Hall (MOR) 220
	Website:	`https://canvas.uw.edu/courses/1218313`
	Required Textbook:	*Topics in Mathematical Modeling* by K.K. Tung
Instructor Information:	**Name**:	Jeremy Upsal
	Email:	jupsal@uw.edu
	Office Hours:	**TBD, if needed**
	Location:	LEW 129
TA Information:	**Name**:	Micah Henson
	Office Hours:	Monday, 2-4 PM, Lewis Hall (LEW) 128

1 Prerequisites

Either AMATH 351, MATH 136, or MATH 307. You should be very comfortable with differential equations.

2 Course Description

This is an introductory level survey of applied mathematics with a focus on modeling problems in the physical sciences using differential and difference equations. The focus of this course will be on model formulation and interpretation of solutions. Solution methods will be discussed, but few new methods will be introduced.

2.1 Pre-class assessment

There will be one pre-class assessment to be completed on or before the first day of class. Depending on how students do on this assessment, they will be asked to do some extra reading/exercises to adequately prepare them for this class.

2.2 Course topics / schedule

The topics in this course will closely follow the required text, they include:

- Working with Jupyter notebooks (python) to interpret mathematical results in terms of what we are modeling
- Scaling laws and "back of the envelope" calculations

- Compound interest and limiting procedures
- Carbon dating
- HIV modeling
- Modeling physical sciences
- Population models, with a focus on phase plane analysis
- Global warming and the snowball effect, with an emphasis on stability analysis
- Interactive population models (predator-prey models): coupled ODEs
- Marriage and divorce models
- Discrete time logistic map, periodic and chaotic solutions
- As time permits, a collection of the following (by choice of the class):
  - Chaos in deterministic continuous systems
  - El niño
  - PDE models, including the age of the earth via the heat equation and bridge collapse via the wave equation
  - Statistical modeling
  - Modeling with data (machine learning)

By the end of the course students will ideally learn something new about each of the topics above, and have a firm grasp on at least some of the models introduced, depending on their interest. Students will demonstrate their mastery of at least one topic of this course through a term paper on a subject of their choice.

2.3 Course design

This class will be entirely focused on **you** doing work instead of watching me do work. As a result, **I will not be lecturing on material from the book.** In fact, there will be no lecture portion of this class. We will spend 80-90% of our time in class working on and discussing problems. The other 10-20% of class time will be devoted to me introducing a Jupyter notebook (python), showing a video of a relevant phenomena, giving feedback about homework, or discussing ideas for a term paper. Since there will be no lecture, students will be required to do selected readigs from the book and answer short questions about the reading to ensure they are keeping up.

3 Course Materials

The **required** text for this course is K.K. Tung's *Topics in Mathematical Modeling.* You will be required to do reading and questions from this book. I know this book is expensive, and I'm sorry. I don't care how you obtain it or if you share with another student, but you need to have access to the book to complete this course. Other books which might prove helpful include but are not limited to:

- *Mathematical Modeling with Case Studies: A Differential Equation Approach Using Maple,* by B. Barnes and G.R. Fulford
- *Differential Equation Models,* by M. Braun, C.S. Coleman, and D.A. Drew

- *Mathematical Models: Mechanical Vibrations, Population Dynamics, and Traffic Flow,* by Richard Haberman
- *Modeling with Differential Equations,* by David N. Burghes and Morag S. Borrie
- *Modeling Differential Equations in Biology,* by C.H. Taubes.

4 Grading

Your grade will be determined by three aspects in this course: homework, a final project, and class participation. There will be no exams. Class participation does not mean simply showing up for class. We will be having many discussions and be working on problems in class. This means that if you are late to class, working on other class material, on your phone, or otherwise not working, you will be marked down for participation. If you are working hard and discussing with other students, you will have a good participation grade.

Your final course grade will be calculated as folllows:

Class participation:	10 %
Final project:	30 %
Homework:	60 %

4.1 Homework

There will be three different parts to the homework in this class, with the following weights:

Part A:	25 %
Part B:	25 %
Part C:	50 %

See https://www.math.nmsu.edu/~davidp/hwrules.pdf for a more complete description of Parts A, B and C for the homework. I've basically copied that page in what follows.

4.1.1 Part A - Advanced preparation

Part A is all about reading and being prepared for class. It is graded on a 0,1,2 scale. 0 means little or no work, 1 means sufficient work, 2 means very good work. It will be due on canvas the evening before class and will consist of:

(a) Assigned reading;

(b) Responses to assigned questions about the reading, to be turned in with complete sentences and neatly written up;

(c) Some explicit questions you have about the reading, what was confusing, how it connects with other material in the class, etc.;

(d) Reflecting on the process of your work both on this reading and in other aspects of the course, e.g. what you didn't understand at first but understood after re reading or how you feel about your current standing in the class;

(e) Write down how much time you worked on part A.

4.1.2 Part B - Warmup exercises to be presented on in class

Part B will consist of a few short problems to be completed and turned in before class. Part B will also be graded on the same 0,1,2 scale as part A. You are encouraged to first try the problems on your own and then, if you are stuck, work with other students. **Each student must write up their solutions individually** and turn them in at the end of class. Depending on how work is going in class, some people will be asked to come up and talk to the class about what they have done and where/if they are stuck. At the end of the assignment, you will write down how much time you worked on part B and with whom you worked.

4.1.3 Part C - Main exercises due the next class period

Part C will consist of one or two longer problems assigned after turning in part B. Part C will be graded on a 4 point scale, with increments of 0.25. Again you should try to start these on your own, but if you are stuck you can work in groups, come to office hours, etc. **Each student must write up their solutions individually** without comparing to other students work. Part C may be turned in in class or online.

4.2 Homework schedule

For a given topic (usually a chapter in the book), you will be assigned part A and part B at the same time. You will turn in part A the evening before Tuesday's class and part B in class on Thursday. You will have one week following the due date of part B to complete part C.

4.3 Presentation and turning in

Every homework set you hand in should have a header containing your name, student number, due date, course, and the homework number as a title. Your homework should be neat and readable. **Your homework score may reflect the presentation of your homework set.**

4.4 Homework grading

Very little partial credit will be awarded for homework in this class. The fact that there will be many homework problems should make up for minor mistakes. **You must show your work on each problem. Solutions with no work presented will be awarded 0 points.** If you get 2.5/4.0 or less on a part C assignment, you may resubmit the assignment up to one week after it was handed back to you to receive up to half of the missed points back (rounded down) or points enough to bring you up to 2.5/4.0, whichever is less. **Only those questions for which you gave a reasonable effort are subject to regrade. In particular, thi does not count if you got a 0 for not turning the assignment in.** This resubmission must include (a) an explanation of what was wrong and why and (b) another attempt. The following table indicates the max score given the raw score

Raw Score	Max possible score
0	2
0.25	2
0.5	2.25
0.75	2.25
1.0	2.5
1.25	2.5
1.5	2.5
2.0	2.5
2.25	2.5
2.5	2.5

4.5 Late Homework Policy

There will be no late homework accepted, except by doctor's notice. If you think you are at risk of not turning in assignment, let me know before it is due.

5 Feedback from Students

I would like any and all feedback from students on how the class is going, any improvement suggestions, or any other questions. The first two options are to (a) speak with me in person or (b) send me an email. If you would prefer to anonymously send feedback, please use the suggestionox link provided on the canvas webpage.

6 Students With Disabilities

In compliance with University of Washington policy and equal access laws, I am available to discuss appropriate academic accommodations that you may require as a student with a disability. Request for academic accommodations need to be made during the first week of the quarter, except for unusual circumstances, so arrangements can be made. Students are encouraged to register with the Disability Services Office for disability verification and for determination of reasonable academic accommodations.

For more Information, visit: `http://www.washington.edu/admin/dso/`