MTH/CSC 4170: Modeling and Simulation (3 credits)
Fall 2020
TR 4:45-6:00pm (online)

"A theory has only the alternative of being right or wrong. A model has a third possibility: it may be right, but irrelevant."—Manfred Eigen (physicist)

Instructor: Andrew Miller, Ph.D.
Office: Working from home for Fall 2020
Office Hours: MWF 10:30-11:30am and 4-5pm, TR 3-4pm; or by appointment
Office Hours Zoom Link:
https://belmontu.zoom.us/j/6131777300?pwd=SU53alZmSFhjSDRPakIrKzU5KzBWQT09
Email: andrew.miller@belmont.edu ◄———[Best way to reach me]

Prerequisites: Calculus II, Programming I

Required Texts: Giordano/Fox/Horton, *A First Course in Mathematical Modeling,* 5th ed

Course Outline: A model is a representation of some aspect of reality. We make models every day—in fact, it would be impossible to learn anything without making mental models. For example, in order to plan a course at Belmont, I need a reasonable model of a student: What will motivate a student to succeed? How will they react to being assigned a 20-page paper? Is it worth it anyway? Will a student do any homework if I don't grade it? If I dress funny, will my student evaluations go down?

A *mathematical* model is a representation of reality using the language, symbols, and techniques of mathematics. In many of your previous math courses, you may have asked yourself, "When will I ever use this?" That time is now! In fact, we will turn that question on its head: instead of asking, "In what situations will I use the mathematics I'm learning now," we will more often ask, "What mathematics do I need to use to analyze the situation I am confronted with now?"

Some situations are too complex for a simple, tractable mathematical model to be an effective representation, or uncertainty is an inherent aspect of the reality we are modeling. In these cases, we turn to *simulation*. In some sense, a simulation is an *algorithmic* model of reality. The power of simulation is that it allows us to run and observe repeated trials of our model, often much quicker than it would take to observe reality itself.

In this course, we will look at modeling and simulation by examining example models and simulations and by constructing our own.

Course Objectives: A student who successfully completes this course will be able to:

- Apply existing mathematical knowledge in order to construct and analyze mathematical models of real-world phenomena.
- Clearly communicate the important characteristics of a mathematical model: its assumptions, conclusions or predictions, limitations, and opportunities for expansion.
- Use computers or other appropriate technology to construct and analyze simulations of real-world phenomena.

Assessment: You will be assessed in the following ways:

- *Reading Quizzes:* You will complete regular reading quizzes on Blackboard to check your understanding of the assigned reading. This is to help facilitate active class discussions. In the past, I have found that some of the most successful Modeling & Simulation semesters have been when we have been able to run the class in a "seminar" style, where class time is spent on clarifications, additional examples, and discussion, *not* on lecture. Moreover, lecture is deadly in the online format! Reading quizzes will be due on **Mondays at 11:59pm Central Time.** Your lowest reading quiz grade will be dropped.
- *Homework:* Homework will be assigned from the textbook weekly and submitted via Gradescope. Homework will always be due on **Thursdays at 11:59pm Central Time.**
- *Projects:* You will be assigned several projects to complete during the semester. Each will entail the construction and analysis of a mathematical model, or the design, implementation, and analysis of a simulation. We will do roughly one project per chapter, and you will work on assigned teams on these projects.
- *Exams*: There are no exams this semester—they don't work well for this class, and they don't work well in an online format. However, we *will* meet during our Final Exam session on **Thursday, Nov 19 from 2-4pm** for team presentations of the final project.

Your final grade in the course will be computed as the weighted average of your performance in each category, with each category weighted as follows:

Reading Quizzes:	20%
Homework:	30%
Projects:	50%

Grades will be assigned according to the following scale: A = [90,100], B+ = [87,90), B = [80,87), C+ = [77,80), C = [70,77), D = [60,70), F = [0,60). (These grade-ranges are given in standard interval notation.)

Classroom Expectations and Policies:

- *Use of class time and preparation for class:* This is a 4000-level (i.e., senior-level) course, and my expectations for your preparation and participation are accordingly high. As much as possible, class time will be used for active engagement with the subject—answering questions, constructing models, working on the computer, going over homework, etc. **I expect you to have your first encounter with the material by reading the assigned section of the text, not by waiting for me to lecture on it in class.**

- *Engagement:* Belmont University is committed to the idea that regular student engagement is essential to successful scholastic achievement. Absence is permitted in cases of illness or other legitimate cause, as determined by the professor. Attendance and engagement are assessed from our first class meeting, whether in the traditional classroom setting, in an online classroom, or a hybrid of the two. Late registrants will automatically have accrued some absences prior to formal registration in the course. In the case of an excused absence from class, students have the right and responsibility to make up all class work missed. Because we are meeting "remotely synchronously," the definition of absence is different for us. For our class, any student who misses *three complete weeks (consecutive or cumulative)* of reading quizzes, homework, *and* synchronous class session attendance may be assigned the grade of FN for "failure for non-engagement. I will send at least one email warning before assigning such a grade.

- *Technology:* We will use several computational tools in this course, but there is nothing that you need to purchase. Of course, having access to a good computational tool can be *tremendously* helpful in modeling and, especially, simulation. MATLAB and Maple are installed on all computers in JAAC 1033. You can purchase student versions of each for $99. Sage is freely available "in the cloud" (it now goes by "CoCalc").

- *Communication:* I will frequently send class-related announcements to you via your Belmont email address. Please check it regularly. If you have a preferred email address, please arrange to have your Belmont email forwarded to it.

- *Late work and missed exams:* It is imperative for your learning in the course that you keep up with the material; thus, you are expected to turn in all work on time. Late homework and late projects will have 5% deducted from the final score for every 24 hrs they are late. Missed reading quizzes are ordinarily not made up (since your lowest quiz grade is dropped).

- *Getting help outside of class:* Please ask me for help if you are struggling with the material or if you have any anxieties or concerns regarding the course, the earlier the better. The best way for you to do this is to attend office hours, but you are also free to email me. If you are unfamiliar with office hours, they are times I have set aside during each week for the express purpose of answering student questions. There you can get one-on-one help for a cheaper rate (free) than hiring a tutor. If my office hours are inconvenient for you, please email me and we will work out another time for you to meet with me. My office hours this semester will be held on Zoom at the following link:

  https://belmontu.zoom.us/j/6131777300?pwd=SU53alZmSFhjSDRPakIrKzU5KzBWQT09

  If you really need to, you may call me on my cell at 615-337-5308.

- *Cheating/plagiarism:* I expect the highest standards of academic integrity from my students; cheating will not be tolerated. I remind you of the Student Honor Pledge:

  > I will not give or receive aid during examinations; I will not give or receive false or impermissible aid in course work, in the preparation of reports, or in any other type of work that is to be used by the instructor as the basis of my grade; I will not engage in any form of academic fraud. Furthermore, I will uphold my responsibility to see to it that others abide by the spirit and letter of this Honor Pledge.

  An honor violation will result in, at minimum, zero credit for the relevant assignment; depending on the severity of the violation, it may result in failing the course. I will endeavor to clarify how this Honor Pledge applies to individual assignments, but always remember: when in doubt as to whether a specific action constitutes an honor violation, ask me.

- *Accommodation of Disabilities:* In compliance with Section 504 of the Rehabilitation Act and the Americans with Disabilities Act, Belmont University will provide reasonable accommodation of all medically documented disabilities. If you have a disability and would like the university to provide reasonable accommodations of the disability during this course, please notify the Office of the Dean of Students located in Beaman Student Life Center (460-6407) as soon as possible.