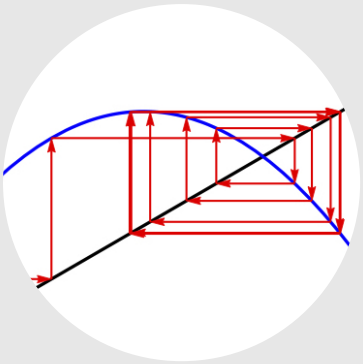

Calculus: Dynamics and Integration

Math 118

Instructor Info

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Course Info

Wednesday, Friday

9:30-10:30 (online, Josh)
11-12 (online, Josh)
11-12 (in-person, Rebecca)
1-2 (online, Josh)
2:30-3:30 (in-person, Josh)
2:30-3:30 (in-person, Rebecca)
4-5 (in-person, Josh)

In-Person Locations:
Stokes 016 (Rebecca)
Sharpless 430 (Josh)

Overview

Math 118 provides a bridge from "some exposure to single-variable calculus" to "readiness for multivariable calculus". We will begin by discussing two topics that are rarely seen in a single-variable calculus course: *discrete dynamical systems* and *differential equations*. These ideas are used to describe systems that evolve over time; they are widely applicable in the natural and social sciences. You will use ideas from calculus (both old and new to you) to examine qualitative, numerical, and exact methods for analyzing these systems. The last few weeks of the course are a more traditional treatment of *integrals and some of their applications*.

The course will involve a focus on *modeling*, since discrete dynamical systems and differential equations are tools for describing real-world process that evolve in time (discrete time in the first case, continuous time in the second).

Prerequisite: Calculus I (Math 105) or equivalent, or placement into 118.

Material

We will follow a set of lecture notes created by various people at Haverford (including Josh). These are available as a PDF on the course Moodle page.

Learning Objectives

Content: You will learn how to . . .

- Use mathematical language to *model* real-world phenomena
- Understand families of functions, i.e. functions and models with parameters
- Work with multiple representations of models (graphs, tables, diagrams, formulae, . . .)
- Analyze approximation and convergence (How can you find good approximations to a solution to a problem, and how can you tell how precise an approximation is?)

Broader: You will . . .

- Contribute to a classroom environment that is lively and collaborative
- Help one another understand the material in the class, through discussions that respect everyone's voice and perspective on the class material
- Become more comfortable with math being less about "getting an answer" and more about marshaling a variety of types of evidence to formulate a convincing argument supporting a particular conclusion.
- Build mathematical persistence, not expecting the answer to arise immediately every time, but rather being prepared to revisit questions more than once, and to seek out available resources when you need help
- Improve your ability to communicate your mathematical findings both orally and in writing with precision, clarity, and a sense of your audience.

Growth, not ability:

There is a widespread belief that you are either "good" or "bad" at math, and if you are "bad" at it, then you will always be bad at it no matter how hard you try. This is false, and the mathematics community bears a lot of responsibility for perpetuating this myth. In reality, mathematics is just like any other discipline or skill: you can improve more and more with practice.

Moodle

Materials for this course, including course announcements, assignments, and deadlines, and overall course information will be posted on the Moodle website.

Respecting each other

We will *all* work to make the classroom a welcoming community in which to experiment, collaborate, and learn. In particular, remember that we are not all coming to this class with the same privileges, resources, time, and knowledge. **As a community, mathematicians and scientists need to do a much better job of making our disciplines more accessible to people of all races, genders (including gender non-conforming folks), sexual identities, and class backgrounds.** While this is a priority for all of us in the classroom, we do not claim to know how to best honor this commitment, and so **we are open to feedback from you when it comes to making the course more accessible and inclusive to all identities.**

It's also important to think about how to respect one another when working together on classroom activities and homework assignments. It's not equally easy for all of us to speak up in a large group, and the voices of historically underrepresented/marginalized students are most easily drowned out in group work. So please keep this in mind when working together.

Grading

Your grade for the course will be determined according to the following weighting:

Lecture Responses 5%
Online Homework 5%
Written Homework 15%
Projects 25% each
Quizzes 5% each
Final 15%

We may also compute an alternate grade with different weights (e.g., one project weighs more than the other); in that case you will receive the higher of the two grades. Note: you must take the final exam in order to pass the class.

Assessments

- **Class Time and Lecture Responses**

  We have thought hard about how to adjust our teaching strategies to meet the current circumstances during COVID-19 and are excited to use a "flipped classroom". Before each class meeting, you will be expected to prepare by watching one or more pre-recorded lectures and/or reading the relevant sections of the textbook. You will then answer a standard set of questions on Moodle. The reading questions will be graded on a "complete / incomplete" scale (where "complete" means that you gave the questions a serious effort). Class time will build on the pre-recorded lectures / readings by answering your questions from Moodle and asking you to discover and engage more deeply with the material in small groups.

- **Online Homework**

  Most weeks, there will be an online homework assignment due by 11:59pm on Monday. The assignment will consist of several problems to help you master fundamentals. You can attempt the online homework as many times as you like until the due date. We highly encourage you to treat the online exercises like a *quiz* when you make your first attempt, working through all of the exercises by yourself, in one sitting, with your book closed. If you have trouble, afterward you can look at your text, talk to your peers, ask questions, and then make further attempts. Doing the on-line exercises as a quiz will give you important feedback about how well you are learning the course material.

- **Written Homework**

  Most weeks, there will also be a written homework assignment, to be turned in on Moodle by 5pm on Wednesday. Written homework is designed to help you deepen your understanding of the material. See the "Writing Clear Homework Solutions" document (on Moodle!) for a description of how to write up your findings.

- **Late Assignments**

  We expect you to keep up with the weekly homework deadlines to maximize your active learning in class. However, we understand that these are unusual times during COVID-19 and each of us have circumstances that may interfere with our learning. We will accept *one* late homework assignment up to Friday at 5pm after the original due date without penalty, no questions asked, so long as you inform us by Wednesday[1]. Other late homework could result in a 50% penalty, depending on the circumstance. **Please do not hesitate to come talk to us about extension requests. These are unprecedented times and we all need to be flexible and understanding with each other.**

[1] It is not necessary to use this extension when dealing with a *serious* illness, a family emergency, or a religious obligation. Please contact us as early as possible in case of any of these events.

- **Projects**

  Instead of midterm exams, you will complete two written projects, which are your golden opportunity to think about how to express and justify your mathematical reasoning clearly and precisely. You will work in groups of two (or perhaps three) on these assignments. You will investigate a mathematical model and then write a short paper explaining and justifying your findings.

Exams

- **Quizzes**

  After each of the Discrete Dynamical Systems topic and the Differential Equations topic, you will take a short take-home quiz to test your understanding of the fundamental ideas and processes introduced. The problems in the quizzes will be on roughly the same level as the online homework.

- **Final Exam**

  The final exam will be a closed-book take-home exam that will have two parts: the first part will be similar to the quizzes and focused on new material, while the second part will be cumulative and more conceptual.

Collaboration

Collaboration on homework is *highly* encouraged, but should be approached carefully. There is a fine balance between learning from working with your fellow students and finding your own way through the material. What you turn in for written HW should reflect your personal understanding of the problems, so **you must write the solutions yourself without referring to notes from your collaborative work.** If you find you are not able to do this, then that is likely a sign that you have not yet fully understood that particular problem and you should pause and seek advice from us or one of the other help resources. Please indicate on your assignment who your collaborators were.

So as to ensure productive collaborative work, you should not be working in groups larger than four people on any given problem at any given time. Two- or three-person groups are better than four. *Large groups of people "working together" are not really working together*. **If at any time in the semester you want to be working in a group but do not have a group of students to work with, please let us know and we will help you find a working group.** This is especially important during the COVID-19 era. If at any time in the semester, you find yourself in a group of students in which people are not feeling respected, please let us know as well.

Note that you are not allowed to use materials aside from the text, materials from Moodle, reserves in the library, and, of course, class notes in this course. These materials have been carefully curated to help you learn. In particular, do not use resources from the internet without express permission. Please help us ensure that we can maintain an environment of trust and respect throughout the semester by working with integrity and coming to us if you have any questions.

Additional Resources

This information will be updated for social distancing protocols due to COVID-19.

- **Student (Office) Hours:** Please stop by to see us during student hours! Ask questions! Hang out with your project partners and other classmates! You are welcome to attend either Josh's or Rebecca's student hours. We have set aside this time specifically to help you learn and be successful in the course.
- **Calculus Resource Center:** The CRC is a space dedicated to collaboration among Math 118 students and tutoring from Math 118 course assistants. The CRC is open on Monday and Tuesday evenings; please see the "Resources and Weekly Schedule" document for times and places.
- **Math Question Center:** The MQC is place you can go to discuss homework with your classmates and ask questions of upperclass student tutors. The MQC is open Sunday through Thursday evenings; please see the "Resources and Weekly Schedule" document for times and places.
- **Peer Tutoring:** Free peer tutors are available through the Office for Academic Resources; see `https://www.haverford.edu/academic-resources/peer-tutoring`.

Equal Access

Haverford College is committed to providing equal access to students with a disability. If you have (or think you have) a learning difference or disability, including mental health, medical, or physical impairment, please contact the Office of Access and Disability Services (ADS) at `hc-ads@haverford.edu`. The Coordinator will confidentially discuss the process to establish reasonable accommodations.

Students who have already been approved to receive academic accommodations and want to use their accommodations in this course should share their verification letter with me and also make arrangements to meet with one of us as soon as possible to discuss their the specific accommodations. Please note that accommodations are **not retroactive** and require advance notice to implement.

It is a state law in Pennsylvania that individuals must be given advance notice if they are to be recorded. Therefore, any student who has a disability-related need to audio record this class must first be approved for this accommodation from the Coordinator of Access and Disability Services and then must speak with one of us. Other class members will need to be aware that this class may be recorded.