



Analysis I

Math 317

Instructor Info



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KINSC / Hilles H213



See Moodle for student hours



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Course Info



Monday, Wednesday, Friday



9:30-10:30 or
11:30-12:30

Overview and Course Goals

When you first took calculus, there were probably many things that you understood at a mostly intuitive level — like limits or the fact that a function with a positive derivative is increasing — or believed because your teacher or the book told you they were true — like the Fundamental Theorem of Calculus. In this course, you will take a more serious look at calculus, turning intuitive notions into rigorous definitions, proving theorems you had taken for granted, and building up an abstract framework in which to understand it all.

*This will be a demanding course. Expect to spend **at the very least** 6–8 hours per week outside of class on homework.*

Understanding Mathematical Content

You will better understand how the following mathematical ideas are defined, the intuition behind them (mainly via examples), and how they are connected.

- What are the real numbers, really? What is a limit? We will also apply this knowledge to infinite series.
- The topology of Euclidean space (the real line, the plane, 3-space, etc.) as a framework for understanding properties of functions.
- Continuous functions and their properties, especially the Extreme Value Theorem and the Intermediate Value Theorem.
- Differentiation and (Riemann) integration, including the Mean Value Theorem and the Fundamental Theorem of Calculus.

Growth in Mathematical Thinking

In order to productively grapple with mathematical ideas, you will need to learn how to better understand and use the formal language of mathematics. We will explicitly discuss how to make sense of mathematical definitions and statements through careful analysis and construction of examples; we will also work through strategies and techniques by which proofs can be analyzed and constructed.

We are all capable of growth in mathematics. You should measure your success in this class by how much your understanding of the concepts have improved over the course of the semester. You should expect to struggle with the material! When you struggle — and practice, and persevere — you are learning and growing. **You are a mathematician.**

Growth in Mathematical Communication

Not only will you learn how to analyze formal mathematical language, but you will also develop the skills necessary to shape it into correct and convincing proofs. Many of you have started this process (in linear algebra, in transitions, in algebra, ...), but no matter where you started, you will improve your mathematical writing in terms of:

- The basics of line-by-line mathematical grammar (e.g. writing in complete sentences and paragraphs, avoiding unnecessary shorthand, setting an inviting tone),
- The clarity of the structure of your argument, and
- The attention to your audience, especially the amount of detail you include.

You will also contribute to a classroom environment that is lively and collaborative, helping one another understand the material in the class through discussions that respect everyone's voice and perspective on the class material.

Once again, it is not easy to learn these processes! While I anticipate that all of you will struggle with some aspect of this class as you work to achieve new levels of mastery, **all of us are eminently capable of learning and growing.**

Class Materials

Materials for this course, including course announcements, assignments, and deadlines, will be posted on the Moodle website. The course text is:

- Abbott, *Understanding Analysis*, 2e. Available as a free ebook through the library, or you can purchase a hard copy in the bookstore or elsewhere.

Class Meetings

Math 317 will be run as a “semi-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. The videos should not exceed 15 minutes in length, and you should not spend more than 30 minutes total in your preparations (less is fine!). You will then answer a standard set of questions on Moodle. The 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 quickly answering your questions from Moodle and then asking you to discover and engage more deeply with the material in small groups; the last part of class will be devoted to a short interactive lecture that builds on the small group activity and introduces new material. Small group teams will rotate every two to three weeks.

You are *not* expected to have completely absorbed the material in the preview assignment or to have solved the class activity problems before class; doing enough to be able to formulate questions or to have a place to start on the discussion problems suffices.

Resources

Student Hours Please stop by to see me during student hours! Ask questions! Meet your classmates! Snuggle my dog (she'll be an occasional office guest)! I have set aside this time specifically to help you learn and be successful in the course. I am going to experiment with appointment slots for student hours this semester; see Moodle for the appropriate link and instructions.

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 located in KINSC H011 (the same place as discussion sessions!) and is open Sunday through Thursday 7–9p.

Math@TheWritingCenter Math@TWC is designed to support you as you learn to write rigorous mathematical proofs. Math@TWC tutors are trained to assist you at the beginning — when you need to use the form of statements to think about how to structure a proof — and at the end — when you need help polishing drafts for structure and clarity — of the writing process. Math@TWC tutors are available by appointment or drop-in Tuesday through Thursday from 7–9p; make appointments at <https://haverford.mywconline.com/>.

Peer Tutoring Free peer tutors are available through the Office for Academic Resources; see <https://www.haverford.edu/academic-resources/peer-tutoring>, though I should admit that it may be difficult to find peer tutors for 300-level classes.

Weekly Problem Sets

Weekly problem sets are due by 11:59p on Wednesdays. The problem sets are divided up into two parts; each should be turned in to separate “folders” on Moodle *in PDF format*. Each part will have three problems; your assignment is to turn in *five of the six problems*. Generally speaking, problems in Part 1 will either focus on using course material to work with definitions and frame arguments; occasionally, they will accomplish this by asks for write-ups of in-class problems. Problems in Part 2 will usually push your understanding of the course content and/or challenge your problem-solving skills. There will also be an occasional, and optional, *challenge problem*.

Each problem will be graded on a 5-point scale, for a total of 25 points per problem set. In addition, you will be given an overall writing assessment on one or two designated problems in each problem set that tracks your progress in meeting the course goals for mathematical communication (look for problems designated (*W*) for primary writing problems and (*w*) for backups in case you skip a primary writing problem). To give room for and to honor your semester-long growth in mathematical writing, only the writing assessments

on the last two assignments will count directly towards your final grade, though the midterms and final exam will also incorporate writing assessments from homework. Speaking of mathematical growth, the first two problem sets will be count half as much as the other problem sets to lower the stakes as you adjust to an upper-level math class.

Please see the *Problem Set Rubric* document for a detailed account of how the problems will be graded, including an explanations of the point values for the mathematical content, the writing assessment, and the bonus point structure for challenge problems and \LaTeX .

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 homework 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.*

It is important to think about how to respect one another when working together on classroom activities and homework assignments. It is 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. Please keep this in mind when 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 me know and I will help you find a working group. If at any time in the semester, you find yourself in a group of students in which people are not feeling respected, please let me 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 all ensure that we can maintain an environment of trust and respect throughout the semester by working with integrity and coming to me if you have any questions.

Late Work Policy

The best way to do well in this course is to keep up with the lectures and homework (even if you do not finish every problem). I will accept one late homework assignment up to Friday at 4p after the original due date without penalty, so long as you inform me by Wednesday.¹ Other late homework could result in a 50% penalty, depending on the circumstance.

Please do not hesitate to come talk to me about extension requests. I understand that these are challenging times and that each of us have circumstances that may interfere with our learning.

Exams

There will be two midterm exams and a final exam. Each of the two midterms — which will be open-book take-home to be taken in a 48-hour window — will be in place of a homework assignment. Continuing the theme of developing your mathematical writing, one problem per midterm will ask you to revise an old homework problem. This problem will be graded almost exclusively for your writing style and entered separately into the grading rubric (see below).

The final will be an untimed open-book take-home exam that will have the same form as the midterms.

Of course, collaboration or use of any resources not specified in the instructions is not allowed on exams.

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

Grading

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

Previews 5%

Homework 30%

Writing Assessments 15% (writing scores from problem sets and revision problems on exams)

Midterms (2) 15% each (not counting the writing assessment)

Final 20% (not counting the writing assessment)

In case of disruptions, I may also compute an alternate grade with different weights; in that case you will receive the higher of the two grades. Note that you must turn in a reasonable final exam in order to pass the class.

Equal Access

I am committed to partnering with you on your academic and intellectual journey. I also recognize that your ability to thrive academically can be impacted by your personal well-being and that stressors may impact you over the course of the semester. If the stressors are academic, I welcome the opportunity to discuss and address those stressors with you in order to find solutions together. If you are experiencing challenges or questions related to emotional health, finances, physical health, relationships, learning strategies or differences, or other potential stressors, I hope you will consider reaching out to the many resources available on campus. These resources include CAPS (free and unlimited counseling is available), the Office of Academic Resources, Health Services, Professional Health Advocate, Religious and Spiritual Life, the Office of Multicultural Affairs, the GRASE Center, and the Dean's Office. Additional information can be found at <https://www.haverford.edu/deans-office-student-life/offices-resources>.

Additionally, Haverford College is committed to creating a learning environment that meets the needs of its diverse student body and 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 Director will confidentially discuss the process to establish reasonable accommodations. It is never too late to request accommodations — our bodies and circumstances are continuously changing.

Students who have already been approved to receive academic accommodations and want to use their accommodations in this course should share their accommodation letter and make arrangements to meet with me as soon as possible to discuss how their accommodations will be implemented in this course. Please note that accommodations are not retroactive and require advance notice in order to successfully implement.

If, at any point in the semester, a disability or personal circumstances affect your learning in this course or if there are ways in which the overall structure of the course and general classroom interactions could be adapted to facilitate full participation, please do not hesitate to reach out to me. *It is a state law in Pennsylvania that individuals must be given advance notice that they may 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 Director of Access and Disability Services and then must speak to me. Other class members need to be aware that this class may be recorded.*