

Math 1080: Mathematics of change; Spring 2024

Class Structure for Spring 2023

What is Math 1080?

Math 1080 is a calculus course designed specifically around the mathematical needs of certain majors. Currently the course is primarily for Wharton students and (prospective) Economics majors.

Compared to other calculus courses covering similar material, Math 1080 places a greater focus on optimization and on qualitative mathematical results. This course also emphasizes the interpretation of mathematical results and mathematical communication—reading math, writing math, and talking to others about math.

Prerequisites

Math 1070 is ideal. Math 1400 or a comparable high school course also suffices; there are a few times we'll want to remember ideas from 1070 that might not have been covered in 1400, but we'll review those ideas when they come up.

this class will suffice for your requirements.

What does Math 1080 Prepare Students For?

Math 1080 might be the last math course you take—together with a previous course, it fulfills the math requirement for an Economics major, and goes beyond the requirements for most Wharton students.

It doesn't have to be the last math course, though. After Math 1080, you'll be prepared to take Math 2400 or most other courses which list Math 1410 as a prerequisite. There are a few topics covered in 1410 which are not covered in 1080, but you'll have the mathematical background to fill the small gaps as you go if you need to.

Textbook

The textbook for this class is the Math 1080 E-textbook, available on our Canvas site.

Pre-Class Work

Before class on Tuesday you will *read the chapter* in the textbook, submit solutions to the *self-check exercises* in the textbook, and take a *pre-class quiz*.

The self-check exercises are a mix of calculations and problems asking you to think about the material you are reading. They will be *graded for completeness*: you get full credit for submitting a real attempt at each problem.

The pre-class quiz will be a calculation similar to one from the chapter. To get full credit, you need to get the correct answer. There will be an opportunity to retake it and replace your score with the score you get on the retake. (You do not need to take the retake unless you want to replace your score.)

Recitation Quiz

There will be a twenty minute quiz in recitation each week. This quiz will typically be: *one (more straightforward) problem* based on the current week's material, and *two (more challenging) problems* based on the previous week's material. We will drop the lowest score from each block of four quizzes (i.e. one from the first four, one from the second four, one from the third four). These quizzes account for 30% of the final grade.

Written Homework

There will be a weekly homework assignment consisting of a mix of computational and conceptual problems. The homework is *not* primarily practice for quizzes and exams. It is the main place students will demonstrate mastery of the more conceptual aspects of the course, and it is weighted in the final grade to reflect its importance: it also accounts for 30% of the final grade.

Final Exam

There will be a cumulative final exam at the time scheduled by the registrar. It counts for 20% of the final grade.

Attendance and Participation

Participation in class is mandatory, as is one recitation per week (which one to be determined before class starts). Anyone who attends (nearly) every class and recitation and engages in any sort of meaningful participation will receive full credit for this part of your grade. The other recitation is an optional opportunity for extra practice.

If you miss more than two class, or more than two mandatory recitations (counted separately), or if you are present but thoroughly disengaged (e.g. chatting on your computer while ignoring group work most of the time), your class participation grade will be penalized.

Late Work

There are different late work policies for different kinds of assignments due to different practical concerns:

- For *self-check exercises*: no credit for late work, but two missing exercises will be excused.

- For the *pre-quiz retake* and *written homeworks*: you may obtain an extension by filling out the *late work* form on Canvas and sending it to me. This form asks you to tell me when you'll be able to submit the work. These are *always* accepted. If you ask for a lot of date changes, we'll work together to find ways to help you keep up with the work in the course.
- For *in-class quizzes*: one quiz from each block of four is dropped. This is how we accommodate students who miss a quiz for whatever reason. If you have a personal emergency that causes you to miss *more than one quiz* in a single month, contact me to work out a specific accommodation.

Topics by Week

- Week 1: Multivariable integrals 1—Multivariable functions and integration in more than one variable
- Week 2: Multivariable integrals 2—Integrating multivariable functions over complicated regions and interpretations of integrals
- Week 3: Linear algebra 1—Vectors and matrices
- Week 4: Optimization 1—Partial derivatives
- Week 5: Optimization 2—Graphing multivariable functions and critical points
- Week 6: Optimization 3—Optimization over regions with a boundary
- Week 7: Linear algebra 2—Determinants and inverses
- Week 8: Optimization 4—Lagrange multipliers
- Week 9: Optimization 5—The multivariable second derivative test
- Week 10: Differential equations 1—Introduction to differential equations
- Week 11: Differential equations 2—Exact solutions to separable and linear differential equations
- Week 12: Differential equations 3—Equilibria of differential equations
- Week 13: Differential equations 4—Solutions to linear system of differential equations and approximating non-linear differential equations

Resources

This is a difficult class. Penn provides many resources to help you succeed in Math 1080:

1. Recitation sections exist to help you learn the material. Make the most of the opportunity: come prepared and ask questions.
2. I hold office hours twice per week. These are times I'm always scheduled to be available, both in my physical office and on Zoom, for you to drop by and ask questions. If you are unable to make those times, I can often (time permitting) schedule additional appointments outside of that.
3. Your TAs will also be holding office hours (times to be announced)
4. The Tutoring Center <http://www.vpul.upenn.edu/tutoring/index.php>
5. The math department maintains a list of tutors <http://www.math.upenn.edu/ugrad/tutors.html>

Active Learning

This class is taught in an *active learning* format. (At Penn, these courses are often called SAIL, which stands for Structured Active In-class Learning.) That means that class time will be spent on a mix of lectures, small group problem solving, and classwide activities and discussion.

All learning requires encountering ideas multiple times, struggling with them, and sometimes being confused. The active learning format has you confront and think about challenging problems *in class*, so that I can be there in the moment to answer questions, talk to you about the problem, and help you.

Respect

We are all responsible for creating a safe classroom environment where everyone feels comfortable asking questions. Exercise consideration and respect when talking to each other. When working in groups, make sure everyone, including you, understands the problem before moving on.

Devices

Students often find it useful to have laptops out in class in order to look up information in the book, use websites to graph functions or do calculations, and so on. However devices can also be very distracting. Consider silencing notifications or otherwise taking steps to avoid being distracted. You should generally not need your phone during class, so please keep them out of sight to avoid distractions.

Food and Drink

There is not a problem with bringing food or drink. (But please be mindful of other students.)

Solutions, not just answers

Writing intelligibly about mathematics is a core topic of this course. A complete solution to a mathematics problem is not just a number or a formula. It is a *convincing explanation* that includes what that number or formula means and why it must be the answer.

What constitutes a convincing explanation depends on your audience. In this class, whenever we write solutions, the audience is *you and your classmates*. Imagine that one of your classmates got a different answer; your solution should convince that student that they made a mistake and your answer is right. (How much do you need to include in intermediate steps? You don't need to include every intermediate step if they're easy to do in their head—after all, you're writing for someone who can probably do the same steps in your head. On the other hand, your classmate is probably a little confused—they got a different, presumably wrong, answer—so if you have to think a bit to get from one step to the next, it's probably too big a leap.)

For quizzes and the final exam, because the work is timed, we don't expect you to have a lot of time to rewrite or fill in steps. But we still want to see your thought process, not just an unexplained answer. You'll get full credit as long as there's enough information for me and your TA to figure out what your steps were.

For the homework, there's a bit more time, so our standards are a bit higher. We expect all your work to be written clearly, in enough detail that anyone in the class would be able to understand how you got your answer and agree that it's correct. You should use words or sentences, as needed, to explain what's going on.

Two homework assignments will be somewhat longer and include a *project*. You can submit the project part of these assignments as a group. Writing clear, high quality explanations will be an important part of these projects.

Collaboration

Collaboration is a fundamental part of this class. For homework assignments, you may:

- talk to other students in the class and share ideas,
- talk to me, TAs, or tutors,
- look at our textbook or other textbooks, video lectures, etc,
- talk to students in other classes about the general ideas on the course.

Do not, however:

- look for answers to these specific problems on the internet,
- look at complete solutions written by current or previous students,
- talk to students not currently in the class about the specific problems.

All your work must be handwritten or typed by you. *You are personally responsible for understanding all solutions you submit.*

Grades

We will compute your numerical grades as follows: pre-class work 10.83%, in-class quizzes 30%, final exam 20%, homework 30%, class participation 9.17%.

I expect to follow the conventional American scheme, in which numeric grades are translated into letter grades by:

[93, 100]:	<i>A</i>
[90, 93):	<i>A-</i>
[87, 90):	<i>B+</i>
[83, 87):	<i>B</i>
[80, 83):	<i>B-</i>
[77, 80):	<i>C+</i>
[73, 77):	<i>C</i>
[70, 73):	<i>C-</i>
[67, 70):	<i>D+</i>
[63, 67):	<i>D</i>
[0, 63):	<i>F</i>

As is common at Penn, an *A+* grade is only given in exceptional cases.

Once in a while, a quiz or exam question turns out to be much harder than I intended, in which case I reserve the right to adjust some grade thresholds downwards. Grade thresholds will not be adjusted upwards. (In other words: if the final is harder than I intend, an 89.8 might get an *A-*, but don't count on it. No matter what, a 90.1 will definitely be an *A-*.)

Regrades

Sometimes we make mistakes when grading. If you think a piece of work was graded incorrectly, give me an explanation describing specifically what you think was graded incorrectly, and why. For anything other than a quiz, submit this on Gradescope. For quizzes, give me the quiz together with a note which has your explanation. Regrade requests should be submitted within two weeks of receiving the graded assignment back.

Accommodations

Students requiring academic accommodations should register their needs with the office of Student Disabilities Services (SDS). Instructors and TAs can not provide any academic accommodations without prior instruction from SDS. In addition, if you plan to register a disability with that office which will require any action, you should email me, even if your accommodations have not yet been registered or approved. You do not need to disclose of the nature of your accommodations or disability, but knowing that you are registered makes it easier to work with SDS to get your the accommodations you need.

Doing the Pre-Class Reading

One aspect of this course that students find challenging is the expectation that you read the textbook before class and come to class having already begun to think about the material.

We do *not* expect you to learn the material on your own from the textbook. Learning new ideas requires thinking about and revisiting them several times. We expect you to come to class with questions and confusions so that we can use class time to start answering those questions.

I recommend that you plan to read the textbook chapter *twice* before coming to class. The first time, read it quickly to get the gist of what's happening—what are the main ideas, how are things early in the chapter going to be used later, what kinds of questions are being asked.

The second time through, read it more slowly. Try to understand each step, even if you don't see the big picture yet. Answer the self-check questions.

Here are some signs you should feel comfortable with what you've learned from book before class:

- you can recognize the new terms and names that are introduced in this section; you probably don't remember what they all mean, but you can look them up quickly,
- you have a good idea how to approach the problem in the pre-class quiz (but might not be completely confident in your answer),
- you could imitate the calculations used in examples from the book (at least if you had the book or your notes as a reference),
- you have answers to all the self-check problems, and feel confident about many (but maybe not all) of them.

On the other hand, here are some warning signs that you're *not* learning enough from the book:

- when terms, definitions, or formulas that were introduced in the chapter come up (later in the chapter or in class), you don't recognize them or can't figure out where they came from,
- you have no idea how to start the pre-class quiz or many self-check problems.

If you're struggling with a chapter (or with lots of chapters) *get help*. Your TA and I will have office hours every week.

Eleven Things to Do to Get an A in this Course

1. Come to class prepared having read the material and starting thinking about it. You'll learn more in class if you come prepared.
2. Be present in class. Attend every day and avoid distractions. Every minute with the professor and TA is meant to help you. Use every minute to your advantage.
3. Ask questions in class. Since you have read the book, you will have questions ready, and more will come to mind during class. Your classmates will be grateful for your questions, even ones you think are "dumb" (which never are).
4. Do problems. There are sample problems for every chapter on the website. The more of these you do, the better you will do in class. You can and should do some of these with classmates in study groups, but you should do the bulk of these by yourself.
5. Re-read and re-visit material. No one learns topics in one gulp: keep returning to old topics and rethinking them in light of new things you've learned.
6. Work with your classmates. Working together allows you to learn from each other, challenge each other, and check that you really know what you think you know. Discuss and debate the material. Figure out what you don't know and what to re-read, or ask the TAs or instructors in recitation, lecture, or office hours.
7. Think for yourself. When working with your classmates, it is easy to end up piggybacking on what they know. After working together, make sure that your homework and other problems you have tried are YOUR OWN work, and that you can reason through every step of the problems independently. If you do not do this, you will fail the midterms.
8. Come to any of the office hours if you are stuck, be it on HW, on something discussed in class, or on the extra problems you are solving from the text. Ask well-prepared questions, not just about specific problems, but also about the concepts you are learning.
9. Start all HW assignments early, and aim to complete them assignments ahead of time. Do not leave your homework until the night before.
10. Follow up. Check problems you didn't get the first time. If you still don't know how to solve them, ask your classmates, your groupmates, your TA, or me in class, recitation, or office hours. If you're not happy with your score on a homework or quiz, see me or your TAs to discuss it to find out what's going wrong.
11. Relate what you are learning to the world around you. We will try to help you do this, but don't stop thinking about the material after you leave the classroom. Think about how it applies to the world around you and to topics you're encountering in other classes, and discuss this with your classmates, your TAs, and the instructors.