Math 18a

Multivariable Calculus for Social Sciences

Course Info ———

📅 Mon, Wed & Fri

🕐 9:00am - 10:15am

📍 Science Center B10

ℹ️ Course website

Exams ———

📅 Mini Exam: 9/19 from 6-7pm

📅 Exam I: 10/10 from 6-8pm

📅 Exam II: 11/14 from 6-8pm

📅 Final: 12/11 from 2-5pm

Instructor Info ——

👤 Roderic Guigo Corominas

🕐 Office Hours

@ rguigo@math.harvard.edu

Overview

Welcome to Math 18a! In the past few years, you've probably spent a lot of time studying functions of one variable. You're familiar with visualizing functions such as $f(x) = \sin(x)$ and $g(t) = e^t$, and you've learned how to differentiate and integrate such functions. In Math 18a, we'll enter the world of functions that depend on more than one variable, such as $f(x,y) = x^2 + y^2$ or $g(u,v,w) = u\sin(v) + w$. We'll first work to understand how we can visualize such functions (which will often require visualizing in 3D!), and then we'll study how we can extend the ideas of differentiation and integration to these multivariable functions. Ultimately, we'll focus on applications to the social sciences, using optimization and modeling techniques relevant in economics, geography, sociology and more.

Prerequisites

Since multivariable calculus extends many ideas of single-variable calculus, you need a strong calculus foundation to be successful in Math 18a. We expect you to have taken the equivalent of a second semester calculus course such as Math 1b.

Materials

You don't need to buy any materials for Math 18a. Class will introduce you to key concepts, but much of your learning will happen outside; the assigned readings and problem sets will help you deepen your understanding of what you learn in class. Math 18a is a fast-paced course which covers a tremendous amount of material.

Software

You won't need a calculator for Math 18a. For some assignments and workshops you'll use open/university licensed software to help to perform calculations, visualize 3D objects and more! Check the corresponding course tab for instructions.

Recommended Text

We will assign readings from two open source textbooks: OpenStax Calculus Volume 3 and Active Calculus Multivariable. Both are freely available online and as PDFs.

Grading Scheme

The midterm score is the higher of

- 40% midterm I + 50% midterm II + 10% mini exam
- 50% midterm I + 40% midterm II + 10% mini exam

The exam score is the higher of

- 40% midterm score + 60% final
- 60% midterm score + 40% final

The effort score is the weighted average

- 80% homework + 15% reasoning with data + 5% attendance

We'll use the chart below to convert your exam and effort scores into a letter grade. Passing both thresholds guarantees the corresponding grade.

Guaranteed Letter grade	Exam Score $\geq$	Effort Score $\geq$
A	90	95
A-	87	92
B+	83	90
B	80	87
B-	77	85
C+	73	82
C	70	80
C-	67	80

Course Format

what should I do...

? Before Section

! We will post readings from the textbooks to prepare for each upcoming lecture. Additionally, homework assigned after class will help you not only review the past lecture, but also prepare for the upcoming section.

? During Section

! Actively contribute to discussions and problem solving opportunities, both with the whole class and in small groups. Intentionally make space for others to contribute and check in with your group members to make sure that everyone in the group understands the material. Remember that class attendance and participation matters for your final grade.

? After Section

! Review what we have done in class and work on your problem set. You may want to stop by office hours to ask any questions related to the course. The homework needs to be submitted on Gradescope by 10:00am the next day of class.

Learning Objectives

As with any college course, we aim for you to gain more than just factual knowledge from Math 18a. Over the course of the semester, you will also:

- Develop your ability to visualize in 3-D and think geometrically (useful skills in all sorts of fields like economics, engineering, linear algebra, data analysis, and more).
- Improve your abstract reasoning and problem solving skills, as well as your computational skills.
- Appreciate how we extend existing mathematical tools to new settings.
- Improve your discussion skills and ability to communicate and evaluate technical ideas (skills that will be useful in the future, no matter what you choose to pursue).

Reasoning with Data

The ideas in multivariable calculus are used to measure climate change indicators such as the size of the Antarctic ice sheet, analyze trends in financial markets, predict the weather, and more! Throughout the semester, we'll analyze real-world data and see how methods for doing so connect with multivariable calculus techniques. We will also focus on critically assessing data, by developing good habits such as understanding and questioning data sources and identifying possible sources of error within data. Because of this, Math 18a fulfills the Quantitative Reasoning with Data (QRD) general education requirement. Once a week, throughout the semester, there will a series of problems assigned with the homework. The course CAs will lead workshop sessions specifically to go over the QRD problems.

Diversity and Inclusivity Statement

Classroom is a place where you will be treated with respect, and we welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability - and other visible and non-visible differences. All members are expected to contribute to a respectful, welcoming and inclusive environment for everyone.

Course Accessibility

If you need accommodation or assistance for a documented disability, please get in touch with the Accessible Education Office as soon as possible so that they can arrange accommodations for you in all of your courses.

Academic Integrity

The University Code of Academic Integrity is central to the ideals of this course. Students are expected to be independently familiar with the Code and to recognize that their work in the course is to be their own original work that truthfully represents the time and effort applied. Violations of the Code are most serious and will be handled in a manner that fully represents the extent of the Code and that befits the seriousness of its violation.

FAQs

❓ Can I type my homework? Can I write it on an iPad? on paper?

❗ Yes! All these are fine as long as you can produce an easy-to-read PDF. If you're using a tablet, please don't make a PDF that's 1 really long page; instead, export your work as a PDF with normal-sized pages.

❓ I submitted my homework a few minutes late; is that ok?

❗ Technical issues sometimes come up; you'll have a grace period of 15 minutes.

❓ What if I need to miss class?

❗ First, let your instructor know. Second, try to get notes from a classmate to help you catch up on what you miss. We'll post the worksheet solutions on Canvas.

❓ Can I get an extension on the homework?

❗ This is what your homework drops are for! We won't give extensions.

❓ I have a DAO or a conflict with an exam.

❗ If you have a DAO testing accommodation or a conflict with the scheduled time for an exam, you'll fill out an OSE request one week before the scheduled exam to arrange an earlier time. Athletic practices and rehearsals don't qualify as approved conflicts. Section meetings and labs can be typically be rearranged to accommodate an exam; contact your section organizers soon to arrange to attend a different section that day.

Resources

Multivariable calculus is challenging, and you shouldn't expect to immediately solve every homework problem. Often you learn the most from things you try that don't work! Give yourself time to try different approaches to a problem and to discuss the material with others. Here are several resources for doing so:

- Your fellow students. We encourage you to form study groups to discuss homework and prepare for assessments. Discussing the material with someone else is a great way to learn it well!
- Office hours are times when you can drop in and ask your instructor or CAs questions, work on your homework, or review material. You don't need to make an appointment; just show up! Office hours are also a great place to meet other students. A schedule will be posted on the course website.
- The Academic Resource Center offers free peer tutoring, academic coaching, workshops, accountability groups, and more.

Homework

The only way to learn math is by doing math, so homework is an essential part of Math 18a. You should expect homework problems to look different from the problems discussed in class. This is intentional; the only way to develop a deep and flexible understanding of the material is to constantly practice applying it in different contexts. When writing up your work, we expect you to explain your thought process; the final answer is less important than the reasoning you used to reach it.

Homework Policy: Problem sets will be posted on the course website. You'll have one assignment due at 10:00 am each day of class. You'll submit your assignments through Gradescope; please see the course website for details. We understand that occasionally things may come up that prevent you from giving full attention to homework. Therefore, we'll drop the 3 lowest homework grades. To be fair to the graders, late work will not be accepted. If you're dealing with more extenuating circumstances, please see the FAQs.

Collaboration & Academic Integrity: We encourage you to collaborate with other students currently taking Math 18a; you're welcome to discuss, brainstorm, and work through problems together. However, you must write up your work independently and in your own words, and you should only submit work that you feel comfortable explaining to another student or CA. If you receive help from any source other than the course intructor and CAs, you must acknowledge that help; your homework score will not be affected by this. Of course, it is always unacceptable to copy a solution from any source.

Generative artificial intelligence (GenAI) tools such as ChatGPT can be a useful tool for developing your understanding of a concept, but you should not ask such tools to solve your homework problems.

Here are some examples of acceptable and unacceptable things to ask a source (whether that's a GenAI tool, person, website, etc.):

✔ Examples of acceptable questions:
- What's the definition of the derivative?
- How do you calculate a derivative using the definition?
- How do I visualize the definition of the derivative?
- Why is the derivative defined the way it is?

✘ Examples of unacceptable uses of support:
- Asking a person, GenAI tool, or other source to solve a specific homework problem for you.
- Asking another student to show you their homework
- Copying a solution from any source

Finally, you may not share any course materials (worksheets, homework, and so on) with anyone not enrolled in Math 18a, with the exception of a peer tutor.