

Math 1b: Integration, Series and Differential Equations

Fall 2024 Course Information and Syllabus

Course head: Jonier Amaral Antunes

Email: jantunes@math.harvard.edu

Summary:

Assessments

What do you need to do?

<u>Class Participation</u>	<u>Homework</u>	<u>Exams</u>
<ul style="list-style-type: none">• Attend section; M - W - F• Participate in class	<ul style="list-style-type: none">• Submit PSETs; Due every class day before section time	<ul style="list-style-type: none">• Mini-exam;• Midterm I;• Midterm II;• Final exam

Percentage of final Grade

5%	25%	70%
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Resources

Where to go?

Online	In Person
<ul style="list-style-type: none">• <u>Canvas</u>; General information, reading material, videos, worksheets, PSETs, solutions, practice exams• <u>Gradescope</u>; Submission of PSETs, feedback on homework and exams	<ul style="list-style-type: none">• Section; M - W - F• <u>Office-hours</u>; Offered most days, led by TFs• <u>MQC</u>; Offered most days, led by CAs• <u>ARC</u>; Scheduled by students, led by peer tutor

Introduction

Welcome to Math 1b! This course is a continuation of the single-variable calculus you have studied in prior courses. In general terms, calculus is the study of change — how to measure, model, and predict changes in quantities that we observe in our universe. Since change occurs in every aspect of our lives, calculus has become an essential tool in every field of study, and the ideas within calculus have helped to create and shape modern human civilization as we know it. We hope that by taking this course, you will gain a deep understanding of and appreciation for these beautiful ideas, as well as their many applications throughout the physical sciences, the life sciences, and the social sciences.

Prerequisites

Math 1b is a second course on single-variable calculus. In order to be successful in Math 1b you need a solid foundation in differentiation and the basics of integration as well as algebra skills and familiarity with functions and their graphs (polynomial, exponential, logarithmic, trigonometric, rational). In particular, we expect you to have taken the equivalent of a first semester calculus course such as Math 1a or Math M.

Course Goals

By the end of this course, we hope that you will be able to:

- Independently study, learn, and apply new mathematical concepts to a variety of challenging problems.
- Work collaboratively with peers to discover mathematical ideas and improve your understanding of them.
- Communicate mathematical arguments clearly and concisely, and evaluate the validity of mathematical arguments made by others.
- Critically analyze real data in order to address important questions about the world in which we live.
- Appreciate mathematics as a fun and practical sense-making process for posing and solving problems, as opposed to an abstract list of rules and formulas.
- Apply the problem-solving techniques, conceptual understanding, and logical thinking that you have developed in this course to problems you may encounter in other courses.

The Role of Data

Some of the problems that you will encounter in the homework throughout this course will involve actual data collected by various agencies. As such, some of these data will be 'messy' and impractical to work with by mental or hand calculations, so it will be beneficial to have a calculator or computer ready for such problems.

Moreover, we will ask you to not only perform calculations, but also to critically analyze the data itself. For example, you will be expected to understand and question the sources, list the possible sources of error, decide which assumptions you can and cannot reasonably make about the data, and which conclusions you can and cannot reasonably draw.

Thus, by completing Math 1b, you will satisfy the Quantitative Reasoning with Data (QRD) general education requirement

Course Structure:

Section Meetings

Math 1b is taught in small active sections instead of a large passive lecture; each section is led by a teaching fellow (TF) with the help of one or more course assistants (CAs), all of whom are there to introduce you to the material and guide you through daily worksheets and activities. In this format, you'll have lots of opportunities to ask and answer questions and **actively do math in small groups**. Research has found that this way of learning is particularly effective: a meta-analysis of 225 studies found that "Active learning increases student performance in science, engineering, and mathematics", and another meta-analysis of undergraduate STEM courses found that "students who learn in small groups generally demonstrate greater academic achievement . . . than their more traditionally taught counterparts."

To get the most out of these meetings, it's essential to be an active participant. Here's what that means:

During section:

- Actively contribute to discussions and problem solving opportunities, both with the entire class and in small groups. Share your successes, mistakes, and confusions. Research shows that we learn more from mistakes than from seeing correct solutions!
- Intentionally make space for others to contribute. Actively listen to others' ideas, and try to understand and build off of them;
- When working in a small group, actively check in with your group members to make sure that everyone in the group understands the material.

Attendance and participation in the section are mandatory. If you need to miss all or part of a section for any reason, you should inform your TF.

In order to make the most out of section time, you can use other course resources:

Before Section:

- Use readings/videos posted on Canvas;
- Reflect on the previous homework. That will help you not only review the past lecture, but also prepare for the upcoming section

After section:

- Review what we have done in class;
- Work on your PSET and submit it 30 min before next section time;
- Go to Office hours/MQC as needed

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.

Homework

The only way to learn math is by doing math, so homework is an essential part of Math 1b. You should expect homework problems to look different from the problems discussed in class. This is intentional; to develop a deep and flexible understanding of the material you need to constantly practice applying it in different contexts. Homework also gives you a chance to practice communicating your reasoning. When writing up your work, we expect you to explain your thought process; **your final answer is less important than the reasoning you used to reach it.** As a rule of thumb, if you're not using any words when writing up the problems, you probably aren't giving enough explanation. It may help to imagine that you're writing to a fellow student to explain how to solve the problem; this will help you include the right level of detail.

You will typically have **three written problem sets (PSETs) each week, due 30 minutes before your section time.** and these will be posted on the course web page. You must write your solutions legibly and neatly on separate paper or tablet with your full name on it, scan it/save it as a PDF, and upload it to the appropriate assignment on Gradescope by the deadline.

We recommend using one of the following free apps for scanning written documents into PDFs: CamScanner, Dropbox Scan, Genius Scan, or Scannable (Apple devices). You should NOT upload any photo images of your p-sets to Gradescope, as they are very difficult to read and grade!

Once your homework is graded, we expect that you will look over the feedback and compare your solutions with the solutions on the course Canvas site. The posted solutions are carefully written out and are a good model for explaining your reasoning completely.

Homework Policy

- **Submission Time:** Every class day (M - W - F) 30 minutes before section time;
- **Late Submissions:** Late submissions incur a penalty of 25% of the PSET grade. **No submissions will be accepted more than 24 hours after the deadline;**
- **Drops:** The two lowest PSET scores will be dropped when computing your final homework average.

Collaboration and Academic Integrity

You are encouraged to collaborate with other Math 1b students on solving homework problems. Talking about your ideas and solutions is a great way to improve your understanding and doing mathematics is really about communicating ideas and questions. However, all work you submit must be written up individually in your own words, and you shouldn't ever submit work that you wouldn't be comfortable explaining clearly to another student or to a TF. You should not under any circumstances turn in work that you have copied from and answer sheet, the internet, from a solution manual, from another student or from any other source. Please see the [Harvard College Student Handbook](#) for Students for University policy on academic dishonesty. Additionally, you may not share any course materials (worksheets, homework, and so on) with anyone not enrolled in Math 1b, with the exception of a peer tutor.

Exams:

This semester Math 1b will have a mini-exam (1 hour long), two midterm exams (2 hour long) and a final exam. Information about content, location, study guides and practice materials will be available on the Math 1b course website prior to each exam. The **tentative exam dates** are:

- **Mini-exam:** Thursday, September 19th
- **Midterm I:** Tuesday, October 8th
- **Midterm II:** Tuesday, November 12th
- **Final exam:** To be determined by the registrar. Tentative: December 12th

Valid Conflicts and Out of Sequence Exams

Out of sequence exams (taken at a different date than the official exam date) are only offered for the following reasons:

- A testing accommodation granted by the Disability Access Office
- A university-sponsored event such as an athletic tournament, play, or musical performance (but not athletic practices and rehearsals)
- A religious holiday
- A medical issue or extreme hardship such as a family emergency

An out of sequence exam must be requested more than a week before the official exam date in order for accommodations to be provided. Further information will be posted on Canvas.

Contingency Plan for Extreme Circumstances

Exams comprise a large percentage of the final grade and should not be missed. In the event that you are not able to take an exam in either the regular time or out of sequence, due to extreme, unforeseeable circumstances (e.g. hospitalization during the exam week), **your resident dean should contact the course head approving your request for a contingency plan.**

The policy for a contingency plan depends on which exam was missed as explained below.

Contingency plan for missed exams (extreme circumstances)

- **Mini-Exam:** The grade for the Mini-exam will be replaced by the grade of a portion of Midterm I of problems covering the same material;
- **Midterm I:** A makeup exam covering the same material will be scheduled by the course head;
- **Midterm II:** The grade will be replaced by a portion of the final exam covering the first two units of the course;
- **Final:** A makeup exam will be scheduled by the registrar in the beginning of the Spring 2025 semester

Grading Policy:

Grades will be determined as follows:

Midterm Score

Take the higher of the two options below

40% Midterm I + 60% Midterm II	or	60% Midterm I + 40% Midterm II
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Course Score

Take the higher of the two options below

5% Class Participation + 25% Homework + 5% Mini-exam + 40% Midterm Score + 25% Final Exam	or	5% Class Participation + 25% Homework + 5% Mini-exam + 25% Midterm Score + 40% Final Exam
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We will use the following table to convert your numerical score to a letter grade:

Course score of at least...	... guarantees a grade
93	A
90	A-
87	B+
83	B
80	B-
75	C+
70	C
65	C-
50	D

Your grade will not be impacted neither by the grades of other students nor by your relative position with respect to the average. There is no “curve” in Math 1b, not for individual exams nor for the final letter grade. Lastly, there are no “grade quotas”; if you all do wonderful work, we are happy to give you all wonderful grades

Resources:

Textbooks

There is no required textbook to purchase for this course; we will provide you with all materials needed. However, we will be referencing two textbooks: *Calculus: an Integrated Approach to Functions and their Rates of Change* by Robin Gottlieb, and *Active Calculus* by Matthew Boelkins. Both books are available to you in PDF format on the Textbook and Background Review page of the course website. Additionally, many notes, videos, worksheets, practice problems, and solutions will be posted on the course website. You are also welcome to refer to other outside sources to supplement your understanding, such as other calculus textbooks (e.g., James Stewart's Calculus textbook), Khan Academy videos, etc.

Technology and AI

You are welcome to use calculators, computers and software (e.g. desmos) in class or when working on your PSETs, unless otherwise specified. Technology can aid your understanding of the material and checking your work. In fact, for some of the PSET problems, computing tools will be necessary. However, **no calculators of any kind are allowed during exams**, so it is not advisable to use technology for doing simple calculations, plotting familiar graphs, computing basic derivatives and integrals, etc.

Generative artificial intelligence (GenAI) tools such as ChatGPT can be helpful for developing your understanding, but you should not use it 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:	Examples of unacceptable uses of support:
<ul style="list-style-type: none">• 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?	<ul style="list-style-type: none">• 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

Educational Accommodations

Harvard University values inclusive excellence and providing equal educational opportunities for all students. Our goal is to remove barriers for disabled students related to inaccessible elements of instruction or design in this course. If reasonable accommodations are necessary to provide access, please contact the [Disability Access Office \(DAO\)](#). Accommodations do not alter fundamental requirements of the course and are not retroactive. Students should request accommodations as early as possible, since they may take time to implement. Students should notify DAO at any time during the semester if adjustments to their communicated accommodation plan are needed.

Course Resources and Getting Assistance

- **Office hours:** Every TF will hold office hours each week at various times, where you can come in and get help on any course material, including the PSETs and assessments. You can bring a friend or classmate with you, or meet new friends there! You can also go to office hours to ask general questions or work in the company of others. You are welcome to attend any TF's office hours (not just the ones held by your TF), and you are strongly encouraged to do so! No appointment is necessary, and you can come and go at any point during the hour. The full schedule and location of office hours will be posted on the course website.
- **Math Question Center (MQC):** The MQC is a community where students and CAs come together to study and work on PSETs. It is held in the Science Center (room to be determined), and is staffed by the CAs. No appointment is necessary; just drop in! Dates and times will be posted on the course website. More information on the [MQC website](#).
- **Academic Resource Center (ARC):** The ARC, located at 1414 Massachusetts Avenue, is an excellent resource outside of the math department that offers peer tutoring, workshops on study skills and test-taking skills, and many other services. For more information, visit the [ARC Peer-Tutoring Website](#).
- **Your fellow students:** There is a great wealth of knowledge and experience among your peers! We strongly encourage you to form study groups for discussing homework problems and preparing for assessments.

Finding the right time to ask for help is a delicate balance; you need to give yourself enough time to work on, get stuck on, and finally persevere in your own problem solving. This is only possible if you give yourself ample time to fully immerse in the problems in the course. Try a few different approaches first before you ask for help from others – often you will learn the most about a new topic from the things that you try that didn't work!

List of Major Topics

Unit 1: Integration	Unit 2: Series	Unit 3: Differential Equations
<ul style="list-style-type: none">• Density problems in 2D and 3D;• Areas and volumes;• Numerical integration;• Improper integrals;• Applications: average value, work, probability density functions	<ul style="list-style-type: none">• Taylor polynomial approximations and Taylor series;• Infinite series: definitions and examples;• Tests for convergence;• Power series representations of functions	<ul style="list-style-type: none">• Modeling with DEs: populations, mixing problems;• Qualitative analysis;• Separation of variables;• Second order DEs;• Phase plane analysis of Systems of DEs

Welcome to Math 1b! We hope you enjoy the course!