MATH 218D-1: FALL 2023 SYLLABUS

Note: *the syllabus and course schedule are subject to change. Any changes to the syllabus and/or course schedule after the semester begins will be relayed to the students through Sakai and email.*

Instructors:	Joe Rabinoff	Eylem Yildiz
Email:	jdr@math.duke.edu	eylem.yildiz@duke.edu
Office Hours:	See the course website	
Course website:	https://services.math.duke.edu/~jdr/2324f-218/	

Description

This is an introductory linear algebra course that will focus on concepts, methods, and applications. Gaussian elimination is presented as the fundamental process for solving systems of linear equations. Deeper understanding is developed by examination of matrix factorizations, orthogonality, and associated vector subspaces. Least squares problems, eigenvalue problems, the singular value decomposition and principal component analysis will also be studied as fundamental tools for solving data-driven applications. Computational considerations will be a major source of motivation for many of the techniques covered in this course.

This course will be more applied and computational than *Math 221* (for students heading to a math major), which goes into much more depth on theory and develops skills in writing rigorous mathematical proofs. Math 218D-1 is also different from *Math 218D-2*—we will spend less time covering differential equations in favor of topics more relevant to data science and statistics.

Textbook

The official text for the course is *Introduction to Linear Algebra* (6th Ed) by Gilbert Strang, Wellesley–Cambridge Press/SIAM (2016). However, we will follow Strang only loosely. Another good reference is the online text *Interactive Linear Algebra*, by Dan Margalit and Joe Rabinoff; it can be found here: https://services.math.duke.edu/~jdr/ila/.

Organization

This course consists primarily of **two 75-minute lectures** and **one 75-minute problem session** each week.

Lectures focus on new theory, concepts, and techniques. They are held in large groups of around 50 students. Your **attendance** in the lectures is strongly encouraged; we try to make them as interactive as possible.

Problem sessions are devoted to working through homework problems with the help of a teaching assistant and your classmates. Problem sessions are meant to be entirely interactive, with students working in small groups. For these reasons, **attendance** in your problem session is required.

Homework will be assigned weekly and posted on the web page above. The homework is where you will directly engage with the concepts, and is absolutely essential for learning the material. As such, expect to spend **several hours** each week on the homework. (Learning math is **hard work:** you will not learn linear algebra just by attending lecture and problem sessions and Googling the answers to your homework questions.) You are strongly encouraged to *collaborate with your classmates* on homework assignments! I do not expect you to be able to finish the homework on time if you do it by yourself.

All homework will be submitted and graded on **Gradescope**. PDF submissions written directly on a tablet are ideal; otherwise, you will need to take photos of your homework or scan it in. Raw photos are very hard to read and are **not accepted**: you must use a scanner or an app. I recommend *Scannable* or *TurboScan* on iOS or *Genius Scan* on Android. You will also need to **tag your submissions** on Gradescope to indicate which problems are found on which page—otherwise the graders waste an enormous amount of time searching for your solutions.

Brief **quizzes** will be given every week during the problem session. These are group quizzes, meaning that you will solve the problems in a group with 2–3 other classmates. They will consist of one or two problems designed to check basic understanding of what happened in the previous two lectures. They are meant to oblige you to review your notes before the problem session.

There will be two **midterm exams**. Each exam will focus on the material covered after the previous exam, but due to the cumulative nature of the material, you will be responsible for knowing all of the material covered up to that point. Midterm exams will take place during the problem session time slots. Only **simple calculators**[1] are allowed on exams (although they're usually not necessary); if you don't have one, you can buy one for $4 on Amazon. You may also bring a 3×5" index card covered with whatever information you like. No other materials are allowed on the midterm exams.

The **final exam** will cover all course materials, except those specifically excluded in class. A **two-sided 8.5×11" note sheet** is allowed on the final exam, as well as a **simple calculator**; all other aids are prohibited.

Most **course materials** will appear on the course website. I will use **Sakai** for the gradebook, announcements, Ed Discussion, and two prerecorded Zoom lectures.

Grades for class work will be weighted as follows:

25%	Homework
5%	Quizzes
20%	Midterm 1
20%	Midterm 2
30%	Final exam

Cutoffs for letter grades will be determined at the end of the semester, subject to the following guarantee: a final score of 90% or above will merit at least an A-; 80% or above is at least a B-, etc.

Course Schedule

A calendar outlining the materials covered each day, the relevant sections of Strang, the midterm and final exam dates, and more can be found on the course webpage.

Policies

Late homework will generally not be accepted, as I will post solutions shortly after the homework is due. Students may be excused from a missed homework assignment on a case-by-case basis.

If you miss a midterm examination (and have a University-approved excuse), you must take a **make-up midterm** during the following week.

Your **final exam score** will count for **half of your lowest midterm score.** More precisely, your final exam score will replace the lowest 10% out of the 40% of your final grade that is determined by the midterms, assuming you performed better on the final than on your worst midterm. For example, if

[1] Namely, calculators that have no linear algebra functionality.

you scored 50% and 80% on the midterms and 90% on the final, then your first midterm score would effectively be computed as $70\% = \frac{1}{2}(50\% + 90\%)$.

Collaboration on homework assignments is encouraged: please work in groups! However, all students must write up their own work, in their own words. Collaboration of any kind on exams is strictly prohibited; suspected instances will result in a referral to the Office of Student Conduct. Please refer to the Duke Community Standard.

How to Get Help

Your first stop for help should be **office hours!** Joe, Eylem, Rohit, Dante, and our undergraduate TA Linda will be holding plenty, and you should not hesitate to show up with questions and chat with the other students there. If you can't make the scheduled office hours, send us an email and we'll set up a meeting.

If you have questions, post them on **Ed Discussion**, available as a tool on Sakai. It's likely that your classmates will have the same question, or maybe one will will know the answer, so it's much better to post the question than to email one of us; plus, you'll likely get a quicker response on Ed Discussion. You can post anonymously if you wish, but I expect that **all of you will get stuck at some point**, so there's no shame in using your name.

The **STEM Advancement Through Group Education (SAGE)** program is a resource offered in conjunction with the Academic Resource Center. These groups meet weekly with a trained undergraduate Peer Facilitator and engage with content closely correlated with the course. SAGE students are highly motivated, want to establish a critical foundation for STEM learning at Duke, and are interested in learning in a community with other students. SAGE helps students learn effective STEM study strategies, provides extra support for the challenging material in the course, and fosters a collaborative community of learners.

Sign-ups will begin after the drop/add period. Information about how to sign up and more details about the program can be found here: https://arc.duke.edu/sage.

The **Academic Resource Center** (ARC) offers free services to all students during their undergraduate careers at Duke. Services include Learning Consultations, Peer Tutoring, Learning Communities, ADHD/LD Coaching, Outreach Workshops, GRE/MCAT Prep, Study Connect, and more. Because learning is a process unique to every individual, we work with each student to discover and develop their own academic strategy for success at Duke. Contact the ARC to schedule an appointment. Undergraduates in any year, studying any discipline can benefit! https://arc.duke.edu • `theARC@duke.edu` • 919-684-5917 • 211 Academic Advising Center Building, East Campus – behind Marketplace.