Math 271, Section 02, Spring 2017: Linear Algebra

MTuThF 12-12:50 PM, SMudd 205

Webpage: `http://www3.amherst.edu/~rlbenedetto/math271`
(Also accessible from the Math 271-02 moodle page.)

Instructor: Rob Benedetto

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Office Hours: Mon, 2–3pm; Tue, 10–11am; Thu, 1:30–3pm; or by appointment.

Teaching Assistants: Rosy Rohling and Obinna Ukogu

Rosy: Email: `rrohling18@amherst.edu` Office hours: Mon, 7–9pm, SMudd 207
Obinna: Email: `oukogu18@amherst.edu` Office hours: Thu, 6:30–8:30pm, SMudd 207

Text: D. Damiano and J. Little, *A Course in Linear Algebra*, Dover, 2011.
Available at Amherst Books.

Exams:

- **Midterm 1**: Tuesday, February 28, in class
- **Midterm 2**: Friday, April 7, in class
- **Final**: 3 hours; exact date during finals period is TBA

Calculators, cell phones, ipods, etc. are not permitted in exams.

The only excuses for missing an exam are incapacitating illness, religious conflict, or the like.

Homework:

- Reading from the textbook will be assigned each week.
- Problem sets will be due (usually) twice a week, **at the START of class**.
See page 3 of this handout for important homework information.

Grading:

- **Effort**: 5%
- **Problem Sets**: 15%
- **Midterm Exams**: 25% for your better one, 20% for your worse one
- **Final Exam**: 35%

"Effort" is a combination of class attendance, class participation, and handing in problem sets. (See pages 2 and 4 for more on attendance and participation.)

If an individual student's final exam or homework grade is substantially higher than his or her other grades, and if the student's effort grade is strong, I will tweak the above percentages a little for that student to favor the better grades. Final course grades will be curved.

Any student who fails to hand in at least 50 homework problems **on time** over the course of the semester AUTOMATICALLY gets an F in the class.

About Cell Phones and Mobile Devices

Cell phones, ipods, tablets, laptops, and other electronic devices have no place in my classroom. Don't use them. Not for talking, not for texting, not for anything. So at every class:

Silence your cell phone, put it away, and pay attention.

Prerequisites

The official prerequisite for this course is second-semester calculus (Math 121 or the equivalent). However, I would strongly recommend that you *also* have taken one other math course beyond 121, like Math 211 (Multivariable Calculus). The point is not the specific material covered but rather the valuable mathematical *experience* of having taken both Math 121 and another course beyond it. If you're not sure whether you belong in this course, please talk to me about it.

Course Content

Naively, linear algebra is about vectors and matrices. Less naively, it's about more abstract and general notions called "vectors" and "linear transformations." You've probably already seen some basic linear algebra, perhaps without knowing it, when solving several equations with several unknowns, but of course the subject goes a lot deeper than that. Here's some of what we'll see.

- Chapter 1: **Vector Spaces** are the fundamental objects of study in linear algebra. The starting example is $\mathbb{R}^2$ (a.k.a. the familiar xy-plane). We'll learn other examples, plus key concepts such as subspaces, span, linear independence, basis, and dimension. We'll also discuss general methods for solving **systems of linear equations**.
- Chapter 2: **Linear Transformations** are special functions from one vector space to another. We'll define and discuss them, along with matrices, which are closely related.
- Chapter 3: **Determinants** are certain special numbers associated with square matrices.
- Chapter 4: **Eigenvalues and Eigenvectors** are probably the most important concepts in the whole course. They provide a way to massively simplify certain important problems in linear algebra. In the same chapter, we'll also study inner products and orthogonality.
- Chapter 5: We'll do a quick survey of **Complex Numbers** and their use in linear algebra.
- Chapter 6: We'll largely skip this chapter due to time constraints.
- Chapter 7: Linear algebra, and especially eigenvalues and eigenvectors, provide methods for solving certain types of **Differential Equations**. We'll see some of the basics in this chapter.

If time permits, we may talk a little about some related topics, possibly including **Adjoints**, **Least Squares Approximations**, or **Markov Processes**.

Class Participation and Classroom Dynamics

Please note that I consider class participation in the Effort portion of your grade. If you are quiet by nature, don't worry; as long as you attend class devotedly, pay close attention, and do the homework, you will get full Effort credit.

But that's only for grading purposes. This is a lecture course, but I believe that lectures should be interactive, and that participating in classroom discussion helps any student learn the material better. So for your own benefit, I strongly encourage you to **speak up** and **ask questions**. In addition, when I ask a question to the class, I'm usually looking for an answer. If you have even a half-formed idea of how to answer the question, please share it.

Teaching Assistants

Our two Math 271 Teaching Assistants, **Rosy Rohling** and **Obinna Ukogu**, will hold Monday and Thursday evening office hours, for you to drop in and seek help. Please make use of them!

Homework

Problem sets will be assigned at a rate of two per week (usually). Your homework consists **BOTH** of reading the relevant sections of the book **AND** of doing the assigned problems. (Only the written work counts directly in your grade, but I expect you to do both.) **Start working on each problem set the same day it is assigned**; do *not* put it off until a night or two before it's due. Please note the following **Important Problem Set Rules**:

1. Problem sets are due **in class** at the **start** of class.
2. Problems must be in the same order as listed in the assignment.
3. **Write legibly**, and leave margins on all four edges of your pages.
4. Multiple pages must be **clipped** or (preferably) **stapled** together, not merely folded at the corner.
5. Don't write on any sheet in the corner where the staple/clip is going to go.
6. Your name must be written on all sheets, in case they get separated.
7. If you worked with other students or got help from a source other than me or the book, then say so explicitly on the first page of your problem set. (See the discussion below on the Statement of Intellectual Responsibility.)
8. The Problem Sets grade for any late problem set will be substantially reduced. The later it is, the greater the reduction; see the course webpage under "Problem Set Rules" for details.

I am often willing to grant penalty-free extensions on problem sets; but see "Extensions, Extra Office Hours, and Class Attendance" on page 4.

I strongly encourage you to work on problem sets together, in pairs or small groups, provided you follow the common-sense guidelines below.

About the Statement of Intellectual Responsibilty

Exams: Your work must be entirely your own, so no looking at other people's papers, no talking to each other or passing signals, and no outside help. Unless I specifically allow it, no aids like calculators, cell phones, books, notes, or cheat sheets are allowed.

Problem sets: I urge you to collaborate with each other, under the following ground rules:

1. If you collaborate with, say, Jane and Joe, write a note on the front of your problem set saying, "I worked with Jane and Joe." (Please make sure your name stands out from Jane's and Joe's, so I know that **you** are the author.) Use similar notation if you get help from a fellow student, a tutor, another professor, another book, the web, etc. If you got help from me or from our textbook, however, you don't need to write that.
2. Working together does not mean that Joe does the first half of the problem set and Jane does the second half; everyone should work on every problem.
3. Each student must hand in his or her own problem set; you can't hand in a single packet as the work of multiple people.
4. Each student must write up each problem **in his or her own words**. Working together means discussing the problems. Copying someone else's solution (even when the source doesn't mind) is plagiarism and a violation of intellectual responsibility.

A common question: What if Joe asks Jane about a problem she has already solved? If Joe simply copies Jane's solution, both Joe and Jane would be guilty of academic dishonesty, leading to an F in the course for both of them and potentially to dismissal from the college. Instead, Jane can explain her solution to Joe (even showing him what she wrote), before Joe writes up his own solution himself, **in his own words**. Joe would then have to write that he got help from Jane (see rule 1 above), but Jane doesn't need to write anything unless she also got help in return.

If at any time you aren't sure about what's OK and what's not as far as intellectual responsibility is concerned for this course, talk to me about it.

Extensions, Extra Office Hours, and Class Attendance

Attendance: You should be at every class meeting, and you should be on time. I do not plan to take formal attendance — although I reserve the right to do so, and to modify the grading scheme appropriately, if it becomes a problem — but I will easily be able to tell who misses class too much. Of course, if you're sick, have a religious conflict, or the like, just let me know (in advance, when possible). In addition, if you happen to oversleep or otherwise accidentally miss class, that's fine if it only happens once or twice; that happens to the best of us. Otherwise, however, **I expect you to be in class, and on time, for every class meeting**.

Extensions: You may request **up to two** homework extensions over the course of the semester, each one until the start of the **next** class meeting at the latest. To claim an extension, you must:

1. Not have taken more than one previous extension,
2. Request the extension (by email, by phone, or in person) **no later than 7pm the day BEFORE the due date**,
3. Have been attending class and handing in homework on time in the recent past, and
4. Attend class **on time** on the original due date **and** the following day that the class meets (which is your new due date).

Note: you do **not** need to provide an excuse or reason for your extension request; just ask.

Office Hours: you are always welcome to attend my regularly scheduled office hours. In addition, **IF you have been attending class and doing the homework**, you are also welcome to make appointments to see me outside of my regularly scheduled office hours.

What to Expect

Abstract Math: For most of you, Linear Algebra will be the most abstract math course you have taken yet. But although it might sound scary at first, abstraction is just a way to cover lots of similar situations in one stroke. And we will see **lots** of examples to illustrate abstract concepts.

Proofs: To answer two common questions:

- **Yes**, you will have to do some basic proofs on a regular basis in Math 271.
- **No**, I don't expect you to have ever done proofs before.

Math 271 is a good first course for learning proofs. Proofwriting requires both strategy and meticulous attention to detail, but you'll have plenty of example proofs in the book and in my lectures to help guide you. And if you're still stuck, visit my office hours or see Rosy or Obinna.

Homework Solutions: Individual homework problems, whether computational or theoretical, will require more strategizing and scratchwork than you may be used to. Please note:

- **Computations**: Show every step and all your work, **using words** along the way.
- **Proofs**: I'll model lots of proofs in class. So **follow my models**!
- **All problems**: Use **complete sentences** and **well-written paragraphs**.

Of course, equations will usually appear, too, and you can certainly use abbreviations and standard mathematical shorthand. But fundamentally, solving any mathematics problem, whether computational or theoretical, is about making an argument using **words**.

Start on Scratch Paper: Please take pride in handing in neat and organized written work in math courses. In particular, unless a given problem is a **totally** straightforward computation,

Don't start working on a problem on the same piece of paper that you will hand in.

Instead, start the problem on scratch paper, to figure things out **before** you write anything about that problem on the piece of paper that you will hand in.