Linear Algebra
MATH 232
Spring 2005
MWF 8:00–8:50 Thompson 316
Th 8:00-8:50 Thompson 311

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Course Overview and Text

This course represents the stepping stone between the calculus sequence and upper division math courses. In successfully completing this course, a student should

- develop understanding of the concepts of linear algebra;
- develop facility with the computational techniques of linear algebra; and
- become proficient in reading and writing mathematical proofs.

We begin the course with a look at solving *systems of linear algebraic equations*. We introduce *matrices* and *vectors* as computationally efficient tools for solving linear algebraic systems. Vectors and matrices themselves then become the focus of our interest and they take on a life of their own. With vectors, we study the ideas of *vector operations, linear combinations, spanning sets,* and *linear independence*. With matrices, we study the ideas of *matrix operations, range, matrix multiplication,* and *matrix inverse*. From these concrete objects (vectors and matrices), we abstract a general notion called a *vector space*. For vector spaces, we study the important ideas of *subspace, basis* and *dimension*. We then look at *the eigenvalue problem* for matrices. The analysis of *dynamical systems* is an important application requiring the use of eigenvalues and eigenvectors. We then look at *linear transformations* as the abstraction of how matrices interact with vectors.

Throughout the semester we will develop skills in reading and writing mathematical proofs. The structure of mathematics is contained in definitions, axioms, theorems, and proofs. "Doing mathematics" often culminates in proving a theorem. Linear algebra provides an ideal setting in which to gain expertise in proving theorems because the basic definitions are clear and straightforward.

Course Texts

The main text for this course is *A First Course in Linear Algebra* (version 0.30) being developed by Rob Beezer here at UPS. This text is freely available (in PDF) on the web at `linear.ups.edu`. You can obtain a PDF version for yourself.

Version 0.30 is a nearly complete draft. We will arrange for you to purchase a printed copy of the entire Version 0.30 at the cost of printing. Details will given in class. I will distribute copies of the first few sections in class to use until the full printed copy is available.

Version 0.30 does not contain a sufficient number of problems for this course. To supplement the main text, we will use *Introduction to Linear Algebra*, 4th or 5th ed., Lee W. Johnson, R. Dean Riess, and Jimmy T. Arnold. Most assigned problems will come from this supplementary text.

An optional text for the course is *The Nuts and Bolts of Proofs* by Antonella Cupillari.

Course Web Pages

Web pages for this course are located at

`www.math.ups.edu/~martinj/courses/spring2005/m232/m232.html`

You can get to this page by following links at `www.math.ups.edu/~martinj`. The web site will have a list of assignments and due dates. I will also post announcements and comments about questions or issues that come up in class. You should check the web site for new announcements several times each week. Class handouts will be available to download as PDF files.

Grading, Coursework, and Policies

In class, we will discuss new material, respond to questions from reading the text, and work through assigned problems on which there are difficulties. When we discuss new material, the focus will be on "the big picture." That is, we will look at new ideas in their simplest form and how these ideas fit together. Often, we will not consider details and variations in depth during a first pass through new material.

Your mastery of the details will begin outside of class with a careful reading of the text and work on the assigned problems. We will address the details by responding to questions on the reading and problems that you bring to class. You are expected to participate in class by being present (and alert), by responding to questions I pose, and by asking the questions that you have.

Outside of class, you should read the relevant sections of the text carefully. This will generally include working through the reasoning of arguments and filling in steps that are omitted in calculations. You should keep a list of specific questions from the reading and find answers to those questions either in class, with me outside of class, with study partners, or with a tutor.

Coursework will include homework problems, exams, and a comprehensive final exam.

Homework problems are essential in building understanding and skill. I will assign homework problems from the textbook on which I expect you to spend considerable time and effort. For many sections, I will designate a few problems to be turned in and evaluated. The problems that I evaluate will focus more on developing and writing proofs than on computations because it is often difficult for students to assess the validity of their own proofs. You should not get in the habit of focusing only on the problems designated to be turned in. You will need to do many more problems in order to become facile with concepts, techniques, and applications.

The Department of Mathematics and Computer Science has designated this course as part of the university's Writing in the Major requirement. I will expect you to write proofs for submission that conform with the standard conventions for writing in mathematics. We will discuss this in class before the first assignment is due and throughout the semester. I will evaluate submitted proofs on both content and writing.

In order to assess your learning, we will have five exams and a final exam. There will be five exams during the semester with exact dates announced at least one week in advance. In order to lower the pressure of time on exams, we will have exams on Thursdays from 8:00 to 9:20. I write exams so that approximately three-fourths of

each exam is "straightforward" and the remainder involves more challenging problems. By this, I intend that a well-prepared student can do the "straightforward" problems without hesitation but will often or always have to struggle with the challenging problems.

The final exam will be comprehensive. It is scheduled for 4:00-6:00 pm on Monday, May 9. It is University policy that no exceptions can be made for taking a final exam at the scheduled time. Please do not make travel arrangements that conflict with the scheduled final exam time.

To determine course grades, I calculate a total course score with assignments weighted at 25%, exams weighted at 60%, and the final exam weighted at 15%. I assign a preliminary course grade based on an objective standard (93.3-100% for an A, 90.0-93.2% for an A–, 86.7-89.9% for a B+, 83.3-86.6% for a B, etc.). I then look at each student's performance subjectively. Occasionally I will assign a course grade that is higher than the objective standard. For example, if a student has a grade of B according to the objective standard but has shown steady improvement, I might assign a course grade of B+.

Office Hours

I am generally available in my office for help several hours each day. I am often in my office during the day in hours at which I do not have a scheduled class, meeting, or other activity. You can see my weekly schedule at

`www.math.ups.edu/~martinj/schedule.html`

Feel free to come look for me. To be (almost) guaranteed that I will be in, come during one of the hours labeled as an "office hour." You can also call, send e-mail, or stop me after class to schedule an appointment for a specific time.

Important Dates for Spring 2005

Tuesday, January 25	Last day to add a course
Monday, January 31	Last day to drop a course without record
Monday, February 14	Last day to drop a course with an automatic W

Note that University policy mandates a grade of WF if you drop a course after Monday, September 27 unless "there have been unusual circumstances beyond the student's control and the student's work has been of passing quality." For full details, see the Academic Policies section of *The Logger*.