Fall 9-1-2000

MATH 221.01: Linear Algebra

Mark Wilson
University of Montana, Missoula

Math 221 Linear Algebra Fall 2000

Lectures MWF 11:10-12, Math 305; T 11:10-12, Math 306

Instructor Dr. Mark Wilson

Office Math 102

Office Phone 243-6941

Email wilsonm@member.ams.org

Office hours to be arranged at first class meeting

Linear algebra is the study of vector spaces and linear transformations. It has its roots in the study of linear equations, and in the geometrical notion of vector. It unifies these subjects conceptually and is absolutely fundamental to further work both in mathematics and applications. It is conceptually simpler than calculus. One can never know too much linear algebra!

Linear algebra could equally well be called linear algebraic geometry. Geometric intuition is often helpful, but for proofs that will convince we usually introduce coordinates, reduce everything to algebra and solve equations. Both algebraic and geometric thinking are useful in this course, and some of the algebra may be slightly more abstract than you have seen before.

There are several different ways to approach the subject matter, though they are all equivalent. Different authors emphasize different aspects and develop the material in a different order, but in a course such as this one they mostly end up covering the same topics. You are encouraged to look at several treatments to find what is best for you. Several books are on reserve in the Mansfield library. The *required text* is Schaum's Outline (Lipschutz); this is really a problem book with worked examples rather than a textbook and will be supplemented by handouts from the instructor. Please *read* the handouts before coming to class, because you may be asked to discuss them.

Unlike the case with calculus, it is possible to prove everything in a first course on linear algebra. We shall do this, and students are expected to gain some facility in simple proofs. A goal of this course is to improve the students' ability to cope with abstraction.

Computations in linear algebra can be rather involved though the basic procedure is straightforward. We will use the computer program MATLAB to investigate numerical examples that are too big to do by hand. However, you must learn how to carry out small computational examples by hand.

The *topics* covered will include at least: linear equations, vectors and geometry, axiomatic treatment of vector spaces and linear transformations (subspaces, spanning, independence, basis, dimension, etc), matrices and matrix computations, eigenvalues and eigenvectors, norm and inner product. It is likely that some other, less major topics will be touched on.

The *assessment* for the course will be based on 2 midterm exams plus a final (80%) and some combination of homework/quizzes/computer lab assignments (20%).

I am experimenting somewhat and teaching this class differently from the way I have in the past. Writing notes takes much more time for me than using a standard textbook. There will likely be less micro-management of your homework. In return for this freedom and saving of money, I want you to take responsibility for your own learning. Come to office hours, read the notes and think hard about them, do the homework even if it is not collected, read the reserve books, talk to your classmates and ask questions in class. If you do it will all come together in your mind by the final exam, and if you don't, it won't.

Information Sheet: Math 221 Applied Linear Algebra, Fall 2000

Catalog Description: U 221 Linear Algebra 4 cr. Offered autumn and spring. Prereq., MATH 153. Vectors in the plane and space, systems of linear equations and Gauss-Jordan elimination, matrices, determinants, eigenvalues and eigenvectors, vector spaces, linear transformations. Calculators and/or computers used where appropriate.

Teachers:

Section 1: Mark Wilson, Office: Math 102 Phone: 243-6941 e-mail: mwilson@selway

Section 2: Greg St. George, Office: Math 205a Phone: 243-4146 e-mail: stgeorge@selway

Tutorial Scholar: Molly Shulte, Corbin 367

Text: Seymour Lipschutz, *Linear Algebra.* 2nd Ed. Shaum's Outline Series. This text will mostly serve as a source of practice problems.

Important Dates:

- **25 Sept.** Last Day to Add/Drop using Dial-a-Bear. Last day to Pay Fees. Last day to receive full refund for drops.
- **16 Oct.** Last day to drop using drop/add form. After this drops will appear on transcript (WP or WF) and a fee will be assessed. Last day to change grading options.
- 7 Nov. Election Day (No Class)
- **10 Nov.** Veteran's Day (No Class)
- **22-24 Nov.** Thanksgiving Vacation

Topics: In no particular order, we will probably cover:

- **Vectors in $\mathbb{R}^n$:** Orthogonality, Inner products and Length, Projections, Subspaces, Graham-Schmidt.
- **Matrices:** Introduced as Maps (see below). Operations, Applications, Determinants
- **Linear Maps $\mathbb{R}^n \to \mathbb{R}^m$:** Kernel and Range spaces and their dimension, "transpose maps"
- **Systems of Equations:** Gauss-Jordan Elimination and LU decomposition. Geometrical Interpretation.
- **Vector Spaces:** Dependence, Independence, Bases.
- **Eigenvalues:** Eigenvectors, Symmetric Matrices.

Depending on time constraints, we may also cover Singular Value Decompositions.

Grading: This will be individual to the sections.

Software A scientific calculator is helpful. We will be introduced, briefly, to the software MATLAB during the course.

On reserve:

Halmos, Paul, *Finite Dimensional Vector Spaces*
Lang, Serge, *Linear Algebra*
Marcus, Marvin, and Minc Henryk, *Elementary Linear Algebra*
Strang, Gilbert, *Linear Algebra and its Applications*
Zelinsky, Daniel, *A First Course in Linear Algebra*