MATH 3000 SYLLABUS

Spring 1999

At the moment we have not settled on a universal textbook, although recently several instructors have used the text by Adams and Shifrin. Below are listed the "standard" topics that every course should cover, along with section numbers in that text and an approximate time allotment (under a MWF teaching schedule).

MATH 3000, as the numbering suggests, is one of our "transitional" or "bridge" courses, in which students must be learning to come to terms with definitions, abstract concepts, and proof writing, *along with* computational skills. Homework and tests—not just the lectures—should contain a significant percentage of proofs. (For example, we should strive for every C student to be able to check whether some subset of $\mathbb{R}^n$ is a subspace, every B student should be able use the definition of linear independence to prove that if $\mathbf{v}$ and $\mathbf{w}$ are linearly independent vectors, then so are $\mathbf{v}+\mathbf{w}$ and $2\mathbf{v}-\mathbf{w}$.)

There should be some discussion of linear transformations and of the interplay between linear algebra and geometry (of particular importance for the mathematics education students). Some nice topics are: rotations and reflections, the interpretation of determinant as signed volume. Hopefully, no matter the text, students should come to understand that a subspace can be specified in two ways:

(i) implicitly: cutting it out by equations (e.g., $\mathbf{N}(A)$ for an appropriate matrix A);
(ii) parametrically: giving a basis for it (e.g., $\mathbf{C}(B)$ for an appropriate matrix B).

Students should understand completely how to go back and forth between these, as well as the relevance of the fundamental equations

$$\mathbf{R}(A)^{\perp} = \mathbf{N}(A) \qquad \text{and} \qquad (V^{\perp})^{\perp} = V.$$

The course should also include discussion of eigenvalues and eigenvectors, along with some substantive application(s). If you have time to cover the Spectral Theorem and its applications to quadratic forms, all the better.

Here is a list of (suggested) topics for the course, together with a breakdown by sections in T. Shifrin and M. R. Adams, *Linear Algebra: A Geometric Approach*, to appear.

Topic	Recommended Supplements	Sections	Days
Vectors, dot product		1.1–1.2	4
Systems, Gaussian elimination		1.3–1.4	3
Theory of linear systems		1.5	2
	Applications	1.6	2
Matrix algebra		2.1–2.3	4
Vector spaces		3.1–3.4	7
	Abstract vector spaces	3.6	2
Least squares, orthogonal bases		4.1–4.2	3
Linear transformations, change of basis		4.3–4.4	3
Determinants		5.1–5.3	3
Eigenvalues and eigenvectors		6.1–6.2	3
	Applications	6.3	2
	Spectral Theorem	6.4	2
	Computer graphics	7.1	
	or		2
	Matrix exp and DE's	7.2	
		<u>Total</u>:	42