MATH 23a, FALL 2003
THEORETICAL LINEAR ALGEBRA AND MULTIVARIABLE CALCULUS I

Course Head: John D. Boller, SC 320, 495-5377, `boller@math.harvard.edu`

Course Meetings: MWF from 11-12 in a location TBA Additional weekly problems sessions will be led by the course assistant(s), and you are encouraged to visit me in my office hours, which will initially be M and W from 12–2, and T from 2–4.

Prerequisites: A strong background in one-variable Calculus and an interest in theoretical mathematics. Prior familiarity with multi-variable Calculus and/or linear algebra is not required.

Topics: (For Math 23a and 23b) The Real Numbers, the algebraic and topological structure of Euclidean space, Finite and Infinite-Dimensional Linear Algebra including eigenvalues and eigenvectors of matrices and systems of linear differential equations, Functions of Several Real Variables including differentiation and integration of such, the Classical Theorems of Vector Analysis, etc.

Goals: Besides learning the content descibed above and in the more detailed list below, it is one of the main goals of the course that the student learn to read, understand, and construct mathematical proofs and learn the nature of mathematical argument.

Exams and Grades: There will be one midterm exam (20%) and one final exam (30%) and the possibility of several in-class quizzes (10%), but by far the greatest portion of your work (in terms of time-commitment and grade) will be devoted to homework (40%).

Texts: There are two required texts, "Matrices and Linear Algebra," by Hans Schneider and George Phillip Barker (Dover, ISBN # 0-486-66014-1) and "Advanced Calculus of Several Variables," by C. H. Edwards, Jr. (Dover, ISBN # 0-486-68336-2) which are available at the Harvard COOP. These will form the basis of our investigations, but you are strongly encouraged to use other sources as well. There is an official course bibliography on the website and some works will be put on reserve in Cabot Library and the Birkhoff Mathematics Library.

Learning to read mathematics texts is an integral part of the course. Some authors have clearer expositions of certain topics, and some arguments make more sense to different readers, and you are encouraged to explore topics presented in different manners. If you find an author you like, you are encouraged to follow his or her development of the material, but the course as a whole will follow the texts listed above.

Homework: Homework problems/proofs are the essential part of this course. You will spend more time on homework than on any other aspect of the course, and it is weighted accordingly.

Homework will be assigned weekly and will, in general, be due on Friday. Your course assistant will return your corrected homework to you within the following week. He/she will also put homework solutions on reserve at Cabot Library, and we expect to have solutions available on the website.

You are strongly encouraged to keep up to date with the homework, otherwise you will find that you do not get all you should out of the classes, and it will become increasingly difficult to catch up again.

You are encouraged to collaborate on homework problems! Mathematics is not a go-it-alone subject, and you should work together in groups, consult with the course assitant(s), and meet with me about any homework problem or any aspect of the course. The only requirement is that, after collaboration to determine a good line of argument, you write up the solutions *yourself*. This cannot be emphasized enough as the shortest route to success in mathematics is to develop the ability not just to do it but to communicate it, and the best way to develop this skill is to write proofs and work problems.

Approximate Syllabus: In the fall semester, we will cover most of Schneider and Barker (chapters 1 and 3–7) and Chapter 1 from Edwards.

Schneider & Barker	Ch. 3	Vector Spaces
Schneider & Barker	Chs. 5 and 1	Linear Transformations and Matrices
Schneider & Barker	Ch. 4	Determinants
Schneider & Barker	Ch. 6	Eigenvalues and Eigenvectors
Edwards	Sect. 1.3	Vector Spaces with an Inner Product
Edwards	Sect. 1.8	The Topology of Euclidean Space $\mathbb{R}^n$
Edwards	Sect. 1.7	Continuity, Compactness, and Connectedness