Math 20 Fall 2003
Application Project Description

The linear algebra and multivariable calculus ideas we will study this semester have applications in a variety of fields. Learning about the ways in which mathematical ideas are applied to problems from other disciplines is one of the goals of this course. To that end, you will be required to complete an application project during the semester.

The application project should demonstrate your understanding of a particular problem from the social sciences or other discipline, the mathematical concepts and techniques that can be used to solve the problem, and the ways in which mathematical modes of thought are brought to bear on the problem. The project should be an extension of mathematical ideas or applications seen in this course.

The project will take the form of a properly formatted paper of an appropriate length. Most papers should be between 5 and 10 pages (double-spaced), but the amount and type of mathematical notation may result in some longer papers. Several software packages enable one to include mathematical notation in a document, including Microsoft Word (through its Equation Editor tool), Mathematica, and various implementations of TEX. Please ask me if you need help using one of these software packages.

The paper should be written as if to a fellow student in Math 20. Thus you may assume that your audience is familiar with the material we have covered together as a class this semester. You will be graded not only on the depth of your understanding of the application you choose, but also on the clarity of your explanations. Grammar and presentation will be factored into your grade to a lesser extent.

You must include at least 3 references in your project. At least 2 of your references must be print media (i.e., non-Internet). Your textbook does not count toward these reference requirements, although you may cite your textbook. A list of references must appear at the end of your paper, formatted appropriately.

You might find a computer algebra system such as Mathematica or Maple helpful in solving the problem you choose for your project, especially if your problem involves real data. See Dr. Bruff for a short tutorial on how to use these software packages to solve linear algebra problems.

Whatever else you do, do not plagiarize! Cite your sources, and consult your student handbook for more information on plagiarism.

You may work with one other student on a joint project. You are responsible for sharing the workload with your partner fairly. Joint projects should be greater in either quality or quantity (that is, depth or breadth) than projects submitted by single students.

In order to assist you in choosing a reasonable scope for your project, the topic and outline of your project must be approved by me by Monday, December 8, 2003, at 5 p.m. You should meet with me for a brief discussion of your project prior to that time in order to obtain that approval. Failure to obtain approval will result in the loss of a letter grade on your project, and could have worse consequences if you choose an inappropriate topic or scope. You are welcome to meet with me more than just the one time if you need help with deciding on a project.

The project is due on Monday, December 15, 2003, at 5 p.m. Late projects will not be accepted. You are welcome to turn in your project early if you wish. However, no extra points will be given to projects turned in early.

The following are some possible project topics.

1. *Linear Programming:* Describe the simplex method and its history. Use the method to solve a linear programming (in more than three variables) drawn from business or some other discipline.

2. *Leontief Economic Models:* Describe the open Leontief economic model and its history. Use the model to analyze a relatively simple economy, perhaps one involving actual (if simplified) data.

3. *Game Theory:* Show how the question of finding optimal strategies for a two-person zero-sum game can be described as a linear programming problem. Use geometric linear programming techniques to find the optimal strategies for a particular game.

4. *Markov Chains:* Analyze the classic real estate board game Monopoly as a Markov process. Determine optimal strategies using Markov chain techniques.

Other topic ideas can be found in the sections of Chapter 11 that we have not covered this semester. Sections 11.7 (graph theory), 11.10 (forest management), and 11.19 (harvesting of animal populations) are the sections most relevant to the social sciences.

The textbook *Linear Algebra and Its Applications*, 3rd edition, by David Lay, is another good source of topic ideas. The textbook is available on reserve in the mathematical textbooks section of Cabot Science Library. The inside front cover gives an index to the linear algebra applications described in the textbook. Additionally, the textbook's web site, `http://www.laylinalgebra.com/`, contains about two dozen case studies and application projects, some of which would make excellent topics.