MATH 524 (Section 1) – Nonlinear Optimization

Instructor Professor Doug Meade

Office Hours:	MW 4:00 – 5:00, Th 8:30 – 9:30 and by *prior* appointment
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WWW URL `http://www.math.sc.edu/~meade/math524-F00/`

Meeting Times MWF 10:10AM– 11:00AM, LC 401

Text A. L. Peressini, F. E. Sullivan, and J. J. Uhl, Jr., *The Mathematics of Nonlinear Programming* Springer–Verlag, 1988.

Prerequisite Completion of MATH 526 or 544 with a grade of C or better; or consent of the Mathematics Department.

Overview The fundamental problem that is addressed in any course in nonlinear programming is to find the optimal (maximum or minimum) values of a nonlinear function on a prescribed domain. ("Program" is a synonym for "problem" that gained popularity during World War II.)

Our investigation of these problems will make use of your background in (Differential) Calculus and Linear Algebra. In particular, we will generalize the First and Second Derivative Tests for local and global extrema for functions of n variables.

The second major topic is convexity. You may know the difference between a convex lens and a concave lens. The mathematical usage of "convex" is similar. Once we become familiar with convex functions, we will develop techniques for solving optimization problems that involve convex functions that avoid much of the tedious computations of the calculus-based methods.

Iterative methods for the solution of optimization problems complement the direct algorithms based on calculus and convexity. Newton's Method can be used to find the zero of a function. We will develop a version of Newton's Method for functions of n variables and then see how this can be applied to find extrema of a function. Other iterative methods will also be discussed.

A common problem that is encountered in scientific, statistical, and business applications is to make predictions from a collection of data. If we knew the function that produced the data, the prediction would be available. The problem of finding the "best" function that is consistent with the data is a nonlinear optimization problem. A combination of ideas from geometry, calculus, and linear algebra will be used to develop solutions to this type of problem.

Course Content The majority of the semester will be spent understanding the first four chapters of the text. Additional material will be included as time permits.

Chapter 1: Unconstrained Optimization via Calculus
Chapter 2: Convex Sets and Convex Functions
Chapter 3: Iterative Methods for Unconstrained Optimization
Chapter 4: Least Squares Optimization

Grading Your grade in this course will be based on your performance on homework, two (2) mid-term exams, and a final exam. The weights assigned to each of these components will be:

Homework	25%
Mid-term exams (2)	50%
Final exam	25%

Course grades will be determined according to the following scale:

A	90 –100
B	80 – 89
C	70 – 79
D	60 – 69
F	0 – 59

Note that the deadline to drop this course with a grade of W is Thursday, October 5, 2000.

Exams There will be two (2) exams during the semester. *Tentative* dates and topics for these exams are:

Friday, September 29
Friday, November 17

There will be no make-up exams. If you miss one exam due to a documented reason of illness, family emergency or participation in a University sponsored event, your score on the final exam will be used to replace the missing exam score. Excuses such as oversleeping, forgetting the time or location of the exam, and lack of studying are explicitly noted as unacceptable grounds for missing an exam.
A comprehensive final will be given at 9:00AM on Friday, December 15, 2000.

Homework Homework problems will be announced for each section that we discuss. The assigned problems will be collected each week, typically on Monday. You will have an opportunity to ask questions before the homework problems are collected, particularly on Fridays. Homework papers are collected at the beginning of the class in which they are due. Your homework grade will be determined from your nine (9) highest homework scores.
No late homework will be accepted for a grade.

Study Hints Before each class, you should both review the material from recent sections and read the section to be discussed that day. This will allow you to both understand my presentation of new material and identify questions that you have about earlier material.

Attendance Regular class attendance is important. Consistent with the USC Undergraduate Bulletin, a grade penalty may be applied to any student missing more than four classes (10%) during the semester.

Academic Honesty Cheating and plagiarism will not be tolerated in this course. You are encouraged to discuss homework problems with others. Violations of this policy will be dealt with in a manner consistent with University guidelines.