CSCI 628
Introduction to Linear Programming

Fall 2006

Instructor

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Course meeting times

MWF 1–1:50pm, Jones 301

Office hours

Monday and Wednesday from 2-3:30pm.

Description

This course is an introduction to linear programming, i.e., optimizing a linear objective function over a set of linear constraints. Linear programming is a fundamental tool in mathematical modeling, and we will examine several different applications. The main mathematical goals of this course will be to discuss how to formulate and solve linear programs. The fundamental material of this course was discovered by George Dantzig in the 1940s and, independently, Kantorovich in the late 1930s, although the underpinnings stretch back further to Fourier, Farkas, Minkowski, and others from 1870 - 1930. Topics discussed include formulating linear programming, duality, the simplex method, and network flow problems.

Required background

Familiarity with linear algebra is assumed (MATH 211 or equivalent).

Course text

Introduction to Linear Optimization, by D. Bertsimas and J. Tsitsiklis. Lieberman.

Homework

Homework will be given on roughly a weekly basis. In general, the homework will entail a reading assignment and a corresponding problem set and/or programming assignment.

Please note: You are encouraged to discuss homework assignments with each other, and allowed to consult references (both electronic and in hard copy), but no copying is allowed. You are REQUIRED to cite any and all sources, including your classmates and myself, in your homework. Please list all sources used at the end of each homework assignment.

NO LATE HOMEWORK WILL BE ACCEPTED.

If you have any questions about the homework (or any other class) policy, please feel free to ask me.

Lecture notes

In addition to the homework, each student will be required to type up a week of lectures into class notes. These notes must be typeset in Latex.

Exams

There will be one midterm exam, tentatively scheduled on 10/25, and one final exam, scheduled for 12/11 on 1:30 - 4:30 pm.

As the date for the midterm approaches, we will discuss when the best day is. College policy dictates both when the final exam is scheduled and what should be done if there is any conflict. I advise all students to review the final exam policies and resolve any possible conflicts as soon as possible. In particular, note that the last day of classes is the last possible date the policy allows for any resolution.

Grades

Your grade will be calculated based on the following:

Homework	20%
Lecture notes	10%
Class Participation	10%
Midterm	20%
Final	40%

Please note that Class Participation includes attendance.

Tentative course outline

1. Introduction to linear programming
   (a) What is a linear program?
   (b) Background: linear algebra
   (c) Background: algorithm counts
2. The geometry of linear programming
   (a) Geometric definitions
   (b) A fundamental theorem of linear programming
3. The simplex method
   (a) Optimality conditions
   (b) Development
   (c) Implementations
4. Duality
   (a) Lagrange and the dual problem
   (b) Dual theorems and complementary slackness
   (c) Dual simplex
5. Sensitivity analysis
   (a) Local sensitivity analysis

(b) Global sensitivity

(c) Parametric programming

6. Network flow problems

   (a) Graphs and minimum cost flow problem

   (b) Network simplex

   (c) The minimum spanning tree problem

   (d) The shortest path problem

   (e) The max flow problem

7. Integer programming

   (a) Modeling

   (b) Difficult versus easy integer programs

   (c) Branch and Bound