IE 5531 – Engineering Optimization I
MATH 5711 – Linear and Combinatorial Optimization

IE 5531 – Engineering Optimization I
(cross listed as MATH 5711 – Linear and Combinatorial Optimization)
4 Credits
Class Hours: Mondays and Wednesdays from 10:10am-12:05pm
Fall 2009
Course Website: http://www.me.umn.edu/education/courses/ie5531/

Instructor
Bharath Rangarajan
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Office hours: Tue 3pm-5pm, Thu 1pm-2p. I am eager to talk to you about any concerns you may have. You can communicate by telephone, e-mail, or in person. Make an appointment to see me when needed.

Teaching Assistant
Xi Chen
Office Hours Meeting Place: TBA
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Office Hours: Wed 1pm-3pm, Fri 1pm-3pm.

Textbook Optimization in Operations Research by Ronald L. Rardin

Course Description
Welcome to IE 5531/MATH 5711. This course will introduce you to basic mathematical models and solution methods that are useful in decision applications where best use of resources must be decided in contexts such as personnel scheduling, natural resources management, banking and finance, new product development, airline fleet management, etc. The applications chosen will illustrate the use of the linear programming model where we maximize or minimize a linear function subject to constraints that are formulated as linear equations and/or inequalities. Surprisingly, many applications are amenable to modeling as a linear programming problem. The course will introduce in details the simplex method used in state of the art software for solving linear programs and also illustrate how to interact with and use software to model and solve linear programs. The course will in its tail end also describe more complex decision models and methods to solve those models.

At the formal level we will introduce and study the linear programming problem. We will also cover formulation of sensitivity analysis, Lagrangian duals, complementary slackness conditions and activity analysis. The course will also introduce solution methods for assignment problems, transportation problems, network flow problems and illustrate the dynamic programming algorithm.

Prerequisites
Students should have a background in linear algebra and calculus, and a familiarity with vector and matrix notation and calculus. See the instructor at the start of the course if you are not familiar with performing matrix operations, such as multiplying matrices, finding the inverse of a matrix, determining if a matrix is singular, dependent vectors, bases, etc. The students are required to know calculus techniques include taking derivatives of single-variable functions and finding partial derivatives of multivariate functions.

Student Learning Objectives

- Can identify, define, and solve problems
- Can locate and critically evaluate information
- Can communicate effectively
- Have acquired skills for life-long learning.

Course Topics

- *Formulation* and *Classification* of Optimization Models (Chapter 2)
- Formulation of *Linear Programming* Models (Chapter 4)
- *Improving Search*-Based Optimization Algorithms (Chapter 3)
- *Simplex* and *Revised Simplex* algorithms for LP (Chapter 5)
- *Interior Point Methods* (Chapter 6)*
- *Duality* and *Sensitivity Analysis* (Chapter 7)
- *Shortest Path* Models and *Dynamic Programming* (Chapter 9)
- Formulation and Structure of *Network Flow* Models (Chapter 10)
- Integer Programming and Branch and Bound Techniques.
- Formulation and Solution of *Unconstrained Nonlinear* Models (Chapter 13)*
- Formulation and Solution of *Constrained Nonlinear* Models (Chapter 14)*

Class Structure

Classes will be primarily lecture based. Class participation is highly encouraged, including asking questions during lecture and answering instructor-posed questions. Short, informal, in-class student activities will also be given regularly.

Weekly Assignments

- Homework will be assigned weekly.
- You are encouraged to work together on homework assignments, but all final answers **must** be written individually, without looking at another student's answers. Look at the section on academic integrity. Ask the instructor if you need any clarification.
- You are responsible for presenting your work with clarity, with attention to detail.
- Reading assignments from the textbook will be included in the weekly assignments to prepare you for the following week. There will be supplementary material available on the course website on topics discussed in class.
- Only two assignments will be allowed to be late by 48 hours. Any additional late submissions will be penalized for 10% of the assignment score.

Some assignments may require use of Excel Solver or OPL Studio software, available in the ITLABS computer lab in ME 308. Non-degree students will need to turn in a waiver form as well.

Project

Teams of 3 or 4 students will perform a case study on a decision problem that requires quantitative analysis using the tools and concepts learned during the course. You will be asked to present final recommendations on the best decision(s) to implement as well as alternative scenarios and decisions that ought to be considered.

Dates
Mid Term I: Oct 14 (Wednesday)
Mid Term II: Nov 16 (Monday)
Project Handed Out : Nov 16 (Monday)
Project Due: Dec 14 (Monday)
Last Day of Classes : Dec 16 (Wednesday)
Final Exam: 8:00am-10:00am Tuesday, December 22 in Civil E 212.

Grades Final grade averages will be computed as follows:

Midterm 1	15%
Midterm 2	15%
Homework	30%
Project	10%
Final Exam	30%

Academic Integrity (IMPORTANT)
The students are encouraged to work together on the homeworks. But the interaction must be restricted to discussion of ideas. The solutions **must be** written individually. For more information on standards of acdemic integrity and plagiarism see the Regents Policy : University Student Conduct code(pdf file). Also see related resources available on the website of the Office for Student Conduct and Academic Integrity. If you need any further clarification, contact the instructor.

Students with Disabilities
Students with disabilities are welcome in this course. If you need any special accommodations, please contact the course instructor before class begins, or any time thereafter. Also, you may wish to contact the Office for Students with Disabilities at 624-4037 for additional assistance.