

OM 380: Optimization 1

Spring 2013

Unique No. 04255

Professor Anant Balakrishnan

Classroom: GSB 5.154

Class time: Tues. 2:00 to 5:00 p.m.

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Office: CBA 6.486

Hours: Mondays, 3 p.m. to 4 p.m.

or by appointment

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Course Description and Objectives

Optimization, using mathematical programming, is one of the cornerstones of management science research and practice. Mathematical programming refers to a broad array of mathematical decision models and underlying optimization methodologies that have applications in remarkably diverse contexts, ranging from management, engineering, and science to public policy and healthcare. Effective use of optimization models and methods to solve practical problems requires applying a structured and systematic approach to define problems, understanding the properties and special characteristics of each problem class, and developing new and effective solution methodologies.

The modern era of constrained optimization began with the development of linear programming, the core branch of mathematical programming. Much of mathematical programming builds upon the principles and concepts underlying linear programming models and solution methodologies. Accordingly, this course will be largely devoted to linear optimization, primarily linear programming, with some coverage of network optimization and integer programming. If time permits, we will also discuss some of the basic principles underlying nonlinear optimization.

Optimization 1 is a foundation course for graduate students who expect to study and apply optimization models and methods. The course aims to provide a strong understanding of the underlying theory and methodologies while also introducing students to modeling, algorithmic development, interpretation of results, and applications. The course will cover the following topics:

- problem representations and basic optimization concepts;
- theoretical principles and properties of linear programs;
- solution methods for linear programs, including the Simplex method and its variants;
- duality theory and sensitivity analysis;
- decomposition methods to exploit special structure in large-scale optimization problems;
- and,
- principles and methods for network optimization, integer programming, and nonlinear programming.

Course materials

The following book chapters will be provided via Blackboard:

- Draft chapters from a preprint of a graduate-level book on Optimization by Professor **Thomas L. Magnanti**, MIT.
- Chapters from the introductory textbook “*Applied Mathematical Programming*” by **Bradley, Hax, and Magnanti**.

Supplementary materials may be provided in class or via Blackboard as needed.

You are also strongly encouraged to purchase and read relevant chapters from the book “*Introduction to Linear Optimization*” by **D. Bertsimas and J. N. Tsitsiklis**, Athena Scientific.

You may also find the following introductory and advanced books useful.

Introductory (for those with no prior exposure to linear programming)

- W. L. Winston. *Operations Research: Applications and Algorithms*, Thomson Brooks/Cole
- V. Chvatal. *Linear Programming*, W. H. Freeman & Company
- F. Hillier and G. J. Lieberman, *Introduction to Operations Research*, McGraw Hill

Advanced

- M. S. Bazaraa, J. J. Jarvis, and H. D. Sherali. *Linear Programming and Network Flows*, Wiley

Course preparation and student evaluation

Before each class, students are expected to read the relevant book sections and chapters (listed in the course schedule). Active class participation—responding to questions, offering explanations and insights, raising interesting issues, and contributing to better understanding the material—is strongly encouraged. The course requirements include regular homework assignments, a mid-term examination, and a final examination.

Homework assignments, approximately one per week, must be turned in at the beginning of class on the day they are due. Unless specified otherwise, homework assignments are *individual* (not group) assignments. Students are permitted to discuss with classmates the broad approach for solving the homework problems, but each student must work out the details (e.g., problem formulations, proofs, computations) and write up the assignment on their own. **Do not copy** answers from other students or other sources (e.g., material from past years, online sources). All questions in each assignment must be answered, but only selected problems may be graded. Homework grades will be based on clarity of work (including specifying assumptions and providing explanations), completeness, and correctness.

The course **exams** may include in-class and/or take-home components. For in-class exams, students are permitted to bring one 8.5 x 11 inch sheet (two-sided) of handwritten notes. Take-home exams must be completed individually, without any discussions or help from other individuals and without consulting materials other than the textbook and class notes.

Grades for the course will be based on class participation and homework assignments (30%), mid-term examination (35%), and final examination (35%).

Feedback

Your feedback is valuable, and facilitates continuous course improvement. Please do not hesitate to let me know, throughout the semester, how to improve the course and the learning experience it provides.

Academic Integrity

By enrolling in this class, you agree to abide by the Honor System. For this course, unless otherwise stated, all assignments and exams should be individual work. For homework assignments, you are permitted to discuss with others in the class the broad approach for answering questions, but you must develop and turn in your own answers (not copied from others). **Do not use or copy any materials (lecture notes, solutions, etc.) from students who have previously taken this course or from other sources (e.g., web, other universities).** If the application of the Honor System to this course is unclear in any way, it is your responsibility to ask for clarification.

Students with Disabilities

Upon request, the University of Texas at Austin provides appropriate academic accommodations for qualified students with disabilities. Information on how to request such accommodation and other policies is available from the Office of the Dean of Students (SSB 4th floor, (512)-471-6259) or online at <http://deanofstudents.utexas.edu/ssd/index.php>.