

**OM 380: Optimization 1**

Spring 2011

Unique No. 04030

***Professor Anant Balakrishnan***

Classroom: GSB 5.154

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

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Office: CBA 6.486

Hours: Wednesdays, 11 a.m. to noon  
or by appointment

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**Course Description and Goals**

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, a major portion of this course will be devoted to linear optimization, primarily linear programming, with some coverage of network optimization and integer programming. We will also discuss, as time permits, 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 of network optimization, integer programming, and nonlinear programming.

**Course materials**

The course will rely largely on the following materials:

- Draft chapters from a preprint of a book on Optimization by Professor Thomas L. Magnanti, MIT.
- Chapters from the book "*Applied Mathematical Programming*" by Bradley, Hax, and Magnanti.

Relevant chapters from these books will be distributed electronically, via Blackboard. For select topics, supplementary materials will be provided as needed

The following books are recommended as introductory or advanced/reference texts. Highly recommended books are shown in bold.

### Introductory texts

- W. L. Winston. *Operations Research: Applications and Algorithms*, Thomson Brooks/Cole, 4<sup>th</sup> edition, 2004
- V. Chvatal. *Linear Programming*, W. H. Freeman & Company, 1983
- F. Hillier and G. J. Lieberman, *Introduction to Operations Research*, McGraw Hill, 9<sup>th</sup> edition, 2010

### Reference texts

- D. Bertsimas and J. N. Tsitsiklis. *Introduction to Linear Optimization*, Athena Scientific, 1997
- M. S. Bazaraa, J. J. Jarvis, and H. D. Sherali. *Linear Programming and Network Flows*, Wiley, 2009

### Course preparation and student evaluation

Students are expected to read before each class 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, algorithms) and write up the assignment on their own. **Do not copy** answers from other students or other sources (e.g., material from past years, web sites). All questions in each assignment must be answered, but only a selected subset of problems will be graded. Homework grades will be based on clarity of work (including specifying assumptions and providing explanations) as well as 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 homework assignments and class participation (30%), mid-term examination (35%), and final examination (35%).

### Academic Integrity

By enrolling in this class, you agree to abide by the Honor System. In particular, **you must NOT use any materials (handouts, solutions, etc.) from students who have previously taken this course or from other sources (e.g., other instructors or universities)**. If the application of the Honor System to this course is unclear in any way, it is your responsibility to ask the instructor for clarification.

### 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.

The University of Texas at Austin provides, upon request, appropriate academic accommodations for qualified students with disabilities. If you have a condition (e.g. learning disability, chronic medical condition, etc.) or event that needs accommodation, please see me early in the semester so that we can take appropriate steps. For additional information about the University's policies, contact the Office of the Dean of Students at 471-6259 or 471-4641.