THE UNIVERSITY OF TEXAS AT AUSTIN
McCOMBS SCHOOL OF BUSINESS

OM 380.15: Optimization I
Spring 2014
Unique #: 04425

Classroom:	CBA 4.342
Lectures:	Mon. & Wed., 11:00 a.m. – 12:30 p.m.

Professor:	**Douglas Fearing**
Office:	CBA 6.458
Office hours:	Wed., 3:00 – 4:00 p.m., or by appointment
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Course Description and Objectives

Optimization through 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 diverse contexts, ranging from management, engineering, and science to public policy and service delivery. Effective use of optimization models and methods requires:

- a structured and systematic approach to defining optimization problems;
- an understanding of the properties and limitations of the chosen problem class; and
- the capability to develop new solution methodologies.

Optimization I is a foundation course for graduate students who expect to study and apply optimization models and methods in their research. The goal of the course is to develop a fundamental understanding of the theory of optimization, while also introducing students to modeling, algorithm development, and applications. The course will cover the following topics:

- theoretical principles of convex sets, functions, and optimization problems;
- geometric interpretations of linear optimization problems;
- general duality theory for convex optimization and sensitivity analysis for linear optimization;
- applications and formulation of linear, nonlinear, and integer optimization problems;
- network flow models and connections to integer optimization; and
- algorithms for solving linear and integer optimization problems.

The modern era of constrained optimization began with the development of the theory and methodologies supporting linear optimization, often referred to as linear programming, with programming used to reference “planning” rather than “coding,” the interpretation associated with software development.

Much of the course will focus on linear optimization, although the course will also provide a solid foundation for future coursework in network, integer, or nonlinear optimization.

Course Materials

The following two textbooks are required for the course:

- *Convex Optimization* by Stephen Boyd and Lieven Vandenberghe.
- *Introduction to Linear Optimization* by Dimitris Bertsimas and John N. Tsitsiklis.

Each of these textbooks provides an excellent reference for the chosen topics, both within the course and to support future optimization-focused research. The lectures will follow closely the material in these two texts.

Course Preparation and Student Evaluation

After each class, students are expected to review the book sections and chapters listed in the course schedule. It is your responsibility to ensure that you understand all of the concepts from the previous lecture before we move on to new material. Class participation – responding to questions, offering explanations and insights, and raising interesting issues – is strongly encouraged and will be incorporated into the final grade. In addition to participation, the course requirements include regular homework assignments, a midterm exam, and a final exam.

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 homework problems, but each students must formalize 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.

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

The grade breakdown for the course will be as follows:

- 10% - Class participation
- 30% - Homework assignments
- 20% - Midterm exam
- 40% - Final exam

Feedback

Feedback regarding the course is always appreciated. Please do not hesitate to let me know, at any point during the semester, if you have suggestions for how to improve the course materials, my lectures, or the classroom learning environment.

Policy on Scholastic Dishonesty

The McCombs School of Business has no tolerance for acts of scholastic dishonesty. The responsibilities of both students and faculty with regard to scholastic dishonesty are described in detail in the BBA Program’s Statement on Scholastic Dishonesty at http://www.mccombs.utexas.edu/BBA/Code-of-

Ethics.aspx. By teaching this course, I have agreed to observe all faculty responsibilities described in that document. By enrolling in this class, you have agreed to observe all student responsibilities described in that document. If the application of the Statement on Scholastic Dishonesty to this class or its assignments is unclear in any way, it is your responsibility to ask me for clarification. Students who violate University rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since dishonesty harms the individual, all students, the integrity of the University, and the value of our academic brand, policies on scholastic dishonesty will be strictly enforced. You should refer to the Student Judicial Services website at http://deanofstudents.utexas.edu/sjs/ to access the official University policies and procedures on scholastic dishonesty as well as further elaboration on what constitutes scholastic dishonesty.

For this course, unless otherwise stated, all assignments and exams should be individual work. **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., the web or other universities)**. For homework assignments, you are permitted to discuss with classmates the broad approach for answering questions, but you must develop and submit your own answers (not copied from others).

Students with Disabilities
Students with disabilities may request appropriate academic accommodations from the Division of Diversity and Community Engagement, Services for Students with Disabilities, 512-471-6259, http://www.utexas.edu/diversity/ddce/ssd/.

Religious Holy Days
By UT Austin policy, you must notify me of your pending absence at least fourteen days prior to the date of observance of a religious holy day. If you must miss a class, an examination, a work assignment, or a project in order to observe a religious holy day, you will be given an opportunity to complete the missed work within a reasonable time after the absence.

Campus Safety
Please note the following recommendations regarding emergency evacuation from the Office of Campus Safety and Security, 512-471-5767, http://www.utexas.edu/safety:

- Occupants of buildings on The University of Texas at Austin campus are required to evacuate buildings when a fire alarm is activated. Alarm activation or announcement requires exiting and assembling outside.
- Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building.
- Students requiring assistance in evacuation should inform the instructor in writing during the first week of class.
- In the event of an evacuation, follow the instruction of faculty or class instructors.
- Do not re-enter a building unless given instructions by the following: Austin Fire Department, The University of Texas at Austin Police Department, or Fire Prevention Services office.
- Behavior Concerns Advice Line (BCAL): 512-232-5050
- Further information regarding emergency evacuation routes and emergency procedures can be found at: http://www.utexas.edu/emergency.

Tentative Schedule (Jan. 9, 2014)

Below is the tentative schedule of material to be covered during the course. The specific sections of required reading will be posted on or before the day of class.

Lecture	Date[1]	Topic	Required Reading[2]
1	Wed., 1/22	Introduction and course overview	BV Chapter 1
2	Mon., 1/27	Convex sets I	BV Chapter 2
3	Wed., 1/29	Convex functions I	BV Chapter 3
4	Mon., 2/3	Convex optimization I	BV Chapter 4
5	Wed., 2/5	Introduction to linear optimization (LO)	BT Chapter 1
6	Mon., 2/10	Linear algebra review	BT Chapter 1
7	Wed., 2/12	LO formulation techniques	BT Chapter 1
8	Mon., 2/17	LO geometry I	BT Chapter 2
9	Wed., 2/19	LO geometry II	BT Chapter 2
10	Mon., 2/24	LO simplex method I	BT Chapter 3
11	Wed., 2/26	LO simplex method II	BT Chapter 3
12	Mon., 3/3	Convex duality I	BV Chapter 5
13		Convex duality II	BV Chapter 5
14		LO duality	BT Chapter 4
	Wed., 3/5	**MIDTERM EXAM**	
15	Mon., 3/17	LO sensitivity analysis	BT Chapter 5
16	Wed., 3/19	LO robust optimization	
17	Mon., 3/24	LO large-scale optimization	BT Chapter 6
18	Wed., 3/26	Introduction to network optimization (NO)	BT Chapter 7
19	Mon., 3/31	NO models and methods	BT Chapter 7
20	Wed., 5/2	Introduction to integer optimization (IO)	BT Chapter 10
21	Mon., 5/7	IO relaxation and formulation strength	BT Chapter 10
22	Wed., 5/9	IO solution methods I	BT Chapter 11
23	Mon., 5/14	IO solution methods II	BT Chapter 11
24	Wed., 5/16	Introduction to nonlinear optimization (NLO)	
25	Mon., 5/21	Convex optimization II	BV Chapter 4
26	Wed., 5/23	NLO approximation and fitting	BV Chapter 6
27	Mon., 5/28	NLO statistical estimation	BV Chapter 7
28	Wed., 5/30	NLO geometric problems	BV Chapter 8
		FINAL EXAM	

[1] Two additional lectures will be scheduled prior to the midterm exam to compensate for the classes cancelled during the first week due to conflicts with the TRB Annual Meeting.

[2] BV = *Convex Optimization* by Boyd and Vandenberghe;
BT = *Introduction to Linear Optimization* by Bertsimas and Tsitsiklis.