IM 2010: Operations Research, Spring 2016

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Operations Research (OR) is a field in which people use mathematical and engineering methods to study optimization problems in Business and Management, Economics, Computer Science, Civil Engineering, Electrical Engineering, etc. In this course, we focus on deterministic optimization techniques, which is a major part of the field of OR. This course is divided into three modules:

1. Linear optimization: basics (four weeks): The first module introduces basic ideas about Linear Programming, the most fundamental optimization technique. We study the definition of linear programs, an applicable algorithm for solving linear programs, and a lot of examples of applying Linear Programming in decision making.
2. Linear optimization: advances (four weeks): The second module discusses some theoretical properties of linear programs and their implications. Moreover, we introduce how to incorporate integer variables into linear programs to solve more complicated decision problems.
3. Nonlinear optimization (four weeks): The last module contains an introduction to Nonlinear Programming, the tool needed for problems that cannot be solved by linear optimization techniques. We discuss basic convex analysis, analytical and numerical ways to solve nonlinear programs, and applications.

This course emphasizes on both theories and applications. We will give you mathematical models, properties, algorithms, and examples. The applicability of those models will be demonstrated with examples in manufacturing, logistics, marketing, finance, supply chain management, human resource management, and information management. Though we focus on business decision making, students may also see these ideas and techniques used in Economics, Statistics, and Computer Science.

This is a required course for the sophomores in the Department of Information Management in National Taiwan University. In most cases, all students who want to enroll in or audit this course are welcome. This course is taught in English.

Basic information

Instructor.

- Ling-Chieh Kung (孔令傑). E-mail: lckung(AT)ntu.edu.tw.
- Office: Room 413, Management Building 2. Tel: 02-3366-1176.
- Office hour: by appointment.
- `http://www.im.ntu.edu.tw/~lckung/`.

Teaching Assistants.

- Kiwi Liu (劉騏瑋). E-mail: r03725034(AT)ntu.edu.tw
- Johnny Chen (陳韋志). E-mail: r04725004(AT)ntu.edu.tw.

Lectures. 9:10-12:10pm, Thursday. Room 103, Management Building 1.

Prerequisites.

- Calculus: "Calculus I" and "Calculus II" in the IM department, or equivalent.
- Linear Algebra: "Management Mathematics" in the IM department, or equivalent.
- Probability: "Statistics I" in the IM department, or equivalent.

- Discrete Mathematics: "Discrete Mathematics" in the IM department, or equivalent.

Textbook. *Introduction to Operations Research* by Hillier and Lieberman, tenth edition, McGraw Hill. 臺灣代理: 東華書局/新月圖書, (02) 2311-4027.

References.

- *Introduction to Management Science: A Modeling and Case Studies Approach with Spreadsheets* by Hillier and Hillier.
- *Operations Research: Applications and Algorithms* by Winston.
- *管理科學：作業研究與電腦應用*，陳文賢、陳靜枝。

On-line Resources.

- To check grades: CEIBA.
- To download or link to materials: `http://www.im.ntu.edu.tw/~lckung/courses/OR16/`.
- To discuss: Piazza (the URL will be announced later).

Grading

Breakdown.

- Quiz: 0%.
- Lecture problems: 15%;
- Pre-lecture problems: 5%; homework: 10%; case assignments: 20%;
- Final exam: 20%; final project: 25%;
- Class participation: 5%;

Conversion rule. The final letter grades will be given according to the following conversion rule:

Letter	Range	Letter	Range	Letter	Range	Letter	Range	Letter	Range
F	$[0, 60)$	C−	$[60, 63)$	C	$[63, 67)$	C+	$[67, 70)$	B−	$[70, 73)$
B	$[73, 77)$	B+	$[77, 80)$	A−	$[80, 85)$	A	$[85, 90)$	A+	$[90, 100]$

Regrading. The TAs will grade everything except the project and regrade them upon request. If you have a regrading request, please contact the TAs directly.

Policies

"Flipped classroom". The main idea of flipped classroom is "lectures in videos, discussions in classes." Before most Thursday lectures, the instructor will upload videos containing the materials to be discussed on that Thursday. Students must watch the videos before the lecture. During the lecture, students may ask questions regarding anything contained in the video. However, the instructor will not redo the whole lecture. Then students will form teams to work on lecture problems assigned by the instructor. Some will present their answers to the class. The instructor may make comments and lead the discussions for extended topics when appropriate. Students must form teams to do lecture problems. Each team must have exactly three students unless a special approval is obtained. Students may change teammates at any time. Of course, one student cannot be in two teams. Students in a team will be required to sit together in the classroom.

Attendance and class participation. We do not require one to attend all the lectures. If you have something to do, feel free to drop a class. The only loss is missing lecture problem points. During lecture time, students are more than welcome to ask or answer questions and provide comments. The one who presents for her/his team is obviously considered as an active participator. You are also welcome to use Piazza for after-class discussion or send the instructors or TAs e-mails at any time. These will not only give one good participation grades but also help one's learning.

Office hour. You are welcome to the instructor office hour to ask him any question. You may ask him to clarify some concepts, give hints for homework problems, discuss the final project, or talk about anything not related to OR. If you want to schedule a meeting, please feel free to send him an e-mail at any time.

Homework, case assignments, and pre-lecture problems. Three homework (HW) will be assigned throughout this semester for students to understand the theories taught in class. Students must do homework individually. Three case assignments (CA) will be assigned for students to apply their knowledge to solve close-to-real business decision problems. Students form teams to do case studies. One pre-lecture problem (PLP) will be assigned to students for them to submit at the beginning of the lecture. For all assignments, discussions are strongly encouraged. However, each individual or team should create her/his/their own work. Copying will result in severe penalties for everyone involved.

Self-study. One lecture will be canceled for students to self-study. The instructor will provide some topics with brief instructions to the students. Each student then choose some of them to study by her/himself. One may propose her/his own topic for the instructor's approval. The final exam contains some bonus problems about the self-study topics.

Final exam. The final exam will be in-class and open book. However, except calculators, all other electronic devices are disallowed. Cheating will result in severe penalties for everyone involved. The exam is comprehensive and may cover anything taught in this semester.

Final project. Students must form teams to do a final project by applying the techniques learned in this course to a self-selected problem. The number of students in each team will be determined after the class size is finalized (according to the past experiences, around five to eight). Each team will make an oral presentation and submit a report. All team members must be in class for the team to present.

Tentative schedule

Week	Date	Lecture	Textbook	Deadline
		Module 1: Linear Optimization: Basics		
1	2/25	Overview and quiz	Chs. 1 & 2	
2	3/3	Linear Programming (LP)	Ch. 3	CA 1: 2/29 (Mon)
3	3/10	The Simplex Method: Basics	Ch. 4	
4	3/17	The Simplex Method: Advances	Ch. 4	
5	3/24	Linearization Techniques & Optimization Software	Ch. 3	HW 1: 3/21 (Mon)
		Module 2: Linear Optimization: Advances		
6	3/31	LP Duality	Ch. 6	CA 2: 3/28 (Mon)
7	4/7	Integer Programming (IP)	Ch. 11	
8	4/14	Network Flow Models	Chs. 8 & 9	
9	4/21	Applications of IP	Ch. 11	
10	4/28	***In-class Problem-solving Challenge***		HW 2: 4/25 (Mon)
		Module 3: Nonlinear Optimization		
11	5/5	Single-variate Nonlinear Programming (NLP)	Chs. 12 & 18	CA 3: 5/2 (Mon)
12	5/12	Multi-variate NLP: Analysis	Ch. 12	
13	5/19	Multi-variate NLP: Algorithms	Ch. 12	
14	5/26	No Class (Self-study on Self-selected topics)		HW 3: 5/23 (Mon)
15	6/2	***Final exam***		
		Final Project and Holidays		
16	6/9	No Class (Dragon Boat Festival)		
17	6/16	***Final Project Presentations***		Report: 6/17 (Fri)
18	6/23	No Class (Thanks to "Flipped Classroom")		