IM2010 – Operations Research, Spring 2014

Instructor: Ling-Chieh Kung

Department of Information Management

National Taiwan University

Operations Research (OR) is a field in which people use mathematical and engineering methods to support decision making. While the main application of OR is to solve business problems, people in the fields of Economics, Computer Science, Civil Engineering, Electrical Engineering, etc., also benefit from OR methods. People use those models, algorithms, and solution processes in OR to optimize all kinds of decisions. This is why people refer to OR as a decision making tool. In this course, we will study how to facilitate decision making for either a single decision maker or multiple decision makers. Most examples will be adopted from the business world while some will be from various engineering fields. Basic knowledge on Calculus, Linear Algebra, Economics, and Probability is assumed for students taking this course.

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. If you want to enroll in this course, you may ask for a registration code from the instructor at the end of the first lecture.

Basic information

Instructor	• Ling-Chieh Kung (孔令傑). E-mail: lckung(AT)ntu.edu.tw.
	• Office: Room 413, Management Building II. Tel: 02-3366-1176.
	• http://www.im.ntu.edu.tw/~lckung/
Teaching Assistants	• Jack Chen (陳嘉豪). E-mail: r02725018(AT)ntu.edu.tw.
	• Tim Chen (陳宗霆). E-mail: r02725052(AT)ntu.edu.tw.
Meetings	• Lectures (*in English*):
	o 2:20-5:20pm, Thursday.
	o Room 201, Management Building II.
	• TA sessions (*in Chinese* unless there is a special announcement):
	o 12:30-1:10pm (*NOT 1:20-2:10!*), Monday.
	o The large computer classroom, Management Building I.
Office hour	• Instructor's office hour:
	o 5:30-6:00pm, Thursday and 4:30-6:00pm, Friday.
	o Room 413, Management Building II.
	• TAs' office hour:
	o 1:10am-1:40pm, Monday.
	o The large computer classroom, Management Building I.
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.
	• Economics: "Economics" in the IM department, or equivalent.
Textbook	• *Introduction to Operations Research* by F. S. Hillier and G. J. Lieberman, Ninth edition, McGraw Hill. 臺灣代理: 東華書局/新月圖書, (02) 2311-4027.
References	• *Management Science Modeling* by S. C. Albright and W. L. Winston.
	• *Operations Research: Applications and Algorithms* by W. L. Winston.
	• *Game Theory for Applied Economists* by R. Gibbons.
	• 「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/ORSp14/.
	• To discuss: the bulletin board "NTUIM-lckung" on PTT.

Overview of topics

This course is divided into four modules:

1. introduction (one week).
2. Linear Programming (four weeks).
3. Integer and Nonlinear Programming (four weeks).
4. Game Theory (four weeks).

By introducing the second and the third modules, we convey the basic concepts and methods for decision problems faced by a *single decision makers*. We start from Linear Programming to study linear problems and then move to Integer and Nonlinear Programming to extend the class of problems that we may solve. Finally, in the last module we introduce Game Theory, which is the fundamental framework for analyzing decision problems with *multiple decision makers*. Besides of giving you mathematical models and algorithms, we will also demonstrate their applicability by covering examples in manufacturing, logistics, marketing, finance, supply chain management, human resource management, and information management.

Grading

Breakdown
- Quiz: 0%.
- Homework: 15%. Five case assignments: 15%. Project: 15%.
- Lecture problems: 15%.
- Two exams: 40% (one of the following two plans will be chosen to maximize your grades):
    o Plan 1: midterm 20% and final 20%.
    o Plan 2: midterm 15% and final 25%.
- (Bonus!) 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]

Policies

"Flipped Classroom"
- The main idea of flipped classroom is "lectures in videos, then discussions in classes". To learn more about the principle, please search "flipped classroom" or "翻轉教室" online.[1]
- Before each Thursday lecture (except the first one), the instructor will upload videos (***in English***) containing the materials to be discussed on that Thursday. The video will be around one and a half hour. Students must watch the video before the lecture.
- During the lecture, we do three things:
    1. Discussing the materials: Students may ask questions regarding anything covered in the video. Students may even ask the instructor to teach a certain part again. However, the instructor will not redo the whole lecture. If no student ask questions, we will move to Part 2 directly.
    2. Solving lecture problems: Students will form teams to work on problems assigned by the instructor (For team formation, see "Teams" below). Once the instructor assigns a problem, students in a team will do discussions until at least one team demonstrate their answer on the whiteboard (***in English***) to the class. The instructor will make comments when necessary.
    3. Further discussions: After enough problems have been solved, some extended topics, which are not limited to course materials, will be discussed.
- In short, students should watch videos before the lecture and still attend the lecture for discussions. Please note that after the lecture, students also need to do assignments at home (see below).

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[1] On my blog, there is an article (in Chinese) regarding flipped classrooms. You may find it at http://wp.me/p2EbKu-8V.

Teams	• Students must form teams to do class problems. Each team *__must__* have *__exactly three__* students unless a special approval is obtained (typically only when the number of students enrolling in this course is not a multiple of three). To form a team, one only needs to enter the names of her/his teammates in one "problem" of Homework 1 and each case assignment. Students may change teammates between case assignments by indicating this on their submissions. Such a change will be valid only if there is no conflict.
	• Students in a team will be required to sit together in the classroom. Therefore, seats will be assigned to students by the instructor.
	• Students also need to form teams for the final project. Team formation for the project has nothing to do with that for lecture problems and case assignments.
Lecture Problems	• We do not require one to attend all the lectures. If you have something to do, feel free to drop a class. Nevertheless, as lecture problems count for grades, missing a lecture makes it impossible for you and harder for your teammates to get this part of grades. Sometimes students may volunteer to answer but sometimes the instructor will randomly ask a team to answer. Points will be given by the instructor.
Office Hour	• You are welcome to my office hour to ask me any question. You may ask me to clarify some concepts, give hints for homework problems, or discuss the final project. In fact, discussions not related to course materials are also welcome. If you don't want to come in the designated time, feel free to send me an e-mail to schedule a meeting.
TA Sessions	• For most Mondays, the two TAs will hold a one-hour session *__in Chinese__* to review the materials covered in the previous Thursday lecture. The TA sessions are offered mainly because that the lectures are given in English. If one finds it easier to learn in Chinese than in English, the TA sessions are highly recommended for her/him. Besides being briefly explained some concepts, students will also be given problems to practice. The TAs will discuss the solutions afterwards.
	• After the TA sessions, the TAs will stay in the same place for another forty minutes for students to ask questions or resolve grading issues (see Homework and Case Assignments below).
	• Two optimization software, MS Excel Solver and AMPL will be taught during TA sessions. As these are required by all students, these TA sessions will be provided *__in English__*.
Class Participation	• As communication skills are essential for almost everyone, we encourage class participation and include it in evaluating each student. In other words, class participation is not just sitting in the classroom. During lecture time, office hour, and TA sessions, students are more than welcome to ask or answer questions and provide comments. For example, attempting to solve a lecture problem may increase one's class participation grades even if the answer is not completely correct. You are also encouraged to use the course bulletin board on PTT 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.
Homework and Case Assignments	• Starting from the first week, homework will be assigned roughly weekly. These homework are designed mainly for students to understand the theory. Students must do homework individually.
	• Five case assignments will also be given in this semester. These are either "bigger" problems describing problems closer to the practice or academic papers that conveying seminal insights. Students follow the rules for lecture problems to form teams to work on case assignments. One's teammates may be different for different case assignment.
	• To submit homework or case assignments, Please put a *__hard copy__* of the work into *__the instructor's mailbox__* on the first floor of the Management Building II by the due time. No submission in class. *__No late submission__*. The *__lowest two__* homework grades will be dropped (i.e., you may skip two homework if you want). No grade for case assignments will be dropped. The TAs will grade these assignments and regrade them upon request. If you have a regrading request, please contact the TAs directly (e.g., in TA sessions).
	• 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.

		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. Each team will make a 25-minute presentation and submit a report. All team members must be in class for the team to present.

Exams • Both the two exams will be in-class and open book. However, except calculators, all other electronic devices are disallowed. Cheating will result in severe penalty for everyone involved. The final exam is comprehensive and covers everything taught in this semester.

Tentative schedule

Week	Date	Lecture	Textbook	Note
		Module 1: Introduction		
1	2/20	Overview and *quiz*	Chs. 1 and 2	*No TA session* on 2/17
		Module 2: Linear Programming		
2	2/27	Linear Programming basics and formulation	Ch. 3	CA 1 announcement
3	3/6	The simplex method (1)	Ch. 4	TA session on 3/3: MS Excel Solver (*in English*)
4	3/13	The simplex method (2)	Ch. 4	CA 1 due
5	3/20	Linear Programming duality	Ch. 6	CA 2 announcement
6	3/27	Network flow models	Chs. 8 and 9	CA 2 due; CA 3 announcement
7	4/3	*Holiday: spring recess*		TA session on 3/31: AMPL (*in English*)
		Module 3: Integer and Nonlinear Programming		
8	4/10	Integer Programming	Ch. 11	CA 3 due
9	4/17	Nonlinear Programming	Ch. 12	CA 4 and project announcement
10	4/24	Optimizing inventory decisions	Ch. 18	
11	5/1	Optimizing economic decisions	N/A	CA 4 due
12	5/8	*Midterm exam*		
		Module 4: Game Theory		
13	5/15	Static games: pure strategies	Ch. 14	Project proposal due
14	5/22	Dynamic games	N/A	CA 5 announcement
15	5/29	Static games: mixed strategies	Ch. 14	
16	6/5	Supply chain contracting	N/A	CA 5 due
17	6/12	*Project presentation*		Project due
18	6/19	*Final exam*		

Some notes:

1. The quiz is only for you to check whether your technical background is appropriate for this course. It counts nothing in calculating the semester grades.
2. There is no TA session on 2/17. The TA sessions on 3/3 and 3/31 will be held *in English*.
3. We will basically follow the flow of the textbook written by Hillier and Lieberman. For the last module, the book written by Gibbons is a great reference. For many lectures, the instructor will provide additional handouts (probably in the format of slides).
4. "CA" stands for "Case Assignment". CA 1 is about Linear Programming. CA 2 is an revision and extension of CA 1. CA 3 is about network flow. CA 4 is about Integer Programming. CA5 is about static and dynamic games.