

IM2010: Operations Research Overview

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National Taiwan University

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Welcome!

- ▶ This is the **introductory** Operations Research course designed for students majoring in **Information Management**.
 - ▶ Introductory: No knowledge regarding Operations Research is assumed.
 - ▶ Information Management: Focus more on computer techniques, algorithms, and mathematical derivations than those for other business majors.

Before you enroll...

- ▶ Prerequisites:
 - ▶ Calculus.
 - ▶ Linear Algebra (or Management Mathematics).
 - ▶ Discrete Mathematics.
 - ▶ Probability (or Statistics I).
- ▶ Language: **“All” English.**
 - ▶ All materials are in English.
 - ▶ Students are welcome to speak Chinese in class.
 - ▶ TA speak Chinese in labs.
 - ▶ I speak Chinese in my office hour unless you prefer English.
 - ▶ I will speak Chinese in lectures **when it helps.**

The instructor

- ▶ Ling-Chieh Kung.
- ▶ B90 and R94.
- ▶ First-year assistant professor.
- ▶ Office: Room 413, Management Building II.
- ▶ Office hour: 10am-noon, Wednesday or by appointment.
- ▶ E-mail: lckung@ntu.edu.tw.

Related information

- ▶ Classroom: Room 201, Management Building II.
- ▶ Meeting time:
 - ▶ Lectures: 2:20-5:20pm, Thursday.
 - ▶ Labs: 12:20-1:10pm, Monday.
- ▶ Textbook: “Operations Research: Applications and Algorithms” by W.L. Winston, 4th edition.
- ▶ References:
 - ▶ “Introduction to Operations Research” by F.S. Hiller and G.J. Lieberman.
 - ▶ “Game Theory for Applied Economists” by R. Gibbons.
 - ▶ “Management Science: Operations Research and Computer Applications” by Wen-Hsien Chen and Ching-Chin Chern.

Online resources

- ▶ CEIBA.
 - ▶ Viewing your grades.
 - ▶ Receiving group messages.
- ▶ <http://www.ntu.edu.tw/~lckung/courses/ORSp13/>.
 - ▶ Downloading course materials.
- ▶ The bulletin board “NTUIM-lckung” on PTT.
 - ▶ Discussions.

Grading

- ▶ Homework: 15%.
- ▶ Projects: 30% (8%, 8%, and 14%).
- ▶ Class participation: 5%.
- ▶ 2 Exams: 50%:
 - ▶ Plan 1: midterm 20% and final 30%.
 - ▶ Plan 2: midterm 15% and final 35%.
- ▶ The final letter grades will be given according to the following conversion rule:

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

Policies: Class participation and labs

- ▶ Class participation:
 - ▶ Attendance does not count.
 - ▶ Speaking to me during lectures or office hour counts.
 - ▶ Speaking to TAs during labs does not count.
 - ▶ Posting on the course bulletin on PTT counts.
- ▶ Labs:
 - ▶ The large computer classroom at Management Building I.
 - ▶ Extra lectures.
 - ▶ Project presentation.
 - ▶ More examples and practices.
 - ▶ Computer techniques.
- ▶ Office hour: **Just come!**

Policies: Homework

- ▶ Homework:
 - ▶ Weekly homework (unless there is a holiday or exam).
 - ▶ **Due 1:00am on Thursday.**
 - ▶ Please put a **hard copy** into **my (physical) mail box** on the first floor of the Management Building II.
 - ▶ No late submission.
 - ▶ The lowest two homework grades are dropped.
 - ▶ The TAs grade homework and regrade them upon request.

Policies: Projects and exams

► Projects:

Project	Number of team members	Presentation	Report Report due
1	1 to 5	At most 5 teams	April 11
2	1 to 5	At most 5 teams	May 5
3	5 to 8	All teams	June 13

► Exams:

- In-class and open-book.
- Except a calculator, no electronic device is allowed.
- Cheating will result in severe penalty.

Policies: Materials

- ▶ All materials used in a lecture will be posted **on-line** before the lecture begins.
- ▶ They may be slightly modified after the lecture.
- ▶ The final version will then be posted.

Before we start...

- ▶ If you are an IM student:
 - ▶ I will keep teaching this course before you graduate. XD
- ▶ If you are not:
 - ▶ Always welcome but think twice!
 - ▶ Ask for the codes for enrollment after this three-hour lecture.

What is Operations Research?

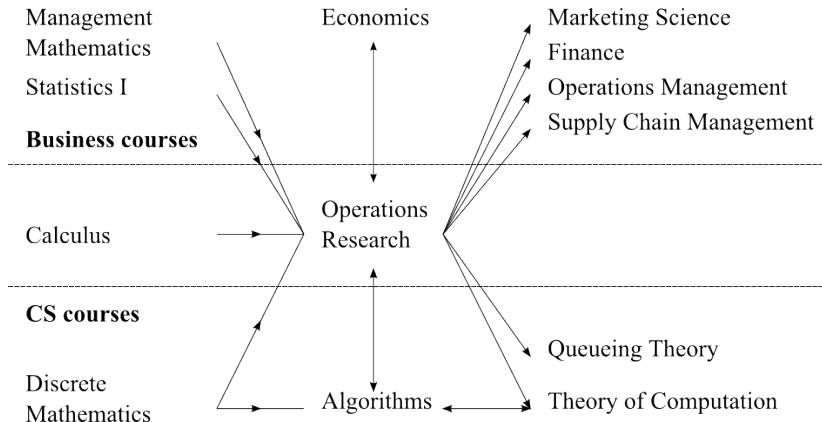
- ▶ **Operations Research** is a **scientific** approach to **decision making** that tries to best **design and operate a system**.
- ▶ Some related fields:
 - ▶ Economics.
 - ▶ Statistics.
 - ▶ Computer Science.
 - ▶ Many other engineering fields.

The role of OR in our IM department

- ▶ It requires **Calculus**, **Management Mathematics**, **Discrete Mathematics**, and **Statistics I**.
- ▶ The integer programming and combinatorial optimization part is highly related to **Algorithms** and **Theory of Computation**.
- ▶ The nonlinear programming part is the foundation for (Intermediate or Advanced) **Economics**.
- ▶ The stochastic part is the foundation for **Queueing Theory**.
- ▶ It is the main prerequisite of **Operations Management** and **Supply Chain Management**.
- ▶ It is also widely used in **Marketing Science** and **Finance**.

└ What is Operations Research?

The role of OR in our IM department



The role of OR in our IM department

- ▶ Operations Research is one of the few courses that lie in the **interface** between Business and Computer Science.
- ▶ It is a promising direction if you:
 - ▶ Want to solve **business problems** with an **engineering approach**;
 - ▶ Like (or do not hate) mathematics, programming, and algorithms.
- ▶ It will also be very useful if you:
 - ▶ Want to become a **theoretical** computer scientists.
 - ▶ Want to work on **mathematical problems** in Computer Science or other engineering fields.
- ▶ For those of you who have not decided yet:
 - ▶ Study it so that you will not miss a chance in the future.

└ What is Operations Research?

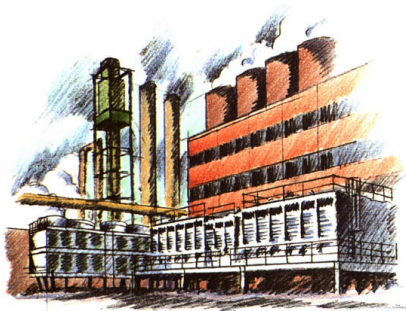
By the way...

Subject	The main prerequisite	The common prerequisite
Marketing	Economics	
Finance	Accounting	
Human Resource Management	Management	Statistics
Operations Management	Operations Research	
Management Information Systems	Introduction to Computer Science	

└ What is Operations Research?

What problems does OR solve?

- ▶ OR is tightly related to **Industrial Engineering**:
 - ▶ Using engineering methods (mainly mathematics and algorithms) to solve industrial (i.e., business) problems.
 - ▶ Production planning, machine scheduling, inventory preparation, vehicle routing, etc.



What problems does OR solve?

- ▶ OR is also tightly related to **Management Science**:
 - ▶ Using scientific ways (mainly mathematics and economic theories) to solve managerial (i.e., business) problems.
 - ▶ Supplier selection, product assortment, staff scheduling, pricing, portfolio optimization, etc.



<http://customdvdkiosk.com/>

- ▶ In general, we want to facilitate better **decision making**.

A short conversation

- ▶ A: I study in Industrial Engineering and Operations Research.
- ▶ B: Oh! Do you make cars in factories?
- ▶ A: Thats mechanical engineering.
- ▶ B: So do you make computers?
- ▶ A: Thats Electrical engineering and Computer Science.
- ▶ B: Do you make bridges or buildings?
- ▶ A: Thats Civil Engineering.
- ▶ B: So what exactly do you make?
- ▶ A: We dont make anything. We make things better.

Course outline

- ▶ Deterministic single-player decision making.
- ▶ Stochastic single-player decision making.
- ▶ Multi-player decision making (if time permits).

Deterministic 1-player decision making

- ▶ One decision maker.
- ▶ The environment has **no uncertainty**.
 - ▶ All parameters are **known**.
 - ▶ Optimizing the **average** performance.
- ▶ Subjects:
 - ▶ Linear programming.
 - ▶ Integer programming.
 - ▶ Nonlinear programming.
 - ▶ Deterministic dynamic programming.

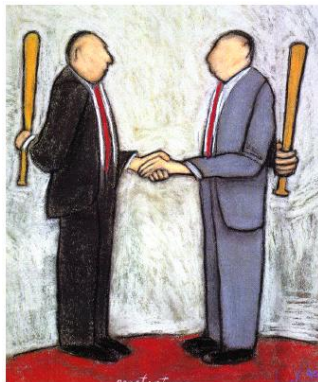
Stochastic 1-player decision making

- ▶ One decision maker.
- ▶ The environment has **uncertainty**.
 - ▶ Some parameters are **unknown** and can only be estimated.
 - ▶ In many cases uncertainties come from the **future**.
- ▶ Subjects:
 - ▶ Stochastic dynamic programming.
 - ▶ Stochastic processes.
 - ▶ Simulation.

└ What is Operations Research?

Multi-player decision making

- ▶ **Multiple** decision makers.
- ▶ Try to find **equilibria** to predict their behaviors.
- ▶ Subjects:
 - ▶ Game theory.
 - ▶ Supply chain coordination.
 - ▶ Contracting.



<http://dalecarnegieapac.files.wordpress.com/>