

Korea University International Summer Campus (KU ISC) 2018

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June 26, 2018 ~ August 2, 2018

ISC297 – Operations Research in Practice

I . Instructor

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Home Institution	The University of Nottingham
Office	Woodang Hall, Room 305
Office Hours	2-3pm Monday to Thursday by Appointment

II. Textbook

Required Textbook	NA
	Introduction to Operations Research. Frederick S. Hillier, Gerald J. Lieberman, McGraw-Hill.
Recommended Additional Readings	Spreadsheet Modeling and Decision Analysis: A Practical Introduction to Business Analytics. Cliff T. Ragsdale. South-Western College Publishing.
	Management Science: The Art of Modelling with Spreadsheets. Stephen G. Powell, Kenneth R. Baker. John Wiley and Sons

III. Course Description and Objectives

Course Description

This course is a hands-on introduction to computational optimization techniques, in particular for modelling and solving linear and discrete optimization problems. Computational optimization is one of the most important areas within operations research (OR), which is a discipline that uses modelling techniques, analytics and computational methods to solve complex problems in industry and business. In this course you will learn to interpret and develop algebraic models for a variety of real-world linear and discrete optimization problems to then use powerful optimization software (linear, integer and mixed-integer solvers) to produce a solution. Optimization technology is ubiquitous in today's world, for applications in logistics, finance, manufacturing, workforce planning, product selection, healthcare, and any other area where the limited resources must be used efficiently. This course will teach students a variety of analytical, modelling and problemsolving techniques. This course is designed for students from different backgrounds including business, engineering, computing, etc. as it assumes no prior knowledge of modelling and optimization. The books are not essential for this course but students will find useful to have it as additional support. Given the practical nature of this course, it is essential that students have access to a recent version of Microsoft Excel in their own computer during the course. Important: students will be provided with brief course notes.

Syllabus

- I. Preliminary Concepts and Techniques
 - 1. Operations Research in Practice
 - Overview of operations research
 - Optimization for decision-making
 - Phases for tackling optimization problems
 - 2. Modelling Optimization Problems
 - Levels of analytics
 - Data, decision variables, objective function, constraints
 - Spreadsheet optimization models
 - Mathematical programming optimization models
 - 3. Solving Optimization Problems
 - Identify elements of model
 - Spreadsheet vs. Algebraic solvers
 - The graphical method
 - 4. Linear Programming vs Integer Programming
 - Feasibility, infeasibility, search space, optimality
 - Binding and non-binding constraints
 - Formulating linear programming models
 - Proportionality, additivity, divisibility and certainty
 - Binary and general integer models
 - The LP-relaxation technique
- II. Product-Mix Optimization
 - 1. Special Cases in LP Models
 - Infeasibility
 - Unbounded search
 - Multiple optimal solutions
 - 2. Product-Mix Problems
 - Manufacturing optimization
 - Diet optimization
 - Other blending optimization
 - 3. Post-optimality Analysis
 - Re-optimization
 - Sensitivity analysis
 - Post-optimality analysis tools
- III. Network Flow Optimization
 - 1. Transportation Problem
 - 2. Minimum Cost Flow Problem
 - 3. Maximum Flow Problem
 - 4. Shortest Path as Flow Problem

Note: algebraic and spreadsheet models will be developed for various examples of network optimization problems.

IV. Integer Optimization I

- 1. Selection Problems
- 2. Assignment Problems
- 3. Packing Problems

Note: algebraic and spreadsheet models will be developed for various examples of selection, assignment and packing optimization problems.

- V. Integer Optimization II
 - 1. Routing Problems
 - 2. Location Problems

Note: algebraic and spreadsheet models will be developed for various examples of routing and location optimization problems.

IV. Grading

Attendance	% - Korea University attendance policy		
Midterm Exam	% - NA		
Final Exam	% - NA		
Participation	% - NA		
	25 % - Five weekly online tests based on in-class assignments		
Quizzes	Several in-class assignments on developing optimization models (algebraic and spreadsheet) are set to be completed in each class. These serve as practice to prepare for the weekly individual assignments. A quiz takes places each Monday covering the assignments from the previous week. Sometimes students are asked to work in groups to complete the assignments but always the quiz is taken individually.		
	25 % - Final group assignment		
Group Assignment In the last week of the course and during class, a final assign undertaken by students in groups. In addition to further dem acquired skills to develop optimization models, this assignment students to develop their communication and teamwork skills will present their work to the class.			
	50 % - Five weekly individual assignments		
Assignments	In each week, an assignment will be set during the last lecture of the we and students submit it for grading before the start of the first lecture the following week. Each weekly assignment consists in developing the spreadsheet and algebraic linear optimization models for a given optimization problem of the type covered in the corresponding week. The size and difficulty of the optimization problem to solve will increase as the court progresses but only accordingly to the material covered in class. Each stude will present and explain their submitted work in class. The assignment will graded using the following criteria: correctness of spreadsheet mod correctness of algebraic model, quality of spreadsheet model, quality explanation and answers to questions.		
Submission Policy	The weekly individual assignments must be submitted by the given deadline, otherwise a penalty of 20% is applied for each day (or part) that the work is submitted late. Non submitted assignments will be counted as zero in the weighted average calculation. The group assignment must be presented in the given date (usually the last day of the course). Progress in the completion of the in-class assignments is monitored regularly and the grade is awarded through the quizzes. If there is a valid reason for not submitting an assignment (e.g. serious illness) the student should get in contact with the professor as soon as possible to explain the situation. Then, the student will have to provide valid evidence to justify the absence. This evidence will be checked by the ISC Staff (room 314). Only after the provided evidence has been accepted by the ISC office, an alternative arrangement may be made for the missed assignment submission.		

V. Class Outline

Date	Торіс	Chapter	Remarks
June 26 (Tue)	Orientation Day		
June 27 (Wed)	Introduction to Course	NIA	NA
	Operations Research in Practice	NA	
June 28 (Thu)	Modelling Optimization Problems	ΝΑ	NA
	Solving Optimization Problems	NA	
June 29 (Fri)	Linear Programming vs Integer Programming	NA	NA
July 2 (Mon)	Special Cases in LO Models	NA	NA
July 3 (Tue)	Product-Mix Problems	NA	NA
July 4 (Wed)	Product-Mix Problems	NA	NA
July 5 (Thu)	Post-optimality Analysis	NA	NA
July 9 (Mon)	Transportation Problem	NA	NA
July 10 (Tue)	Minimum Cost Flow Problem	NA	NA
July 11 (Wed)	Maximum Cost Flow Problem	NA	NA
July 12 (Thu)	Shortest Path as MCF	NA	NA
July 16 (Mon)	Selection Problems	NA	NA
July 17 (Tue)	Assignment Problems	NA	NA
July 18 (Wed)	Packing Problems	NA	NA
July 19 (Thu)	Solving Integer Optimization Problems	NA	NA
July 23 (Mon)	Routing Problems	NA	NA
July 24 (Tue)	Solving Routing Problems	NA	NA
July 25 (Wed)	Location Problems	NA	NA
July 26 (Thu)	Solving Location Problems	NA	NA
July 30 (Mon)	Solving Larger Integer Optimization Problems	NA	NA
July 31 (Tue)	Group Assignment	NA	NA
Aug 1 (Wed)	Group Assignment	NA	NA
Aug 2 (Thu)	Group Assignment Presentations	NA	NA