Operations Research

1. Course Description

Operations Research (also called Management Science) is the study of scientific approaches to decision-making. Through mathematical modeling, it seeks to design, improve and operate complex systems in the best possible way. The mathematical tools used for the solution of such models are either deterministic or stochastic, depending on the nature of the system modeled. In this class, we focus on basic deterministic models and methods in Operations Research as well as stochastic models. In this class, you will learn very powerful modeling and solution techniques for decision-making problems that are used today by many successful companies to help them save/earn millions of dollars. The module covers topics that include: linear programming, transportation, assignment, dynamic programming and integer programming. Analytic techniques and computer packages will be used to solve problems facing business managers in decision environments.

2. Course Objectives and Requirements

1. Course Objectives

The objectives of this course are:

- To introduce the students how to use variables for formulating complex mathematical models in management science, industrial engineering and transportation science.

- To provide the students with opportunity of using various software package for solving linear programming and integer programming models
- To introduce the students to the use of basic methodology for the solution of linear programs and integer programs.
- To introduce the students to the basic concepts of polyhedral theory and valid inequalities and how to integrate the theory to the solution methods for integer programming.
- To introduce the students to the advanced methods for large-scale transportation and assignment problems.

2. **Requirements**：

Students are expected to get prepared for lectures, finish and submit assignments as required.

3. Course Arrangement

Course name		Operations Research	Total Credit Hours	51
unit	Credit hours	Contents	Preparation of class and reading materials	Cases
1	3	Introduction to operations research 1. History of operations research 2. Applications 3. Modeling the linear	Chapter 1,2	

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		programming		
2	12	Linear programming 1. Geometry 2. Solving the linear programming: the Simplex method 3. Shadow price 4. Theory of the simplex method	Chapter 3,4,5	
3	6	**Duality** 1. Dual theory 2. Sensitivity analysis	Chapter 6	
4	6	**Other algorithms for linear programming** 1. The dual simplex method 2. Big-M method 3. The two phase method	Chapter7	
5	6	**The transportation and assignment problems** 1. The transportation problem 2. A streamlined simplex method for the transportation problem 3. The assignment problem 4. A special algorithm for the assignment problem	Chapter 8	
6	6	**Dynamic programming** 1. Characteristic of dynamic	Chapter 10	

		programming 2. Deterministic dynamic programming		
7	12	**Integer programming** 1. Prototype examples, BIP applications and formulation examples 2. Some perspectives on solving integer programming problems 3. The branch-and-bound algorithm for mixed integer programming 4. The branch-and-cut approach to solving BIP problems 5. The incorporation of constraint programming	Chapter 11	

4. Textbook

- Frederick S. Hiller, Gerald J. Lieberman, Introduction to Operations Research (Ninth Edition)(English), Mc-Graw Hill， 2010.
  The book is available on Amazon.cn:
  http://www.amazon.cn/%E8%BF%90%E7%AD%B9%E5%AD%A6%E5%AF%BC%E8%AE%BA-%E5%BC%97%E9%9B%B7%E5%BE%B7%E9%87%8C%E5%85%8B%C2%B7%E5%B8%8C%E5%88%A9%E5%B0%94/dp/B003G30GLG/ref=sr_1_2?ie=UTF8&qid=1361762856&sr=8-2

5. References

- W. Winston, Operations Research, Duxbury Press.
- 胡运权等编， 《运筹学教程》第三版，清华大学出版社

1. Course slides will be available for reference before the lecture on the course web page.

2. Computing tools: Matlab Optimization Toolbox, CPLEX 12.3.

3. Assignments: There will be problem sets due approximately every 2 week. Students are encouraged to work together, but each student should write up his/her solutions independently.

4. Examination: The format of the exam is to be determined.