

# **Quantitative Methods for Decision Making**

## **ADC6510**

### **Spring 2008**

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## **Introduction**

This course is designed to provide students with a working knowledge of quantitative techniques for economic and management decision problems. Stress is placed on problem formulation in decision-making situations, and the interpretations of the problem solution results. Solution procedures will be discussed also to facilitate the interpretations, but not in a rigorous manner, so that no advanced mathematics are required.

The course aims, in particular, to enhance the students' problem solving capacity in economic and management decision problems with the aid of management science techniques. For that purpose, a number of (small and large) cases will be presented and discussed in the class. Cases provide descriptions of practical situations where modeling and analysis can play an important role. Some of the cases are abbreviated descriptions, where much of the detail is left to the reader's imagination. Cases provide opportunities to practice translating situations into problem structures and, in doing so, to adapt the general concepts of modeling to particular circumstances. Discussion questions for each case are attached as part of this course description.

Topics covered in the course include decision analysis, linear programming (LP), LP network models (transportation and transshipment models), integer programming, and network models for project scheduling (PERT/CPM). Excel and LINGO running on Windows XP are used to solve linear, integer, and network models (You can download a free trial version of LINGO from the following LINGO homepage: <http://www.lindo.com/>.)

In sum, the objectives of this course are the following:

1. Introduce you to the basic principles and techniques of management science. You will learn to use some of the important analytic methods, to recognize their assumptions and limitations, and to employ them in decision-making.
2. Enhance your ability to structure problems and to perform logical analyses. You will practice translating descriptions of decision problems into formal models, and will analyze those models in an organized fashion.
3. Expose you to settings in which models can be used effectively. You will apply management science concepts in practical situations.
4. Reinforce your computer skills. You will exploit the computer as a resource

in your analysis, and you will confront the special character of the computer as a decision-support tool.

All the students are responsible for the lecture material and the required readings. Regular assignments (readings, cases, and exercises) are scheduled for each class session. It is important to complete the assigned readings prior to each class session. Weekly or bi-weekly homework sets will be assigned. The exercises are due to be submitted on assigned due-dates, and no late homework will be counted. Homework assignments should be done in group (group size is 2 to 3). Each group should hand in one set with all names on it. Each student is responsible for all the material covered on the homework. The purpose of this arrangement is to facilitate learning from classmates. Remember that it is considered a violation of the Honor Code to utilize information from last year in doing the homework assignments. Homework exercises provide opportunities to practice the skills of modeling and analysis that are introduced in the course. Homework emphasizes quantitative aspects of the course material and provides feedback on how well the analytic techniques have been mastered. The instructor's philosophy with regard to this course is that learning by doing is the best way to learn the concepts and techniques of management science and managerial and economic model building. There will be a midterm examination. Additionally, a short research paper will be required. The research paper should be written by a group of 2 or 3 students. The final research paper should be no longer than 10 1.5-spaced, type-written pages including figures and tables (using the font Times New Roman 12 points).

The general policies of the Graduate School of International Relations apply. This means that all students are expected to attend class regularly. Personal illness or family emergency, but not placement activities, are considered grounds for excused absences. Penalties for unexcused absences will be reflected in the class participation component of the course grade.

### **Course Evaluation**

In determining your course grade, your work will be evaluated approximately in accordance with the following weights:

- Midterm Examination (in class) 45%
- Term paper 45%
- Homework assignments 5%
- Class participation (constructive) 5%

In-class examination is an open note exam.

### **Office Hours**

My regular office hours will be as follows:

- Tuesday 15:00-16:00
- Wednesday 14:30-15:30

You may come to my office anytime other than these time periods, but it should be done by prior appointment.

**Required Texts**

1. Taylor III, Bernard W., *Introduction to Management Science*, 7<sup>th</sup> ed., Prentice Hall International Inc., 2002
2. Cook, T.M., and R.A. Russell, *Introduction to Management Science*, 5th ed., Prentice Hall, 1993..

**Recommended Texts**

1. Baker, K.R., and D.H. Kropp, *Management Science: An Introduction to the Use of Decision Models*, John Wiley & Sons, 1985. Chapters 1, 2, 3, 4, 5, 6, and 8.
2. Baumol, W.J., *Economic Theory and Operations Analysis*, 4th ed., Prentice-Hall, 1977. Chapters 5, 6, and 12.

**Course Schedule and Suggested Readings*****Week 1 and 2 (April 10 and 17)*****Course Introduction and Decision Analysis**

- (Cook & Russell) Ch.11, pp.437-499.
- (Taylor) Ch.12, pp.480-516.

***Week 2 (April 17)*****Models and Modeling, LP (Linear Programming) Formulation, and Graphical Method for Solving LP Problems**

- (Cook & Russell) Ch.1, pp.1-28; Ch.2, pp.32-58; Ch.3, pp.74-97.
- (Taylor) Ch.2, pp.26-56.
- Small Case: Yamato Fertilizer

***Week 3 (April 24)*****LP Applications and Model Formulations**

- (Cook & Russell) Ch.2, pp.32-58.
- (Taylor) Ch.4, pp.104-142.
- Small Cases: Akita Investment; Niigata Manufacturing; Manpower Planning

**Computer Lab. Session (LINDO software)**

- (Cook & Russell) Ch.4, pp.145-151.
- (Schrage User's Manual) Ch.1,2,3,4, and 5, pp.1-16.
- (Schrage) Ch.2, pp.8-13.
- (Taylor) Ch.3, pp.66-89.

### ***Week 4 (May 1)***

#### **Simplex Method**

- (Cook & Russell) Ch.4, pp.106-142, pp.151-154.

### ***Week 5 (May 8)***

#### **Duality and Sensitivity & Parametric Analysis with LINDO**

- (Cook & Russell) Ch.5, pp.165-202.
- (Schrage) Ch.3, pp.16-27; Ch. 19, pp.228-236.
- (Taylor) Ch.3, pp.66-89.

#### **Case: Red Brand Canners (A)**

- What are the decisions to be made by Red Brand (to determine the amount of each product to produce and whether to buy the extra-tomato)?
- What data are available in the case?

### ***Week 6 (May 15)***

#### **1. LP Network Models (Transportation and Transshipment Models): Formulation**

#### **2. Transportation Models and Solution Algorithm: Duality and Modified Simplex Method**

- (Cook & Russell) Ch.6, pp.214-235, pp.239-243, pp.252-267.
- (Taylor) Ch.6, pp.214-231.
- (Schrage) Ch.12, pp.124-130.
- (Baumol) Ch.6.
- Small Cases: Akita Brewery Company; Transshipment Problem

#### **Case: Hollingsworth Paper Co. (HPC)**

- Assess the current pattern of shipments made by HPC. Could the recent year's costs have been reduced with the use of a different distribution plan?
- Devise an analytic framework within which you could evaluate the economic aspects of the location alternatives faced by HPC. Are sufficient data available to permit a reasonable economic comparison?

### ***Week 7 (May 22)***

#### **1. Transportation Models and Solution Algorithm: Duality and Modified Simplex Method (Continuation)**

#### **2. Integer Programming 1: Applications and Formulation Possibilities**

- (Cook & Russell) Ch.9, pp.360-366, pp.373-381.
- (Taylor) Ch.5, pp.174-199.
- (Schrage) Ch.17, pp.186-191, pp.193-202.
- Small Cases: Japan Airlines; Binary Knapsack Problem; Capital Budgeting; Fixed Charge Problem; Warehouse Location Problem; Generalized

Assignment Problem

***Week 8 (May 29)***

**Midterm Examination**

***Week 9 (June 5)***

**Integer Programming 2: Branch & Bound Method and LINDO**

- (Cook & Russell) Ch.9, pp.366-373, pp.395-398.
- (Schrage) Ch.17,191-193.
- (Schrage User's Manual) Ch.9, pp.31-40.

**Case: Hunt Wesson Foods, Inc., pp.571-579**

- What is the structure of Hunt-Wesson's distribution system, and what operational policies apply?
- What motivated this model-building effort?
- What are the limitations of an LP approach?
- What simplifications were made in the course of building the model?
- What are the detailed elements of the Hunt-Wesson model?

***Week 10 (June 12)***

**Network Models for Project Scheduling (PERT/CPM)**

- (Cook & Russell) Ch.8, pp.309-319, pp.324-340.
- (Taylor) Ch.8, pp.306-339.