American University of Beirut
Faculty of Engineering and Architecture
Engineering Management Program

ENMG 500 Engineering Management I

Fall 2006, CRN 12223: 8:00 - 9:15 AM, TTH - Bechtel 403

Instructor

Dr. Bacel Maddah
Office: Bechtel 505A
E-mail: bacel.maddah@aub.edu.lb. Office phone: 01 350 000 Ext. 3551.
Webpage: `http://staff.aub.edu.lb/~bm05/`
Office hours: Tue 10:00 - 11:30 AM and Thu 2:00 - 3:30 PM

Course Description

Operations Research (OR) is a decision science concerned with optimal allocation of scarce resources. (Check out *www.informs.org* .) OR applications include production planning and scheduling in manufacturing, staffing, pricing, and capacity planning in service industries (e.g. airlines, hotels, retailing), military operations, health care management, and financial asset management, among others. Operations researchers develop mathematical models of real life systems with the objective of enhancing performance. Many OR models come in the form of mathematical programs, which generally aim at finding the best (optimal) value of a real-valued (objective) function of decision variables subject to constraints on these variables. Mathematical programming is further classified into several areas depending on the properties of the objective function and constraints. Among the most popular areas of mathematical programming is *linear programming* (LP) which, as the name implies, assumes a linear universe in terms of objective and constraints. LP popularity stems from its ability to model many real world systems effectively with simple and elegant mathematics. This course will introduce you to the OR methodology of mathematical modeling and to linear programming in particular. Two LP applications will be emphasized: The *transportation problem* and *project management*.

Course Objectives

- Understand the OR methodology of mathematical modeling.
- Develop mathematical models for real problems.
- Understand LP and how it is used in mathematical modeling.
- Learn the basic theory behind LP.
- Understand the simplex method, the main tool for solving linear programs.
- Use the simplex method by hand and by computer (with Excel Solver and Tora).
- Perform postoptimality analysis and use it to gain insights into the real system.
- Become familiar with the transportation problem and project management.
- Solve transportation and project management problems with LP and other techniques.

Textbook

Taha, H. A. *Operations Research: An Introduction*. Eight Edition. Prentice Hall, 2006.

Additional References

1. Bazaraa M. S., J. J. Jarvis, and H. D. Sherali. *Linear Programming and Network Flows*. Third Edition. Wiley, 2004.
2. Hillier, F. S. and G. J. Lieberman. *Introduction to Operations Research*. Eight Edition. McGraw-Hill, 2004.
3. Wagner, H. M. *Principles of Operations Research: With Applications to Managerial Decisions*. Second Edition. Prentice Hall, 1975.
4. Winston, W. L. *Operations Research: Applications and Algorithms*. Fourth Edition. Duxbury Press, 2003.

Tentative Schedule

Topics will be covered according to the following schedule. Exams will be on the specified dates. **These dates will not change**. Modeling examples will be covered in parallel with these topics.

- Week 1: Introduction to OR, math modeling, and LP
- Week 2: LP graphical method and graphical motivation for the simplex method
- Week 3: The simplex method in tabular form and general steps of the simplex method
- Week 4: Big-M method and simplex variants (degeneracy, unboundness, alternate optima, infeasibility)
- Week 5: Simplex method in matrix form (revised simplex method).
- Week 6: Duality in LP.
- Week 7: **Test 1 on Tuesday 11/14/2006 (evening)**
- Week 8: Economic interpretation of duality
- Week 9: The dual simplex method and sensitivity (postoptimal) analysis
- Week 10: Sensitivity analysis.
- Week 11: The Transportation problem
- Week 12: **Test 2 on Friday 12/15/2006 (evening)**
- Week 13: Project Management with CPM
- Week 14: Project Management with CPM/PERT
- **Final Exam on a date after 1/12/2007 (comprehensive)**

Grading

Test 1	25%
Test 2	25%
Final	25%
Project	10%
Homework	15% (see note below)

Homework

Homework problems will be assigned frequently. However, the homework grade will be counted only if it helps your final grade. For example, if you don't submit any homework then the homework grade will be distributed on the three tests which will count for 90 % of your final grade. Specifically, your final grade (FG) will be computed function of tests (T_1 and T_2), final (F), homework (HW), and project (P) grades as follows:

$$FG = 0.25T_1 + 0.25T_2 + 0.25F + 0.15 \max\left(\frac{T_1 + T_2 + F}{3}, HW\right) + 0.1P\ .$$

All students are encouraged to solve the homework problems. Doing the homework is the best way to excel in this course.

Project

The project will involve a case study on applying LP modeling to a real life problem. It is intended to give you a taste of realistic OR/LP applications and to enhance your writing skills. The project will be done in two phases in groups of two. You'll submit the first phase, receive feedback from the instructor, and then submit the second phase close to the final exam date. The project deadlines and group assignments will be announced later in the semester. The project should not exceed 6 pages. This is a "small" project.

Attendance Policy and Class Management

Attendance will be noted. A student is allowed **four** unexcused absences at most. Each additional unexcused absence will lead to losing five points from the final grade. No student will be admitted to class after 10 minutes from the beginning of the lecture. Delays (beyond 10 minutes) will be counted as absences.

Course Website

`http://staff.aub.edu.lb/~bm05/ENMG500/`

Look for assignments and slides presented in class there.