

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

ENMG 501 Engineering Management II

Spring 2007, CRN 20005: 11:00 AM - 12:15 PM, TTH - Bechtel 405

Instructor

Dr. Bacel Maddah

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Office hours: TTH 12:30 - 2:00 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. In ENMG 500 Engineering Management I, the emphasis is on “deterministic” OR models, which assume certainty and linearity. Here, in ENMG 501 Engineering Management II, we continue our OR adventure by exploring decision problems involving one or more elements of uncertainty and nonlinearity. The assumption of uncertainty is quite realistic for most problems. However, it brings with it additional complexities. The mere evaluation of the objective function and constraints for a given set of decision variables requires creative use of *probability theory*. In this course, we will explore the art and science of “modeling under uncertainty.” The course will start with a review of probability and then emphasis three areas of probabilistic OR applications: *Markov Chains*, *Queueing Systems* and *Inventory Control*. In addition, we will touch on *Revenue Management*.

Course Objectives

- Understand the OR methodology of mathematical modeling.
- Develop probabilistic models for real problems.
- Enhance the understanding of probability theory through real applications.
- Understand the probability theory of Markov chains, queueing and inventory models.
- Identify and understand the applications of Markov chains and queueing theory.
- Master the fundamental techniques for analyzing basic Markov chains and queues.
- Understand and appreciate the importance of inventory management.
- Determine the optimal control policy for basic inventory systems.
- Acquire familiarity with revenue management.

Textbook

Taha, H. A. *Operations Research: An Introduction*. Seventh Edition. Prentice Hall, 2003.

Additional References

1. Feller, W. (1968). *An Introduction to Probability Theory and Its Applications*, Vol. 1, 3rd Edition. Wiley.
2. D. Gross and C. Harris (1998). *Fundamentals of Queueing Theory*, 3rd Edition. Wiley.
3. Hillier, F. S. and G. J. Lieberman. *Introduction to Operations Research*, 8th Edition. McGraw-Hill, 2004.
4. Ross, S. M. (2002). *Introduction to Probability Models*, 8th Edition. Academic Press.
5. Silver, E. A., D. F. Pyke, and R. Peterson (1998). *Inventory Management and Production Planning and Scheduling*, 3rd Edition. Wiley.
6. Winston, W. L. *Operations Research: Applications and Algorithms*, 4th Edition. Duxbury Press, 2003.

Tentative Schedule

Topics will be covered according to the following schedule. Exams will be on the specified dates.

- Week 1: Course introduction and the OR modeling approach
- Week 2: Basic probability theory, sets, probabilistic models, conditional probability, Bayes' rule, independence.
- Week 3: Random variables, discrete and continuous, mass and density functions, expectation, variance, independence.
- Week 4: Discrete time Markov chains, classification of states, stationary solution
- Week 5: Continuous time Markov chains, Poisson process, birth-death processes
- Week 6: Queueing models, application of birth-death analysis to Markovian queueus.
- Week 7: Detailed analysis of Markovian queues, single- and multi-server, finite waiting space, finite population.
- Week 8: **Midterm on Monday 04/02/2007 (evening)**
- Week 9: More queueing models, networks of queues, single-server general service times model, approximations and bounds for more general cases.
- Week 10: Introduction to inventory systems, importance and main characteristics
- Week 11: Deterministic economic order quantity model and variants

- Week 12: Probabilistic single period (newsvendor) model, Revenue management applications
- Week 13: Multi-period continuous review and periodic review models with no setup cost
- Week 14: Periodic review with setup cost, the power approximations, the lost sales case.
- Week 15: **Final Exam (Comprehensive) on on 05/29/2007**

Grading

Midterm	35%
Final	35%
Project	10%
Homework	20%

Project

The project will involve a case study on applying Markov chains modeling to a real life inventory control problem. It is intended to give you a taste of realistic OR 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.

Course Website

<http://staff.aub.edu.lb/~bm05/ENMG501/>

Look for assignments and slides presented in class there.