LOM 6331 Supply Chain Modeling

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Office Hours: Wed 3:00 – 4:00 or by appointment

Course Overview

This course provides a graduate-level introduction to *Prescriptive Analytics* (also known as *Optimization*) and its applications in supply chain and operations management. Both deterministic and stochastic modeling methodologies will be covered. Deterministic approaches include mathematical programming (linear and integer programming), network optimization, constraint programming and dynamic programming. For stochastic methods, we will introduce Monte Carlo simulation, and the topic of stochastic optimization for decision-making under uncertainty.

This class features hands-on learning experience on the state-of-the-art optimization software ILOG OPL Studio, which has been applied by Fortune 500 companies such as IBM, HP, Monsanto, etc. In addition, we will teach how to use Oracle's Crystal Ball for Monte Carlo simulation and integrated Simulation-Optimization in the user-friendly spreadsheet environment.

For each modeling methodology module, we start with its modeling techniques, general solution methods/ideas, and implementation of the model and solution methods using state-of-the-art modeling software. Examples and case studies in the domain of supply chain and operations management will be provided for each module. These application examples include but are not limited to: production planning, transportation and distribution, supplier/vendor selection, supply chain configuration, vehicle routing, and machine scheduling.

Course Objectives

Students taking the class will be able to:

1. Construct and build various prescriptive optimization models for supply chain optimization problems;
2. Understand the solution methods of an optimization approach;
3. Implement an optimization model the corresponding solution methods in state-of-the-art modeling software such as the ILOG OPL Studio and Oracle's Crystal Ball;
4. Apply optimization modeling approaches for real world applications.

Course Prerequisites

LOM 6330 Business Logistics Systems
LOM 4350/6350 Management Science (Recommended)

Course Format

Course contents and materials will be delivered as class lectures. Since some topics can be mathematically challenging, students' active *in-class* participation and arduous *out-class* work are both crucial for their success in this class.

Textbook

Modeling Building in Mathematical Programming, fifth edition, by H. P. Williams, Wiley, 1999.

Recommended Reading

Network Models in Optimization and Their Applications in Practice, by F. Glover, D. Klingman and N. V. Philips, Wiley, 1992.

Planning and Scheduling in Manufacturing and Services, by M. Pinedo, Springer, 2005.

Term Projects

Two term projects will be assigned: an individual project and a group project.

<u>Individual Project</u>

A student may choose an arbitrary optimization problem he/she is interested in to work on. It can be an extension/variant of an example, assignment or case study we worked out in class, or a replicate of a model/methodology in an academic journal article. Demonstrating new modeling features and innovations of your work is a plus. An individual Project Report and a Power Point presentation are due at the end of the semester. The Individual Project Report should be 7 to 10 pages with 12pt font size and 1.5 line spacing.

<u>Group Project</u>

Students work in teams on a real-world optimization problem. Each team should first identify and describe the problem to be addressed. A one-page Research Proposal is due before the 6-th week of semester to be approved by the instructor. With an approved proposal, the team may proceed to construct mathematical model for the addressed problem, implement the model and solution methods using appropriate modeling software, conduct detailed computational study, and interpret/summarize results and recommendations. A Team Project Report (10 to 15 pages with 12 pt font size and 1.5 line spacing) will be prepared by the team to document details of their work. The Project Report and a Power Point presentation are due at the end of semester.

Exams

Two exams will be given: Midterm Exam and Final Exam. An exam can be either in-class or take-home. Only under special circumstances, such as sickness, work leave or other emergencies, will a make-up exam be given. Proper documents need to be provided (e.g., doctor's prescription, hospital admission notice, employer's letter) for verification purpose.

The Use of Computer

The use of a personal computer (PC) is essential for this class. It can be either a desktop or laptop of your own. A laptop is preferred as it can be used in the classroom to facilitate hands-on learning experience on the modeling software.

Grading

Class Participation: 10%
Case Studies and HW Assignments: 10%
Individual Project: 15%
Group Project: 25%
Midterm Exam: 20%
Final Exam: 20%

90 ~ 100	A
80 ~ 90	B
70 ~ 80	C
60 ~ 70	D
Below 60	F

Tentative Schedule

Weeks	Lecture Topics	Notes
1 (Jan 18)	Introduction and Module 1-I: Math Programming Modeling (HW-1 assigned)	
2 (Jan 25)	Module 1– II: Math Programming using OPL Studio (HW-2 assigned)	
3 (Feb 1)	**Lab: OPL Studio for Optimization Modeling**	HW-1due
4 (Feb 8)	Module 1-III: Applications of Math Programming in Supply Chains (HW-3 assigned) (Case Study – 1 assigned)	**Reading Assignment: Graves and Willems (2005)** HW-2 due
5 (Feb 15)	Module 1-IV: More Applications of Math Programming from H.P. Williams (2009) (HW-4 assigned)	
6 (Feb 22)	Module 2 – I: NETFORM Modeling (HW-5 assigned)	**Reading Assignment: Camm et al. 1997** HW-3 due
7 (March 1)	Module 2 – II: Applications of NETFORM (Case Study – 2 assigned)	HW-4 due
8 (March 8)	Module 3 – I: Constraint Programming (HW-6 assigned)	HW-5 due **Case Study – 1 due** **Group Project Proposal due**
9 (March 15)	**Midterm Exam**	
10 (March 22)	Module 3 – II: Applications of CP	HW-6 due
11 (March 29)	**Spring Break**	
12 (Apr 5)	Module 4 – I: Introduction to Sequential Decision Modeling and Dynamic Programming (HW-7 assigned) (Case Study – 3 assigned)	**Case Study – 2 due**
13 (Apr 12)	Module 4 – II: Application of Dynamic Programming	
14 (Apr 19)	Module 5 – I: Introduction to Monte Carlo Simulation and Crystal Ball (HW-8 assigned)	HW-7 due **Reading Assignment: Glover et al. 1999**
15 (April 26)	Module 5 – II: Integrated Simulation-Optimization with Crystal Ball	**Case Study – 3 due**
16 (May 3)	**Project Presentations**	HW-8 due Both the Individual Project and Group Project
17 (May 10)	**Final Exam Week**	**Individual Project Paper Due** **Group Project Paper Due**

Note: While we will try our best to follow the schedule, changes and/or adjustments are expected according to progress of the class.