

# SOM752 Deterministic Models in Management Science

*Department of Finance and Operations Management*

*Isenberg School of Management, UMass, Amherst*

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INSTRUCTOR: Ahmed Ghoniem (SOM 317, e-mail: aghoniem@isenberg.umass.edu, Phone: 5-3927)

**Office Hours:** Tuesdays and Thursdays 12:45-2:00 pm

**COURSE DESCRIPTION:** This course emphasizes the science and art of developing deterministic optimization models that lend themselves to efficient solution methodologies. Although classical optimization algorithms are surveyed in conjunction with relevant classes of problems, the course essentially focuses on model building using linear and mixed-integer programming for applications arising in production, logistics, supply chain management, and finance. Innovative modeling techniques, insights into specially-structured models, and symmetry-defeating approaches are explored in the context of business and engineering applications.

**TEXT:** No textbook is required for this course. However, a list of recommended references is provided at the end of the syllabus.

**COMPUTER REQUIREMENTS:** We will use AMPL (which you can download from <http://ampl.com/>) to implement mathematical programs. For the solution of larger models, you can use selected machines in the PC labs in the Isenberg School.

**GRADE:** Homeworks 30%; Midterm Exam 25%; Final Exam 30%; Term Paper 15%.

**HOMEWORKS:** Homework consists of selected problems posted online. You should work on your own. Make sure you turn in neat reports where your solution is clearly developed and discussed. All homeworks should be done on single sides of  $8.5 \times 11$  paper. Each exercise should begin on a new page.

**EXAMS:** There will be two exams, each of which will be closed book, closed notes, in-class exams. You will be given advance notice of when each exam will be held. You may bring to the exam one  $8.5 \times 11$  sheet with formulas and notes written on it.

**TERM PAPER:** Select an article (Operations Research; Management Science; Interfaces; European Journal of Operational Research; Journal of the Operational Research Society, etc.) that reports implementation of an optimization model in the real world. You are required to submit a report on the article and the model presented in the article. The report will include (a) A short description of the application; (b) The entire model with a complete definition of the variables; (c) a table that reports the results obtained for 10 prototype instances of the model that you will solve using AMPL; (d) A discussion about what you have learned about the real-world decision making scenario; A copy of the AMPL model should be included as an appendix. The grade for this assignment will not only depend on the quality of the report but also on the quality and relevance of the selected

article. As part of the assignment, you are required to make a 5-10 minute presentation at the end of the semester.

#### TENTATIVE SCHEDULE

Session	Topic
1	Introduction to Model Building in OR
2-5	LP models; graphical solution; sensitivity analysis; selected applications
6-7	Model manipulation/reformulation
8-9	Multi-period models
10	Case-study; Abstract for Term Paper
11	MIDTERM EXAM
12-17	Integer and mixed-integer models
18	Piece-wise linear objectives
19-21	Network Models
22-24	Multi-objective optimization; Goal Programming
25-27	Class presentations; Exam Revision; Course Evaluation
	FINAL EXAM

Table 1: Tentative course outline

#### REFERENCES:

##### 1. Model Building and Solving

- Sarker, R. A., Newton, C. S. (2008), *Optimization Modelling: A Practical Approach*, CRC Press.
- Williams, H. P. (1999), *Model Building in Mathematical Programming*, 4th Edition, Wiley.
- Castillo, E., Conejo, A.J., Pedregal, P., Garca, R., Alguacil, N. (2001), *Building and Solving Mathematical Programming Models in Engineering and Science*, John Wiley & Sons.

##### 2. LP and IP Theory

- Bazaraa, M. S., Jarvis, J. J., Sherali, H. D. (2005), *Linear Programming and Network Flows*, 3rd edition, John Wiley & Sons.
- Wolsey, L. A. (1998), *Integer Programming*, John Wiley & Sons.

##### 3. Some OR/MS journals: *Management Science; Operations Research; European Journal of Operational Research; Mathematical Programming; Naval Research Logistics; IIE Transactions; Interfaces; Networks; Operations Research Letters; Journal of the Operational Research Society; Production and Operations Management.*