## COURSE SYLLABUS

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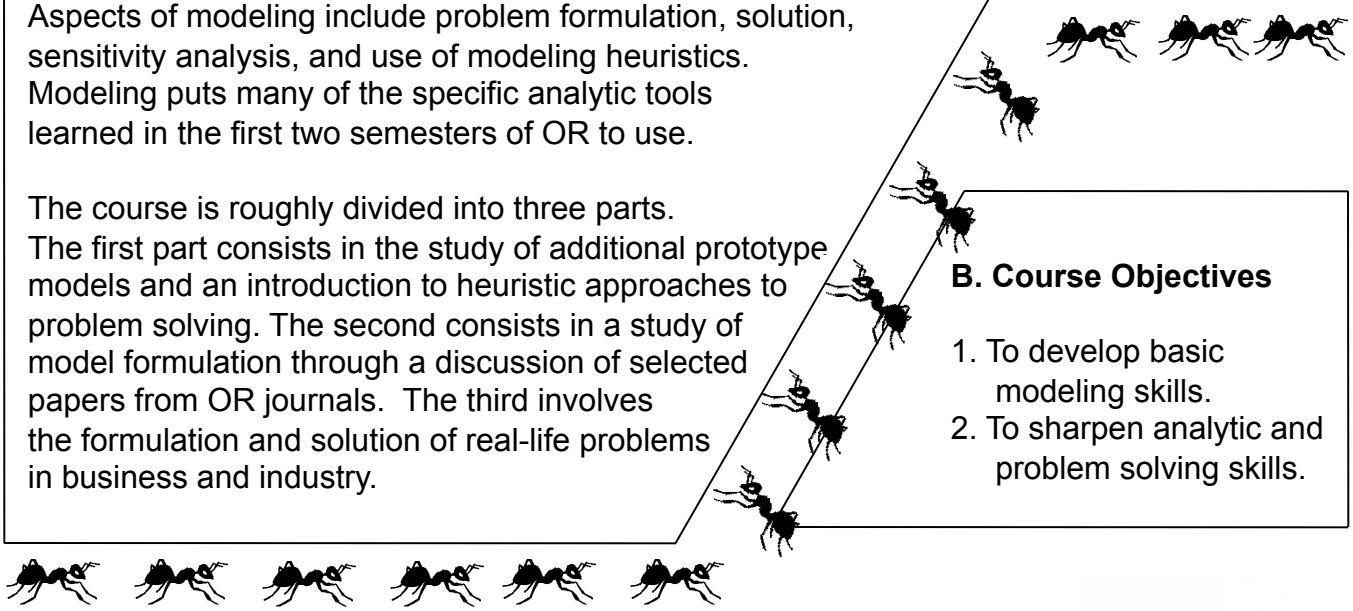
|---|---|---|---|
| Course No. | **QMT 129** | Title | : **Operations Research Modeling Application** |
| Department | : **QMIT** | School | : **JGSOM** |
| Semester | : **I** | School Year | : **2012-2013** |
| Credit | : **3 units** | Instructors | : **Mari-Jo P. Ruiz** |

### A. Course Description

The art of modeling is at the core of Operations Research (OR). Aspects of modeling include problem formulation, solution, sensitivity analysis, and use of modeling heuristics. Modeling puts many of the specific analytic tools learned in the first two semesters of OR to use.

The course is roughly divided into three parts. The first part consists in the study of additional prototype models and an introduction to heuristic approaches to problem solving. The second consists in a study of model formulation through a discussion of selected papers from OR journals. The third involves the formulation and solution of real-life problems in business and industry.



### B. Course Objectives

1. To develop basic modeling skills.
2. To sharpen analytic and problem solving skills.

### C. Course Outline

**1. Markov Analysis**
- 1.1. Markov Chains
  - 1.1a. Transition matrices and their properties
  - 1.1b. Limiting Transition Probabilities
  - 1.1c. Absorbing Markov chains
- 1.2. Markov Decision processes
- 1.3. Markov chains applied to Monopoly

**2. Monte - Carlo Simulation**
- 2.1. Sampling from discrete distributions
- 2.2. Sampling from continuous distributions
- 2.3. Simulation modeling

**3. Graph Theory Techniques**
- 3.1. Graph theory concepts
- 3.2. Routing problems
  - 3.1a. Euler tours
  - 3.1b. Chinese Postman Problem
  - 3.1c. Hamilton Cycles

3.3. Graph coloring and applications
  3.3a. Scheduling
  3.3b. Security
3.4. Centrality and applications
  3.4a. Facility location
  3.4b. Predicting World Cup results
  3.4c. Uncovering terrorist networks

**4. Heuristic Problem Solving**
4.1. Introduction to Computational Complexity
4.2. Traveling Salesman Problem
  4.2a. Nearest neighbor heuristic
  4.2b. Nearest insertion heuristic
  4.2c. Geometric heuristic
  4.2d. Christofides heuristic
  4.2e. Space-filling curve heuristic
4.3. Vehicle Routing Problem
  4.3a. Clarke-Wright heuristic
4.4. Plant Lay-out

**5. Recent Advances**
5.1 Ant Colony Optimization
5.2 DNA Computing

**6. Study and Presentation of Selected Papers in Operations Research**
A list of suggested papers is given in the Appendix.
Students will work in groups. Each group will give a 40-minute presentation of the paper chosen.

**7. Modeling and Solution of a Real-life Problem**
Students will work in groups on a chosen problem to be modeled for both QMT 129 and POM 105. There will be regular progress reports. Each group will give a final presentation to a panel.

**A. Suggested References**

**Simulation and Markov Analysis**

F. Hillier and G. Lieberman, *Introduction to Operations Research*, 7th Edition, McGraw Hill, New York, 2005.

H. Taha, *Operations Research: An Introduction*, 7th Edition, Prentice-Hall, Upper Saddle River, N.J., 2003.

W. Winston, *Operations Research Application and Algorithms*, 4th Edition, Brooks/Cole, Toronto, 2004.

**Graph Theory**

M. Aigner and G.M. Ziegler, *Proofs from the Book*, Speinger,Berlin 2001.

J.A. Bondy and U.S. R Murty, *Graph Theory* (GTM 244), Springer, Berlin, 2008.

J. Clark and D.A. Holton, *A First Look at Graph Theory*, World Scientific, Singapore, 1991.

J. O'Rourke, *Art Gallery Theorems and Algorithms*, Oxford University Press 1987.

D. West, Introduction to Graph Theory, 2nd Edition, Prentice Hall, Upper Saddle River, N.J., 2001.

**Heuristics**

J. Bartholdi, R. Collins et.al., A minimal technology routing system for Meals on Wheels, I*nterfaces*, 13 (3) 1-8.

H. Daellenbach, J. George, D. McNickle, *Introduction to Operations Research Techniques* (2nd Ed.), Allyn and Bacon, 1983.

L.R. Foulds, *Combinatorial Optimization for Undergraduates*, Springer-Verlag, New York, 1984.

http://www.kfunigraz.ac.at/ifwwww/pg/downloads/Ungran%20Transp.doc

http://www.idsia.ch/~luca/abstracts/papers/corso_urp_metanet.pdf

http://www.math.princeton.edu/tsp/index.html

**Recent Advances**

L. Adleman, Computing with DNA, *Scientific American*, 54-61 (Aug 1998).

E. Bonabeau, M. Dorigo and G. Theraulaz, Inspiration for optimization from social insect behaviour, *Nature* 406, 39-42 (2000).

E. Bonabeau and G. Theraulaz, Swarm smarts, Scientific American, 72-79 (March 2000)

M. Dorigo and L.M. Gambardella, Ant Colonies for the traveling salesman problem, *Bio Systems* 43, 73-81 (1997)

http://www.usc.edu/dept/molecular-science/fm-papers.htm

**Modeling**

F. Giordano, M. Weir, W. Fox, A First Course in Mathematical Modeling, 3rd Edition, Brooks/Cole, Pacific Grove, CA, 2003.

http://home.ubalt.edu/ntbarsh/opre640/opre60.htm

**E. Grading System**

| | | |
|---|---|---|
| | 92 – 100 | A |
| 86 – 91 | B+ | |
| 77 – 85 | B | |
| 69 – 76 | C+ | |
| 60 – 68 | C | |
| 50 – 59 | D | |
| 49 & below | F | |

Grades will be based on three announced long tests, a group paper presentation which will be counted as one long test and a modeling project which will be counted as two long tests.

**F. Classroom Policies**

Lateness for class (beyond 15 minutes) is considered an absence.

Observe classroom decorum.

Observe the JGSOM dress code.

**G. Consultation Hours**

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|---|---|---|
| W– F | 10:30 – 11:30 | JGSOM Faculty Room (SOM 302) |
| | 3:00 – 4:00 | Mathematics Dept ( SEC A 321) |

or by appointment.