Department of Industrial Engineering & Management
Faculty of Engineering and Architecture
American University of Beirut

ENMG 604: Deterministic Optimization Models

Spring 2016-2017, 4:00-5:10 PM Tuesdays & Thursdays

Course Description:

This course is an introduction to the fundamental models, methods and applications of deterministic optimization. The focus will be on formulating and analyzing large-scale deterministic optimization models, which include linear, integer, dynamic, and non-linear programs. 3 crdts.

Prerequisites: Students are expected to have a good understanding of linear algebra and calculus. Please see the instructor if you are unsure of your background.

Learning Outcomes

1. Recognize the major capabilities and limitations of deterministic operations research modeling as applied to practical real-world problems in business and engineering.
2. Build skills in recognizing and formulating deterministic optimization models: Constraints, Objective function and Decision variables.
3. Use optimization algorithms to find the optimal solutions and be able to perform sensitivity analysis.
4. Understand of the theory behind the models and the importance of simplifying assumptions. (Linear, integer, network & nonlinear)
5. Build a broader understanding of the types of mathematical models and their appropriate context.

Instructor:

Prof. Ali Yassine
311 Bechtel. Tel: 3494, ali.yassine@aub.edu.lb
Office Hours: 2:30 pm - 4:00 pm Tues. & Thur., or by appointment.

Required Text:

Jensen, P. and Bard, J., Operations Research Models and Methods, John Wiley & Sons, 2003.

Evaluation & Grading:

- There will be one midterm exam (30%) and a final exam (40%).
  - ✓ Exams are OPEN BOOK and NOTES.
  - ✓ No make-up exams will be given unless in extreme circumstances and with prior arrangement.
  - ✓ The final exam is CUMULATIVE, but new chapter material will be emphasized on the final exam.
  - ✓ Each student must bring a current picture ID in order to be allowed to take the exam. ANY student not having a picture ID will NOT be allowed to take the exam.
- Homework assignments are 10% of total grade.
- Term project is 15% of total grade (10% on the written report and 5% on the oral presentation).
- Attendance and class participation is 5% of the grade.
- Dishonest conduct related to any examination, homework, or report will not be tolerated. Students who cheat will receive a failing grade. Cheating includes but is not limited to GIVING / RECEIVING unauthorized help and the use of unauthorized material during an examination, or copying homework assignments.

Homework:

Homework problems will be assigned almost bi-weekly throughout the semester. The homework assignments and solutions will be posted on Moodle on timely basis. Please check Moodle at least once a week.

Attendance:

Each lecture 10 random names will be called to check attendance. A student is allowed to miss 2 lectures only (with a legitimate excuse). Each additional absence will result in reducing the student's final grade by 3 points.

Term Project – Written Final Report

Discuss the potential role of Mathematical Models in a real world problem for which you can obtain data. You must clearly define a management situation that you think optimization methods can be used to bring about significant improvement. The written project reports must be computer printed. The length of the written report is strictly limited to 10 pages, but exhibits up to 5 additional pages may be appended. Each report must include the following information in this order:

- **Purpose of Model** – Motivation, project description, and problem statement or definition.
- **Literature Review** – Each team is required to include in their project report the summary and discussion of **at least two journal articles** from the INTERFACES journal (or related journals such as Management Science, European Journal of Operational Research, etc. Alternatively, you can use Google Scholar to look for relevant articles). Please confirm the article selection with me before proceeding further.
- **General Model Structure:** Model Formulation
    - Decision Variables or Decision alternatives
    - Objective(s)
    - Constraints
    - Data Sources
- **Model Solution**: You must apply optimization models to a representative data set. Use MS Excel Solver, Excel premium Solver, LINDO, GAMS, or CPLEX to run your model.
- **Model Sensitivity Analysis**: Perform sensitivity analysis on important input model parameters
- **Recommendations**: make recommendations based on a through sensitivity analysis of the model output.
- **Summary and Conclusion**

Term Project – Written Final Oral Presentation (5-7 Overheads)

1. Problem Context
2. Literature Review
3. Model Structure or Content in WORDS (NO MATHEMATICAL FORMULA)
    - Decision Variables,
    - Objectives,
    - Constraints,
    - Planning Horizon,
    - System Scope

4-5 Model Usage -

- What issues did it address?
- What was its impact?
- Who were the model users?

6. Implementation Issues & Concerns if discussed in paper
7. Your lessons learned & analogies
    - The analogies could relate to potential use of the model or to implementation in other areas

Team Contribution

Each team member will also supply a one page summary outlining the contributions made by him/or her and the other members of the team to the final project. I will use these summaries to determine a differential grading structure for the final project.

DETAILED COURSE SCHEDULE

Wk	Date	Topic
1	Jan. 24 Jan. 26	**Overview of course and Introduction to Operations Research (OR)** **Linear Programming (LP): Graphical Solution**
2	Jan. 31 Feb. 2	**Linear Programming (LP): Models & Formulation I** Team formations **Linear Programming (LP): Models & Formulation II**
3	Feb. 7 Feb. 9	**Simplex Method** Homework Solution. HW #1 due
4	Feb. 14 Feb. 16	**Duality& Sensitivity Analysis I** Homework Solution. HW #2 due
5	Feb. 21 Feb. 23	**Revised Simplex Method** Homework Solution. HW #3 due
6	Feb. 28 Mar. 2	**Advanced Linear Programming: Interior Point Methods** Project proposal is due (1-pager)
7	Mar. 7 Mar. 9	**Review for Midterm** **Midterm** (2 hrs)
8	Mar. 14 Mar. 16	**Transportation Model**
9	Mar. 21 Mar. 23	**Network Models & Methods** Homework Solution. HW #4 due
10	Mar. 28 Mar. 30	**Dynamic Programming** Homework Solution. HW #5 due
11	Apr. 4 Apr. 6	**Integer Programming I** Project status/progress report is due (1-pager)
12	Apr. 11 Apr. 13	**Integer Programming II** Homework Solution. HW #6 due
13	Apr. 18 Apr. 20	**Nonlinear Programming I**
14	Apr. 25 Apr. 27	**Nonlinear Programming II** Homework Solution. HW #7 due
15	May 2 May 4	**Review** **Final project presentations** Written report due
16	**Friday May 5**	**Final Exam**