

Deterministic optimization models and methods

MSCI 332 Fall 2018

Course outline

Instructor and course information

- Instructor: Dr. Fatma Gzara
Office: CPH 3622
Email: fgzara@uwaterloo.ca
Ext.: 38940
- Lectures: T, TH 10:00 AM – 11:20 AM, Room CPH 3681
- Tutorial: F 8:30 AM – 9:20 AM, Room CPH 3681
- Office hours: T 11:30 AM – 12:30 PM., Room CPH 3622
- Teaching assistant: Gohram Baloch
Office: CPH 4357
Email: ggohram@uwaterloo.ca
Office hours: F 11:30 AM – 12:30 PM, Room CPH 4357
- Course website: <http://learn.uwaterloo.ca>

- No Lecture: Tuesday Oct 9 (Study day)
- No Tutorial: Friday Oct 12 (Wednesday schedule)

- Laptop policy. Laptops are only allowed to take notes. If caught using your laptop otherwise, you will not be allowed to use it anymore.
- Cellphone use is not allowed. Cellphones should be kept out of sight during lectures and tutorials. Same for all other electronic devices.
- All distractors are not allowed: social media, web browsing, messaging, gaming, working on homework, etc.
- Video/audio recording is not allowed.

Course description

This course builds on the material covered in MSCI 331 Introduction to Optimization. It covers advanced topics in deterministic optimization with application to Management Engineering decision problems. The goal of the course is to develop the ability to formulate fairly complex decision problems, and to design solutions using advanced methods. The main topics are advanced linear and integer optimization, dynamic programming, heuristics and metaheuristics, and nonlinear optimization.

Course objectives

1. Recognize the major capabilities and limitations of deterministic optimization models and methods as applied to Management Engineering decision problems.
2. Formulate deterministic optimization models: objectives, decisions and constraints.
3. Describe the theory behind available solution methods and apply exact and heuristic algorithms.
4. Describe a problem related to deterministic optimization by placing it in its general context and framework.
5. Compare and contrast design solutions by assessing the validity of proposed solutions.
6. Develop an exact or heuristic solution methodology to solve a model.

Evaluation

- Assignments (3x10%) : 30%
- Test 1 : 15%
- Test 2 : 15%
- Final Exam : 40%

Learning material

Throughout the term, **lecture notes and tutorial material** will be posted on Learn under contents\Lecture notes. This course assumes that students have reasonable command of the concepts covered in MSCI 331 Introduction to Optimization as well as basic linear algebra concepts. For that purpose, posted on learn are a **review of linear algebra and MSCI 331 lecture notes** from Spring 2016. Please do review this material and make sure that you are familiar with all the content.

There is no required textbook for the course. You may use any book on Operations Research or optimization for further readings. Specifically, the following two **books are recommended**:

- F.S. Hillier and G.J. Lieberman (HL), Introduction to Operations Research, McGraw Hill ISBN: 9781259174001.
 - A hard copy is available in the Davis Centre Library course reserves. Institutional access is not available for the e-book.
- W. L. Winston and M. Venkataramanan (WV), Introduction to Mathematical Programming, Duxbury Press, ISBN: 0-534-35964.
 - I have a few extra copies of this book that you may borrow (24-hour loan).

Tutorials: There are 12 tutorials that will be delivered by the teaching assistant. You are required and highly encouraged to attend tutorials. You are responsible for material discussed in the tutorials.

Tutorial material is posted prior to the tutorial. You are expected to read, understand and attempt the exercises before coming to the tutorials.

Assignments: The goal of the assignments is to present students with a realistic Management Engineering design problem. Students are responsible on designing models and solutions and analyzing scenarios. Assignments 1 and 2 focus on modelling and solution using R/Gurobi. Assignment 3 focusses on developing heuristics and implementing them in R.

Software: We will use Gurobi as solver and R for implementations.

Other Information

- **Learn website:** Course material including lecture notes, tutorials, practice problems, solutions, announcements, and marks are posted on Learn. Since this course builds on knowledge learned in MSCI 331, MSCI 331 lecture notes are posted for your reference.
- **Exams:** The tests and final exam are closed book and closed notes. The final exam is comprehensive. Exam announcements, examples, and practice problems are posted on Learn.
- **Late submissions:** Late submissions are not accepted and will not be marked.
- UW policies and regulations, below, must be observed at all times.

This course outline is subject to "in class" changes as considered necessary by the instructor.

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check www.uwaterloo.ca/academicintegrity/ for more information.]

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity [check www.uwaterloo.ca/academicintegrity/] to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties check Guidelines for the Assessment of Penalties, www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm.

Appeals: A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) www.adm.uwaterloo.ca/infosec/Policies/policy72.htm.

Note for Students with Disabilities: The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.