

INSTRUCTOR : DR. AMER OBEIDI, P.ENG
OFFICE : CPH-3627
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OFFICE HOURS : TUESDAY AFTERNOON.

COURSE DESCRIPTION

This introductory course to optimization uses quantitative approaches to decision making and problem solving involving mathematical modeling and formulations, solution methods, and output analysis. Students are introduced to a variety of practical problem formulations in management and engineering, a number of solution methods, including, but not limited to linear optimization, network models, project management, and decision analysis. Students are also involved in group projects of real-life applications, where they go through conceptual and operational model design, analytical solution, output analysis, and recommendation.

COURSE OBJECTIVES

The emphasis in this course will be on the systematic structuring of the main characteristics of a real-life problem using mathematical models to explore a range of scenarios and determine which decisions are robust under a number of assumptions. Hence, our focus will be on developing your modeling skills, carrying out sensitivity analysis ("What-if"), interpretation and analysis of output results, and computer implementations of operations research (OR) techniques using some software packages such as LINDO, LINGO, and GAMS. The use of quantitative modeling in different settings and hierarchical levels of decision-making will be illustrated through the modeling and analysis of realistic case studies. Upon a successful completion of the course, each student should be able to:

- Analyze a problem situation in engineering, management, or business environment, focusing on important details.
- Building relevant models that provide valuable insights for operational and/or strategic decision making.
- Use relevant computer application software to solve and understand an operations research model.
- Appreciate the advantages and limitations of operations research in addressing real-life situations.
- Become an active and critical modeler rather than a passive consumer of analytical work.
- Learn key communication skills of report writing and develop independent learning skills.

CLASS SCHEDULE

Tuesday	8:30-9:20 AM	E2 1303A
Tuesday	4:30-5:20 PM	E2 1303A
Thursday	8:30-10:20 AM	RCH 305

OFFICE HOUR

Tuesday Afternoon. Email before you come. Other days or times, such as Monday or Thursday, can also be arranged by appointment.

TEACHING ASSISTANT

Mr. Ahmed Saif, asaif@uwaterloo.ca. Office hour: Email the TA to book a meeting.

REQUIRED TEXTBOOK

Introduction to Mathematical Programming: Applications and Algorithms: Volume 1, 4th Edition by Wayne L. Winston and Munirpallam Venkataramanan. Duxbury Press/Cengage Learning, 2003. ISBN-13: 978-0-534-35964-5 (available at UW-Bookstore).

In addition to the textbook, I encourage you to search and read articles from a number of relevant journals that contain the latest information regarding the theory and practice of problem solving and operations research (OR) of real-life applications. In particular, the January-February issue of *INTERFACES* contains award-winning articles of OR applications, while *ORMS TODAY* magazine

provides a comprehensive look at OR and management science through stories, feature articles, case studies, software reviews and surveys. These Journals are accessible to UW students for free.

ALTERNATIVE BOOK

You also may wish to use an alternative book in case you cannot buy the required one. I would suggest the popular book by Hillier, F. and Lieberman, G., *Introduction to Operations Research*, but you are free to choose any other introductory to operations Research book.

SOFTWARE

A wide range of OR software packages are available for solving linear and integer programming models. Xpress-Optimizer is the best for solving large-scale linear, integer and mixed integer programming problems. You can download and use Xpress-MP Student Edition, which is free, from Dash Optimization (<http://optimization.fico.com/student-version-of-fico-xpress.html>). An alternative software to use is LP-Solve which is free, open source, mixed integer program solver. You can also use LINDO, LINGO, GAMS, or the optimization toolbox in MATLAB for solving a wide variety of OR models. A comprehensive list of LP software packages can be found at <http://www.lionhrtpub.com/orms/surveys/LP/LP-survey.html>.

SUMMARY OF TOPICS

- Linear programming model formulation and solution.
- LP sensitivity analysis.
- LP duality analysis.
- Integer programming model formulation and solution.
- Network models.
- Decision analysis.

COURSE MANAGEMENT

The course will be administered through the learning management system UW Learn. You are expected to use [MSCI331-Winter 2013](#) on Waterloo Learn (<http://learn.uwaterloo.ca>) website regularly for all course-related correspondence and announcements. Summary of some concepts and students' grades will also be posted in the course website.

EVALUATION

The course grade will be based on a *midterm examination*, *five quizzes*, a group project, and a final examination. If you miss any examination due to a **VERIFIED** extenuating circumstance,¹ you would be offered an opportunity for a makeup exam. The breakdown of the marking scheme is as follows:

Homework assignment (2)	Not marked
Quizzes (5)	20 %
Team Project	15 %
Midterm Examination	25 %
Final Examination	40 %

EXAMINATIONS

All midterm and final examinations will be closed book and notes. You are permitted to bring your *own-handwritten*, one-page, two-sided 8 ½ x 11 crib sheet. Make sure to prepare an efficient and well organized sheet. An announcement about the exact date and time for the examination will be confirmed in class. As for the final examination, the day, time, and location will be determined by the Office of the Registrar. So you should start checking <http://www.registrar.uwaterloo.ca/exams/finalexams.html> by early March.

¹ Extenuating circumstance is an unforeseeable and beyond your control situation, which either prevents you from taking an examination or submitting a coursework or which affects your academic performance in the course. Extenuating circumstances will usually be health related or of a personal nature such as accident, bereavement or other personal issues. At any rate a verification letter (VIF or counselling letter) is required but producing them does not guarantee an immediate accommodation.

If you require special accommodation for religious or cultural observances please notify me in writing by the **second week** of the term. Notice that “Student travel plans are NOT considered acceptable grounds for granting an alternative examination time.”

COURSE PROJECT

The goal of the project is to present students with real-life applications of the models and solution methods discussed in the course. The project will be done in teams, each consists of of three students. Refer to the Project Information document for more information.

HOMEWORK AND QUIZZES

Five quizzes will be given during tutorial times (specific dates are in the table below). **Do not** miss any of the quizzes, so schedule your calendar accordingly. Marked quizzes will be returned back to students during tutorial times or can be picked up from the TA’s office. The main objective of the quizzes is to *evaluate how students systematically analyze and solve problems using the appropriate mathematical modeling technique*. Another objective is to *assess the accuracy and correctness of the applied technique in solving problems*. It is important that you demonstrate a thorough understanding of the different approaches and procedures as well as accuracy in your answers; if not, expect some deduction of marks. In addition, there will be two unmarked homework assignments. Each assignment will cover topics that share compatible conceptual framework. These assignments will help you get acquainted to solving challenging problems.

Unclaimed student submissions will be kept for the duration of the term after that time the material in question will be securely destroyed. Final examinations will be kept for the duration of one year.

Quiz	Date
1	January 22
2	February 5
3	March 5
4	March 19
5	April 2

LATE ASSIGNMENT POLICY

All and reports must be submitted on time using the appropriate drop-box located in the second floor of CPH building. If you know that you are going to be late and have an extenuating circumstance, you must contact the TA to explain your situation and arrange for a new submission time. Otherwise, a late report will be accepted but will incur a penalty. Work that is submitted late during the first two days without an extension granted will be penalized 25% of the report mark per calendar day or part of a day (including weekends and vacations). After two days, the work will not be accepted and it will be given a zero mark. Submitting a late assignment must not affect the submission date of subsequent ones. In addition to submitting a hardcopy, all reports have to be submitted in a proper Drop-box on the course website.

CLASS ATTENDANCE

Students are expected to attend all classes and tutorials (on time) and will be held responsible for all material discussed in each class regardless of whether the student actually attended class. If you come to class late, please be considerate to others.

PERSONAL COMMUNICATION AND COMPUTER DEVICES

Personal Communication and Computer devices such as cell phones, digital recorders, iPods, MP3 players, cameras or laptops are not to be used during class unless I authorize their usage for a class-related purpose. All cell phones are to be turned off and not be used during a class. If I give permission for the use of a personal computer for note-taking that is the sole purpose to which these devices should be put. Cell phones/camera phones are to be turned off and not used during any testing or examination period. During the testing session cell phones/camera phones are to be stored in a knapsack or purse, and may not be placed on the table, desktop, or individual’s lap. Students may access the internet during class sessions for only instructor authorized, class-related purposes.

COMMUNICATION

I will make every effort to respond to your e-mails within a reasonable time. When you email me please include your full name and UW ID number. Do not e-mail me asking to explain or clarify concepts or what you have missed in class; lecture time, tutorials, and office hours are set for that purpose.

RE-EVALUATION OF COURSE WORK

If you feel you deserve more marks on any given quiz, report, or examination, first carefully check the provided solutions and determine where and how many marks you believe you deserve. Contact the TA to arrange a convenient time to discuss the work and your complaint. If you feel that the TA did not respond adequately to your grievance contact me.

On the other hand, to discuss your midterm exam mark, look carefully through your midterm answer paper when it is returned to you. If you are *absolutely* certain that you deserve more marks on your midterm exam, you must give it back immediately. A photocopy of it will be made and the original will be returned to you. You then have at **most two weeks** to make specific demands about your midterm exam.

ACADEMIC INTEGRITY, GRIEVANCE, DISCIPLINE, APPEALS AND NOTE FOR STUDENTS WITH DISABILITIES

The following statements were taken from www.uwaterloo.ca/accountability/documents/courseoutlinestmts.pdf :

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.

Plagiarism detection software (Turnitin) will be used to screen assignments and project reports in this course. This is being done to verify that use of all materials and sources in assignments is documented. Students will be given an option if they do not want to have their assignment screened by Turnitin. In the first week of the term, details will be provided about arrangements and alternatives for the use of Turnitin in this course. Students have the right to say NO to submit to Turnitin. If you do not wish to have your work submitted to Turnitin let me know in writing by the second week of the term.

COURSE SCHEDULE FOR WINTER 2013

Notice that topic coverage may be adjusted as the course progresses.

Week	Topics	Chapter Reading	Project	Assignment and Quiz
1	Introduction to the course Linear Programming (LP): Formulation	3		
2	Linear Programming (LP): Formulation and graphical solution	3	Assigning teams (Jan. 18)	
3-4	Geometric properties and the Simplex Algorithm	4	Part I: Literature review report (Feb 1)	Quiz 1 (Jan 22)
5	Sensitivity analysis	5 & 6.8		Quiz 2 (Feb. 5)
6	Duality	6		
6	Midterm Examination			
7	Duality and sensitivity analysis	6		
8	Integer programming (IP)	9		Quiz 3 (March 5)
9	Integer programming (IP)	9		
10	Decision analysis	Class notes	Part II: Mini-case final report (March 22)	Quiz 4 (March 19)
11	Network models: Formulation (Transportation and Transshipment)	7-8		
12	Class + Project presentations			Quiz 5 (April 2)
	Final exam to be announced			