DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus
Department of Mathematics and Statistics
MATH 3300
Optimization
Fall 2019

Instructor:	Mr. C. DeGagné	DeGagne@dal.ca	Chase 328
Lectures:	TR 14:35-15:55	LSC 244	
Office Hours	MF 10:00 – 11:00	Learning Centre	

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Course Description

An introduction to the concepts and applications of linear programming. Topics include the simplex, Big M, and Two Phase methods for linear programming, duality, sensitivity analysis, and integer programming problems.

Course Prerequisites

A passing grade in MATH 1030.03.

Course Objectives/Learning Outcomes

This course presents the theory, application, and algorithms relevant to solving linear programming problems. In this course, students will achieve the following outcomes:

Student will:
1) Be able to mathematically formulate an applied word problem involving revenue, costs, and constraints as a linear program.
2) Be able to geometrically solve a linear program in two variables.
3) Be able to convert a linear programing problem into standard form.
4) Be able to apply the simplex algorithm to solve a linear programming problem.
5) Be able to find alternate solutions to a linear program problem.
6) Be able to utilize computer software to solve a linear programming problem.
7) Be able to solve a linear programming problem using either the Big M Method or the Two-Phase Simplex Method.
8) Be able to solve a linear programming problem with unrestricted-in-sign variables.
9) Be able to analyze small changes to a linear programming problem.
10) Be able to produce the dual of a linear program.
11) Be able to describe the Dual Theorem and its consequences.
12) Be able to use shadow prices to analyze changes to a linear programming problem's optimal solution.
13) Be able to use duality to analyze changes to a linear programming problem's optimal solution.

Course Materials

We will be using the textbook *Operations Research: applications and Algorithms (4th Ed.)* by W. L. Winston, Brooks/Cole, Belmont, 2004. The textbook will be useful, but is not required.
The course website will be on **BrightSpace**.

Class Content Outline

The course will be structured into the following weeks.

Lecture Date	Sections	Topics
Sept. 3	2.1 – 2.6	Matrices and Vectors, Matrices and Systems of Linear Equations, The Gauss-Jordan Method for Solving Systems of Linear Equations, Linear Independence and Linear Dependence, The Inverse of a Matrix, Determinants
Sept. 5	3.1	What is a linear programming problem?
Sept. 11	3.2	The graphical solution of two-variable linear programming problems
Sept. 10	3.3, 3.4, 3.5, 3.8	Special cases, a diet problem, a work-scheduling problem, Blending problems
Sept. 17	4.1, 4.2	How to convert an LP to standard form continued, preview of the simplex algorithm
Sept. 19	4.5, 4.6	Simplex algorithm, using the simplex algorithm to solve minimization problems
Sept. 24	4.7, 4.3, 4.8	Alternative optimal solutions, direction of unboundedness, and unbounded LPs
Sept. 26	4.12	The Big M method
Oct. 1	4.13	The two-phase simplex method
Oct. 3	6.1, 6.2	A graphical introduction to Sensitivity Analysis, some important formulas
Oct. 8	Assignment 3	Groups will go to the locations for assignment 3
Oct. 10	Assignment 3	Groups will go to the locations for assignment 3
Oct. 15	**Midterm**	**8:00AM to 10:00AM** - Chapters 3 and 4
Oct. 17	6.2	Some Important Formulas continued
Oct. 22	Assignment 3	Group presentations
Oct. 24	Assignment 3	Group presentations
Oct. 29	6.3	Sensitivity Analysis
Oct. 31	6.5, 6.7	Finding the Dual of an LP, the dual theorem and its consequences
Nov. 5	6.8, 6.9	Shadow prices, Duality and Sensitivity Analysis
Nov. 7		
Nov. 12	No Class	November Break
Nov. 14	No Class	November Break
Nov. 19	Test	Chapter 6
Nov. 21	9.1, 9.2	Introduction to Integer Programming, Formulating Integer Programming problems

Nov. 26	9.3, 9.5	The Branch-and-Bound method for solving pure integer programming problems, Solving Knapsack problems by the Branch-and-Bound method
Nov. 28	Review	
Dec. 3	No Class	

Course Assessment Component

Component	Weight (% of final grade)	Date
Assignments	25%	Given: Sept. 11, Sept 25, Oct. 9, Oct 30, Nov. 22
Test	10%	Nov. 19 in class
Midterm	20%	Oct. 15 in class
Final	45%	Scheduled by Registrar

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)   B+ (77-79)   C+ (65-69)   D (50-54)

A   (85-89)   B   (73-76)   C   (60-64)   F   (<50)

A-   (80-84)   B-   (70-72)   C-   (55-59)

Course Policies

1) Late assignments may be accepted with a valid reason, until solutions are posted, after which no late assignments can be accepted.
2) Missed assignments, with a valid reason, will be dealt with on an individual basis.
3) You are allowed to discuss your work with your class mates when solving the assignment problems, but you are required to do your final write-up by yourself.
4) Assignments 1, 2, 4, and 5 will be done in two parts. Part one will be through webwork and will consist of 70% of the overall grade for the assignment. Part two will be a write up of the webwork questions and will consist of the remaining 30%.

Written Portion Check List

Requirement	Details
Title Page	Does the student include a title page with their name, B00 number, course number, and assignment number?
Problems	Does the student clearly write out each assigned problem?
Solutions	Does the student clearly write out each solution? Are the solutions easy to follow, and the information easy to find?
Cleanliness	Is the student's writing clear and legible with no errors/scratching out? For students writing in pen, white-out will be required for errors – do not scratch it out and then continue.
Graphs	Are graphs clear, labelled, and visually pleasing?

5) This course will only be cancelled in relation to weather related emergencies when the university is officially closed. If homework was due on that date it will be due on the date of the next scheduled class for this course.
6) There will be no makeup midterm or test. If you miss the midterm without **prior** permission, then it will count as a zero. Exceptions are made in two cases: (1) if you obtain the instructor's permission **prior** to a midterm or test, or (2) if you miss a midterm or test for a medical reason and have a doctor's note (you must notify the instructor **prior** to the midterm/test, and provide a medical note upon your return). In these cases, the weight of the missed midterm/test will be shifted to the final exam (so, for example, your final exam will be worth 65% of your final grade if you miss the midterm).
7) It will not be possible to write the final exam early and there will only be a make-up of the final exam in case of illness or family emergencies. So do not schedule your flight home before the final exam date.
8) Office hours will be on Mondays and Fridays from 1 until 2 in the Learning Centre.

DALHOUSIE UNIVERSITY

University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.
Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).
Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.
Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness
Statement: http://www.dal.ca/cultureofrespect.html)

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit the office (Rm 3037, McCain Building), e-mail (elders@dal.ca) or leave message (902-494-6803).
Information: https://www.dal.ca/campus_life/communities/native.html

Important Dates in the Academic Year (including add/drop dates)
https://www.dal.ca/academics/important_dates.html

University Grading Practices
https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Student Resources and Support

Advising

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: https://www.dal.ca/faculty/science/current-students/academic-advising.html

Aboriginal Student Centre: https://www.dal.ca/campus_life/communities/native.html

Black Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: https://libraries.dal.ca/

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: https://libraries.dal.ca/services/copyright-office.html

Fair Dealing Guidelines https://libraries.dal.ca/services/copyright-office/fair-dealing.html

Other supports and services

Student Health Services: https://www.dal.ca/campus_life/health-and-wellness/health-services/services.html

Counselling: https://www.dal.ca/campus_life/health-and-wellness/counselling.html

Student Advocacy: https://www.dsu.ca/services/community-student-services/student-advocacy-service

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Research Lab Safety
https://www.dal.ca/content/dam/dalhousie/pdf/dept/safety/lab_policy_manual_2007.pdf

Biosafety: https://www.dal.ca/dept/safety/programs-services/biosafety.html

Chemical Safety: https://www.dal.ca/dept/safety/programs-services/chemical-safety.html

Radiation Safety: https://www.dal.ca/dept/safety/programs-services/radiation-safety.html

Scent-Free Program: https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html