Faculty of Science Course Syllabus
Department of Mathematics and Statistics
MATH 3300
Optimization
Fall 2015

Instructor(s): Jason I. Brown  jason.brown@dal.ca  Chase 204
Lectures:       TR 11:35 – 12:55  LSC 206

Course Description
An introduction to the concepts and applications of linear programming. Topics include the simplex method for linear programming, duality and sensitivity analysis. Some of these topics are illustrated by means of interactive computer packages.

Course Prerequisites
A passing grade in MATH 2030.03.

Course Objectives/Learning Outcomes

This course presents the theory, application and algorithms relevant to solving linear programming problems.

Objective: “The student will be able to mathematically formulate an applied word problem involving revenue, costs and constraints as a linear program.”
   Condition: Given an applied word problem involving revenue, costs and constraints.
   Behaviour: The student will be able to translate the problem into a mathematical formulation as a linear programming (LP) problem.

Objective: “The student will be able to geometrically solve a linear program in two variables.”
   Condition: Given a linear programming problem involving two variables.
   Behaviour: The student will be able to solve the problem geometrically.

Objective: “The student will be able to convert a linear programming problem into standard form.”
   Condition: Given a linear programming problem.
   Behaviour: The student will be able to convert the problem into its standard form.

Objective: “The student will be able to apply the simplex algorithm to solve a linear programming problem.”
Condition: Given a linear programming problem in standard form.
Behaviour: The students will be able to solve the problem with the simplex method.

Objective: “The student will be able find alternate solutions to an LP problem.”
  Condition: Given an LP problem with multiple optimal solutions.
  Behaviour: The student will be able to find more than one solution to the problem.

Objective: “The student will be able to utilize computer software to solve a linear programming problem.”
  Condition: Given a linear programming problem.
  Behaviour: The student will be able to use computer software to find a solution to the problem.

Objective: “The student will be able to solve a linear programming problem using either either the M-Method or the Two-Phase Simplex Method.”
  Condition: Given a linear programming problem.
  Behaviour: The student will be able to solve the problem via either the M-Method or the Two-Phase Method.

Objective: “The student will be able to solve a linear programming problem with unrestricted-in-sign variables.”
  Condition: Given a linear programming problem, with some variables unrestricted-in-sign.
  Behaviour: The student will be able to convert the problem into another LP problem with no unrestricted-in-sign variables.

Objective: “The student will be analyze small changes to a linear programming problem.”
  Condition: Given a linear programming problem, an optimal solution, and some small alterations to the parameters.
  Behaviour: The student will be able to qualitatively and quantitatively determine the effect of the changes on the optimal solution.

Objective: “The student will be able to produce the dual of a linear programming.”
  Condition: Given a linear programming problem.
  Behaviour: The student will be able to formulate the dual LP problem.

Objective: “The student will be able to describe the Dual Theorem and its consequences.”
  Condition: Given the name of the Theorem.
  Behaviour: The student will be able to recall the statement of the Theorem and its implications.

Objective: “The student will be able to use shadow prices to analyze changes to a linear programming problem’s optimal solution.”
  Condition: Give a linear programming problem.
Behaviour: The students will be able to use shadow pricing for sensitivity analysis of the LP problem’s optimal solution.

Objective: “The student will be able to use duality to analyze changes to a linear programming problem’s optimal solution.”

Condition: Give a linear programming problem and the optimal tableau of its dual.

Behaviour: The students will be able to use the dual tableau for sensitivity analysis of the LP problem’s optimal solution.

Course Materials

Course website: www.mathstat.dal.ca/~brown/math3300

Course Assessment

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<thead>
<tr>
<th>Component</th>
<th>Weight (% of final grade)</th>
<th>Date</th>
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<tbody>
<tr>
<td>Tests/quizzes</td>
<td>25%</td>
<td>Thursday, November 5, 2015</td>
</tr>
<tr>
<td>Final exam</td>
<td>50%</td>
<td>(Scheduled by Registrar)</td>
</tr>
<tr>
<td>Assignments</td>
<td>25%</td>
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</tbody>
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Other course requirements

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

Late assignments may be accepted with a valid reason, until solutions are posted, after which no late assignments can be accepted. Missed assignments, with a valid reason, will be dealt with on an individual basis. Missed exams require a valid reason (such as a medical note), and will be rescheduled as a make-up exam.

Course Content

1) Review of Linear Algebra Background
2) Introduction to Linear Programming
a) What is a Linear Programming (LP) Problem?
b) Graphical Solution to a Two-Variable LP Problem
c) Variety of Real-Life Applications and LP Formulations

3) The Simplex Algorithm
   a) Converting an LP to Standard Form
   b) A Preview of the Simplex Algorithm
   c) Direction of Unboundedness
   d) The Simplex Algorithm
   e) Solving Minimization Problems
   f) Alternative Optimal Solutions
   g) Software Packages and LP Problems
   h) The Big M Method
   i) The Two-Phase Simplex Method
   j) Unrestricted-in-Sign Variables
   k) Karmarkar’s Method

4) Sensitivity Analysis and Duality
   a) Graphical Introduction to Sensitivity Analysis
   b) Sensitivity Analysis
   c) The Dual of an LP problem
   d) The Dual Theorem and its Consequences
   e) Shadow Prices
   f) Duality and Sensitivity Analysis

ACCOMMODATION POLICY FOR STUDENTS

Students may request accommodation as a result of barriers related to disability, religious obligation, or any characteristic protected under Canadian Human Rights legislation. The full text of Dalhousie’s Student Accommodation Policy can be accessed here:

Students who require accommodation for classroom participation or the writing of tests and exams should make their request to the Advising and Access Services Centre (AASC) prior to or at the outset of the regular academic year. More information and the Request for Accommodation form are available at www.dal.ca/access.

ACADEMIC INTEGRITY

Academic integrity, with its embodied values, is seen as a foundation of Dalhousie University. It is the responsibility of all students to be familiar with behaviours and practices associated with academic integrity. Instructors are required to forward any suspected cases of plagiarism or other forms of academic cheating to the Academic Integrity Officer for their Faculty.
The Academic Integrity website (http://academicintegrity.dal.ca) provides students and faculty with information on plagiarism and other forms of academic dishonesty, and has resources to help students succeed honestly. The full text of Dalhousie’s Policy on Intellectual Honesty and Faculty Discipline Procedures is available here:

http://www.dal.ca/dept/university_secretariat/academic-integrity/academic-policies.html

STUDENT CODE OF CONDUCT

Dalhousie University has a student code of conduct, and it is expected that students will adhere to the code during their participation in lectures and other activities associated with this course. In general:

“The University treats students as adults free to organize their own personal lives, behaviour and associations subject only to the law, and to University regulations that are necessary to protect
• the integrity and proper functioning of the academic and non–academic programs and activities of the University or its faculties, schools or departments;
• the peaceful and safe enjoyment of University facilities by other members of the University and the public;
• the freedom of members of the University to participate reasonably in the programs of the University and in activities on the University's premises;
• the property of the University or its members.”

The full text of the code can be found here:

## SERVICES AVAILABLE TO STUDENTS

The following campus services are available to help students develop skills in library research, scientific writing, and effective study habits. The services are available to all Dalhousie students and, unless noted otherwise, are free.

<table>
<thead>
<tr>
<th>Service</th>
<th>Support Provided</th>
<th>Location</th>
<th>Contact</th>
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| **General Academic Advising**| Help with understanding degree requirements and academic regulations, choosing your major, achieving your educational or career goals, dealing with academic or other difficulties | Killam Library Ground floor Rm G28 Bissett Centre for Academic Success | In person: Killam Library Rm G28  
By appointment:  
- e-mail: advising@dal.ca  
- Phone: (902) 494-3077  
- Book online through MyDal |
| **Dalhousie Libraries**      | Help to find books and articles for assignments, help with citing sources in the text of your paper and preparation of bibliography | Killam Library Ground floor Librarian offices | In person: Service Point (Ground floor)  
By appointment:  
Identify your subject librarian (URL below) and contact by email or phone to arrange a time:  
| **Studying for Success (SFS)** | Help to develop essential study skills through small group workshops or one-on-one coaching sessions, match to a tutor for help in course-specific content (for a reasonable fee) | Killam Library 3rd floor Coordinator Rm 3104 Study Coaches Rm 3103 | To make an appointment:  
- Visit main office (Killam Library main floor, Rm G28)  
- Call (902) 494-3077  
- email Coordinator at: sfs@dal.ca or  
- Simply drop in to see us during posted office hours  
**All information can be found on our website:** [www.dal.ca/sfs](http://www.dal.ca/sfs) |
| **Writing Centre**           | Meet with coach/tutor to discuss writing assignments (e.g., lab report, research paper, thesis, poster), learn to integrate source material into your own work appropriately, learn about disciplinary writing from a peer or staff member in your field | Killam Library Ground floor Learning Commons & Rm G25 | To make an appointment:  
- Visit the Centre (Rm G25) and book an appointment  
- Call (902) 494-1963  
- email writingcentre@dal.ca  
- Book online through MyDal  
We are open six days a week  
**See our website:** [writingcentre.dal.ca](http://writingcentre.dal.ca) |