

CARLETON UNIVERSITY

Department of Economics

ECON 4004 A Operations Research I

Course Outline

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Welcome to Operations Research I!

"Classroom teaching and learning activities, including lectures, discussions, presentations, etc., by both instructors and students, are copy protected and remain the intellectual property of their respective author(s). All course materials, including PowerPoint presentations, outlines, and other materials, are also protected by copyright and remain the intellectual property of their respective author(s).

Students registered in the course may take notes and make copies of course materials for their own educational use only. Students are not permitted to reproduce or distribute lecture notes and course materials publicly for commercial or non-commercial purposes without express written consent from the copyright holder(s)."

Prerequisite

The prerequisite for this course is ECON 1402 (or equivalent) with a grade of C- or higher, as outlined in the 2022-2023 Undergraduate Calendar. Students who believe that they have taken a similar background course or courses from another university must provide appropriate documentation to the Department of Economics Undergraduate Administrator, Renee Lortie renee.lortie@carleton.ca

Introduction

Linear programming, duality, sensitivity analysis, transportation and network problems. Both theory and a wide range of applications are studied.

Precludes additional credit for BUSI 2300 (no longer offered), MATH 3801, and SYSC 3200.

Learning Outcomes

By the end of this course, students will:

- 1) be conversant with and be able to define key linear programming (LP) terminology
- 2) understand the logic, structure, and graphical solution of LP models
- 3) have had significant experience in the formulation of basic LP problems
- 4) understand and be able to implement the simplex algorithm
- 5) be able to solve LP problems and interpret their solutions using modern LP software
- 6) understand the concept of duality and the use and interpretation of sensitivity analysis
- 7) be familiar with various common extensions of the basic LP model, such as transportation, assignment, and network models and their specialized solution algorithms

Organization

This is an in-person course and is NOT suitable for online students. The class will meet once a week in SA 316 at 8:35 a.m. on Tuesdays for a 2 hour and 50 minute session with a short intermission.

There will be three (3) required assignments and a final exam.

Please note that Brightspace and the Carleton email system will be used extensively as a means of communication with students. Therefore, students are strongly advised to access Brightspace and to check their Carleton email at regular intervals in order to check for new information. To access Brightspace and the Carleton email system, students require a MyCarletonOne account. For questions about MyCarletonOne accounts, students should access carleton.ca/its/get-started/ (and then click on either New Students or New Grad Students, as appropriate) or contact the ITS Service Desk.

Academic Integrity

Please ensure that you are familiar with and comply with the Carleton University Academic Integrity Policy:

<https://carleton.ca/secretariat/wp-content/uploads/Academic-Integrity-Policy-2021.pdf>

And, more specifically, with regard to written work required for this course, please be sure to avoid any form of plagiarism:

The Academic Integrity Policy defines plagiarism as “*presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one’s own.*” This includes reproducing or paraphrasing portions of someone else’s published or unpublished material, regardless of the source, and presenting these as one’s own without proper citation or reference to the original source.

Examples of sources from which the ideas, expressions of ideas or works of others may be drawn from include but are not limited to: books, articles, papers, literary compositions and phrases, performance compositions, chemical compounds, artworks, laboratory reports, research results, calculations and the results of calculations, diagrams, constructions, computer reports, computer code/software, material on the internet and/or conversations.

Examples of plagiarism include, but are not limited to:

- any submission prepared in whole or in part, by someone else;
- using ideas or direct, verbatim quotations, paraphrased material, algorithms, formulae, scientific or mathematical concepts, or ideas without appropriate acknowledgment in any academic assignment;
- using another's data or research findings without appropriate acknowledgement;
- submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own; and
- failing to acknowledge sources through the use of proper citations when using another's work and/or failing to use quotations marks.

Plagiarism is a serious offence that cannot be resolved directly by the course's instructor. The Associate Dean of the Faculty conducts a rigorous investigation, including an interview with the student, when an instructor suspects a piece of work has been plagiarized. Penalties are not trivial. They can include a final grade of "F" for the course.

For further information, please see "[Academic Integrity and Offenses of Conduct](#)"

Assignments

Assignments will be posted on Brightspace and will be submitted through Brightspace according to the following schedule:

	<u>Posted</u>	<u>Due</u>
Assignment 1	October 11	November 1
Assignment 2	November 8	November 22
Assignment 3	November 22	December 6

Evaluation

The final % grade for this course will be calculated as follows:

Assignments	50%	(3 assignments equally weighted)
Final Examination	50%	

This % grade will then be converted into the alphabetical grade system using the standard equivalences, as outlined in Section 5.4 of the Academic Regulations of the University in the 2022-2023 Undergraduate Calendar.

In the event that one or more components of the term work are not completed, the weight of the incomplete component(s) will not be transferred to the final examination without a documented and compelling reason. In place of a doctor's note or medical certificate, students are advised to complete the self-declaration form, which is available on the Registrar's Office website <https://carleton.ca/registrar/wp-content/uploads/self-declaration.pdf>

Students who do not write the final examination because of illness or other circumstances beyond their control may apply to write a deferred final examination. In order to write a deferred final examination, students must contact the Registrar's Office. (For further details, see Section 4.3 of the Academic Regulations of the University in the 2022-2023 Undergraduate Calendar.) In the event that a student writes a deferred examination, the deferred examination will carry the same weight as the final examination in determining the course grade. Needless to say, any deferred examination will not be identical to the original final examination.

Finally, please note that: "Standing in a course is determined by the course instructor subject to the approval of the Faculty Dean. This means that grades submitted by an instructor may be subject to revision. No grades are final until they have been approved by the Dean."

Student Mental Health

As a university student you may experience a range of mental health challenges that significantly impact your academic success and overall well-being. If you need help, please speak to someone. There are numerous resources available both on- and off-campus to support you. Here is a list that may be helpful:

Emergency Resources (on and off campus): <https://carleton.ca/health/emergencies-and-crisis/emergency-numbers/>

Carleton Resources:

- Mental Health and Wellbeing: <https://carleton.ca/wellness/>
- Health & Counselling Services: <https://carleton.ca/health/>
- Paul Menton Centre: <https://carleton.ca/pmc/>
- Academic Advising Centre (AAC): <https://carleton.ca/academicadvising/>
- Centre for Student Academic Support (CSAS): <https://carleton.ca/csas/>
- Equity & Inclusivity Communities: <https://carleton.ca/equity/>

Off Campus Resources:

- Distress Centre of Ottawa and Region: (613) 238-3311 or TEXT: 343-306-5550, <https://www.dcottawa.on.ca/>
- Mental Health Crisis Service: (613) 722-6914, 1-866-996-0991, <http://www.crisisline.ca/>
- Empower Me: 1-844-741-6389, <https://students.carleton.ca/services/empower-me-counselling-services/>
- Good2Talk: 1-866-925-5454, <https://good2talk.ca/>
- The Walk-In Counselling Clinic: <https://walkincounselling.com>

Pandemic Measures

It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are [a number of actions you can take](#) to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you're sick, washing your hands and maintaining proper respiratory and cough etiquette.

Feeling sick? Remaining vigilant and not attending work or school when sick or with symptoms is critically important. If you feel ill or exhibit COVID-19 symptoms do not come to class or campus. If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. In all situations, you should follow Carleton's [symptom reporting protocols](#).

Masks: Masks are no longer mandatory in university buildings and facilities. However, we continue to recommend masking when indoors, particularly if physical distancing cannot be maintained. We are aware that personal preferences regarding optional mask use will vary greatly, and we ask that we all show consideration and care for each other during this transition.

Vaccines: While proof of vaccination is no longer required to access campus or participate in in-person Carleton activities, it may become necessary for the University to bring back proof of vaccination requirements on short notice if the situation and public health advice changes. Students are strongly encouraged to get a full course of vaccination, including booster doses as soon as they are eligible and submit their booster dose information in [cuScreen](#) as soon as possible. Please note that Carleton cannot guarantee that it will be able to offer virtual or hybrid learning options for those who are unable to attend the campus.

All members of the Carleton community are required to follow requirements and guidelines regarding health and safety which may change from time to time. For the most recent information about Carleton's COVID-19 response and health and safety requirements please see the [University's COVID-19 website](#) and review the [Frequently Asked Questions \(FAQs\)](#). Should you have additional questions after reviewing, please contact covidinfo@carleton.ca.

Academic Accommodation

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Pregnancy obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For accommodation regarding a formally-scheduled final exam, you must complete the Pregnancy Accommodation Form ([click here](#)).

Religious obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details [click here](#).

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting

accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable).

Survivors of Sexual Violence

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: <https://carleton.ca/equity/sexual-assault-support-services>

Accommodation for Student Activities

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation will be provided to students who compete or perform at the national or international level. Write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. <https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf>

Academic Assistance

Students should be aware of and feel free to take advantage of the various services offered through the Centre for Student Academic Support (CSAS) <https://carleton.ca/csas/>

Textbook

The required textbook for this course is:

Winston, Wayne L. (2004), Operations Research: Applications and Algorithms (4th Edition), Nelson/Brooks/Cole Duxbury Press. ISBN-10: 0534380581, ISBN-13: 9780534380588 (hardcover)

Note that a relatively inexpensive eTextbook version of this textbook is available directly from Cengage at <https://www.cengage.ca/c/isbn/9780357337769/>

Computer Package

Use of the LINDO linear programming package will be an integral part of this course. A free copy of LINDO 6.1 Educational may be downloaded by students who have acquired a copy of the Winston textbook, see

<https://www.lindo.com/index.php/help/textbook-materials/wayne-winston>

Information as to how to use LINDO will be provided in class.

NOTE: The hardcopy of the Winston textbook comes with a CD-ROM that includes a copy of this same LINDO package, as well as various other software packages referred to in the

textbook. For this course, you will ONLY need the LINDO package. Moreover, if you have the CD-ROM, then you should be careful NOT just to install all of the programs on the CD-ROM. (There is one program on the CD-ROM that may be required for ECON 4005. This program only has a 120-day evaluation period and you do not want to start this 120-day period prematurely.)

Course Content

1. Basic Linear Algebra, Winston Ch. 2
2. Introduction to Linear Programming. Winston Ch. 3
3. Simplex Algorithm, Winston Ch. 4
4. Sensitivity Analysis and Duality, Winston Chs. 5 and 6
5. Transportation, Assignment, and Transshipment Problems, Winston Ch. 7
6. Network Models (Shortest Path, Critical Path Methods), Winston Ch. 8

IF YOU HAVE PROBLEMS WITH THIS COURSE, PLEASE LET ME KNOW!

IF I DON'T KNOW THAT YOU HAVE PROBLEMS, I CAN'T FIX THEM!