MATH_V 340 101 2025W1 Introduction to Linear Programming
Term 1, 2025/2026: Sep 2025 -- Dec 2025.

Math 340 Introduction to Linear Programming

Instructor: Young-Heon Kim (https://personal.math.ubc.ca/~yhkim/index.html)

Email: Please use the Canvas email.

Office hours: TBA

Classes: Sept. 2, 2025 -- Dec. 5, 2025.

Mon/Wed/Fri: 14:00--15:00.

First class on Sept. 3 (Wed).

Location: The Leonard S. Klinck Building (LSK) | Floor: 2 | Room: 201

TA Office hours: TBA

About the Course

This course would be more properly called Linear Optimization, optimizing a linear objective function subject to linear constraints. The word `programming' is not used in the sense of computer programming. The word `programming' refers to the program of activities given by a solution.

Prerequisites: One of MATH 152, MATH 221, MATH 223.

- It is highly recommended that students have taken a multi-variable calculus course (e.g. Math 200, 253, etc.).
- Also, basic knowledge of mathematical proofs (e.g. Math 220) is highly recommended for taking this course.

Main Reference:

Linear Programming by Robert Vanderbei

(https://gw2jh3xr2c.search.serialssolutions.com/?

sid=sersol&SS_jc=TC0002299077&title=Linear%20Programming%20Foundations%20and%20Extensions)

(electronic copy available to download through the UBC library!).

For your note, I am using the 5th edition, and will use it for referring the numbers of sections and exercise. Vanderbei's webpage:https://vanderbei.princeton.edu/LPbook/index.html

Supplementary:

Understanding and using linear programming by Jiří Matoušek , Bernd Gärtner

(https://gw2jh3xr2c.search.serialssolutions.com/?sid=sersol&SS_jc=TC0000320571&title=Understanding and using linear programming)

Electronic copy available to download through the UBC library.

Course topics (subject to changes):

- Basics of LP problems and computer packages. 3 weeks.
- Simplex method and related geometry. 2-3 weeks.
- Duality theory. 3-4 weeks.
- Matrix games. 1-2 weeks.
- Optimal transport. 1 week, if time permits.

Learning Goals:

- To be familiar with basic concepts of optimization
- To be able to translate practical (high dimensional) optimization problems into linear programming
- To understand the basic geometry of convex sets and its relation to linear programming
- To be able to compute solutions of linear programming by the simplex method and its variants
- To be able to manipulate matrix calculations to analyze linear optimization problems
- To understand and utilize duality to analyze linear optimization problems
- To be able to give mathematical proofs for simple statements regarding convex sets, optimization, simplex method, duality, etc.
- To be familiar with computer packages for doing mathematics

Expectations:

- Students are expected to attend all lectures and complete all assignments, quizzes, and exams to their full extent.
- Students should expect to spend between 6 and 10 hours per week outside of lectures. In the case a class meeting has to be missed, it is the student's responsibility to make up the missed material.

How to succeed in this course:

It is very important to learn mathematics by "doing". For example, it is not enough to read a worked out example from a book or lecture notes. It is not enough to understand each step in the solution. You have to struggle to work out examples or problems by yourself, without looking at the solutions. This way, you build up mathematical intuition on the subject.

Very useful advice on how to solve problems are in Polya

https://sass.queensu.ca/sites/sasswww/files/uploaded_files/Resource%20PDFs/polya.pdf

Links to an external site.
-- I strongly recommend you to read the book "How to Solve It" by G. Polya.

Grading

Your grade for the course will be computed as follows:

HW Assignments 3%. 9 weekly HWs to be submitted. These will be **self-graded.** The HW problems will be released mostly on Wednesdays.

- The solutions will be provided by the instructor, three days after HW is released.
- Students mark their HW and then submit the self-graded papers by the due date.
- You will get full mark (3% for the term grade) for HW if you complete 6 weekly HWs (out of those 9 weekly HWs).

Python/Jupyter notebooks Assignments: 2%. These will be auto-graded assignments.

Four In-class Midterms, Total 45%. The best three midterms will be counted (15% each).

- Midterm 1. Friday, Sept. 26. In class.
- Midterm 2. Friday. Oct. 17. In class.
- Midterm 3. **Wednesday**, Nov. 5. In class.
- Midterm 4. Friday, Nov. 21. In class.

Final Exam 50%:

IMPORTANT: Students with failing term mark (that is, less than 25/50) will not be admitted to write the final exam and will fail the course.

All marks are subject to scaling.

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Missing midterms: There are *no make-up midterms* in this course. Missing a midterm for a valid reason normally results in the weight of that midterm being transferred to the final exam.

Examples of valid reasons include illness and travel to play a scheduled game for a varsity team.

Examples of reasons that are not valid include conflicts with personal travel schedules or conflicts with work schedules or with other classes.

Please note that a student who misses the midterms and has otherwise not completed a substantial portion of the term work shall not be admitted to the final examination.

Missing the Final Exam: You will need to present your situation to the Dean's Office of your Faculty to be considered for a deferred exam. See the Calendar for detailed regulations (http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,41,94,0).

Your performance in a course up to the final exam is taken into consideration in granting a deferred exam status (e.g. failing badly generally means you will not be granted a deferred exam). In Mathematics, generally students sit the next available exam for the course they are taking, which could be several months after the original exam was scheduled.

Note that your personal travel schedule is NOT a valid reason for missing a final exam and students who miss the MATH 340 exam for this reason will receive a grade of 0 on the exam and fail the course.

IT IS ESPECIALLY IMPORTANT that students know that IF THEY DO NOT FULFILL THE COURSE REQUIREMENTS DURING THE TERM (including not writing the midterm tests even if you agree to transfer the weight to the final) AND THEN MISS THE FINAL EXAMINATION, THEY MAY BE DEEMED INELIGIBLE FOR A DEFERRED FINAL.

HW Assignments Schedule: All times are the Vancouver time.

- Sept 17 (Wed): HW 1 due
- Sept 24 (Wed): HW 2 due
- Oct 1 (Wed): HW 3 due
- Oct 8 (Wed): HW 4 due
- Thanksgiving break: Oct. 10--13
- Oct 22 (Wed): HW 5 due
- Oct 29 (Wed): HW 6 due
- Nov 19 (Wed): HW 7 due
- Nov 26 (Wed) HW 8 due
- Dec 3 (Wed): HW 9 due
- Optional HW 10 has no due date.

Homework Assignments Policy:

- We will be using the Canvas for collecting the HWs.
- **Late homework is not accepted.**
- Work must be shown.
- The number of each homework problem should be clearly printed.

How to ask for change of marking: If you feel that a returned assessment is incorrectly marked, you can appeal that mark by submitting a regrade request statement to the instructor within one week of the return of the marked assignment. The statement should include a summary of what you think was incorrectly evaluated, with some justification of the claim. Your work will be re-evaluated in accordance with the established grading procedures, and re-marked if necessary. Note in unusual circumstances, if you mistakenly received a higher grade than earned, your final grade might decrease upon remarking.

Computing (and Python/Jupyter notebook assignments)

- **There will be "Introduction to Python and Jupyter Zoom lecture" (outside lecture time) at the beginning of the term. TBA.**
- **Python TAs will be available in the MLC to answer questions.**
- Instructions and support material posted on https://ubcmath.github.io/python/Links to an external site.

For certain assignments, you will need to use software packages for computing linear programming problems.

Our default programming language is Python language via Jupyter Notebook, which is available via the UBC syzygy server (https://ubc.syzygy.ca/jupyter/hub/

Links to an external site.
) You can use this using your UBC CWL. There is Python library for linear programming, called PuLp. More details will be given in the class.

- For learning python language, there are many sources; e.g. the online book https://automatetheboringstuff.com/Links to an external site.

Canvas email:

If you have course related questions for the instructor, then please use the Canvas email. Of course, visiting the office hours is a great way to communicate with the instructor. Please avoid using my math email address, unless urgent, to help me keep my math mailbox under the storage limit; using the Canvas email will also help your message to be not classified as a spam and missed.

Other general information:

About the use of generative AI (e.g. ChatGPT or similar) tools:

The use of generative AI tools, including ChatGPT and other similar tools, to complete or support the completion of any form of assignment or assessment in this course is **not** allowed, unless explicitly stated otherwise by the instructor in this course, and would be considered academic misconduct.

Academic Integrity:

Academic integrity, in short, means being an honest, diligent, and responsible scholar.

- **To what extent can students collaborate on homework or other assignments?**
  - You are encouraged to collaborate with fellow students to work on problems together. However, the final work should be in your own terms and your own writing, acknowledging all sources of information or help. This also means you should not cheat, copy, or mislead others about what is your work; nor should you help others to do the same.
- **What is permitted to be used during tests?**
  - Only pen/pencils/erasers.
- **How should I, as a student, resolve any uncertainty I may have about academic integrity and academic misconduct?**
  - Contact your instructor.

For more information, see https://academicintegrity.ubc.ca/resources/. Find information in Canvas Modules.

Academic concession

Question: How do I submit an academic concession?

Answer: Academic concessions for final assignments and exams are handled through your Faculty Advising Office. For in-term concessions, fill in and submit the form here to your instructor.

UBC Vancouver Senate's **Academic Concession Policy V-135 (http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,329,0,0).** Students are advised to read **this policy carefully.**

Accessibility resources at UBC:

Centre for Accessibility: https://students.ubc.ca/about-student-services/centre-for-accessibility/

Equity/Diversity/Inclusion:

Treat people with equal respect regardless of their gender, class, sexual orientation, ethnicity, appearance, religion, and so on, and regardless of their current level of mathematical ability. Be inclusive and considerate.

https://students.ubc.ca/campus-life/equity-diversity-inclusion-resources/

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