**Department of Statistical and Actuarial Sciences**

# Course Outline FM 3817B

**Optimisation methods in financial modelling**

# Course Information

**Term:** Winter 2025

**Venue:** TBD

**Day/time:** Monday (4:30-7:30 pm)

**Prerequisite(s):** Mathematics 1600A/B and one of Calculus 2302A/B, Calculus 2502A/B or Calculus 2402A/B

Unless you have either the requisites for this course or written special permission from your Dean’s Designate (Department/Program Counsellors and Science Academic Advisors) to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

# Instructor and TA Information

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| **Instructor** | Yifan Li |
| **Office** | WSC 268 |
| **Email** | yifan.li@uwo.ca |
| **Office Hours** | 3:00 - 4:00 pm (Monday) |

Rule for instructor’s office hour: If your questions are short (taking no more than 20 min), feel free to drop by. Otherwise, please notify the instructor by email one day before (so that the instructor can better allocate the time to make it beneficial to all students in need).

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| **TA** | Phillip Braun |
| **Office** | WSC 191 |
| **Email** | pbraun@uwo.ca |
| **Office Hours** | TBA |

## Important

***Students must use their Western (@uwo.ca) email addresses when contacting the instructor. Email messages from non-UWO account will NOT be read.***

***The subject of your email should have the format:* FM 3817 (insert “at most 4 words about your query”)**; failure to do so can result in a delayed response. The instructor will endeavour to respond to email messages within 48 hours (or through announcements).

# Course Syllabus, Schedule, and Delivery Mode

**Course description:** An introduction to linear programming, simplex method, duality theory and sensitivity analysis, formulating linear programming models, nonlinear optimization, unconstrained and constrained optimization, quadratic programming. Applications in financial modelling (investment portfolio selection). Extra Information: 3 lecture hours

## Key Sessional Dates:

Classes begin: January 6, 2025

Spring Reading Week: February 15 – 23, 2025

Classes end: April 4, 2025

Exam period: April 7 – 30, 2025

**Delivery mode:** In-person setting

# Course Materials

**Course coverage**

## Part One: Pertinent elements of mathematical analysis in Rn

* 1. Open and closed sets of real numbers
  2. Analysis on Rn: distance in Rn, bounded sets on Rn, open balls
  3. Continuity in general
  4. Open set in Rn
  5. Sequences and closed sets in Rn
  6. Compactness
  7. Derivative of *f*: Rn  Rm
  8. Higher-order derivatives: differentiability, continuity, Jacobian, Hessian matrix
  9. Convex sets and concave and convex functions

**Recommended readings:**

* + - Simon, C.P. and Blume, L. *Mathematics for Economists.* Chapter 12 and Section 13.4; Sections 10.1- 10.4; Sections 13.1-13.2; Sections 14.1-14.4 & 14.6-14.8

## Part Two: Optimisation of functions of several variables

* 1. Introduction
  2. Unconstrained optimisation
  3. Constrained optimisation
     1. Equality constraints: Lagrange multiplier method
     2. Inequality constraints
     3. Mixture of equality and inequality constraints
     4. Minimisation
  4. The Kuhn-Tucker Lagrangian
  5. Meaning of multipliers
  6. Envelope theorems

**Recommended readings:**

* Simon, C.P. and Blume, L. *Mathematics for Economists.* Chapter 17, sections 17.1 and 17.2; Chapter 18; Chapter 19, sections 19.1 and 19.2
* Ostaszewski, A. *Mathematics in Economics.* Sections 15.6-15.8

## Part Three: Theory of linear programming and applications

* 1. Introduction
  2. Separating and supporting hyperplanes
     1. Convex sets
     2. Separating hyperplanes theorem
     3. Supporting hyperplanes
  3. Linear programming in general
     1. The basic linear program
     2. Location of optimal solutions
  4. Linear programming duality
  5. Games
     1. Zero-sum games
     2. Matrix games
     3. Existence of optimal mixed strategies
     4. Finding the optimal mixed strategies geometrically

**Recommended readings**

* Ostaszewski, A. *Advanced Mathematical Methods.* Chapters 10 and 12
* Simon, C.P. and Blume, L. *Mathematics for Economists.* Chapter 17, sections 17.1 and 17.2; Chapter 18; Chapter 19, sections 19.1 and 19.2

## Part Four: Intro to quadratic programming (Portfolio optimization theory)

**Recommended readings:**

* Cornuejols, G. and Tutuncu, R. *Optimisation Methods in Finance*. Chapters 7 and 8

All course material will be posted to OWL: https://westernu.brightspace.com/

Students are responsible for checking the course OWL site (https://westernu.brightspace.com/) regularly for news and updates. This is the primary method by which information will be disseminated to all students in the class.

If students need assistance with the course OWL site, they can seek support on the [OWL Brightspace Help](https://brightspacehelp.uwo.ca/) page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

# Methods of Evaluation

The overall course grade will be calculated as listed below.

**Assignments** (2) 16%: [Due date: 04 Feb and 05 Mar]

**Midterm Tests** (2) 34%

* Dates: Feb 24 (Midterm 1), Mar 18 (Midterm 2),
* Time: 4:30-6:30PM (in-class)
* Location : (in-class)
* You are allowed to bring a **one-sided**, letter-sized and hand-written cheat sheet.

**Final Exam** 50%:

* Dates: TBD
* Time: TBD
* Location : TBD
* You are allowed to bring a **two-sided**, letter-sized and hand-written cheat sheet.

## Accommodated evaluations

If you miss a course requirement due to an excused absence (see also Section 6) then the weight of that assessment will be moved to the final exam. If the absence is not excused, then you will receive a grade of zero. There is no option to submit late or alternate work.

## Rounding of marks statement

Across the Sciences Undergraduate Education programs, we strive to maintain high standards that reflect the effort that both students and faculty put into the teaching and learning experience during this course. All students will be treated equally and evaluated based only on their actual achievement

***Final grades*** on this course, irrespective of the number of decimal places used in marking individual assignments and tests, will be calculated to one decimal place and rounded to the nearest integer, e.g.,

74.4 becomes 74, and 74.5 becomes 75. Marks WILL NOT be bumped to the next grade or GPA, e.g. a 79 will NOT be bumped up to an 80, an 84 WILL NOT be bumped up to an 85, etc. The mark attained is the mark you achieved, and the mark assigned; requests for mark “bumping” will be denied.

# Student Absences

For missing a course component less than 10% of the final course grade, contact the instructor (before the occurrence or the due date of the assessment).

For missing a course component totalling 10% or more of the final course grade, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible. Please also contact the instructor (before the occurrence or the due date of the assessment)

For further information, please check the following link:

<https://www.uwo.ca/sci/advising/procedures/academic_consideration_for_absences/index.html>

The Student Medical Certificate is available at https://[www.uwo.ca/univsec/pdf/academic\_policies/appeals/medicalform.pdf.](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf)

## Absences from Final Examination

If you miss the Final Exam, please contact the Academic Counselling office of your Faculty of Registration as soon as you are able to do so. They will assess your eligibility to write the Special Examination (the name given by the University to a makeup Final Exam).

You may also be eligible to write the Special Exam if you are in a “Multiple Exam Situation” (e.g., more than 2 exams in 23-hour period, more than 3 exams in a 47-hour period).

If a student fails to write a scheduled Special Examination, the date of the next Special Examination (if granted) normally will be the scheduled date for the final exam the next time this course is offered. The maximum course load for that term will be reduced by the credit of the course(s) for which the final examination has been deferred. See the Academic Calendar for details (under Special Examinations).

**General information about missed coursework**

Students must familiarize themselves with the *University Policy on Academic Consideration – Undergraduate Students in First Entry Programs* posted on the Academic Calendar:

<https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf>,

This policy does not apply to requests for Academic Consideration submitted for **attempted or completed work**, whether online or in person.

The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult [Accessible Education](http://academicsupport.uwo.ca/accessible_education/).

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar’s webpage:

<https://registrar.uwo.ca/academics/academic_considerations/>

All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

# Accommodation and Accessibility

**Religious Accommodation**

When conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request an accommodation for their absence in writing to the course instructor and/or the Academic Advising office of their Faculty of Registration. This notice should be made as early as possible but not later than two weeks prior to the writing or the examination (or one week prior to the writing of the test).

Please visit the Diversity Calendars posted on our university’s EDID website for the recognized religious holidays:

[https://www.edi.uwo.ca](https://www.edi.uwo.ca/).

**Accommodation Policies**

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

[https://www.uwo.ca/univsec/pdf/academic\_policies/appeals/Academic Accommodation\_disabilities.pdf](https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic%20Accommodation_disabilities.pdf).

# Academic Policies

The website for Registrar Services is <https://www.registrar.uwo.ca/>.

In accordance with policy,

<https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf>,

the centrally administered e-mail account provided to students will be considered the individual’s official university e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner.

Only ***non-programmable calculators that do not make any sound*** will be permitted on tests and exams. All other electronic devices are not allowed.

**Scholastic offences** are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

[http://www.uwo.ca/univsec/pdf/academic\_policies/appeals/scholastic\_discipline\_undergrad.pdf.](http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf)

# Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https[://w](http://www.uwo.ca/sci/counselling/)ww.[uwo.ca/sci/counselling/.](http://www.uwo.ca/sci/counselling/)

Students who are in emotional/mental distress should refer to Mental Health@Western (https://uwo.ca/health/) for a complete list of options about how to obtain help.

Western University is committed to a thriving campus. We encourage you to check out the Digital Student Experience website to manage your academics and well-being: https[://w](http://www.uwo.ca/se/digital/)ww[.uwo.c](http://www.uwo.ca/se/digital/)a[/se/digital/.](http://www.uwo.ca/se/digital/)

Additional student-run support services are offered by the USC, <https://westernusc.ca/services/>