

ECON 4001 A
Mathematical Analysis in Economics
Summer 2022

Classes: M/W: 18:05-20:55 (EST)

Location: Online

Office hours: Monday: 18:00-19:00 (by appointment only)

Instructor: Dr. Eyob Fissuh

Instructor's e-mail: Eyob.Fissuh@carleton.ca

Prerequisites

- ✓ ECON 3001 with a grade of C+ or higher.
- ✓ Students who believe they have taken a similar background course or courses from another university must provide appropriate documentation to the Department of Economics Undergraduate Advisor.

Course Content

The course covers various concepts of mathematics and their applications to problems in economics. It consists of three parts. The first part focuses on [linear algebra](#). The second part is devoted to [multivariate calculus](#) and [static optimization](#). The last section deals with [dynamic economic analysis](#).

This is an economics course, not a mathematics course. Students are expected to understand and apply economic reasoning to the tools that they learn. An important emphasis of the course is to provide students with 'hands-on' experience of mathematical tools using a variety of economic applications.

The course consists of two lectures per week. All lectures will be delivered asynchronously in the form of narrated PowerPoint presentations or pre-recorded Zoom lectures that will be posted on the course website on [Brightspace](#). You will be able to watch them according to your own schedule. You will not need PowerPoint on your computer to view them. Course materials, including notes, PowerPoint presentations, assignments, and exam schedules will also be made available on [Brightspace](#). Please ensure that you check your [Brightspace](#) account for updates on regular basis.

All course materials, including PowerPoint presentations, videos, outlines, and other materials, are 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, including pre-recorded lectures and live lectures (or consultations), and other course materials publicly for commercial or non-commercial purposes without express written consent from the copyright holder(s).

Course Requirements

Students must fulfill all the requirements described in the **Course Evaluation** section (of this syllabus) to achieve a passing grade (D- or higher). Failure to write the final examination when the student has achieved satisfactory performance during the term will result in a grade of DEF ('Deferred Final Examination'). Application to write a deferred final examination must be made at the Registrar's Office. See Academic Regulation 2.3 for the official meanings of these grades and note that it stipulates that no course grades are final until approved by the Faculty Dean. Note also that course grades may be scaled upwards or downwards in a rank-preserving manner to better fit the relevant departmental distributional norm.

Textbook and references

Michael Hoy, John Livernois, Chris McKenna and Ray Rees, *Mathematics for Economics* (3rd edition), MIT Press, 2011. ISBN: 9780262516228. [Recommended textbook: lecture notes will follow this book]

Alpha C. Chiang and Kevin Wainwright. *Fundamental Methods of Mathematical Economics*, 4th ed., McGraw-Hill, 2013.

Knut Sydsaeter, Peter Hammond, Atle Seierstad, Arne Strom, *Further Mathematics for Economic Analysis* (2nd edition), Prentice Hall, 2008.

Communication with the instructor

E-mail is an effective tool to communicate with the instructor. Students can expect a response within 24 hours during weekdays. For verification and security purposes, the instructor will not reply to e-mails originating from non-Carleton e-mail accounts, and which are not signed with a student's name and student number.

Course evaluation

- Midterm Exam (30% weight, 3 hours) — July 25, from 18:00-21:00 EST
- Three assignments (30% weight)—due dates: July 8, July 18 and August 8
- Final Exam (40% weight)—to be scheduled by the Registrar's office

Course content

1. Linear algebra
 - 1.1. Basic rules for matrices and determinants
 - 1.2. Linear independence, rank of a matrix
 - 1.3. Eigenvalues and eigenvectors
 - 1.4. Quadratic forms
 - 1.5. Diagonalization
 - 1.6. Partitioned Matrices
2. Multivariable calculus
 - 2.1. Partial Differentiation
 - 2.2. The First-Order Total Differential
 - 2.3. Second-Order Partial Derivatives
 - 2.4. The First-Order Total Differential
 - 2.5. Convex sets
 - 2.6. Concave and convex functions
 - 2.7. Concavity and convexity
 - 2.8. Taylor series expansion
3. Static optimization theory
 - 3.1. Unconstrained optimization
 - 3.1.1. First order conditions
 - 3.1.2. Second order conditions
 - 3.2. Constrained optimization
 - 3.2.1. First order conditions
 - 3.2.2. Second order conditions
 - 3.2.3. Existence and uniqueness of solutions
 - 3.2.4. Kuhn-Tucker concave programming
4. Integration and series
 - 4.1. Review of rules of integration
 - 4.2. The Riemann integral and improper integrals
- 4.3. Integration by parts, substitution or partial fractions
- 4.4. Leibniz's formula
- 4.5. Multiple integrals
5. Differential equations & dynamic analysis
 - 5.1. Linear first order differential equations (FODE)
 - 5.2. Nonlinear FODE
 - 5.3. Second and higher order differential equations
 - 5.4. System of simultaneous differential equations
6. Dynamic optimization and optimal control theory
 - 6.1. The maximum principle and the Hamiltonian
 - 6.2. Optimization and discounting
 - 6.3. Alternative boundary conditions
 - 6.4. Infinite time horizon problems
 - 6.5. Constraints on the control variables
 - 6.6. Free terminal time problems
 - 6.7. Multiple control variables
7. Difference equations and dynamic analysis*
 - 7.1. Linear first order difference equations
 - 7.2. Nonlinear first order difference equations
 - 7.3. Second and higher order difference equations
 - 7.4. System of simultaneous difference equations
8. Dynamic programming and discrete time optimization*

*It will be covered only if time permits.

Course policy

- There will be no deferred midterm exam. If a student misses a midterm exam and provide a valid medical certificate or a verifiable compassionate reason within one week of the missed exam, the assigned weight (of 30%) will be added to your final exam. If a student fails to write the midterm exam (without a verifiably good reason), a mark of zero will be awarded.
- The mid-term exam will take place during regular lecture hours on July 25th, but it will not be e- proctored.
- No late or deferred assignments will be accepted. If a student fails to submit an assignment on time (without a verifiably good reason), a mark of zero will be awarded.
- Any documentation (e.g. a doctor's note or police report) provided by students for missed midterm may be subject to verification.
- All assignments and exams will be posted on [Brightspace](#).
- All assignments and exams should be submitted via [Brightspace](#).
- Students can NOT submit assignments by e-mail.
- The final exam will be cumulative and cover the entirety of the course material.
- The final exam will be e-proctored.
- **Re-grading policy:** If a student feels that there is a marking error in their work, they can always make an appeal. In case of an appeal, the student should submit written request detailing why they deserve extra points within *one week* after grades are announced on [Brightspace](#). If the instructor decides to re-mark the exam, it is important to keep in mind that the revised grade may be *higher or lower* than the original grade, as a consequence of re-marking.
- No course grades are final until approved by the Faculty Dean.

Plagiarism

Plagiarism is considered a form of academic dishonesty. Students should be aware that there is zero tolerance policy towards plagiarism. Please visit the following link on how to avoid it: [Academic Integrity and Offenses of Conduct](#).

Requests for Academic Accommodation

You may need special arrangements to meet your academic obligations during the term. Carleton provides [academic accommodation to students](#) for reasons of disability, religious observance, pregnancy and/or parental leave, sexual violence, and student activities. The following page provides only a brief overview of the accommodations policy and process. Please contact [Equity and Inclusive Communities](#) for a full explanation.

Pregnancy or parental leave

Requests for parental leave must be made in writing to the Registrar's Office. The student should meet with the instructor as soon as possible to arrange a temporary modification to her program. An [Equity Services](#) advisor can also be consulted if a student has questions about pregnancy and/or parental leave.

Religious obligation

Please contact your instructor 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, visit the A list of multi-faith holy days is accessible through the [Equity Services website](#).

Academic Accommodations for Students with Disabilities

Carleton is strongly committed to providing access and accommodation for all individuals with identified and duly assessed disabilities. The university has a [Senate-approved policy on academic accommodation](#) that forms part of its human rights policy. If you have a documented disability requiring academic accommodations in this course, please contact the [Paul Menton Centre](#) for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, contact your instructor as soon as possible to ensure accommodation arrangements are made (carleton.ca/pmc).

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 its 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 carleton.ca/sexual-violence-support.

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 must be provided to students who compete or perform at the national or international level. Please contact your instructor 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, see [the policy](#).

For more information on academic accommodation, please contact the departmental administrator or visit: students.carleton.ca/course-outline.

If you have any problem or question, please do not hesitate to [contact](#) the instructor!