

Carleton University
Department of
Economics

ECON 4001 A
Mathematical Analysis in Economics
Summer 2021

Classes: Tuesday and Thursday: 18:05 - 20:55

Location: Online

Office hours: Wednesday: 17:00-17:00 (by appointment only)

Instructor: Dr. Eyob Fissuh

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

TA:

Tutorial classes:

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 (Amanda Wright).

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: rank of a matrix, eigenvalues and eigenvectors, quadratic forms, diagonalization and partitioned matrices. The second part is devoted to multivariate calculus and static optimization: the Weierstrass, Lagrange, Kuhn-Tucker and the envelope theorems. The last section deals with dynamic economic analysis: the Hamiltonian and the Maximum Principle.

The course consists of two three-lecture hours. All lectures will be delivered through pre-recorded video lectures with links to the videos on [Brightspace](#). Students do not need to attend lectures live; all pre-recorded lectures will be posted on [Brightspace](#). Course materials, including notes, PowerPoint presentations, assignments, and mid-term exam schedules will also be made available on [Brightspace](#). However, the mid-term exam will be administered during regular class time. 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

Required textbook:

Michael Hoy, John Livernois, Chris McKenna and Ray Rees, Mathematics for Economics (3rd edition), MIT Press, 2011. ISBN: 9780262516228.

References

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

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

Communication with the instructor:

E-mail is an effective tool to communicate with the instructor. Students can expect a response within 24 hours. For verification and security purposes, I 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 22nd
- Three assignments (30% weight; 10% each)–due dates: July 12th, July 26th and August 9th
- Final Exam (40% weight) — *to be scheduled by the Registrar's office.*

Course Outline:

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. Kuhn-Tucker concave programming
4. Integration and series

- 4.1. Review of rules of integration
- 4.2. Integration by parts, substitution or partial fractions
- 4.3. Leibniz's formula
- 4.4. Multiple integrals
- 4.5. Sequences and series
- 5. Differential equations and 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
 - 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.
- 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](#).
- The final exam will be cumulative and cover the entirety of the course material.
- **Re-grading policy:** If you feel that there is a marking error in your work, you can always make an appeal. In case of an appeal, you should submit written request detailing why you deserve extra points to the T.A. within *one week* after grades are announced on [Brightspace](#). If you are still not happy with the T.A.'s decision, you can send the request to the instructor (including both your request and the T.A.'s decision). If the instructor decides to re-mark your exam, it is important to keep in mind that your grade may be higher or lower than the original grade, because 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: [Pammatt on Plagiarism and Paraphrasing](#).

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 arrange for proper accommodation (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 is 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 of the University](#).

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](#) me for help!

Note: Changes may be made to this outline prior to July 2nd, 2021.