



ECON 211 – Introduction to Mathematical Economics Spring 2021

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1. Course Description

This course focuses on the mathematical methods and models that are required to understand current economics and to investigate economic models. The objective of this course is to provide the students with all the necessary mathematical tools that are required to follow 300 level courses in economics. Topics may include limits, sequences and series, combinatorics, set theory; univariate and multivariate calculus; matrix algebra and systems of linear equations; and applications in economic models.

2. Learning Outcomes:

By the end of the course a student should be able to:

- Use and explain the underlying principles, terminology, methods, techniques, and conventions used in the subject,
- Solve economic problems using the mathematical methods described in the subject,
- Develop an initial understanding of how to frame economic modelling ideas in mathematical format,
- Possess a solid grasp of essential mathematical tools required for the further studies in economic theory,
- Use appropriate techniques to solve problems with calculus and linear algebra,
- Model economic questions as mathematical problems.

3. Course Materials

3.1. Recommended Textbook

This course will be based on “*Mathematics for Economics, 3rd edition, Hoy, Livernois, McKenna, Rees, and Stengos, MIT Press, March 2011, ISBN-10:0-262-01507-2, ISBN-13: 978-0-262-01507-3. Access to e-book: <https://mitpress.ubliish.com/book/mathematics-economics#purchase>”*

However, the topics are generally covered by standard mathematical economics textbooks. You may want to read through the relevant sections of some such book because (a) it can provide a

different perspective on material presented, (b) it has a more space devoted to discussions and examples, and (c) it serves as a source of exercises and practice problems. Here is a list of such textbooks:

- Simon, C.J., Blume, L., (1994). Mathematics for Economist, W.W. Norton & Company
- Chiang, A. C., Wainwright, K. (2004). Fundamental Methods of Mathematical Economics (4th edition), McGraw-Hill/Irwin.
- Baldani, J., Bradfield, J., Turner, R. W. (2013). Mathematical Economics (3rd edition). Linus Publications.
- Sydsæter, K., Hammond, P. (2006). Essential Mathematics for Economic Analysis (2nd edition). FT Prentice Hall.

3.2. Readings Available on LEARN:

Lecture slides, lecture videos, exercises with their solutions and/or answers, and assignment questions will be posted on LEARN. It is your responsibility to download all materials uploaded on LEARN.

4. Course Requirements and Assessment

Assessment	Weighting
Assignments	20%
Midterm 1	17%
Midterm 2	17%
Midterm 3	17%
Final Exam	29%
Total	100%

4.1. Assignments:

Four assignments to be submitted through Dropbox on LEARN. You will have a problem set to solve. Each assignment worth 5% of the final grade. Students with a concern about the marking of an assignment must consult with me within two weeks of the date that it is returned to the class. After two weeks I will not make any adjustments to an assignment mark. Assignments will be handed out one week in advance of the due date, while the material is covered in lectures.

Due date	
Assignment 1	May 30 th , 11:59 pm
Assignment 2	June 20 th , 11:59 pm
Assignment 3	July 11 th , 11:59 pm
Assignment 4	August 1 st , 11:59 pm

4.2. Midterms:

Three midterms to be completed during the whole term through LEARN. You will have access to the midterm for 24 hours (from 12:01 am to 11:59pm) and once you start, you will have only one attempt and limited time. Details about the coverage of the midterms will be announced on LEARN.

	Due date
<i>Midterm 1</i>	June 4 th , 12:01 am to 11:59 pm
<i>Midterm 2</i>	June 25 th , 12:01 am to 11:59 pm
<i>Midterm 3</i>	July 16 th , 12:01 am to 11:59 pm

4.3. Final Exam:

The final exam is cumulative and will test all the material in the course. You will have access to the final exam for 24 hours and once you start, you will have only one attempt and limited time. Note that the final will not be rescheduled under any circumstances if all midterms have been missed. You should by now be familiar with the deferred final exam policy of the department.

	Due date
<i>Final Exam</i>	TBA

4.4. Policy on Academic Integrity and Honesty

The University of Waterloo subscribes to the strictest interpretation of academic integrity. Faculty members and students bear joint responsibility in assuring that cheating on assignments or any examination is not tolerated. Students who engage in academic dishonesty will be subject to disciplinary action under [Policy 71](#). Course assessments such as questions on assignments and exams are protected by copyright. Reproduction or dissemination of exams, quizzes or the contents or format of any assessments in any manner (for example posting/e-mailing/texting/sharing the content and questions with other students) is strictly prohibited. Students who are enrolled in ECON 211 agree to the following academic honesty and integrity statement:

By taking this course, every student affirms his/her/their agreement to the following statements:

- I confirm that I will keep the content of the examinations and other assessments confidential. I will not post questions, solutions, or content to third party websites or transfer it to other individuals.
- I confirm that I will not receive any unauthorized assistance in preparing for or writing examinations.
- I confirm that I will not access the Internet or any other unauthorized resource in the writing of the assessments such exams.
- I understand that I am responsible for being honest and ethical as per [Policy 71](#).

- I understand that there is no group work or cooperation involved in the assessments in this course. The assessments such as assignments and exams will be completed by my own efforts and I will not collaborate with any other person for ideas or answers.

4.5. Upload Policy on Exams and Assignments

All due date times are for Waterloo. Some questions on exams will be multiple choice, multiple select, or true/false format. Some other questions will require you to show your work and upload. The uploaded solutions to exams must be handwritten and scanned. Typed solutions will not be accepted for uploads. You will need to write your solutions on paper, write your name on each page along with question number (do not write the questions), scan and submit it. To ensure your scanned document is clear, the use of Microsoft Office Lens, which can be installed on your phone or iPad as an app (free of charge), is recommended. It is your responsibility to make sure that your handwriting is easy to read for marking purposes, no marks will be assigned if the handwriting is not easy to read.

4.6. Policy on Missed Exams and Late Assignments

There will be no make-up exams or assignments. No additional assignments or work will be assigned to improve the marks. The weight of a missed midterm for which a VIF is accepted will be shifted to the final exam. If you happen to be sick for all midterms you should consider dropping the course. The UW verification of illness form must be obtained at the day of the exam and submitted within 3 days of missed exam date. Any medical notes submitted after 3 days of a missed deadline or a missed exam will not be accepted. Medical notes brought up at the end of the term to cover missed deadlines will not be accepted.

There are no new exam arrangements by the instructor if you miss the final exam. You will need to apply for a consideration of a deferred exam through the office of Department of Economics. If you have compelling and verifiable evidence that you are unable to write the final exam at the scheduled time, you must follow this procedure to apply for a deferred exam. Please check the [Deferred Final Exam Policy](#) of the department.

There is no make up or shifting the weight for missed assignments. Students are responsible for submitting the assignments to Dropbox before the due date. A deduction of 5% per day will be applied to an assignment handed in late for any reason. Assignments are not accepted after 3 days of the due date. Excuses for extensions or shifting the weight of assignments are not accepted. Assignment marks cannot be shifted to other course components.

5. Course Modification Warning

The instructor and university reserve the right to modify elements of the course during the term. The instructor might need make changes to course components due to the issues with the use of technology and uploading files to LEARN. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary,

reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check his/her University of Waterloo email and course website on LEARN daily during the term and to note any changes.

6. Office Hours and Contacting the Instructor/TA

When sending email to me, please use your official UWaterloo account and have ECON 221 in the subject line. It is generally a good idea to also have a signature line that includes your full name and student ID. Please treat email correspondence as a somewhat formal venue of communication. Before sending an e-mail, please check the “Discussions” on LEARN.

If you need a virtual meeting, please ask for an appointment. Instructor and/or TA will give you an appointment (approximately 30 min per student). Please send your questions with your e-mail while asking an appointment. This will reduce the unnecessary time lost during the virtual meeting. Please be clear about your questions. Instructor/TA cannot re-explain the whole topic however can help you to understand the unclear points of the topic.

7. Weekly Course Schedule

Please note that our coverage from the textbook chapters is limited to the concepts covered on the lecture slides. We do not cover the entire chapter in most cases. It is your responsibility to check the coverage of lecture slides while making the readings.

Weeks	Topics	Assessments
1 – 3 May 10th – May 30th	1. Introduction and Fundamentals 1.1. Introduction 1.2. Sets and Numbers 1.3. Some Properties of Point Sets in R 1.4. Functions 1.5. Sequences, Series, and Limits <i>Readings:</i> Mathematics for Economics, 3rd edition, Hoy, Livernois, McKenna, Rees, and Stengos, MIT Press, Chapters 1 – 2 – 3	Assignment 1 – due date May 30 th , 11:59pm Midterm 1 –June 4 th , 12:01 am to 11:59 pm
4 – 6 May 31st – June 20th	2. Univariate Calculus and Optimization 2.1. Continuity of Functions 2.2. Definition of the Tangent Line and the Derivative 2.3. Rules of Differentiation 2.4. Unconstrained Maxima and Minima 2.5. Second-order Conditions <i>Readings:</i> Mathematics for Economics, 3rd edition, Hoy, Livernois, McKenna, Rees, and Stengos, MIT Press, Chapters 4 – 5 – 6	Assignment 2 – due date June 20 th , 11:59pm Midterm 2 –June 25 th , 12:01 am to 11:59 pm

<p>7 – 9</p> <p>June 21st – July 11th</p>	<p>3. Linear Algebra</p> <p>3.1. Systems of Linear Equations 3.2. Matrices 3.3. Determinants and Inverse of 3x3 Matrix 3.4. Cramer’s Rule 3.5. Advanced Topics in Linear Algebra</p> <p><i>Readings:</i> Mathematics for Economics, 3rd edition, Hoy, Livernois, McKenna, Rees, and Stengos, MIT Press, Chapters 7 – 8 – 9 – 10</p>	<p>Assignment 3 – due date July 11th, 11:59pm</p> <p>Midterm 3 –July 16th, 12:01 am to 11:59 pm</p>
<p>10 – 12</p> <p>July 12th – August 1st</p>	<p>4. Multivariate Calculus</p> <p>4.1. Partial Differentiation 4.2. Curvature Properties 4.3. Properties of Functions with Economic Applications 4.4. Optimization of Function of n-Variables 4.5. Constrained Optimization</p> <p><i>Readings:</i> Mathematics for Economics, 3rd edition, Hoy, Livernois, McKenna, Rees, and Stengos, MIT Press, Chapters 11 – 12 – 13</p>	<p>Assignment 4 – due date August 1st, 11:59pm</p>
<p>13</p> <p>August 3rd – August 5th</p>	<p>Final Review</p>	<p>Final Exam – Scheduled by the Registrar’s Office during the final exam weeks (Aug 7th – Aug 16th)</p>

8. Institutional-required statements for undergraduate course outlines approved by Senate Undergraduate Council.

8.1. Economics Department Deferred Final Exam Policy

Deferred Final Exam Policy found at

<https://uwaterloo.ca/economics/undergraduate/resources-and-policies/deferred-final-exam-policy>

8.2. Cross-listed course

Please note that a cross-listed course will count in all respective averages no matter under which rubric it has been taken. For example, a PHIL/PSCI cross-list will count in a Philosophy major average, even if the course was taken under the Political Science rubric.

8.3. Academic Integrity

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo are expected to promote honesty, trust, fairness, respect and

responsibility. See the [UWaterloo Academic Integrity](#) webpage and the [Arts Academic Integrity](#) webpage for more information.

Discipline: A student is expected to know what constitutes academic integrity, to avoid committing academic offences, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about “rules” for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. When misconduct has been found to have occurred, disciplinary penalties will be imposed under Policy 71 – Student Discipline. For information on categories of offenses and types of penalties, students should refer to [Policy 71 - Student Discipline](#). For typical penalties check [Guidelines for the Assessment of Penalties](#).

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. [Read Policy 70 - Student Petitions and Grievances](#), Section 4. When in doubt, please be certain to contact the department’s administrative assistant who will provide further assistance.

Appeals: A decision made or penalty imposed under Policy 70 - Student Petitions and Grievances (other than a petition) or Policy 71 - Student Discipline may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to [Policy 72 - Student Appeals](#).

8.4. Accommodation for Students with Disabilities

Note for students with disabilities: [The AccessAbility Services office](#), located on the first floor of the Needles Hall extension (1401), collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the AS office at the beginning of each academic term.

8.5. Intellectual Property

Students should be aware that this course contains the intellectual property of their instructor, TA, and/or the University of Waterloo.

Intellectual property includes items such as:

- Lecture content, spoken and written (and any audio/video recording thereof);
- Lecture handouts, presentations, and other materials prepared for the course (e.g., PowerPoint slides);
- Questions or solution sets from various types of assessments (e.g., assignments, quizzes, tests, final exams); and

- Work protected by copyright (e.g., any work authored by the instructor or TA or used by the instructor or TA with permission of the copyright owner).

Course materials and the intellectual property contained therein, are used to enhance a student's educational experience. However, sharing this intellectual property without the intellectual property owner's permission is a violation of intellectual property rights. For this reason, it is necessary to ask the instructor, TA and/or the University of Waterloo for permission before uploading and sharing the intellectual property of others online (e.g., to an online repository).

Permission from an instructor, TA or the University is also necessary before sharing the intellectual property of others from completed courses with students taking the same/similar courses in subsequent terms/years. In many cases, instructors might be happy to allow distribution of certain materials. However, doing so without expressed permission is considered a violation of intellectual property rights.

Please alert the instructor if you become aware of intellectual property belonging to others (past or present) circulating, either through the student body or online. The intellectual property rights owner deserves to know (and may have already given their consent).

8.6. Chosen/Preferred First Name

Do you want professors and interviewers to call you by a different first name? Take a minute now to verify or tell us your chosen/preferred first name by logging into [WatiAM](#).

Why? Starting in winter 2020, your chosen/preferred first name listed in WatiAM will be used broadly across campus (e.g., LEARN, Quest, WaterlooWorks, WatCard, etc). Note: Your legal first name will always be used on certain official documents. For more details, visit [Updating Personal Information](#).

Important notes

- If you included a preferred name on your OUAC application, it will be used as your chosen/preferred name unless you make a change now.
- If you don't provide a chosen/preferred name, your legal first name will continue to be used.

8.7. Mental Health Support

All of us need a support system. The faculty and staff in Arts encourage students to seek out mental health support if they are needed.

On Campus

Due to COVID-19 and campus closures, services are available only online or by phone.

- Counselling Services: counselling.services@uwaterloo.ca / 519-888-4567 ext. 32655
- **MATES**: one-to-one peer support program offered by the Waterloo Undergraduate Student Association (WUSA) and Counselling Services

Off campus, 24/7

- [Good2Talk](#): Free confidential help line for post-secondary students. Phone: 1-866-925-5454
- Grand River Hospital: Emergency care for mental health crisis. Phone: 519-749-4300 ext. 6880
- [Here 24/7](#): Mental Health and Crisis Service Team. Phone: 1-844-437-3247
- [OK2BME](#): set of support services for lesbian, gay, bisexual, transgender or questioning teens in Waterloo. Phone: 519-884-0000 extension 213

Full details can be found online on the Faculty of Arts [website](#)

Download [UWaterloo and regional mental health resources \(PDF\)](#)

Download the [WatSafe app](#) to your phone to quickly access mental health support information.

8.8. Student Notice of Recording (Live and/or recorded video conferencing on WebEx, Microsoft Teams, ... etc.)

Activities for this course might involve recording, in partial fulfillment of the course learning outcomes. You might receive notification of recording via the Learning Management System (LEARN), a message from your course instructor, course syllabus/website, or other means. Some technologies may also provide a recording indicator. Images, audio, text/chat messaging that have been recorded may be used and/or made available by the University to the instructor,

Econ 211 students, TAs and tutorial leaders for the purpose of review. Recordings will be managed according to the University records classification scheme, WatClass, and will be securely destroyed when no longer needed by the University. Your personal information is protected in accordance with the [Freedom of Information and Protection of Privacy Act](#), as well as University policies and guidelines and may be subject to disclosure where required by law.

The University will use reasonable means to protect the security and confidentiality of the recorded information but cannot provide a guarantee of such due to factors beyond the University's control, such as recordings being forwarded, copied, intercepted, circulated, disclosed, or stored without the University's knowledge or permission, or the introduction of malware into computer system which could potentially damage or disrupt the computer, networks, and security settings. The University is not responsible for connectivity/technical difficulties or loss of data associated with your hardware, software, or Internet connection.

By engaging in course activities that involve recording, you are consenting to the use of your appearance, image, text/chat messaging, and voice and/or likeness in the manner and under the conditions specified herein. (In the case of a live stream event, if you choose not to have your image or audio recorded, you may disable [the audio and video functionality](#) (see: Student privacy during live events). Instructions to participate using a pseudonym instead of your real name are included where the feature exists; however, you must disclose the pseudonym to your instructor in advance in order to facilitate class participation.) If you choose not to be recorded, this notice serves as confirmation of your understanding that you can watch the recordings later and ask your questions via e-mail.

You are not permitted to disclose the link to/URL of an event or an event session recording or copies of recording to anyone, for any reason. Recordings are available only to authorized individuals who have been directly provided the above instructions/link for their use. Recordings for personal use, required to facilitate your learning and preparation of personal course/lecture notes, should not be shared with others without the permission of the instructor or event coordinator. Review [the University's guidelines for faculty, staff and students entering relationships with external organizations](#) offering access to course materials for more information on your obligations with respect to keeping copies of course materials. For more information about accessibility, connect with [AccessAbility Services](#).

9. Territorial Acknowledgement

We acknowledge that we are living and working on the traditional territory of the Attawandaron (also known as Neutral), Anishinaabe and Haudenosaunee peoples. The University of Waterloo is situated on the Haldimand Tract, the land promised to the Six Nations that includes ten kilometres on each side of the Grand River.

For more information about the purpose of territorial acknowledgements, please see the [CAUT Guide to Acknowledging Traditional Territory](#).

10. Academic freedom at the University of Waterloo

[Policy 33, Ethical Behaviour](#) states, as one of its general principles (Section 1), “The University supports academic freedom for all members of the University community. Academic freedom carries with it the duty to use that freedom in a manner consistent with the scholarly obligation to base teaching and research on an honest and ethical quest for knowledge. In the context of this policy, 'academic freedom' refers to academic activities, including teaching and scholarship, as is articulated in the principles set out in the Memorandum of Agreement between the FAUW and the University of Waterloo, 1998 (Article 6). The academic environment which fosters free debate may from time to time include the presentation or discussion of unpopular opinions or controversial material. Such material shall be dealt with as openly, respectfully and sensitively as possible.” This definition is repeated in Policies 70 and 71, and in the Memorandum of Agreement, Section 6