



Department of Economics

## **Econ 211**

Introduction to Mathematical Economics

**Winter 2023**

Instructor: Dr. Olivia Mesta

e-mail: [omesta@uwaterloo.ca](mailto:omesta@uwaterloo.ca)

Office hours: will be announced on LEARN

You are welcome to contact me via e-mail. I check e-mails regularly during the day. I usually respond within a day or two. You should not expect to hear from me evenings, weekends or holidays.

Please note that course schedule, methodology, assessments, and exam policies have been planned based on current public health guidelines. Should these guidelines change, adjustments and changes might be necessary. The changes will be communicated to students with announcements on LEARN.

### **Course Description**

The course aims to connect mathematical tools and elementary economics analysis. It is an introduction to mathematical techniques of particular use in economics. Students are expected to learn the mathematical concepts which are required to tackle problems in economic analysis. 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. The focus is on mathematics, but different concepts will be taught using applications in economics. Topics include functions, continuity, differentiation, partial derivatives, and optimization techniques including constrained optimization. Students are advised to refresh their knowledge on basic arithmetic and algebra, and sets, subsets and functions before proceeding to higher level topics in this course. The goal is to motivate students of economics to study appropriate mathematical tools by demonstrating their power to deal with economic problems.

### **REQUIRED TEXTBOOK**

*Mathematics for Economics*, 3<sup>rd</sup> 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>

*Student's Solutions Manual*, (optional): 3<sup>rd</sup> edition, Hoy, Livernois, McKenna, Rees, and Stengos, MIT Press, April 2012 ISBN-10:

0-262-51794-9, ISBN-13: 978-0-262-51794-2

Lecture notes from Martin J. Osborne - Department of Economics-University of Toronto:

<https://mjo.osborne.economics.utoronto.ca/index.php/tutorial/index/1/toc>

(free access)

## Support Structures, Practice resources & the Use of Technology

- Instructor: Dr. Olivia Mesta [omesta@uwaterloo.ca](mailto:omesta@uwaterloo.ca)
- Class meetings with the prof takes place on Mondays and Wednesdays as scheduled by the registrar.
- Tutorials: Held weekly on Wednesdays based on your enrollment schedule.
- Lecture slides with solutions posted on LEARN
- Supplementary videos (optional to watch) posted on LEARN
- Exercises with solutions on Osborne sections under exercises tab:  
<https://mjo.osborne.economics.utoronto.ca/index.php/tutorial/index/1/toc>
- Examples with solutions on the textbook
- Additional practice questions posted with solutions before exams
- Bi-weekly quizzes on Mobius
- Homework sets on Crowdmark
- Exams will be proctored in-person in class as scheduled by the registrar.
- Student IT support services <https://uwaterloo.ca/student-it-services/>
- LEARN help e-mail for technical assistance: [learnhelp@uwaterloo.ca](mailto:learnhelp@uwaterloo.ca)  
(<https://uwaterloo.ca/learn-help/students>)
- MOBIUS help line: [mobiushelp@uwaterloo.ca](mailto:mobiushelp@uwaterloo.ca)

## COURSE CONTENT

The coverage consists of two sources, one of which is the textbook *Mathematics for Economics*, 3<sup>rd</sup> edition, Hoy, Livernois, McKenna, Rees, and Stengos. The other source is the lecture notes from Martin J. Osborne - Department of Economics-University of Toronto:

<https://mjo.osborne.economics.utoronto.ca/index.php/tutorial/index/1/toc>

Please note that the following coverage might be modified depending on the pace of the lectures and in case of a necessary switch between remote and in-person instruction. This might have an impact on the coverage and/or the number of quizzes. The instructor reserves the right to make changes as necessitated by possible changes. Any changes will be announced on LEARN.

Winter term 2023: January 9 – April 10, 2023

1. (1.1) from Osborne; Logic, ...
2. (1.4) from Osborne; Intervals and functions, intermediate value theorem, ... (“Continuous functions” section is excluded since it will be covered from the textbook later; however, intermediate value theorem is included.)

**Quiz 1** January 20 open between 8:00 am – 8:00 pm

---

3. Chapter 2 from Hoy; functions, convex/concave set, convex/concave functions, ...
4. (1.7) from Osborne; Graphical representation of functions, ...
5. Chapter 3 from Hoy; Definition of limit
6. Chapter 4 from Hoy; Continuity of functions and applications, ...

**Quiz 2** February 3 open between 8:00 am – 8:00 pm

---

7. Chapter 5 from Hoy; Differentiation, total differential, link to convex/concave functions, ...
- 

### READING WEEK

---

8. Chapter 6 from Hoy; Optimization in one variable, ...
9. (2.1) from Osborne; Introduction to multivariate calculus

**Quiz 3** February 17 open between 8:00 am – 8:00 pm

---

10. Chapter 8 from Hoy; Intro to Matrices, ...
11. Chapter 9 from Hoy; Determinant, ...
12. Chapter 10 from Hoy; Quadratic form, ...

**Quiz 4** March 10 open between 8:00 am – 8:00 pm

---

13. Chapter 11 from Hoy; Functions of  $n$  variables, implicit function theorem, ...

---

14. (2.2) from Osborne; Chain rule – exclude Leibniz's formula, ...

15. (2.3) from Osborne; Derivatives of functions defined implicitly, ...

16. (2.5) from Osborne; Homogeneous functions, ...

**Quiz 5** March 24 open between 8:00 am – 8:00 pm

---

17. Chapter 12 from Hoy; Optimization in  $n$  variables, ...

18. Chapter 13 from Hoy; Optimization with constraints - Lagrange multiplier method, ...

**Quiz 6** April 6 open between 8:00 am – 8:00 pm

---

19. April 10: last class

Please note that our coverage from the textbook chapters is limited to the concepts covered on the posted lecture slides. We do not cover the entire chapter in most cases. You must download the posted lecture notes and solutions to your computer from LEARN and look at it from slide show; otherwise, you will not be able to see hand-written solutions with an electronic pen.

## Evaluation

Quizzes(not cumulative)	6 quizzes (1 reserved for illnesses)	20%
Homework sets	5 homework sets (1 reserved for illness)	10%
Exam 1	Friday February 10 at 4:30 pm	20%
Exam 2 (not cumulative)	Friday March 17 at 4:30 pm	20%
Final exam (cumulative)	To be announced by the registrar	30%

Homework sets are due by 6:00 pm and will be uploaded to Crowdmark:

HW 1 January 26

HW 2 February 16

HW 3 March 9

HW 4 March 23

HW 5 April 5

Please note that you are required to answer all questions in every homework set; however, not all questions will be marked. A set of randomly selected questions will be marked from each homework set.

### Upload Policy on Exams, Quizzes and HW sets

*All due date times are for Toronto time zone.* Some questions on quizzes, hw sets and exams might be multiple choice, multiple select, type your answer using equation editor on Mobius or true/false format. Some other questions might require you to show your work and upload. In the case of upload type questions, uploaded solutions must be hand-written and scanned. Typed solutions will not be accepted for uploads. You will need to write your solutions on paper (do not write the questions), scan and submit it as a single page.

University of Waterloo students get **5TB** of cloud storage with OneDrive, which allows you to take pictures of documents, save the files, and have access to your files from any device. Log in with your UW credentials at <http://portal.office.com/> to access the OneDrive app using your browser and download the OneDrive mobile and desktop app. You should install the mobile app in your phone in order to take pictures of your work. You can take a picture directly with “OneDrive” app on your phone, save it to your OneDrive and upload to Mobius or Crowdmark from your OneDrive.

To ensure your scanned document is clear, you can also use Microsoft Office Lens, which can be installed on your phone or iPad as an app (free of charge). Take a picture of the handwritten page with Microsoft Office Lens, save it in pdf format to your OneDrive and upload from your OneDrive to Crowdmark for hw sets and to Mobius for quizzes. 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.

There is a “trial quiz” posted on Mobius. It has upload questions as well as some other types of questions. Please take the trial quiz in order to familiarize yourself with the workings of Mobius. You need to click on “upload” after you select the file.

### **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 quizzes, or any type of examination is not tolerated. Students who engage in academic dishonesty will be subject to disciplinary action under Policy 71. **Course lectures and assessments such as questions on quizzes, homework assignments and exams are protected by copyrights. Reproduction or dissemination of lectures, exams, quizzes or the contents or format of any assessments in any manner (for example posting/e-mailing/texting/sharing the content and questions/answers with other students) is strictly prohibited.**

Students who are enrolled in Econ 211 agree to the following academic honesty and integrity statement:

- I confirm that I will keep the content of the quizzes, examinations and other assessments confidential. I will not post questions, solutions, ideas or content to third party websites or transfer it to other individuals in any way.
- I confirm that I will not receive any unauthorized assistance in preparing for or writing quizzes/examinations.
- I confirm that I will not access the Internet or any other unauthorized resource in the writing of the assessments such as quizzes and 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 quizzes and exams will be completed by my own efforts, and I will not collaborate with any other person for ideas, questions or answers.

### **Policy on Missed Quizzes**

- Quizzes are not cumulative. Each quiz has its own coverage. Coverage and number of quizzes might be modified due to changes required by the pace of the lectures or any possible move between in-person and remote instruction. Any changes will be announced on LEARN. If a quiz question requires a solution to be uploaded, it must be handwritten. Typed solutions will not be accepted.
- The lowest ONE quiz mark out of 6 quizzes will be dropped at the end of the term to allow for legitimate excuses such as due to illness. Self-declaration of short-term illness or public health event requiring an absence due to illness or a requirement to self-isolate is accepted for dropping ONE quiz score. Alternatively, students can e-mail verification of illness (VIF) covering the day of the quiz within a day of missing the quiz. Sending VIF days or weeks after the quiz or at the end of the term trying to cover a missed quiz is not accepted.
- No more than ONE quiz (out of total number of 6 quizzes) will be dropped.
- There are no make-up quizzes or alternative assignments to cover missed quizzes or to improve the marks.

- Missing a quiz without timely self-declaration or sending VIF within a day will result in zero mark.
- Students must write at least 5 out of 6 quizzes.
- If a student has a medical condition or other documented reason that would cause missing *more than one quiz*, the instructor would like to be notified about circumstances the student is experiencing at the day of the quiz. Contact your instructor with verification before the access to the quiz closes for a consideration of shifting the weight for the missed quizzes in excess of one to final exam. No shifting of the weight will be considered if a student misses both midterm exams. Students cannot make arrangements at the end of the term bringing medical notes or excuses to cover all the quizzes missed.
- Students who write all 6 quizzes as scheduled will be rewarded by dropping the lowest quiz score out of 6 quizzes. The reward does not apply if a student misses at least one quiz for any reason including, illness, self-declaration, other documented reasons or VIF.

### **Policy on Missed Exams**

- Midterms are scheduled as TST time slots and the exam dates show on your official schedule of classes when you enroll into the course. It is not possible to arrange for alternative times for the midterm exams.
- There is no make-up exams. No additional assignments or work will be assigned improve the marks.
- For students who self-declare illness on Quest or submit the verification of illness form within a day to the instructor, the weight of the missed midterm exam will be shifted to the final exam. It is not possible to cover missed exams by bringing in documentation days or weeks after the missed exam.
- Final exam is scheduled by the registrar. Instructor does not make arrangements for deferring the final exam with or without self-declaration of illness or VIF. There are no alternative date arrangements by the instructor if you miss the final exam. Deferring final exam for any reason is subject to the Deferred Final Exam Policy. If you have compelling and verifiable evidence that you are unable to write the final exam at the scheduled time, you must follow the procedure outlined below to apply for a consideration of a deferred final exam:  
<https://uwaterloo.ca/economics/undergraduate/resources-and-policies/deferred-final-exam-policy>
- You must write at least one of the two midterm exams to pass the course.
- No deferred final exam will be provided for students who missed all the exams (including the final exam) in this course.

### **Policy on Late or Missed Homework Assignments**

- There is no make-up for missed homework sets. Students are responsible for submitting the homework assignments to Crowdmark before the due date. There is a reasonable number of days to work on each hw set. It is not a good idea to wait until the very last hours or minutes to upload your solutions. If you are unable to submit by the deadline,

late penalty of 1% per hour will apply when the assignment is submitted late.  
Homework sets are not accepted after 3 days of the due date.

- Your solutions to homework assignments must be handwritten, scanned and uploaded to Crowdmark. Typed solutions will not be accepted.
- HW set solutions sent via e-mail are NOT accepted under any circumstance.
- The lowest ONE hw set score out of 5 hw sets will be dropped at the end of the term to allow for legitimate excuses such as due to illness. Self-declaration of short-term illness or public health event requiring an absence due to illness or a requirement to self-isolate is accepted for dropping ONE hw set score. Alternatively, students can e-mail verification of illness (VIF) at the due date of the hw set. Sending VIF days or weeks after the deadline or at the end of the term trying to cover a missed hw set is not accepted.
- No more than ONE hw set score (out of total number of 5 hw sets) will be dropped.
- There are no make-up hw sets or alternative assignments to cover missed hw sets or to improve the marks.
- Missing a hw set without timely self-declaration or sending VIF at the due date of the hw set will result in zero mark.
- Students must submit at least 4 out of 5 hw sets.
- Homework marks cannot be shifted to other course components. If a student has a medical condition or other documented reason that would cause missing *more than one hw set*, the instructor would like to be notified about circumstances the student is experiencing at the due date. Contact your instructor with verification before the deadline expires for the hw set for a consideration of an extension on the deadline for the hw sets in excess of one. No shifting of the weight will be applied to hw sets. No extension will be provided to students who miss both midterm exams. Students cannot make arrangements at the end of the term bringing medical notes or excuses to cover missed hw sets.
- Students who submit all 5 hw sets on time as scheduled will be rewarded by dropping the lowest hw set score out of 5 hw sets. The reward does not apply if a student misses at least one hw set for any reason including self-declaration, other documented reasons or VIF.

### **Notice of recording on video conferencing**

In the case of remote instruction, there might be live and/or recorded activities using WebEx involving class meetings, tutorials, practice sessions or Q&A sessions during the term. No marks will be assigned to such activities. Notice of recording is posted to LEARN under content as well as at the last pages of this course outline. 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.

### **Course Modification Warning**

The instructor and university reserve the right to modify elements of the course during the term. The instructor might need to make changes to course components due to the changes in public health guidelines, changes between in-person and remote instruction, issues with the use of technology and/or uploading files to LEARN. The university may change the dates and deadlines and delivery methods for any or all courses in certain 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 students to check their UWaterloo email and course website on LEARN daily during the term and to note any changes.

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

### **Economics Department Deferred Final Exam Policy**

Deferred Final Exam Policy found at

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

### **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.

### **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](#).

### **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.

### **Mental Health Support**

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

#### **On Campus**

- Counselling Services: [counselling.services@uwaterloo.ca](mailto:counselling.services@uwaterloo.ca) / 519-888-4567 xt 32655
- [MATES](#): one-to-one peer support program offered by Federation of Students (FEDS) and Counselling Services
- Health Services Emergency service: located across the creek from Student Life Centre

#### **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: 519-749-433 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 at 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

## 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](#).

### **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 six miles on each side of the Grand River.

I wish you a productive semester

Dr. Olivia Mesta