UNIVERSITY OF
WATERLOO

Department of Economics
ECON 311: Mathematical Economics

Course Outline
(Winter 2020)

Instructor:	Chaussé, Pierre
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Lecture Time:	T-Th 1:00 to 2:20
Lecture Location:	MC 4064
Office Hours:	Tuesdays 9:30 to 12:00 or by appointment

Course description

Economics 311 is the second course in a two course sequence representing the core of mathematical economics offered to undergraduate students in economics. The objective of this course is to prepare the students for most 400 level economics courses, especially the required courses for the Intensive Specialization program (ECON 392, 421, 472, 491 and 496), and for graduate schools.

Topics include multivariate calculus, constrained and unconstrained optimization of n-variables, comparative statics and the Envelope Theorem, integration, techniques for solving first order linear and non-linear difference and differential equations, and the Optimal Control Theory – all developed within the context of economic theory.

Textbook

The students are expected to read the chapters mentioned in the Topics section below. Ideally, the readings should be done before attending the lectures.

- Hoy, M., Livernois, J., McKenna, C., Rees, R., and Stengos, T., *Mathematics for Economists*, Third Edition, The MIT Press 2011 **(previous editions can also be used)**

Topics

For each topic, some problems are suggested. It is strongly recommended to try them before looking at the solution. They are good examples of the kind of questions you will find in the exams.

The following order is not written in stone. We may skip topics and/or change the order in which they are presented during the term.

1. Linear algebra, a review and a little more (Chapters 8 to 10).

2. Calculus for functions of n-variables (Chapter 11)
   Analysis of functions through differentiation.

   ◇ **Problems:** 1, 3, 5, 7, 9 (pages 471 and 472)

3. Unconstrained optimization (Chapter 12)
   Maximization and minimization of functions of n variables.

   ◇ **Problems:** 1 and 3 (pages 482-483), 1, 3, 5 (page 491), and 1 to 5 (pages 500 to 501)

4. Constrained optimization (Chapter 13)
   Maximization and minimization of functions of n variables subject to linear or nonlinear constraints using the technique of the Lagrangian.

   ◇ **Problems:** 1, 3, 5, 7 (pages 516 and 517), 1, 3, 5 (pages 525 to 526), and 1, 3 (pages 526 to 527)

5. Optimization with inequality constraints (Chapter 15)
   Introduction to the Kuhn-Tucker conditions.

   ◇ **Problems:** 1, 3, 5, 6 (pages 580 and 581)

6. Comparative statics and the Envelope Theorem (Chapter 14)
   Analyzing the impact of changing the value of a coefficient on the solution of an optimization problem.

   ◇ **Problems:** 1, 3, 5, 7 (pages 538 and 539), 1, 3, 5 (pages 561 and 562), and 1, 2, 3, 5 (pages 563 to 565)

7. Integration (Chapter 16)
   Introduction to different techniques of integration.

   ◇ **Problems:** 1, 3, 5, 7 (pages 591 to 593), 1, 3, 5, 6 (pages 604 and 605) 1 to 4 (page 613), 1, 3, 5 (page 622) 1, 3 (page 628), and 1, 3, 7, 9 (pages 630 and 631)

8. Linear and non linear difference equations (Chapters 17 to 20)
   Solving dynamic problems in discrete time

   - ◇ **Problems (Chapter 17):** 1, 3, 5, 7, 9, 11, 15 (page 642)
   - ◇ **Problems (Chapter 18):** 1, 4, 7 (pages 655 and 656), and 1, 5, 7 (pages 662 to 664)
   - ◇ **Problems (Chapter 19):** 1, 2, 3 (page 672), 1, 2, 3, 4 (pages 677 and 678), and 1, 3, 5, 7 (pages 679 and 680)
   - ◇ **Problems (Chapter 20):** 1, 4, 5 (pages 706 and 707), and 1, 3, 5, 11, 13, 14 (pages 712 and 713)

9. Linear and nonlinear differential equations, and the Optimal Control Theory (Chapters 21 to 25)
   Solving dynamic problems in continuous time

   - ◇ **Problems (Chapter 21):** 1, 3, 5, 7 (pages 729 and 730), 1, 3, 5, 7 (page 736), and 1, 3, 5, 7 (pages 737 and 738)
   - ◇ **Problems (Chapter 22):** 1, 3, 5 (page 747), and 1, 3, 5 6 (pages 750 and 751)
   - ◇ **Problems (Chapter 23):** 1, 3 (pages 771 and 772), 1, 3, 5 (page 777), and 1, 3, 4, 5 (pages 778 to 780)
   - ◇ **Problems (Chapter 24):** 1, 3 (page 803), 1, 3 (pages 824 and 826), 1, 3, 5 (pages 838 and 839), and 1, 3, 5 (pages 840 to 842)
   - ◇ **Problems (Chapter 25):** 1, 3, 5 (pages 858 and 859), 1, 3, 5 (pages 870 and 871), 1, 3 (pages 884 and 885), and 1, 3 (page 898), and 1, 3, 5, 7 (pages 917 to 919)

Evaluation

Assignments (up to five): 20%
Midterm 1 (Thursday January 30 in class): 20%
Midterm 2 (Thursday March 5 in class): 20%
Final exam (cumulative): 40%

Policies on assignments

The assignments are done individually. Collaboration is of course encouraged, but each submitted copies must be significantly different from each other. For students submitting identical copies (or identical parts), disciplinary penalties will be imposed under Policy 71 (see below).

The purpose of the assignments is to help you understand the material through challenging problems. The marking scheme is 0-1-2, which means that if you try all problems, you get 2/2, if you try more than 50% but less than 100% of the problems, you get 1/2, and you get 0 otherwise. By trying, I mean putting substantial effort into it.

Internet is a great source of information. It is therefore possible that some of you find the solution of my assignment questions online. Before copying those solutions and submit them as your own, remember that using outside sources without citing them is considered as plagiarism. Also, why would you do it since I give you 2/2 if you try, even if your answers are all wrong.

Policy regarding missed midterm exams

If a student provide the proper documents to the instructor within 2 business days of the exam and that the justification is considered valid by the instructor, the weight of the midterm exam is moved to the final exam.

Economics Department Deferred Final Exam Policy

Deferred Final Exam Policy found on our website.

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

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: 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 / 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 form 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