

UNIVERSITY OF WATERLOO

Department of Economics
ECON-625/474: Numerical methods for economists

Course Outline (Winter 2019)

Instructor: Chaussé, Pierre
Office: HH 211
Phone: 519-888-4567 ext. 32422
Email: pchausse@uwaterloo.ca

Lecture Time: T-Th 4:00 to 5:20

Lecture Location: HH 139

Office Hours: Mondays, 2:00 to 5:00 or by appointment

Course description

The course covers important topics related to scientific computing through applications in either microeconomics, macroeconomics or econometrics. The topics include: floating point arithmetic, nonlinear equations, optimization, numerical derivatives and numerical integration, differential equations, and simulation of dynamic models. The course is entirely based on the open source statistical environment R (<http://www.r-project.org/>) and the use of that language by the students is mandatory.

The objective of the course is not only to teach the students how to program efficiently and accurately, but also to be organized. In order to achieve that goal, we will learn how to take advantage of the object-oriented aspect of R. This way of programming allows us to create environments in which functions behave according to our preference. For example, we can create an object of class "Macrodata" for which methods like `summary()` or `plot()` produce output commonly used by macro-economists. We could also create an object of class "Consumer" for which the method `solve()` would compute optimal choices and the method `plot()` would draw indifference curves. An introduction will be given during the first two weeks.

The student will practice the concepts covered in class through several small individual numerical projects. It is imperative that you practice writing codes continuously throughout the semester. The lecture notes include several programs for solving most of the problems we will cover. However, I strongly recommend that you try to write your own on a weekly basis. This is the only way to become good at solving problem by yourself.

Textbook

- The course is almost entirely based on the following textbook. Some copies are available at the bookstore. It is, however, not required to purchase it. A set of lecture notes with examples in R is available on the course website.
 - Judd, Kenneth L., *Numerical Methods in Economics*, MIT Press (1999)
- The following links provide free manuals on how to use R. Choose the one that suits you most.
 - R for beginners:
http://cran.r-project.org/doc/contrib/Paradis-rdebuts_en.pdf
 - Econometrics in R:
<http://cran.r-project.org/doc/contrib/Farnsworth-EconometricsInR.pdf>
 - Several other manuals are available at <http://cran.r-project.org/other-docs.html> in many different languages. Of course, you can download the official manual on the main R web site.

Topics

1. Introduction: (Lecture Notes: Chapter 1)
Programming with R
2. Floating point arithmetic (Chap. 1 and 2, and the article: [Goldberg\(1991\)](#))
Understanding how computers compute
3. Linear equations (Chap. 3)
Solving systems of linear equations
4. Optimization (Chap. 4)
Solving univariate or multivariate optimization problems
5. Nonlinear equations (Chap. 5)
Solving systems of nonlinear equations
6. Numerical calculus (Chap. 7)
Computing numerical integrals and derivatives
7. Monte Carlo methods (Chap. 8)
Introduction to simulation methods in statistics
8. Differential equations (Chap. 10 and 11)
Solving differential equation by finite-difference methods
9. Dynamic Programming (Chap. 12)
Simulating the solution to dynamic models

Evaluation

Biweekly projects: 60%

Final exam (Open book, on a computer): 40%

The evaluation criteria for the exam and the assignments will be different for graduate (Econ 625) and undergraduate students (Econ 474). The problems that they will have to solve may also differ. For example, economic applications will be based on undergraduate economics and econometrics courses for Econ 474 students and from graduate courses for Econ 625 students.

Final Exam

The final exam is 4.5 hours long and must take place before April 6 2019. Therefore, we will have to agree on a date and time in class. If everyone is comfortable working on his/her own laptop, we will do it in a regular classroom. If any of you do not have a laptop, we will reserve one of the computer lab.

Policy regarding assignments

You must submit your assignments in Learn's drop box before the due time. Past that time, the drop box will not accept any upload. Therefore, do not wait until the last minute to submit it. A late submission will result in a grade of 0. The format of the document(s) that you have to upload will be described in class. Although you are encouraged to work in groups, you have to submit your own answers. Failure to do so will result in disciplinary penalties under Policy 71.

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

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 Accessibility 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 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

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.