UNIVERSITY OF
WATERLOO

Department of Economics
ECON485/673: Numerical methods for economists

Course Outline
(Winter 2012)

Instructor: Chaussé, Pierre
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Lecture Time: T-Th 2:30 to 3:50   **Lecture Location:** MC 4064

Office Hours: Friday, 9:30 to 11:30

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 equation, optimization, numerical derivatives and numerical integration. 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 assignments done in groups of maximum 3 students, and one individual numerical project. The latter must be approved by the instructor. A detailed description of the requirements for a project to be accepted will be discussed during the first lecture. For example, it must be related to economics and be relatively challenging numerically. The level of difficulty that will be required depends on whether you are a graduate of undergraduate student.

Textbook

- The course is almost entirely based on the following textbook. Some copies are available at the bookstore and one copy is in reserve at Dana Porter library. A set of lecture notes with examples in R will also be 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

Evaluation

Assignments (between four and five): 30%
Numerical project: 35%
Final exam (Open book, on a computer): 35%

Policy regarding assignments: The assignments are due at the beginning of class on the due date. If I leave the class without your copy, you get 0. I won't accept excuses like: ma printer did not work, my teammate let me down etc. Don't wait until the last minute to do it and you won't get those problems.

Policy regarding missed exams: If you miss an exam because of health problem, you have to provide me with the appropriate original documentation from your doctor. If you miss the scheduled final exam, you MUST petition the department within five calendar days to write the departmental deferred examination. If the student has failed to write the departmental deferred examination, the student will automatically receive a grade of 0 for the missed deferred final examination.

Avoidance of Academic Offenses

All students registered in the courses of the Faculty of Arts are expected to know what constitutes an academic offense, to avoid committing academic offenses, and to take responsibility for their academic actions. When the commission of an offense is established, disciplinary penalties will be imposed in accord with Policy #71, Student Academic Discipline. For information on categories of offenses and types of penalties, students are directed to consult the summary of Policy #71, Student Academic Discipline http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm

If you need help in learning how to avoid offenses such as plagiarism, cheating, and double submission, or if you need clarification of aspects of the discipline policy, ask your course instructor for guidance. Other resources regarding the discipline policy are the graduate advisor and the Associate Dean of Graduate Affairs. Students who believe that they have been wrongfully or unjustly penalized have the right to grieve; refer to Policy #70, Student Grievance http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm