Applied Computational Economics
ECON 647

Professor Barczyk
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Office hour: by appointment

Lectures:
10:05am-11:25am, M/W, LEA424

Course description

This is a graduate course open to both MA and PhD students. The prerequisites for the course are linear algebra, multivariable calculus, a good understanding of probability, and at least a B+ in ECON 620 or equivalent. If you are a PhD student there is no grade requirement. The goal of the course is to familiarize you with numerical methods useful for solving economic problems for which closed-form solutions are not available. The first part of the course focuses on basic numerical methods and the second part on solving dynamic models in both discrete and continuous time. Throughout, the emphasis is on applications. In order to perform computations I will be using Matlab. I do not assume that you have any previous experience with Matlab or any other computing software.

Textbook

We will closely follow the book *Applied Computational Economics and Finance* by Mario Miranda and Paul Fackler. A wider coverage of numerical methods may be found in *Dynamic General Equilibrium Modeling* by Burkhard Heer and Alfred Maussner and *Numerical Methods in Economics* by Kenneth Judd. A good introduction to dynamic programming with numerical techniques is the book *Dynamic Economics: Quantitative Methods and Applications* by Jerome Adda and Russell Cooper.

Grading policy

- Problem sets: 40%
- Presentations: 20%
- Term paper: 40%

Problem sets

For the problem sets you are encouraged to work in groups of two or three. Your write-up should be typed and include:

1. a brief summary of the methods used;
2. tables and/or graphs to describe your results;
3. your computer programs in an appendix.

Term paper

You have considerable flexibility for what you do for your term paper. However, you should come up with your own research question and utilize computational methods from the course. A research question that is a derivative of an existing paper can also be acceptable. There is no need to have a long paper, e.g., avoid a long-winded introduction or literature review, instead, concentrate your efforts on finding an interesting topic, on the computations, and the interpretation of your results.

April 15: Paper proposal is due

May 15: Paper is due (by email)

The paper proposal can be short (1-2 pages) and should explain your research question and the computational methods you expect to utilize. Your paper should be accompanied by a "code toolbox" which is structured in a way that enables me to replicate your results easily. What this means is that there is a main program that calls all the other functions and returns the results in tables and/or graphs. Also, document your code along the way with short comments.

Course Outline

Part I: Basic Numerical Methods

1. Linear equations: Ill conditioning, LU decomposition, and iterative methods.
2. Nonlinear equations: Nonlinear root-finding problems and nonlinear fixed point problems.
3. Complementarity problems: Compute economic models in which control variables are subject to constraints.

4. Numerical integration and differentiation. Solving ordinary differential equations.

5. Function approximation: The interpolation and collocation methods. Solving functional equations approximately.

Part II: Dynamic Programming

1. Discrete time, *discrete* state dynamic (Markov) models. Economic examples. Numerical solution algorithms: Backward recursion, function iteration, and policy iteration. Simulation and analysis.

2. Discrete time, *continuous* state dynamic (Markov) models. Theory and examples of dynamic optimization and dynamic equilibrium models such as American option pricing, economic growth, dynamic games, and asset pricing models.

3. Methods to solve discrete time, *continuous* state dynamic (Markov) models.

4. Depends on how much time is left...

Academic Integrity
McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offenses under the code of student conduct and disciplinary procedures (see http://www.mcgill.ca/integrity/ for more information).

L'université McGill attache une haute importance à l'honnêteté académique. Il incombe par conséquent à tous les étudiants de comprendre ce que l'on entend par tricherie, plagiat et autres infractions académiques, ainsi que les conséquences que peuvent avoir de telles actions, selon le Code de conduite de l'étudiant et des procédures disciplinaires (pour de plus amples renseignements, veuillez consulter le site http://www.mcgill.ca/integrity).

Language of Submission:
In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded. This does not apply to courses in which acquiring proficiency in a language is one of the objectives.