Computational Economics
FALL 2018

Instructor: Prof. Aaron Hedlund (e-mail: hedlunda@missouri.edu)

Time and Location: T, R 2:00pm – 3:15pm, Naka Hall 355

Office Hours: By Appointment, 226 Professional Building

Canvas: https://missouri.instructure.com

Dropbox Link: https://www.dropbox.com/sh/sntet369vykenx2/AAAH6AeLBNStZHbDLnRZri6Ua?dl=0

Final Exam: N/A

Overview and Objectives

Course Description

This course has two primary objectives. First, the course aims to provide a solid understanding of modern computational techniques used in economics. The emphasis here is on developing efficient, accurate solution algorithms to solve a wide class of economic models. Second, the course will explore how to bring models to the data (and vice-versa), i.e. how to use economic models to answer research questions of a quantitative nature.

Prerequisites and What to Expect

This course is primarily an *applied tools* course. The course is a *tools* course in the sense that the fundamental objects of study are algorithms and techniques, rather than economic theory. However, it is *applied* because the tools are designed with specific types of economic questions and models in mind.

The course is designed as an upper-level PhD course; therefore, a background in core PhD microeconomics and macroeconomics is expected. Also, some background in computer programming (especially Matlab, Fortran, and/or C/C++) is helpful but not necessary. It is possible to pick up sufficient programming knowledge as the semester progresses, particularly in the case of the more user-friendly Matlab. In the long run, I recommend learning Fortran to students who anticipate heavy computational work in their research. **Important:** this course is *not* a programming course. From time to time, I expect to discuss code for different algorithms in class, but my focus will be on the algorithms and the models themselves, not on programming syntax.

Resources

The main reference book is *The Handbook of Computation Economics, Volume 3*, but I also suggest gradually adding the following books to your research library:

General texts:

- *Economic Dynamics in Discrete Time* (Miao)
- *Numerical Methods in Economics* (Judd)
- *Applied Computational Economics and Finance* (Miranda and Fackler)
- *Computational Methods for the Study of Dynamic Economies* (Marimon and Scott)

Geared toward macroeconomics (but still useful to non-macroeconomists):

- *Dynamic General Equilibrium Modeling* (Heer and Maussner)
- *Dynamic Economics* (Adda and Cooper)
- *Frontiers of Business Cycle Research* (Cooley)
- *The ABCs of RBCs* (McCandless)
- *Methods for Applied Macroeconomic Research* (Canova)
- *Structual Macroeconometrics* (Dejong and Dave)

Assessment

Your course grade will be based on three computational projects that are designed to develop your ability to use economic theory, data, and computational methods to conduct research. In these projects, you will compute economic models from class to see how well they explain data and to perform "computational experiments." You may use any computer language of your choice, though I suggest Matlab for people who are not well-versed in computer programming. You will need to turn in the output *and* source code (compiled so that I can run it) for each project.

Grading Scale Each project accounts for one third of your semester grade, and the grading scale is as follows: A (85 – 100), B (70 – 85), C (55 – 70), F (<55).

Course Outline

1. **Discrete Time Stochastic Dynamic Programming**
2. **Representative Agent Models**
   (a) Value Function Methods
      - Value Function Iteration
        Grid search, multi-grid, accelerators, monotonicity, concavity, multi-dimensional optimization (e.g. consumption/savings with endogenous labor; portfolio choice)
      - Policy Function Iteration
      - Endogenous Grid Method

   (b) Euler Equation Methods
      - Perturbation
      - Projection

   (c) Error Analysis

   Partial List of Numerical Tools: discretization of stochastic processes, interpolation, numerical integration/differentiation, root finding
3. **Heterogeneous Agent Models with Incomplete Markets**
   (a) Steady State of Infinite Horizon Models
   (b) Steady State of Life Cycle Models
   (c) Transitional Dynamics
   (d) Models with Default
4. **Heterogeneous Agent Models with Incomplete Markets and Aggregate Risk**
   (a) Solution Methods to Krusell-Smith Economies
   (b) Models with Multiple Assets
5. **Data and Identification**
   (a) Some Useful Data and Tools
   (b) Calibration and Estimation

Papers to investigate: Aiyagari 1994, Gourinchas Parker 2002, Kaplan Violante 2014, Krusell Smith 1997/1998, Krusell et al 2010, Chatterjee et al 2007, Arellano 2008, Shimer 2005, Hagedorn Manovskii 2008, Smets Wouters 2007, Christiano et al 2005, Epple et al 2006/2013, Gavazza et al 2014, etc.

MU Policies

Academic Integrity

Academic integrity is fundamental to the activities and principles of a university. All members of the academic community must be confident that each person's work has been responsibly and honorably acquired, developed, and presented. Any effort to gain an advantage not given to all students is dishonest whether or not the effort is successful. The academic community regards breaches of the academic integrity rules as extremely serious matters. Sanctions for such a breach may include academic sanctions from the instructor, including failing the course for any violation, to disciplinary sanctions ranging from probation to expulsion. When in doubt about plagiarism, paraphrasing, quoting, collaboration, or any other form of cheating, consult the course instructor.

Accommodation of Disabilities

If you anticipate barriers related to the format or requirements of this course, if you have emergency medical information to share with me, or if you need to make arrangements in case the building must be evacuated, please let me know as soon as possible. If disability related accommodations are necessary (for example, a note taker, extended time on exams, captioning), please register with the Disability Center, S5 Memorial Union, 882-4696, and then notify me of your eligibility for reasonable accommodations. For other MU resources for students with disabilities, click on "Disability Resources" on the MU homepage.

Intellectual Pluralism

The University community welcomes intellectual diversity and respects student rights. Students who have questions or concerns regarding the atmosphere in this class (including respect for diverse opinions) may contact the Departmental Chair or Divisional Director; the Director of the Office of Students Rights and Responsibilities (http://osrr.missouri.edu/); or the MU Equity Office (http://equity.missouri.edu/), or by email at equity@missouri.edu. All students will have the opportunity to submit an anonymous evaluation of the instructor(s) at the end of the course.

Academic Inquiry, Course Discussion and Privacy

University of Missouri System Executive Order No. 38 lays out principles regarding the sanctity of classroom discussions at the university. The policy is described fully in Section 200.015 of the Collected Rules and Regulations. In this class, students may make audio or video recordings of course activity unless specifically prohibited by the faculty member. However, the redistribution of audio or video recordings of statements or comments from the course to individuals who are not students in the course is prohibited without the express permission of the faculty member and of any students who are recorded. Students found to have violated this policy are subject to discipline in accordance with provisions of section 200.020 of the Collected Rules and Regulations of the University of Missouri pertaining to student conduct matters.