Computational Methods in Macroeconomics (Officially: Computable GE Modeling) Preliminary Syllabus

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1 Organizational Information

Classroom: 133 Armory

Times: Monday and Wednesday 17:00-19:00

Course Home Page:
`https://netfiles.uiuc.edu/makoto/www/200409econ552/index.html`

Structure: 12 weeks of lectures and 2 weeks of student presentations

Course Materials: There is no required textbook that I will closely follow. Instead, I will prepare slides and lecture notes, which will be available through the course home page.

However, there are some books which are useful for this course. Below is the list. Among those in the list, the first three books are particularly useful for the course. I will refer to the three books occasionally. Actually, you are supposed to have Ljungqvist and Sargent (2004) already. Judd (1998) is a must have for people doing computational macro. Víctor's chapter in Marimon and Scott (1999) serves as a concise summary of a part of the course.

1. **Ljungqvist and Sargent (2004):** The textbook in macroeconomics which matches best with this course.
2. **Judd (1998):** Toolbox of computational methods which are useful for economists.
3. **Marimon and Scott (1999):** Collection of papers covering various branches of computational methods.
4. **Stokey, Lucas, and Prescott (1989):** Toolbox of dynamic programming for economists.
5. **Harris (1987):** Baby version of Stokey, Lucas, and Prescott (1989).

6. **Cooley (1995):** Collection of papers on business cycles, occasionally mentions computational methods used in the research.
7. **Miranda and Fackler (2002):** Relatively new textbook and I don't know about it.
8. **Ada and Cooper (2003):** Not a macro book but the approach is the same as this lecture.
9. **Press, Teukolsky, Vetterling, and Flannery (2001):** Extremely useful book collecting various codes for numerical operations. Also there is a C language version.

2 About the Instructor

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3 Course Description

This course teaches you how to *(i)* write a model, *(ii)* define an equilibrium, *(iii)* approximate the equilibrium using computational methods, *(iv)* calibrate the model so that the model can be used to answer interesting questions in macroeconomics. The course equips you with powerful tools to answer many interesting questions in macro, instead of giving you the questions themselves. The focus of the course is *(iii)* computational methods and *(iv)* calibration, because you have already learned how to *(i)* write a model and *(ii)* define an equilibrium in the first year macro courses (especially, Macroeconomic Theory II), and many of the models that you construct to answer interesting questions in macro cannot be solved by paper and pencil. We will carefully look at standard models which are extensively used in macro today in the lectures, and computational tools used for these models, and discuss the extensions of the basic models in the series of student presentations. At the same time, you will write baby codes for those standard model economies as your homework.

4 Course Prerequisites

1. Students need to have completed the first two sequences of Ph.D. macro courses (Macroeconomic Theory I and II).

2. Students need to have a basic knowledge in writing programs in one of the languages used for scientific computing (Fortran, C, Matlab, Gauss, Octave, etc.).

5 Course Requirements

There are three requirements to satisfactorily complete the course, all of which I believe help your career as an economist:

1. **Problem Sets (60% of the final grade):** I strongly believe the effect of learning-by-doing. You need to do by yourself to learn. Based on this belief, you will be given a problem set every week. Most (or all, possibly) of the problems are of computational nature, so basically you need to write your own programs every week. The problem sets are designed such that, when you finish the course, you will be familiar with writing basic codes for some of the most standard models currently used in macroeconomics. Naturally, you must have a prior knowledge in programming languages, or you are going to teach yourself the art of programming as you work on the homework. Please see the following section for more information on computation.

2. **Student Presentations (20% of the final grade):** Each of you are asked to make a 30 minutes presentation of a paper from the list distributed in the first class (or alternative suitable paper proposed by you). You should present the summary of the findings of the paper, make a critical evaluation of the paper, and comment on the computational methods employed in the paper. The presentations are in the last weeks of the course. You need to prepare and distribute a written summary of the paper at the time of the presentation.

3. **Original Research Proposal (20% of the final grade):** By the last day of the class, you need to submit a written proposal of an original project for which you can use the tools acquired in the course. I am more than happy to be of your help if you would like to keep working on it.

6 More on Computation

6.1 Hardware

All I can say is that it's enough if you have Pentium III or IV or Athlon XP or higher, to run programs for this course in a reasonable amount of time (assuming that your codes aren't insane).

6.2 Software

You need to be able to use one of programming languages. There are two groups. One group consists of Matlab, Gauss, and Octave. The other group consists of Fortran (90) and C(++) (of course you can use Pascal, Basic, or Java if you want).

Those in the first group are interpreters, and thus are equipped with better debuggers than the second group. They are more user-friendly, require less discipline in writing codes, and are equipped with powerful matrix manipulation commands and accessible numerical toolboxes. You can also draw graphs easily. The downside is the speed. Codes in Fortran and C are much faster than those written in Matlab or Gauss (I heard the same for Octave). Fortran and C have a long tradition, so there is a huge amount of numerical libraries available (many on the web), although you might need to dig a bit by yourself to find them. It's harder to draw graphs using Fortran or C, but you can output the results and use independent graphic softwares.

Among the first group, Gauss is the oldest and thus used to be popular, but Matlab is the most popular one right now. Octave is a new language but increasingly popular because it's free (although you can buy Matlab at a very low student discounted price of around $100). I used Matlab most extensively, but according to my experiences, all of the three are very similar in terms of the grammar and the user-friendliness.

Among the second group, I use extensively Fortran 90 and all the macro people around me use Fortran 90 as well. They are expensive (unless you use Linux and Intel Compilers) but hopefully the computers in the department are equipped with Fortran 90 or C. In addition, if you want to use Parallel computing in the future, you need to use Fortran 90 or C.

I heard that you have experiences with Matlab in Macroeconomic Theory II. You can complete all the problem sets using Matlab (or Gauss, or Octave). However, if you are considering to work in this area in the future, I recommend that you spend some time to pick up Fortran (or C). The initial investment might be huge, but the opportunity cost for the initial investment is cheapest for you now. Plus you will feel less constrained by the size of problems in the future, if you are using faster languages, which I am sure helps you.

7 Outline of the Course

From the next page.

1 Introduction

2 Representative Agent Model: Steady State

2.1 Model

Ljungqvist and Sargent (2004), Chapter 3, 4, and 5.

2.2 Computational Methods: Discretization

Ljungqvist and Sargent (2004), Chapter 3 and 4. Judd (1998), Chapter 12. Arouba et al. (2003).

3 Representative Agent Model: Transition

3.1 Computational Methods: Solving Sequence of Prices

Judd (1998), Chapter 16.

4 Ex-Post Heterogeneity & Complete Market

5 Ex-Post Heterogeneity & Self-Insurance: Steady-state

5.1 Model

Aiyagari (1994). Ljungqvist and Sargent (2004), Chapter 16 and 17.

5.2 Computational Methods: Approximation of Optimal Decision Rule

Judd (1998), Chapter 6. Press et al. (2001), Chapter 3. McGrattan (1999).

5.3 Computational Methods: Approximation of a Type Distribution of Agents

Ríos-Rull (1999).

5.4 Computational Methods: Solving a Non-Linear Equation

Judd (1998), Chapter 5. Press et al. (2001), Chapter 9.

6 Ex-Post Heterogeneity & Self-Insurance: Transition

Ríos-Rull (1999).

7 Overlapping Generations & Self-Insurance: Steady-State

Ljungqvist and Sargent (2004), Chapter 9.

8 Overlapping Generations & Self-Insurance: Transition

9 Overlapping Generations, Ex-Post Heterogeneity & Self-Insurance: Steady-State

9.1 Model

Huggett (1993). Ljungqvist and Sargent (2004), Chapter 9.

10 Overlapping Generations, Ex-Post Heterogeneity & Self-Insurance: Transition

10.1 Model

Heathcote et al. (2003). Conesa and Krueger (1999).

11 Calibration

Cooley and Prescott (1995). Gourinchas and Parker (2002). Cagetti (2003). Castañeda et al. (2003). Chatterjee et al. (2002).

11.1 Computational Methods: Approximation of a Continuous Shock Process by a Markov Process

Tauchen and Hussey (1991).

11.2 Computational Methods: Minimization

Judd (1998), Chapter 4. Press et al. (2001), Chapter 10.

12 Models with Aggregate Uncertainty

12.1 Model

Krusell and Smith (1998). Díaz-Giménez et al. (1992). Krusell and Smith (1997). Ríos-Rull (1996). Storesletten et al. (2001).

12.2 Computational Methods: Approximation of Forecasting Functions of Prices

Ríos-Rull (1999).

13 Models with Multiple Assets

14 Models

Diaz et al. (2003). Fernández-Villaverde and Krueger (2001). Aiyagari and Gertler (1991).

14.1 Computational Methods: Multidimensional Interpolation

Judd (1998), Chapter 6. Press et al. (2001), Chapter 3.

15 Models with Limited Enforceability

Ljungqvist and Sargent (2004), Chapter 20. Krueger and Perri (2001). Alvarez and Jermann (2000). Chatterjee et al. (2002).

16 Models with Informational Friction

17 Various Applications

Chang and Kim (2004). Huggett et al. (2004). Guvenen (2004). Domeji and Heathcote (2004). Haliassos and Michaelides (2003). Guvenen (2003). Meh and Quadrini (2004). Brundell, Pistaferri, and Preston (2003). Eckstein and Nagypál (2004). Kambourov and Manovskii (2004). Lee and Wolpin (2004). Michelacci and Quadrini (2004). Veracierto (2004). Yao and Zhang (2003).

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