BLM - Recursive Methods for Macroeconomics

Dr. Gianluca Violante

Course Information

The course meets for 10 weeks in the Autumn term, every Tuesday 2-5 pm in 24 Gordon Square, Room 105. My office hours are Monday 12:00-1:00 or by appointment. To contact me, you are advised to use my email <g.violante@ucl.ac.uk>, and if that fails, use phone 020-7679-5246. Some course material (syllabus, homeworks, lecture notes) will be posted on my website, www.ucl.ac.uk/~uctpgvi to be downloaded and printed in pdf format.

This is an advanced course in Macroeconomic Theory that concentrates on recursive methods used in modern macroeconomics and presents some of their applications. Recursive representations of macroeconomic models are useful because they are parsimonious and because they allow the computer to “understand” the model. The computer can then be used to solve for the equilibrium of the model. In this course you will also learn some numerical methods to solve for the equilibrium of two classes of economies (in GAUSS, MATLAB, Fortran, or the like).

The objective of the course is to teach you how to write a model economy in recursive form, define its equilibrium, compute it, and ask your model a quantitative question. This is not a course in which we suggest you interesting economic questions, however there are plenty of such courses on offer this and next term, and my course is complementary to those. Being an advanced course, we take as given the basic concepts of Arrow-Debreu general equilibrium theory and some standard concepts of macroeconomics.

The main textbooks for this part of the course are:

1. (C) Cooley, Thomas (editor), Frontiers of Business Cycle Research, Princeton University Press.
Course Outline

1 Dynamic Programming
We start by studying how to solve and characterize dynamic optimization problems in discrete time. We begin with the finite horizon case, we define the Bellman equation and we describe the backward induction algorithm. Then we move to the infinite horizon case for which we need to define some more mathematical concepts, such as the contraction mapping. We interpret the Bellman operator as a contraction mapping and show that the value function is the corresponding fixed point.

2. LS chapters 3-4.

We study the equivalence between three competitive equilibrium definitions (Arrow-Debreu, sequence of markets and recursive equilibrium) within the one-sector neoclassical growth model. Next, we show that the Planner’s problem can be used to find the equilibrium, thanks to the Welfare theorems.

1. LS, chapters 2, 3, 4, 7
4. Harris, Milton, Dynamic Economic Analysis, Oxford University Press, chapters 3-4

4 The Stochastic Growth Model: Calibration and Numerical Solution
We extend the notion of Recursive Competitive Equilibrium in a stochastic framework (i.e. with aggregate uncertainty), and use it to “calibrate” the growth model. Next, we learn some numerical tools to use the computer to find the equilibrium of the stochastic growth model.
5-6 Bewley Economies

We start by studying the problem of a household who faces a periodic income shock and makes the optimal consumption/saving decision subject to a borrowing constraint (the “income fluctuation” problem). Next, we study the equilibrium of whole economies where agents are ex-ante homogeneous, but are subject to idiosyncratic uninsurable shocks, so they become ex-post heterogeneous. Besides dynamic programming, the key tool to study these economies are Markov Chains, used to compute stationary distributions of various variables across agents in the economy. The novelty is that the solution of these problems involves not just variables, but whole distributions. Next, we study one method to solve for the equilibrium of heterogeneous agents economies with aggregate risk. The computational difficulty arises because the policy functions depend on distributions. So the question is: how can we meaningfully “approximate” distributions?


7 Politico-Economic Equilibrium

We study economies where heterogenous agents determine government policies, through some voting mechanism. The agents’ behaviour is rational and forward-looking, i.e. they vote over the politico-economic equilibrium they prefer.


**8-9 Overlapping Generations**

Economies with overlapping generations are useful environments to think about government debt, social security, money, fiscal policy, etc... In this section of the course we study the OLG model, starting from a pure exchange economy and moving swiftly towards a production economy. We will also learn how to compute stationary equilibria and transitional dynamics in deterministic OLG models.

1. **LS** chapter 8

2. ... to be determined

**10 Optimal Unemployment Insurance**

We study the problem of provision of an optimal unemployment compensation scheme faced by a government. This is an example of economies with “limited enforcement”, i.e. economies where contracts cannot be perfectly enforced, i.e. at any point in time the household is free to walk away from the contract, subject to some punishment. In the case of the unemployment insurance contract, the government can choose the amount of insurance to offer to the agent, but it cannot force him entirely towards the optimal job-search effort: the government faces a trade-off between giving insurance and giving incentives to search. The structure is that of a dynamic principal-agent problem.

1. **LS**, chapter 15
