This is the second half of ECON2149 “Computational Economics” at Harvard, co-taught with Jesus Fernández-Villaverde.

My part of the course will focus partly on substance and partly on tools. In terms of substance, we will be concerned with “distributional macroeconomics” by which I mean the study of macroeconomic questions in terms of distributions of microeconomic variables rather than just aggregates. Equivalently, we will be concerned with macroeconomic theories in which the relevant state variable is a distribution. We will first cover some theories aiming to explain why income and wealth are so unequally distributed and why inequality has increased over time in many developed countries, and then explore the implications of income and wealth heterogeneity for macroeconomic dynamics and macroeconomic policy. Finally (time permitting) we will think about the determinants of firm size distribution and the implications of firm heterogeneity for the macroeconomy. The models we cover have implications for both cross-sectional data and for time series behavior of an economy as a whole.

At the beginning of the course we will cover a number of analytical and computational tools, namely continuous time methods that are useful for macroeconomics, and in particular for the study of theories in which the relevant state variable is a distribution. These include Hamiltonians, Stochastic Calculus, Hamilton-Jacobi-Bellman equations, and Kolmogorov Forward Equations. Rather than presenting an in-depth technical derivation of the methods from first principles, my aim is to provide you with a “cookbook” for you to use these methods in your own research and then to cover a few applications.

All lecture slides will be available from my website http://www.princeton.edu/~moll/notes.htm. Codes for solving many of the models we will consider are available at http://www.princeton.edu/~moll/HACTproject.htm.

Organization: The class meets on Mondays and Tuesdays 10:00 to 11:30am. A syllabus is attached.

Grading: Homeworks will be voluntary/self-graded. Your final grade will be based on either a written research proposal or a take-home final. You can choose which you prefer:

- The take-home final will consist of a computational project that you will have to complete.
- The 10-page research proposal will consist of: a clearly defined question; motivation of why the question is economically interesting; a synthesis of relevant background literature focusing on the points most germane to the question at hand; a discussion of an appropriate model; preliminary results; and a discussion of next steps.
1. Deterministic Continuous Time Methods

1.A Methods:

Lecture Notes: Hamiltonians and Phase Diagrams

Acemoglu (2010), Chapter 7 “Review of the Theory of Optimal Control” in “Introduction to Modern Economic Growth”

1.B Applications:

Lecture Notes: Neoclassical Growth Model in Continuous Time

Acemoglu (2010), Chapter 8 “The Neoclassical Growth Model” in “Introduction to Modern Economic Growth”

Lecture Notes: “New Keynesian Model in Continuous Time” (useful for HANK papers in Section 3.D)


2. Stochastic Continuous Time Methods, Modeling Distributions

2.A Methods:

Lecture Notes: Stochastic Calculus, Hamilton-Jacobi-Bellman Equations, Kolmogorov Forward Equations, Finite Difference Methods

Codes for finite difference solution to HJB and KF equations: http://www.princeton.edu/~moll/HACTproject.htm


2.B Applications:


3. Income and Wealth Distribution in Macroeconomics

3.A. Prerequisites and Useful Background (Not Taught)


Nakamura and Steinsson (2018), “Identification in Macroeconomics” (particularly Section 3 on “Aggregate Versus Cross-Sectional Identification”)

3.B. Resources for numerical solution of discrete-time heterogeneous agent models (not taught)


Gianluca Violante’s lecture notes and codes:
Macroeconomic Theory I: https://sites.google.com/a/nyu.edu/glviolante/teaching/macrotheory
Quantitative Macroeconomics: https://sites.google.com/a/nyu.edu/glviolante/teaching/quantmacro15


3.C. Key Facts on Income and Wealth Distribution


3.D Theories of Income and Wealth Inequality


3.E Macroeconomic Implications of Income and Wealth Heterogeneity


Cloyne, Ferreira and Surico (2018) “Monetary Policy when Households have Debt: New Evidence on the Transmission Mechanism”

Ahn, Kaplan, Moll and Winberry (2018), “When Inequality Matters for Macro and Macro Matters for Inequality,” NBER Macroeconomics Annual


Reiter (2009b), “Approximate and Almost-Exact Aggregation in Dynamic Stochastic Heterogeneous-Agent Models”

3. F Inequality and Growth/Development


4. Firm Heterogeneity

4.A Methods: Stopping time problems

Stokey (2008), Chapter 6 “Exercising an Option” from “The Economics of Inaction: Stochastic Control Models with Fixed Costs”


4.B Theories of Firm Size Distribution


Khan and Thomas (2008), “Idiosyncratic shocks and the role of nonconvexities in plant and aggregate investment dynamics” Econometrica


5. Useful Advice on how to do Research


Also see other articles in CSWEP newsletters https://www.aeaweb.org/about-aea/committees/cswep/newsletters/archives and other CSWEP mentoring material https://www.aeaweb.org/about-aea/committees/cswep/mentoring/reading