Advanced Techniques in Macroeconomics I

2022-23 Academic Year
Master of Research in Economics, Finance and Management

1. Description of the subject

- Advanced Techniques in Macroeconomics I
- Total credits: 3 ECTS

Code: 31804
Workload: 75 hours
Term: 1st

- Type of subject: Optative
- Department of Economics and Business
- Teaching team: Davide Debortoli

2. Teaching guide

Objective

The main objective of this course is to introduce students to numerical techniques that are used to solve workhorse Macroeconomic models. We will first review the basics of numerical analysis (rootfinding, optimization, etc.) and then analyze common solution methods (local perturbation and discretization / value function iteration) and their applications (neoclassical growth, RBC, NK models). This course is meant to be taken in conjuction with Advanced Techniques in Macroeconomics II, for which this course constitutes a pre-requisite.

Contents

1. **Basics of numerical analysis.**
   Numerical differentiation and Integration. Rootfinding. Unconstrained and Constrained Optimization. Solution of Deterministic Models.
   Applications: The Diamond-Mortensen-Pissarides model.
   Deterministic Ramsey growth model.
   Portfolio Choices

2. **Perturbation Methods.**
   Linearization. Higher-order perturbation. Pruning. Dynare.
   Application: Medium-scale DSGE models.
   Models with Occasionally Binding Constraints.
   Optimal Monetary Policy models

3. **Discretization and Value Function Iteration**
   Discretization of stochastic processes. Value function and policy function iteration. Howard improvement. “Endogenous” grid method.
   Application: the Income Fluctuation problem.
   Models with Sovereign Default

Teaching methodology

Approach and general organization of the subject

The focus of the course will be on the numerical solution of macroeconomic models, as a complement to the theoretical aspects covered in other courses (e.g. Topics in Macroeconomics, International Economics, Topics in Corporate Finance). Previous knowledge of specific models is not required, as they will be described in class, or specific notes will be distributed. However, students should be familiar with general concepts of dynamic models, as taught for example in Macroeconomics or Advanced Macroeconomics courses.

For each topic covered, lectures will be divided into the following parts: (i) theoretical description of the numerical technique; (ii) application of the technique to a standard model; (iii) application of the technique to specific models (see list above).

This is not a course about computer languages. Students will have to learn how to write computer programs to implement the techniques discussed in class using whichever language they like (MATLAB, Fortran, C, Julia, Python, etc.). The programming language used in the course will be MATLAB. Basic knowledge of MATLAB (or another programming language) is highly recommended.

Training activities
Lectures, proposed readings, study and development of computer programs.

Assessment and Grading System

The grade of the course will be based on a series of homeworks, requiring to write computer programs to solve standard problems and models. Homeworks could be performed in small groups (max. 2 people, one solution per group).

Textbook and References

My slides are the main resource for this course. They will be regularly posted on Box.

Important references for the **numerical techniques** covered in class is the book

Miranda, M. J. and Fackler, P. L. (2002), *Applied Computational Economic and Finance*, MIT Press (henceforth MF).

Judd, K. L. (1998), *Numerical Methods in Economics*, MIT Press, Cambridge and London.

Sargent, T. and Stachurski, J. (2019), *Lectures in Quantitative Economics*, https://lectures.quantecon.org/.

Other references for **numerical methods for macroeconomic models** are

Aruoba, S. B., Fernandez-Villaverde, J., & Rubio-Ramirez, J. F. (2006). Comparing solution methods for dynamic equilibrium economies. *Journal of Economic dynamics and Control*, 30(12), 2477-2508.

Fernandez-Villaverde J. and J. Rubio Ramirez (2016), "Solution and Estimation Methods for DSGE Models", *Handbook of Macroeconomics,* Vol. 2.

Sims, C. A. (2001), "Solving linear rational expectations models", *Computational Economics* 20(1-2), 1-20.

References for specific **applications** are:

Arellano, C. (2008), "Default Risk and Income Fluctuations in Emerging Economies", American Economic Review, 98(3), 690-712.

Fernández-Villaverde, J. , G. Gordon, P. Guerrón-Quintana and J. Rubio-Ramírez (2015). "Nonlinear adventures at the zero lower bound," *Journal of Economic Dynamics and Control*, 57(C), 182-204.

Floden, Martin (2001), The Effectiveness of Government Debt and Transfers as Insurance, *Journal of Monetary Economics*.

Mortensen, D. and C. A. Pissarides, (1994) "Job Creation and Job Destruction in the Theory of Unemployment", *Review of Economic Studies*, vol. 61(3), 397-415.

Smets, F. and R. Wouters, (2007). "Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach", *American Economic Review*, American Economic Association, 97(3), 586-606.