Quantitative Economics

Fall 2023

University of Warsaw

Instructor: Piotr Żoch

Email: p.zoch@uw.edu.pl
Office Hours: by appointment

Course Description This course is an introduction to quantitative methods used in modern economics. We will focus mostly on tools, techniques and theories used by macroeconomists who study distributional issues. We will analyze consumption-savings problems, income dynamics and wealth inequality in partial and general equilibrium. To confront our models with the data we will solve them on a computer and compare their predictions with empirical regularities.

We will make extensive use of mathematics, numerical methods and computer programming. There is a heavy theoretical component: this course provides basic background in dynamic programming techniques (Bellman equation) frequently used in modern economics. We will also study economic theory related to consumption, savings, wealth and income distributions. There is also a heavy computational component: we will study numerical methods and learn to apply them in deterministic and stochastic settings.

We will use Julia, a modern, open source, high productivity language primarily used in technical and scientific computing. No prior knowledge of Julia is needed as a brief introduction to this language and example code will be provided.

Students who do not find such a quantitative, computational approach to economics appealing, are strongly advised against taking this course.

Outline

1. Introduction, programming in Julia.
2. Root-finding, optimization and interpolation.
3. Deterministic dynamic programming: consumption-savings problems, life cycle models.
4. Stochastic dynamic programming: precautionary savings, search models.

5. Numerical dynamic programming: endogenous grid method, projection methods.
6. General equilibrium: Bewley, Aiyagari, Huggett models.

Requirements

- Problem sets (x3) 50%
- Final project 40%
- Class participation 10%

There will be three problem sets. They will usually ask you to derive some theoretical results and/or implement some extensions of material covered in class on a computer and study their properties. If you wish, you may work on the assignments in groups of up to three students. Please turn in one assignment per student on Moodle, with all group members' names clearly indicated on the assignment. You can (and you are encouraged to do so) discuss your solutions with other students, even those outside of your group. You must credit the people with whom you have worked on the problem set. You will have two weeks for each problem set. You can also work in a different programming language, such as C, Fortran, Matlab, Python or R, if you are already proficient in it.

There will be also a final project, similar in style to problem sets, but longer and more difficult. Its details will be announced in the last week of classes. You will have three weeks to solve it. You are allowed to work on it in a group of up to three students.

Class attendance and participation will also be rewarded. Sometimes I will assign mandatory readings and you will be cold-called to give a short (5 minutes) summary of them at the beginning of class.

Materials There does not exist a single textbook for this course. We will mostly rely on materials posted here. I will also post journal articles. Textbooks which you might find useful to get better understanding of theoretical aspects of the course are:

- Stokey, Lucas and Prescott (1989) *Recursive Methods in Economic Dynamics*
- Ljungqvist and Sargent (2018) *Recursive Macroeconomic Theory*
- Sargent and Stachurski (2023) *Dynamic Programming Volume I: Foundations*
- Jappelli and Pistaferri (2017) *The Economics of Consumption*

This great book provides a gentle introduction to Julia:

- Kamiński (2023) *Julia for Data Analysis*

Extra resources related to computation in economics:

- QuantEcon: https://quantecon.org/. The most relevant lectures in the Julia module (https://julia.quantecon.org/intro.html) are Lectures 31-38 and 51.

- Heer and Maussner (2009) *Dynamic General Equilibrium Modeling*
- Miranda and Fackler (2002) *Applied Computational Economics and Finance*
- Judd (1998) *Numerical Methods in Economics*