INTRODUCTION

QUANTITATIVE ECONOMICS 2023

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COMPUTATION IN ECONOMICS

- Macro: dynamic general equilibrium models, heterogeneous agents, ...
- Micro: dynamic games, life-cycle models, industry dynamics, ...
- Econometrics: machine learning, non-standard estimators, large datasets, ...
- International/spatial: models with heterogeneous firms and countries, dynamic models of trade, spatial models, climate change, ...
- Finance: asset pricing, risk, non-arbitrage conditions, ...
- Economic history: large sets of non-standard information, library data, historical counterfactuals, ...

Computation helps, complements, and extends economic and econometric theory (Judd (1997)).

ABOUT THIS COURSE

Goal of the course:

- teach you (some) tools and techniques useful in modern (macro)economics (focus on recursive methods)
- exposure to heterogeneous agent macroeconomics (focus on households)

We will:

- formulate dynamic models
- use numerical methods to solve them on a computer

This course: an introduction to the above

Ideal outcome: apply what you learn here to write a cool thesis!

QUANTITATIVE (MACRO)ECONOMICS

Data-driven study that solves and estimates structural models using **computational** techniques.

- Question: measurement
- Answer: numbers
- Key piece: a structural model (theory of the (aggregate) economy)
- Use the model to get quantitative implications of the theory
- The model is calibrated along some dimensions and used to explain some other dimensions of the data
- The computer is used to solve for the equilibrium of the model and run computational experiments that answer the research question (and explain mechanism behind the result)

ROADMAP

1. Tools
   - Introduction to Julia
   - Numerical methods: root finding, optimization, interpolation
2. Techniques
   - Dynamic Programming: mathematical foundations
   - Numerical implementation of DP
   - Projection methods
3. Economics
   - Consumption-savings problems
   - Search models
   - General equilibrium: Aiyagari, Bewley, Huggett models

REQUIREMENTS

1. Problem sets (2-3) 50%
   - You may work on the assignments in groups of up to three students. One assignment per student on Moodle, with all group members' names clearly indicated on the assignment. Two weeks for each problem set.
2. Final project 40%
   - 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.
3. Class participation 10%
   - Class attendance and participation also rewarded. Sometimes mandatory readings, you will be cold-called to give a short (5 minutes) summary of them at the beginning of class.

SOFTWARE

- You are free to use any programming language you wish!
  - However, *all* my examples and code will be in Julia.
- I will teach you some basics of Julia, but it is practice that makes perfect
- Recommended introduction I: Julia Academy
- Recommended introduction II: QuantEcon
- Amazing book: Julia for Data Analysis
- Why Julia? What are the other options?

SOFTWARE

- Low-level languages: good performance (C, C++, Fortran)
- High-level languages: good productivity (Mathematica, Matlab, R, Python)
- Julia: good performance and productivity
  - Modern language
  - High performance and parallel
  - Easy to use
- In quant. macro you will mostly see Fortran, Matlab, Julia and Python
- Good to know more than one (+ something like R/Stata)