INTRODUCTION

QUANTITATIVE ECONOMICS 2024

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ABOUT THIS COURSE

- Goal of the course:
  - Teach you tools and techniques useful in modern economics.
  - Give you understanding of scientific computing.
  - Prepare you for work on quantitative projects.
- We will:
  - Learn how to write code in Julia.
  - Study elementary numerical methods.
  - Apply recursive methods to economic problems.
  - Solve and simulate economic models.
- This course: an introduction to the above.

COMPUTATION IN ECONOMICS

- Computational methods are used in many fields of 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, ...
- Judd (1997): "Computation helps, complements, and extends economic and econometric theory."

QUANTITATIVE 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
   - Recursive methods with discrete and continuous states
   - Projection methods
3. Economics
   - Consumption-savings problems
   - Search models
   - Heterogeneous agent models
   - Dynamic stochastic general equilibrium models

REQUIREMENTS

1. Problem sets (4) 50%
   - Up to three students per group. Two weeks for each problem set. Submit code and write-up via GitHub.
2. Final project 40%
   - Three weeks to solve it.
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.

LOGISTICS

- All class materials will be available on GitHub.
- Create a GitHub repo for your group. Send us the link to it.
- Your group composition must remain the same throughout the semester.
- Submit code and write-up via GitHub.
- Your code must be in Julia. It can be in a Jupyter or Pluto notebook or a Julia script. Your write-up must be in a PDF.
- We will not accept submission via email or other means.
- We will not accept late submissions (unless you have a good reason and let us know in advance).
- Your code must be reproducible. We need to be able to run it without any modifications (except for installing packages through `instantiate`).

SOFTWARE

- We 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 easy to parallelize.
  - Easy to use.
- In quant. economics you will mostly see Fortran, Matlab, Julia and Python.
- Good to know more than one (+ something like R/Stata).
- Once you know one, it is easy to learn another.