CENTER FOR
ECONOMIC
BEHAVIOR &
INEQUALITY

1. Introduction

Introduction to Programming and Numerical Analysis

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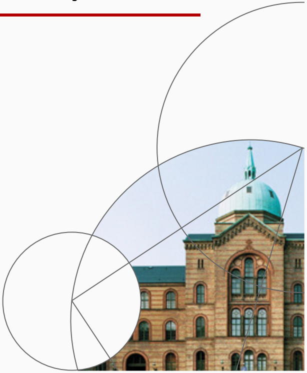

Plan

Introduction

Intended learning goals

- **In a nutshell:** *Learn how to use numerical analysis to improve your understanding of economic problems*
    1. Visualize solutions and simulations of well-known models
    2. Explore alternative assumptions regarding functional forms and calibrations of parameters
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- You will get **a better understanding of**
    1. economic theory itself
    2. how to empirically test economic theories
    3. scientific programming in itself
    4. collaboration on code projects

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- **High level:** Very few (if any) econ bachelor programs provide education on numerical analysis on the level you will get

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- **Programming is more than writing code:** Structuring, testing and documenting your code is a central aspect of this course

First Example

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- We work with **Python 3.7**
- **Suggested environment:**
  1. **Distribution:** Anaconda
  2. **Editor/IDE**: VSCode
- **I will show** how to
  1. Run Python in a Jupyter Notebook
  2. Solve the consumer problem

Course Plan

Course plan - lectures

1. Introduction
2. Fundamentals: Primitives
3. Fundamentals: Printing and Plotting
4. Fundamentals: Random Numbers and Simulation
5. Fundamentals: Workflow and Debugging
6. Working with Data: Load/Save and Structure Data
7. Working with Data: Basic Data Analysis
8. Supervision on data project
9. Algorithms: Searching and Sorting
10. Algorithms: Solving Equations (Numerically and Symbolically)
11. Algorithms: Numerical Optimization
12. Further Perspectives: The Need for Speed
    + supervision on model project
13. Further Perspectives: R and MATLAB
14. Further Perspectives: Julia

Course plan - classes

1. DataCamp
2. DataCamp
3. DataCamp
4. Problem Set 1: Solving the Consumer Problem
5. Problem Set 2: Finding the Walras Equilibrium in a Multi-Agent Economy
6. Problem Set 3: Loading and Combining Data from Denmark Statistics
7. Problem Set 4: Analyzing Data form Denmark Statistic
8. Work on your data project
9. Problem Set 5: Writing Your Own Searching and Sorting Algorithms
10. Problem Set 6: Solving the Solow Model
    $+$ feedback on data analysis project
11. Problem Set 7: Solving the Consumer Problem with Income Risk
12. Problem Set 8: Comperehension, Vectorization and Numba
13. Work on your model analysis project
14. Feedback on model project

Infrastructure

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  2. Data analysis project
  3. 2x useful peer feedback on data analysis projects
  4. Model analysis project
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- **Groups:** All projects can be done in *fixed* groups (maximum of 3)

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- **Repositories:**
  1. **lectures-2019**: slides, course plan, guides etc.
  2. **exercises-2019:** problem sets, solutions etc.
  3. **projects-2019-YOURGROUPNAME**: your own repository
  4. **NumEcon:** Python package
- **Note:** Everything will be public

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- **In between classes and lectures:** *No curriculum to read!*
  $\Rightarrow$ spend your time on solving the problem sets
  $+$ experimenting with your own ideas

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- **Everybody often forgets the correct syntax** ⇒ trial-and-error and testing is central, never a single correct approach

Projects

Basic programming test

- **You must complete the following courses on DataCamp**
    1. Intro to Python for Data Science
    2. Intermediate Python for Data Science
    3. Python Data Science Toolbox (Part 1)
    4. Python Data Science Toolbox (Part 2)
- **First 3 classes:** Reserved for your work on DataCamp

Data analysis project

- **Objectives:**
  1. Apply data analysis methods
  2. Structure code project
  3. Document code
  4. Present results
- **Content:**
  1. Import data from an online source
  2. Present the data visually (and perhaps interactively)
  3. Apply some method(s) from descriptive economics (»samfundsbeskrivelse«)
- **Structure:**
  1. A self-contained single notebook presenting the analysis
  2. Fully documented python files
- **Hand-in:** Create and commit folder called "data_analysis_project" in your GitHub repository

Model analysis project

- **Objectives:**
  1. Apply model analysis methods
  2. Structure code project
  3. Document code
  4. Present results
- **Content:**
  1. Description of algorithm to solve simple economic model
  2. Solution (and perhaps simulation) of simple economic model
  3. Visualization of results across e.g. parametrization
  4. Analysis of extensions of the baseline model
- **Structure:**
  1. A self-contained single notebook presenting the analysis
  2. Fully documented python files
- **Hand-in:** Create and commit folder called "model_analysis_project" in your GitHub repository

More Examples

More Examples

- **I will show** how to
  1. Simulate the AS-AD model
  2. Write modules in VSCode
  3. Run python code in VSCode

Summing Up

Summing up

- **I hope your have:**
    1. An idea of why learning numerical analysis is important
    2. What you will learn in this course
    3. How you will learn it by working actively
    4. How you will qualify for and pass the exam
- **Examples:** Can be accessed online through **binder** without installing Python

Your to-do list

1. **First priority:** Login to DataCamp (see info in e-mail)
2. **Second priority:**
   2.1 Install **Anaconda with VSCode**
   2.2 Open a **Jupyter Notebook** and experiment
3. **Third priority:**
   3.1 Create **GitHub account**
   3.2 Clone **exercises-2019** and **lectures-2019**
   3.3 **Create/join group** here

- **Next time:** Fundamental introduction to Python