Ph.D. Course on

"Numerical Methods in Economics"

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Aims and scope

- Numerical methods designed to solve highly non-linear **systems of functional equations** are nowadays essential elements in the macroeconomist's toolbox.
- This short course will introduce the main topics from both a **theoretical** and **practical** point of view.
- At the end of the course, the students will (hopefully) be able to understand and use a **MATLAB toolbox** based on the algorithms discussed in the course.

Course outline

- Introduction: overview of non-linear solution methods and their applications to quantitative macroeconomics.
- **The basic toolbox**: how to efficiently solve linear and non-linear system of equations, calculate derivatives and integrals, and so on …
- Topics in **Approximation Theory**.
- An introduction to **Projection Methods**, with a particular emphasis on spectral methods.
- A brief introduction to **Dynare**.
- Some examples and their implementation in **MATLAB**.

An overview of solution methods

- **Local methods:**
  - *First-order methods*
    - **Value function iteration** with linear-quadratic approximation of objective function.
    - **Log-linearization** of equilibrium conditions.
  - *Second-order (and higher) methods*
    - **Perturbation** of equilibrium conditions: quadratic approximation of policy function.

- **Global methods:**
  - **Numerical dynamic programming**: value function/ policy function iteration with discretization of state space.
  - Minimum weighted residual methods, or **projection methods**:
    - *Finite-element methods*: approximation of policy function or value function with splines.
    - *Spectral methods*: approximation with polynomials.
  - **Parameterized expectations**.
  - In this course, we will mainly focus on projection methods (in particular spectral methods) and value function/policy function iteration.