Computational Economics

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Computational Economics

- The aim of the course «Econ 407: Computational Economics» is to provide students with a general overview of MATLAB and how it can be used to solve problems in economics.
- Specifically we are going to see applications in optimization and simulating model dynamics.

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Introduction to Matlab Fundamentals

This session will cover the basis of MATLAB and its language.

Introduction.

Basic operations in MATLAB.

Arrays and Matrices.

Relational and Logical Operators.

Control Flow.

Generating random numbers.

Data analysis. Plotting

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Computational economics course blends economics with the numerical techniques required for solution of the problems, providing explained codes.

It is precise and concise, meaning that it balances theory and practice.

The course provides and explains, with detail, the MATLAB implementation of the algorithms.

The intuition and central ideas of the numerical methods required to deal with the mathematical theory underlying the economic problem are pedagogically provided.

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The topics covered also prepare the reader to undertake more complex models and/or to develop new research.

They give **economic readers** the skills needed to understand the essentials about numerical methods to solve economic problems, and provide more **technical readers** with an easy way to cope with economics through modelling and simulation.

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The main ingredients of the course are seminal economic models, relevant and efficient numerical methods and (explained) software solutions.

The aim behind this choice is twofold.

First, the course should be suitable for those who do not have skills in either economics or in scientific programming.

Second, the course should be instructive, providing the basics and skills to deal with this multi disciplinary topic.

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Economic models: A set of microeconomic and macroeconomic models were selected to be included in this course.

The topics on microeconomic models start by examining how the behaviour of individual agents affect the supply and/or demand for goods and services, which determines prices, and how prices, in turn, determine the quantity supplied and/or quantity demanded of goods and services.

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The proposed models meet exactly this outline, by first considering a static **supply–demand model**, which is extended to consider

international trade policy, in the context of comparative advantage and opprtunity cost framework,

and then a dynamic **cobweb model** that represents agricultural markets. The cobweb model is based on a time lag between supply and demand decisions.

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In this sequence, afterwards a dynamic **duopoly game model**, through which firms compete by quantities, is analysed.

There are different ways of modelling oligopolies, depending on the way firms interact in the market. These approaches are as follows.

Firms choose quantity and then price adjusts so that demand equals supply – these are the ***Cournot* and *Stackelberg* models**;

Firms choose the prices and then consumers choose from which firm to buy – this is the ***Bertrand* model**.

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As it is common in industrial organisation literature, to understand the Nash equilibrium of the above models, this part focuses on the duopoly case, in which the market has only two firms, and the aim is to analyse the market equilibria.

It starts with a simple static case and then a dynamic interpretation is considered, using a discrete time formulation – simultaneous difference systems.

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Finally, to accommodate optimisation problems, an **optimal portfolio model** resulting from the setup originally proposed by Markowitz is presented and solved using different approaches.

The portfolio optimisation model, intends to select the proportions of various assets to be included in a portfolio which, according to certain criteria is the best solution. The criteria combine considerations of the portfolio's expected return and of the return's dispersion.

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The main idea behind this model is thus the need to diversify in investing, with the aim of choosing a set of assets that has collectively the highest expected return for a defined level of risk or, alternatively, the lowest risk for a given level of expected return, resulting clearly that the investor should ‘not put all eggs in one basket’.

MATLAB is used to gain important insights on how to develop an effective computational procedure to determine efficient portfolios.

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Regarding the short run stability of the macroeconomic models, the classical fixed price **IS–LM model**, in closed economy and then **Mundell-Fleming Model** open economy framework, is presented.

Then the flexible prices and the determinants of inflation is covered by aggregate demand and aggregate supply model: **AD-AS Model**.

Following on from the former models, the AD curve from the IS–LM model is introduced along with the short- and long-run AS curve.

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The ***SP–DG model****, Short-run expectations augmented Phillips–Demand Growth*, is a macroeconomic framework used to analyse the dynamics of inflation and output gap in three different cases:

disinflation strategies,

permanent demand shocks and

temporary supply shocks.

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For the long-run macroeconomic growth models, finally neo classical **Solow Model** is presented. In this part solution methods of differential equations methods especially Runge-Kutta method is shown.

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For the numerical implementation of the economic models as well as of the numerical methods, MATLAB is used.

Our choice was primarily based on their adequacy for the purposes of the course, mainly due to ease of code writing, availability of a plethora of functions programmed on state-of-the-art methods, nice and rich plotting capabilities and ease of debugging.