# 15D019

# Economic Methods for Data Science

**Fall Term - 3 ECTS**

**Mandatory Course**

**Prof. Nandan Rao**

**Prof. Caterina Calsamiglia**

## Prerequisites to Enroll

Not applicable.

## Overview and Objectives

The objective of this course is to bring students into contact with a broad spectrum of traditional and modern topics at the boundary between economic theory and data science. Students will be prompted to think of novel ways of combining ideas from both fields to develop or improve research projects and business applications.

## Prerequisite reading

There is no prerequisite reading for this course.

## Course Outline

The first part of the course will focus on causal inference. We will consider randomized control trials and the history of statistical inference and think critically about the act of moving from experiments to decision making. Students will be taught about: structural causal models, DAG representations of causal systems, causal graph recovery from data, transportability, potential outcomes, matching, propensity scores, instrumental variables, and heterogeneous effect recovery.

The second part of the course will cover fairness of recommender systems (diagnosis and potential solutions) and manipulability of AI algorithms, where we will see examples of manipulability with simple and well understood algorithms. Students will be taught to consider real-world applications of machine-learning algorithms, learn techniques to identify potential problems, and become familiar with modern solutions to overcome them.

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## Required Activities

In-class discussions, readings, and completion of individual and group projects.

## Evaluation

Individual and group Projects (100%)

## Competences

☒ Modeling and predicting high-dimensional data with advanced statistical methods in the field of data science in order to improve strategic decision making.

☒ Solve the real problems that arise in the fields of study through the accurate analysis of the data.

☒ Communicate with conviction in English the results and implications of the required analytical study using a language related to the receiver.

☒ Work in a heterogeneous team of researchers in the field of the economic analyst using specific group techniques.

☒ Own and understand knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, often in a research context.

☒ That students know how to apply the acquired knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.

☒ That the students be able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, include reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.

☒ That the students know to communicate their conclusions and the knowledge and last reasons that sustain them to specialized and non-specialized publics in a clear and unambiguous way.

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☒ That students have the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

## Learning Outcomes

☒ Make decisions based on the fundamentals of the markets and the behavior of public agents.

☒ Apply mathematical and statistical analysis using economic theory in complex problems with high-dimensional data.

☒ Apply mathematical theory and statistics on data sets from disparate disciplines.

## Materials

Counterfactuals and Causal Inference: Methods and Principles for Social Research. Second Edition. Stephen L. Morgan and Christopher Winship. Cambridge University Press 2015.

Additional articles and lecture notes to be provided by the professors.