21BDM01 An intermediate course in mathematics and statistics

Brush-up Course

0 ECTS

Overview and Objectives

This course provides students with the fundamental mathematical and programming tools needed to follow the Master of Data Science for Decision Making. Everything taught in this subject will be used in later courses. The program has three different pillars: Mathematics, Statistics and Probability, and Programming.

We will program in R, Python, and Stata. Students will learn to work in the three programs.

Course Outline

Algebra

- Definition of matrix, types of matrices.
- Operations with matrices.
- Determinants and regular matrices. Linear combinations.
- Rank of a matrix.
- Characteristic polynomial and eigenvalues of a matrix.
- Understanding matrix notation and matrix algebra.

Analysis

- Definition of a function.
- Sequences and the concept of convergence.
- Derivatives and integrals.
- Taylor's theorem.

Statistics and probability

- Basic definitions and moments. Discrete and continuous distributions.
- Models and data. Likelihood function. Maximum likelihood.
- Expectations: definition, properties, condition expectations and generating functions.
- Confidence intervals and hypothesis testing. Types of errors. Neyman-Pearson Lemma.
- Asymptotic theory.
- Monte Carlo and bootstrap simulations.
- Markov Chains.

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Programming

- Introduction to programming. Installing the software and syntax.
- Introduction to Stata, R and Python. Which one should I use?
- Looking for help.
- Basic functions and definition of objects. Installing packages.
- Visualizing data and working with databases.
- Loops.
- Functions.

Required Activities

- Daily homework.
- Exam.

Evaluation

You need a pass grade in an exam that will be given to you at the end each brush up course.

If you fail this exam you need to retake it within 5 days from the first one. We encourage you to hire a tutor to prepare you best for this retake. We can make suggestions for a tutor but we will not cover the cost of tutoring. In order to be able to follow satisfactorily the rest of the program a pass mark in these exams is a must and we need to make sure that you have reached the necessary level before the program starts. The point of the courses and the exams is to make sure we have helped you to reach the necessary level before the real program starts.