

40972 - Probability Theory II

PhD in Statistics & Computer Science - Bocconi University

A.Y. 2026-2027

Instructor: Antonio Lijoi

Course Description.

The course will cover some fundamental topics in Probability Theory, with a special focus on the theory of weak convergence, characteristic functions and central limit theorems, conditional expectations and probabilities.

Course Syllabus

- Convergence of distributions. Weak convergence in metric spaces. The portmanteau theorem. Other criteria for weak convergence.
- Glivenko-Cantelli type theorems. Uniform laws of large numbers.
- Metrics for convergence.
- Relative compactness and tightness. Prokhorov's theorem.
- The space $C[0,1]$. Donsker's theorem.
- Characteristic functions, inversion formulae, Lévy's continuity theorem
- Central limit theorems: independent and identically distributed summands, Lindeberg's and Lyapunov's theorems
- Infinitely divisible distributions
- Conditional expectation, regular conditional probabilities, conditional independence

Textbooks

P. Billingsley (1999). *Convergence of Probability Measures*. Wiley, New York.

R. Dudley (2002). *Real Analysis and Probability*. Cambridge University Press.

Instructor's lecture notes will be uploaded on Blackboard.

Exam

Written test.