UNIVERSITÀ CATTOLICA del Sacro Cuore

Advanced calculus and stochastic processes

PROF. FAUSTO MIGNANEGO

Course aims and intended learning outcomes

The aim of the course is to prepare students in using Martingales and Markov Chains, Linear Differential Equations and Laplace Transforms for financial and actuarial applications.

Course content

FIRST PART

- Definition of Integral depending on parameters and Laplace Transform.
- Definition of antitransform, use of antitransform in simple cases.
- Definition of linear differential equations of order n, with constat coefficients.
- Solutions of linear diff. equations by characteristic polynomial and / or Laplace Transforms.
- Power series: convergence intervals, uniform convergence intervals.
- Necessary and sufficient conditions for convergence.

SECOND PART

- Definitions of sigma-algebras and filtrations, definitions of probability conditioned by a filtration.
- Definition of measurable stochastic precess with respect to a filtration and definition of martigale.
- Definition of predictive stochastic processes, and of stopping time random variables.
- Definition of Brownian Motion use of M.B. as a martingale, applications to finance.
- Definition of Poisson processes.
- Use of previous tools in simple examples.
- Definition of Markov Chain with finite parameters, transition matrices, transient and recurrent states.
- Definition of closed classes of states and irreducible chains.
- Stationary probability vectors and absorbing probabilities.

Assessment method

Tests are essentially written. Mid-term tests are given.

Oral exams are possible on request.

Students that want to improve examinations marks can give short seminars on subjects provided by the syllabus.