
Advanced Mathematics for Statistics

Probability Theory

A.Y. 2021/22

Stefano Pagliarani

Course schedule

Lectures will take place, in presence, every Thursday from October 14th to December 16th, in the hours 9.00-11.00 and 13:15-15:15.

One additional lecture will take place on Friday, December 10th, from 09:00 to 11:00.

- Thu 14/10: Review of limit theorems: Laws of Large Numbers and Central Limit Theorems. Monte Carlo simulation.
- Thu 21/10: Homeworks/mini-seminars.
Conditional expectation of a random variable and conditional distribution.
- Thu 28/10: Homeworks/mini-seminars.
Stochastic processes: general definitions, filtrations, martingales, stopping times
- Thu 04/11: Homeworks/mini-seminars.
Homogeneous Markov chains in discrete time: Markov property and transition matrix. Canonical representations.
- Thu 11/11: Homeworks/mini-seminars.
Communication, irreducibility and periods. Stationarity.
- Thu 18/11: Homeworks/mini-seminars.
Time reversibility. Strong Markov property and regeneration.
- Thu 25/11: Homeworks/mini-seminars.
Recurrence and invariant measures. Stationary distribution and positive recurrence. Ergodic theorem.
- Thu 02/12: Homeworks/mini-seminars.
Convergence to steady state. Renewal equation and renewal theorem. Time to absorption and probability of absorption.
- Thu 09/12: Homeworks/mini-seminars.
Generalities on continuous-time stochastic processes. Poisson process. Continuous time Markov chains: transition semigroup, infinitesimal generator.
- Fri 10/12: Continuous time Markov chains: Kolmogorov equations, stationary distributions, Ergodic theorem.
- Thu 16/12: Homeworks/mini-seminars.
Diffusion processes.

References

- [1] Bass, R.F., *Stochastic processes*. Vol. 33. Cambridge University Press, 2011.
- [2] Brémaud, P., *Markov chains*. Springer, 1999.
- [3] Pagliarani, S., *Lecture notes*. Padova, 2021.