Advanced Mathematics for Statistics
Probability Theory
A.A. 2023 / 2024
Athena Picarelli

Course schedule

November 2023

1. Friday 3 (4 hours, 14.30-18.30).
   Basics on probability spaces and random variables.

2. Friday 10 (3 hours, 14.30-17.30).
   Independence of random variables. Conditional distribution and expectations.

3. Friday 17 (4 hours, 14.30-18.30).
   Characteristic and moment generating functions (Ch.3,4 [Sev]). Functions of random variables (Ch.7 [Sev]).

4. Friday 24 (4 hours, 14.30-18.30).
   Applications (order statistics and martingales, Ch.2,7 [Sev], Ch 7 [Gut]) and exercises.

December 2023

5. Friday 1 (3 hours, 14.30-17.30).
   Normal distribution theory (Ch.5 [Gut], Ch.8 [Sev])

6. Thursday 7 (3 hours, 9.30-12.30).
   Convergence of random variables (Ch.6 [Gut], Ch.11 [Sev]);

7. Thursday 14 (3 hours, 9.30-12.30).
   The Law of Large Numbers.

8. Thursday 21 (3 hours, 9.30-12.30).
   The Central Limit Theorem (Ch.6 [Gut], Ch.12 [Sev]);

January 2024

9. Thursday 11 (4 hours, 9.00-13.00).
   Stochastic processes: general definitions, filtrations, martingales, stopping times.

10. Monday 15 (4 hours, 9.00-13.00).
    Discrete time Markov processes: Markov property and transition matrix. Canonical representations. MC methods (Ch. 4 [Bre])

11. Thursday 18 (4 hours, 9.00-13.00).
    Stochastic processes in continuous time: Poisson processes and continuous time Markov models (Ch. 8 [Bre]);

12. Monday 22 (3 hours, 9.30-12.30).
Exercises.

Bibliography

[**Sev**] T.A. Severini, Elements of distribution theory, Cambridge University Press, 2005.

[**Gut**] A. Gut, An intermediate course in probability, Springer Verlag, 1995.

[**Bre**] P. Bremaud, Markov chains, Gibbs fields, Monte Carlo simulation and queues, Springer Verlag, 1998.