

Statistics I & Statistics II

Naples Ph.D. in Economics

Winter 2023 (Term 3) and Spring 2023 (Term 4)

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1 Overview

Description. Statistics I & Statistics II together provide a graduate-level (albeit short and fast-paced) introduction to Probability Theory, Mathematical Statistics, and Stochastic Processes. I will try to make the course useful both for students interested in Economic Theory and for students interested in Econometrics. How we will split the material in the syllabus (see Section 4) across Terms 3 and 4 depends on how fast we progress throughout the course.

Prerequisites. Basic knowledge of Mathematical Analysis, Topology, Linear Algebra, Matrix Analysis, Probability, and Statistics.

2 Course Material

Lecture Notes will be provided. You will be responsible only for the material in the Lecture Notes and the mandatory readings the Lecture Notes explicitly refer to. However, studying good textbooks (see Section 5 for suggestions) improves one's understanding of the subject. The Lecture Notes will also contain references to relevant (non-mandatory) additional readings.

3 Evaluation

Besides studying the Lecture Notes, to understand the material of this course (and, for that matter, to succeed in this course), you need to re-do and complete the proofs made in class and solve the assigned (and, if you like, more) problems.

- Statistics I: Problem Sets (50%) and Final Exam (50%).
- Statistics II: Problem Sets (50%) and Final Exam (50%).

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4 Detailed Syllabus

The plan below is ambitious and only indicative. We will have to skip (or only treat briefly) some topics.

Probability Theory

1. σ -Algebras and Probability Measures
2. Random Variables and Distributions
3. Independence
4. Integration, Mathematical Expectation, and Convergence Theorems
5. Characteristic Functions
6. Conditional Expectation
7. Discrete and Continuous Random Variables
8. Common Distributions
9. Convergence of Random Variables
10. Laws of Large Numbers
11. Central Limit Theorems
12. Probabilistic Inequalities
13. Information Theory

Mathematical Statistics

14. Models, Statistical Inference, Learning, and the Two Cultures of Statistical Modeling
15. Populations and Sampling
16. Identification
17. Extremum, Maximum Likelihood, and Method of Moments Estimation
18. Hypothesis Testing
19. Confidence Intervals
20. Estimating the CDF and Statistical Functionals
21. Non-Parametric Curve Estimation
22. Bayesian Statistics
23. Statistical Decision Theory

Stochastic Processes

24. Introduction to Stochastic Processes
25. Markov Chains
26. Point Processes
27. Stationary Processes
28. Renewal Processes
29. Martingales
30. Diffusion Processes

5 References

There is a lot of overlap between these books, but you will develop strong opinions if you spend much time with them.

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