

# Course Description

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**Office Hours** Via teams on request or Room P2-S58: Tuesday  
11:00-13.30 and 16:00-17:30 I will always be available

**Teaching Assistant** Giacomo Caserta  
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**Course Website** <http://www.economia.uniroma2.it/>

## MEZZETTI-8010848-STATISTICS 2024-2025



The course is designed to provide an in-depth knowledge of the main aspects of statistical inference (point estimation and hypothesis testing), both from a conceptual and a technical point of view. Optimality principles are discussed for the main procedures, based on the properties of estimators and on the likelihood principle. The implications of such concepts are analyzed both within the finite sample case and in the asymptotic setting. Principles and techniques discussed in the course are fundamental to the development and analysis of statistical models in econometrics.

The course is an introduction to the fundamental principles and tools of statistical inference, i.e. how to draw conclusions from data subject to random variation. Topics include: random sampling; principles of data reduction; point estimation; hypothesis testing; confidence intervals.

In Particular:

- Brief review of probability
- Random samples and asymptotic methods
  - Sampling and sums of random variables
  - Laws of large numbers and central limit theorem
- Principles of Data Reduction: Sufficiency
- The Likelihood Principle: the Likelihood Function.

- Point Estimation
  - Methods of Finding Estimators: Methods of Moments, Maximum Likelihood Estimators.
  - Finite Sample Properties: Unbiasedness and Efficiency.
  - Asymptotic Properties: Asymptotic Unbiasedness, Consistency and Efficiency.
  - Fisher Information and the Cramer-Rao theorem.
- Hypothesis Testing
  - Methods of Finding Tests: Neyman Pearson lemma
  - Large sample tests: Likelihood Ratio Tests, Score Test, Wald Test
  - Methods of Evaluating Tests: the Power Function, Most Powerful Tests.
  - The p-value.
- Special topics (if time permits)
  - Robustness
  - Notes on Bayesian Inference
  - Non Parametric Inference: Kolmogorov-Smirnov Test

# Course Materials: Text Book

**Required:** G. Casella, R.L. Berger. Statistical inference. Cengage Learning, 2021.

**Suggested:**

- K. Knight. Mathematical statistics. Chapman Hall/CRC (2000).
- N. Mukhopadhyay. Probability and Statistical Inference, Dekker-CRC Press (2000).

**Introductory readings:**

- T. H. Wonnacott and R. J. Wonnacott. Statistics: Discovering Its Power. John Wiley Sons; International Ed edition (1982).
- A. Mood, F. Graybill and D. Boes. Introduction to the theory of statistics, McGraw-Hill (1974).

- <http://www.economia.uniroma2.it/>
- You can find
  - Lecture slides
  - Exercises suggested
  - Past Exams
  - Tutorials slides

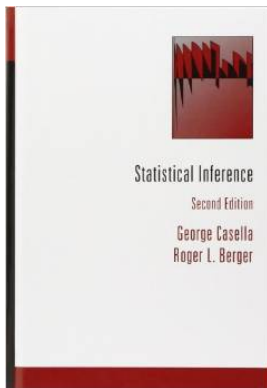
Strongly suggested: JOIN THE COURSE MAILING LIST



- SLIDES are always posted in advanced
- Section: HOMEWORKS: Every week exercised will be posted: STRONGLY encouraged to SOLVE in advance (No grading)

Strongly Suggested to use the book to prepare the exam, website materials consist only on notes, that cannot replace the book!

Casella\_Berger\_Statistical\_Inference.pdf



- Some exercises will be solved using Matlab (the use during class is encouraged)

# Detailed Program

## September

Monday	16th	9-11	Course Introduction and Brief review of probability
Tuesday	17th	9-11	Property of Random Sample
Wednesday	18th	9-11	Property of Random Sample
Monday	23rd	9-11	Exercise Matlab: Random Sample
Tuesday	34th	9-11	Introduction to Inference and Sufficiency
Wednesday	25th	9-11	Inference and Point Estimation
Thursday	26th	9-11	Tutorials
Monday	30th	9-11	Methods of Evaluating Estimators

## October

Tuesday	1st	9-11	MOM Maximum Likelihood Estimators
Wednesday	2nd	9-11	Maximum Likelihood Estimators
Thursday	3rd	9-11	Tutorials
Monday	7th	9-11	Fisher Information and Cramér-Rao Bound
Tuesday	8th	9-11	Comparison among estimators and optimality results
Wednesday	9th	9-11	Exercises on point estimation
Thursday	10th	9-11	Tutorials
Monday	14th	9-11	Confidence Intervals
Tuesday	15th	9-11	Hypothesis Testing: Methods of Finding Tests
Wednesday	16th	9-11	Neyman-Pearson Lemma
Thursday	17th	9-11	Tutorials
Monday	21th	9-11	Large-Sample Inference
Tuesday	22nd	9-11	Review of all the theory
Wednesday	23rd	9-11	Simulation of Exam
Thursday	24th	9-11	Tutorials

- **Final Exam** will be written, will consist on exercises and open-ended questions on theory, covering all the program. Score will up to 30. *Only in the winter Session:* maximum 2 points can be added solving one/two homework assignments and/or by taking a surprise multiple choice test during the class.
- **In case of Covid Emergence** Exam will be online and an oral exam is required
- **Assignments**
  - ① Due October 9th
  - ② Due October 23rd

There are no different assessment method/exam program between attending and non attending students, but attendance is strongly recommended.

In MaterialeDidattico/PastExams you can find some examples of past exam, NOTICE: the more recent the test, the higher the probability that the difficulty level matches those of future tests.

- In order to take an exam, students **MUST** register on-line via the web-site <http://delphi.uniroma2.it>. Students who are not registered for the scheduled exam are not admitted to the exam.
- Grades cannot be "frozen" by postponing registration to a future exam date: **BELATED REGISTRATION OF GRADES IS NOT ALLOWED!**
- In the case of failure the failing grade will not be recorded and on the DELPHI system you will read *ritirato* - withdrawn
- Bargaining on grading is not allowed.

# Zero tolerance policy in relation to cheating in examinations.

- Any act of academic dishonesty will result in a failing grade. This failing grade may be registered in the student's record, implying that it will affect the grade point average. Some examples of academic dishonesty include (but are not limited to!!!):
  - ① use of textbooks, classnotes or any other unauthorized materials during the exam;
  - ② access unauthorized computing and communication devices during the exam (mobile phones, smartwatches etc...);
  - ③ collaboration and communication with other students during the exam;
  - ④ looking at other student's papers during the exam;
  - ⑤ taking the exam for someone else or having someone take the exam for you;
  - ⑥ obtaining exam questions in advance through illicit means, etc...
- Please notice that *ignorance of the law does not excuse*.



# The Importance of Office Hours



# Advices for Students:

- **Don't Get Lost** Ask questions in class. If something isn't clear to you, it probably isn't clear to others either. Most questions arise because the instructor hasn't made a connection clear or has inadvertently left out an important point. Your question gives the instructor a chance to explain more clearly.
- If you have difficulty with problems, ask for help from the instructor or a TA. Don't wait until just before the exam (or worse just after) to ask for help. By then it may be too late.
- **Office Hours** They are there for your benefit, take advantages!