# Statistical theory

**Dehaene Guillaume**

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## Summary

The course aims to develop certain key aspects of the theory of statistics, providing a common general framework for statistical methodology. While the main emphasis will be on the mathematical aspects of statistics, an effort will be made to balance rigor and relevance to statistical practice.

## Content

- Stochastic convergence and its use in statistics: modes of convergence, weak law of large numbers, central limit theorem
- Formalization of a statistical problem: parameters, models, parametrizations, sufficiency, ancillarity, completeness
- Point estimation: methods of estimation, bias, variance, relative efficiency
- Likelihood theory: the likelihood principle, asymptotic properties, misspecification of models, the Bayesian perspective
- Optimality: decision theory, minimum variance unbiased estimation, Cramér-Rao lower bound, efficiency, robustness
- Testing and Confidence Regions: Neyman-Pearson setup, likelihood ratio tests, UMP tests, duality with confidence intervals, confidence regions, large sample theory, goodness-of-fit testing

## Learning Prerequisites

**Recommended courses**

- Real Analysis
- Linear Algebra
- Probability
- Statistics

## Learning Outcomes

By the end of the course, the student must be able to:

- Formulate the various elements of a statistical problem rigorously.
- Formalize the performance of statistical procedures through probability theory.
- Systematize broad classes of probability models and their structural relation to inference.
- Construct efficient statistical procedures for point/interval estimation and testing in classical contexts.
- Derive certain exact (finite sample) properties of fundamental statistical procedures.
- Derive certain asymptotic (large sample) properties of fundamental statistical procedures.
- Formulate fundamental limitations and uncertainty principles of statistical theory.
• Prove certain fundamental structural and optimality theorems of statistics.

Teaching methods
Lecture ex cathedra, exercises in class, homework

Assessment methods
Written exam
Dans le cas de l’art. 3 al. 5 du Règlement de section, l’enseignant décide de la forme de l’examen qu’il communique aux étudiants concernés.

Resources
Ressources en bibliothèque
• Mathematical Statistics (e-book)
• Mathematical Statistics / Knight