EPFL

MATH-442	**Statistical theory**
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Cursus	Sem.	Type
Data Science	MA1, MA3	Opt.
Ing.-math	MA1, MA3	Opt.
Mathematics for teaching	MA1, MA3	Opt.
Mathématicien	MA1, MA3	Opt.

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	Written
Workload	150h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

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 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