EPFL

MATH-442	**Statistical theory**
	Koch Erwan

Cursus	Sem.	Type
Data Science	MA1, MA3	Opt.
Ing.-math	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 at developing 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 intuition.

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, uniformly most powerful (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 using slides as well as the blackboard (especially for some proofs). Examples/exercises presented/solved at the blackboard.

Assessment methods

Final written exam.
Dans le cadre 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.

Supervision

Office hours   No
Assistants   Yes
Forum   Yes

Resources

Ressources en bibliothèque

- Mathematical Statistics / Knight
- Mathematical Statistics (e-book)

Notes/Handbook

The slides will be available on Moodle.