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**

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<th>Office hours</th>
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<td>Assistants</td>
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**Resources**

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

**Notes/Handbook**
The slides will be available on Moodle.