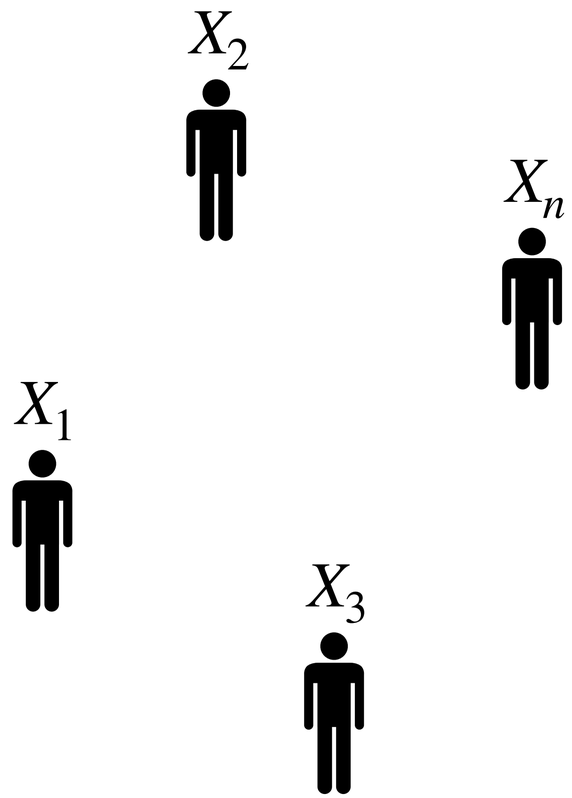
Asymptotic Statistics : Introduction

M2RI - Toulouse University

Author : Clément Lalanne

Objectives



$$X_1, X_2, \ldots, X_n \overset{\text{i.i.d.}}{\sim} \mathscr{L}_{\theta_0}$$

Question : What is θ_0 ?

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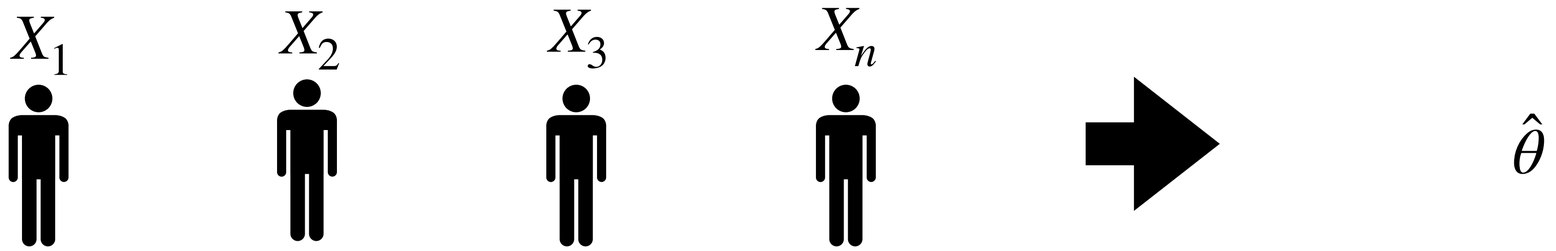


When can we write $\hat{\theta} \approx \theta_0$?

Objectives

$X_1, X_2, \ldots, X_n \overset{\text{i.i.d.}}{\sim} \mathscr{L}_{\theta_0}$ **Question** : What is θ_0 ?

When can we write $\hat{\theta} \approx \theta_0$?

Strong law of large numbers : $\frac{1}{n}\sum_{i=1}^{n} X_i \xrightarrow[n\to\infty]{\text{p.s.}} \mu := \mathbb{E}(X_1)$

Central limit theorem : $\sqrt{n}\left(\frac{1}{n}\sum_{i=1}^{n} X_i - \mu\right) \xrightarrow[n\to\infty]{\mathscr{L}} \mathcal{N}(0, \sigma^2 := Var(X_1))$

Content

Random vectors

- Different convergences
- Fourier transform
- Asymptotic probabilistic notations

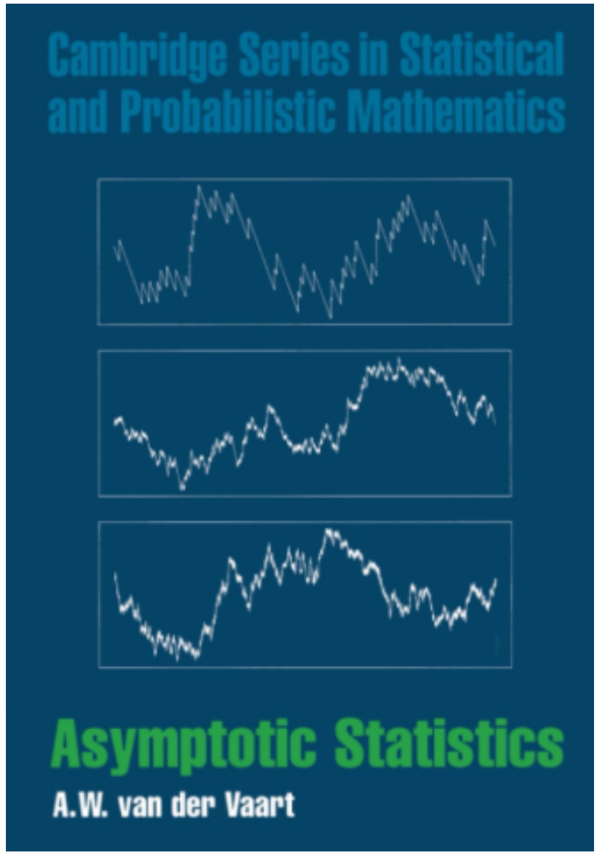
Tools for statistics

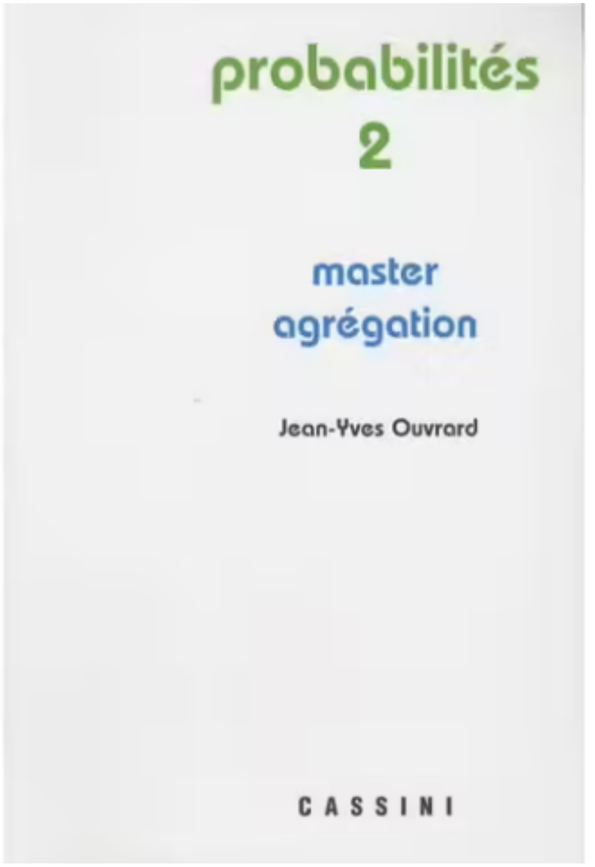
- Laws of large numbers
- Delta method
- Method of moments
- M and Z estimators

Empirical processes theory

- Uniform convergence
- Bracketing numbers
- Consistency of M and Z estimators
- Asymptotic normality

References


Cambridge Series in Statistical and Probabilistic Mathematics
Asymptotic Statistics
A.W. van der Vaart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Clément Lalanne

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AI co-chair @ ANITI.
My work focuses on Machine Learning, Differential Privacy, Statistics and Optimization.

Teaching

- **Assymptotic Statistics (M2 RI Toulouse University / ISAE Supaero) : ...**
- **Mathematical Methods for Supervised Learning (M1 SID Toulouse University) : Course 2025-2026.**
- **Mathematics of Machine Learning (M2 MAPI3 Toulouse University) : Course 2025-2026, Projects 2025-2026.**
- **Teaching Archive**

Contact

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