

MATH-562

**Statistical inference**

Davison Anthony

Cursus	Sem.	Type
Ing.-math	MA1, MA3	Opt.
Mathématicien	MA1, MA3	Opt.
Statistics	MA1, MA3	Obl.

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

**Summary**

Inference from the particular to the general based on probability models is central to the statistical method. This course gives a graduate-level account of the main ideas of statistical inference.

**Content**

Formalisation of inferential problems. Frequentist, Bayesian and design-based inference. Parametrisation. Quick overview of point and interval estimation, and of testing. Bias/variance tradeoff. Pivots and evidence functions. Role of approximation.

Exponential family models.

Principles of statistics: conditioning, sufficiency, etc.

Significance testing, its implementation and applications. Multiple hypothesis testing. Effect of selection.

Likelihood inference and associated statistics (maximum likelihood estimator, likelihood ratio statistic). Varieties of likelihood (conditional, marginal, partial, empirical, etc.). Issues arising in high dimensions. Misspecification, efficiency, robustness.

Data and sampling problems (truncation, censoring, etc.).

Shrinkage estimation.

Elements of Bayesian inference; choice of prior and related issues.

Predictive inference and its assessment.

**Keywords**

Bayesian inference; calibration; data; decision theory; evidence; likelihood inference.

**Learning Prerequisites****Required courses**

Courses on basic probability and statistics (e.g., MATH-240, MATH-230) and a first course on the linear model (e.g., MATH-341).

**Important concepts to start the course**

Basic statistical background.

**Learning Outcomes**

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

- Formulate a statistical model suitable for a given situation
- Analyze the properties of a statistical inference procedure

- Assess / Evaluate the adequacy of a statistical formulation
- Assess / Evaluate the evidence for a statistical hypothesis

### Transversal skills

- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Continue to work through difficulties or initial failure to find optimal solutions.
- Demonstrate a capacity for creativity.
- Demonstrate the capacity for critical thinking

### Teaching methods

Slides and board

### Expected student activities

Attending lectures and problem classes; interacting in class; tackling problem sheets.

### Assessment methods

Final exam. Maybe a mid-term test.

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.

### Supervision

Office hours	No
Assistants	Yes
Forum	Yes

### Resources

#### Virtual desktop infrastructure (VDI)

No

#### Bibliography

Cox, D. R. (2006) Principles of Statistical Inference  
Cox, D. R. and Hinkley, D. V. (1974) Theoretical Statistics  
Davison, A. C. Statistical Models

#### Ressources en bibliothèque

- [Principles of Statistical Inference / Cox](#)
- [Statistical Models / Davison](#)
- [Theoretical Statistics / Cox](#)

#### Notes/Handbook

Will be provided on Moodle.

#### Moodle Link

- <https://go.epfl.ch/MATH-562>