

MATH-524

**Nonparametric estimation and inference**

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Cursus	Sem.	Type
Ing.-math	MA2, MA4	Opt.
Mathématicien	MA2	Opt.
Statistics	MA2, MA4	Opt.

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

**Summary**

Nonparametric models are used to identify nonlinear relationships within data. This course gives a graduate-level overview of nonparametric statistical estimation and inference theory.

**Content**

- Kernel Smoothing methods (Stone's theorem, kernel density estimation and regression and local polynomial kernel estimation)
- Estimation consistency and minimaxity (nonparametric minimax rates, relevant empirical process theory results)
- Model selection (bias-variance tradeoff, curse of dimensionality, VC dimension)
- Inference methods (functional approximations, variance estimation, jackknife, bootstrapping)
- Regression and classification trees
- K-nearest neighbours and SVM algorithms
- Semi-parametric regression (partially linear models)

**Keywords**

Nonparametrics, inference, empirical process theory, machine learning, adaptive methods

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

Courses on basic probability and statistics (e.g., MATH-240, MATH-230) and a first course on linear regression (e.g., MATH-341). A basic understanding of any programming language (e.g. R, Python, Julia, Matlab)

**Recommended courses**

Statistical Inference (MA-562).

**Important concepts to start the course**

Basic statistics, probability and linear algebra

**Learning Outcomes**

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

- Assess / Evaluate properties of nonparametric estimation methods
- Interpret construction of complex statistical models
- Prove consistency and convergence results
- Choose appropriate estimation and inference methods

### Transversal skills

- Demonstrate a capacity for creativity.
- Demonstrate the capacity for critical thinking
- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Use both general and domain specific IT resources and tools

### Teaching methods

Board and slides

### Expected student activities

Attending lectures and problem classes; interacting in class.

### Assessment methods

Final Exam

### Supervision

Office hours	No
Assistants	Yes
Forum	Yes

### Resources

#### Virtual desktop infrastructure (VDI)

No

### Bibliography

Hastie, Trevor, et al. *The elements of statistical learning: data mining, inference, and prediction*. Vol. 2. (2009)

Györfi, László, et al. *A distribution-free theory of nonparametric regression*. Vol. 1. (2002)

Wasserman, Larry. *All of nonparametric statistics* (2006)

### Notes/Handbook

Will be shared on course Moodle.

### Moodle Link

- <https://go.epfl.ch/MATH-524>