MATH-517

Statistical computation and visualisation

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

Language of teaching	English
Credits	5
Session	Winter
Semester	Fall
Exam	During the semester
Workload	150h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

The course will provide the opportunity to tackle real world problems requiring advanced computational skills and visualisation techniques to complement statistical thinking. Students will practice proposing efficient solutions, and effectively communicating the results with stakeholders.

Content

- Modern statistical computing environments (e.g., R, Rstudio and Python)
- Overview of other software (e.g., SAS, SPSS, MATLAB).
- Data management, wrangling and ethics
- Aids to efficiency and reproducibility (e.g., GitHub, Markdown, Jupyter etc.).
- Statistical graphics (grammar, good practices, applications and examples).
- Resampling methods for uncertainty assessment (bootstrap, jackknife, cross-validation), with applications to regression, time series and dependent data.
- EM algorithm and applications.
- Elements of random number generation and variance reduction.
- Markov chain Monte Carlo techniques (Gibbs sampler, Metropolis-Hastings algorithm, Hamiltonian Monte Carlo, convergence diagnostics) and software (e.g., Stan)
- Other methods for Bayesian inference (e.g., importance sampling, INLA, AGHQ, ...)

Keywords

Statistical computation, data visualisation, data wrangling, resampling methods, EM algorithm, Bayesian inference

Learning Prerequisites

Required courses

Probability and Statistics. Linear regression

Learning Outcomes

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

- Plan complex visualisation and computational tasks
- Perform complex visualisation and computational tasks
- Implement reproducible computational solutions to statistical problems in modern environments and platforms.

Transversal skills

- Take feedback (critique) and respond in an appropriate manner.
- Communicate effectively with professionals from other disciplines.
- Demonstrate the capacity for critical thinking
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.

Teaching methods

Two lecture hours per week, two hours of exercises and support on mini-projects.

Expected student activities

Students will work on mini-projects in teams.

Assessment methods

Contrôle continue
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

Bibliography

Wickham H. & Grolemund G. (2017) R for Data Science (https://r4ds.had.co.nz/)
Davison A. C. & Hinkley D. (1997) Bootstrap Methods and their Application

Ressources en bibliothèque

- R for Data Science / Wickham
- Bootstrap Methods and their Application / Davison

Prerequisite for

Applied statistics