MATH-341

Linear models

Masák Tomas

Cursus	Sem.	Type
Data Science	MA1, MA3	Opt.
Digital Humanities	MA1, MA3	Opt.
Life Sciences Engineering	MA1, MA3	Opt.
Mathematics	BA5	Opt.

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

Summary

Regression modelling is a fundamental tool of statistics, because it describes how the law of a random variable of interest may depend on other variables. This course aims to familiarize students with linear models and some of their extensions, which lie at the basis of more general regression model

Content

- Properties of the multivariate Gaussian distribution and related quadratic forms.
- Gaussian linear regression: likelihood, least squares, geometrical interpretation.
- Distribution theory, confidence and prediction intervals.
- Gauss-Markov theorem.
- Model checking and validation: residual diagnostics, outliers and leverage points.
- Analysis of variance.
- Model selection: bias/variance tradeoff, stepwise procedures, information-based criteria.
- Multicollinearity and penalised estimation: ridge regression, LASSO.
- Robust regression and M-estimation.
- Nonparametric regression and smoothing splines.

Learning Prerequisites

Recommended courses

Analysis, Linear Algebra, Probability, Statistics

Learning Outcomes

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

- Recognize when a linear model is appropriate to model dependence
- Interpret model parameters both geometrically and in applied contexts
- Estimate the parameters determining a linear model from empirical observations
- Test hypotheses related to the structural characteristics of a linear model
- Construct confidence bounds for model parameters and model predictions
- Analyze variation into model components and error components
- Contrast competing linear models in terms of fit and parsimony

- Construct linear models to balance bias, variance and interpretability
- Assess / Evaluate the fit of a linear model to data and the validity of its assumptions.
- Prove basic results related to the statistical theory of linear models

Teaching methods

Lectures ex cathedra, exercises in class, take-home projects

Assessment methods

Continuous control, final exam.
Seconde tentative : 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

Moodle Link

- https://go.epfl.ch/MATH-341