DEPARTMENT OF NEUROBIOLOGY, CARE SCIENCES AND SOCIETY

H1F5569, Linear Regression Analysis in Neuroscience: Model Choice, Implementation, Analysis Errors and Interpretation, 3 credits (hec)

Linjär regressionsanalys i neurovetenskap: modellval, implementering, slumpfel och tolkning, 3 högskolepoäng

Third-cycle level / Forskarnivå

Approval

This syllabus was approved by The Committee for Doctoral Education on 2023-12-13, and was last revised on 2026-09-16. The revised course syllabus is valid from spring semester 2027.

Responsible department

Department of Neurobiology, Care Sciences and Society, Faculty of Medicine

Prerequisite courses, or equivalent

Basic Course in Medical Statistics (for example KI courses in basic statistics for doctoral students) and being familiar with basic R programming.

Purpose & Intended learning outcomes

Purpose

The main purpose is for students to understand basic regression analysis principles through a variety of examples with Neuroscience data and help students adapt them to the needs of their research questions using the R language. The course content has been developed to solve regression problems often faced in Neuroscience and all examples will be based on Neuroscience studies.

Intended learning outcomes

After the course the student is supposed to:

- Be able to explain how linear regression analysis works and decide when regression should/should not be used depending on the research question.

- Be able to implement and assess a linear regression model in a basic statistical programming language from scratch but also with packages (This course is not focused on learning R, basic R programming skills are required).

Course content

The course covers both theoretical and practical regression aspects, with a focus on the application and errors of linear regression modelling.

Special focus throughout the course will be given to the:

- Regression optimization, warnings and errors produced and their relation to study design, available data (singularity, autocorrelation, small sample sizes, outliers), and model output (heterogeneous residuals etc).
- Search for alternative models that can tackle a scientific question more accurately.
- Understanding fixed and random effects.

The course focuses mainly on the application of linear regression. Thus, the student will learn how/why linear regression works by using simulated and real datasets from the field of Neuroscience (including brain imaging, neuropsychological assessment, fluid markers).

The course is divided in two parts:
Part one:
1) Statistical hypothesis testing versus statistical modelling (Introduction).
2) Linear regression.
3) Alternative linear regression models (PCR, PLS, lasso/ridge/elastic net, variable selection models).

Part two:
4) Polynomial regression.
5) Introduction to random and fixed effects.

Forms of teaching and learning

Teaching is predominantly in the form of lectures and computer labs. Student activities will include group discussions and presentations, quiz, Q&A sessions, computer labs, and two assignments. The students will receive the time schedule before the course to adjust their working activity accordingly.

Language of instruction

The course is given in English

Grading scale

Pass (G) /Fail (U)

Compulsory components & forms of assessment

Compulsory components

Lectures, student group discussion and labs. The course responsible assesses whether and if so, how absence can be compensated.

Forms of assessment

Examination of the course's intended learning outcomes is carried out through a written classroom examination.

Course literature

Recommended course literature:
Faraway, Julian J. Linear models with R. Chapman and Hall/CRC, 2015, ISBN: 978-1-4398-8734-9.