Syllabus - Methods 3 - 2025

Lau Møller Andersen

Table of contents

Lesson plan 1
Exam details 3
Reading list 5

The syllabus contains:

1. The lesson plan
2. Exam details
3. The reading list for each lesson and practical exercise

Lesson plan

Lectures: Tuesdays 14-16

Classes: Thursdays 8-10 and 10-12

Instructors: Lydia Pauli Rambrand and Lau Møller Andersen

Programming languages: *R* (multilevel modelling) and *Python* (machine learning)

Overview:

- Week 37:
  - Lesson 0: What is it all about?
  - Class 0: Setting up R and Python — and recollection of the general linear model (Lau)
- Week 38:
  - Lesson 1: Multilevel linear regression

  - Class 1: Modelling subject level effects – and how do they differ from group level effects? (Lydia)

- Week 39:
  - Lesson 2: Beyond linear regression — link functions
  - Class 2: What to do when the response variable is not continuous? (Lau)
- Week 40:
  - Lesson 3: Evaluating generalised linear mixed models — and the spectre of collinearity
  - Class 3: Code review (Lydia)
- Week 41:
  - Lesson 4: Explanation versus prediction
  - Class 4: Summarising mixed models (Lydia)
- Week 42: no teaching (go fetch potatoes instead)
- Week 43:
  - Lesson 5: Mid-way evaluation and machine learning introduction
  - Class 5: Getting Python running (Lau)
- Week 44:
  - Lesson 6: Linear and logistic regression revisited (machine learning)
  - Class 6: Categorizing responses based on informed guesses (Lau)
- Week 45:
  - Lesson 7: Model evaluation and hyperparameter tuning
  - Class 7: Code review (Lydia: To be moved)
- Week 46:
  - Lesson 8: Dimensionality reduction — principled component analysis (PCA)
  - Class 8: What to do with very rich data? (Lau)
- Week 47:
  - Lesson 9: Neural networks

  - Class 9: Code review (Lau)

- Week 48:
  - Lesson 10: Unsupervised classification
  - Class 10: Create video explainers of central concepts (shared resource) (Lydia)
- Week 49:
  - Lesson 0 again: What *was* it all about? and final evaluation
  - Class 11: Summarising machine learning (Lydia)
- Week 50:
  - Student presentations:
  - Class 12: Work on portfolios: Ask anything! (Lydia & Lau)

Exam details

(Italicised text below has been copied from the Academic Regulations)

Aid:

Not defined

Assessment:

Passed /failed

Grading:

Internal co-examination

Notes

Ordinary examination: *The exam consists of a portfolio containing a number of assignments. The total length of the portfolio is: 3-7 assignments.*

Their form and length will be announced on Brightspace by the teacher at the start of the semester. The portfolio may include products. Depending on their length, and subject to the teacher's approval, these products can replace some of the standard pages in the portfolio.

It must be possible to carry out an individual assessment. So if some parts of the portfolio have been produced by a group, it must be stated clearly which parts each student is responsible for, and which parts the group as a whole is responsible for.

The complete portfolio must be submitted for assessment in the Digital Exam system by the date specified in the exam plan. Each student submits a portfolio.

Final portfolio:

Everything can be handed in groups, but it **has** to be specified who has done what.

Revised assignments, handed in as short reports formatted as Markdown documents on GitHub

Assignment 0: **Using mixed effects modelling to model hierarchical data** (Winter & Grawunder, 2012)

Assignment 1: **Mixed effects modelling of accuracy** (Andersen et al., 2019)

Assignment 2: **Using logistic regression to classify subjective experience from brain data** (Sandberg et al., 2016)

Assignment 3: **Dimensionality reduction; finding the signal among the noise**

Re-examination: *The exam consists of a portfolio that contains the same type and number of assignments as the ordinary exam. The total length of the portfolio is: 3-7 assignments.*

Their form and length will be announced on Brightspace by the teacher at the start of the semester. The portfolio may include products. Depending on their length, and subject to the teacher's approval, these products can replace some of the standard pages in the portfolio.

It must be possible to carry out an individual assessment. So if some parts of the portfolio have been produced by a group, it must be stated clearly which parts each student is responsible for, and which parts the group as a whole is responsible for.

The complete portfolio must be handed in for assessment in the Digital Exam system by the date specified in the exam plan. Each student submits a portfolio.

Note about feedback

Detailed written feedback will be provided for ***Assignment 0 only***, with the aim of aligning expectations of the instructor and students regarding how assignments will generally be read and graded. This ***has to be*** handed in as a ***study group assignment*** – otherwise you do ***NOT*** get feedback.

Oral feedback will be provided on subsequent portfolio assignments during in-class assignment preparation sessions, where students will have ample opportunity to ask the instructors questions on their assignments-in-progress.

Reading list

Textbooks

The first part of the course, multilevel modelling, is mostly based on:

- Gelman, A., Hill, J., 2006. Data Analysis Using Regression andd Multilevel/Hierarchical Models. Cambridge University Press

The second part of the course, machine learning, is mostly based on:

- Raschka, S., 2015. Python Machine Learning. Packt Publishing Ltd.

Both books are available through the Royal Library (kb.dk)

Literature

Week 37: What is it all about?

- Lesson:
  - Chapters 1 & 2, Gelman, A., Hill, J., 2006

Week 38: Multilevel linear regression

- Lesson
  - Chapters 11 & 12, Gelman, A., Hill, J., 2006
  - Bates D, Mächler M, Bolker B, Walker S (2015) Fitting Linear Mixed-Effects Models Using lme4. Journal of Statistical Software 67:1–48. https://doi.org/10.18637/jss.v067.i01
- Assignment 0: **Using mixed effects modelling to model hierarchical data**
  - Winter, B., 2013. Linear models and linear mixed effects models in R with linguistic applications. arXiv:1308.5499 [cs]. https://arxiv.org/abs/1308.5499
  - Background literature: Winter, B., Grawunder, S., 2012. The phonetic profile of Korean formal and informal speech registers. Journal of Phonetics 40, 808–815. https://doi.org/10.1016/j.wocn.2012.08.006

Week 39: Beyond linear regression — link functions

- Lesson:
  - Chapters 5 & 6 Gelman, A., Hill, J., 2006.

    - In Chapter 6, only read sections 6.1 and 6.2

- Assignment 1: **Mixed effects modelling of accuracy**
  - Background literature: Andersen, L.M., Overgaard, M., Tong, F., 2019. Visual expectations change subjective experience without changing performance. Consciousness and Cognition 71, 59–69. https://doi.org/10.1016/j.concog.2019.03.007

Week 40: Evaluating generalised linear mixed models — and the spectre of collinearity

- Lesson:
  - Chapter 21 Gelman, A., Hill, J., 2006.

Week 41: Explanation versus prediction

- Lesson:
  - Yarkoni, T., Westfall, J., 2017. Choosing Prediction Over Explanation in Psychology: Lessons From Machine Learning. Perspect Psychol Sci 12, 1100–1122. https://doi.org/10.1177/1745691617693393
  - Breiman, L., 2001. Statistical Modeling: The Two Cultures (with comments and a rejoinder by the author). Statistical Science 16, 199–231. https://doi.org/10.1214/ss/1009213726

Week 43: Mid-way evaluation and machine learning introduction

- Lesson:
  - Chapters 1 & 2: Raschka, S., 2015.

Week 44: Linear and logistic regression revisited (machine learning)

- Lesson:
  - Chapters 3 & 10: Raschka, S., 2015.
  - Have a look at the examples in section 1.1 https://scikit-learn.org/stable/supervised_learning.html#supervised-learning
- Assignment 2: **Using logistic regression to classify subjective experience from brain data**
  - Sandberg K, Andersen LM, Overgaard M (2014) Using multivariate decoding to go beyond contrastive analyses in consciousness research. Front Psychol 5:1250. https://doi.org/10.3389/fpsyg.2014.01250

Week 45: Model evaluation and hyperparameter tuning

- Lesson:
  - Chapter 6: Raschka, S., 2015.

Week 46: Dimensionality reduction — principled component analysis (PCA)

- Lesson:
  - Chapter 5: Raschka, S., 2015
  - Shlens, J., 2014. A Tutorial on Principal Component Analysis. arXiv:1404.1100 [cs, stat]. https://arxiv.org/abs/1404.1100
- Assignment 3: **Dimensionality reduction; finding the signal among the noise**

Week 47: Neural networks

- Lesson:
  - Chapter 12: Raschka, S., 2015

Week 48: Unsupervised classification

- Lesson:
  - Chapter 11: Raschka, S., 2015

Week 49: What *was* it all about? and final evaluation

No readings

Week 50: Student presentations

No readings