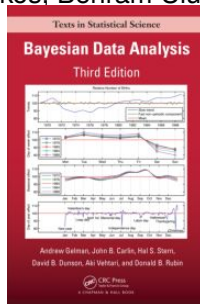


Bayesian data analysis (Aalto fall 2025)

Practical matters

- Book: Gelman, Carlin, Stern, Dunson, Vehtari & Rubin: Bayesian Data Analysis, Third Edition. (online PDF available)
- The course website has more detailed information
https://avehtari.github.io/BDA_course_Aalto/Aalto2025.html
- Timetable: see the course website
- TAs: David Kohns, Osvaldo Martin, Wanxian Chen, Ningyi Peng, Maksim Sinelnikov, Reza Soumi, Herman Tesso, Quan Tran, Aristomenis Tsopelekos, Behram Ulukir



Bayesian data analysis

Schedule

- Periods I and II
- No lecture on evaluation week
- 9 assignments as MyCourses quizzes
- Project report deadline 30th November
- Project presentations on week starting 8th December

Bayesian data analysis

prerequisites

- Basic terms of probability theory
 - probability, probability density, distribution
 - sum, product rule, and Bayes' rule
 - expectation, mean, variance, median
- Some algebra and calculus
- Basic visualization techniques (R or Python)
 - histogram, density plot, scatter plot

These will be tested with the first assignment round

Bayesian data analysis

prerequisites

- What to do if the course seems to be too difficult
 - refresh your memory on prerequisites (see the course web site for some links)
 - ask for help
 - consider reading Regression and Other Stories
<https://avehtari.github.io/ROS-Examples/>
 - consider reading Statistical rethinking + watching videos
<https://xcelab.net/rm/statistical-rethinking/>

Bayesian data analysis

Course contents

- Background (Ch 1)
- Model, likelihood, prior, posterior, integration (Ch 2)
- Integration in multiparameter models (Ch 3)
- Basic integration methods (Ch 10)
- Markov chain Monte Carlo integration (Ch 11–12)
- Stan and probabilistic programming
- Hierarchical models (Ch 5)
- Model checking (Ch 6)
- Evaluating and comparing models (Ch 7 + extra material)
- Decision analysis (Ch 9)
- Large sample properties and Laplace approximation (Ch 4)
- Bayesian workflow (project)

Bayesian data analysis

Different learning styles

- Reading
- Listening lectures
- Solving problems
 - mathematical derivations
 - programming

Bayesian data analysis

Assessment

- Assignments 40%
 - E-exam 10%
 - Project work and presentation 50%
-
- Minimum of 50% of points must be obtained from each

Bayesian data analysis

- Lectures describe basics and give broader overview (recorded and made available)
 - written material has all the details and self-study is possible
- Supporting material and assignments in https://avehtari.github.io/BDA_course_Aalto/Aalto2025.html
 - reading instructions and chapter notes
 - demos (very useful for assignments)
 - slides (not very useful without the lectures)
 - video clips
 - links to additional material
- R demos https://avehtari.github.io/BDA_course_Aalto/demos.html#BDA_R_demos
- (Python demos https://avehtari.github.io/BDA_course_Aalto/demos.html#BDA_Python_demos)
- Aalto Zulip chat instance (link in MyCourses)

Bayesian data analysis

Assignments

- Weekly assignments (some have two weeks time)
 - R simulation assignments
 - Stan probabilistic programming assignments (via R)
- Related R code demos available (see the course web site)
- TAs available: the web page for TA session times
- Assignment deadlines on Sunday (see detailed info in the course web page)
 - we recommend to submit before Friday 3pm as TAs are not available during the weekend
 - we allow the late submission on Sunday as some students are working on weekdays
- Submit assignment answers via MyCourses Quizzes
 - autosubmission of Quiz answers at the deadline time

Bayesian data analysis

R

- We use R in the course as there are more packages for Stan and statistical analysis in general in R
 - this will make specifically it easier to work with hierarchical models in the later part of the course

Bayesian data analysis

Assignments

- Assignments are available in the course website
- Assignments are returned by answering MyCourses Quizzes

Assignments

MyCourses Quizzes

- Assignment answerd submitted via MyCourses Quizzes
 - multiple choice questions
 - multiresponse questions
 - numerical value questions (with tolerance)

Assignments

Plagiarism and empty reports

- It's OK to discuss assignments with others
- It's OK to use code from the demos (mention the source)
- It's OK to use AI, but need to mention when and how used
 - Warning: I have tested these and they can provide very vague or completely wrong results for the course contents
 - Might be most useful for getting ideas for code and markdown syntax
- Don't copy reports from others or from internet
- Don't submit empty, almost empty or nonsense report
 - these will be problematic for other students
 - if you see such, send TAs a message and mark it as problematic in Peergrade and get another one for grading

E-exam

- All exam questions picked from the assignment questions
- No programming tasks
- Choose your own time to take the e-exam in period II

Project work

- Project work in groups of 2–3
 - combines all the pieces learned in one project work
 - Quarto notebook report
 - project report peer graded (30% of the project score)
 - oral presentation graded by me and TAs (70% of the project score)
- More about projects later

Project work

FeedbackFruits

- Peergrading used in BDA course since 2016
 - peergrade.io used 2016–2023, but it was shut down in 2023
 - FeedbackFruits is missing some features, and that's why we use it only for the project report
- The benefit is seeing reports by others
- Submit report as PDF
- Each student grades 3 assignment reports (randomly distributed)
- Detailed grading instructions – rubric (available also on the course website)
- Graders provide also text feedback
- Quality of grading is evaluated, too
- See more at https://avehtari.github.io/BDA_course_Aalto/project.html

Project work

Feedbackfruits

- Login with Aalto account
- Combined score: 90% submission performance, 10% feedback performance

Zulip chat

bda2025.zulip.aalto.fi

- Aalto login, hosted by Aalto IT, deleted after one year
- The web interface is better, although most receive mobile app is much improved
- Different channels for announcements, general, assignments, etc.

RStudio, Quarto, R markdown

- RStudio and Positron are a great IDEs for R
- Quarto is a markdown language for making reports mixing text, code, equations, tables, etc
 - *Quarto is the next iteration of R Markdown, and allows you can create dynamic content with Python, R, Julia, and Observable, author documents as plain text markdown or Jupyter notebooks, and output to multiple format types.*
- RStudio and Positron have also visual editor for Quarto (and R markdown) making it easy for new users
- RStudio is also installed in Aalto JupyterHub

- No need to install anything locally, everything can be done in Aalto JupyterHub
 - The **notebooks** folder is the only persistent folder (stays there if you sign out) so save everything to that folder!
 - You may access JupyterHub folder as a network drive by SMB mounting it on your own computer
 - See more in the course FAQ
- There is some support for local installations (see FAQ in the course web page)

FAQ

- https://avehtari.github.io/BDA_course_Aalto/FAQ.html
- For example,
 - R packages used in demos
 - Installing aaltobda package
 - Installation problems
 - Remote access
 - Tidyverse and pipes
 - What if I missed some deadline or wasn't able to do some part of the course