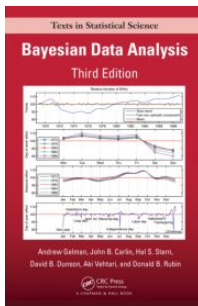


Bayesian data analysis (Aalto fall 2020)

- Book: Gelman, Carlin, Stern, Dunson, Vehtari & Rubin: Bayesian Data Analysis, Third Edition. (online pdf available)
- The course website has more detailed information than these slides
https://avehtari.github.io/BDA_course_Aalto/Aalto2020.html
- Timetable: see the course website
- TAs: Alejandro Catalina, Akash Dhaka, Kunal Ghosh, Noa Kallioinen, Anton Mallasto Topi Paananen, Teemu Säilynoja



- TAs as “Panelists”
- Chat
- Q&A
- Polls
- Raising hand

Bayesian data analysis

Pre-requisites

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

These will be tested with the first assignment round

Bayesian data analysis

Pre-requisites

- What to do if the course seems to be too difficult
 - refresh your memory on pre-requisites
 - 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

Learning styles

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

Bayesian data analysis

Example analyses

- Treatment/control
 - randomize patients to treatment or control
 - is the treatment effective?

Bayesian data analysis

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Bayesian data analysis

Example analyses

- Treatment/control
 - randomize patients to treatment or control
 - is the treatment effective?
- Continuous valued treatment
 - randomize patients with different dosages
 - which dosage is sufficient without too many side effects?
- Different effects for different patients?
 - Is the treatment effect different for male/female, child/adult, light/heavy, ...

Bayesian data analysis

Computer exercises

- Basic visualisation techniques
- Binomial distribution – Algae
- Normal distribution – Windshield
- Difference between binomials – Treatment/control
- Difference between normals – Windshield
- Generalized linear model (GLM) + importance sampling – Bioassay
- GLM + Metropolis + convergence diagnostics – Bioassay
- GLM + Bioassay + Stan
- Linear model + Stan
- Hierarchical model + Stan
- Model selection + Stan

Stan is a probabilistic programming framework and ecosystem

40+ developers, 100+ contributors, 100K+ users

R, Python, Julia, Scala, Stata, Matlab, command line interfaces

More than 100 R packages using Stan



mc-stan.org

- Exercises 2/3, and project work and presentation 1/3
 - Minimum of 50% of points must be obtained from both the project work and the exercises.

Bayesian data analysis

- Pre-recorded lectures describe basics and give broader overview
 - written material has all the details and self-study is possible
- Supporting material and assignments in https://avehtari.github.io/BDA_course_Aalto/Aalto2020.html
 - reading instructions and chapter notes
 - demos
 - slides (not very useful without the videos)
 - 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 chat instance

- Weekly exercises (some have two week time)
 - R (Python) simulation exercises
 - Stan probabilistic programming exercises (via R (Python))
- Related R (Python) demos available
- TAs available: see Oodi for exercise sessions
- Exercise deadlines on Sunday (see detailed info in the course web page)
- After exercise deadline grading period Monday–Tuesday
- Students grade 3 other exercises using peergrade.io

- We strongly recommend using R in the course as there are more packages for Stan and statistical analysis in general in R
- If you are already fluent in Python, but not in R, then using Python may be easier, but it can still be more useful to learn also R

- Exercises are given on PeerGrade (also available in the course website)
- Exercises are returned and graded on Peergrade

- Used in BDA course since 2016
- Each student grades 3 exercises (randomly distributed)
- Detailed grading instructions – rubric (available also on the course website)
- Also text feedback
- Possible to flag inappropriate grading
- TAs check flagged gradings
- Possible to give thumb up for great feedback
 - those who give good feedback will get bonus points

- Combined score: 70% submission performance, 30% feedback performance

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- Hand-in score:
 - averaging the scores from peers
 - after flagging teacher may overrule the score
 - different exercises have different weight

See details at

[http://help.peergrade.io/interfaces-and-features/
grading-and-scores/the-hand-in-score](http://help.peergrade.io/interfaces-and-features/grading-and-scores/the-hand-in-score)

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- Feedback score:
 - When students receive a review, they are asked to react to it using a scale ranging from "Not useful at all" to "Extremely useful".
 - These ratings each correspond to a score between 0% and 100%.
 - The feedback score is the average of the reaction scores.

- Go to peergrade.io/join
- Use class code: (see MyCourses announcements)
- Use your Aalto email or we can't match you to your student id

- Project work in groups of 1–3
 - combines all the pieces learned in one project work
 - R or Python notebook report
 - project report peer graded
 - oral presentation graded by me and TAs

