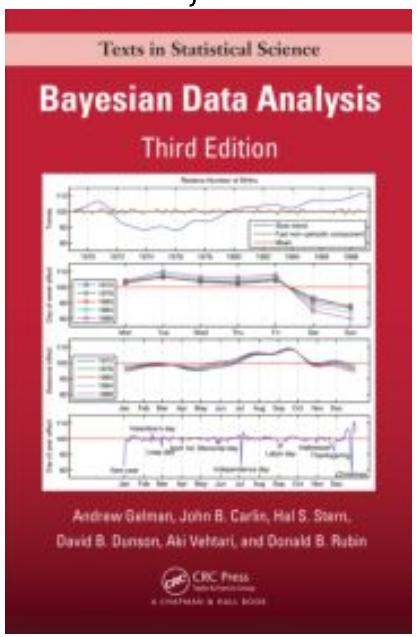
Bayesian data analysis (Aalto fall 2021)

- 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/Aalto2021.html
- Timetable: see the course website
- TAs: Aleksei Tiulpin, Anna Riha, Antti Lankinen, Asael Alonzo Matamoros, Elena Shaw, Kunal Ghosh, Noa Kallioinen, Osvaldo Martin, Teemu Sailynoja



Zoom webinar

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

- 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

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

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

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  - 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, ...

- 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 seletion + Stan

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 120 R packages using Stan

Many packages to support diagnostics and workflow

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/Aalto2021.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 Zulip chat instance (link in MyCourses)

- Weekly assignments (some have two weeks time)
  - R (Python) simulation exercises
  - Stan probabilistic programming exercises (via R (Python))
- Related R (Python) demos available (see the course web site)
- TAs available: see Oodi for exercise sessions
- Exercise 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
- 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

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

Assignments

peergrade.io

- Peergrading 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

Assignments

peergrade.io

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  - 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

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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.

Peergrade.io

Registration

- Go to BDA MyCourses page
- Click Peergrade and login with Aalto account

Assignments

Plagiarism and empty reports

- It's ok to discuss assignments with others
- It's ok to use code from the demos (good to mention the source)
- Don't copy reports from others or from internet
- Don't submit empty, almost empty or nosense report
  - these will be problematic for other students
  - if you see such, you can mark it as problematic and get another one for grading

Project work

- 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

Zulip chat

bda2021.zulip.cs.aalto.fi

RStudio, R markdown