



**UNIVERSITÀ
DEGLI STUDI
DI TRIESTE**



Dipartimento di scienze economiche,
aziendali, matematiche e statistiche
"Bruno de Finetti"

Bayesian Statistics

General informations

A.A. 2020/2021

Lecturers

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TBA

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Room ...

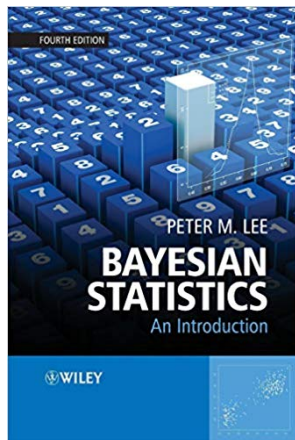
Office hours
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Textbook and reference books

Lee

Bayesian Statistics: an introduction

Wiley

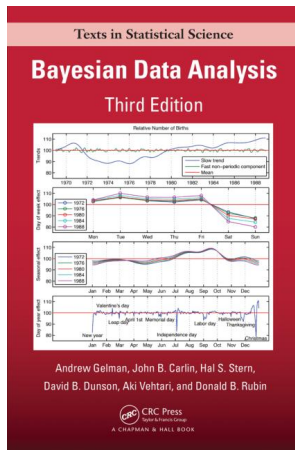


Textbook and reference books

Gelman, Carlin, Stern, Dunson, Vehtari,
Rubin

Bayesian Data Analysis

CRC press

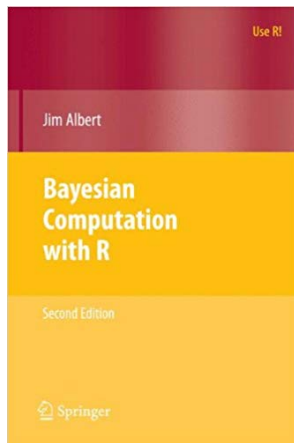


Textbook and reference books

Albert

Bayesian Computation with R

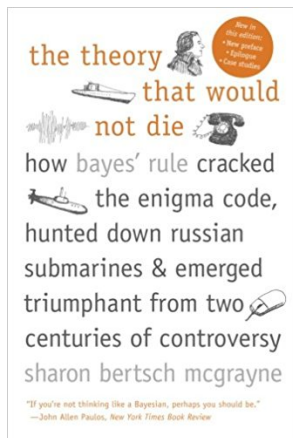
Springer



Additional readings

Sharon Bertsch Mcgrayne

*The Theory That Would Not Die: How
Bayes' Rule Cracked the Enigma Code*
Yale University Press



Moodle

Course slides and additional material on moodle2.units.it

- ▶ the materials include video lectures of the first part recorded last year, these are mainly for review, but some topics may be skipped in the front lectures to allow more classroom time for interactive discussion.



Moodle web-page will be used also to communicate variation in the lecture schedules.



Recording will be available on MS-Teams on the Team of the course.

Special topic

As a major discussion topic we will consider the paper [Safety and Efficacy of the BNT162b2 mRNA Covid-19 Vaccine](#) by Polack *et al*, NEJM 2020.



The paper reports on the trial for a Covid-19 vaccine and is particularly interesting to us because the statistical analysis is done with a Bayesian model.



We will focus on efficacy of vaccine (we will not discuss safety). Try to understand the statistical model, ask yourselves

- ▶ what is the population
- ▶ what is the sample
- ▶ what is the likelihood

Understanding the details of this paper may not be easy, but try your best and then we will analyze it together (probably on March, 17th)

Exam

Oral exam, discussion of a practical exercise and occasional homeworks.

- ▶ In the oral examination the student will have to prove knowledge of theoretical results illustrated in the course.
- ▶ The discussion of the practical exercise will serve the purpose of assessing his capacity of applying the methods taught in the course.
- ▶ Homeworks will be assigned approximately each couple of weeks to groups of three students. Homeworks have strict deadlines, and they may contribute for a maximum of $3/4$ points to the final mark.

Syllabus

Aim

The student will understand the Bayesian inferential paradigm and its difference with respect to classical inferential paradigm. He will be able to specify and estimate a range of models within the Bayesian approach, assess the quality of the models and interpret the results.

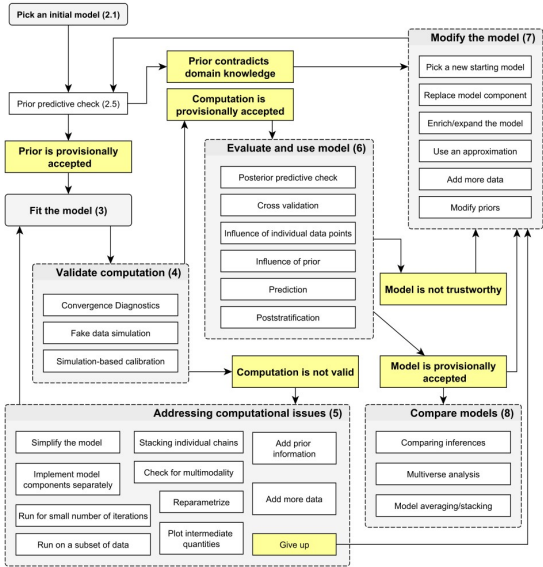


- ▶ Introduction to Bayesian inference (with refresh of probability calculus and likelihood inference)
- ▶ Single parameter models: binomial, normal, Poisson
- ▶ Bayesian estimate, credibility interval (HPD)
- ▶ Predictive distribution (PPP), exchangeability
- ▶ Non informative/ weak informative / reference prior
- ▶ Multiparameter models: multivariate normal, known and unknown variance

Syllabus (continua)

- ▶ Asymptotic approximation (parallel with classical inference)
- ▶ Hierarchical models
- ▶ Regression model
- ▶ MCMC general introduction (Gibbs-Metropolis)
- ▶ Programming an MCMC algorithm in R
- ▶ Introduction to Stan and use of Stan for estimation.
- ▶ Optional: sketch of other approximation methods (Laplace, INLA); model selection and averaging

Bayesian workflow



Bayesian inference and Bayesian Workflow

Bayesian inference is just the formulation and computation of conditional probability or probability densities.



Bayesian workflow includes the three steps of model building, inference, and model checking/improvement

- ▶ model specification
- ▶ model fitting and computational issues
- ▶ model checking
- ▶ model comparison and selection



This is not very different from a general Data Analysis workflow (save for the prior-related issues, although the same issues may be there, more or less under the carpet),