Advanced Methods: Bayesian statistics

Constituting Session

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Introduction to Bayesian Statistics with R

- Dr. Oliver Lindemann
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- Workshop
  - 19. Feb.–23. Feb. 2018 (9:00–15:00)
  - Room: 2.14.0.18
  - Website: `http://bit.ly/bayes2018`

What is Bayesian Statistics?

Procedure

Theory $\rightarrow$ **Hypothesis** $\rightarrow$ Experiment $\rightarrow$ **Data** $\rightarrow$ Statistics

What does now the p-value tell us?
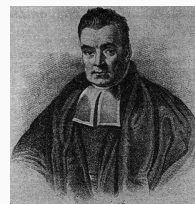
$$p(\text{Data}|\neg\text{Hypothesis})$$

But what do we actually what to know from the data?

$$p(\text{Hypothesis}|\text{Data})$$

But...$p(\text{Hypothesis}|\text{Data}) \neq p(\text{Data}|\neg\text{Hypothesis})$

Thomas Bayes (1701 – 1761)

Bayes Theorem

$$p(H|D) = \frac{p(D|H)\,p(H)}{p(D)}$$

Aims of this Course

- Recent developments in behavioral statistics
  - critical view on frequentist interference (i.e., *classical* statistics)

- Basic principles of Bayes statistics
  - understanding the some mathematical principles
  - Markov-chain-Monte-Carlo (MCMC) sampling

- **Hands on experiences in conducting Bayesian analyses**
  - Using R and the sampling software JAGS (later more)

Outline

1. Bayesian analysis of beliefs and probabilities
   - mathematical and procedural basics
   - MCMC sampling
   - coin flips, coin flips, coin flips ...
2. Bayesian Data analysis for psychologist
   - Bayesian t-test
   - Bayesian ANOVAs
   - Bayesian regressions
   - Bayesian confidence intervals
   - Bayesian model comparison
3. Maybe
   - Bayesian Cognitive Processes Models
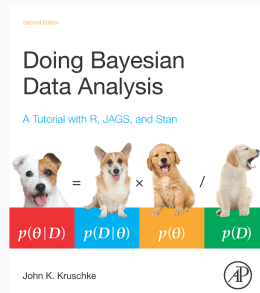   - Hierarchical Linear Model/Linear Mixed Models

Key readings

Krusche, J. K.(2015) *Doing Bayesian Data Analysis* (2nd Edition), Academic Press, Amsterdam.

$\sim$ 45 Euro via `http://bit.ly/2D6vGPR`

Further literature will be provide during the course

Second Edition

Doing Bayesian
Data Analysis

A Tutorial with R, JAGS, and Stan

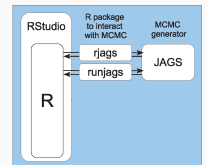$p(\theta|D)$ $p(D|\theta)$ $p(\theta)$ $p(D)$

John K. Kruschke

Technical Requirements

- preferable: own laptop

- Only free software

- Bayesian Modelling
  - **R 3.1**
  - **RStudio OpenSource Edition**
  - **JAGS 3.4**

- "SPSS"-like statistical software package
  - Jasp

Links

R	`http://mirrors.softliste.de/cran/`
RStudio	`http://www.rstudio.com/products/rstudio/download/`
JAGS	`http://sourceforge.net/projects/mcmc-jags/files/JAGS/3.x`
Jasp	`https://jasp-stats.org/`