Bayesian meta-analysis

What is a meta-analysis

"An analysis of analyses"

⇒ a single quantitative summary of studies answering the *same research* question

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<u>Ex:</u> medical therapies effects are often evaluated in multiple different studies.

- ⇒ pool individual observations from multiple studies ?
 - notential differences in the pooled experiments
 - noly aggregated summary statistics estimates ("effect sizes") available
 - alongside uncertainty (e.g. standard errors)

Study Heterogeneity

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 - within-study uncertainty, or
 - real heterogeneity in effect size between the different studies

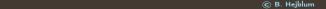
Study Heterogeneity

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 - · within-study uncertainty, or
 - real heterogeneity in effect size between the different studies

Often, different studies used different populations

- ⇒ potential extra-variability
- + different sample sizes ⇒ also impact the estimate and its variability





Meta-analysis random effects model

Common approach for meta-analysis:

$$y_i \sim \mathcal{N}(\theta_i, \sigma_i^2)$$

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 \Rightarrow between study variability: $y_i \sim \mathcal{N}(\mu, \sigma_i^2 + \tau)$

Hierarchical generalization of the fixed effect model:

$$y_i \sim \mathcal{N}(\mu, \sigma_i^2)$$

⇒ assume same average effect for each study

Bayesian meta-analysis in practice

Meta-analysis: a perfect usecase for Bayesian analysis?

Bayesian meta-analysis in practice

Meta-analysis: a perfect usecase for Bayesian analysis?

- few observations
- informative prior
- sequential

Scientific literature search

★ FIRST (!) exhaustive search of the scientific literature

Scientific literature search

Scientific literature search

Evidence synthesis

Meta-analysis \in evidence synthesis

e.g. meta-regression, mechanistic modeling, ...

Scientific literature search

Evidence synthesis

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Still active research domains:

- random effects model will down-weight studies with larger sample sizes
 - Serghiou & Goodman, JAMA, 2018

Scientific literature search

Evidence synthesis

Meta-analysis ∈ evidence synthesis

e.g. meta-regression, mechanistic modeling, ...

Still active research domains:

- random effects model will down-weight studies with larger sample sizes
 - Serghiou & Goodman, JAMA, 2018
 - a bug or a feature ?



Your turn!



Practical: exercise 6