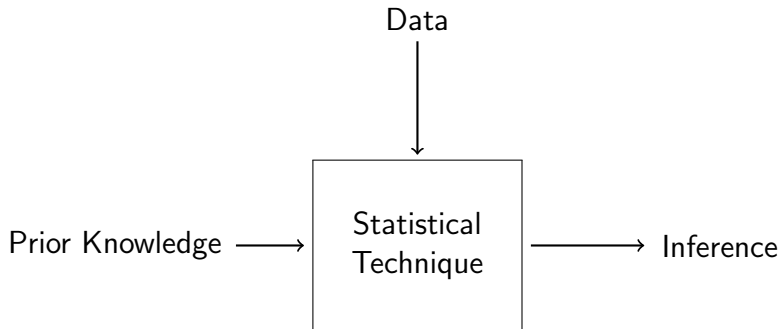


STAT 431 — Applied Bayesian Analysis — Course Notes

Introduction

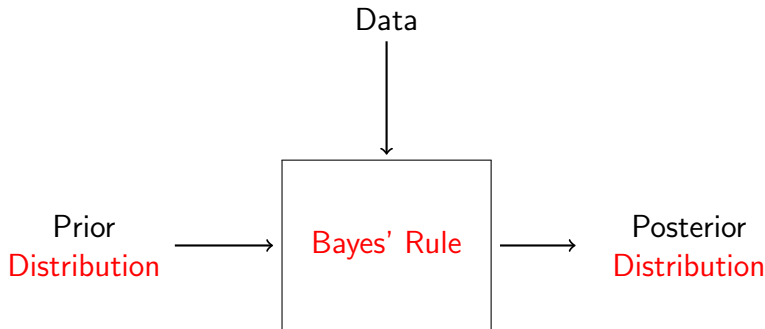
Fall 2022

Statistics (Oversimplified)



The “statistical technique” may involve a probability **model** for the data.

Bayesian Perspective



Bayes' rule involves a model, which defines a **likelihood** for the data.

The fundamental Bayesian relationship (Bayes' rule):

$$\underbrace{\text{Prob}(\text{Model} \mid \text{Data})}_{\text{posterior}} \propto \underbrace{\text{Prob}(\text{Data} \mid \text{Model})}_{\text{likelihood}} \times \underbrace{\text{Prob}(\text{Model})}_{\text{prior}}$$

“Proportional to” (\propto) means that there is a positive multiplier (proportionality constant), possibly depending on the Data but **not** the Model, that would make the two sides equal.

Challenges

What should the prior be?

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Could come from:

- ▶ actual prior information
earlier research, surveys, ...

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What should the prior be?

Could come from:

- ▶ actual prior information
earlier research, surveys, ...
- ▶ a carefully calibrated guess
subjective priors
- ▶ intention to be as objective as possible
noninformative/objective priors

How do we get access to the posterior?

How do we get access to the posterior?

Some tools:

- ▶ Bayes' rule

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- ▶ Bayes' rule
- ▶ conjugacy

How do we get access to the posterior?

Some tools:

- ▶ Bayes' rule
- ▶ conjugacy
- ▶ Markov chain Monte Carlo (MCMC)
Gibbs sampling

Software

R:

- ▶ flexible computing environment
- ▶ basic knowledge is a course prerequisite

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JAGS:

- ▶ Bayesian MCMC package
 - ▶ simulation tool of choice for this course
- (others: WinBUGS, OpenBUGS, Stan, NIMBLE, ...)