

Bayesian Analysis of Data

Key Steps, following Krushcke, 2015 / Hobbs et al 1015

DRME

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Outline

Introduction

Step 1: Identify Relevant Data

Step 2: Define Descriptive Model

Step 3: Specify Prior Distribution

Step 4: Bayesian Inference

Step 5: Posterior Predictive Check

Hobbs et al 2015

Bayesian Analysis Steps: Krushcke, 2015

1. Identify relevant data and measurement scales.
2. Define a descriptive model for the data.
3. Specify a prior distribution on parameters.
4. Use Bayesian inference to allocate credibility.
5. Check posterior predictions against data.

Step 1: Identify Relevant Data

- ▶ Determine measurement scales.
- ▶ Identify predictor and response variables.

Step 2: Define Descriptive Model

- ▶ Choose a mathematical form for the model.
- ▶ Ensure parameters align with theoretical goals.

Step 3: Specify Prior Distribution

- ▶ Obtain audience approval for the prior.
- ▶ Ensure the prior reflects prior knowledge.

Step 4: Bayesian Inference

- ▶ Use data to update beliefs (Bayesian inference).
- ▶ Interpret the posterior distribution.

Step 5: Posterior Predictive Check

- ▶ Verify that posterior predictions match observed data.
- ▶ Consider alternative descriptive models if needed.

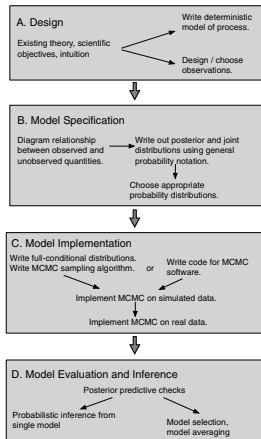


Figure 0.0.1. Gaining insight from Bayesian models involves the same sequence of steps for virtually all research problems, steps that fall into four broad groups. The sequence of steps is indicated by the long and short arrows. This book is organized to explain these steps in a logical way. **(A)** Design is not uniquely Bayesian, but we include it here because we want to encourage the thoughtful development of mathematical models of ecological processes as a starting point for analysis (chapter 2). **(B)** The premise of this book is that mathematical models must be combined with data to allow us to learn about how ecological systems operate. Chapters 3, 4, 5, and 6 show how we specify models to include data. **(C)** A key idea is that a properly specified model provides all we need to know to implement the enormously powerful algorithm Markov chain Monte Carlo (MCMC). We provide a principled understanding of how and why MCMC works in chapter 7. **(D)** We then cover how to use output from MCMC as a basis for inference from single models (chapter 8) and from multiple ones (chapter 9). Finally, we return to the key process of