

General Outline

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2024-01-20

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General objective

- In this section, we will review:
 - Basic probability concepts and various probability distributions.
 - Uses of Bayes inference in Ecology.
 - Some criticisms to the use of p-values.

Key Concepts

- Probability basics
- Common probability distributions (binomial, Dirichlet, gamma, exponential, log-normal)
- Time to say good-bye to p-values
- Bayes in Ecology

Activities

- Review: Unit 3. Bodine et al and the ASA statement.
- Read: Bayesian inference in ecology. Ecology Letters (2004) 7: 509–520 doi: 10.1111/j.1461-0248.2004.00603.x
- Find a paper in your area of expertise and revise the use of p-values, write down a short analysis (max 1000 words) of the possible ways to solve the problems you might have detected.

Readings

Basic readings

- Unit 3. Bodine et al [Read Online](#)
- Ellison. 2004. Bayesian inference in ecology. Ecology Letters. 7: 509–520 doi: 10.1111/j.1461-0248.2004.00603.x
- ASA statement [Read Online](#)

Should read

- Chapter 5. Sokal & Rohlf
- Chapter 1. Anderson's perspective on Science and Experimental design [Read Online](#)
- Storopoli (2022). Bayesian Statistics: a graduate course.

- van de Schoot, R., Depaoli, S., King, R. et al. Bayesian statistics and modelling. Nat Rev Methods Primers 1, 1 (2021).

Probability

General objective

- In this section, we will review:
 - Basic probability concepts and various probability distributions.

Key Concepts

- Probability basics
- Common probability distributions (binomial, Dirichlet, gamma, exponential, log-normal)

Activities

- Review:
 - Chapter 2: Introduction: Credibility, Models, and Parameters [Kruschke, J. K. \(2014\). Doing Bayesian data analysis. Academic press.](#)
 - Chapter 4: What is This Stuff Called Probability? [Kruschke, J. K. \(2014\). Doing Bayesian data analysis. Academic press.](#)
- Prepare the exercises in both chapters.
- Review: Chapter 3: Principles of Probability [Hobbs, N. \(2015\). Introduction to statistical thinking. CRC Press.](#)

Readings

Basic readings

- Chapters 2 & 4 [Kruschke, J. K. \(2014\). Doing Bayesian data analysis. Academic press.](#)
- Chapter 3 [Hobbs, N. \(2015\). Introduction to statistical thinking. CRC Press.](#)

Should read

- Unit 3. Bodine et al [Read Online](#)
- Chapter 5. Sokal & Rohlf
- Ellison. 2004. Bayesian inference in ecology. Ecology Letters. 7: 509–520 doi: 10.1111/j.1461-0248.2004.00603.x

Likelihood

General objective

- In this section, we will review:
 - Basic likelihood concepts.

Key Concepts

- Likelihood

Activities

- Review: Chapter 4: Likelihood [Hobbs, N. \(2015\). Introduction to statistical thinking. CRC Press.](#)

Readings

Basic readings

- Chapter 4 [Hobbs, N. \(2015\). Introduction to statistical thinking. CRC Press.](#)

Should read

- Ellison. 2004. Bayesian inference in ecology. Ecology Letters. 7: 509–520 doi: 10.1111/j.1461-0248.2004.00603.x

Bayes

General objective

- In this section, we will review:
 - Bayes' rule

Key Concepts

- Conditional probability
- Bayes' theorem (or Bayes' rule)

Activities

- Review:
 - Chapter 5: Likelihood [Hobbs, N. \(2015\). Introduction to statistical thinking. CRC Press.](#)
 - Chapter 5: Bayes' Theorem [Kruschke, J. K. \(2014\). Doing Bayesian data analysis. Academic press.](#)

Readings

Basic readings

- Chapter 5 [Hobbs, N. \(2015\). Introduction to statistical thinking. CRC Press.](#)
- Chapter 5 [Kruschke, J. K. \(2014\). Doing Bayesian data analysis. Academic press.](#)

Should read

- Ellison. 2004. Bayesian inference in ecology. Ecology Letters. 7: 509–520 doi: 10.1111/j.1461-0248.2004.00603.x

hLRt - Bayes Factors

General objective

- In this section, we will review:
 - Hierarchical likelihood ratio tests (hLRt) and Bayes factors.

Key Concepts

- Hierarchical likelihood ratio tests (hLRt)
- Bayes factors

Activities

- Review the following Wikipedia pages:
 - Likelihood-ratio test: https://en.wikipedia.org/wiki/Likelihood-ratio_test
 - Bayes factor: https://en.wikipedia.org/wiki/Bayes_factor

Readings

Basic readings

- Kass, R. E., & Raftery, A. E. (1995). The Bayes factor. [Journal of the Royal Statistical Society. Series B \(Methodological\)](#), 57

Should read

- Ellison. 2004. Bayesian inference in ecology. *Ecology Letters*. 7: 509–520 doi: 10.1111/j.1461-0248.2004.00603.x

Markov Chain Monte Carlo

General objective

- In this section, we will review:
 - Markov Chain Monte Carlo (MCMC) methods.

Key Concepts

- Sampling
- Markov Chain Monte Carlo (MCMC)

Activities

- Review:
 - Chapter 7: Markov Chain Monte Carlo [Hobbs, N. \(2015\). Introduction to statistical thinking. CRC Press.](#)
 - Chapter 7: Markov Chain Monte Carlo [Kruschke, J. K. \(2014\). Doing Bayesian data analysis. Academic press.](#)

Readings

Basic readings

- Chapter 7 [Hobbs, N. \(2015\). Introduction to statistical thinking. CRC Press.](#)
- Chapter 7 [Kruschke, J. K. \(2014\). Doing Bayesian data analysis. Academic press.](#)

Should read

- Ellison. 2004. Bayesian inference in ecology. Ecology Letters. 7: 509–520 doi: 10.1111/j.1461-0248.2004.00603.x

Some examples

General objective

- In this section, we will practice with R and apply concepts of MCMC to ecological examples:
 - Estimating bias in a coin (Kruschke, 2014, Chapter 5.3).
 - Simulating a population growth model (adapted from Kruschke, 2014, Chapter 7.2.1).

Activities

- Review Chapters 5-7: Markov Chain Monte Carlo in Kruschke (2014).

Readings

Basic readings

- Chapters 5-7 [Kruschke, J. K. \(2014\). Doing Bayesian data analysis. Academic press.](#)

Should read

- Ellison. 2004. Bayesian inference in ecology. Ecology Letters. 7: 509–520 doi: 10.1111/j.1461-0248.2004.00603.x