

Short Course: Bayesian Modeling for Ecologists and Social Scientists

N. Thompson Hobbs, Mary B. Collins, and Christian Che-Castaldo

August 1-10, 2016

Course preparation

- Consider studying chapters 1-5 in “Bayesian Models: A Statistical Primer for Ecologists,” by Hobbs and Hooten, in preparation for the course. We will cover these materials at the start of the course.

General logistics

- Each day the course will begin at 9am and end at 5pm.
- Coffee will be provided throughout the day by SESYNC.
- Each day, SESYNC will provide various snacks around 10:30am and 3:30pm. Some days we will plan to break, other days you can feel free to grab a snack during our lab activities if you need it.
- Each day we will break from 12:30 to 1:30 for lunch, which will be provided by SESYNC.
- Course materials can be printed at SESYNC if desired. There is a computer with printer access in the common area.

Day 1: What Sets Bayes' Apart

(Mon Aug 1, 2016)

Reading: Hobbs and Hooten—Preface and Chapter 1-2

Introductions, compute overview (30 min total)

Lectures:

- (1) Broad course overview (*Hobbs*)
- (2) What sets Bayes' apart? (*Hobbs*)
- (3) Laws of probability (*Collins*)

Labs:

- (1) Confidence intervals.
- (2) DAGs and Marginal Distributions

Happy Hour at SESYNC

Day 2: Introduction to Probability and Maximum Likelihood

(Tues Aug 2, 2016)

Reading: Hobbs and Hooten, Chapter 3

Lectures:

- (1) Probability distributions (*Hobbs*)
- (2) Maximum likelihood (*Collins*)

Labs:

- (1) Distributions lab
- (2) Light limitation of trees

Day 3: Bayes' Derived and Intro to Priors

(Wed Aug 3, 2016)

Reading: Hobbs and Hooten—Chapter 4-5

Lectures:

- (1) Bayes' made simple: Deriving Bayes' theorem (*Hobbs*)
- (2) Priors distributions I (*Collins*)

Labs:

- (1) Write R code for each component for Bayes' Law
- (2) Conjugate priors lab

Day 4: MCMC

(Thurs Aug 4, 2016)

Reading: Hobbs and Hooten—Chapter 7-8

Lectures:

- (1) MCMC I: Overview (*Hobbs*)
- (2) MCMC II: Implementing accept-reject sampling (*Hobbs*)

Labs:

- (1) Gibbs sampling
- (2) Accept-reject sampling

Day 5: JAGs

(Fri Aug 5, 2016)

Lectures:

- (1) Simple Bayesian Regression (*Che-Castaldo*)
- (2) Inference from a single model (*Hobbs*)

Labs:

- (1) JAGS primer
- (2) Islands problem (including breakout regarding consequences of priors on non-linear derived quantities)

Day 6: Bayesian Models I

(Sat Aug 6, 2016)

Reading: Hobbs and Hooten—Chapter 6

Lectures:

- (1) Hierarchical Models: Group-Level Effects (*Hobbs*) including focus on *vaguely* informative priors.
- (2) Overview of Bayesian Hierarchical Models (*Hobbs*)

Labs:

- (1) Multi-level model on N₂O
- (2) Commonly encountered problems in analysis

Day 7: OFF

(Sun Aug 7, 2016)

Day 8: Bayesian Models II

(Mon Aug 8, 2016)

Reading: Hobbs and Hooten—Chapter 6

Lectures:

- (1) Hierarchical models: Designed Experiments (*Che-Castaldo*)
- (2) Hierarchical models: Mixture, zero-inflation and occupancy (*Hobbs*)

Labs:

- (1) Designed experiments
- (2) Swiss birds I: Occupancy modeling

Day 9: Bayesian Models III

(Tues Aug 9, 2016)

Reading: Hobbs and Hooten—Chapter 8: Sections 1 and 5; Chapter 9

Lectures:

- (1) Model checking (*Hobbs*)
- (2) Model selection (*Hobbs*)
- (3) Meta analysis including use of informed priors (*Hobbs*)

Labs:

- (1) N₂O, part II: Model evaluation
- (2) Model selection
- (3) Meta Analysis

Day 10: Dynamic models

(Wed Aug 10, 2016)

Lectures:

- (1) Hierarchical Models: Dynamic models (*Hobbs*)

Labs:

- (1) Lynx: Dynamic models