



# Bayesian Modeling for Socio-Environmental Data

August 15-25, 2017

Instructors: Chris Che-Castaldo, Mary B. Collins, N. Thompson Hobbs

*Course syllabus is subject to change.*

**Course Preparation:** R is a crucial skill for success in this course. Considering reviewing Tom's R Primer, and head over to Quick R, <http://www.statmethods.net/index.html>, which gives a nice overview of basic R functionality. We ask that you are fluent with the following topics from Quick-R:

1. Data Types, Importing Data (from excel or a .csv file), Keyboard Input, and Missing Values under Data Input
2. All topics under Data Management
3. All topics under Graphs

Specifically, you should be very comfortable with manipulating matrices and lists and writing and using custom functions.

We strongly recommend purchasing Hobbs & Hooten 2015 <https://www.amazon.com/Bayesian-Models-Statistical-Primer-Ecologists/dp/0691159289>. The first three chapters provide foundational material that we will cover fairly quickly in the course, so if you have not had a course in mathematical statistics, reading those chapters before the course is crucial. The structure of the course closely follows the organization of the book. It will be a useful reference after the course.

**Course Logistics:** We will be starting on the first day at 8am. Every other day we will begin at 9am. We will usually end at 5 or 5:30.

Remember that lunch will be served at SESYNC each day during the course.

Course materials will be distributed throughout the course via [GitHub](#). Clone our repo and plan on pulling down new material often.

## Course Schedule

### Day 1: Probability (*review H&H Chs 1-3*)

- Participant and Course Introduction
- *What Sets Bayes Apart?*
- *Laws of Probability* & Probability Lab Exercises: I-VI
- *Probability Distributions and Moment Matching* & Probability Lab Exercise VII-VIII

### Day 2: Likelihood & Bayes' Theorem (*review H&H Chs 4-6*)

- *Probability Distributions and Moment Matching* & Probability Lab Exercise IX
- *Likelihood*
- *Bayes' Theorem* & Bayes' Theorem Exercises
- Happy Hour at SESYNC

### Day 3: *Introduction to Hierarchical Models* & Hierarchical Modeling Board Work

### Day 4: MCMC & JAGS (*review H&H Chps 8*)

- *Conjugate Priors* & Conjugate Priors Brief Exercise
- *MCMC*
- JAGS Primer Work *and/or* MCMC I and II lab

### Day 5: MCMC & JAGS (*review H&H Chps 8*)

- JAGS Primer Work *and/or* MCMC I and II lab
- *Inference From a Single Model*
- *Vague Priors in Non-Linear Models* & Islands Problem Set

### Day 7: Bayesian Regression, Analysis of Covariance, & Multi-Level Modeling (*review H&H Chp 9-12*)

- *Bayesian Regression* & Practice: Writing Models and Psuedo Coding
- *Multi-Level Modeling* & Begin Multi-Level Modeling Lab

### Day 8: Multi-Level Modeling Continued, Model Checking, & Model Selection

- *Model Checking*
- Continue Multi-Level Modeling Lab
- *Model Selection*

### Day 9: Flavors of Modeling

- *Mixture Models, Zero Inflation, & Occupancy*
- Continue Multi-Level Modeling Lab
- *Dynamic Models*
- Swiss Birds *and/or* Lynx Lab Exercises

**Day 10:** Spatial Modeling

- *Continuous Spatial Process Modeling* & Source Diversity Lab

**Day 11:** Using Your Bayes' Skills

- Participant Project Presentations and Feedback