



Bayesian Modeling for Socio-Environmental Data

May 29 - June 8, 2018

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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: (5/29) Probability (*review H&H Chs 1-3*)

- Participant and Course Introduction (TH)
- *What Sets Bayes Apart?* (TH)
- *Laws of Probability* & Probability Lab Exercises: I-V (MC)
- *Probability Concepts and Notation* & Probability Lab Exercise VI (TH)
- *Probability Distributions* & Probability Lab Exercise VII (TH)
- *Marginal Distributions* & Probability Lab Exercise VIII (TH)
- *Moment Matching* & Probability Lab Exercise IX (TH)

Day 2: (5/30) Likelihood & Bayes' Theorem (*review H&H Chs 4-6*)

- *Likelihood* & Likelihood Problem Set (CCC)
- *Bayes' Theorem* & Bayes' Theorem Exercises
- *More about Priors* & Lab Exercise

Day 3: (5/31) *Introduction to Hierarchical Models* & Hierarchical Modeling Board Work

Day 4: (6/1) Markov Chain Monte Carlo (*review H&H Ch 7*)

- *MCMC Overview* & MCMC Exercise (TH)
- Begin JAGS Primer Work
- Happy Hour at SESYNC

Day 5: (6/2) JAGS & Modeling Practice (*review H&H Chps 8*)

- Continue with JAGS Primer Work
- *Inference From a Single Model* (TH)
- *Vague Priors in Non-Linear Models* (TH)
- Islands Problem Set
- *MCMC Accept Reject* & MCMC Metropolis-Hastings Coding Exercise (TH, if time allows)

Day 6: (6/3) OFF

Day 7: (6/4) Bayesian Regression, Analysis of Covariance, & Multi-Level Modeling (*review H&H Chp 9-12*)

- *Bayesian Regression* & Writing Models and Psuedo Coding Lab (CCC)
- *Multi-Level Modeling* & Multi-Level Modeling Lab (TH)

Day 8: (6/5) Multi-Level Modeling Continued, Model Checking, & Model Selection

- *Model Checking & Selection* (MC & TH) & Birds Lab
- *Designed Experiments* & Lab (CCC)

Day 9: (6/6) Flavors of Modeling

- *Dynamic Models* & Lab (TH)
- *Mixture Models, Zero Inflation, & Occupancy* & Fitting Mixture Models & Classic Zero Inflation (TH)

Day 10: (6/7) More Models & Applying Your Knowledge

- *Spatial Modeling* (TH & CCC)
- *Ordinal Modeling* (TH & MC) & Lab
- *Bayesian Modeling Practicalities* & Participant Project Work (TH)

Day 11: (6/8) Using Your Bayes' Skills

- Participant Project Presentations and Feedback