Instructions for Using BayesLabs

This repository contains a series of laboratory exercises designed to support an introductory course in Bayesian modeling for graduate students, post-docs, faculty, and research scientists. The material can be adapted for use in a 10-day intensive workshop format or a more traditional semester-long course. Examples are drawn from social science and ecology. The materials were developed by N. Thompson Hobbs, Mevin B. Hooten, Christian Che-Castaldo, Mary Collins, Kiona Ogle, and Maria Uriarte with support from the National Science Foundation (awards DBI 1052875 and DEB1145200). The labs were designed to compliment reading and lectures based on Hobbs, N. T., and M. B. Hooten. 2015. Bayesian models: a statistical primer for ecologists. Princeton University Press, Princeton, N.J. (Table 1).

Each folder in the repository contains an R markdown file with switches that toggle output of .html files for exercises alone and exercises with answers. Using these switches is explained in the R markdown files. The files `/Labs/title.txt` and `/Labs/subtitle.txt` specify the course name on all materials, allowing users to change the title to match the name of the course they are teaching. We ask that the logo acknowledging NSF support remain unchanged by users.

The `/Admin` folder contains instructions for pulling the repository and for creating an R package containing the data library required for the exercises.

Table 1: Laboratory exercises supporting an introductory course in Bayesian modeling. Readings are chapters from Hobbs and Hooten 2015. Exercises are arranged with introductory topics at the top of the table and more advanced topics toward the bottom.

Folder in `/Labs`	Topics and challenges	Reading
`Probability`	Rules of probability. Factoring joint distributions. Probability distributions. Marginal distributions. Moment matching.	Chapter 3
`HemlockLightExample`	Likelihood functions. Computing total likelihoods from multiple observations. Using prior information in the likelihood framework.	Chapter 4
`ConjugatePriors`	Find parameters of posterior distributions using conjugacy between likelihoods and priors.	Chapter 5.3
`BayesTheorem`	Compute the likelihood, prior, and marginal distribution of the data and assemble them to compute the posterior distribution.	Chapter 5.1, 5.2
`MCMC1`	Introduction to Markov chain Monte Carlo using Gibbs sampling for normal mean and variance.	Chapter 7
`MCMC2`	Accept-reject sampling using Metropolis-Hastings algorithm.	Chapter 7
`JAGSPrimer`	A tutorial on JAGS and rjags for implementing Markov chain Monte Carlo.	none
`JAGSProblem`	Using JAGS and rjags.	none
`ModelBuilding`	Word problems to teach drawing directed acyclic graphs and using them to write posterior and joint distributions.	Chapters 6, 10, 11, 12
`MultiLevelModels`	Model building and computation for group-level intercepts and slopes.	Chapter 6.2.2
`PosteriorPredictiveChecks`	Using data simulation to test for lack of fit. Computing Bayesian p values.	Chapter 8.1
`SwissBirds`	Occupancy models. Zero inflation. Derived quantities.	Chapter 6.2.3
`ModelSelection`	Evaluating evidence for alternative models using the DIC, WAIC, and posterior-predictive loss.	Chapter 9
`DynamicModels`	State space models. Predictive process distributions. Forecasting.	Chapter 8.4, 8.5
`MetaAnalysis`	Combining information from multiple studies in priors and likelihoods.	Chapter 4