
Examples from Two Undergraduate Bayesian Courses

— Tools, Resources, and
Suggestions for Teaching —
Jingchen (Monika) Hu & Mine Dogucu

bit.ly/SDSS2021Bayes



Jingchen (Monika) Hu

 [@monika76five](https://twitter.com/monika76five)



Mine Dogucu

 [@MineDogucu](https://twitter.com/MineDogucu)

Introduction: Bayesian undergraduate education

Bayesian education at the undergraduate level is getting popular

- new courses
- new textbooks
- new papers
- new teaching and learning materials

(check out the references!)

The State of Undergraduate Bayesian Education

Major Discipline	Elective	Required	Total
Statistical Sciences	29	2	31
Mathematical Sciences	13	0	13
Combination of Statistical, Mathematical, Computer, or Data Sciences	12	0	12
Data Sciences	6	2	8
Business, Economics, and Management	7	0	7
Computer Sciences	5	0	5
Biological Sciences	5	0	5
Psychology and Cognitive Sciences	3	0	3
Public Policy and Political Science	2	0	2
Geological and Planetary Sciences	1	0	1
Quantitative Sciences	1	0	1
Physics	1	0	1
Philosophy	1	0	1
No Specific Major	1	0	1

(Dogucu & Hu, *in preparation*)

Bayesian Statistics @ Vassar College

Context

- **Prerequisite:** calculus and probability
- **Enrollment:** about 20 - 25 students
- **Student background:** (double) majors of mathematics and statistics, cognitive science, computer science, neuroscience, physics, biochemistry, environmental studies, economics, political science, drama, philosophy, history
- **Major / minor fulfillment:** mathematics and statistics major and minor

Content

13 weeks & 6 topics

- Bayesian inference for a proportion
- Bayesian inference for a mean
- Gibbs sampler and MCMC
- Bayesian hierarchical modeling
- Bayesian linear regression

Computing

- **Lab session:**
 - scheduled during class meeting times
 - 5 labs
 - RMarkdown
- **Programming languages & packages**
 - R / RStudio
 - [ProbBayes](#)
 - Just Another Gibbs Sampler (JAGS)

Assessment

Assessment component	Percentage
Homework and Labs	25%
Participation (R modules, case studies, paper discussions)	10%
Midterm exams (in-class + take-home)	40% (20% * 2)
Project	25%

Introduction to Bayesian Data Analysis @ UC Irvine

Context

- **Prerequisite:** STATS 120C. Introduction to Probability and Statistics III
- **Recommended:** STATS 110. Statistical Methods for Data Analysis I
- **Offered:** every Winter quarter (and often in Summer quarter)
- **Enrollment:** 30 students
- **Students:** Data Science major (required), Statistics minor (elective)

Content

Weeks 1 - 4, Bayesian Foundations

Weeks 5 - 7, Posterior Simulation and Analysis

Week 8 - 10, Bayesian Regression and Classification

Computing

Programming languages: R / RStudio

Packages: [bayesrules](#), rstan, rstanarm, bayesplot

Assessment

Attendance	5%
Quizzes	15%
Homework Assignments	15%
Midterm	25%
Final Exam	25%
Final Project	15%

Suggestions & Resources

Suggestions for course development

- **Real world applications**
 - Examples
 - Case studies
- **Bayesian computing**
 - Simulation-based teaching and learning
 - R, Python, JAGS, Stan
- **Student research**
 - Course projects
 - Accessible papers for reading, discussion, and critique with a reading guide; design labs around papers
- **Comparisons to Frequentist methods**

Resources

- **Course websites**
 - [Bayesian Statistics](#) @ Vassar
 - stats115.com @ UC Irvine
- [Undergraduate Bayesian Education Network](#) (Slack)
- **List of textbooks, papers, courses**
 - [Undergraduate Bayesian Education Resources](#)
 - [Undergraduate Bayesian Resources](#)
- **Workshops at USCOTS, June 24, 2021**
 - [Introducing Bayesian Statistical Analysis into Your Teaching](#)
 - [Teaching Bayesian Statistics at the Undergraduate Level](#)

References

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