Reading Course with Prof. Daniel Simpson

January 2019 - May 2019

1 Summary

The course will give a thorough overview on Bayesian approach to inference, its theoretical foundations and its application in diverse areas. It will cover 4 main topics: Bayesian Inference, Bayesian Data Analysis, Regression Models, and Specific Models. The course will also go over readings on Computation Techniques that can be applied for the presented analysis.

2 Grading

The course will be evaluated based on a coding project and final paper.

1. Coding Project: Project based on one of the topics covered in the course readings which will be due by mid March (date determined during the semester by Professor and Student)
2. Final Paper: Final Paper will be either based on current research paper on topic covered by course the course chosen by the student and professor, or an original research topic proposed by student to Professor for which they both can agree on (also revolving around topics covered by the course readings).

3 Topics Covered

1. Inference from large samples and comparison to standard non-Bayesian methods (Chapter 4).
2. Hierarchical models, estimating population parameters from data, rat tumor rates, SA T coaching experiments, meta-analysis (Chapter 5).
3. Model checking, posterior predictive checking, sensitivity analysis, model comparison and expansion, checking the analysis of the SAT coaching experiments (Chapter 6).
4. Data collection—ignorability, surveys, experiments, observational studies, unintentional missing data (Chapter 7).

5. General advice, connections to other statistical methods, examples of potential pitfalls of Bayesian inference (Chapters 8 and 9).

6. Computation: overview, uses of simulations, Gibbs sampling (Chapter 10, Sections 11.1–11.3).

7. Normal linear regression from a Bayesian perspective, incumbency advantage in Congressional elections (Chapter 14).

8. Hierarchical linear models, selection of explanatory variables, forecasting Presidential elections (Chapter 15).

9. Generalized linear models, police stops example, opinion polls example (Chapter 16).

10. Robust inference and Non-linear Models, population toxicokinetics and serial dilution assay (Chapter 17 and 20).

11. Mixture models, reaction times and schizophrenia (Chapter 18).

12. Multivariate models, Time series and spatial models (chapter 19).

13. Missing data, multiple imputation for a series of polls (chapter 21).

14. Decision analysis, medical screening (Chapter 22).

4 Material Used

1. Primary: Bayesian Data Analysis, by Andrew Gelman, John B.Carlin, Hal S.Stern, and Donald B.Rubin, 2nd Edition (Used for theory)

2. Secondary: Probabilistic Programming & Bayesian Methods for Hackers, by Cameron Davidson-Pilon (Used for the applications with Tensorflow Probability in addition to STAN)