STAT 525: Bayesian Statistics
Course Project

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Project description

The purpose of the final project is to encourage each student individually to read one (or more) paper in depth on Bayesian statistics. **The paper should focus on Bayesian methods, Bayesian theory, or Bayesian computing**. Additional related papers may be necessary to provide background. Review papers and papers that simply apply existing Bayesian methods to a dataset are generally **not** acceptable for this project, but may be helpful resources.

A significant portion of the project will be a detailed summary of your selected paper. However, it is expected that your project will expand beyond the paper, such as:

- Model or algorithm implementation for data analysis;
- Model or algorithm comparisons on real or simulated data; or
- Theoretical extensions of the results in the paper(s).

Material covered in the course may be used at this stage of the project. For example, you might compare the methods in your paper to a regression model covered in class, or use MCMC and model diagnostics from class to evaluate algorithm or model performance. Some papers may have R code or packages available, while other papers may require implementation in R or Stan. Use of these computing resources and documentation is permissible.

Project requirements

The first component of the project is the **project proposal**. The project proposal should be 1-2 pages and accomplish the following:

1. List the paper(s) to be studied;
2. Outline the main topics to be covered;
3. Discuss how you plan to apply or extend the results in the paper(s).

The proposal counts for 5% of the project grade, so it should be taken seriously. Projects may be approved at any time, but you should **not** work on your project until the proposal has been approved. I am happy to discuss potential projects during my office hours.

The second component of the project is the **written report**. The specifications for the report are as follows:

1. The report must include a summary, an introduction, and references;
2. The report should be 12-20 pages using **12pt font, 1 inch margins, double-spaced**, including figures and references (excluding code and output);
3. Conciseness is preferable, and large tables should be avoided whenever possible.

The written report will be graded based on clarity, correctness, completeness, and originality.

Reports that plagiarize or copy text from the paper(s) will receive substantial grade reductions and may be reported to the Rice Honor Council.

Deadlines

- Project proposal: Thursday, October 31, 5pm (5% of project grade);
- Final written report: Thursday, December 5, 5pm (95% of project grade).

Resources for selecting papers

It is advised that you select your paper(s) carefully. Consider topics that interest you, as well as topics that you may have heard about but not studied. This project could serve as the foundation or literature review for a future research project with a faculty member, or it could provide you with experience in a completely new area.

Below I have provided a suggested list of journals and individual papers to guide your search. **However, these lists are not exhaustive, nor do they guarantee project approval.**

Unless special permission has been granted, **each student must select his/her own unique paper**, so multiple students cannot work on the same paper. However, there may be overlap in the necessary background reading for related topics, which is expected and permissible.

Suggested Journals

The following journals contain papers with strong statistical methods, theory, and computing. Searching through the journals for Bayesian papers will give you a survey of some available options.

- *Journal of the American Statistical Association, Theory and Methods*
- *Journal of the Royal Statistical Society, Series B*
- *Biometrika*
- *Annals of Statistics*
- *Bayesian Analysis*
- *Journal of Business and Economic Statistics*
- *Journal of Computational and Graphical Statistics*

Suggested Papers

The following papers **may** be suitable for projects in this course—some are more challenging than others. However, project proposals using these papers are **not** guaranteed approval. Searching for related papers, papers by the same authors, or papers that cite these (e.g., using Google Scholar) may provide appealing alternatives.

- Bayes and empirical-Bayes multiplicity adjustment in the variable-selection problem (Scott and Berger, 2010)
- BART: Bayesian additive regression trees (Chipman and George, 2010)
- Decoupling shrinkage and selection in Bayesian linear models: a posterior summary perspective (Hahn and Carvalho, 2015)
- Sparse Bayesian infinite factor models (Bhattacharya and Dunson, 2011)
- Spike-and-slab priors for function selection in structured additive regression models (Scheipl, Fahrmeir, and Kneib, 2012)
- Large Bayesian vector auto regressions (Banbura and Giannone, 2010)
- Penalising Model Component Complexity: A Principled, Practical Approach to Constructing Priors (Simpson, Rue, Riebler, Martins and Sorbye, 2017)
- Bayesian Regularized Quantile Regression (Li, Xi, and Lin, 2010)
- Bayesian Nonparametric Covariance Regression (Fox and Dunson, 2015)
- Bayesian Generalized Additive Models for Location, Scale, and Shape for Zero-Inflated and Overdispersed Count Data (Klein, Kneib, and Lang, 2015)
- Consistent High Dimensional Bayesian Variable Selection via Penalized Credible Regions (Bondell and Reich, 2012)
- Scalable Variational Inference for Bayesian Variable Selection in Regression, and Its Accuracy in Genetic Association Studies (Carbonetto and Stephens, 2012)

- Nonparametric Bayes modelling of count processes (Canale and Dunson, 2013)
- Bayesian Kernel Mixtures for Counts (Canale and Dunson, 2011)
- Nonparametric Bayesian models through probit stick-breaking processes (Rodriguez and Dunson, 2011)
- Particle Markov chain Monte Carlo methods (Andrieu, Doucet, and Holenstein, 2010)
- Slice Sampling (Neal, 2003)
- Wavelet-based functional mixed models (Morris and Carroll, 2006)
- Large Bayesian VARs: A Flexible Kronecker Error Covariance Structure (Chan, 2018)
- Bayesian Graphical Regression (Ni, Stingo, and Baladandayuthapani, 2019)
- Scaling It Up: Stochastic Search Structure Learning in Graphical Models (Wang, 2015)
- To center or not to center: That is not the question—an Ancillarity-Sufficiency Interweaving Strategy (ASIS) for boosting MCMC efficiency (Yu and Meng, 2011)