AMS 241: Bayesian Nonparametric Methods
Fall 2010

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Web page: http://www.soe.ucsc.edu/classes/ams241/Fall10/

Lectures: Tuesday, Thursday 10-11:45am (Baskin Engineering 169)
Office hours: Monday 1-2pm; Thursday 12-1pm (or by appointment)

Course description: Bayesian methods are central to the application of modern statistical modeling in a wide variety of fields. Bayesian nonparametric methods increase the flexibility and utility of Bayesian models, and are becoming increasingly popular in recent years.

This course will offer, at a graduate level, a survey of the theory, methods, and applications of Bayesian nonparametrics. Some elements of the theoretical construction of nonparametric priors will be introduced. However, emphasis will be placed on modeling approaches, implementation for inference and prediction using Markov chain Monte Carlo (MCMC) methods, and applications.

The Bayesian nonparametrics literature comprises by now a large collection of prior probability models for spaces of (random) distributions and functions, including: Dirichlet processes; Dirichlet process mixture models; Polya trees; Stick-breaking priors for general nonparametric mixtures; Species sampling models; Product partition models; Neutral to the right processes; Gamma and extended gamma processes; Beta processes; dependent Dirichlet processes; and Gaussian process priors for nonparametric regression.

We will study some of these prior models and discuss applications of Bayesian nonparametrics in areas that include categorical data analysis, density estimation, nonparametric regression, spatial statistics, and survival analysis.

Background: Knowledge of Bayesian theory, modeling, and computing (at the level of AMS 207) will be assumed.

Grading: The course grade will be based on homework assignments and a project. The homework assignments will involve data analyses using nonparametric priors and associated MCMC methods for inference and prediction. A typical project will consist of expository review of a specific part of the literature, and may include illustration of related Bayesian nonparametric models with relevant data sets/case studies. A written report on the project will be required; moreover, there will be in-class project presentations. For the project presentations, we will likely use the assigned time by the registrar for the final exam, on Wednesday December 8, 12-3pm.
References: There is no textbook. The course material is taken from books and various papers covering theory, methods, and applications of Bayesian nonparametrics. Some of the material is included in notes that will be provided during the quarter through the course website.

Books on Bayesian nonparametrics include:

Review papers include: