Nonparametric Bayes methods (STA 5934)
Fall 2016

Classes: Tuesday/Thursday 11:00 AM – 12:15 PM, **OSB 0215**

Instructor: Dr. Debdeep Pati

- Email: debdeep@stat.fsu.edu (*When you send me an e-mail, use subject-line* "[STA5934]")
- Office: OSB 201D
- Office Hours: Tuesday/ Thursday: 3:15 – 4:15 pm (*If you are unable to meet at these times, then schedule an appointment with the instructor for an alternative time.*)
- Mailbox location: 214 OSB (accessible during 8:00 am - 5:00 pm on working days only)

Objective: The objective of the course is to familiarize students with nonparametric Bayesian methods for modeling densities, conditional densities and functions from multivariate, longitudinal and functional data. Methods will be motivated by real data applications in biomedical research and machine learning. The course will primarily have an applied emphasis.

Overview: Introduction to random probability measures, finite mixture models and Dirichlet process. Basic properties, methods for computation, and applications of Dirichlet process mixture models to density estimation, clustering and random effects modeling. Overview of some alternatives to the Dirichlet process. Nonparametric Bayes methods for multivariate, longitudinal, and functional data using dependent Dirichlet processes, kernel mixtures, and various stick-breaking formulations. Priors for densities with quantile constraints, shape constraints, and stochastic ordering constraints, applications to flexible residual density modeling and dose response modeling. Including predictors in flexible models for conditional distribution modeling and density regression. Construction of Gaussian processes, properties, applications in regression and classification, approximation methods for large datasets. Methods for model and variable selection in high-dimensions, shrinkage priors. Nonparametric Bayes deconvolution. Nonparametric Bayes modeling of categorical data, Nonparametric Bayes models for complex objects like networks, graphs and tensors.

Prerequisites: Familiarity with basic parametric Bayesian hierarchical models and Markov chain Monte Carlo (MCMC) computation is assumed.

Computation. Computational algorithms will be discussed without focusing on specific software or packages. Students will be expected to have adequate background in computing to implement algorithms. MATLAB or R is recommended for computing.

Student Responsibilities:

(1) Class participation [10%]: Students are expected to attend and participate actively in class.

(2) Assignments [40%]: Approximately 10 short homework assignments, 1 or 2 problems each and will include a computational problem on simulated / small-scale real data.

(3) Projects [50%]: Students will be expected to write-up and present results from a project (about 15 pages). The project is due last day of semester. I will provide data sets to students, unless a student has a particular data set they wish to analyze (must be approved by me).

Textbooks: The notes provided in the class will be sufficient. The material will be based on the referred papers in class and the following books.

- *Andrew Gelman, John Carlin, Hal Stern, David Dunson, Aki Vehtari, and Donald Rubin, Bayesian Data Analysis, 3rd Edition*
- *Peter Müller and Abel Rodriguez, Nonparametric Bayesian Inference, NSF-CBMS Conference Series in Probability and Statistics, 2013.*
- *N.L. Hjort, C Holmes, P Müller and S.G. Walker (eds), Bayesian Nonparametrics, Cambridge Series in Statistical and Probabilistic Mathematics, 28, Cambridge University Press, 2010.*
- *J.K. Ghosh and R.V. Ramamoorthi Bayesian Nonparametrics, Springer, 2003.*
- *Carl Edward Rasmussen and Christopher K. I. Williams. Gaussian Processes for Machine Learning, The MIT Press, 2006. ISBN 0-262-18253-X.* (Entire book available online at http://www.gaussianprocess.org/gpml/)

Homeworks:

- Homework assignments and their due dates will be communicated in class. The solutions must be handed to me during class on the due date. One assignment, with the lowest grade, will be dropped. Please write clear and detailed answers to the homework problems. Homework solutions will be posted at the time the homework is due. Any questions concerning homework grades should be addressed to the grader during his/her office hours.
- To receive credit for the homework you must show **all** work neatly, write in blue or black pen or pencil (never in red), clearly **label** each problem, **circle** your final answers, **staple** your entire assignment together in the correct order with your **full name printed** (as appeared in the blackboard) on the first page.
- Each homework carries equal weight.
- You are allowed to work with other students on the homework problems, however, verbatim copying of homework is absolutely forbidden and constitutes a violation

of the Honor Code. Therefore, each student must ultimately produce his or her own homework to be turned in and graded.

Add/drop dates: See `http://registrar.fsu.edu/dir_class/fall/acad_cal.htm`

Homework/exam regrade: You have one week to request a regrade of a homework or exam from the date on which the graded homework/exam is available to the students of the class. Submit a written request detailing the nature of the grading error to the grader or instructor along with the relevant homework or exam.

Exam policies:

"*The Academic Honour System of The Florida State University is based on the premise that each student has the responsibility to uphold the highest standards of academic integrity in the students work, refuse to tolerate violations of academic integrity in the academic community, and foster a high sense of integrity and social responsibility on the part of University community.*" Please note that violations of this Academic Honor System will not be tolerated in this class. Specifically, incidents of plagiarism of any type or referring to any unauthorized material during examinations will be rigorously pursued by this instructor. Before submitting any work for this class, please read the Academic Honor System in its entirety (as found in the FSU General Bulletin and in the FSU Student Handbook) and ask the instructor to clarify any of its expectations that you do not understand.

Disability policy: Students with disabilities needing academic accommodation should:

(1) register with and provide documentation to the Student Disability Resource Center; and

(2) bring a letter to the instructor indicating the need for accommodation and what type. This should be done during the first week of class.

This syllabus and other class materials are available in alternative format upon request. For more information about services available to FSU students with disabilities, contact the:
Student Disability Resource Center 874 Traditions Way
108 Student Services Building
Florida State University
Tallahassee, FL 32306-4167
(850) 644-9566 (voice)
(850) 644-8504 (TDD)
sdrc@admin.fsu.edu
http://www.disabilitycenter.fsu.edu/

Free Tutoring from FSU:. On-campus tutoring and writing assistance is available for many courses at Florida State University. For more information, visit the Academic Center for Excellence (ACE) Tutoring Services comprehensive list of on-campus tutoring

options - see http://ace.fsu.edu/tutoring or contact tutor@fsu.edu. High-quality tutoring is available by appointment and on a walk-in basis. These services are offered by tutors trained to encourage the highest level of individual academic success while upholding personal academic integrity.

Syllabus Change Policy: Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advance notice.