STAT 7630 Nonparametric Function Estimation
Spring 2019

Lecture: TR 12:40–2:30 PM (2 credit hours) in Journalism Building 274

Instructor: Yoonkyung Lee
Office: 305B Cockins Hall
Office Hours: T 10:30–11:25AM F 2:00–2:55PM or by appointment
Email: yklee@stat.osu.edu

Grader: Shanshan Tu
Office: 454 Mathematics Building
Office Hours: by appointment only
Email: tu.162@osu.edu

Text: *Smoothing Spline ANOVA Models* by Chong Gu (2013), 2nd edition, Springer.
References: *Spline Models for Observational Data* by Grace Wahba.
Nonparametric Regression and Generalized Linear Models by Peter Green and Bernard Silverman.
Learning with kernels by Bernhard Schölkopf and Alexander Smola.

Website: The course has a web page on Carmen (`https://carmen.osu.edu`). You will find homework assignments, solutions, and other course announcements on the web page. Please check it on a regular basis.

Prerequisites: Mathematical maturity in analysis and linear algebra, and a good knowledge of basic statistical inference (6802) and regression (6450/6950) are expected. Some knowledge of functional analysis (familiarity with Hilbert spaces), multivariate analysis (6560), and generalized linear models (7430) would be helpful, but not required. The course development is intended to be self-contained.

Course Description:

Statistics 7630 aims to introduce a nonparametric function estimation method with roughness penalties. Starting from smoothing splines for univariate data, a unified framework for penalized likelihood approach will be developed for flexible model building with splines covering multivariate data with both Gaussian and non-Gaussian responses. Mathematical formulation of smoothing splines, reproducing kernel Hilbert space methods, selection of a smoothing parameter, computation, and their applications will be treated in detail. In addition, connection between spline models and kernel methods in machine learning (especially support vector machines) will be discussed.

Grading: There will be no in-class written exam. Course grades will be assigned on the basis of performance on homework assignments (40%) and the take-home final (60%). Tentatively, the take-home final will be given on April 22 and due on April 29.

Homework Assignments: Homeworks will be assigned approximately weekly. Homework will involve analytical exercises, computational work using `R`, and data analysis. Each homework (a hard copy of your work) will be due at the beginning of class on the due date. No late homework will be accepted. Homework assignments and solutions will be posted on the course web page.

Tentative Course Schedule:

Week	Topics
1	Introduction to smoothing splines (CG 1.1, GW Foreword, GS Ch 1)
	Splines for interpolation and smoothing (GS 2.1-2.3), Natural splines, B-splines
2	Functional analytic approach to smoothing splines (CG 2.3, GW 1.2-1.3)
	Characterizing the solution to the smoothing problem, Representer theorem
3	Influence of the tuning parameter on smoother matrix (CG 3.1, GW 1.3)
	Smoothing parameter selection, cross-validation (CG 3.2, GW 4.2-4.3, GS 3.1-3.4)
4	Smoothing splines as Bayes estimates (CG 2.5, GW 1.5, GS 3.8)
	Confidence intervals (CG 3.3, GW Ch 5)
5	Introduction to Reproducing Kernel Hilbert Spaces (CG 2.1, GW 1.1, SS 2.1-2.2)
	Properties of reproducing kernels (CG 2.1, 2.4)
6	Smoothing Spline ANOVA models (CG 3.1, GW Ch 10)
	Generalized spline models with non-Gaussian responses (CG 5.1-5.3, GS 5.1-5.3)
7	Support vector machines (SS 7.1-7.3)
	Nonlinear support vector machines, Constrained optimization (SS 7.4-7.5)

Academic Misconduct: Please help us to maintain an academic environment of mutual respect, fair treatment, and personal growth. Although students are encouraged to work together on homework assignments, all students must submit their own written work IN THEIR OWN WORDS. It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct `http://studentlife.osu.edu/csc/`.

Special Accommodations: Students with disabilities (including mental health, chronic or temporary medical conditions) that have been certified by the Office of Student Life Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office of Student Life Disability Services is located in 098 Baker Hall, 113 W. 12th Avenue; telephone 614-292-3307, `slds@osu.edu`; `slds.osu.edu`.