STAT 161 Introduction to Nonparametric Methods

Fall 2019

Course Description

This is an advanced undergraduate course in modern nonparametric methods for statistical estimation and inference.

Nonparametric inference is about statistical methods and models that make weak assumptions. A typical nonparametric approach estimates a nonlinear function from an infinite dimensional space, rather than a linear model from a finite dimensional space. This course gives an introduction to nonparametric statistics, with a focus on density estimation, regression, bootstrap, confidence sets, orthogonal functions, and kernels. The course treats nonparametric methodology and its use, together with theory that explains the statistical properties of the methods.

Textbook and Readings.

The textbook is *All of Nonparametric Statistics*, by Larry Wasserman (Springer, 2006). The book is succinct and technical in places. While we will cover much of the material in this text, it will be presented at a more elementary level.

Other possible readings:

- Hollander, Wolfe and Chicken (2014). Nonparametric Statistical Methods Using R.
- Tsybakov (2008). Introduction to Nonparametric Estimation.
- Efron and Tibshirani (1994). An Introduction to the Bootstrap.

Work load.

Assignments will be handed out and due every week. Some assignment problems require the use of R. There will be an in-class midterm exam and a 3-hour final exam.

- Assignments: 45%
- In-class midterm exam: 25% (Date: Oct. 17, Thursday)
- Final exam: 30%

Prerequisites: STAT 110, STAT 111.

List of topics:

1. What is nonparametric inference? (§§ 1.1–1.4)
2. CDFs and statistical functionals (§§ 2.1–2.3)
3. Jackknife and Bootstrap (§§ 3.1–3.4)
4. Nonparametric regression (§§ 4.1, 4.5), (§§ 5.1–5.4, 5.6, 5.7)
5. Density estimation (§§ 6.1–6.3)
6. Nonparametric Bayes (§§ 10.3)
7. Normal means (§§ 7.1–7.3), SURE and minimax risk (§§ 7.4–7.6)
8. Splines and RKHSs (§§ 8.1–8.2)
9. Wavelets (§§ 9.1–9.4)