半参数模型 (Semiparametric model)

课程中文简介

本课程将介绍半参数模型的基本理论并运用半参数理论解决一些典型的统计推断问题。在大数据时代，面对生物医学，流行病学和社会经济等研究中的大规模和复杂数据，参数模型无能为力。允许无限维参数，仅依赖最基本假定的半参数模型得到快速发展，展示出分析复杂数据的优势，已成为因果推断，缺失数据分析，生存分析等领域的一个核心工具，最近的研究表明半参数模型与机器学习结合能提高机器学习的统计推断能力。

课程英文简介

The purpose of this course is to establish the fundamental concepts, methods, and theory for semiparametric models and to apply semiparametric models to solve several statistical inference problems.

基本目的

本课程的目标是学习半参数模型的概念，理论和方法，使用半参数模型解决因果推断，缺失数据和生存分析等领域的几个统计推断问题。

先修课程

概率论; 数理统计。

参考书：

1. Van der Vaart. (2000) Asymptotic Statistics, chapter 25.
2. Tsiatis, A. (2006) Semiparametric Theory and Missing Data. (the first half of the book gives an accessible non-super technical introduction to semiparametric theory. Our treatment of semiparametric theory will be at a technical level somewhat in between the books of Tsiatis and van der vaart).
3. Newey, W. (1990). Semiparametric efficiency bounds. Journal of Applied Econometrics, vol 5, 99-135. (this is a GREAT introductory paper on semiparametric theory)
4. Van der Vaart. (2002) Semiparametric Statistics in Lectures on Probability and Statistics, (This is a monograph with material expanded a bit more than chpater 25 of the asymptotic statistics book)
5. Bickel, Klaassen, Ritov and Wellner. (1993) Efficient and adaptive inference in semiparametric models. (This book provides a rigorous treatment of semiparametric theory but it is hard to read)

成绩评定办法

作业 30%，期中开卷考试 30%， 期末开卷考试 40%。

教学方式
课堂讲授为主，每次课讨论。

内容提要
1. Introduction to semiparametric and parametric models. Brief review on statistical inference, probability, and functional analysis.

2. Efficiency theory in parametric models.
The Cramer Rao bound, Regular parametric models, Regular estimators, Hajek representation theorem, Asymptotically linear estimators, Characterization of the influence functions of regular asymptotically linear estimators, The efficient influence function, The efficient score.

3. Efficiency theory in semiparametric models.
Regular Parametric Submodels, Regular Parameters, The Semiparametric Variance bound, Pathwise differentiable parameters, Gradients, The Tangent Space, The efficient influence function, Asymptotic Efficiency in Semi Parametric Models The semiparametric efficient score. Convex models. Double-robust estimation. One-step estimation. Semiparametric maximum profile likelihood estimation.

4. Examples.
(a) Estimands in the non-parametric model.
(b) Parameters of models defined by conditional moment restrictions.
(c) Parameters of partially parametric regression model,
(d) Regression parameter in the proportional odds model and in the location shift model.
(e) Parameters of missing data and causal inference models.