

山东财经大学
研究生院与统计学院联合举办讲座

Propensity Score Analysis

倾向值分析

Instructor: Shenyang Guo*

郭申阳

美国圣路易斯华盛顿大学讲座教授

西安交通大学长江学者

美国社会工作与社会福利科学院院士

* This instructor owns copy right for all course materials



About the Instructor:

Shenyang Guo, Ph.D., is Frank J Bruno Distinguished Professor at Brown School of Washington University in St Louis, the Yangtze River Scholar at Xi'an Jiaotong University, and the fellow of American Academy of Social Work and Social Welfare. He is an expert on the application of advanced statistical models to the solution of social welfare problems. Guo is the author (with Mark Fraser) of *Propensity Score Analysis: Statistical Methods and Applications, Second Edition* (2015), a comprehensive guide to the many ways that propensity scores can be used to improve causal inference. Other books include *Survival Analysis* (2010) and *Structural Equation Modeling* (2011) (with Natasha Bowen). He has published more than 80 journal articles and book chapters. He is on the editorial boards of *Social Service Review*, *Journal of the Society for Social Work and Research*, and *Children and Youth Services Review*. He teaches graduate courses on survival analysis, hierarchical linear modeling, growth curve modeling, structural equation modeling, and propensity score analysis.

郭申阳，复旦大学经济学学士和硕士，南开大学第一期社会学专业班毕业，美国密执安大学社会学博士，现任美国华盛顿圣路易斯大学 Frank J Bruno 杰出教授，西安交通大学长江学者讲座教授，美国社会工作社会福利科学院院士。教授硕博生统计和定量研究方法课程，在动态研究，多层次研究，结构方程模型，事件史研究，倾向值匹配，内核匹配，项目评估等方法及其运用等领域发表论文 100 余篇。著作或合著《倾向值分析》，《生存分析》，及《结构方程模型》。多次应邀在美国国立健康研究所暑期班，儿童署，全美社会工作研究年会做统计分析讲座。曾担任北卡大学奥顿研究所应用统计工作组主席。研究课题包括儿童福利，贫困人群，福利政策及改革，老年人群抚养，等。担任社会服务纵览 编辑委员会委员，经常为多种杂志评审文章，经常受邀对文稿有争议的复杂统计方法发表意见。

【课程名称】 COURSE TITLE

倾向值分析 (Propensity Score Analysis)

【授课教师】 COURSE HOLDERS

姓 名：郭申阳 Shenyang Guo

国 籍：美国 U.S.A.

职 称：Frank J Bruno 杰出教授

Frank J Bruno Distinguished Professor

来自学校：华盛顿圣路易斯大学 Washington University in St. Louis

【课程大纲】 COURSE CONTENTS

Subject to modification (可能会有临时调整)

1. 倾向值分析简介，课程综述

1. *Introduction and Course Overview*

1. Observational studies and challenges
2. History and development
3. Fisher's randomized experiment
4. Why and when propensity score analysis is needed?
5. Course overview

【阅读资料 Readings】

Guo & Fraser, chapter 1.

2. 反事实理论框架

2. *Counterfactual Framework*

1. The Neyman-Rubin's counterfactual framework
2. The assumption about strongly ignorable treatment assignment
3. The stable unit treatment value assumption
4. Types of treatment effects

【阅读资料 Readings】

Guo & Fraser, chapter 2 (pp.21-61).

Rubin, D. B. (1974). Estimating causal effects of treatments in randomized and nonrandomized studies. *Journal of Educational Psychology*, 66, 688-701.

Rubin, D.B. (2008). For objective causal inference, design trumps analysis. *Annals of Applied Statistics*, 2, 808-840

Holland, P. (1986). Statistics and causal inference (with discussion). *Journal of the American Statistical Association*, 81, 945-970.

3. 样本选择模型与干预效益模型

3. *Sample Selection and Treatment Effect Models*

1. Truncation, censoring, and incidental truncation
2. Key features of Heckman's sample selection model
3. Treatment effect model
4. Illustrations

【阅读资料 Readings】

Guo & Fraser, chapter 4

Heckman, J. J. (1978). Dummy endogenous variables in a simultaneous equations system. *Econometrica*, 46, 931-960.

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica*, 47, 153-161.

4. 倾向值贪婪匹配与优化匹配

4. *Propensity Score Greedy Matching and Optimal Matching*

1. Overview of propensity score matching
2. The Rosenbaum and Rubin's model (1983)
3. Strategies to seek optimal propensity scores
4. Greedy matching
5. Optimal matching
6. Post-optimal-matching analysis

【阅读资料 Readings】

Guo & Fraser, chapter 5: 5.1-5.3, 5.4.1, 5.5.1, 5.5.2.

Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, 70, 41-55.

D'Agostino, R. B., Jr. (1998). Tutorial in biostatistics: Propensity score methods for bias reduction in the comparison of a treatment to a non-randomized control group. *Statistics in Medicine*, 17, 2265-2281.

Guo & Fraser, chapter 5: 5.4.2, 5.5.2-5.5.5, 5.7-5.8.

Haviland, A., Nagin, D. S., & Rosenbaum, P. R. (2007). Combining propensity score matching and group-based trajectory analysis in an observational study. *Psychological Methods*, 12, 247-267.

5. 倾向值分层与权重分析

5. *Propensity Score Subclassification and Weighting*

1. Propensity score subclassification
2. Strategy to deal with limited overlap
3. Propensity score weighting
4. Generalized boosted regression

【阅读资料 Readings】

Guo & Fraser, chapter 6.

Crump, R. K., Hotz, V. J., Imbens, G. W., & Mitnik, O. A. (2009). Dealing with limited overlap in estimation of average treatment effects. *Biometrika*, 96, 187-199.

Guo & Fraser, chapter 7.

McCaffrey, D. F., Ridgeway, G., & Morral, A. R. (2004). Propensity score estimation with boosted regression for evaluating causal effects in observational studies. *Psychological Methods*, 9, 403–425.

6. 匹配估算法

6. *Matching Estimators*

1. Simple matching estimator
2. Bias-corrected matching estimator
3. Variance estimator allowing for heteroskedasticity
4. Efficacy subset analysis

【阅读资料 Readings】

Guo & Fraser, chapter 8.

Abadie, A., Drukker, D., Herr, J. L., & Imbens, G. W. (2004). Implementing matching estimators for average treatment effects in Stata. *The Stata Journal*, 4, 290-311.

7. 基于非参数回归的倾向值分析

7. *Propensity Score Analysis with Nonparametric Regression*

1. The kernel-based matching estimator
2. Review of the basic concepts of *lowess*

【阅读资料 Readings】

Guo & Fraser, chapter 9.

Heckman, J. J., Ichimura, H., & Todd, P. E. (1997). Matching as an econometric evaluation estimator: Evidence from evaluating a job training programme. *Review of Economic Studies*, 64, 605-654.

Heckman, J. J., Ichimura, H., & Todd, P. E. (1998). Matching as an econometric evaluation estimator. *Review of Economic Studies*, 65, 261-294.

Abadie, A., Imbens, G.W. (2008). On the failure of the bootstrap for matching estimators. *Econometrica*, 76(6):1537–1557.

8. 倾向值剂量分析

8. *Propensity Score Dosage Analysis*

1. Overview of propensity score dosage analysis
2. Modeling dosage with a multinomial logit model
3. The generalized propensity score estimator

【阅读资料 Readings】

Guo & Fraser, chapter 10.

9. 筛选误差、敏感度分析、课程总结

9. *Selection Bias, Sensitivity Analysis, and Concluding Remarks*

1. Overview of selection bias
2. Rosenbaum's sensitivity analysis
3. Critical review of evaluation studies
4. Results of a Monte Carlo study comparing different methods
5. Concluding remarks

【阅读资料 Readings】

Guo & Fraser, chapter 11.

Rosenbaum, P.R. (2005). Sensitivity analysis in observational studies. In B.S. Everitt and D. C. Howell (Eds.) *Encyclopedia of Statistics in Behavioral Science* (pp.1809-1814). New York: John Wiley & Sons, Ltd.

Guo & Fraser, chapter 11.

Guo & Fraser, chapter 12

【课程教材】 COURSE MATERIAL

Required Textbook

Guo, S. & Fraser, W.M. (2015). *Propensity Score Analysis: Statistical Methods and Applications, Second Edition*. Thousand Oaks, CA: Sage Publications.

Recommended Textbooks

Rosenbaum, P. R. (2010). *Design of Observational Studies*. New York: Springer.

Morgan, S.L, & Winship, C. (2015). *Counterfactuals and Causal Inference: Methods and Principles for Social Research, Second Edition*. New York: Cambridge University Press.

【倾向值分析一书的网址】 WEBSITE OF GUO & FRASER 2015

关于 Guo & Fraser (2015) 一书示例的所有程序和数据可通过下列网址下载 <https://ssw.unc.edu/psa/>

All syntax files and illustrative datasets of Guo & Fraser (2015) can be downloaded at the Propensity Score Analysis support site <https://ssw.unc.edu/psa/>