

THE UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL  
SCHOOL OF SOCIAL WORK

**COURSE NUMBER:** SOWO 922

**COURSE TITLE, SEMESTER AND YEAR:** Advanced Topics in Causal Inference:  
Propensity Score and Related Models  
Fall semester, 2014

**INSTRUCTOR:** Alan R. Ellis, PhD, MSW

Department of Social Work  
North Carolina State University  
CB 7639, 1911 Building  
Raleigh, NC 27695-7639

Tel: (919) 515-9303  
Fax: (919) 515-4403  
Email: arellis@ncsu.edu

**CLASS MEETINGS:** Fridays 9:00-11:50 am (Room 107 TTK)

**OFFICE HOURS:** Fridays 12-1 pm or by appointment

**COURSE DESCRIPTION:**

With a focus on propensity scoring, this course examines advanced methods for causal inference. The overall goals of the course are (1) to equip students with the information and tools required to conduct appropriate propensity score analyses of data from observational studies or quasi-experiments, (2) to describe how propensity score methods fit within the broader context of causal inference, and (3) to provide resources for a more general exploration of causal inference. Readings, lectures, lab and classroom exercises, and assignments emphasize student engagement and practical skills. Programming instruction focuses on the R and SAS languages, but with the instructor's permission, students may choose to complete assignments using a different programming language (e.g., stata).

**COURSE OBJECTIVES:**

At the completion of the course, students will be able to:

1. Identify contexts under which randomized experiments are impractical or unethical;
2. Describe the challenges involved in evaluating quasi-experimental or observational data and understand the importance of taking remedial strategies within such contexts;
3. Understand the Neyman-Rubin counterfactual framework and two fundamental assumptions: strongly ignorable treatment assignment and stable unit treatment value;
4. Estimate propensity scores using logistic regression, boosted classification and regression trees (BCART), and/or other methods;
5. Implement propensity scores using matching, weighting, stratification, and covariance adjustment;
6. Report the findings of a propensity scoring analysis;
7. Conduct appropriate sensitivity analyses and report the results;
8. Critique a study involving the use of propensity scores;
9. Describe recent advances in propensity scoring, such as the covariate-balancing propensity score (CBPS);
10. Describe the general principles involved in other advanced methods of confounding control, such as instrumental variable analysis and doubly robust estimation.

## PREREQUISITES:

This course requires familiarity with descriptive and inferential statistics, including linear and logistic regression and analysis of variance, and familiarity with a statistical programming language such as R or SAS. Students who are unfamiliar with these topics or uncertain about their level of preparation should contact the instructor to determine their eligibility to take the course.

## REQUIRED READINGS:

This course is based on journal articles, all of which are available through the UNC libraries' e-journals facility and/or from the course sakai site.

## ADDITIONAL RESOURCES:

Guo, S., & Fraser, M. W. (2014). *Propensity Score Analysis: Statistical Methods and Applications*. (2<sup>nd</sup> ed.) Los Angeles: SAGE.

Holmes, W. M. (2014). *Using Propensity Scores in Quasi-experimental designs*. Los Angeles: SAGE.

## GRADING

<u>Assignments</u>	<u>Grade Percentage</u>
Study questions & class participation *	20%
Assignment 1	10%
Assignment 2	10%
Assignment 3	10%
Assignment 4	10%
Final Exam (take home)	40%

\* I expect you to prepare by reading assignments and responding to study questions, which are due at the beginning of class. I expect you to be present, participate in discussions, ask questions when needed, and exercise leadership in creating a successful learning experience for yourself and your colleagues. (Also, see attendance policy below.)

The School of Social Work's standard interpretation of grades and numerical scores will be used:

H = 94-100

P = 80-93

L = 70-79

F = 69 and below

## **POLICY ON CLASS ATTENDANCE**

Students are expected to attend all scheduled sessions. In the event that you expect to miss class due to a medical or family emergency, please notify the instructor by email in advance. Unexcused absences will result in a grade reduction of 7 percentage points for each session missed.

## **POLICY ON ASSIGNMENT SUBMISSION**

Assignments 1-4 are to be turned in to the professor by 5 pm on the due date noted in the course outline. With at least 24 hours' advance notice, extensions may be granted by the professor. If an assignment is submitted late, the grade for that assignment will be reduced by 10 percentage points for each day or partial day between the due date and the actual submission date (including weekend days). A grade of incomplete will be given only under extenuating circumstances and only in accordance with University policy.

## **POLICY ON ACADEMIC HONESTY**

Students are expected to follow the UNC Honor Code. Please include the honor code statement along with your signature on all assignments: "I have neither given nor received unauthorized aid on this assignment."

Please refer to the Publication Manual of the American Psychological Association, the School of Social Work Manual, and the School of Social Work Writing Guide for information on attribution of quotes, plagiarism, and appropriate use of assistance in preparing assignments.

If the instructor believes that academic dishonesty has occurred, a referral will be made to the Office of the Student Attorney General for investigation and further action.

## **POLICY ON ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES**

If you have a disability that affects your participation in the course, please register with UNC Accessibility Resources & Service and contact the instructor to request any needed accommodations.

**COURSE OUTLINE (TOPICS, READINGS, AND ASSIGNMENTS):**

Date	Readings due	Topic	Assignments
08/22		<b>Introduction and course overview</b> Introductions Background – rationale, history, uses of PS Examples Course overview	
08/29	<b>Tutorials:</b> D'Agostino Jr., R. B. (1998) Stürmer et al. (2014)  <b>Counterfactual framework:</b> Rosenbaum & Rubin (1983) Holland (1986a), Sections 1-3 and Section 8 Cox (1986) on Holland Rubin (1986) on Holland Holland (1986b) (rejoinder), Sections 1-3	<b>Neyman-Rubin counterfactual framework</b> Assumptions: <ul style="list-style-type: none"> <li>• Strongly ignorable treatment assignment</li> <li>• Stable unit treatment value</li> </ul> Study design considerations  <b>Variable selection in PS models</b> Including instruments in PS models Variable selection High-dimensional propensity scores	
09/05	<b>Tutorials:</b> Glynn et al. (2006) Harder et al. (2010)  <b>Variable selection:</b> Steiner et al. (2010) Brookhart et al. (2006)  <b>Balance measures &amp; relative performance:</b> Rubin (2001) Belitser et al. (2011), Abstract & introduction	<b>Covariate balance</b> Balance measures Calculation Relative performance Model selection  <b>Lab: Introduction to propensity scoring using R and SAS</b> Descriptive statistics Balance assessment Propensity scoring	

Date	Readings due	Topic	Assignments
	Ali et al. (2014) Imai et al. (2008), Section 7		
09/12	<b>Variable selection:</b> Patorno et al. (2014) Wyss & Stürmer (2014) on Patorno et al.  <b>Machine learning &amp; BCART:</b> Westreich et al. (2010) Lee et al. (2009) McCaffrey et al. (2004)  <b>CBPS:</b> Wyss et al. (2014)	<b>PS estimation</b> Logistic regression Boosted classification & regression trees (BCART) Covariate-balancing PS (CBPS)  <b>Simulation studies</b>	
09/19	<b>Weighting:</b> Cole & Hernán (2008) Hernán & Robins (2006) Sato & Matsuyama (2003)	<b>PS application I</b> Covariance adjustment Weighting  <b>Lab: PS estimation with logistic regression &amp; weighting</b>  <b>Mid-semester evaluations</b>	#1 out: PS estimation with logistic regression & weighting
09/26	<b>Stratification:</b> Mojtabai & Zivin (2003) Rosenbaum & Rubin (1984) Perkins et al. (2000)  <b>Matching:</b> Haviland et al. (2007) Parsons (2001)	<b>PS application II</b> Stratification Matching  <b>Lab: PS estimation with logistic regression &amp; stratification/matching</b>	#1 due  #2 out: PS estimation with logistic regression & stratification/matching
10/03	<b>Treatment effects &amp; heterogeneity:</b> Kurth et al. (2005) Lunt et al. (2009)	<b>Treatment effects &amp; heterogeneity</b>	#2 due

<b>Date</b>	<b>Readings due</b>	<b>Topic</b>	<b>Assignments</b>
	Ellis et al. (2013)		
<b>10/10</b>	<b>Extensions of the PS:</b> Imbens (2000) Foster (2003) Imai & Van Dyk (2004) Robins et al. (2000) - skim Hernán et al. (2000) - skim	<b>Extensions of the PS</b>  <b>Lab: Plots/diagnostics (or open lab)</b>	
10/17		No Class – Fall Break	
<b>10/31</b>	<b>Reviews &amp; commentary:</b> Rubin (2004) Weitzen et al. (2004) Thoemmes & Kim (2011) Imbens & Wooldridge (2009) - skim	<b>State of the science</b>  <b>Reporting &amp; critiquing PS results</b>	<b>#3 out: Article critique (in written and presentation form)</b>
<b>11/3</b>  <b>2-5 pm</b>	Stürmer et al. (2005) Ellis & Brookhart (2014)	<b>External control for confounding</b>  <b>Inverse Probability of Selection Weighting (IPSW)</b>  <b>PS calibration</b>  <b>Lab – IPSW, PS calibration, boosted classification and regression trees (bCART), covariate-balancing propensity score (CBPS)</b>	<b>#4 out</b>
<b>11/07</b>	N/A	<b>Individual presentations</b>  <b>Group discussion of assignment #4</b>  <b>Lab - PS estimation and balance checking in R</b>	<b>#3 due</b>

<b>Date</b>	<b>Readings due</b>	<b>Topic</b>	<b>Assignments</b>
<b>11/14</b>	Griswold et al. (2010) Rosenheck et al. (2000) Hong & Yu (2008) optional: Thoemmes & West (2011)	<b>Group presentations</b>  <b>PSs in multilevel contexts</b>  <b>bCART/CBPS (continued)</b>	<b>#4 due (group presentations)</b>
<b>11/21</b>	Rosenbaum (2005) Rosenbaum (2002), Ch. 4 McCaffrey et al. (2004)	<b>Rosenbaum sensitivity analysis</b>  <b>Lab – sensitivity analysis &amp; stratification in R</b>	<b>Final exam out</b>
11/28		No Class - Thanksgiving	
12/06			<b>Final exam (take-home) due at 12:00 noon</b>  <b>In this take-home exam, you are required to write a paper comparing the results of at least two propensity score methods. The paper should include: (1) a brief introduction to describe background information, research questions, and hypotheses; (2) a detailed methods section to describe the correction methods being compared; (3) results; and (4) discussion. The paper should follow APA style guidelines and should meet the requirements and standards for publication in a peer-reviewed journal.</b>