

Instructor: Dr. Ruth Heller

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Office Hours: S 10:30-11:30 and by appointment

Prerequisites: Mathematical statistics and a previous course in probability.

Course Description: This course will cover statistical methods for the design and analysis of observational studies. Topics for the course will include the potential outcomes framework for causal inference; randomization inference; methods for controlling for observed confounders in observational studies; sensitivity analysis for hidden bias; instrumental variables; tests of hidden bias.

Text:

OS Paul R. Rosenbaum, Observational studies, 2nd edition, Springer, 2002.

DOS Paul R. Rosenbaum, Design of observational studies, Springer, 2011.

Course Requirements: There will be 3 or 4 homework assignments, a final project and a final exam. Students will be expected to make a presentation on their project towards the end of the semester. The grade distribution will be: 30% on homeworks, 30% on project, and 40% on final exam.

Computing Software: We will make use of the freeware statistical computing software R. R can be downloaded from <http://www.r-project.org/> .

Course Overview (tentative):

1. Introduction to observational studies, goals, randomized experiments and how they solve the fundamental problem of causal inference (OS 1, 2.1-2.2) .
2. Randomization inference
 - Common randomization tests, classes of test statistics and simple models for treatment effects (OS 2.3-2.5).
 - Confidence intervals, point estimates, more complex outcomes (OS 2.6-2.8).
3. Adjusting for overt bias in observational studies
 - the propensity score; pair matching using estimated propensity scores (OS 3.2 and 10.2).
 - Assessing balance (OS 3.4 and 10.3, DOS 9).
 - Propensity score caliper matching, full matching, how to make use of more than one control to increase efficiency (DOS 8).
 - Fine balance matching (DOS 10, OS 10.3-10.4).
4. Sensitivity analysis for hidden bias (OS 4.1-4.5).
5. Models for treatment effects (OS 5.1-5.3).
6. Instrumental variables methods (OS 5.4).
7. Tests if hidden bias
 - Known effects (OS 6).
 - Multiple control groups (OS 8).