

**Final Exam**

1. Identification of Terms. Define and state the significance of the following terms or phrases. Be concise, and focus on key issues.
  - a. Treatment-by-covariate interaction
  - b. Trimming bounds vs. extreme value bounds
  - c. Within-subjects design
  - d. Mediation
  - e. Meta-analysis
  
2. Short answer
  - a. Briefly summarize the implications of clustered random assignment for experimental design and analysis. What complications arise when clusters (e.g., media markets) contain different numbers of subjects?
  - b. Explain (preferably using a bit of algebra) why rejecting the null hypothesis that  $\text{Var}(Y_i(1)) = \text{Var}(Y_i(0))$  implies rejection of the null hypothesis of homogeneous treatment effects (i.e., the hypothesis that  $\text{Var}(\tau_i) = 0$ ).

### 3. Modeling and data analysis

The table below shows the results of an experiment in which 630,640 subjects were randomly sent a “social pressure” mailing immediately prior to an election in June of 2012. Social pressure mailings showed voters whether they and their neighbors voted in the last election. The remaining 33,380 subjects were sent nothing. Turnout in that election is indicated by the variable `votedS`. This variable equals 1 when a subject voted; 0 otherwise. Later that year, a presidential election occurred, and subjects voted or abstained (see the variable `votedG`).

Suppose you sought to estimate the “downstream” effect of `votedS` on `votedG`.

- Briefly explain why the identification of “downstream” effects is akin to the identification of the CACE in the presence of two-sided noncompliance.
- Show algebraically how one can identify the average causal effect among those who vote in the June election if and only if they are encouraged by the mailer. Indicate what assumptions you invoke in the course of your identification proof.
- Explain and critically evaluate the excludability assumption in this particular study.
- With a hand calculator (or a calculator on your cell phone), use the results below to estimate this average causal effect. (Don’t worry about estimating standard errors.)

Subjects assigned to the control group

votedG	votedS		Total
	0	1	
abstained	7,990	1,275	9,265
	69.96	5.81	27.76
voted	3,431	20,684	24,115
	30.04	94.19	72.24
Total	11,421	21,959	33,380

Subjects assigned to the treatment (mail) group

votedG	votedS		Total
	0	1	
abstained	147,147	24,721	171,868
	70.46	5.86	27.25
voted	61,691	397,081	458,772
	29.54	94.14	72.75
Total	208,838	421,802	630,640

#### 4. Interpreting results

Researchers in Uganda recently conducted a study in which popular movies were shown free of charge in 56 rural trading centers during a four-week film festival. In 24 randomly selected trading centers, messages encouraging empathy for women who suffer medical complications arising from (illegal) abortions were aired during commercial breaks, whereas in the remaining 32 trading centers, messages about other topics were aired. Outcomes are measured at the level of the individual villager. (For purposes of answering the questions below, you can ignore the complications associated with clustered assignment in this study.) Outcome measures were collected six weeks later via an ostensibly unrelated survey that covered a variety of topics, including abortion. For our purposes, the outcome is scored 1 if the respondent expresses willingness to help a woman ostracized on account of abortion and 0 otherwise. (In the tables below, these outcomes are labeled “help” and “no help,” respectively.) Compliance was measured at the end of the end-line survey; subjects were asked whether they attended any of the films and, if not, whether they knew others who had attended. Compliers are those who attended; partial compliers are those who know others who attended; and never-takers are those who neither attended nor knew others who attended.

- (a) Define the relevant potential outcomes: exposure to the abortion message, knowing others who were exposed to the abortion message, and not being exposed directly or indirectly to this message.
- (b) Define average treatment effects of interest in this study. Explain whether these estimands are identified given the design and whatever assumptions you see fit to invoke. Be sure to make your assumptions explicit.
- (c) The table below shows the results for each of the three compliance strata. Estimate the causal estimands you identified in part (b), and interpret the results.

Group 1: Never-takers

Y	Z		Total
	Control	ABO Treat	
No Help	112 25.34	84 25.38	196 25.36
Help	330 74.66	247 74.62	577 74.64
Total	442 100.00	331 100.00	773 100.00

Group 2: Partial Compliers

Y	Z		Total
	Control	ABO Treat	
No Help	238 31.82	141 26.40	379 29.56
Help	510 68.18	393 73.60	903 70.44
Total	748 100.00	534 100.00	1,282 100.00

Group 3: Compliers

Y	Z		Total
	Control	ABO Treat	
No Help	56 28.00	29 16.48	85 22.61
Help	144 72.00	147 83.52	291 77.39
Total	200 100.00	176 100.00	376 100.00