

HOMWORK #7

CS262Z

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Question 1

Convert the model in Figure 8.1 to a set of counterfactual statements.

Question 2

Prove, using counterfactual logic and your conversion of Question 1, that the effect of treatment on the treated (Eq. (8.18)) is identifiable whenever subjects can get treatment only if assigned.

Question 3

Prove, using counterfactual logic and your conversion of Question 1, that the effect of treatment on those subjects that would comply (consistently) with their assignments is identifiable.

Question 4

Prove that the three properties: effectiveness, composition and reversibility are logical independent of each other. (i.e., there exists an assignment of truth values to counterfactual sentences that satisfies any two of the properties and violates the third.)

Question 5

Show, by example, that setting X to x can increase the probability of $Y = y$ regardless of what value X is set to.

Question 6

Suppose we run interventional experiments on three binary variables, X , Y , and Z , under fixed background conditions $U = u$. Prior to intervention we observe $X = Y = Z = 1$. Now we set every subset of variables to every possible combination of their values and record the values of the other variables.

What is the minimum number of experiments we must conduct in order to predict the outcome of the rest. (Assume the underlying model is causal, but not necessarily recursive.)

Question 7

Test if the following independencies hold in the model of Figure 7.5.

a. $(Y_z \perp\!\!\!\perp Z_x | \{Z, X\})$

b. $(Y_z \perp\!\!\!\perp Z_x | Z)$

c. $(Y_z \perp\!\!\!\perp Z_x | \{Z, X, Y\})$