

Solutions

Question 1

Table 1: Counterfactuals

Individual	M_0	M_1	Y_{1M_1}	Y_{1M_0}	Y_{0M_1}	Y_{0M_0}
4	1	0	$Y_{10} = 1$	$Y_{11} = 1$	$Y_{00} = 1$	$Y_{01} = 0$
5	0	1	$Y_{11} = 1$	$Y_{10} = 1$	$Y_{01} = 1$	$Y_{00} = 0$
6	0	1	$Y_{11} = 1$	$Y_{10} = 0$	$Y_{01} = 1$	$Y_{00} = 0$

We have defined the individual causal effects as,

$$TE = Y_{1M_1} - Y_{0M_0}$$

$$CDE(0) = Y_{10} - Y_{00}$$

$$CDE(1) = Y_{11} - Y_{01}$$

$$NDE = Y_{1M_0} - Y_{0M_0}$$

$$NIE = Y_{1M_1} - Y_{1M_0}$$

Table 2: Individual Causal Effects

Individual	TE	$CDE(0)$	$CDE(1)$	NDE	NIE
4	1	0	1	1	0
5	1	1	0	1	0
6	1	0	0	0	1

Question 2

- a) Conditional on C , assumptions (i) and (ii) in the notes hold and so the controlled direct effects are identified.
- b) The natural direct and indirect effects are not identified in this causal diagram since there is an unmeasured confounder of the exposure-mediator relationship.
- c) This diagram could not have come from a trial in which A was randomized within levels of C since there is an unmeasured confounder U of the exposure-mediator relationship. Because of randomization, the only variable that could have an effect on A is C .