Causal Inference - Homework 3

Introduction to Causal Inference 096260
Winter 2020/2021

Submission date: 27 December , 2020

Question 1

Consider the DAG in Figure 1. For each of the following pairs of nodes, list: (1) all possible paths between them (2) what set of nodes is required (in a d-separation sense) to block all of their paths:

(1) $Z \to Y$.

(2) $X \to W$.

(3) $H \to S$.

Question 2

Consider the casual graph in Figure 2.

(i) List all of the sets of variables that satisfy the backdoor criterion to determine the causal effect of T on Y.

(ii) List all of the minimal sets of variables that satisfy the backdoor criterion to determine the casual effect of T on Y (i.e., any set of variables such that, if you removed any one of the variables from the set, it would no longer meet the criterion).

(iii) Give a minimal set of variables that need to be measured in order to identify the effect of D on Y.

Question 3

Consider the following scenario, which is loose adaptation of the LaLonde experiment (as described in the tutorial).
You received data collected from an experiment run in a 3 years (2025-2027) span in Gotham City, USA, trying to estimate the effect of job training on real income a year following the training. In the data (See Table 1), you have binary indicators for: prior education (Z), whether the annual

real income in 2025 is higher than 50K\$ (X), had job training (T), whether the annual real income in 2027 is higher than 100K\$ (Y), and whether the citizen bought a house in 2027 (W).
We know the following:

(i) The income in 2024 depends solely on the prior education.

(ii) A person is selected to the job training program based on her prior education, and income in 2025.

(iii) The income in 2027 depends on the job training, prior education and income in 2025.

(iv) Whether a citizen purchased a house is directly based on her income in 2025 and 2027.

Your task is as follows:

1. Draw the causal graph that describe the above experiment.
2. Calculate and specify the conditional probability tables of the model from Table 1
3. Calculate the ATE of the experiment (derive the necessary probabilities from Table 1)

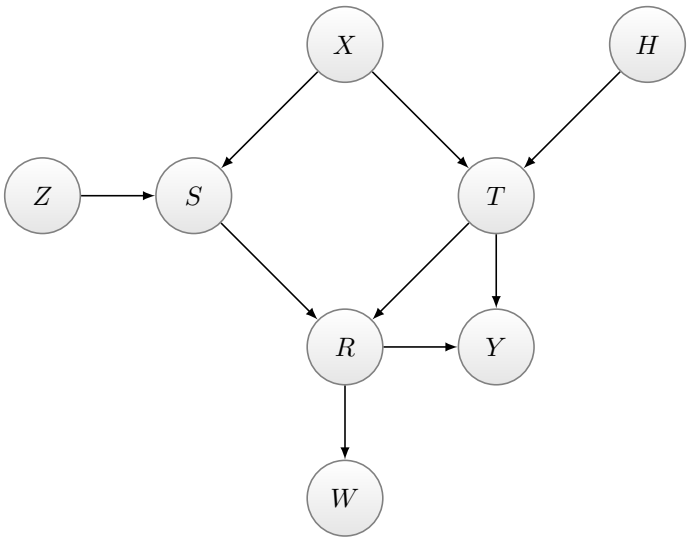

Figure 1

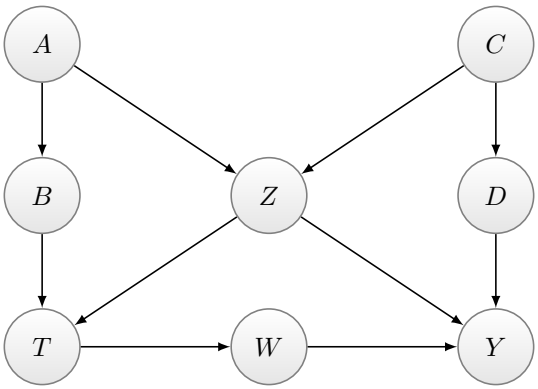

Figure 2

Z	**X**	**T**	**Y**	**W**
0	1	1	1	0
0	0	1	1	0
0	0	1	1	0
1	1	1	1	1
1	0	1	1	1
1	0	1	1	1
1	1	0	0	0
1	0	0	0	0
0	0	0	0	0
1	1	1	1	1
1	0	0	1	0
1	0	1	0	0
1	1	0	1	1
1	1	0	0	1
0	1	0	0	0
1	0	0	0	0
0	0	0	0	0
0	0	1	0	0
1	0	1	0	1
0	0	1	0	1
1	1	0	1	1
0	1	1	0	1

Table 1: Table1