

Data driven Business analytics – MGT-302

Homework 2 - Problem 4. Causal inference [15]

Eduardo Neville & Åke Janson

May 19, 2023

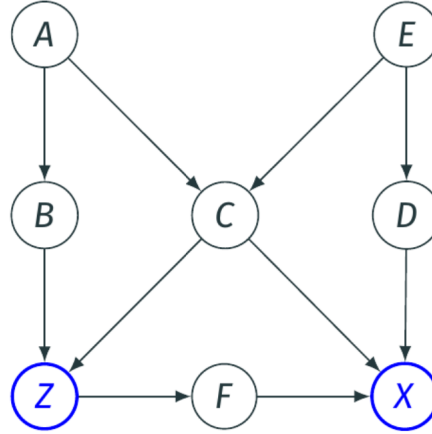


Figure 1: A direct acyclic graph.

1 Find a subset of variables that d-separates Z from X .

A set K d-separates Z from X if and only if K blocks every path from Z to X . So we can choose $\{ABFZ\}$, A , B and F are chosen because they each block the causal paths $A \rightarrow B \rightarrow Z$, $B \rightarrow Z \rightarrow F \rightarrow X$ and $Z \rightarrow F \rightarrow X$, respectively. And Z is chosen because it is one of the variables we want to d-separate.

2 Find two different valid adjustment sets for the ordered pair (Z, X) , i.e., for computing $P_{do}(Z = z)(X)$.

Two valid adjustment sets for the pair (Z, X) are $\{A, E\}$ and $\{B, C\}$. The first set, $\{A, E\}$, is valid because A blocks the paths $Z \leftarrow B \leftarrow A \rightarrow C \rightarrow X$, E blocks $Z \leftarrow C \leftarrow E \rightarrow D \rightarrow X$, and A and E will block all the backward paths for X and Z . The second set, $\{B, C\}$, is valid because B blocks $Z \leftarrow B \rightarrow Z \rightarrow F \rightarrow X$, C blocks $Z \leftarrow C \rightarrow X$, and B and C will block all the backward paths for X and Z .

3 What are all the edges that one can modify in the graph so that the modified graph stays in the same Markov equivalence class?

There are 5 possible modifications we can do without modifying the Markov Equivalency class; reverse the edge between $\{A, B\}$, $\{C, X\}$, $\{Z, F\}$ or $\{E, D\}$. The fifth is the following reverse $\{B, Z\}$ and $\{C, Z\}$.