

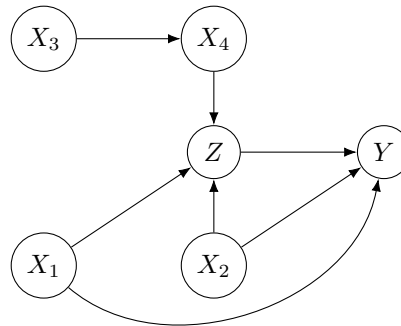
MATH 598/782 – PROJECT 2

Please submit your solutions by 11.59 pm (EDT) on Sunday 25th February by uploading a single pdf to myCourses.

The data set

<https://www.math.mcgill.ca/dstephens/598-Causal-2024/Exercises/Project2/P2data.csv>

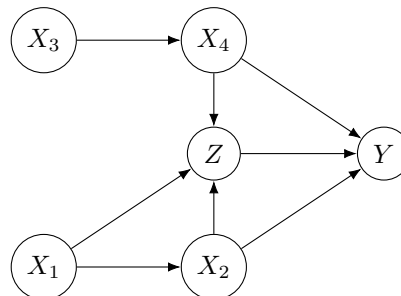
comprises four predictor variables X_1, X_2, X_3, X_4 , a binary treatment variable Z , and outcome variable Y . The following DAG is understood to capture the structural relationships between the variables.



1. Carry out an analysis based on the following causal adjustment procedures to estimate the average treatment effect of Z on Y .
 - (a) Propensity score regression based on a linear outcome model, where the effect of treatment is captured by the additive parametric component $\psi_0 Z$. 4 Marks
 - (b) Inverse probability weighting (IPW) 4 Marks
 - (c) Augmented inverse probability weighting (AIPW). 4 Marks

In each case, use a **bootstrap** procedure to estimate the variance of the estimator as follows: for $N = 1000$ resampled replications, resample a new data set of the same sample size, equally weighted and with replacement, from the original data set, and repeat the estimation procedure for each resampled data set. Then report the variance of the 1000 sampled estimates.

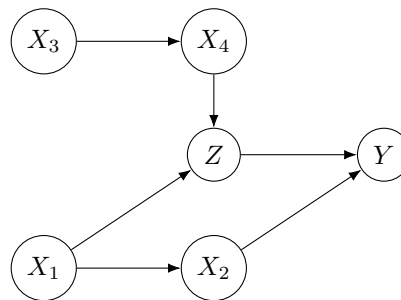
2. Suppose now that the structural DAG is believed to take the following form:



Explain how (if at all) the analysis should change from Q1; if the analysis changes, perform the new analysis using one of the methods from Q1; if it does not need to change, explain why not.

4 Marks

3. Suppose finally that the structural DAG is believed to take the following form:



Explain how (if at all) the analysis should change from Q1; if the analysis changes, perform the new analysis using one of the methods from Q1; if it does not need to change, explain why not.

4 Marks