Problem 1. Linear Models [25 points]

Consider the following (linear) causal diagram below:

The lowercase letters next to each edge represent the corresponding structural coefficients.

(a) [5 points] Assume we perform a linear regression following the equation

\[ Y = \alpha_1 X + \alpha_2 R + \alpha_3 Z + \alpha_4 Q, \]  

(1)

where \( \alpha_i, \ i = 1, 2, 3, 4 \) are the corresponding regression (not structural) coefficients. Is any \( \alpha_i \) equal to 0? Explain your reasoning.

(b) [5 points] Is \( E[Y|do(X)] \) identifiable in this case? If so, explain your reasoning.

(c) [15 points] Identify as many structural coefficients as possible. Justify (briefly) each answer.
Problem 2. Study question 4.3.2 from the Primer [10 points]

(Hint: read Primer section 4.3.4)

(a) [5 points] Describe how the parameters a, b, c in Figure 4.1 can be estimated from nonexperimental data

(b) [5 points] In the model of Figure 4.3, find the effect of education on those students whose salary is $Y = 1$. [Hint: Use Theorem 4.3.2 to compute $E[Y_1 - Y_0 | Y = 1]$.]