Homework for Chapter 8: Causal Paths

1. Assuming that a path has no colliders on it, what is the difference between a path being Open and Closed?
2. Consider the below generic causal diagram.  
   Diagram, shape

   Description automatically generated
   1. List every path from X to Y.
   2. Which of the paths are front-door paths?
   3. Which of the paths are open back-door paths?
   4. What variables must be controlled for in order to identify the effect of X on Y? (only list what *must* be controlled for, not anything that additionally *could* be controlled for).
3. Consider the research question: Does having higher income cause better health?
   1. Draw a causal diagram depicting the data generating process for this relationship with 5-10 variables on it.
   2. Identify the Front Door paths.
   3. Identify the Back Door paths.
   4. Identify the paths that represent direct effects.
   5. Identify the Good Paths and the Bad Paths.
4. Which of the following describes a causal path where all the arrows point away from the treatment?
   1. Open Path
   2. Closed Path
   3. Front Door Path
   4. Back Door Path
5. Consider the figure below, which depicts the relationship between teaching quality, number of publications (e.g., articles, books), and popularity among scholars and students in a population of professors.  
   Line chart

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   1. What type of variable is Popularity in one path on this diagram?
   2. Discuss what would happen if you controlled for Popularity.
6. Consider the figure below, which depicts the relationship between a pandemic-related lockdown and an economic recession. The research question of interest is: Does a pandemic-related lockdown cause recession?   
   A picture containing text, antenna, line

   Description automatically generated
   1. Write down all the paths in the diagram from Lockdown to Recession. To make our lives simpler (there are a lot of paths in this diagram), ignore any path that goes through Stimulus.
   2. List all of the paths that are Front Door Paths.
   3. What would happen if we controlled for unemployment?
   4. Is it possible to measure each of the variables adequately?
   5. Can you think of any variables and paths not depicted in the diagram that may be relevant to identify the answer to the research question? List at least one and no more than three.
7. Consider the question: Does obtaining a higher education improve income? Think of a couple of examples of Bad Paths in a causal diagram depicting the data generating process for this research question.