Homework for Chapter 9: Finding Front Doors

1. Which of the following describes when randomization of treatment occurs without a researcher controlling the randomization?

Answer: b. Natural experiment

* 1. Exogenous variation
  2. Natural experiment
  3. Instrumental variable
  4. Randomized experiment

1. Necessary conditions:
   1. What needs to be true about the variation we need to isolate when we’re trying to isolate front door paths?

Answer: The variation should be the source of the variation of the treatment and does not have back doors.

* 1. How do we know that the variation we get from a randomized controlled experiment fulfills the condition(s) from part a?

In randomized controlled experiments, researchers create a form of variation in the treatment that has no back doors by random assignment. If the treatment was assigned randomly, then for everyone in the experiment, variation in all the variables on all the back doors should be unrelated whether they got the treatment or not.

1. Describe the four major differences between randomized experiments and natural experiments discussed in the chapter. As a bonus, there’s a fifth difference described in the chapter having to do with sample size and representativeness.

Answer: The first difference is that sometimes there will be back doors from the Natural Randomness to the Outcome in natural experiments, which doesn’t happen with pure randomization in randomized experiments.

The second difference is that natural experiments are more natural and realistic, and sample sizes tend to be bigger. People may not realize that they are parts of the experiments. While the randomized experiments’ samples might be made up of a bunch of volunteer-types.

The third difference is that natural experiments only focus on the effect among people who are sensitive to Natural Randomness. So we cannot see the effect of treatment on outcome among the people who are not sensitive to Natural Randomness. While in randomized experiments, we may deal with this problem.

The fourth difference is that it is a little bit hard to convince people that our not-perfectly random source of exogenous variation is totally exogenous in our data generating process. After all, everything is related to everything else in social science. We cannot guarantee that we have closed all the backdoor paths from Natural Randomness in natural experiments while in randomized experiments, we can do this in a way.

Th fifth difference is that natural experiments might have less representativeness than randomized experiments no matter how big the sample of natural experiments is because natural experiments only focus on a very narrow slice of the data which is naturally randomized. In natural experiments, the data might not represent the wider population, so we might not get the true effect among the wider population. So natural experiment might have less representativeness than randomized experiments.

1. Provide an example of a of research question that is causal in nature but cannot be feasibly answered by a randomized experiment. Explain your reasoning.

Answer:

Research question: Does drinking polluted water affect people’s emotions?

We cannot use a randomized experiment in this study or randomly assign treatment because it is unethical to ask volunteer to drink polluted water and it may cause some serious health problems after the study. But we could apply natural experiments here. Whether a region settle a purified water system will affect whether people drink polluted water, and which regions have a purified water system is almost randomized and it seems that it has no back door paths.

1. Define the concept of exogenous variation.

Answer: The exogenous variation refers to the variation in treatment that has no open back doors and is not caused by any other variable that belongs on the causal diagram. The exogenous variation is external to the generating process of outcome in the causal diagram.

1. Provide an example of a natural experiment. It could be an idea of your own, from the book, or from a study you read.
   1. Draw a causal diagram using 5-10 variables.

Research Question: does go to a concert will make people are more willing to buy the performer’s albums?

图示

描述已自动生成

* 1. List the paths from the source of exogenous variation to the outcome.

Drawlots→ Concerts→ Willingness to buy performers’ albums

Drawlots → Concerts→ ConcertsQuality→ Willingness to buy performers’ albums

(The other paths are closed with a collider, Concerts, along the paths)

* 1. Which paths need to be closed?

Concerts← Popularity of performers → Willingness to buy performers’ albums

Concerts ←Income→ Willingness to buy performers’ albums

Concerts← Performers’ scandals→ Willingness to buy performers’ albums

* 1. Is it believable in this context that you haven’t missed any paths and that you can close all the paths you need? Why or why not?

Answer: I might miss some paths that shows the alternative explanations of the relationship between concerts and willingness to buy performers’ albums. However, the application of the exogenous variation, drawlots, predicts the treatment and closes all the back door paths of the treatment, no matter whether I have missed any back door paths or draw all the back door paths in this diagram.

1. Which of the following best explains how “using exogenous variation to predict treatment, and then using the prediction instead of the treatment itself” lets you isolate just the front door from treatment to outcome?

Answer: b. (The sentence “…, so nothing it predicts can have back doors either” means that the variation in prediction based on exogenous variation contains none of the back doors of the treatment in the original causal diagram. As for c., if we control for the exogenous variation, the treatment is also controlled for, then the path from exogenous variation to outcome via treatment closes.)

* 1. Because it allows you to control for treatment assignment
  2. Because the exogenous variation has no back doors, so nothing it predicts can have back doors either
  3. Because it takes the relationship between treatment and outcome and, by controlling for the exogenous variation, removes the back doors
  4. It can’t unless the treatment itself is also exogenously assigned

1. Consider the following natural experiment design: in 2019, United States president Donald Trump increased tariffs on Chinese imports considerably. This made United States consumers want to switch to non-Chinese sources of imports. If you are an exporter to the US, like Brazil, then demand for your products just went up *if* China is a competitor of yours. So Brazilian manufacturers of machinery saw their exports increase by a lot, but Brazilian pop musicians didn’t. You want to know whether exporting to a country makes you like it more. You plan to isolate the variation in Brazilian exports driven by the tariffs to see if industries with more exports have a higher opinion of the United States.
   1. What potential back doors might remain between the tariffs and the opinion of the United States?

Answer: the tariffs and the opinion of US could be correlated due to US-China relation, and types of US/Brazilian governments. So the potential back doors between the tariffs and the opinion of the United States could be:

Tariffs ← US-China Relation → Opinion of the United States

Tariffs ← US government → Opinion of the United States

Tariffs ←Brazilian government→ Opinion of the United States

* 1. If someone told you that they performed this study as described, and found that increased exports had no effect on opinion of the US, would you believe the result? Why or why not?

Answer: I do not believe the result. It is likely that the Brazilian exports here is Brazilian pop music, then the increased tariff on Chinese imports will not be a source of variation of Brazilian pop music export. The reason is that the Brazilian pop music is not the substitute products of Chinese import products, while Brazilian machinery could the substitute of Chinese import products. The mechanism of the effect of tariffs on Chinese import products bases on the substitute rule in economics. If Product A is a substitute of Product B, then the increasing price of Product B will lead to the decrease in demand of Product B and then the demand of Product A will increase. So the mechanism of the effect tariffs on Chinese products on Brazilian Exports should be: Tariffs on Chinese imports→Price of Chinese import products→Demand of Chinese import products→Demand of Substitute products (Brazilian products)→ Brazilian Exports. From the mechanism, we could see that whether the Brazilian export products are the substitutes of Chinese products is the key to the effect of tariffs on Brazilian exports. So once the Brazilian products, such as Brazilian pop music, is not a substitute of the Chinese import products, then the tariffs on Chinese imports will not lead to the variation in Brazilian exports.

Therefore, people should be careful about the kinds of industries in this study.