Introduction

1. History

Main idea : Probability can not explain causality.

Even the cases which you think have high cause-effect relation, They are still accepting lots of uncertainty influencing their probability. For example:

Take drug and the patients are healed, but it may be other factors of influence here. Like, the patients who can pay for these drug can be taken careful management.

2. Causal Revolution

Begain from 100 years ago, but real development began in 1980s.

3. Calculus of causation

3.1 causal diagrams

To express what we know

There are lots of kinds expression of causal relation. But the auhtor prefer to use causal diagrams. It likes dot-arrow graph which we will introduce in the latter.

3.2 symbolic language

1. Language

To express what we want to know

Explain the difference symbolic rules between statistic and causality inference.

Here is a example.

- **In statistic**

  $P(L|D)$: shows that D have correlation with L. For example:

  Falling barometer fall increase the probability of the storm.

- **In causality**

  There are kinds of formula, here they introduce the do operation.

  $P(L|do(D))$: shows the probability of L's happen when we **do D**. For example:

  If we force falling barometer to fall, it won't affect the probability of rainning.

2. Inference

And causal revolution gave a way to predict the effect of intervention without actually enacting it. Because we don't have conditions to control everything around the target.

The inference actually include two parts:

- Ask the question, like do.
- Devised a way to emulate it by non-invasive means.

4. Counterfactual

What L will be if we did't do D.

The most difficult part in causality. It will give robot the ability to ask why.

5. Blueprint of reality

5.1 The working mechanism of inference

It is showed in graph p12.

The detail of the mechanism is in the book, The main point is that:

- The inference consists of statistic and causality, which there is a interaction between them.
- `Assumption` is the important part to model causality, it indicate the main rules to causality inference system.
- `Estimand` is the recipe to cook the data in to answer for query. It will summarize the information of $P(L|do(D))$ but not $P(L|D)$ to the model

5.2 Discussion

- Compared to science which only use data(ML and statistic), causal model can deal with the problem of intervention and counterfactual.

- Counterfactual can make robot to ask "why". And we can use caual model to answer Counterfactual query.

- Causal model has adaptability, because the use of data is after estimand which guarantees the independence between data and estimand.

  On the contrary, deep-learning and statistic don't have the property of adaptability. For example, The model trained on a set of data only have high accuarcy in that data.

- **Causal lens** to depict a question.

6. Introduction of book's chapters

6.1 Chapter1

- Ladder of causation : observation $\rightarrow$ intervention $\rightarrow$ counterfactual
- Basic reasoning with causal diagram

6.2 Chapter2

- Statistic inflicts casual blindless on itself.

- The story of hero.

6.3 Chapter3

- Why traditional AI is wrong and Why author convert to causality?
- A causality-minded Introduction to bayes's rule and Bayesian method of reasoning.
- Some examples of bayes network.

6.4 Chapter4

- Major contribution of statistic to causal inference : Randomized controlled trial, do with $P(L|do(D))$
- A simple solution to the general confounding problem.

6.5 Chapter5

- History

6.6 Chapter6

- Introduce some paradox : show that human intuition is grounded in causal not statistic.

6.7 Chapter7

The seriously introduction about **Ladder of causation** from chapter7 to chapter9.

- intervention , do-type question
- Causal inference engine : produce yes/no in Figure1.1

6.8 Chapter8

- Counterfactual

6.9 Chapter9

- Mediation : to judge if interaction between D and L directly or indirectly

6.10 Chapter10

- strong AI