# Causal inference notes

## note 1 divine form of causal inference

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# The divine form of causal inference

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- The comparison of the outcomes in two worlds
  - the real world
  - the counterfactual world
- $Y_{1i} - Y_{0i}$

# The differences of the experiments in natural and social sciences

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- Natural science:
  - controlled experiment
  - output: experimental data(with the data in the two worlds)
- social science:
  - nearly no controlled experiment
  - output: observable data(with the data only in the one world, missing data problem)

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- How to do experiments with observable data
- Put it another way, it is a missing data problem

# What can we do with an observable dataset?

# What we can do easily

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- Calculate its mean value of a variable
- Calculate the difference of two groups: $E(Y|D=1) - E(Y|D=0)$
  - notation: Y is the actual observable outcome, $Y_1$ or $Y_0$ is the potential possibilities
- What is the problem of getting such a value with data only in one world?

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- Make all other conditions the same, except for what you are exploring!
  - actually, the (D = 1) and the (D = 0) groups are different other than the D condition!
  - think with examples

# How to solve this problem?

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- If we can do experiment, that is fantastic, just like what happens in natural sciences...
- Sometimes, we can do experiment, this is called RCT
  - it is intervened by us, so all other conditions are the same, except for D
  - in observable data, it is naturally formed, D's difference will bring more differences to the two groups