Causality (Part 2)

Fifth week of machine learning workshop

Outline

- Review of previous week and emphasizing important concepts
- Confounder
    - Backdoor path
    - How to adjust for confounder? Valid adjustment set
- Instrumental variable
- Structural equations model (SEM)
    - How to construct the graph from SEM
    - How to calculate observational distribution and interventional distribution from SEM
    - Why conditional distribution is different from interventional distribution
- Total cause effect.
- Counterfactuals
    - Role of counterfactuals in everyday thinking and decision making. Responsibility attribution and credit assignment
    - Counterfactuals are not falsifiable
    - For answering counterfactual question, SEM is necessary; i.e., two different SEM can lead to the same observational and interventional distributions, but they provide different answers to counterfactual.
    - Counterfactuals are individualistic.
- Background on graph theory
    - D-separation
    - V-Structure, immorality, selection bias

      o Path and skeleton

- How to make connection between graph and distribution
  - Markov property
  - Faithfulness
  - Markov equivalent class

References

1. Causality: Models, Reasoning and Inference Hardcover – September 14, 2009. Second edition. by Judea Pearl
2. The Book of Why: The New Science of Cause and Effect. Book by Dana Mackenzie and Judea Pearl. 2018
3. Elements of Causal Inference: Foundations and Learning Algorithms. Book by Bernhard Schölkopf, Dominik Janzing, and Jonas Peters. MIT press. 2017