

Machine Learning for Causal Inference

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1 Description of the tutorial topic

Causal inference is the key ingredient for achieving the human-level intelligence and is described as one of the fundamental goals of science. Causal understanding of phenomena plays a vital role in many fields of science such as healthcare, education, social science, politics, and law enforcement. Making intelligent and reliable decisions often hinges upon determining the effect of a treatment or a policy on a targeted outcome. For instance, public authorities need to assess the causal impact of different non-pharmaceutical COVID-19 policies on the outbreak dynamics to enforce more impactful and reliable regulations. With recent advances in machine learning and the availability of copious data, efforts have been made to leverage machine learning and deep neural networks to develop causal effect estimation algorithms for large-scaled high-dimensional data. In this tutorial, we provide an overview of causal effect estimation accompanied by easy-to-understand examples, introduce traditional approaches as well as cutting edge machine learning algorithms for this task, and discusses the commonly used evaluation methods and benchmark datasets.

2 Tutorial Structure

- Introduction to causal inference
 1. Correlation vs causation
 2. Randomized control trial
 3. Observational study
- Causal effect estimation
 1. Problem definition
 2. Potential outcome framework
- Traditional causal effect estimation
 1. Parametric g-formula
 2. Propensity score-based approaches
 3. Doubly robust estimation
- Machine learning for causal effect estimation
 1. Methods based on balanced representation learning
 2. Double Machine learning
 3. Generative modeling for causal effect estimation
- Evaluation and benchmarking
 1. Evaluation metrics
 2. Benchmark datasets
 3. Resources

3 Expected Audience

This tutorial is intended for students, researchers, and practitioners interested in causality from data mining and machine learning perspective to satisfy their curiosity and desire to learn and excel causal inference. Audience with wide range of backgrounds in data mining, machine learning, and social science can benefit from this tutorial.

4 Short bio and contact information of the organizers

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