Causal Effect Identification by Adjustment under Confounding and Selection Biases

Causal Inference
Answer questions about change, i.e. How will the click through rate ($Y$) change, if an agent picks the topic ($X$) of the ad displayed to the users?

Selection Bias
Proportions in the sample do not match those in the whole population! Will our conclusions hold for the general advertisement business?

Confounding Bias
- Age ($Z$) of the user influences what topics are likely to be shown.
- Age ($Z$) affects the likelihood of the user clicking the ads.

How much is the topic ($X$) affecting the click through rate ($Y$)?
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Our Task

• Consider both Selection Bias and Confounding bias simultaneously

• Use external data without selection bias to enhance the robustness of the inference process

Applications

Robotics  Statistics  Economy
Medicine  Biology  Experimental Design
Epidemiology  Marketing

Contributions

• Complete criterion to decide valid covariate adjustment sets without external data.

• Complete criterion when measures on the covariates are available from external data.

• Efficient (polynomial delay) algorithm to find such sets systematically.