

# New developments at the intersection of Machine Learning, Causal Inference, and Marketing

A comparison of DiD, Synthetic Controls and Synthetic DiD via Simulations

Benjamin Herzberger

Submission date:17.06.2024

## 1 Introduction

## 2 Methodology

Thus, the three different estimands emerge as:

$$\begin{aligned}(\hat{\tau}_{\text{did}}, \hat{\mu}, \hat{\alpha}, \hat{\beta}) &= \arg \min_{\alpha, \beta, \mu, \tau} \left\{ \sum_{i=1}^N \sum_{t=1}^T (Y_{it} - \mu - \alpha_i - \beta_t - W_{it} \tau)^2 \right\} \\(\hat{\tau}_{\text{sc}}, \hat{\mu}, \hat{\beta}) &= \arg \min_{\mu, \beta, \tau} \left\{ \sum_{i=1}^N \sum_{t=1}^T (Y_{it} - \mu - \beta_t - W_{it} \tau)^2 \hat{\omega}_{isc} \right\} \\(\hat{\tau}_{\text{sdid}}, \hat{\mu}, \hat{\alpha}, \hat{\beta}) &= \arg \min_{\tau, \mu, \alpha, \beta} \left\{ \sum_{i=1}^N \sum_{t=1}^T (Y_{it} - \mu - \alpha_i - \beta_t - W_{it} \tau)^2 \hat{\omega}_{is} \hat{\lambda}_t^{\text{sdid}} \right\}\end{aligned}$$

## 3 Data