Regularized Synthetic Control Methods

Lennart Bolwin
IW Köln

Abstract

The Synthetic Control (SC) method is a widely used tool for estimating causal treatment effects in observational studies. Typically, the counterfactual of the treated unit is synthesized using a weighted average of the donor units in the post-treatment period. The weights are computed in a data-driven manner and aim to minimize the distance between the treated unit and its counterfactual in the pre-treatment window. To avoid overfitting the pre-treatment data, the original approach proposed by Abadie, Diamond, and Hainmueller (ADH) incorporates the constraint that all weights are weakly positive and must sum up to one. Building on the work of Doudchenko and Imbens (2016), we propose an alternative regularized SC approach (REG-SC), which shrinks individual coefficients towards zero and coefficient sum towards one. The REG-SC estimator combines the strengths of the original SC method and the elastic net as it features a closed form with tunable hyperparameters. It also has a simple Bayesian representation which is valuable when the associated estimation uncertainty is quantified by means of Bayesian credibility intervals. By appending the donor pool with lagged values of the donors and the treatment series, the REG-SC framework is also applicable in dynamic (non-stationary) contexts. Monte Carlo experiments as well as applications to existing empirical studies indicate that the REGSC estimator outperforms other SC methods previously proposed in the literature.