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An Exact and Robust Conformal Inference Method for Counterfactual and Synthetic Controls

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ABSTRACT

We introduce new inference procedures for counterfactual and synthetic control methods for policy evaluation. We recast the causal inference problem as a counterfactual prediction and a structural breaks testing problem. This allows us to exploit insights from conformal prediction and structural breaks testing to develop permutation inference procedures that accommodate modern high-dimensional estimators, are valid under weak and easy-to-verify conditions, and are provably robust against misspecification. Our methods work in conjunction with many different approaches for predicting counterfactual mean outcomes in the absence of the policy intervention. Examples include synthetic controls, difference-in-differences, factor and matrix completion models, and (fused) time series panel data models. Our approach demonstrates an excellent small-sample performance in simulations and is taken to a data application where we re-evaluate the consequences of decriminalizing indoor prostitution. Open-source software for implementing our conformal inference methods is available.

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1. Introduction

We consider the problem of making inferences on the causal effect of a policy intervention in an aggregate time series setup

the trajectory of policy effects in the posttreatment period, $\theta = \{\theta_t\}_{t=T_0+1}^{T_0+T_*}$. Specifically, we postulate a trajectory $\theta^0 = \{\theta_t^0\}_{t=T_0+1}^{T_0+T_*}$ and test the sharp null hypothesis that $\theta = \theta^0$