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Title: Geospatial Synthetic Controls for Agricultural Impact Evaluation

This paper adapts cutting-edge methods from econometrics and machine learning to measure the effects of a policy on agricultural productivity using satellite remote sensing data. It does this by finding areas that were most similar to those that received the policy before the policy was implemented. Given some treated areas, it samples hundreds of thousands of points outside of the treated plots and constructs a synthetic control that best matches the pre-treatment trend of the outcome of interest for each treated area. The synthetic control is constructed using observed covariates and unobserved factors driving the variation of treated units in the pre-treatment period. This allows us to generate estimates of average and individual treatment effects as well as confidence intervals for those estimates. Furthermore, the method allows us to observe the spatial distribution of points that were heavily drawn upon for any synthetic control unit and the distribution of factors that went into the creation of that control. Rather than relying on a black-box machine learning method, we show how the method constructs counterfactual outcomes for the treated plots. We test the method on real data with a simulated effect and show how we applied the method to a land-titling intervention in Benin. The paper has two major contributions: First, it allows a researcher to estimate the treatment effect of an intervention in which only treated units were demarcated, opening hundreds of completed interventions to further analysis. Secondly, it allows a researcher to investigate and interpret the inner-workings of this machine learning model.