Tool

A Toolkit for a Score-Based Balance Metric for the Synthetic Control Method

A Tutorial for the synth_asmd Stata Program

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About This Tool

This tool includes background information on the **`synth_asmd`** program for Stata, a tutorial on its use, and the sample code and datasets used in the tutorial.

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Summary

Lack of balance results in the confounding of treatment effect estimates. In the context of the synthetic control method, researchers may be unsure whether a synthetic control group and treated group are balanced. This *Toolkit for a Score-Based Balance Metric for the Synthetic Control Method* contains background information on a Stata program to calculate the Absolute Standardized Mean Difference (ASMD), as a test of balance between a synthetic control unit and a treated unit of the synthetic control method. For a full description of the ASMD metric in the synthetic control method context, see Parast et al., 2020.

This toolkit includes an overview of the **`synth_asmd`** program commands for Stata, a tutorial on their use, and the sample code and datasets used in the tutorial.

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1. Introduction

The synthetic control method (SCM) involves the optimal selection of weights, which are applied to a group of untreated (or control) units to produce an estimated counterfactual (or "synthetic control") to the treated unit (Abadie, Diamond, and Hainmueller, 2010). If the synthetic control and treated units are balanced, the researcher conducts inference and estimates the treatment effect. Parast et al., 2020, demonstrates the utility of the mean and maximum Absolute Standardized Mean Difference (ASMD) as a test of balance between a synthetic control unit and a treated unit. ASMDs can be used to help quantify the size of the imbalances shown in typical SCM gap plots by providing a simple numerical summary for researchers to compute and assess in an SCM application. This toolkit provides the **`synth_asmd`** program in the Stata environment and an example of how to use it.

The ASMD for a given factor equals the absolute difference between the weighted synthetic control (SC) group and the treated unit, divided by the standard deviation of the given factor in the SC control group, as shown in the following equation:

$$ASMD_t = \frac{|Y_{treated,t} - Y_{SC,t}|}{sd(Y_{SC,t})},$$

where $Y_{treated,t}$ is the outcome of the treated unit in the pre-intervention time *t*, $Y_{SC,t}$ is the weighted mean outcome in the SC group in the pre-intervention time *t* where the weights are specified by the SCM, and $sd(Y_{SC,t})$ is the weighted standard deviation of the outcome in the SC group in the pre-intervention time period *t*. The estimated standard deviation in the denominator must come from the control group in this case because there is no variability in the treated condition (single group) within a single unit of time *t*. The estimate provides us with a sense of how much variability there typically might be for the measure of interest among controls that are given a non-zero weight by the SCM, and accounting for the estimated weights. The ASMD provides a way to gauge how similar the treated unit and its synthetic control are on each pre-intervention period *t* used to match in the SCM.

The **synth_asmd** program provides two summaries of the ASMD values across time: the maximum ASMD (max ASMD), denoted as max_{ASMD}, and the mean of the ASMD values across time, denoted as $mean_{ASMD}$, which can be expressed as follows:

$$mean_{ASMD} = T_0^{-1} \sum_t^{T_0} \frac{|Y_{treated,t} - Y'_{SC,t}\omega|}{sd(Y_{SC,t})}$$

and

$$max_{ASMD} = max_{year} \sum_t^{T_0} \frac{|Y_{treated,t} - Y'_{SC,t}\omega|}{sd(Y_{SC,t})},$$

where T_0 is the number of pre-intervention periods and ω is the vector of SCM weights.

2. An Example

Set-up

The **synth_asmd** program is written for the Stata software package and requires the **synth** module (Abadie, Diamond, and Hainmueller, 2020). If you have not already done so, set up your directory (using the **cd** statement before the directory location of where you want the program and example data stored), then install **synth** on your system using the commands

```
. cd C:\ado\plus\s
. ssc install synth, all
```

Load Example Data and Results Needed for **synth_ASMD**

Identify the path where you saved the example data during your installation of the **synth** module with the command

```
. cd C:\ado\plus\s
```

The following panel dataset contains information for 39 U.S. states for the years 1970–2000 (see Abadie, Diamond, and Hainmueller, 2010, for details):

```
. sysuse synth_smoking
```

Declare the dataset as a panel

```
. tsset state year
```

You will need to declare the directory where you want to keep the results of **synth**, using the optional **keep** command. Therefore, identify a path where you prefer to store your data for the data you wish to study.

Declare the location for keeping the result file

```
. cd C:\Users\yourname\Desktop\smokingproject
```

For our example, construct an SC group and store those results with the command

```
. synth cigsale beer(1984(1)1988) lnincome retprice age15to24
cigsale(1988) cigsale(1980) cigsale(1975), trunit(3)
trperiod(1989) keep("synth_cigsale.dta") replace
```

In this example, the outcome is cigarette sales and the unit affected by the intervention is unit number 3 (California) in the year 1989. The results file is stored as

```
C:\Users\yourname\Desktop\smokingproject\synth_cigsale.dta
```

Calculate the Mean ASMD and Maximum ASMD

The above example includes the four **required** pieces of information in the **`synth_asmd`** command line:

1. the treated unit (**`trunit[3]`**, or California)
2. the treatment period (in this case, **`trperiod[1989]`**)
3. the dependent, or outcome, variable (**`cigsale`**, or cigarette sales)
4. the location of the synth result (.dta file).

Calculate the mean ASMD and max ASMD with

```
. synth_asmd, trunit(3) trperiod(1989) depvar(cigsale)
data("synth_cigsale.dta")
```

Example Results

The results in this example are as follows:

```
ASMD mean:
.03837381
ASMD max:
.11773901
```

3. Conclusion

This toolkit provides background information and an example of using the **`synth_asmd`** program for Stata. The ASMD indicates when there may be a problem of equivalence between control and treatment groups, with an established threshold (e.g., 0.10) for the mean of the covariate balance metrics (mean ASMD) or the maximum of the balance metrics (max ASMD).

As a good rule of thumb, evidence suggests that an ASMD mean value of less than or equal to 0.10 indicates good balance; this is somewhat conservative for the max ASMD (Griffin et al., 2017). However, this is a rule of thumb, and I encourage users to consider whether small imbalances (i.e., close to but greater than 0.10) are sufficient. The example results suggest that the match would be considered "good enough," although the max ASMD is slightly greater than 0.10. Indeed, the authors of this balance metric have provided several examples like this, and others, to help researchers think through whether the synthetic control unit is a good-enough match for the treated unit (Parast et al., 2020).

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