# Synthetic Difference-in-Differences for Stata: The `sdid` Command

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**Abstract**

In this document we provide a number of examples of the `sdid` command written for Stata. This command implements Arkhangelsky et al. (2021)'s synthetic difference-in-differences method for Stata. The program generates the ATT estimate derived in Arkhangelsky et al. (2021), and conducts inference following their bootstrap, placebo, or jackknife methods. The command allows for multiple treatment dates and multiple treatment units directly, as well as cases with only a single treatment unit.

## Examples

Here we first provide an example presented in Arkhangelsky et al. (2021), based on the data and context described in Abadie et al. (2010). These data consiste of single treated state (California) which adopted a Tobacco control measure in 1989 ("Proposition 99"). Using the `sdid` command, we replicate the results from Arkhangelsky et al. (2021). In the below code example, we first download the data, and then conduct the Synthetic Difference-in-Differences implementation using a placebo inference procedure. The `graph`, `graph_export()` and `g1_opt()` options all relate to graphs, which are exported by default as presented in Figure 1.

```
. global link "https://raw.githubusercontent.com/synth-inference/synthdid/"
. import delimited "$link/master/data/california_prop99.csv", clear delim(";")
. sdid packspercapita state year treated, vce(placebo) seed(123) reps(50)
    graph graph_export(sdid_, .eps) g1_opt(xtitle(""))
```

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As well as the graphs which are produced, Stata reports the estimated treatment effect of -15.60383 (identical to that reported by Arkhangelsky et al. (2021) `synthdid` implementation in R, and estimated standard error of 6.65902 (comparable to that in R, subject to variation owing to randomness in permutations).

Figure 1: Proposition 99 Example from Abadie et al. (2010); Arkhangelsky et al. (2021)

(a) Unit-Specific Weights ("g1")  (b) Outcome Trends and Time-Specific Weights ("g2")
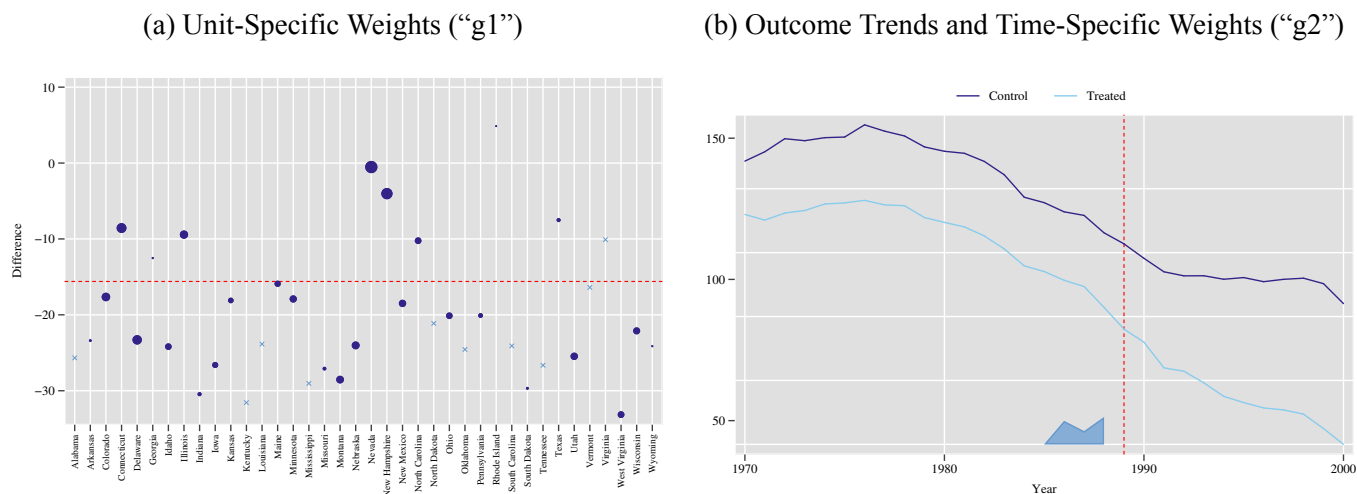


This example based on the passage of California's "Proposition 99" is a case in which there is a single adopting state (California) and many potential donors. However, as derived in the Appendix of Arkhangelsky et al. (2021), Synthetic difference-in-differences can be applied to settings where a staggered adoption design occurs, ie where states potentially adopt treatments at different points in time (or remain entirely untreated). Our `sdid` seamlessly incorporates such cases where multiple treatment periods are observed. A simple example can be seen based on Stevenson and Wolfers (2006). This example considers the passage of state-level no-fault divorce laws on rates of homicides against women. In this case we sub-set only to states which *had not* adopted the reform at the beginning of the panel, as synthetic difference-in-difference implementations require pre-treatment periods for all treated states. In the code excerpt below we first show an example where we conduct synthetic difference-in-differences based on all treatment adoption dates, and generate bootstrapped standard errors. We then additionally document how covariates can be simply incorporated into these methods, using the `covariates()` option.

```
. webuse set www.damianclarke.net/stata/
. webuse bacon_example.dta, clear
. drop if stfips==22|stfips==24|stfips==37|
  stfips==40|stfips==49|stfips==50|stfips==51|stfips==54
. sdid asmrs stfips year post, vce(bootstrap) seed(12011303)
. sdid asmrs stfips year post, vce(bootstrap) seed(12011303) covariates(asmrh
  cases pcinc, projected)
```

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# References

A. Abadie, A. Diamond, and J. Hainmueller. Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program. *Journal of the American Statistical Association*, 105(490):493–505, 2010.

D. Arkhangelsky, S. Athey, D. A. Hirshberg, G. W. Imbens, and S. Wager. Synthetic Difference-in-Differences. *American Economic Review*, 111(12):4088–4118, December 2021. doi: 10.1257/aer.20190159.

B. Stevenson and J. Wolfers. Bargaining in the Shadow of the Law: Divorce Laws and Family Distress*. *The Quarterly Journal of Economics*, 121(1):267–288, 02 2006. ISSN 0033-5533. doi: 10.1093/q-je/121.1.267.