

# Triply RObust Panel (TROP) Estimator

diff-diff v2.7

*Athey, Imbens, Qu & Viviano (2025)*

One estimator, three robustness guarantees

# Which Estimator

## Do You Trust?

### Difference-in-Differences

Assumes parallel trends

### Matrix Completion

Assumes low-rank factor model

### Synthetic Control

Assumes similar donor units exist

*Different assumptions that are difficult  
to validate or even compare in practice*

Athey et al. (2025)

# What If You Didn't Have to Choose?

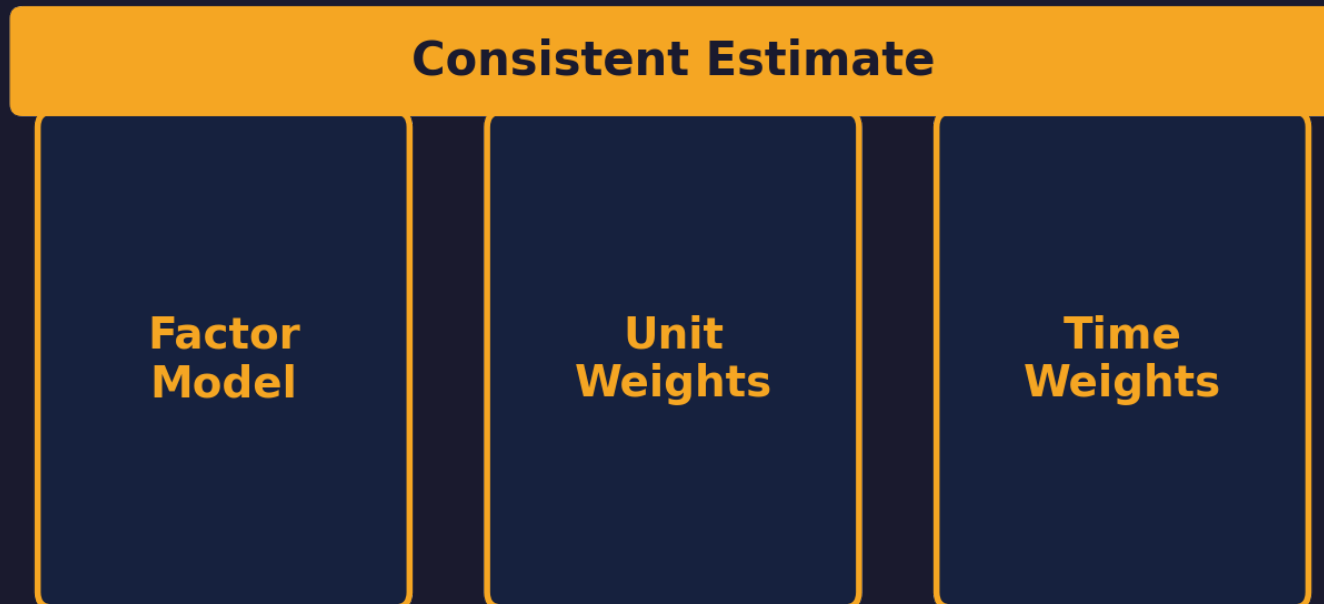
TROP subsumes all three approaches

-- each is a special case.



**Consistent if any one modeling  
component is correct**

# Triple Robustness



Any one pillar is sufficient

TROP models counterfactual outcomes as:

$$Y_{it}(0) = \alpha_i + \beta_t + L_{it} + \varepsilon_{it}$$

$\alpha_i, \beta_t$  = unit and time fixed effects

$L_{it}$  = low-rank factor structure (key innovation)

# When to Use TROP

- **Unobserved confounders**

Factor-structured interactive fixed effects

- **Staggered adoption**

Different treatment timing across units

- **Uncertain assumptions**

You don't know which estimator to trust

- **Heterogeneous effects**

Individual treatment effects per unit and time

# The Code

```
from diff_diff import TROP

trop = TROP(method='local')

results = trop.fit(

    data, outcome="y",

    treatment="D", unit="id",

    time="t")

results.print_summary()
```

sklearn-like API | optional Rust backend

# Data-Driven Tuning

All tuning parameters selected automatically via  
leave-one-out cross-validation.

## LOOCV

Selects all three lambda parameters

## Individual effects

$\tau(i,t)$  for each treated observation

## Factor diagnostics

Estimated factor matrix and effective rank

## Two methods

Local (per-observation) or global (faster, simultaneous)

# Get Started

```
pip install diff-diff
```

[github.com/igerber/diff-diff](https://github.com/igerber/diff-diff)

[arXiv:2508.21536](https://arxiv.org/abs/2508.21536)

## diff-diff v2.7

Difference-in-Differences for Python