



# diff - diff

**There's a clean line between  
treated and control.**

**Until there isn't.**

**Spillover-Aware DiD.**

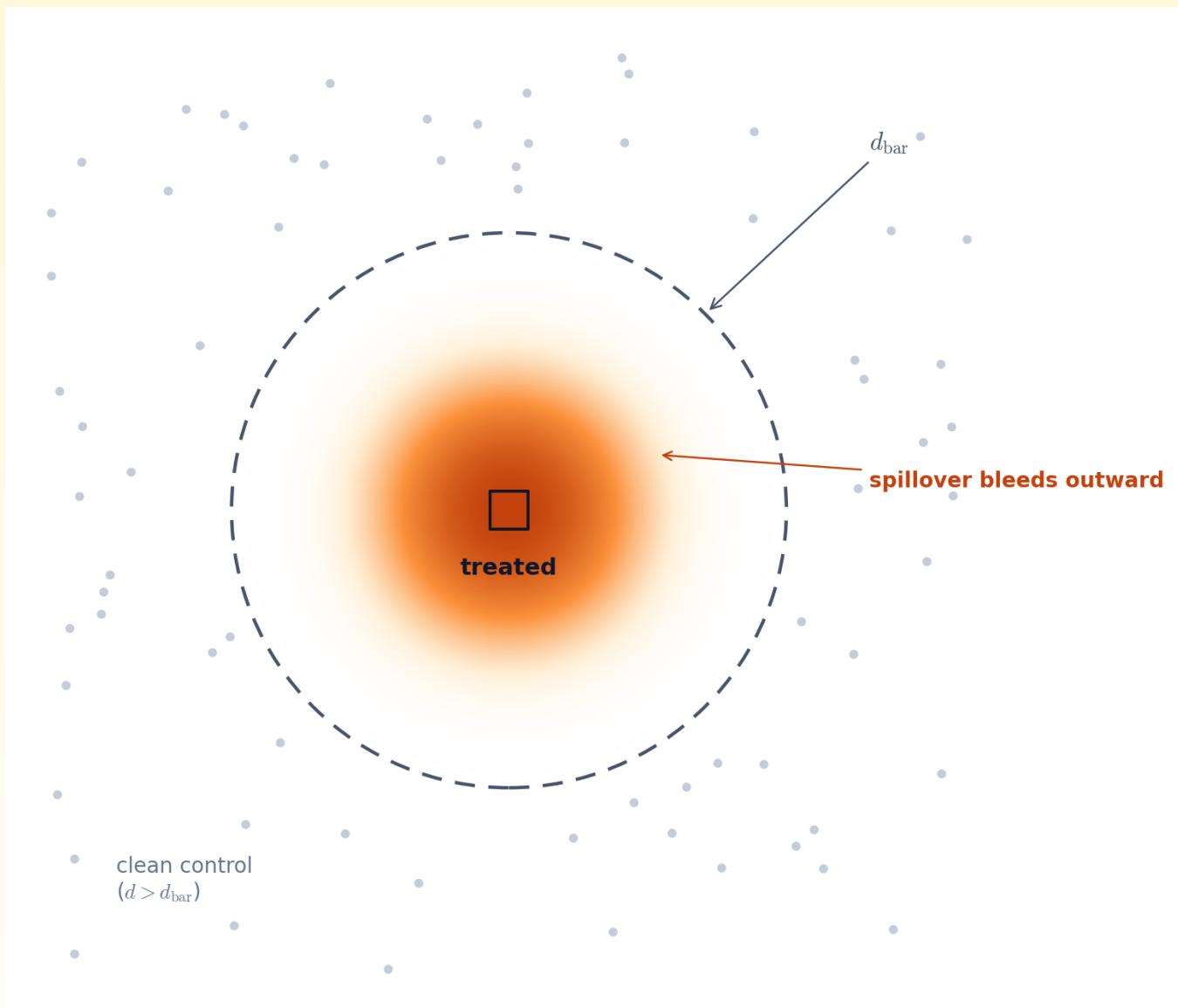
*Now in diff-diff.*

*Butts (2021).*

arXiv:2105.03737

**diff-diff v3.4.1**

# Some treatment leaks into your controls.



*The 'control' isn't. (Partly.)*

# Sometimes treatment **leaks** across borders.

## **Place-Based Economic Policy**

Enterprise zones lift local investment - and bleed into adjacent neighborhoods.

## **Out-of-Home Media Buys**

Billboards reach commuters who live outside the placement DMA.

## **Geo-Targeted Digital Campaigns**

Meta / Google geo-fences leak via household-IP and travel boundaries.

## **Retail Footprint Tests**

A new store lifts sales in adjacent trade areas, not just at the location.

# The SpilloverDiD estimator.

*For partial-contamination DiD.*

Recovers both direct effects on treated  
and per-ring spillover on near-controls.

## Two effects, one regression.

Direct  $\tau_{\text{total}}$  on treated AND per-ring  $\delta_j$  on near-controls.

## Far-away controls anchor identification.

Beyond  $d_{\text{bar}}$ , controls are uncontaminated.

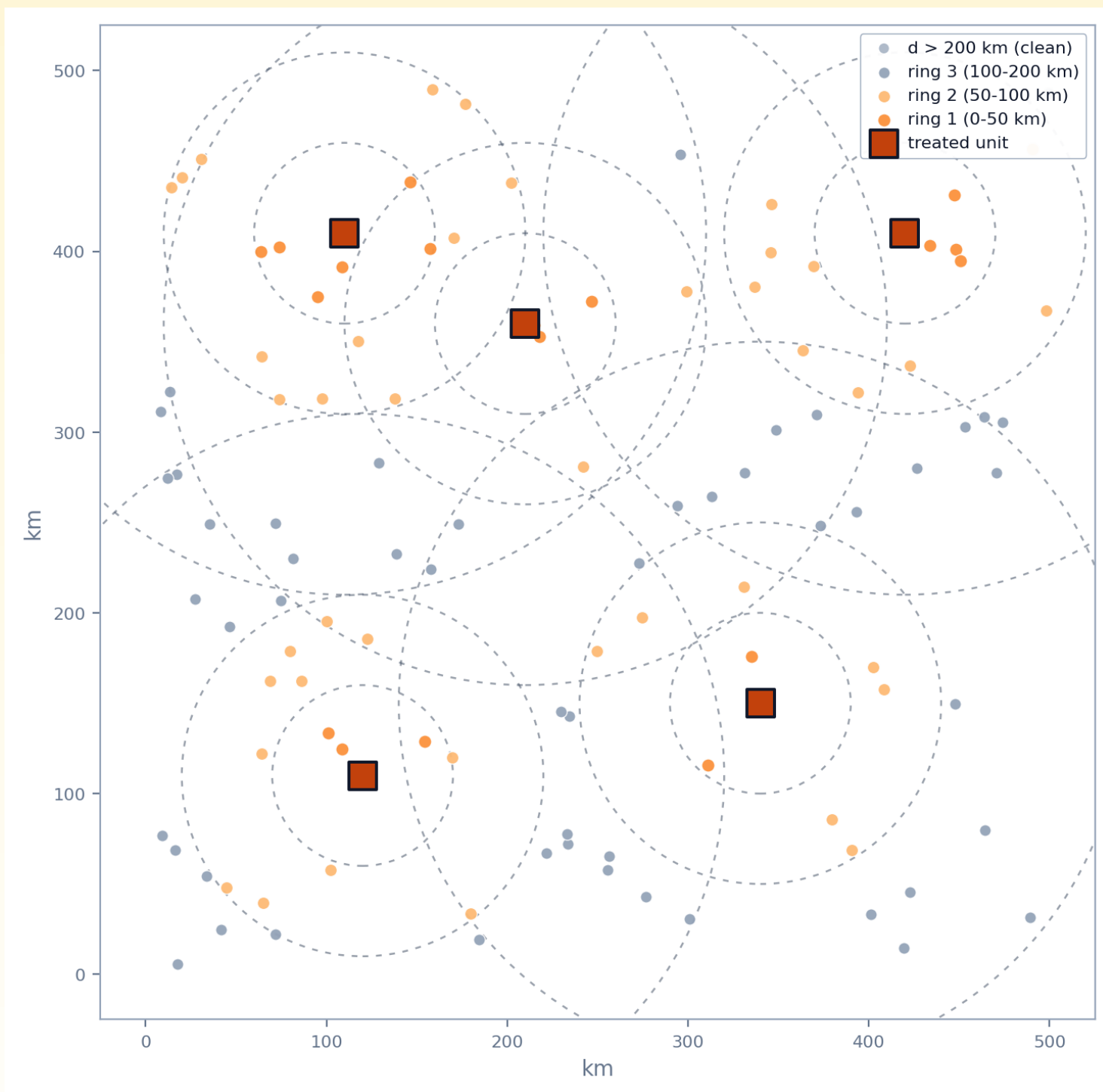
## Spatial-HAC inference, out of the box.

Conley (1999) panel-block standard errors.

*Built on two-stage Gardner (2022) DiD.*

**diff-diff v3.4.1**

# Identify the spillover ring by ring.



Each ring estimates its own spillover effect.

# The hidden bias.

*(Butts 2021, Proposition 2.1)*

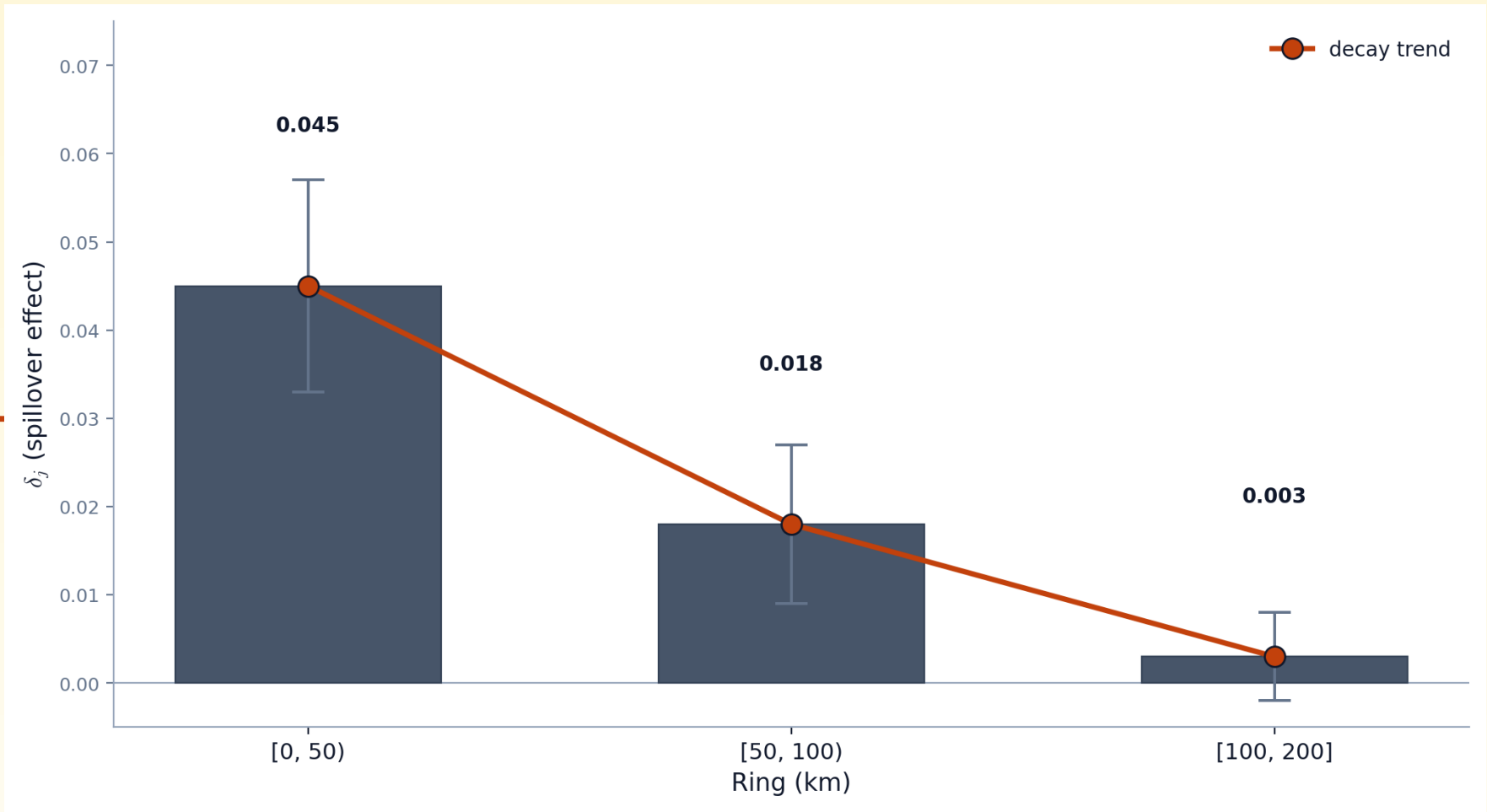
$$\beta_{\text{DiD}} \approx \tau_{\text{total}} - \tau_{\text{spill}}(0)$$

↑  
**hidden bias term**

Standard DiD recovers  $\tau_{\text{total}}$  only when spillover is zero.

SpilloverDiD identifies  $\tau_{\text{total}}$  and  $\delta_j$  separately.

# Spillover decays with distance.



Per-ring  $\delta_j$  attenuates toward zero.

# The Code.

Same sklearn-like API as every diff-diff estimator.

```
from diff_diff import SpilloverDiD

result = SpilloverDiD(
    rings=[0, 50, 100, 200],
    conley_coords=('lat', 'lon'),
).fit(
    data,
    outcome='sales', unit='store',
    time='week', treatment='campaign',
)

print(result.att)          # tau_total = 0.124
print(result.spillover_effects) # per-ring delta_j

#           coef    se    p_value
# [0, 50)    0.045  0.012  0.001
# [50, 100)   0.018  0.009  0.041
# [100, 200]  0.003  0.005  0.561
```

Two outputs. One fit() call.



# Production-ready.

## Spatial-HAC SEs

Conley (1999) panel-block,  
kdtree fast path

## Cluster-Robust

HC1 / CR1 with  
Gardner GMM correction

## Survey Design

pweights, strata, PSU,  
FPC via Binder TSL

## Subpopulation Domains

Full-design retention  
via zero-pad scores

## Event-Study Mode

Per-event-time x ring  
decomposition

## Staggered Timing

Gardner two-stage;  
non-staggered too

*All composable on the basic fit() call.*

# Validated.

*Documented synthesis + Monte Carlo recovery on synthetic DGPs.*

## Butts Eq 5/6 + Proposition 2.1

Time-varying ring-exposure synthesis (Butts Sec 5 + Gardner + Conley).

## Gardner Two-Stage GMM (Section 4)

Stage-1 FE absorption + stage-2 with first-stage uncertainty correction.

## Conley (1999) Spatial-HAC

Matched to R conleyreg at atol=1e-6 on parity fixtures.

## Monte Carlo Recovery

Recovers known  $\tau_{\text{total}}$  +  $\delta_j$  on synthetic spillover DGPs.

*Now in diff-diff.*

# Spillover-Aware DiD.

```
$ pip install --upgrade diff-diff
```

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

## diff - diff

Difference-in-Differences for Python