Data Scientist Assessment
DATA Lab at Philadelphia DAO

J.J. Naddeo

Georgetown University and Justice Innovation Lab

February 12, 2023

1. Which research design(s) might be appropriate to understand the causal relationship (if any) between housing improvements and shootings?

1. Which research design(s) might be appropriate to understand the causal relationship (if any) between housing improvements and shootings?

2. What method(s) would you consider or plan to use to investigate these questions?

Task #1: Research Design

1. Which research design(s) might be appropriate to understand the causal relationship (if any) between housing improvements and shootings?

2. What method(s) would you consider or plan to use to investigate these questions?

3. What limitations do you foresee in such an analysis? Are there complementary research designs that could be conducted to mitigate them?

RESEARCH DESIGN: RCT

- The cleanest (and most expensive) way to answer such questions is to run a randomized experiment
- Here if possible one would randomly pick neighborhoods and then "treat" them with housing improvements
  - Increased lighting, green space, renovations of abandoned houses, re-pavement of roads/sidewalks, etc.
- Method: Use OLS to evaluate if treatment reduces shootings in neighborhoods that receive treatment

1. Cost
   - Limit to neighborhoods of interest (based on some clear criteria)$\rightarrow$ reduces external validity

LIMITATIONS OF RCT

1. Cost
   - Limit to neighborhoods of interest (based on some clear criteria)$\rightarrow$ reduces external validity
2. Ethical issues
   - If we know *a priori* that renovations reduce shootings we are knowingly withholding helpful treatment to untreated groups

LIMITATIONS OF RCT

TASK #1

TASK #2

1. Cost
   - Limit to neighborhoods of interest (based on some clear criteria)$\rightarrow$ reduces external validity
2. Ethical issues
   - If we know *a priori* that renovations reduce shootings we are knowingly withholding helpful treatment to untreated groups
3. Spillovers
   - Two adjacent neighborhoods: one treated, one untreated
   - Maybe treatment impacts adjacent neighborhoods (positively or negatively)
   - Solution: Ensure treated and untreated have "buffers" (may not be possible given area constraints)

LIMITATIONS OF RCT

1. Cost
   - Limit to neighborhoods of interest (based on some clear criteria)→ reduces external validity
2. Ethical issues
   - If we know *a priori* that renovations reduce shootings we are knowingly withholding helpful treatment to untreated groups
3. Spillovers
   - Two adjacent neighborhoods: one treated, one untreated
   - Maybe treatment impacts adjacent neighborhoods (positively or negatively)
   - Solution: Ensure treated and untreated have "buffers" (may not be possible given area constraints)
4. Imbalance by observables
   - Even with randomization there can be imbalance (e.g. treatment neighborhoods are higher income)
   - Solution: Control for observables and/or block randomize using some observables that are first-order important

Research Design: Observational

- If RCT is not feasible one may try to use historical observational data to determine causality
- First look for events that may have changed the "quality" of housing in neighborhoods but did not impact any other variables that could affect shootings
- Example: Citywide renovation of public goods that was rolled out in a staggered manner
- Method: Difference in differences
  - Compare shootings in treated areas to those yet treated
  - Be careful and use correct comparisons (Roth et al. 2023)
- Limitations: Parallel trends could be impacted by spillover effect previously discussed

- Testing for racial bias in stop/search behavior is difficult
    - Distribution of individuals on road
    - Distribution of contraband/criminal activity

- Testing for racial bias in stop/search behavior is difficult
  - Distribution of individuals on road
  - Distribution of contraband/criminal activity
- Potential solutions:
  - Look at differences in hit rates
  - Look at differences in search/frisk rates

HIT RATES

- "Hit rates" by race, γ^r
- If $\gamma^A > \gamma^B$ for races A and B it suggests that there is racial bias against group B
- Restrict to vehicle stops in 2021 in districts with at least 100 stops
- Mean hit rate in sample: 2.4%

HIT RATES

- "Hit rates" by race, γ^r
- If $\gamma^A > \gamma^B$ for races A and B it suggests that there is racial bias against group B
- Restrict to vehicle stops in 2021 in districts with at least 100 stops
- Mean hit rate in sample: 2.4%
- Compared to vehicles driven by White (non-latino) motorists vehicle searches of Black (non-Latino) [-5.2 p.p.], White Latino [-7 p.p.] drivers are less successful and searches of Asian [7.7 p.p.] are more sucessful
    - controls: age, gender, month, day of week, and district the stop occurred in

SEARCH/FRISK RATES

- Can also look at rates of search/frisk
- Restrict to vehicle stops in 2021 in districts with at least 100 stops
- Mean search/frisk rate in entire sample 13.4%
- Results indicate that compared to vehicles driven by White (non-Latino) motorists vehicle are searched at higher rates for Black (non-Latino) [3.6 p.p.] and White - Latino [0.2 p.p. NSS], lower rates for Asian [-2.6 p.p.] drivers
    - controls: age, gender, month, day of week, and district the stop occurred in

Veil of Darkness

- Using variation in light we can look at how these relationships vary by visibility
- The intuition is that darkness shields police from seeing the race/ethnicity of drivers and makes stops less susceptible to bias
- Comparing night to day could introduce issues with driving patterns→limit to 3 hours where transition occurs
  - Note: should do a more robust analysis using daylight savings and controlling for hour as in Grogger and Ridgeway (2006), but did not have time
- Define dark as when sun is $12°$ below horizon
- Hit rate: Racial differences in hit rates closes under veil of darkness
- Search/frisk rates: Gap widens for Black (non-Latino) and Asian

LIMITATIONS

- Inframarginality bias: For hit rate analysis we assume that we are identifying the marginal search, could be the case we aren't (Simoiu et al. 2017)
- Misreporting: Police are likely aware of hit rate analysis and may misreport drivers race/ethnicity (Luh 2022)
- Street lighting could make veil of darkness ineffective, especially in well lit urban areas (Horrace and Rohlin 2016)
- Darkness may change traffic patterns which changes distribution of drivers/risk

FUTURE WORK

- Incorporate information that control for incidents
- Merge in information regarding streetlight location/brightness
- Conduct an regression discontinuity in time (potentially using a donut estimator) around light/dark
- Explore heterogeneity by age/gender, as well as socioeconomic features of areas