Investigating spatial concentration and contagion of gun violence during the COVID-19 pandemic

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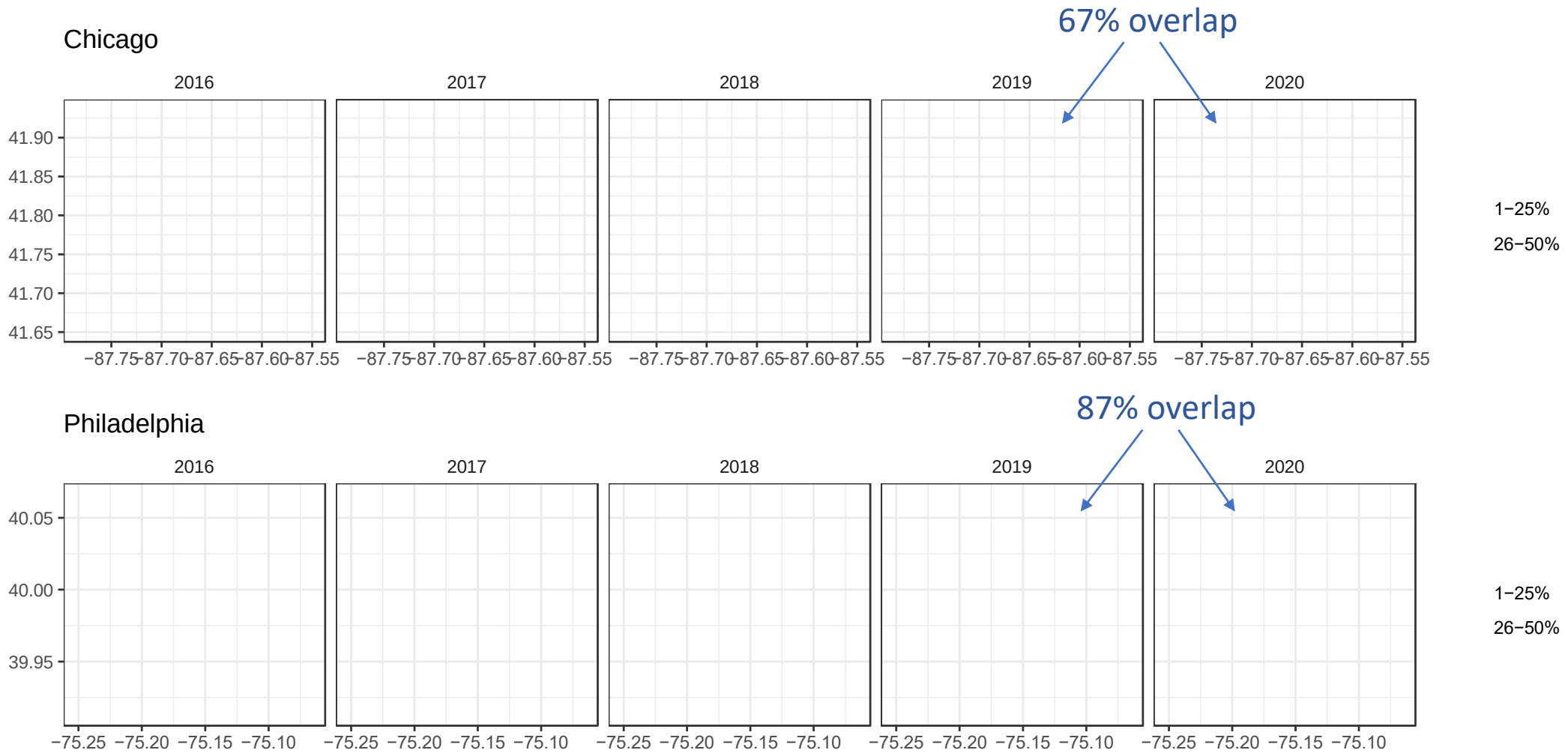
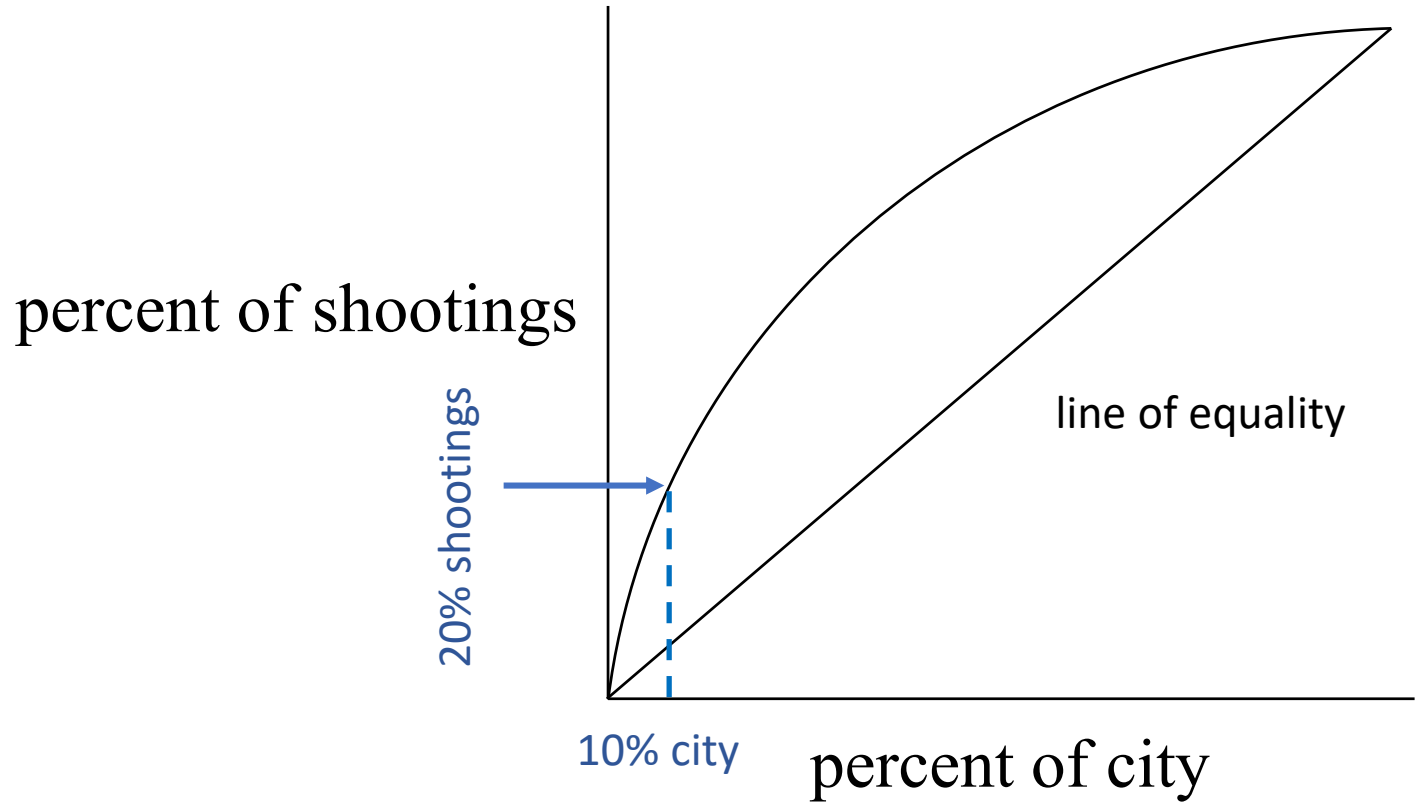
Overview

- Extent to which shootings during the pandemic concentrated in space
- Role contagion played in the increase in shootings
- Data: open source shooting incidents
  - location, date, time, race/ethnicity of victim
  - Chicago, New York, Los Angeles, & Philadelphia
  - 2016-2021

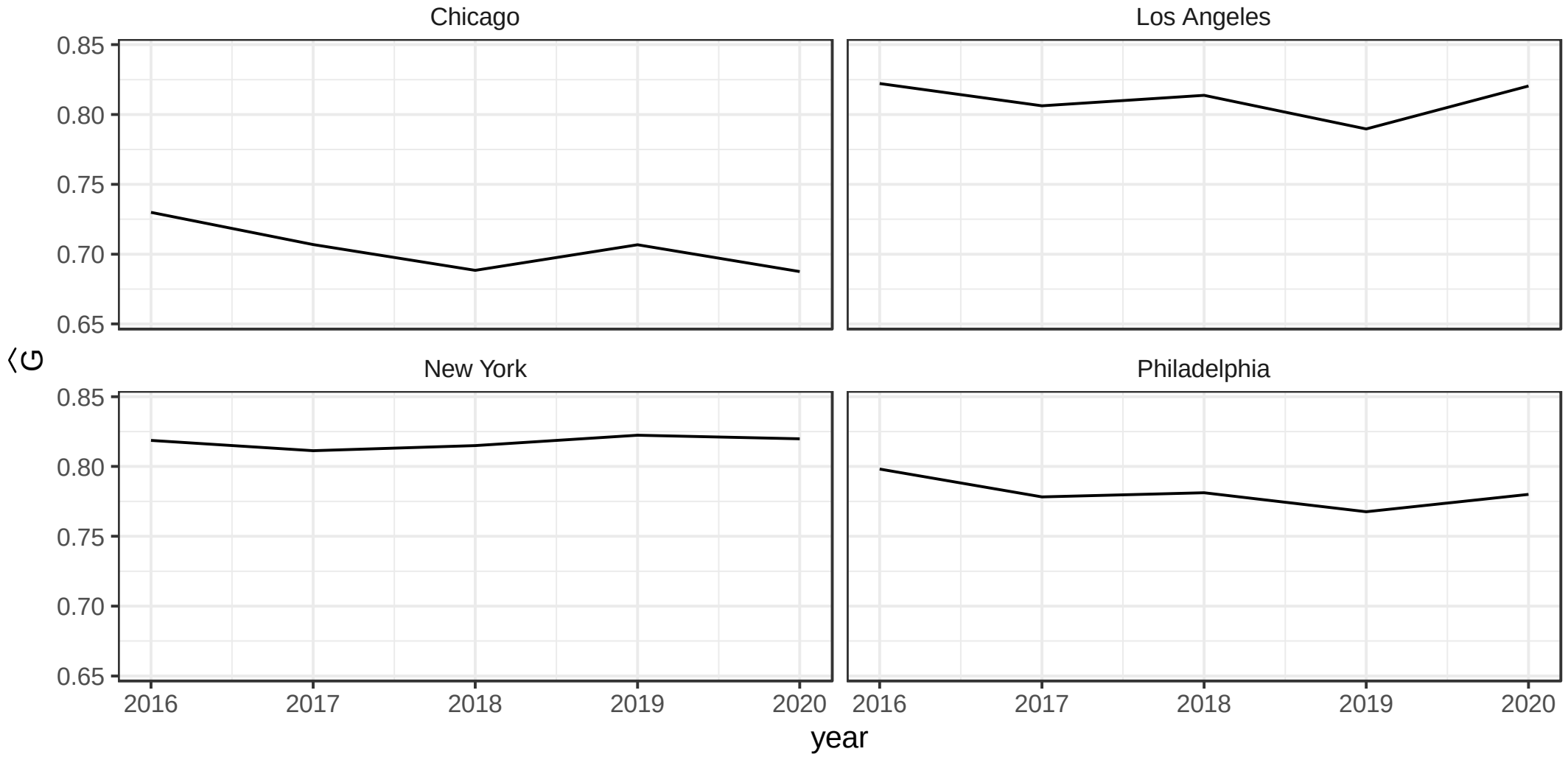
Stability of gun violence hotspots over time



Gini index of spatial concentration



Gini index of gun violence hotspots over time



Gun violence concentration by top decile of census blocks and race

Demographics of shooting victims vs. population in gun violence hot spots. First two columns contain the fraction of shootings in the top decile of census blocks (ranked by shootings) in 2016–2019 and 2020–2021. Remaining columns contain demographics of the population and shooting victims in the top decile of census blocks ranked by aggregate shootings in that time period (closest ACS range of 2015–2019 was used).

city	frac. top decile 16–19	frac. top decile 20–21	frac. pop. white 15–19	frac. vict. white 16–19	frac. vict. white 20–21	frac. pop Black 15–19	frac. vict. Black 16–19	frac. vict. Black 20–21	frac. pop. Hisp. 15–19	frac. vict. Hisp. 16–19	frac. vict. Hisp. 20–21
Phil.	0.44	0.44	0.09	0.04	0.06	0.59	0.78	0.83	0.27	0.18	0.11
L.A.	0.50	0.57	0.04	0.02	0.02	0.20	0.54	0.56	0.71	0.42	0.38
N.Y.	0.66	0.74	0.08	0.02	0.02	0.44	0.73	0.71	0.39	0.23	0.25

Increase in gun violence by top decile of census blocks and race

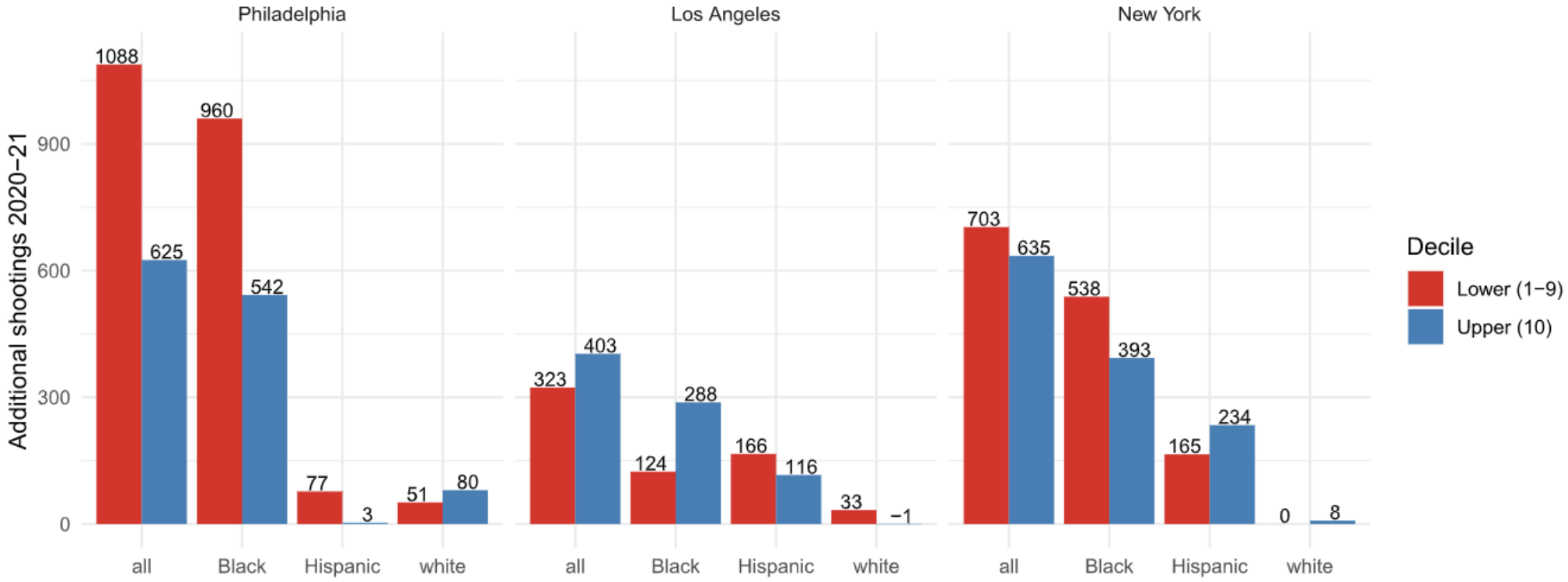


Fig. 2. Additional shootings during 2021–22 relative to the expected number of shootings predicted by a Poisson regression with pandemic indicator variable set to false. Deciles determined by counts of aggregate shootings in census block groups during 2016–2019.

Literature on contagiousness of gun violence

- Green, Ben, Thibaut Horel, and Andrew V. Papachristos. "Modeling contagion through social networks to explain and predict gunshot violence in Chicago, 2006 to 2014." *JAMA internal medicine* 2017.

  R=0.63, co-offending networks, Chicago

- Loeffler, Charles, and Seth Flaxman. "Is gun violence contagious? A spatiotemporal test." *Journal of quantitative criminology* 2018.

  R=0.13, acoustic gunshot detections, Washington D.C.

Branching point process model of the space-time intensity (rate) of shootings

Dynamic reproduction number

$$\lambda(x,t) = f(x)h_d(t)h_m(t)h_y(t) + \sum_{t>t_i} R_{t_i} g_t(t-t_i;\omega) g_x(x-x_i;\sigma)$$

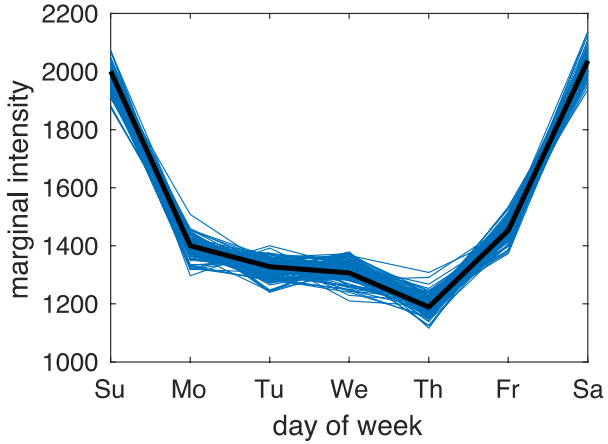
Poisson baseline rate:
controls for spatial heterogeneity,
day of week, month and yearly effects

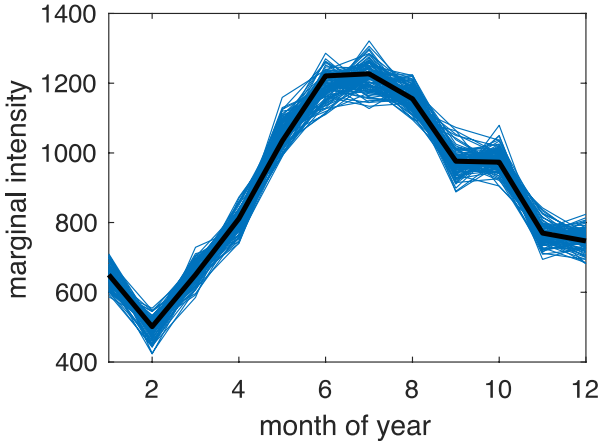
"recovery rate"

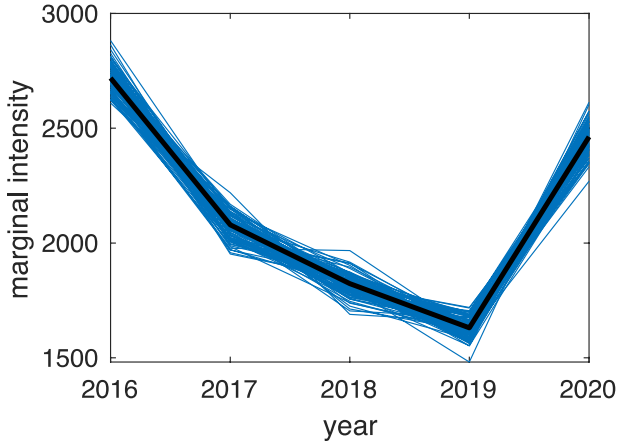
length scale of
spatial diffusion

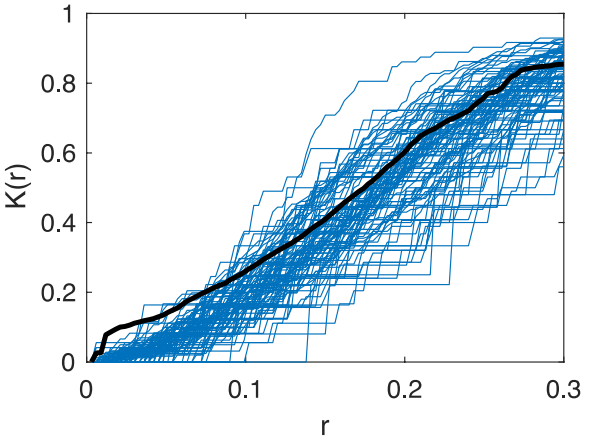
Goodness of fit

Chicago

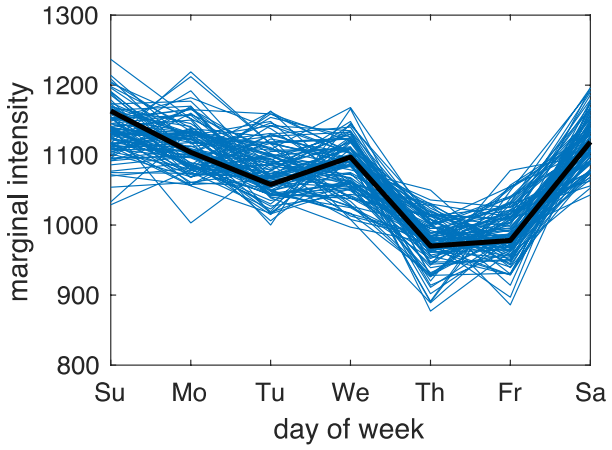


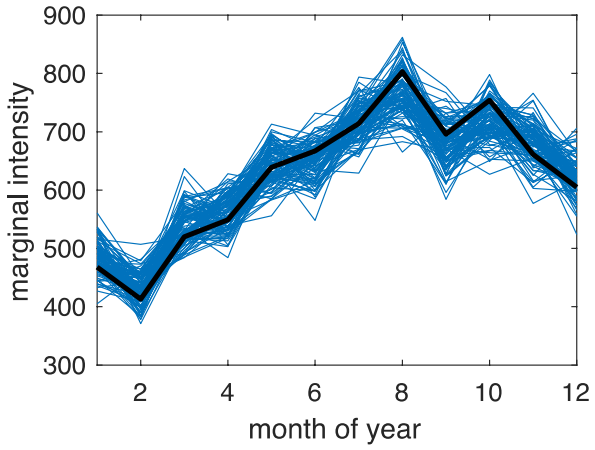


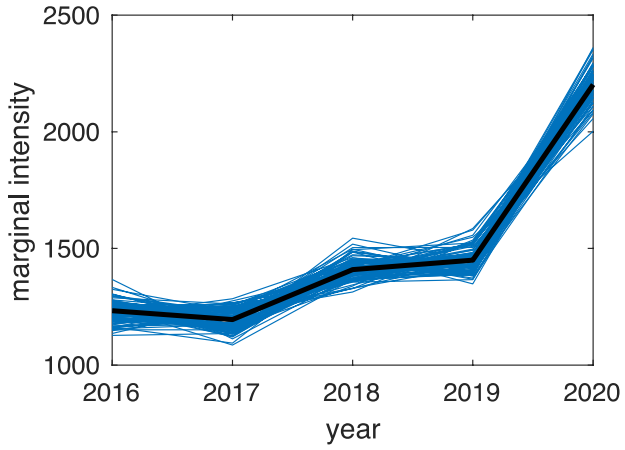


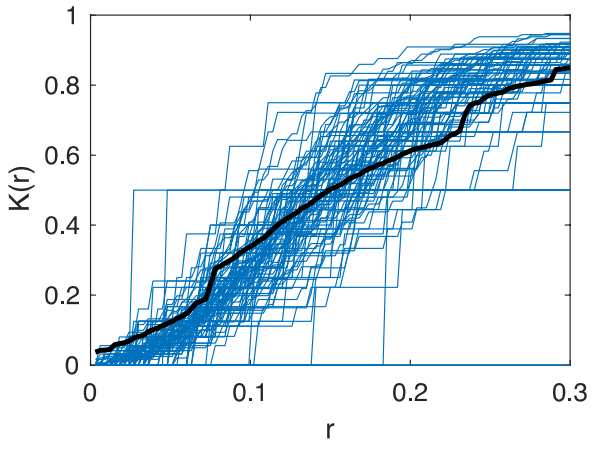


Philadelphia









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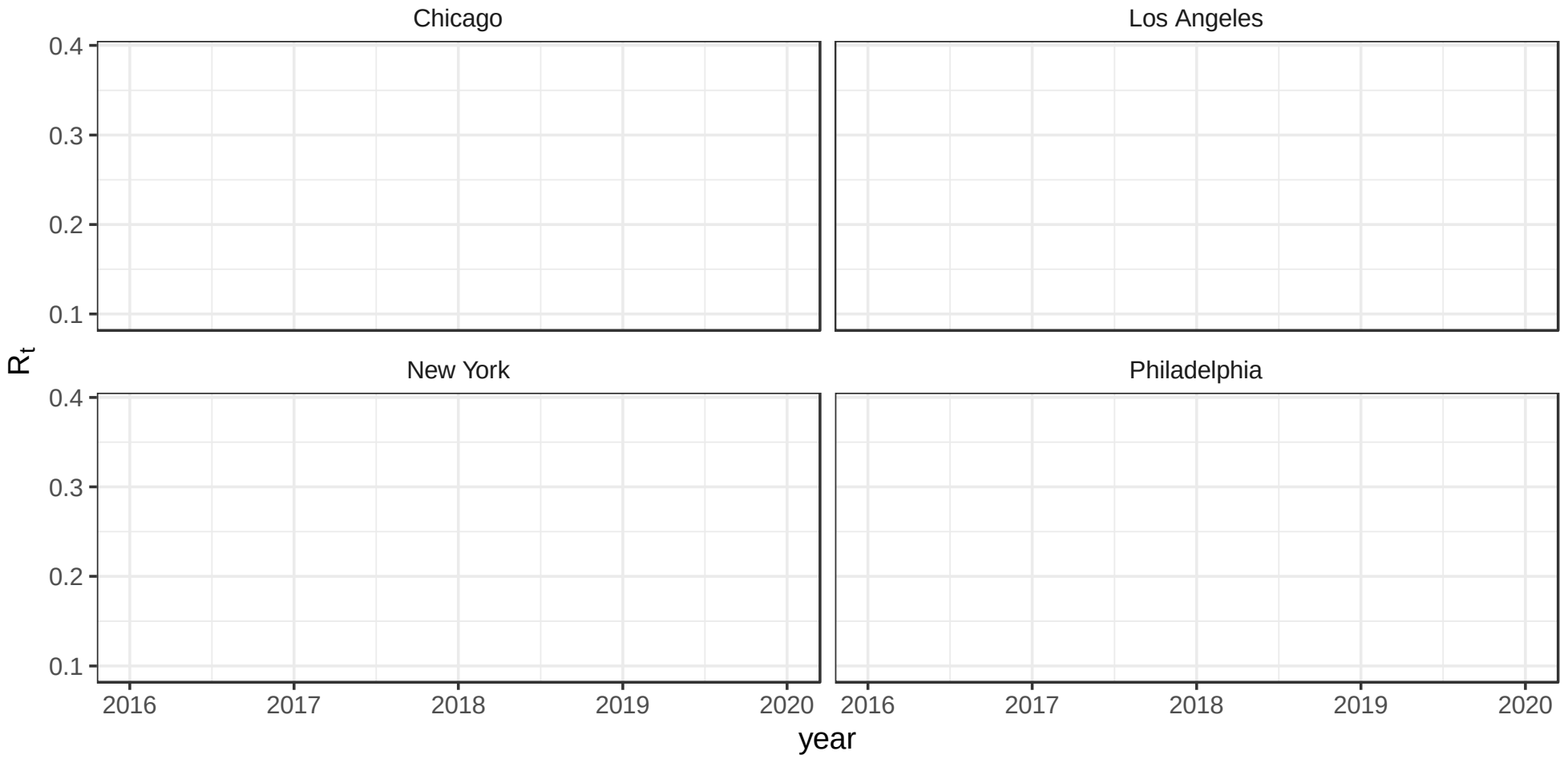

Distribution of events (contagion vs. spontaneous)

	Chicago			Los Angeles			New York			Philadelphia		
Year	Sp.	Cnt.	%	Sp.	Cnt.	%	Sp.	Cnt.	%	Sp.	Cnt.	%
2016	2349	370	14%	829	171	17%	851	357	30%	947	286	23%
2017	1740	330	16%	734	167	19%	682	284	29%	919	276	23%
2018	1547	271	15%	714	156	18%	628	323	34%	1000	409	29%
2019	1402	226	14%	634	170	21%	666	301	31%	1044	406	28%
2020	2000	458	19%	791	355	31%	1443	499	26%	1483	718	33%

Limitations

- Focused on small subset of U.S. cities

- Measured spatial contagion, non-local network effects may be missed

References & acknowledgements

- Brantingham, P. J., Carter, J., MacDonald, J., Melde, C., & Mohler, G. (2021). Is the recent surge in violence in American cities due to contagion?. *Journal of criminal justice*, *76*, 101848.

- MacDonald, J., Mohler, G., & Brantingham, P. J. (2022). Association between race, shooting hot spots, and the surge in gun violence during the COVID-19 pandemic in Philadelphia, New York and Los Angeles. *Preventive medicine*, 107241.

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