

NYC SHOOTINGS CASE STUDY

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0.1 Shooting data description

New York City has approximately 8.5 million inhabitants distributed across five boroughs: Manhattan, Brooklyn, Queens, the Bronx, and Staten Island [6]. As the most populous city in the United States and a major center of commerce, the daily movement of residents creates complex urban dynamics where gun violence remains a persistent public safety challenge, causing significant harm and economic losses to communities.



Figure 1: Geographic location of NYC

This study analyzes 29,744 shooting incidents recorded between 2006 and 2024, provided by the New York Police Department [4]. The number of incidents by year demonstrates clear temporal patterns: 2006 (1,892), 2011 (1,821), 2015 (1,093), 2019 (977), 2020 (1,868), 2021 (1,877), and 2024 (903).

Evolution of shootings

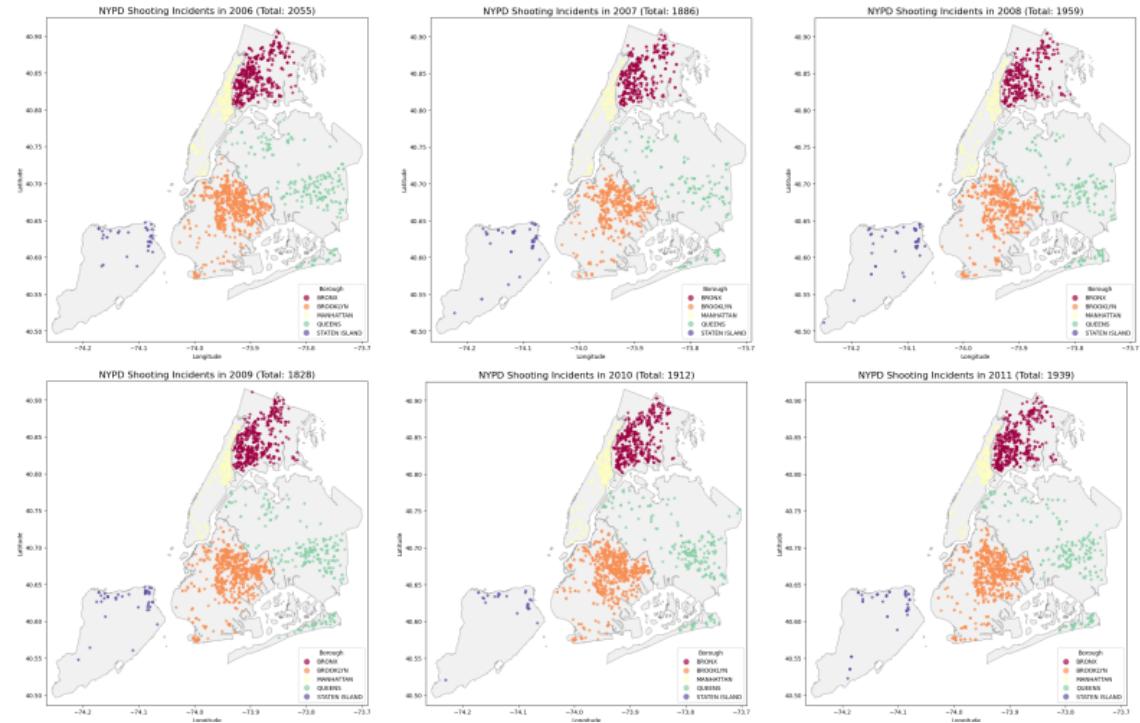


Figure 2: Spatial distribution of shooting incidents across New York City boroughs for selected years (2006-2011), revealing persistent geographic concentration in Brooklyn and the Bronx.

Figure 2 shows the spatial distribution across these years, revealing persistent geographic concentration in Brooklyn and the Bronx.

The temporal evolution reveals three distinct phases. From 2006 to 2019, incidents declined steadily as part of broader crime reduction initiatives. However, 2020 brought a dramatic 125% surge coinciding with the COVID-19 pandemic, with elevated levels continuing through 2021. Since 2022, incidents have declined but remain above pre-pandemic levels [5].

Evolution Of Murder

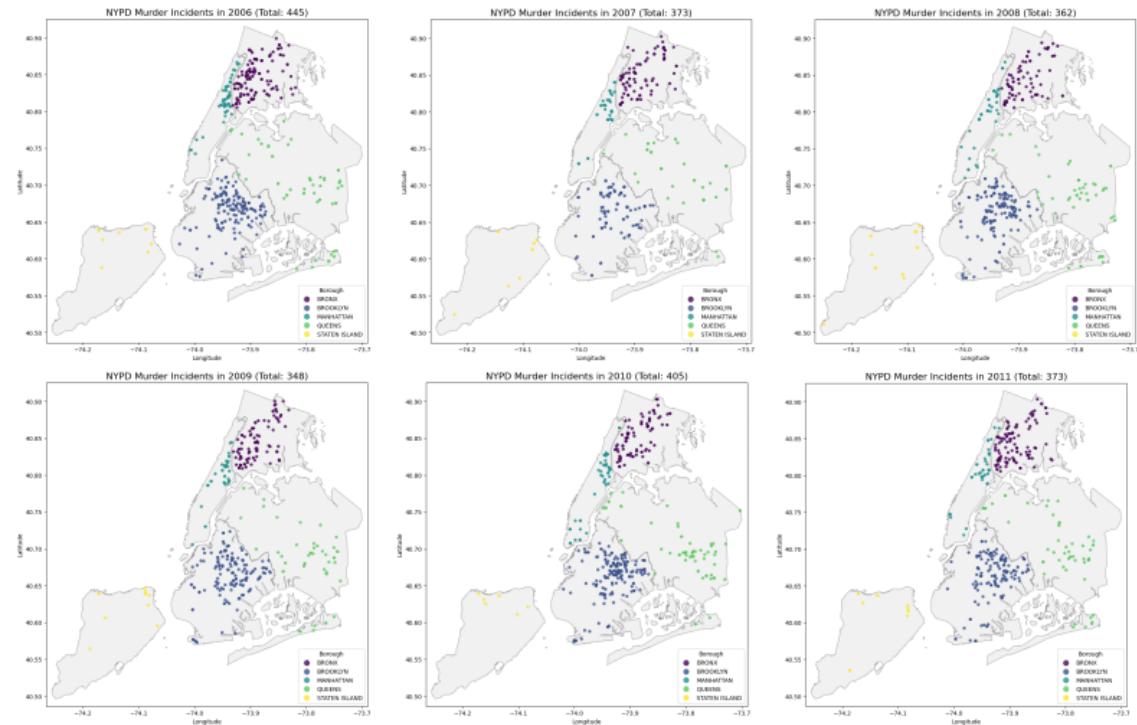


Figure 3: Spatial distribution of murder incidents across New York City boroughs for selected years (2006-2011), following similar temporal patterns to shooting incidents.

Murder incidents followed similar patterns, as shown in Figure 3.

Shooting incidents show strong temporal and spatial structure.

Weekly Shooting Incidents Trend

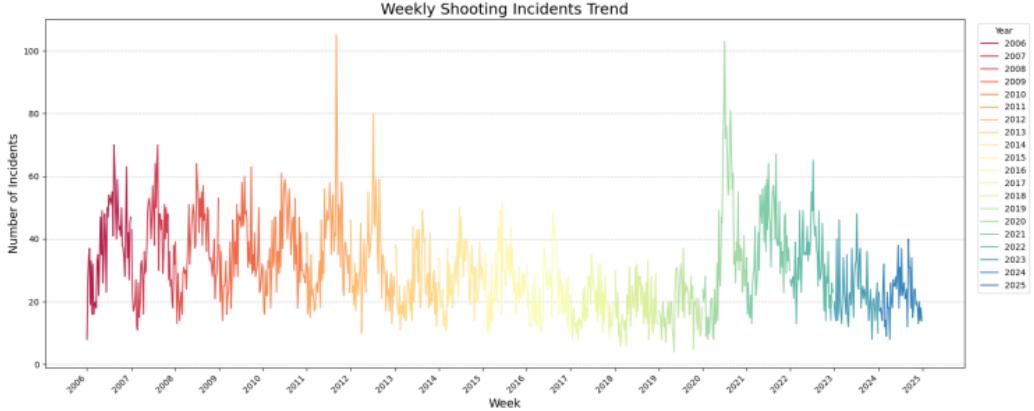


Figure: Weekly shooting incidents from 2006-2025 show a declining trend with a notable spike in 2020-2021.

Figure 4: Weekly shooting incidents from 2006-2024 show a declining trend with a notable spike in 2020-2021, revealing pronounced seasonality with summer peaks and winter troughs.

Figure 4 displays weekly patterns from 2006 to 2024, revealing pronounced seasonality with summer months experiencing 75% higher rates than winter months. The highest incident counts occur during July and August, declining through autumn to reach minimum levels in February. Diurnal analysis shows peak activity between 10 PM and midnight.

Geographic concentration is substantial: Brooklyn and the Bronx account for 68.9% of all incidents. When normalized by population, the Bronx experiences the highest rate at 33.5 incidents per 100,000 residents. Victims are predominantly male (90.7%) and aged 18-44 (81.2%), with 19.4% of incidents resulting in fatalities. Correlation analysis reveals strong associations with poverty rates ($r = 0.69$) and unemployment rates ($r = 0.41$) [3].

The observed spatial and temporal clustering patterns suggest self-excitation dynamics [7], motivating the application of Bayesian spatio-temporal point process models including Log-Gaussian Cox processes [1] and Hawkes processes [2] to characterize the intensity surface and quantify triggering effects.

References

- [1] Peter J Diggle, Paula Moraga, Barry Rowlingson, and Benjamin M Taylor. Spatial and spatio-temporal log-gaussian cox processes: extending the geostatistical paradigm. *Statistical Science*, 28(4):542–563, 2013.
- [2] George Mohler. Marked point process hotspot maps for homicide and gun crime prediction in chicago. *International Journal of Forecasting*, 30(3):491–497, 2014.
- [3] George O Mohler, Martin B Short, P Jeffrey Brantingham, Frederic Paik Schoenberg, and George E Tita. Self-exciting point process modeling of crime. *Journal of the American Statistical Association*, 106(493):100–108, 2011.
- [4] New York Police Department. Nypd shooting incident data (historic). <https://data.cityofnewyork.us/Public-Safety/NYPD-Shooting-Incident-Data-Historic-/833y-fsy8>, 2024. Accessed: 2024.
- [5] New York Police Department. Crime down across new york city in 2024, with 3,662 fewer crimes. <https://www.nyc.gov/site/nypd/news/pr001/crime-down-across-new-york-city-2024>, 2025. Press Release, January 2025.
- [6] NYC Department of City Planning. New york city’s population estimates and trends 2025 release. Technical report, City of New York, 2025.
- [7] Alex Reinhart and Joel Greenhouse. Self-exciting point processes with spatial covariates: modeling the dynamics of crime. *Journal of the Royal Statistical Society Series C: Applied Statistics*, 67(5):1305–1329, 2018.