Visualizing Neighbourhood Crime Rates in Toronto*

Is Toronto getting more dangerous?

Ian Quan

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Toronto has maintained a low crime rate in comparison to other major cities. This paper endeavors to ascertain whether Toronto exhibits a tendency of becoming more dangerous over time. This study delves into the crime rate trends observed over the past decade, identifying neighborhoods with high crime rates across various crime categories. Additionally, the analysis explores the relationship between population density and crime rates. Upon careful examination, the findings suggest that Toronto is indeed experiencing an increase in overall crime rates but remains relatively safe when compared to other cities. Furthermore, the analysis reveals that there is no direct correlation between population density and crime rates.

1 Introduction

Toronto consistently ranks high in assessments of urban safety. In The Econimist (2021), Toronto earned the distinction of being the second safest city globally, surpassed only by Copenhagen in the Netherlands. However, despite these rankings, crime rates in Toronto have exhibited an upward trajectory in 2023, notably marked by a significant increase in shootings since 2019. In 2017, with the exception of homicide, all major crime offenses have shown an uptick in reported numbers compared to the corresponding period last year. To gain a holistic understanding of the overall trend in crime rates over the past decade, we have gathered a comprehensive dataset on crime rates in Toronto.

While previous statistics, such as those from BREL Mississauga Real Estate (2023), have identified the most dangerous neighborhoods based on total reported crimes, these analyses often lack a nuanced perspective by not considering the population density of each neighborhood. To address this gap and offer a more comprehensive and equitable analysis, our study aims to

*Code and data are available at: https://github.com/IanQuan/STA302-Term-Papaer-1

examine crime rates per density. This approach is crucial for understanding the true impact of crime in different neighborhoods, as it considers the density of the population, providing a fair comparison and allowing for more targeted interventions. By investigating crime rates over time and incorporating population density, our analysis aims to contribute valuable insights for policymakers, law enforcement, and community stakeholders in fostering safer urban environments in Toronto.

2 Data

2.1 Data Sourcing

Data used in this paper are retrieved from Open Data Toronto Portal using the library `opendatatoronto` Gelfand (2022). The dataset is provided by Toronto Police Service (2023).

2.2 Variable of interest

The neighbourhood investigated in this paper is based on the new 158 City of Toronto Neighbourhoods structure. We collected each neighbourhood's population and its respective crime rates across 9 different crime categories, including assault, auto theft, bike theft, break and enter, homicide, robbery, shooting, theft from motor vehicle and theft over $5000. We analyzed the crime rate data from 2014 to 2023.

2.3 Data Preprocessing

Data was cleaned and analyzed using the open source statistically programming language R (R Core Team (2022)) , using functionalities from tidyverse (Wickham et al. (2019)), ggplot2 (ggplot), dplyr (dplyr), sf (Pebesma (2018)), sp (Bivand, Pebesma, and Gomez-Rubio (2013)) and knitr (knitr). A sample of cleaned data of neighbourhood crime rate in 2023 can be viewed in Table 1.

Table 1: Sample of Clean Neighbourhood Crime Rate Data in 2023

Neighbourhood	Population	Assault Rate	Auto Theft Rate	Shooting Rate	Homicide Rate	Robbery Rate
Yonge Bay Corridor	14731	3.6864	1.5478	0.0136	0.0068	0.4209
Fenside-Parkwoods	22909	0.5674	0.1746	0.0044	0.0044	0.0611
North Toronto	15077	0.6964	0.1194	0.0072	0.0012	0.0929
Dorset Park	26286	0.8293	0.3728	0.0076	0.0152	0.1141
North Riverdale	12168	0.6575	0.2219	0.0164	0.0082	0.0740

3 Results

3.1 Overall trend of crime rates

Based on the crime rate data spanning from 2014 to 2023, the majority of crime rate categories have remained relatively stable, with the notable exceptions of assault and auto theft crimes, see Figure 1. The data reveals a significant uptick in both categories post-2020 and into 2021. Specifically, from 2014 to 2023, the assault crime rate exhibited a 34% increase, rising from 0.6104 to 0.8063. Concurrently, the auto theft crime rate experienced a substantial surge of 211%, escalating from 0.1229 to 0.3822. Both categories reached its highest levels in 2023.

Furthermore, the analysis underscores assault as the predominant crime in Toronto, recording nearly three times the occurrence of other crime categories. This observation emphasizes the significance of addressing and understanding the dynamics of assault-related incidents within the city.

3.2 Relationship between population density and crime rates

To comprehensively explore the relationship between population density and crime rates on a geographic scale, we generated a heatmap illustrating crime rates across different neighborhoods. This analysis specifically focused on population data from the year 2023 for simplicity. Notably, areas with heightened population density, particularly in downtown and northeast Toronto, were identified as depicted in Figure 2.

Upon scrutinizing the heatmap across various crime categories, there is no clear correlation between population density and specific crime rates, except in the case of bike theft. However, notable patterns are observed in the northwest area, including neighborhoods such as West Humber-Clairville, York University Heights, Downsview, and Oakdale-Beverley Heights, all of which are characterized by high population density. In this region, an elevated occurrence

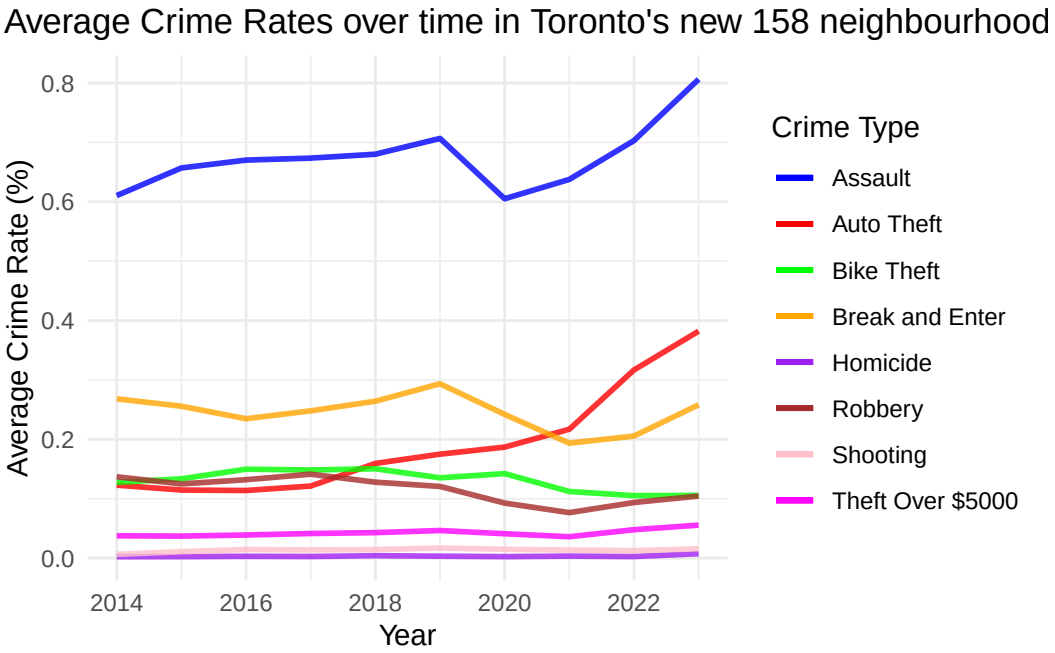

Figure 1: Average Crime Rates over time in Toronto's new 158 neighbourhood

of crime is observed across seven out of nine crime categories. Moreover, bike theft crimes were concentrated in downtown Toronto, aligning with the primary location of the city's bike-sharing program.

See Figure 3.

3.3 Neighbourhood with the highest crime rate

After analyzing the distribution of crime across various neighborhoods, our focus shifted towards identifying the neighborhood with the highest crime rate in Toronto. The chart in Figure 4 illustrates the average crime rates across the nine categories utilized in this study for the top 20 neighborhoods. This analysis specifically concentrates on crime rate data from the year 2023, aligning with the rationale mentioned earlier.

Downtown Yonge East and Yonge-Bay Corridor emerge prominently as the two areas with the highest crime rates, both recording nearly 0.8% of the population involved in some form of criminal activity. Surprisingly, a noteworthy finding surfaces as four out of the top five neighborhoods with the highest crime rates are located in downtown Toronto, namely Downtown Yonge East, Yonge-Bay Corridor, Moss Park, and Kensington-Chinatown. This observation underscores that downtown Toronto carries the highest crime rate within the city.

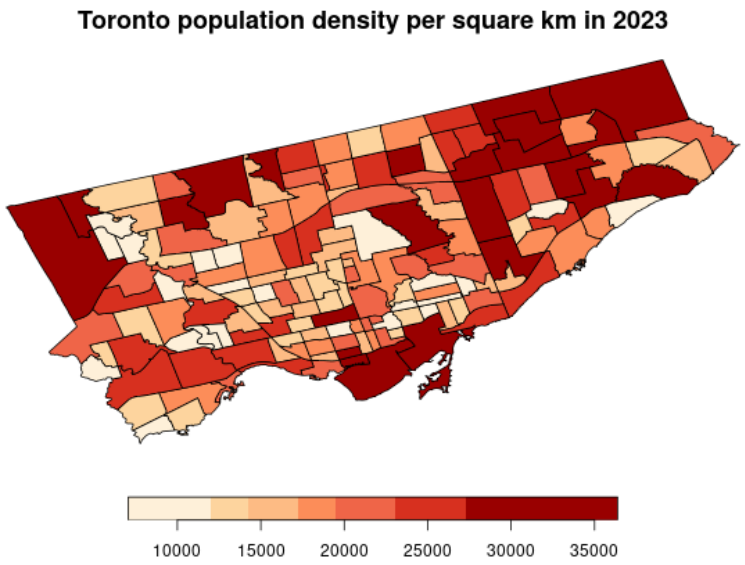

Figure 2: Toronto Population Density in 2023

Figure 3: Crime Rate Heat Maps in Toronto

Figure 4: Top 20 Neighbourhood's Average Crime Rates

References

Bivand, Roger S., Edzer Pebesma, and Virgilio Gomez-Rubio. 2013. *Applied Spatial Data Analysis with R, Second Edition*. Springer, NY. https://asdar-book.org/.

BREL Mississauga Real Estate. 2023. *Worst Toronto Neighbourhoods for Crime*. https://www.getwhatyouwant.ca/how-safe-is-your-toronto-neighbourhood.

Gelfand, Sharla. 2022. "Access the City of Toronto Open Data Portal." https://sharlagelfand.github.io/opendatatoronto/.

Pebesma, Edzer. 2018. "Simple Features for R: Standardized Support for Spatial Vector Data." *The R Journal* 10 (1): 439–46. https://doi.org/10.32614/RJ-2018-009.

R Core Team. 2022. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

The Econimist. 2021. *Safe Cities Index 2021*. https://safecities.economist.com/safe-cities-2021-whitepaper/.

Toronto Police Service. 2023. *Neighbourhood Crime Rates*. https://open.toronto.ca/dataset/neighbourhood-crime-rates/.

Wickham, Hadley, Mara Averick, Jennifer Bryan, Winston Chang, Lucy D'Agostino McGowan, Romain François, Garrett Grolemund, et al. 2019. "Welcome to the tidyverse." *Journal of Open Source Software* 4 (43): 1686. https://doi.org/10.21105/joss.01686.