Urban Crime Dynamics: Trends in Theft and Assault Over 2014 to 2023*

Analyzing Theft and Assault Trends Across Neighborhoods

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This paper focuses on the temporal and spatial trends of burglary and assault crime rates in different urban areas from 2014 to 2023. Through analyzing the data Neighbourhood Crime Rates, it is found that there are significant differences in robbery and attack rates in different regions and different time periods. And crime in some areas continues to increase, while in others it fluctuates or decreases. In addition, it is worth noting that there is also a correlation between population size and assault rates. Based on the research results, this paper provides targeted management schemes and resource reallocation schemes for the government and law enforcement agencies to reduce the community crime rate.

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*Code and data are available at: https://github.com/MingxuanLiu506/Crime_Rate.git

1 Introduction

Between 2014 and 2023, as urbanization accelerates, the crime dynamics in Toronto change significantly. Crime is concentrated in certain neighborhoods, such as those with poor socioeconomic conditions, where residents tend to face a higher risk of property and violence (Wang, Lee, and Williams 2019). Since 2020, the Covid-19 outbreak has intensified this trend. (Syamsuddin et al. 2021) noted a spike in thefts in many cities around the world during the pandemic, due to socio-economic instability and reduced social activity caused by lockdowns. Toronto's neighbourhoods are no exception, with economic pressures leading to a marked increase in property crime in some neighbourhoods. In addition, population growth also increases the chance of crime, and the chance of crime is higher in areas with higher population density and resource shortage (Bettencourt et al. 2007).

Data on Neighbourhood Crime Rates were obtained, as described in Section 2.1. This paper mainly analyzes the burglary and assault rates in each community from 2014 to 2023, exploring the differences in community size and crime rates and the accompanying time fluctuations. The research focuses on the dynamic change of crime rate in different communities before and after the epidemic (Figure 1 and Figure 2) and the relationship between population density and crime rates in 2023 (Figure 3 and Figure 4). By assessing these dynamics, we hope to inform crime prevention and resource allocation in Toronto, particularly in high-risk neighbourhoods where there is a long-term need for more police and social resources.

The structure of this paper is as follows: {#sec-data-overview} presents the data sources and methodology, {#sec-data-overview} presents the results of the analysis, and {#sec-discussion} discusses the policy implications of the findings, particularly with regard to how to respond to crime hotspots in Toronto.

2 Data

2.1 Overview

The dataset used in this analysis is Neighbourhood Crime Rates published by Toronto Police Services, which was last updated on Jan 11, 2024. In addition, this dataset can be found in Toronto Open Data (Gelfand 2022) and is considered opendata. Also, an opendata search for "Neighbourhood Crime Rates" in Toronto Open Data had only one matching dataset (Gelfand 2022).

The crime data in this dataset is broken down by the different neighbourhoods of Toronto into different types of crime such as assault, auto theft, burglary, robbery, theft, homicide, etc. In addition, the crime rate in this data is calculated according to Statistics Canada's standard that the number of crimes per 100,000 population * per year (Gelfand 2022).

The variables or measurements included in this analysis are "crime type", referring to various forms of crime and violation, which are called THEFTOVER_RATE_year and ASSAULT_RATE_year in the original data. In addition, the "population number" is used as the comparison data, which is called "POPULATION_2023" in the original data.

The R programming language (R Core Team 2023) and `tidyverse` (Wickham et al. 2019) were used to simulate and test the data set. Then, use `opendatatoronto`(Gelfand 2022) and `tidyverse` (Wickham et al. 2019) to download Neighbourhood Crime Rates data. Finally, `tidyverse`(Wickham et al. 2019) is used to clean up the original data, select the required data information to clean up the data that does not meet the requirements, and test the cleaned data again.

2.2 Results

After loading the dataset using the R programming language (R Core Team 2023) and the `opendatatoronto` package (Gelfand 2022), the `tidyverse` (Wickham et al. 2019) package was used to generate graphs.

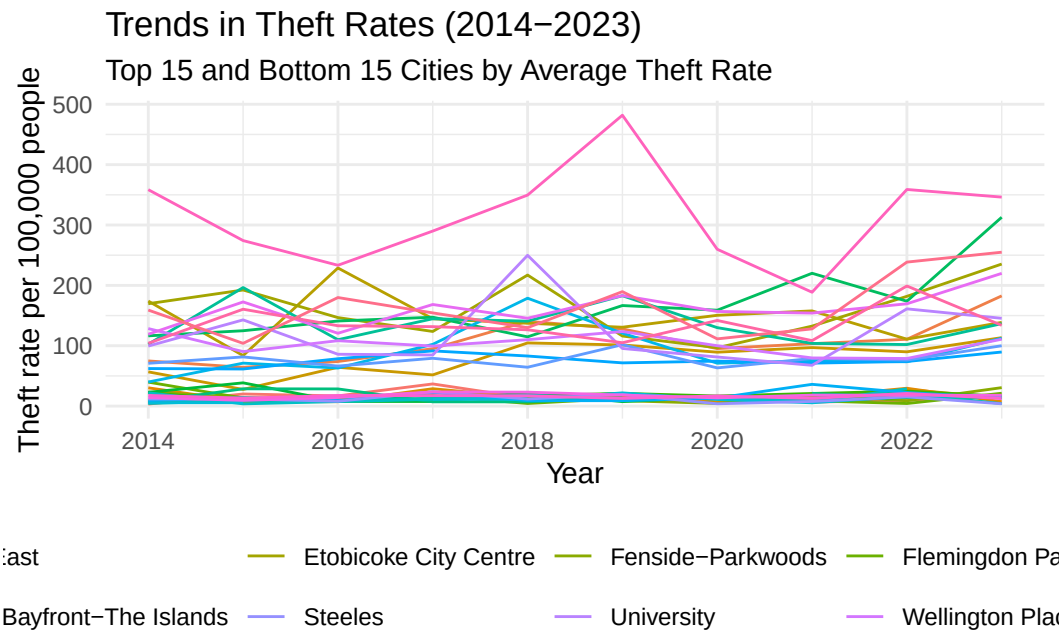

Figure 1: Trends in theft Rates in the 15 neighborhoods with the Highest Average theft Rates and the 15 neighborhoods with the Lowest Theft Rates, 2014-2023

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Figure 1 shows trends in the Top 15 and Bottom 15 Cities by Average Theft Rate from 2014 to 2023. Regardless of the theft rate, most areas show relatively stable crime rate in a long period of time, which may prove that this area has relatively perfect social security management mode and relatively stable life state. In addition, crime rates vary widely in some areas and are generally higher than in others. It is worth noting that between 2019 and 2020, most regions showed a trend of rising theft rates, reflecting changes in social conditions or economic development at the time. Overall, theft rates remained relatively flat in most regions, with only slight fluctuations. In addition, there are significant differences in the theft rate between different regions during the same period, which may be related to different social conditions in different regions, such as law enforcement efforts, economic conditions, population distribution and other factors.

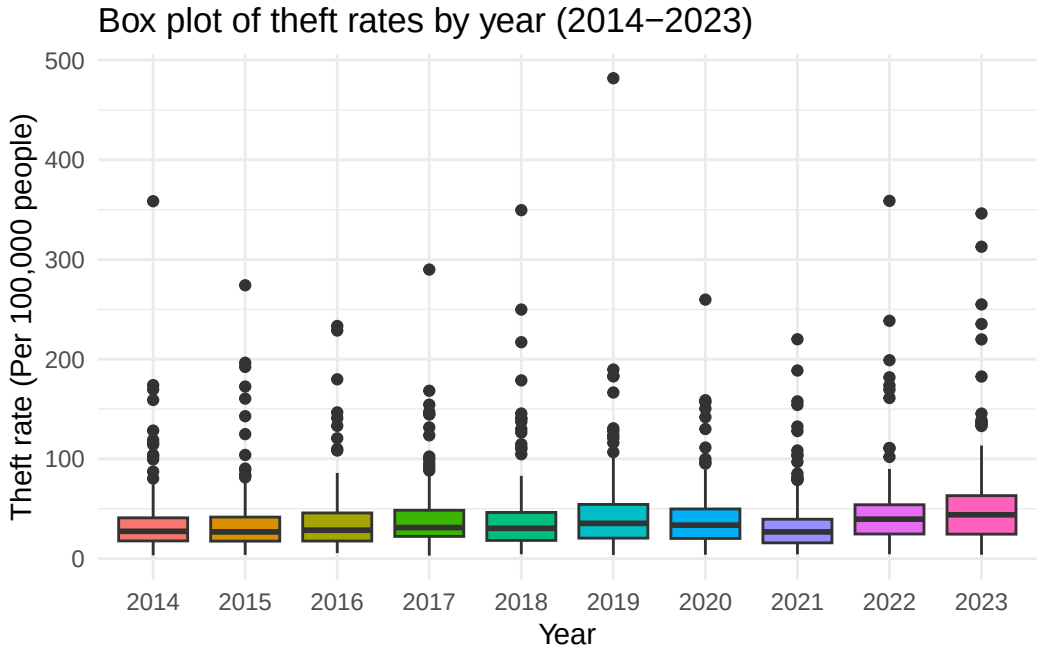

Figure 2: box plot in theft rates by region from 2014 to 2023.

The overall distribution of theft rates and their outliers for each region between 2014 and 2023 can be studied using Figure 2. First, while the median showed a relatively flat change, the median theft rate increased slightly between 2018 and 2023. In 2020 and 2021 in particular, the median appears to have reached a higher position. In addition, outliers (indicated by black dots) show unusually high theft rates across years. It is worth mentioning that more significant outliers have appeared in 2019, and the number of outliers has increased significantly. This indicates that in 2019 there were a large number of areas with much higher than general theft rates, and that this was the case in multiple areas. Secondly, the quartile distance also showed a certain fluctuation in this year. The reasons for this may be related to changes in

the socio-economic environment during the year, changes in enforcement policies, or social unrest.

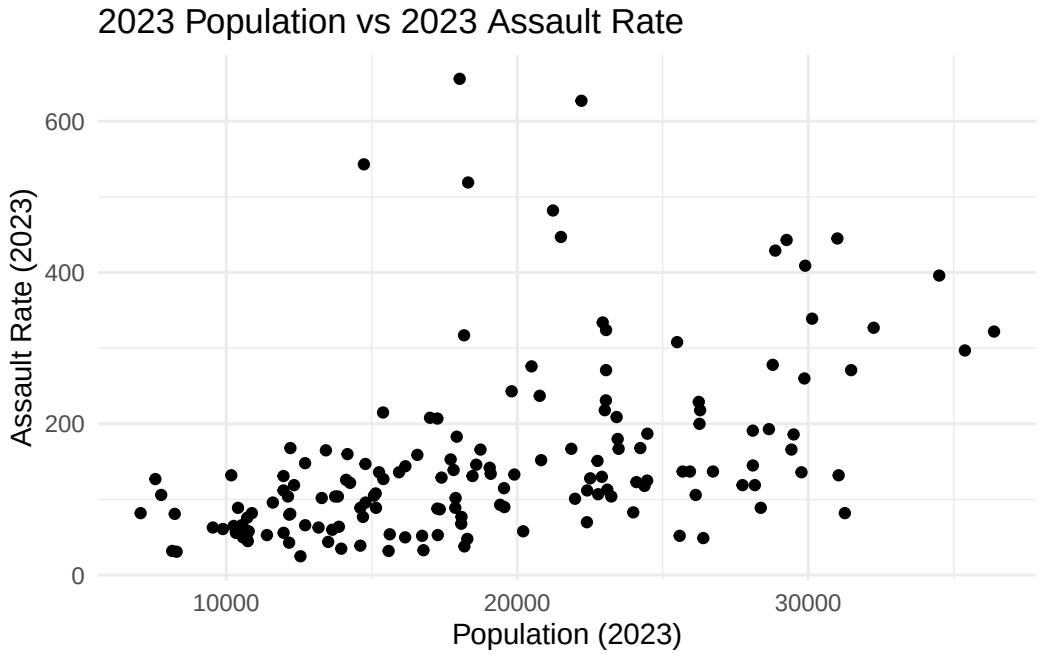

Figure 3: 2023 population and assault rate relations with a scatter diagram

Figure 3 shows that there is no obvious linear relationship between population and attack rates across regions in 2023. However, it can be found that the attack rate in the more populated areas (close to 30,000 people) seems to be relatively high and has an increasing trend, while the attack rate in the less populated areas is more volatile. And there are several outliers that show very high attack rates in areas with higher populations.

This bar chart (Figure 4) shows the 20 areas with the highest theft rates in Toronto in 2023. The chart shows that the Yonge-Bay Corridor has a significantly higher theft rate than all other areas, at 312.8. Several other areas with high theft rates, such as Humber Summit and Yorkdale-Glen Park, also had relatively high theft rates of 255 and 235.5, respectively. This suggests that the area may have different conditions or characteristics than other areas, such as high traffic or rich commercial clusters that attract thieves.

3 Discussion

This paper examines community crime dynamics, specifically the patterns of theft and assault across time and region. With the rapid progress of urbanization, the higher crime rate may be

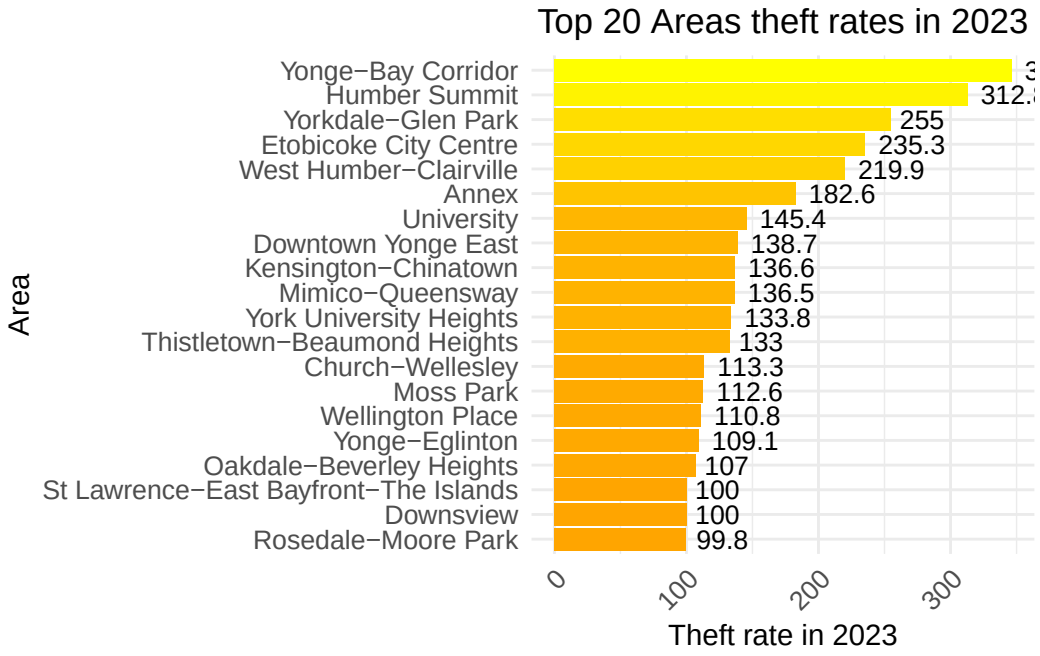

Figure 4: The 20 areas with the highest theft rates in 2023

related to the increase in population density. This article will discuss the effects of socioeconomic, social unrest, and population on crime rates, based on the analysis of theft and assault rates in each region in previous years.

3.1 First discussion point

First of all, Figure 1 emphasizes the spatial distribution of crime and the importance of analyzing crime in time and space dimensions. The data chart shows that theft rates vary from place to place at different times. Some regions have maintained steady fluctuations, while others have fluctuated more. This is connected with the research of Newton and Felson (2015). They believe that the crime hotspot often changes with time, for example, different time or social and economic events will affect the criminal's motive. Analyzing trends in theft can help develop targeted crime prevention strategies. In addition, we also found that external shocks, such as Covid-19, also have an impact on crime rates. The Figure 2 show that outliers have unusually high values in 2019-2020. In particular, the median theft rate in residential areas also increased significantly, possibly due to the socio-economic unrest caused by the pandemic. In 2019, almost most places are in lockdown due to the Covid-19 epidemic. By Syamsuddin et al. (2021), there is a study in Makassar, Indonesia, also documented a similar trend where burglary rates increased significantly during lockdowns, especially in residential areas where people were forced to stay at home due to social restrictions. This external impact has greatly changed people's way of life. Many people have lost their source of income, and the economic

pressure of burglars provides the motive to commit crimes. According to the Syamsuddin et al. (2021), this significant change in the theft rate verifies the theory of criminal opportunity.

3.2 Second discussion point

Another key point in the discussion is the impact of demographics on theft rates. The Figure 3 shows the relationship between theft rates and population in 2023. Although there is no clear linear relationship, it is not difficult to find that communities with larger populations also tend to show higher rates of assault. This is consistent with the emphasis in Bettencourt et al. (2007): The non-linear relationship between population growth and crime rate indicates that with the expansion of community size, especially the incidence of crimes such as assaults related to social interaction will also increase. However, the data also shows that some areas, despite having smaller populations, also have unusually high attack rates. This could be related to a lack of local law enforcement or social instability. Local police should step up patrols to reduce conflicts. Second, Figure 4 shows the 20 areas with the highest theft rates in 2023, and it's not hard to find that the spatial distribution of crime shows significant differences across different neighborhoods. The Yonge-Bay Corridor and Yorkdale-Glen Park areas with large population traffic have higher theft rates. By Wang, Lee, and Williams (2019) Criminal activity is often concentrated in some specific neighborhoods, which is closely related to the socioeconomic status of the community. Here, the view emphasized by Bettencourt et al. (2007) that communities with higher population density usually have higher assault crime rates has also been verified.

3.3 Weaknesses and next steps

In general, through data analysis and data review, we found that external disturbances such as population size, economic status and Covid-19 would have an impact on the community crime rate.But this paper only for 2014 to 2023, the theft rate and 2023 assault rate is analyzed, without fully considering the other types of crime. To pursue these two modes of crime, the following measures should be taken. For areas with high population flow, police patrols should be increased to reduce the occurrence of conflicts. And for some areas with poor economic conditions, more rescue stations can be established, and plenty of food and daily necessities can make those who have no economic sources can survive and avoid theft or robbery. Developing targeted community safety and crime prevention strategies can help keep communities safe.

Appendix

A Dataset and Graph Sketches

The dataset used in this paper, and the related sketches generated from the dataset, can be found in the folder named 'sketches' in the folder named 'other' in the GitHub repository

B Additional data details

The process of data cleansing is to extract the columns required for data analysis in this paper and store them in a new csv file.

References

Bettencourt, Luís MA, José Lobo, Dirk Helbing, Christian Kühnert, and Geoffrey B West. 2007. "Growth, Innovation, Scaling, and the Pace of Life in Cities." *Proceedings of the National Academy of Sciences* 104 (17): 7301–6.

Gelfand, Sharla. 2022. *Opendatatoronto: Access the City of Toronto Open Data Portal*. https://CRAN.R-project.org/package=opendatatoronto.

Newton, Andrew, and Marcus Felson. 2015. "Crime Patterns in Time and Space: The Dynamics of Crime Opportunities in Urban Areas." *Crime Science*. Springer.

R Core Team. 2023. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

Syamsuddin, Rahman, Muhammad Ikram Nur Fuady, Muh Djaelani Prasetya, Kusnadi Umar, et al. 2021. "The Effect of the COVID-19 Pandemic on the Crime of Theft." *International Journal of Criminology and Sociology* 10: 305–12.

Wang, Lu, Gabby Lee, and Ian Williams. 2019. "The Spatial and Social Patterning of Property and Violent Crime in Toronto Neighbourhoods: A Spatial-Quantitative Approach." *ISPRS International Journal of Geo-Information* 8 (1): 51.

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.