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

Analyzing Theft and Assault Trends Across Neighborhoods

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September 21, 2024

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 specific communities, such as those with poor socio-economic conditions. In some marginalized communities in Toronto, due to deteriorating economic conditions and insufficient social resources, the crime rate is always high, and residents in this community are often at higher risk of property and violent crime, such as theft and assault (Wang, Lee, and Williams 2019).

Since 2020, the Covid-19 outbreak has intensified this trend. Thefts have spiked in many cities around the world during the pandemic due to economic instability worldwide and reduced social interaction due to lockdown policies (Syamsuddin et al. 2021). Toronto's neighbourhoods are no exception, with economic pressures leading to a marked increase in property crime in some neighbourhoods. In addition, population growth is also a factor in the rising crime rate. Population growth increases the opportunity for crime, and areas with higher population density and tight resources have more opportunities for crime (Bettencourt et al. 2007). That's because densely populated areas have limited law enforcement resources, and they can't respond to crime suspects everywhere in a short period of time.

In order to further explore the spatio-temporal changes of the crime rate in Toronto, this study obtains the crime data of various communities from 2014 to 2023 according to the method described in Section 2.1, especially the data of theft and assault rates. Through these data, this paper analyzes the change trend of crime rates in different communities during these years. The differences between community size and crime rate and the fluctuations in different time periods are discussed. In addition, 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, this paper aims to inform law enforcement and city planners in Toronto, particularly with regard to resource allocation and crime prevention in high-risk neighbourhoods.

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.

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The Figure 1 shows trends for the top 15 and bottom 15 cities with average theft rates from 2014 to 2023. Regardless of the theft rate, the crime rate in most areas is relatively stable over a long period of time, which may prove that the social security management model in the area is relatively perfect, and the living condition is relatively stable. In addition, crime rates vary widely in some areas and are generally higher than in others. Notably, most regions showed a trend of rising theft rates between 2019 and 2020, which is related to the worsening socio-economic conditions caused by the Covid-19 outbreak at the time studied. (Syamsuddin et al. 2021). Overall, theft rates remained relatively flat in most areas, with only slight fluctuations. In addition, there are clear differences in theft rates between different regions

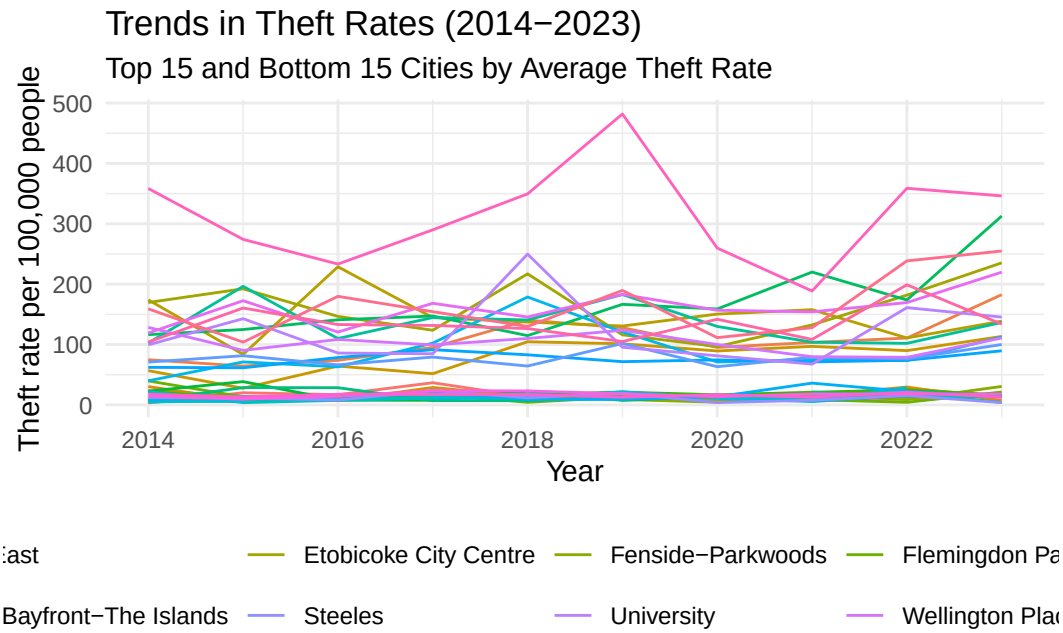

Figure 1: Trends in theft Rates in the 15 neighborhoods with the Highest Average theft Rates and the 15 neighborhoods with the Lowest Theft Rates, 2014-2023

over the same period, which may be related to different social conditions in different regions, such as more opportunities for crime in areas with higher population density and tight resources (Bettencourt et al. 2007). We will discuss the relationship between population and crime rates later on Figure 3 and Figure 4.

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. This is evidence of the abnormal fluctuation in crime rates caused by Covid-19 (Syamsuddin et al. 2021).

The Figure 3 shows that there is no significant linear relationship between population and assault rates by region in 2023. However, it can be found that the assault rate in more populated areas (close to 30,000 people) appears to be relatively high and on the rise, while the fluctuation is greater in less populated areas. And there are several outliers that show very high rates of assault in more populated areas. This is consistent with the point made by Bettencourt et al. (2007) that areas with larger populations tend to experience higher crime

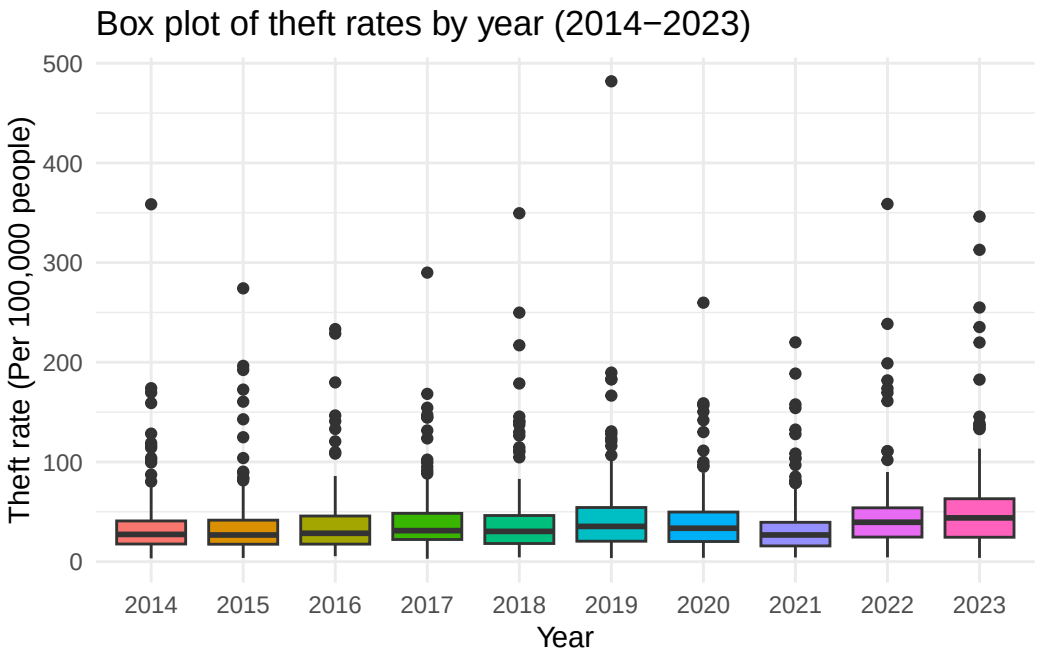

Figure 2: box plot in theft rates by region from 2014 to 2023.

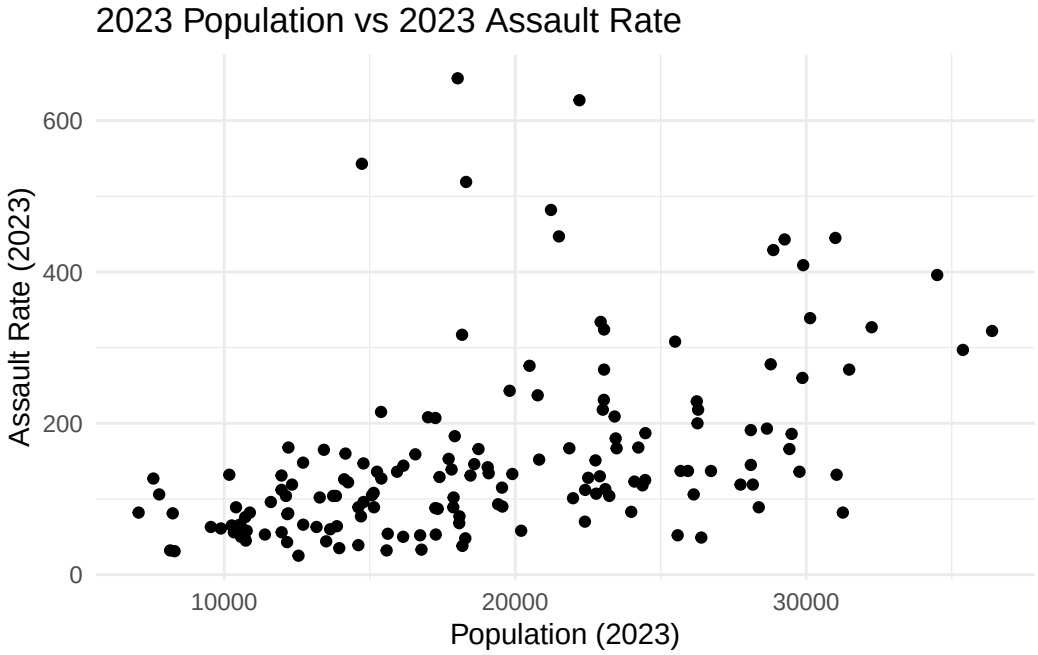

Figure 3: 2023 population and assault rate relations with a scatter diagram

rates due to increased social interaction and strained resources (Bettencourt et al. 2007).

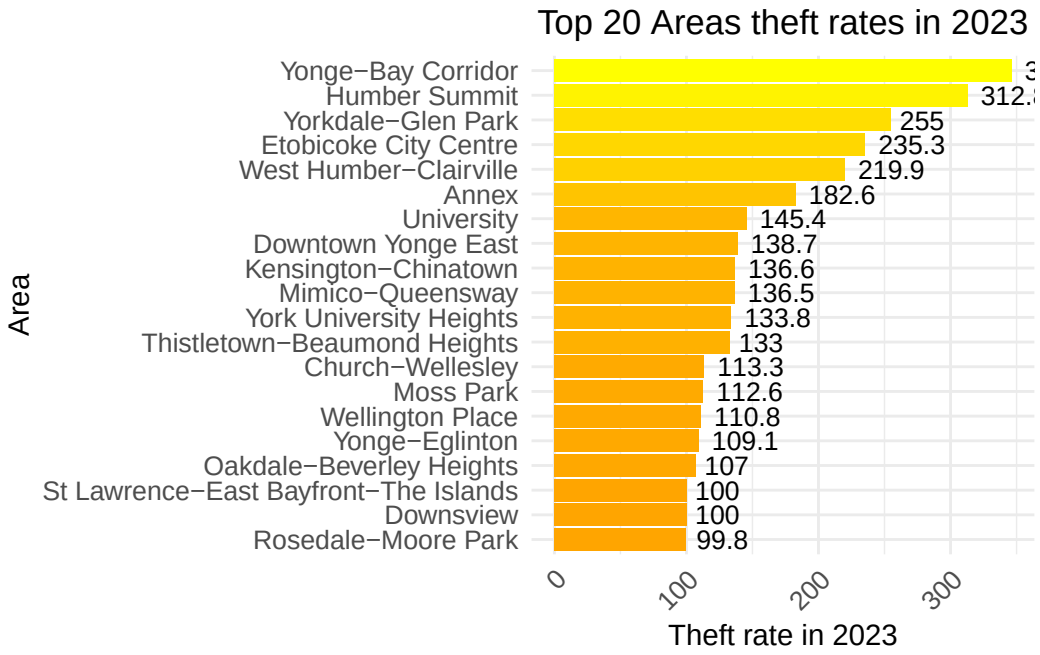

Figure 4: The 20 areas with the highest theft rates in 2023

This bar chart (Figure 4) shows the 20 areas in Toronto with the highest theft rates in 2023. The chart shows that the Yonge-Bay Corridor area has a significantly higher theft rate than all other areas, at 312.8. Far beyond his several areas with high theft rates, which were 255 and 235.3, 255 and 235.5 respectively. Combined with the characteristics of these areas, it is concluded that these areas have a high flow of people or concentrated business districts. This phenomenon has also been verified in combination with the urban size effect theory of Bettencourt et al., where people with high traffic or rich commercial clusters attract thieves. This suggests that the area may have different conditions or characteristics than other regions, such as high traffic or rich business clusters that attract thieves and become a crime hotspot (Bettencourt et al. 2007).

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 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.

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