

# Urban Crime Dynamics and Demographic Correlates: A Comprehensive Analysis of Crime Trends in Toronto (2018-2023)\*

Dingning Li

22 January 2024

## Abstract

This research investigates the changes in the number of crime cases to identify trends and underlying factors, thereby contributing to more effective crime prevention strategies and enhancing public safety. It provides a detailed crime trends in Toronto during last few years, with particular focus on the total crime cases in Toronto and the relationship between population size and crime rates across various areas of Toronto. The overall number of crimes has shown an increasing trend over these years, and there appears to be some connection with population density.

## Contents

<b>1</b>	<b>Introduction</b>	<b>2</b>
<b>2</b>	<b>Data</b>	<b>2</b>
2.1	The Aggregate Number of Cases in Toronto . . . . .	2
2.2	Crime Patterns Across Different Area in Toronto . . . . .	4
2.3	Demographic Influences on Crime Incidence . . . . .	5
<b>3</b>	<b>Discussion</b>	<b>5</b>
	<b>Reference</b>	<b>7</b>

---

\*Code and data are available at: [https://github.com/iamldn2002/starter\\_folder](https://github.com/iamldn2002/starter_folder)

# 1 Introduction

In recent years, urban crime dynamics has become a topic of increasing concern and interest, particularly in metropolis like Toronto. One of the criteria for judging whether a city is livable also includes its crime rate. The city's diverse neighborhoods present an opportunity to research variations in crime patterns and their potential correlations with demographic factors. The goal of this report is to understand these dynamics by conducting analysis of crime data within Toronto, emphasizing the interaction between population density and criminal activities.

The study begins with an aggregation and examination of crime data from 2018 to 2023, focusing on four crime types: assault robbery, break&enter, and bike theft. Data records of these crimes are relatively completed, and it is helpful for the accurateness of final analysis. By collating data from all neighborhoods, the report provides an idea of the crime landscape in Toronto, building a foundation for next step of my analysis. Subsequent sections of the report contain three different perspectives on analyzing urban crime dynamics. Firstly, the report starts by counting the total number of crimes in Toronto, depicting a more comprehensive picture of crime trends. Secondly, the analysis is specifically tailored to compare three key areas: Downtown Toronto, Western Toronto and Scarborough, which are distinct on the regional density of population. I will conduct a regional analysis of each type of crime to observe whether there are visible patterns in crime rates across different areas in Toronto. Ultimately, it focuses on the relationship between population size and crime rates based on the provided information in the data. So that we may ascertain whether there is correlation between the density of population and the rate of each type of crime.

Moreover, the report employs statistical methodologies to uncover patterns and potential correlations, supplemented by visual representations through graphs and charts. This not only aids in understanding the current state of urban crime in Toronto, but also contributes to the broader discourse on urban planning and public safety.

In a research project, the (Wickham et al. 2019) suite, including packages like (Wickham Year of Publication) and (Wickham 2024), is crucial for efficient data manipulation and visualization, while (Firke 2021) aids in data cleaning, (Smith Year of Publication) provides access to Toronto's open datasets, (Augie Year of Publication) arranges multiple plots, and (Xie Year of Publication) integrates data analysis with report generation, creating comprehensive, reproducible documents. And also, I utilized (OpenAI 2023) for assistance with coding and troubleshooting issues in my scripts.

## 2 Data

### 2.1 The Aggregate Number of Cases in Toronto

The dataset used in this study is a detailed collection of information about people and crime statistics from 158 different neighborhoods in Toronto. It contains around a decade's worth of data, detailing population densities and occurrences of various crimes, alongside their corresponding rates. In an effort to ensure the integrity and relevance of the analysis, the scope of the data has been refined. Four specific crime categories have been selected for their societal impact, and the focus has been narrowed to the years 2018 through 2023. This decision was influenced by the availability and consistency of records during this period, allowing for a more focused and rigorous examination of recent criminal trends. The cleaned data thus provides a foundation for analyzing the correlation between demographic variables and crime rates.

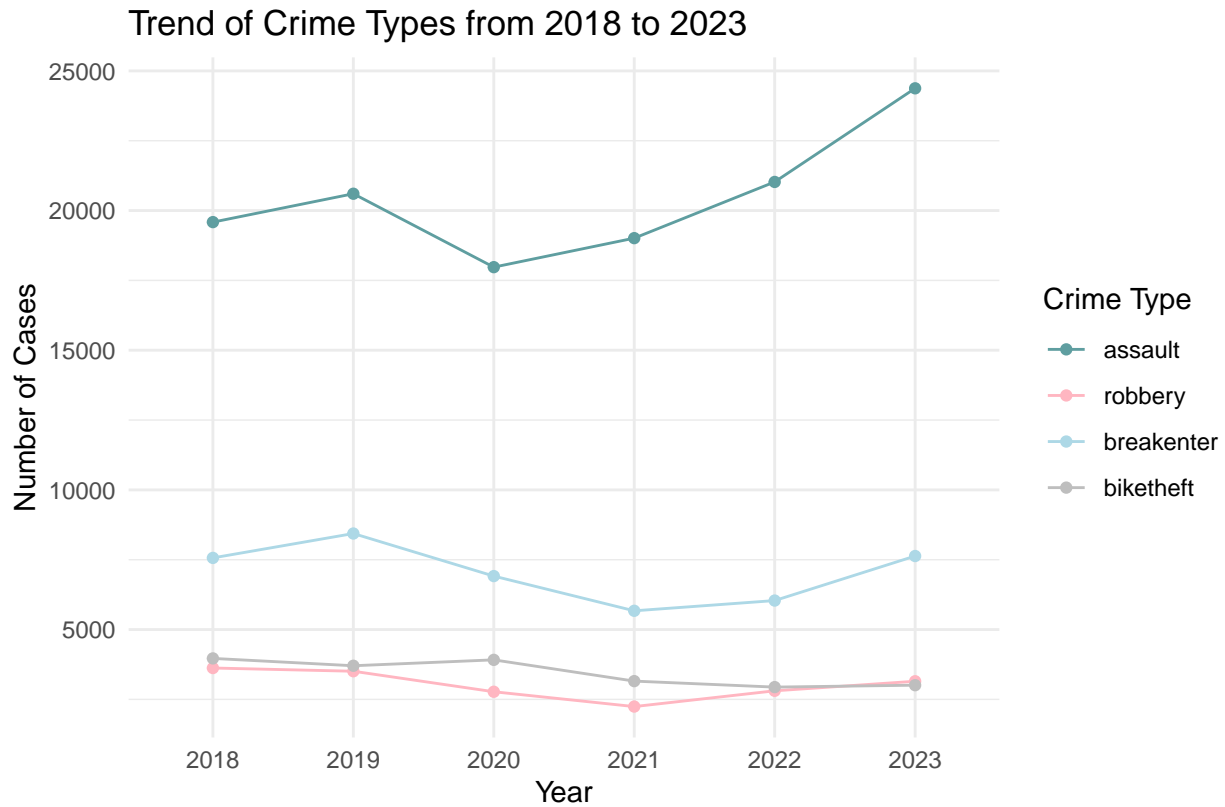


Figure 1: Trend of four types of crime cases from 2018 to 2023

Figure 1 provides a compelling visual representation of crime trends across Toronto from 2018 to 2023, drawing on comprehensive data from 158 distinct areas within the city. It illustrates a notable dominance of assault cases, which consistently eclipse the frequencies of other crimes each year. In contrast, robbery and break and enter incidents exhibit a relatively stable occurrence, with minimal variations over the observed timeframe. The graph also indicates a modest uptick in bike theft cases in 2021, followed by a subsequent decline. However, contrary to the suggestion that all other crime types show a decline, the line for assault actually depicts a significant upward trend, particularly from 2021 to 2023. This apparent surge in assault cases necessitates further examination to identify underlying factors or events that may have contributed to this increase. Overall, the graph encapsulates the varying dynamics of crime incidents in Toronto, with assault standing out as an area of growing concern.

## 2.2 Crime Patterns Across Different Area in Toronto

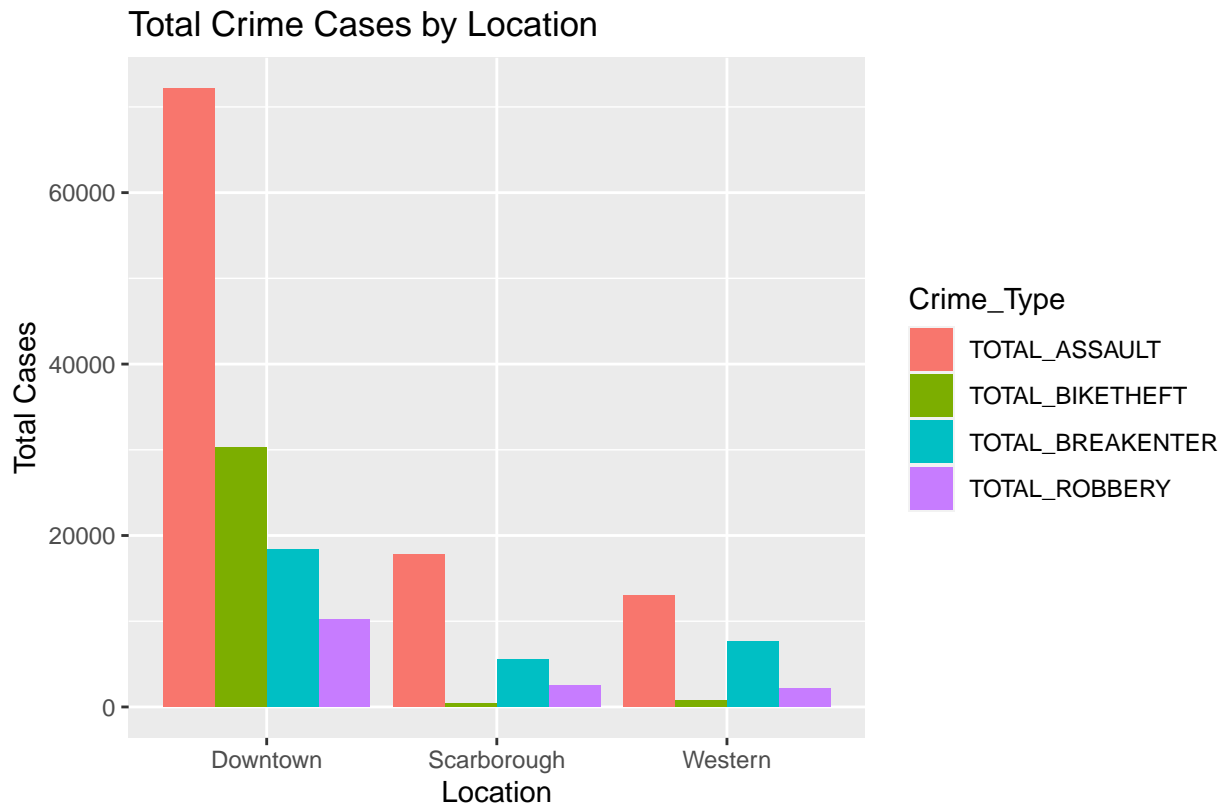


Figure 2: Numbers of four types crime across three regions in Toronto

Figure 2 presents a comparative analysis of crime occurrences across three regions: Downtown, Scarborough, and Western Toronto. Given the numerous areas in Toronto, we have broadly categorized the city into three sections mentioned above. From the raw data, we selected three representative neighborhoods for each segment to compile the data. It is notable that assault cases stand out as the predominant crime type in all locations, with Downtown presenting the highest frequency, significantly surpassing other areas and crime categories. What's more, bike thefts are markedly less frequent, particularly in regions like Scarborough and Western Toronto. There could be several reasons to lead this consequent. For example, in downtown, buildings and residences are more concentrated, making bicycles a preferred mode of transportation. Conversely, in other regions, the distribution of buildings is more dispersed, promoting people to choose other types of vehicles, such as automobile. Overall, the data shows the occurrence of each crime types is much more frequent in Downtown than other areas of Toronto. It underscores a correlation between urban infrastructure, specifically transportation modalities and the prevalence of specific crimes, reflecting how lifestyle patterns influence criminal activity.

## 2.3 Demographic Influences on Crime Incidence



Figure 3: Population vs Total Crime Cases

The Figure 3, collection of scatter plots titled “Population vs Total Crime Cases” provides an analytical comparison between population size and the total number of crime cases for the four crimes. The trend lines plotted over the data points offer an initial assessment of the relationship between the two variables. For assault and break and enter cases, the trend lines are relatively flat, suggesting a weaker or less direct correlation between population size and the occurrence of these crimes. This could imply that factors other than population might play a more significant role in the frequency of these crimes. However, the plots for robbery and bike theft exhibit steeper trend lines, indicating a more pronounced relationship between population size and crime occurrences. Particularly for bike theft, the downward trend suggests that as population size increases, the number of bike theft cases tends to decrease. This counterintuitive result warrants further investigation into urban dynamics, such as the availability of secure bike storage or the prevalence of cycling as a mode of transport in denser areas.

## 3 Discussion

The graphs and explanations of crime data from 2018 to 2023 has yielded a multifaced view of the criminal landscape in Toronto, illustrating not only the prevalence of various crimes but also their distribution across the areas in urban city. The increase in the overall number of crimes, particularly assaults, underscores a pressing need for targeted intervention strategies. The decline in the majority of crimes in 2020 may be associated with specific policies, such as the lockdown during the pandemic period.

The regional research among Downtown Toronto, Western Toronto and Scarborough illustrates that crime is not uniformly distributed across the city. Downtown presents a higher crime occurrence, particularly in assaults, may be influenced by its dense urban environment, which can facilitate anonymity and escape opportunities for perpetrators. In contrast, the decline in bike thefts in areas with growing populations prompts further investigation into the potential deterrents in place, such as enhanced security measures

or changes in public behavior. Additionally, the report further revealed that the type of crime can reflect the lifestyles across different areas. For example, the prevalence of bike theft in Downtown areas could reflect the higher reliance on bicycles for transportation. These frameworks should be tailored to the unique characteristics of each area, ultimately creating a safer and more secure urban environment for all residents.

However, the research and data selection are limited. The data does not record the full spectrum of criminal activity, missing the part of unreported crimes. Moreover, the causality between crime rates and population density cannot be established from this analysis alone. Future research should consider additional data sources, such as economic dynamics and police presence, to build a more comprehensive model of crime prediction and prevention.

## Reference

- Auguie, Baptiste. Year of Publication. *gridExtra: Miscellaneous Functions for "Grid" Graphics*. <https://CRAN.R-project.org/package=gridExtra>.
- Firke, Sam. 2021. *Janitor: Simple Tools for Examining and Cleaning Dirty Data*. <https://github.com/sfirke/janitor>.
- OpenAI. 2023. "ChatGPT: Optimizing Language Models for Dialogue." <https://openai.com/chatgpt>.
- Smith, Phillip L. F. Year of Publication. *Opendatatoronto: Access the City of Toronto Open Data Portal*. <https://CRAN.R-project.org/package=opendatatoronto>.
- Wickham, Hadley. Year of Publication. *Ggplot2: Create Elegant Data Visualisations Using the Grammar of Graphics*. <https://CRAN.R-project.org/package=ggplot2>.
- . 2024. *Tidyr: Easily Tidy Data with 'Spread()' and 'Gather()' Functions*. <https://CRAN.R-project.org/package=tidyr>.
- Wickham, Hadley, Mara Averick, Jennifer Bryan, Winston Chang, Lucy D'Agostino McGowan, Romain François, Garrett Golemund, et al. 2019. "Welcome to the tidyverse." *Journal of Open Source Software* 4 (43): 1686. <https://doi.org/10.21105/joss.01686>.
- Xie, Yihui. Year of Publication. *Knitr: A General-Purpose Package for Dynamic Report Generation in r*. <https://CRAN.R-project.org/package=knitr>.