Crime in Toronto*

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In this study, we conducted a comprehensive analysis of crime trends in Toronto, utilizing a dataset detailing various criminal activities from 2014 to 2023. Our analysis focused on the evolution of different types of crimes, with a specific emphasis on contrasting violent crimes, such as assault and robbery, against non-violent offenses like theft. The findings reveal significant patterns in both categories, highlighting an evolving landscape of criminal behavior in Toronto. This research is crucial as it sheds light on the changing dynamics of urban crime, providing valuable insights for policymakers, law enforcement agencies, and community leaders in developing targeted strategies for crime prevention and enhancing public safety in metropolitan areas.

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*Code and data are available at: https://github.com/leoyliu/Crime-in-Toronto.

1 Introduction

Urban crime, a significant issue impacting communities worldwide, poses substantial threats to public safety and social stability. Toronto, Canada's largest city, is no exception. The broader context of urban crime in Toronto is critical in understanding its impact on the city's development, public perception, and policy formulation. Despite extensive research in urban criminology, there remains a gap in comprehensively understanding how different types of crimes, especially violent and non-violent, have evolved over recent years in Toronto. This gap is crucial for developing effective crime prevention strategies and enhancing public safety.

This paper provides a thorough examination of Toronto crime patterns from 2014 to 2023. The paper focuses on two types of crimes: violent crimes and nonviolent crimes. By using a comprehensive dataset, we delve into how these crime categories have changed over time and their implications for urban safety and policing strategies. The analysis not only uncovers patterns and trends in these crime categories but also offers a comparative perspective, highlighting the distinct trajectories of violent and non-violent crimes.

The findings of this paper are noteworthy for several reasons. First, they provide a nuanced understanding of the crime dynamics in a large metropolitan area, offering insights that are vital for policymakers, law enforcement, and community leaders. The patterns observed suggest shifts in criminal behavior and possibly reflect broader social and economic changes in the city. Second, the comparative analysis between violent and non-violent crimes offers a unique perspective on the nature of criminal activities, contributing to a more targeted approach in crime prevention and community safety initiatives.

The paper is structured to facilitate a comprehensive understanding of the study and its implications. Following Section 1, Section 2 presents the data, detailing the data sources, analytical techniques, and the rationale behind the chosen methods. Section 3 discusses the results, elaborating on the observed trends and patterns in crime data. Section 4 provides an in-depth discussion of these findings, exploring potential factors influencing these trends, drawing connections to broader urban issues, and providing suggestions for future research in this area.

2 Data

This section aims to offer an insightful understanding of the dataset utilized in our analysis, focusing on its content, origin, and the methods applied for data manipulation and visualization.

2.1 Source of the Data

The dataset comprises crime statistics in Toronto, spanning from 2014 to 2023. The dataset analyzed in this report was obtained in csv format from the City of Toronto Open Data Portal(Toronto Police Services 2014) using the R package `opendatatoronto`(Gelfand 2020). It includes the Crime Data by Neighbourhood. Counts are available for Assault, Auto Theft, Break and Enter, Robbery, Theft Over, Homicide and Shooting & Firearm Discharges. Data also includes the crime rate per 100,000 population calculated using the population estimates provided by Environics Analytics. For the purpose of this study, we focus solely on the number of reported incidents. The data, which is updated as of January 14th, 2024, is a well-regarded resource for scholarly and policy-making endeavors, valued for its thoroughness and dependability.

Although alternative datasets were considered, this specific dataset was selected for its detailed year-wise breakdown and the diversity of crime types it encompasses. Other datasets either lacked the temporal detail or the variety of crime categories present in our chosen dataset.

2.2 Data Manipulation and Cleaning

The data was processed and cleaned using R(R Core Team 2020), a powerful statistical programming language. For key operations, please refer to the Section 6.

2.3 Variables Explanation

To better understand the data, the summary_table dataset was developed to offer a more structured and aggregated view of the crime data. By transforming and summarizing the data into a format that displays crime types against years, this dataset simplifies the task of identifying and analyzing trends over time. The dataset includes various crime categories, such as assault, theft, and other types, with each variable representing the annual count of reported cases for each crime type. This longitudinal data provides a detailed view of the crime trends in Toronto over a decade.

Table 1: Crime Incidents Summary by Year

Crime Type	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023

Assault	5,971	6,567	6,843	7,390	7,683	7,750	6,674	7,124	7,864	9,147
Auto Theft	1,244	1,085	1,095	1,209	1,681	1,817	1,835	2,078	3,043	3,660
Bike Theft	1,228	1,253	1,516	1,630	1,756	1,524	1,290	1,300	1,293	1,387
Break and Enter	2,155	2,155	1,976	2,183	2,465	2,814	2,258	1,954	1,980	2,396
Homicide	18	25	27	19	30	28	26	26	22	57
Robbery	1,311	1,326	1,392	1,539	1,380	1,289	1,045	838	1,052	1,094
Shooting Incidents	45	84	124	124	138	145	127	134	135	130
Theft from Motor Vehicles	3,613	3,153	2,814	2,948	3,144	3,496	3,355	2,658	3,021	2,830
Major Theft	367	397	400	423	481	522	437	424	526	680

For Table 1, we observe a detailed enumeration of various crime incidents reported annually in Toronto from 2014 to 2023. Assault cases dominate the data, climbing substantially in subsequent years, indicating a worsening public safety concern. Each crime category follows its own trajectory, with theft from motor vehicles and major theft also showing significant fluctuations.

We proceeded to organize the dataset into two categories: 'Violent' crimes, which included offenses such as 'Assault' and 'Homicide', and 'Non-Violent' crimes, encompassing acts like 'Theft'. It is particularly valuable for understanding the overall landscape of crime in Toronto, focusing on the comparison between violent and non-violent incidents.

Table 2: Crime Incidents Summary of Violent and Non-Violent Crime Cases by Year

Crime Type	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Non-Violent	6,452	5,888	5,825	6,210	7,062	7,359	6,917	6,460	7,883	8,557
Violent	9,500	10,157	10,362	11,255	11,696	12,026	10,130	10,076	11,053	12,824

Table 2 organized view of crime statistics over a range of years, specifically differentiated into two main categories: 'Violent' and 'Non-Violent' crimes. Each row in the table represents one of these two categories. The columns of the table are divided by year, ranging from 2014 to 2023. Under each year's column, the table displays the total number of reported incidents for each crime category. Here, violent crimes exhibit a steady rise over the years, dwarfing the non-violent crimes, which display slight variability.

3 Results

In this section, we delve into the core findings of our study, shedding light on the intricate patterns and trends of crime in Toronto from 2014 to 2023. Our analysis dissects both violent and non-violent crime statistics, revealing insightful correlations and variations over the decade.

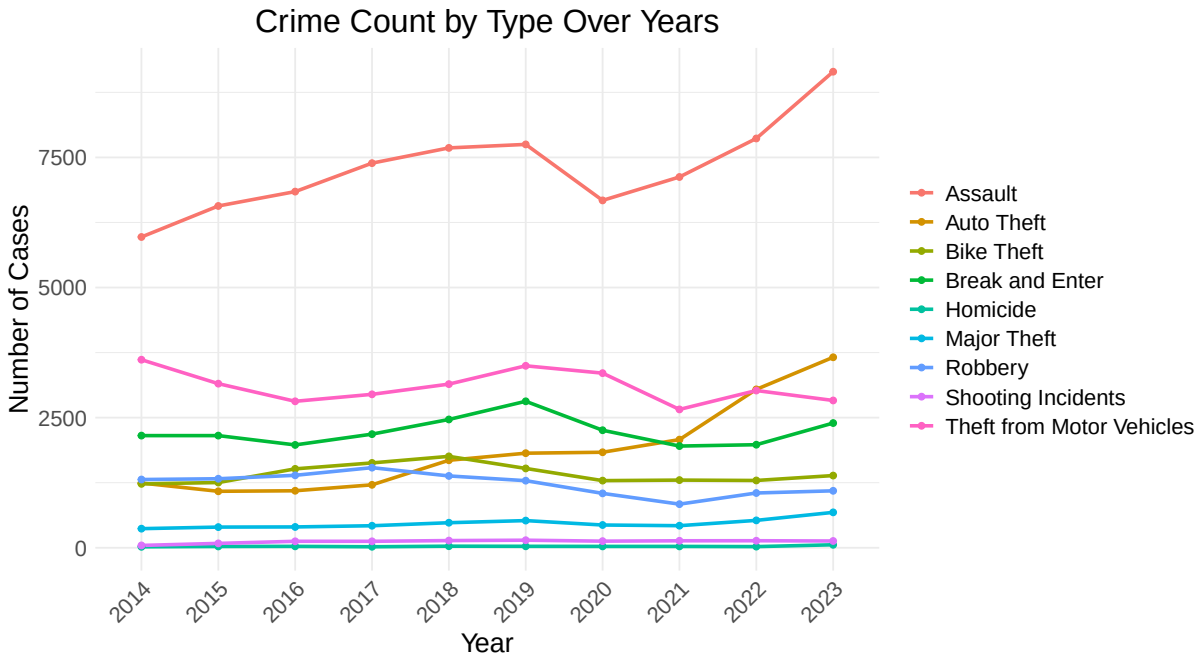

Figure 1: Trends in Crime Cases in Toronto

Figure 1 reveals distinct trends for various crime types in Toronto over the years. We notice that assault crimes have been on the rise in recent years. This could signal a growing concern in public safety and might prompt law enforcement to investigate the underlying causes, such as increased urbanization, changes in population density, or other socio-economic factors. Conversely, there is a noticeable decline in theft-related crimes, which could reflect the success of recent crime prevention initiatives, improved security measures, or increased public awareness.

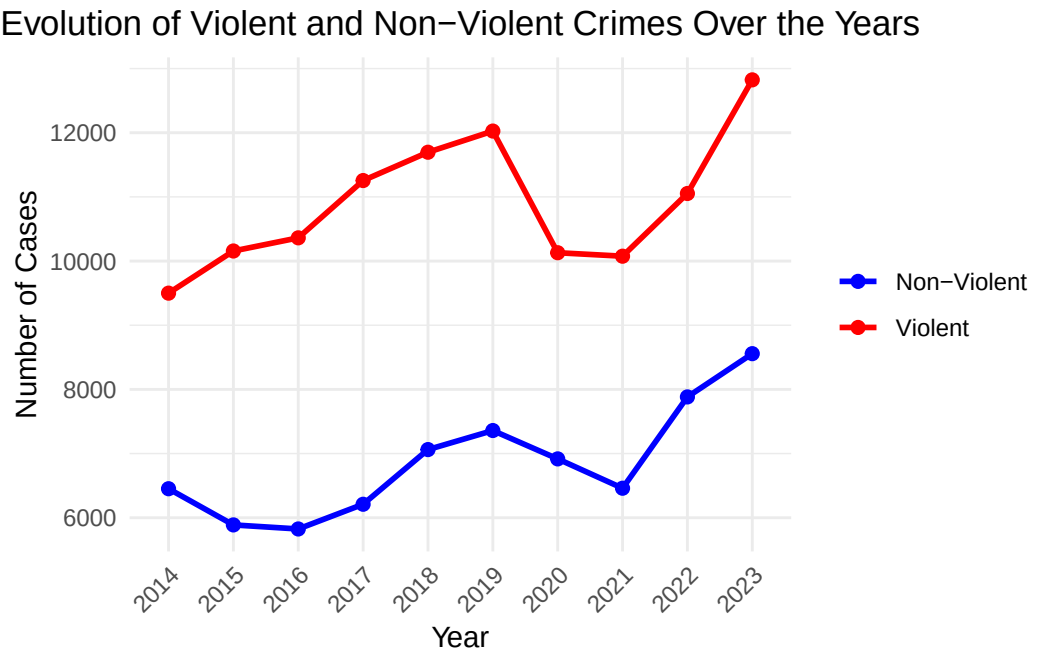

Figure 2: Comparative Trend Analysis of Violent and Non-Violent Crime Cases

Figure 2 compares the number of cases reported for violent and non-violent crimes from 2014 to 2023. The x-axis represents the years, and the y-axis indicates the number of cases.

The red line represents violent crimes, and the blue line represents non-violent crimes. The plot shows distinct trends for both categories over the specified time frame.

- **Violent Crimes (Red Line):** There has been an overall increasing trend in the number of violent crime cases over the years. There are some fluctuations, with a noticeable dip occurring in one of the years, but the general direction is upwards, especially towards the end of the period, indicating a rise in violent crimes or an increase in reporting.
- **Non-Violent Crimes (Blue Line):** The trend in non-violent crime cases shows some variability but does not have as clear an increasing pattern as violent crimes. There are years where the rate has increased or decreased, but the last year shows a notable increase, suggesting a possible upward trend at the end of the period.

Overall, the graph indicates that while both violent and non-violent crimes have seen rises and falls, the increase in violent crimes towards the later years is more pronounced. This could reflect changes in societal conditions, law enforcement practices, or reporting mechanisms.

4 Discussion

The analysis of Toronto's crime trends from 2014 to 2023 reveals a complex and evolving landscape of public safety. The pronounced increase in assault cases in recent years is alarming, suggesting that the city may be facing emerging challenges in maintaining public order. This rise in violent crime needs a closer investigation of possible causative factors, such as the effects of increased urbanization, economic disparity, and shifts in population density.

4.1 Variation in Crime Trends

Simultaneously, the decline in theft-related crimes offers a more hopeful narrative. This trend may reflect the successful implementation of preventative measures by law enforcement agencies, such as community policing efforts and the integration of advanced surveillance technology. The use of crime prevention techniques, potentially aided by increased public awareness and education, appears to be bearing fruit.

The contrast between the trajectories of violent and non-violent crime rates underscores the need for a differentiated approach to policy-making and law enforcement. While we appreciate our gains in decreasing property crimes, the data motivates us to pursue more effective interventions for preventing and reacting to violent crimes. This might include extending social services, improving community engagement, and investing in data-driven police strategies.

4.2 Weaknesses and Next Steps

While the visualization provides a high-level overview of crime trends in Toronto, it's essential to conduct a more detailed analysis to understand the underlying causes of these trends. This includes examining subcategories of crimes, focusing on specific geographic areas within the city, and considering other relevant data sources.

Furthermore, this study emphasises the need for ongoing monitoring and analysis of crime data to comprehend the ever-changing dynamics of urban crime. In light of these findings, future studies should focus on understanding the influence of specific policies and social changes on crime rates. Only by doing such a comprehensive analysis can we hope to develop strategies that will ensure the safety and well-being of all Toronto residents.

5 References

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6 Appendix

6.1 Data Manipulation and Cleaning

- **Data Cleaning:** The initial phase of cleaning the Toronto crime rates dataset involved importing the raw data using the `read_csv` function from the `readr`(Wickham, Hester, and Bryan 2024) package. Following the import, the dataset was streamlined using the `select` function from `dplyr`(Wickham et al. 2023), a tidyverse(Wickham et al. 2019) package, to remove irrelevant columns such as `X_id`, `HOOD_ID`, `POPULATION_2023`, and `geometry`. This step was crucial to focus the analysis on relevant variables. Additionally, the `na.omit` function was employed to discard any rows with missing values (NA), ensuring the dataset's completeness and reliability. The final step in the cleaning process was the exportation of the cleaned data into a new CSV file using the `write_csv`function from `readr`(Wickham, Hester, and Bryan 2024), thereby preserving the cleaned and refined dataset for subsequent analysis.
- **Data Transformation:** The dataset was transformed from a wide format to a long format using the `gather` function from the `tidyr`(Wickham, Vaughan, and Girlich 2023) package. This transformation is crucial for simplifying the data structure and making it more amenable to analysis. Also, the separate function, again from `tidyr`(Wickham, Vaughan, and Girlich 2023), was instrumental in dividing the 'Crime_Year' column into two distinct parts: 'Crime_Type' and 'Year'. This enhances the granularity of the dataset, allowing for more detailed analysis.
- **Aggregation:** The `group_by` and `summarise` functions from `dplyr`(Wickham et al. 2023) were employed to aggregate the data by year and crime type.
- **Data Visualization:** For visual representation, `ggplot2`(Wickham 2016), a versatile package in R for data visualization, was employed. It was used to create comprehensive line plots depicting the trends of various crime categories over the years.
- **Paper Generation:** The packages `knitr`(Xie 2021) is used in generating R Markdown reports.