Crime Hotspots in Toronto*

Exploring the Patterns of Violent and Non-Violent Crimes in Local Communities

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In this paper, we analyzed crime trends in Toronto from 2014 to 2023, focusing on selected neighborhoods with the highest recorded crime rates. By transforming and visualizing crime data over the years, we identified patterns of increasing or decreasing crime across various neighborhoods. The findings highlight specific areas, like Moss Park and Yonge-Bay Corridor, where crime rates have significantly fluctuated, providing critical insights for community safety and resource allocation. Understanding these trends is essential for developing targeted interventions and improving public safety in Toronto's most affected areas.

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*Code and data are available at: Crime Hotspots in Toronto.

1 Introduction

Crime rates in major cities are a central concern for policymakers, law enforcement, and communities alike. Understanding how crime fluctuates over time and identifying areas most affected by criminal activity are essential for ensuring public safety and optimizing the allocation of resources. In a city as diverse as Toronto, crime does not affect all neighborhoods equally, making it crucial to examine specific trends across different areas to inform targeted interventions. This paper explores crime trends in Toronto from 2014 to 2023, focusing on selected neighborhoods with notable crime patterns. The study seeks to provide insights into how crime has evolved over time and which neighborhoods require greater attention for crime prevention efforts.

Although overall crime trends in Toronto have been explored in previous studies, less attention has been given to how these trends differ at the neighborhood level over extended periods. This paper addresses that gap by analyzing crime data from specific neighborhoods across ten years, offering a detailed view of local crime dynamics. By analyzing data, we identify key patterns in how crime has fluctuated, with particular emphasis on neighborhoods such as Moss Park and Yonge-Bay Corridor, which have shown significant changes over time.

To conduct this analysis, we transformed raw crime data into a summarized format and visualized trends across each year from 2014 to 2023. The findings indicate that certain neighborhoods have experienced sharp increases in crime, while others have remained relatively stable or shown improvements. These insights are crucial for informing public safety strategies and ensuring that resources are directed to areas where they are most needed. By identifying which neighborhoods have the highest crime rates and how those rates have changed, policymakers can develop more targeted interventions to improve community safety.

The structure of the paper is organized as follows: following Section 1, Section 2 outlines how the data was collected, cleaned, and analyzed. Section 3 presents the main findings, including detailed crime trends for each neighborhood and year. Finally, 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 provide a clear understanding of the dataset used in our analysis, focusing on its content, source, and the methods applied for organizing, aggregating, and visualizing crime data. The dataset serves as the foundation for our exploration of crime trends in

Toronto's neighborhoods, particularly examining the top 10 areas with the highest reported crime rates between 2014 and 2023.

2.1 Source and Methodology

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 11th, 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. 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 A.

2.2 Variables

The dataset includes several variables representing different types of crimes reported across Toronto's neighborhoods from 2014 to 2023. Given the extensive dataset, which covers 150 neighborhoods, we have chosen to focus on the top ten neighborhoods with the highest total crime counts. This allows for a more focused and manageable analysis while still capturing significant crime trends across the city.

To simplify the analysis, we aggregated the data to produce a `Total Crimes` variable by summing the various crime types for each year. Figure 1 shows a bar chart of the top ten neighborhoods with the highest overall crimes, emphasizing the variation in crime levels across these areas. Notably, **West Humber-Clairville** reports the highest total crimes over the period, followed by **Moss Park** and **Downtown Yonge East**. The graph clearly shows a gradient of total crimes from the highest in **West Humber-Clairville** to relatively lower totals in **South Riverdale** and **West Hill**. This ranking allows for an easier comparison across neighborhoods and provides insight into which areas may require more focused crime prevention efforts.
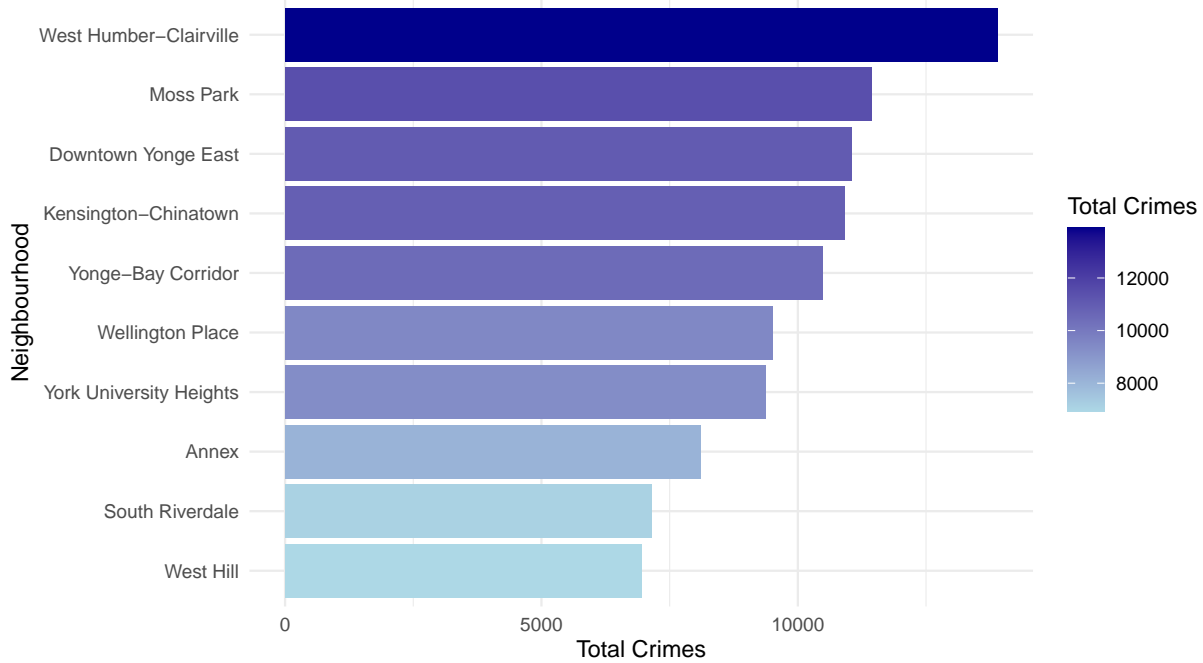
Figure 1: Top 10 Neighborhoods with the Most Crimes

Transitioning from the visualization to a more detailed breakdown, Table 1 presents a summary of the total crime numbers for each neighborhood across the ten years from 2014 to 2023. This table provides a year-by-year view of how crime rates have fluctuated in each of the top ten neighborhoods.

Table 1: Yearly Crime Counts in the Top 10 Toronto Neighborhoods (2014-2023)

Neighbourhood	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
West Humber-Clairville	1,247	1,119	1,135	1,177	1,553	1,393	1,286	1,341	1,785	1,856
Moss Park	956	948	1,016	1,044	1,335	1,415	1,430	1,171	1,011	1,113
Downtown Yonge East	922	904	853	1,131	1,211	1,410	1,086	1,217	1,052	1,259
Kensington-Chinatown	1,186	1,208	1,239	1,258	1,241	1,258	991	757	775	999
Yonge-Bay Corridor	931	1,005	950	1,172	1,220	1,339	946	763	1,040	1,117
Wellington Place	930	919	1,016	1,052	1,080	957	854	838	964	898
York University Heights	735	815	844	861	910	932	1,042	928	1,065	1,236
Annex	665	692	753	795	862	915	870	780	841	933
South Riverdale	683	624	769	712	800	717	709	686	684	768
West Hill	604	635	689	720	697	718	641	684	736	828

Table 1 reveals how crime rates in these neighborhoods have fluctuated over time. Some areas, such as West Humber-Clairville, have seen consistent increases, while others, like Kensington-

Chinatown, have experienced more volatility, with crime rates dropping in recent years. This breakdown is essential for understanding not just the overall crime totals but also the year-to-year shifts that could reflect the impact of local policies, demographic changes, or external factors influencing crime trends.

We further differentiated the crime data by classifying crimes into two categories: `Violent` and `Non-Violent`. Violent crimes include offenses such as Assault, Homicide, Break-and-Enter, Robbery, and Shooting Incidents, while non-violent crimes encompass acts like Theft. The stacked bar chart in Figure 2 visualizes this distinction, showing the proportion of violent and non-violent crimes for each of the top 10 neighborhoods.
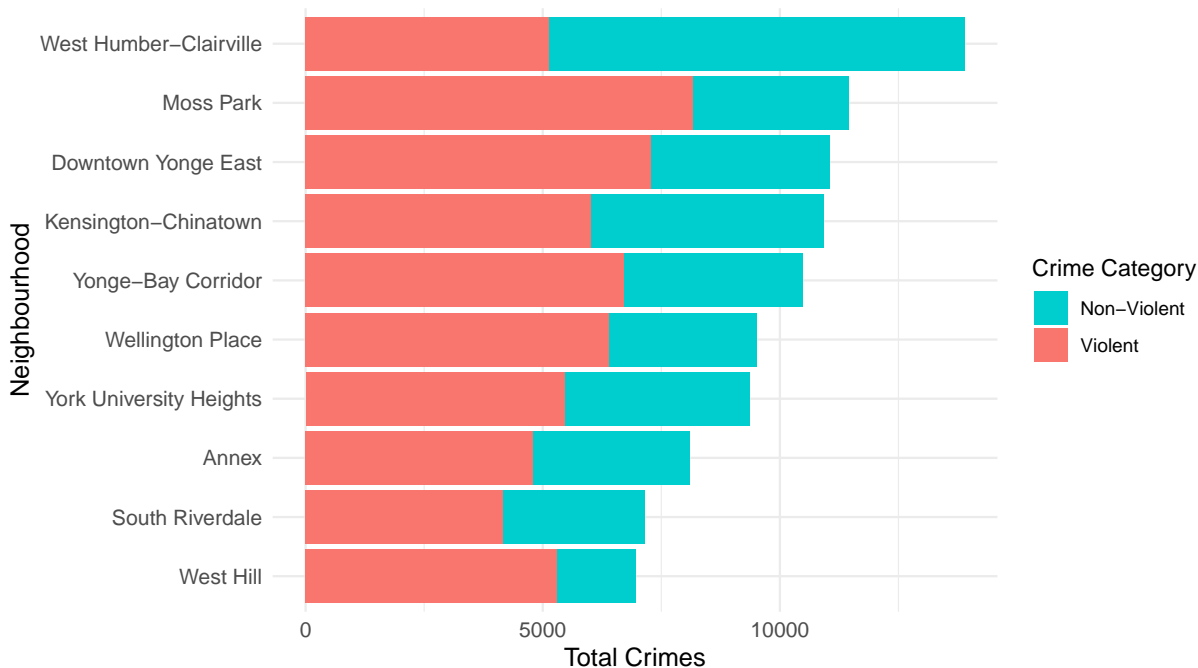

Figure 2: Distribution of Violent and Non-Violent Crimes in the Top 10 Neighborhoods

Figure 2 highlights the relative proportions of violent and non-violent crimes in each neighborhood. In some neighborhoods, like West Humber-Clairville, non-violent crimes make up a significant portion of the total, while others, like Moss Park and York University Heights, violent crimes constitute a significant proportion of the total, highlighting the need for targeted interventions. Downtown Yonge East and Kensington-Chinatown show a slightly higher prevalence of non-violent crimes, likely due to high population density and economic activity. Overall, the chart indicates that different neighborhoods experience varying proportions of violent and non-violent crimes, suggesting that crime prevention strategies need to be tailored to the specific needs of each area to effectively address both categories of crime.

2.3 Measurements

The data used in this study was measured based on official crime reports collected by law enforcement agencies and the City of Toronto. Each crime type, such as assault, auto theft, and break-and-enter, was measured as the total number of reported incidents per neighborhood, recorded annually from 2014 to 2023. These incidents were classified based on standard legal definitions and recorded by police officers responding to each reported crime.

The measurement of crime data is straightforward, as each crime variable represents the count of incidents reported within a calendar year for each neighborhood. The dataset ensures consistency in measurement across neighborhoods and years, enabling accurate time-series analysis of crime trends. While reporting practices may vary slightly due to local policing efforts or societal factors, the dataset's reliance on official records ensures a high degree of validity and reliability in how crime is measured and represented.

A `Total Crimes` variable was constructed by aggregating all individual crime types for each year and neighborhood. This aggregate measurement helps provide an overall view of criminal activity while still allowing for the examination of individual crime types when needed. Additionally, new variables were created to distinguish between `violent` and `non-violent` crimes. Crimes such as assault, homicide, break-and-enter, robbery, and shooting incidents were classified as violent, while other crime types were categorized as non-violent. These new variables allowed for the analysis of broader crime patterns by crime category, providing insights into the composition of criminal activity in Toronto neighborhoods over time.

3 Results

This section presents the findings of the study, providing visualizations and insights into the crime trends across Toronto's top 10 neighborhoods. The results are explored both by individual neighborhood and by overall trends in violent and non-violent crimes over time. These analyses reveal correlations and variations over the decade.

Figure 3 illustrates the total crime trends across the top 10 Toronto neighborhoods from 2014 to 2023. The data reveals notable fluctuations in crime across different areas, with some neighborhoods experiencing significant changes in crime rates over the years.

In this graph, West Humber-Clairville stands out with a sharp increase in crimes towards the end of the period, especially in 2022 and 2023. Similarly, Moss Park and Yonge-Bay Corridor show an upward trend in the later years, while other neighborhoods like Kensington-Chinatown exhibit more variability with periods of decline followed by recovery. Annex and South Riverdale experience relatively lower crime rates compared to the other neighborhoods but still show noticeable fluctuations over time. This graph highlights the varying crime dynamics across neighborhoods, signaling areas where targeted interventions may be necessary.
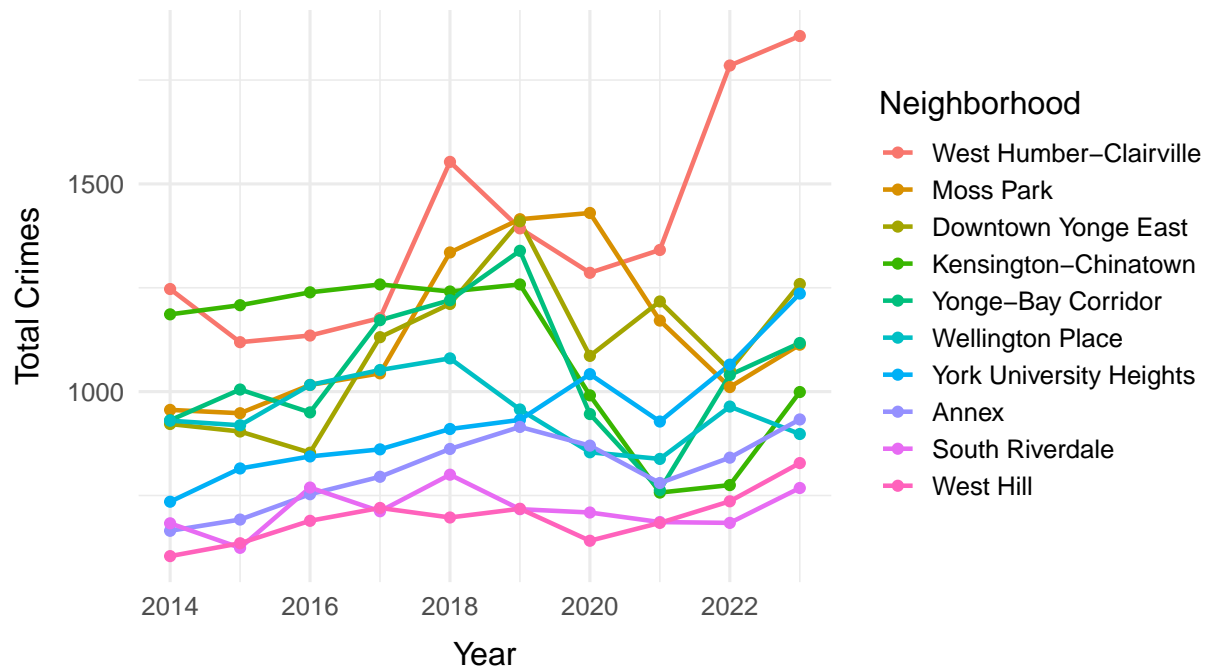
Figure 3: Trends in Crime Cases in Toronto

To further explore the crime trends, we now focus on the overall categorization of crimes into violent and non-violent categories. Figure 4 shows the aggregated crime trends for violent and non-violent crimes from 2014 to 2023.

Both violent and non-violent crime trends have shown an overall upward trend from 2014 to 2023. Notably, both trends display a significant dip around 2020, likely caused by the COVID-19 lockdowns, which led to decreased opportunities for certain types of crimes, such as thefts and break-ins, as people stayed indoors and public spaces were less accessible. However, as restrictions eased, there was a noticeable increase in both categories of crime, particularly in 2023. Overall, the rise in violent crimes is more pronounced in the later years, indicating a shift in crime dynamics, possibly influenced by societal and economic changes during the pandemic period.
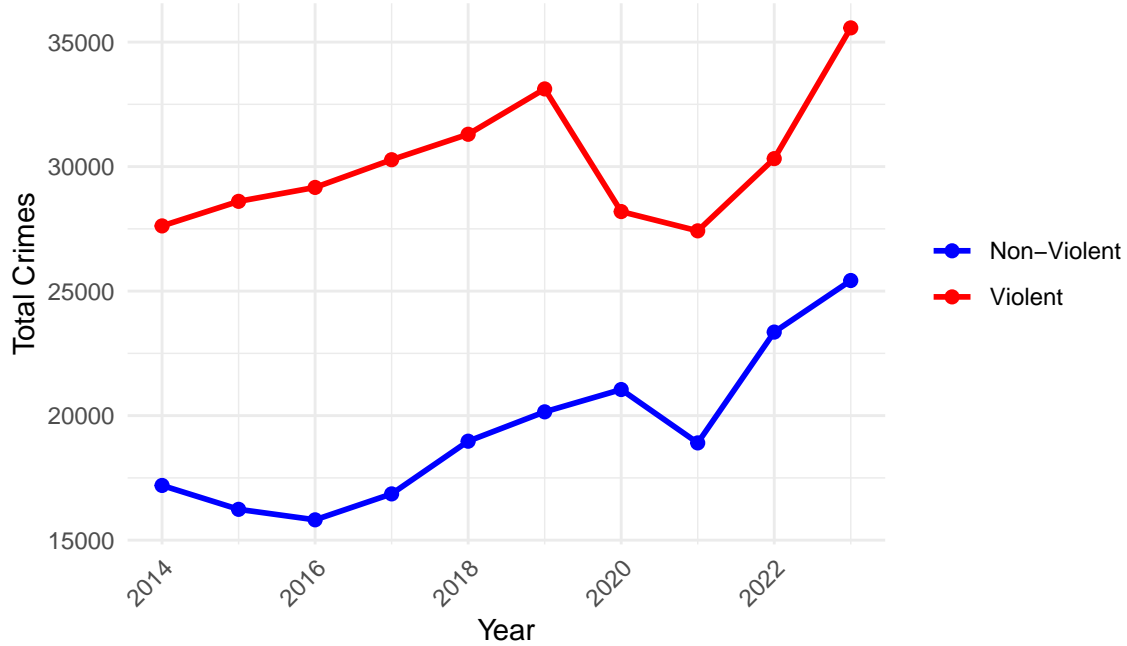
Figure 4: Trends in Violent and Non-Violent Crimes in Toronto (2014-2023)

4 Discussion

The results of this study highlight significant trends in crime patterns across Toronto's neighborhoods from 2014 to 2023, revealing both geographic crime hotspots and broader shifts in violent and non-violent crime trends over time. In this section, we explore potential factors contributing to the persistence and evolution of crime in certain neighborhoods, while also acknowledging the limitations of this analysis and proposing directions for future research.

4.1 Factors Behind Crime Hotspots in Toronto

The neighborhoods with the highest crime cases, such as West Humber-Clairville, Moss Park, and Downtown Yonge East, stand out as crime hotspots due to a combination of socio-economic factors and their urban environments. These areas are characterized by a high population density, extensive commercial activity, and, in some cases, socio-economic challenges such as poverty and homelessness. For instance, Moss Park is known for its affordable housing and shelters, which may contribute to both the volume of crimes and the types of crimes committed in the area, particularly violent crimes such as assault and robbery.

Over the years, crime rates in these hotspots have evolved in response to broader urban development and law enforcement strategies. For example, West Humber-Clairville has seen a

sharp rise in crime in recent years, potentially linked to suburban expansion, increased mobility, and higher traffic in the area. Similarly, areas like Downtown Yonge East and Yonge-Bay Corridor have shown upward trends in non-violent crimes, likely reflecting the dense commercial and tourist activity in these neighborhoods. Public spaces, retail hubs, and transport centers attract higher foot traffic, increasing opportunities for property crimes, such as theft and break-ins.

The COVID-19 pandemic also had a marked impact on crime trends. As lockdowns restricted movement, both violent and non-violent crimes dropped in 2020. However, post-lockdown, crime rates surged again, particularly in 2022 and 2023, indicating that societal disruptions during the pandemic may have altered crime patterns, but not permanently reduced them.

4.2 Weaknesses and Next Steps

Despite the insights provided by this analysis, there are several limitations to consider. First, the study relies solely on reported crime data, which may underrepresent the actual level of criminal activity, especially in cases of non-violent crimes that are less likely to be reported. The influence of changes in law enforcement practices, such as increased policing in certain neighborhoods or shifts in crime reporting systems, was not factored into this analysis but could significantly impact crime statistics.

For the next steps, a more comprehensive analysis incorporating socio-economic indicators such as unemployment rates, housing conditions, and educational attainment could help explain the underlying causes of crime in these hotspots. Moreover, integrating spatial data, such as proximity to transit hubs or commercial centers, would enhance the understanding of how the urban environment influences crime patterns. Finally, exploring the impact of public safety interventions and social programs over time would provide a clearer picture of how effective current strategies have been in reducing crime and promoting community safety.

By addressing these limitations and expanding the scope of analysis, future research can provide more detailed insights into the root causes of crime and help inform targeted interventions to reduce criminal activity in Toronto's most vulnerable neighborhoods.

Appendix

A 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 `_id`, `HOOD_ID`, `POPULATION_2023`, and `geometry`. Additionally, any columns containing "RATE" in their names were excluded from the dataset. To address missing data, the `mutate` function was used to replace all NA values with 0. The dataset was then cleaned further by applying the `clean_names` function from the `janitor` package (Firke 2021), ensuring consistent and readable column names. We also renamed the `area_name` column to `Neighbourhood` for clarity. Finally, underscores in column names were replaced with spaces using the `str_replace_all` function from `stringr` (Wickham 2023). The cleaned dataset was saved for further analysis in CSV format.

- **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 line plots depicting the trends of various crime categories over the years. To present the cleaned dataset, the `kable` function from the knitr package(Xie 2021) was used to generate clear and readable summary tables.

- **Paper Generation:** The packages `knitr`(Xie 2021) is used in generating R Markdown reports.

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