Toronto's continuously growth reported crime cases in past years.*

An Analysis of Toronto's reported crime from 2014 to 2022

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This study presents a comprehensive analysis of reported crime data in Toronto, as sourced from Open Data Toronto, to explore the trend of urban criminal patterns in Toronto over the past years. By examining reported incidents from 2014 to 2022, this paper identifies key trends in crime cases across different years and police divisions, highlighting possible key factors that may caused such results. In a word, the paper seeks to provide actionable insights for city planners, law enforcement, and community advocates, aiming to build a safer, more enjoyable urban living environment.

1 Introduction

Public safety, as one of the most important factors in ensuring a high-quality life for people, is an important aspect that requires continuous evaluation and enforcement. The city of Toronto, as one of the places with the largest population in Canada, is not an exception to the challenges posed by crimes. This paper takes a deep dive into the extensive reported crime data provided by Open Data Toronto(Gelfand 2020), covering the period from 2014 to 2022. The analysis is grounded in a methodical approach to identify and interpret crime trends across the past years, also within the city's diverse police divisions, offering a detailed chronicle of criminal activity over a selected time span. To be more specific, this research analyzed and visualized how crime spreads out across different divisions and how it changes over the years. By dissecting the data year by year, division by division, this study uncovers patterns that could inform future urban planning and law enforcement strategies. The role of population growth, natural diseases, and urban development, are considered potential catalysts influencing these patterns.

*Code and data are available at: https://github.com/iJustinn/Totonto_Reported_Crimes.git

Moreover, the paper aims to a little beyond simply displaying statistics. It endeavors to contextualize the numerical findings within the broader spectrum of Toronto's urban structure. The motivation for this discussion is that changes in crime rates are often associated with changes in other indicators of the city, such as education level(Bell, Costa, and Machin 2022), unemployment rate(Phillips and Land 2012), economic level(Machin and Meghir 2004), and so on. By doing this, the study aims to offer useful advice that can help city officials and the police create plans to make the city safer and better for all residents. Through these ways, the paper is not just an exposition of data, but a roadmap towards a better living environment.

The subsequent sections of this paper are organized to facilitate a comprehensive understanding of the study and its implications. Following this introduction, Section 2 outlines the methodology employed in the analysis, ensuring transparency and replicability. Section 3 presents the findings in detail, charting the trends in reported crimes over time and across Toronto's police divisions. also discusses these findings in other aspects such as infrastructure construction, structure of the city, etc. Finally, Section 4 concludes the paper, summarizing the key insights and findings in this research.

2 Data

2.1 Data Source

The data used in this paper was collected by the OpenDataToronto Library (Gelfand 2020). The specific data set used in this research is the 'police-annual-statistical-report-reported-crimes' (Data 2023).

Data used in this paper was downloaded, cleaned and analyzed with the programming language R (R Core Team 2022). Also with support of additional packages in R: `tidyverse` (Wickham et al. 2019), `ggplot2` (Wickham 2016), `janitor` (Firke 2023), `dplyr` (Wickham et al. 2023), `readr` (Wickham, Hester, and Bryan 2023), `knitr` (Xie 2014).

2.2 Data Processing

2.2.1 Raw and Cleaned Data

Table 1: Head of Raw Toronto Reported Crimes Data

ID	Reported Year	Division	Category	Sub Type	Total Case	Cleared Case
1	2014	D11	Crimes Against the Person	Other	22	9

ID	Reported Year	Division	Category	Sub Type	Total Case	Cleared Case
2	2014	D11	Crimes Against Property	Theft Over $5000	1	1
3	2014	D11	Crimes Against the Person	Other	1	1
4	2014	D11	Crimes Against the Person	Robbery-Financial	1	1
5	2014	D11	Crimes Against Property	Break & Enter-House	23	13
6	2014	D11	Crimes Against Property	Theft Over $5000	1	1

Table 2: Head of Cleaned Toronto Reported Crimes Data

Reported Year	Division	Total Case
2014	D11	22
2014	D11	1
2014	D11	1
2014	D11	1
2014	D11	23
2014	D11	1

The raw data set, first few lines shown in Table 1, contains more than 30000 reported crime cases in Toronto from 2014 to 2022 in all police divisions, including reported crime types, case status, case ID, etc. Since this research does not need that much information, thus the data was cleaned as needed. Now the cleaned data only shows the number of reported crime cases in corresponding years and the police division to each case was reported. The first few lines of the cleaned data were shown in the Table 2.

2.2.2 Further Data Processing

In order to make it easier to draw the data in the future, the cleaned data has been further processed into data with only two variables, which are used to correspond to the x-axis and y-axis when drawing.

Table 3: Head of Toronto Reported Crimes Data by year

Reported Year	Total Cases
2014	113432
2015	117365
2016	122626
2017	129970
2018	143204
2019	144532

As mentioned earlier, this paper will first analyze the trends of reported crimes in different years. Therefore, the first further processed data will add up all data from different policy divisions in each year to form a total number of reported crimes for a specific year. The head of these data was shown in Table 3.

Table 4: Head of Toronto Reported Crimes Data by police division

Division	Total Cases
D11	52546
D12	43158
D13	38712
D14	88678
D22	72300
D23	56343

Then, this paper will analyze the total number of reported crimes received for different policy divisions disregard of the year. Therefore, the process of this data ignores the year and adds up all the data received by each policy division in the cleaned data set to form the data set shown in Table 4.

3 Discussion

3.1 Across years

As the bar chart (Figure 1) displayed, the total reported crime cases in Toronto for each year from 2014 to 2022. From a visual inspection, the following trend can be observed: starting in 2014, there appears to be a relatively steady or slight increase in the number of cases, reaching a peak around 2017 and 2018. After this peak, there is a major decreasing in the number of reported crime cases, with almost no trend up to 2021.

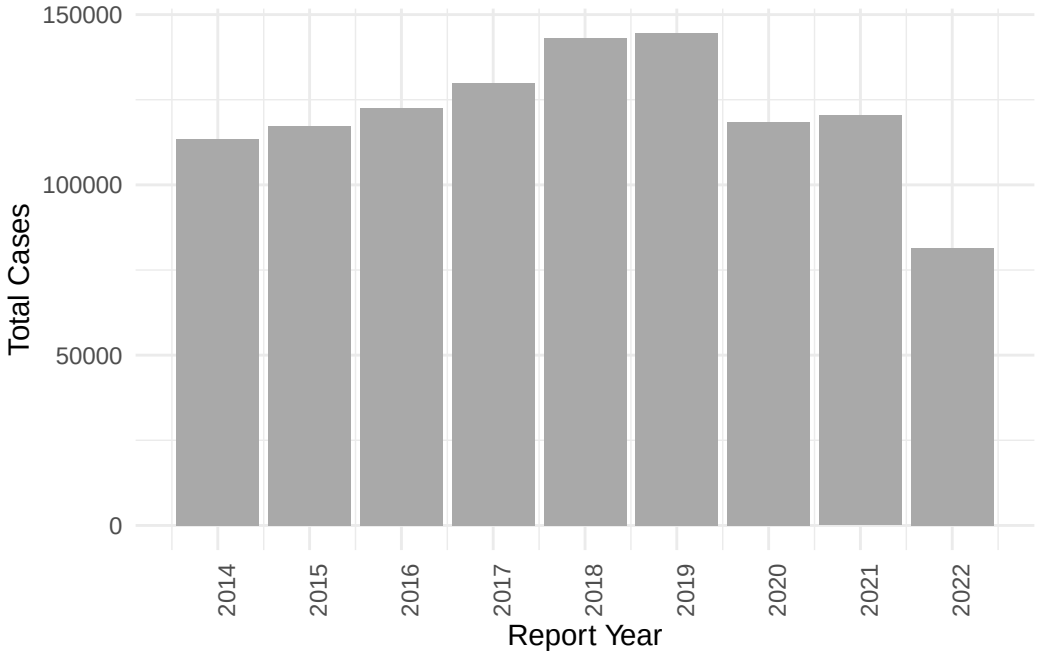

Figure 1: 2014 to 2022 Toronto Total Reported Crime Cases by Year

Notably, there are two significant drop in the total reported crime cases in 2020 and 2022 compared to their previous years. These declines could be of particular interest and worth further investigation to understand the underlying factors contributing to this change.

The drop in 2020 has a more obvious reason. Starting from the end of the year in 2019(Ryan 2021), people around the world have started on a period of over two years of the pandemic. Public health measures such as lockdowns, physical distancing, and restrictions on gatherings have drastically changed social behaviors and daily activities. This unprecedented situation has had a ripple effect across various sectors, including the realm of public safety and crime.

As communities went into isolation and businesses temporarily closed or shifted to remote operations, the opportunities for certain types of crimes, like burglaries and thefts in commercial areas, may have diminished(Abrams 2021). Conversely, there have been concerns about the potential rise in domestic incidents and cybercrimes as more people stayed home and activities moved online.

The impact of the pandemic on mental health(Semo and Frissa 2020), due to prolonged social isolation and economic stressors, could also not be understated. These factors have influenced community dynamics and possibly crime patterns(Peay 2010). Law enforcement agencies and social services have had to adapt to these changes, sometimes shifting their focus to community support and online safety initiatives. The extended period of the pandemic has

also challenged traditional crime prevention and response strategies, prompting a reevaluation of resource allocation and policing methods.

3.2 Across divisions

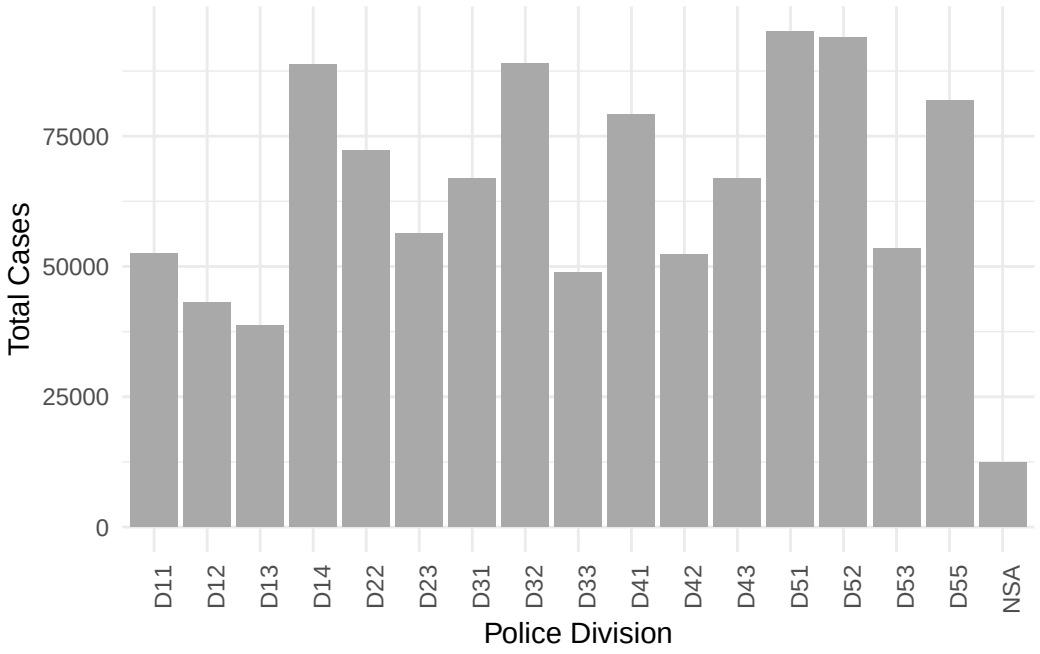

Figure 2: 2014 to 2022 Toronto Total Reported Crime Cases by Division

The bar chart (Figure 2) depicts the total reported crime cases in Toronto by police division from 2014 to 2022. Focusing on some specific divisions, some patterns may be concluded. The map(Esri(OpenStreetMap contributors) 2024) produced by TPS, Toronto Police Service, downtown Toronto (divisions 51) shows a significant number of reported cases, with Division 51 notably having one of the highest total crime cases counts on the entire chart, which can be strong evidence of the relation between the high density and activity levels in downtown areas and the crime rates(Battin and Crowl 2017).

Not only in downtown Toronto but also in some of the areas where large shopping malls are located (North York, division 32), the total crime cases also exceeded other divisions by a significant amount. Moreover, other divisions with signs of high population density also show a high number of crime cases such as Division 52 (CN tower and Scotiabank Arena located), division 14 (numerous train stations), etc.

Conversely, Scarborough, division 43, while still manifesting a sizeable aggregate of cases, doesn't reach the level of numbers observed in divisions discussed above, possibly mirroring

the majority of its house type and development situation. This again suggests that population density can influence crime rates(Battin and Crowl 2017). While other factors such as socioeconomic status, community engagement, and policing strategies also play crucial roles, we need more information to assess further.

4 Conclusion

In conclusion, this paper reflects on the significant findings from the analysis of reported crime data in Toronto between 2014 and 2022. The data revealed fluctuating crime rates, with notable peaks and troughs corresponding to various factors and events, most prominently the COVID-19 pandemic. This period notably saw changes in crime patterns due to altered social behaviors and policing strategies. The analysis across police divisions highlighted the impact of population density and development level on crime distribution. By leveraging detailed crime data, Toronto can continue to enhance its urban safety strategies, aiming for a city that is not only safer but also more equitable and responsive to the needs of its swiftly growing population("Toronto, Canada Metro Area Population 1950-2024" 2024).

Bibliography

Abrams, David S. 2021. "COVID and Crime: An Early Empirical Look." *Journal of Public Economics* 194: 104344.

Battin, Joshua R, and Justin N Crowl. 2017. "Urban Sprawl, Population Density, and Crime: An Examination of Contemporary Migration Trends and Crime in Suburban and Rural Neighborhoods." *Crime Prevention and Community Safety* 19: 136–50.

Bell, Brian, Rui Costa, and Stephen Machin. 2022. "Why Does Education Reduce Crime?" *Journal of Political Economy* 130 (3): 732–65.

Data, Toronto Open. 2023. "Police-Annual-Statistical-Report-Reported-Crimes." https://open.toronto.ca/dataset/police-annual-statistical-report-reported-crimes/.

Esri(OpenStreetMap contributors), Toronto Police Service. 2024. "My Neighbourhood." https://www.tps.ca/my-neighbourhood/.

Firke, Sam. 2023. *Janitor: Simple Tools for Examining and Cleaning Dirty Data*. https://CRAN.R-project.org/package=janitor.

Gelfand, Sharla. 2020. *Opendatatoronto: Access the City of Toronto Open Data Portal*. https://cran.r-project.org/package=opendatatoronto.

Machin, Stephen, and Costas Meghir. 2004. "Crime and Economic Incentives." *Journal of Human Resources* 39 (4): 958–79.

Peay, Jill. 2010. *Mental Health and Crime*. Routledge.

Phillips, Julie, and Kenneth C Land. 2012. "The Link Between Unemployment and Crime Rate Fluctuations: An Analysis at the County, State, and National Levels." *Social Science Research* 41 (3): 681–94.

R Core Team. 2022. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

Ryan, J Michael. 2021. "Timeline of COVID-19." *COVID-19: Global Pandemic, Societal Responses, Ideological Solutions. Routledge*.

Semo, Bazghina-werq, and Souci Mogga Frissa. 2020. "The Mental Health Impact of the COVID-19 Pandemic: Implications for Sub-Saharan Africa." *Psychology Research and Behavior Management*, 713–20.

"Toronto, Canada Metro Area Population 1950-2024." 2024. https://www.macrotrends.net/cities/20402/toronto/population; Macrotrends.

Wickham, Hadley. 2016. *Ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. https://ggplot2.tidyverse.org.

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.

Wickham, Hadley, Romain François, Lionel Henry, and Kirill Müller. 2023. *Dplyr: A Grammar of Data Manipulation*. https://CRAN.R-project.org/package=dplyr.

Wickham, Hadley, Jim Hester, and Jennifer Bryan. 2023. *Readr: Read Rectangular Text Data*. https://CRAN.R-project.org/package=readr.

Xie, Yihui. 2014. *Knitr: A Comprehensive Tool for Reproducible Research in R*. Edited by Victoria Stodden, Friedrich Leisch, and Roger D. Peng. Chapman; Hall/CRC. http://www.crcpress.com/product/isbn/9781466561595.