Mental health issue linked to major crimes*

Max LI

September 21, 2024

This paper discusses the relationship between mental health issues and crime, focusing on Mental Health Act Apprehensions and major crime indicators in several Toronto police divisions. A positive linear relationship is found between the number of MHA apprehensions and reported crimes, suggesting that mental health-related interventions could help reduce crime rates while also supporting affected individuals.

Table of Contents

---

*Code and data are available at: https://github.com/ShaotongLi-Max/Mental_health_issue_related_to_major_crime.

8.Appendix   15

9.Reference   17

1.Introduction

Mental Health Act is a law that describes what should happen when someone with a mental illness should be treated to protect themselves and others around. The new Mental Health Act issued in 2014 set new regulations towards teenagers: "MHA Apprehensions of individuals aged 17 and under have been omitted to protect youth identity. From 2014 to 2020, these individuals comprised 6.5% (4,724 of 71,717) of all MHA Apprehensions, with individuals under 12 comprising 0.4% (320 of 71,717), and 12-17 comprising 6.1% (4,404 of 71,717) respectively. There are instances where an individual's age group is classified as "Not Recorded"; these account for 1.3% (915 of 71,717) of all MHA Apprehensions."(City of Toronto 2024b) Now all data of MHA Apprehensions is stored in the data set provided by Toronto police department.

According to the research provided by Public Safety Canada, of the 5 million people who came into contact with police, approximately one in five (18.8%) met the criteria for a mental or substance use disorder. One in three Canadians with a mental health disorder reported having contact with police for at least one reason studied (34.4%).(Public Safety Canada 2017) This is suggesting that there could be a positive relationship between mental illness and crime rates.

This paper investigates the relationship between mental health apprehensions under the Mental Health Act (MHA) and major crime incidents across various police divisions in Toronto. Using two datasets, this paper analyzes the distribution of both mental health-related incidents and crimes across divisions through visualizations and statistical methods.It further develops a linear regression model to quantify and explore the positive correlation between MHA reports and crime rates, suggesting that a better understanding of this relationship could aid in crime control and mental health care strategies.

In section 3 and 4, this paper shows descriptions and visualizations of MHA apprehensions data as well as major crimes across different police divisions, with plots depict how the number of two factors varies across divisions, providing insights into the distribution of mental health-related events.

In section 5, this paper compares MHA apprehensions with crime data and develops the positive linear regression model between the two factors. In section 6, the paper further discuss the model and how it can be used in reality.

In section 7, this paper explains the limitation of the original data and the model. In section 8, this paper lists the cleaned data as well as the full model summary table.

2.Data

2.1 Packages

The data used in this paper came from the Open Data Toronto portal through the library opendatatoronto (City of Toronto 2022). Data were cleaned and analyzed using the open source statistical programming language R (R Core Team 2023). Libraries tidyverse (Wickham, H. et al. 2019), dplyr (Wickham, H. et al. 2023), and lubridate (Grolemund, G. and Wickham, H. 2011) were used for simulating, cleaning and testing. Graphics were made using ggplot2 (Wickham, H. 2016), gt(Graham, J. 2023) and broom(Robinson, D. and Wickham, H. 2023).

2.2 Clean data process

The cleaned data comes from two raw data sets: Mental Health Act Apprehensions Dataset, which contains records of Mental Health Act (MHA) reports grouped by police division, and Major Crime Indicators Dataset, which includes records of crimes similarly categorized by police division. The cleaned data set aggregates the number of MHA reports and crimes for each district, providing a comprehensive overview of the relationship between mental health reports and crime incidents across the specified districts.

3.Mental Health Act Apprehensions Data

The Mental Health Act Apprehensions Data are provided by Toronto Police Services. It includes all Mental Health Act (MHA) Apprehensions pursuant to the Mental Health Act, assigning different event numbers as distinct MHA Apprehensions. This data set is queried based on reported date and the last refreshed date is July 23,2024.

This data set specifically list the identity of the person who has MHA Apprehensions as well as the corresponding MHA type, which are as follows:

- Section 15 (Form 1 - Physician - Application for Psychiatric Assessment);
- Section 16 (Form 2 – Justice of the Peace – Order for Examination);
- Section 17 (Police Officer's Power of Apprehension);
- Section 28 (1) (Form 9 - Elopee - Order for Return); and,
- Section 33.4 (Form 47 - Community Treatment Order for Examination).

However, there are limitations to this data: A unique event number should not be interpreted as an apprehension of a distinct individual. An individual may have been apprehended multiple times under the Mental Health Act, with each apprehension recorded using a unique event number.(City of Toronto 2024b)

Therefore, the columns chosen for this analysis were simply: "DIVISION" representing the Police Division where Offence Occurred. In cleaning data process, a new column "num_mha_reports" was made in the analysis data, representing the number of MHA reports in each police division.

The bar plot (Figure Figure 1) and the line plot (Figure Figure 2) show the number of MHA Apprehensions in each police division and its trend.
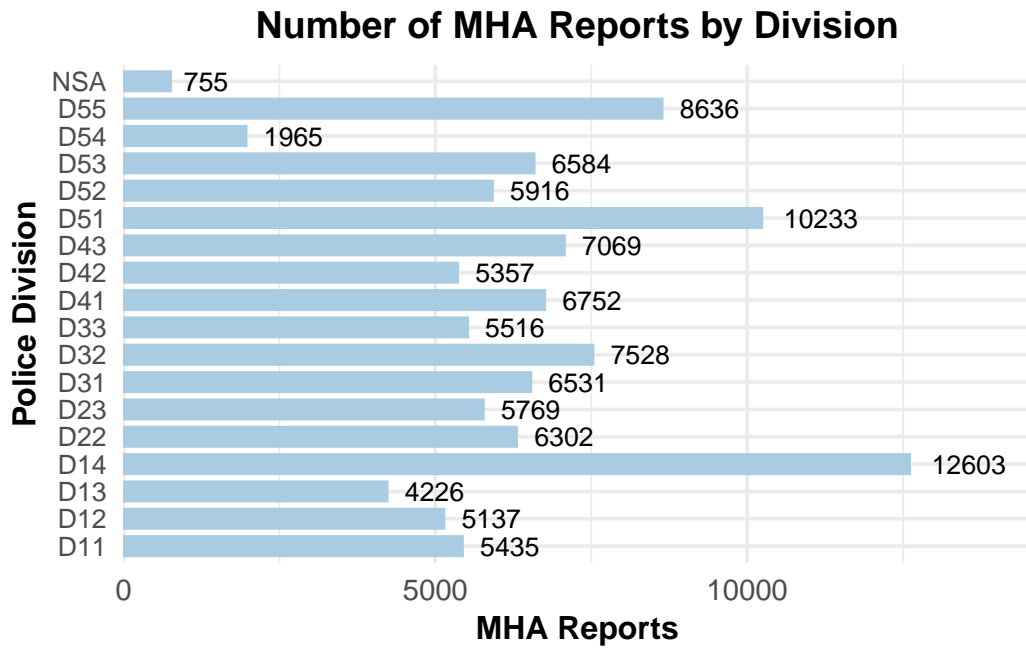
3.1 Overview of MHA Apprehensions Data

Number of MHA Reports by Division

Figure 1: Number of MHA reports in each Police division (2014-2024)
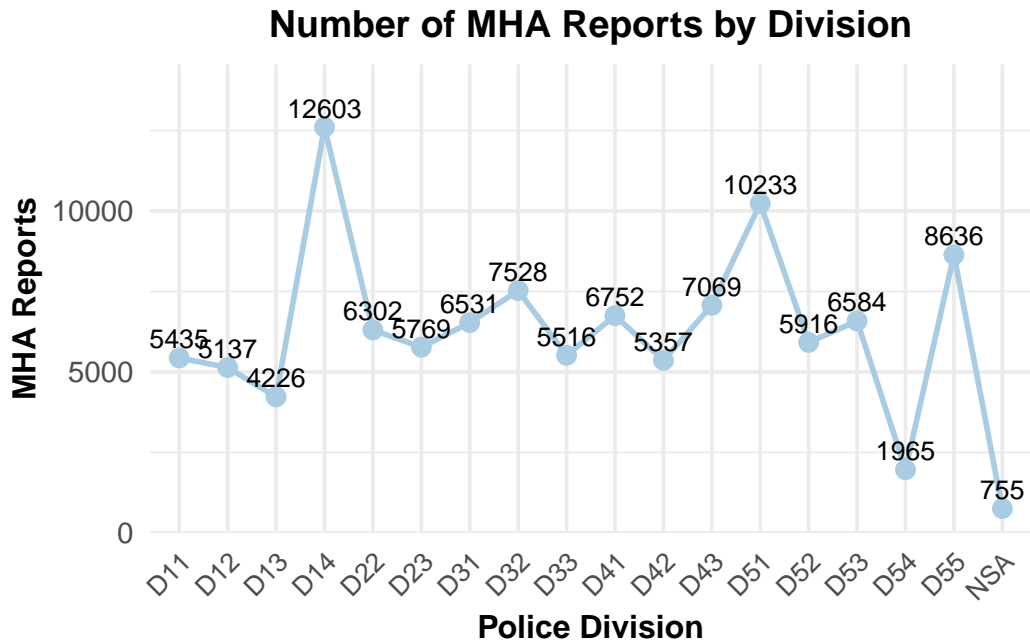
Number of MHA Reports by Division

Figure 2: Number of MHA reports in each Police division (2014-2024)

4.Major crime indicator

This data set includes all Major Crime Indicators (MCI) occurrences by reported date. The Major Crime Indicators categories are Assault, Break and Enter, Auto Theft, Robbery and Theft Over (Excludes Sexual Assaults).(City of Toronto 2024a)This data set is queried based on reported date and the last refreshed date is July 23,2024.

This data includes all MCI occurrences reported to the Toronto Police Service, including those where the location has not been able to be verified.This is not an issue since this paper only takes into account the number of crimes in different division.This data does not include occurrences that have been deemed unfounded, or "has been determined through police investigation that the offence reported did not occur, nor was it attempted".Therefore, every crime in the dataset is a crime that has been confirmed by the police department.(City of Toronto 2024a)

The columns chosen for this analysis were simply: "DIVISION" representing the Police Division where major crime Occurred. In cleaning data process, a new column "num_crimes" was made in the analysis data, representing the number of major crimes took place in each police division.

The bar plot (Figure Figure 3) and the line plot (Figure Figure 4) show the number of Major Crime Indicators in each police division and its trend.
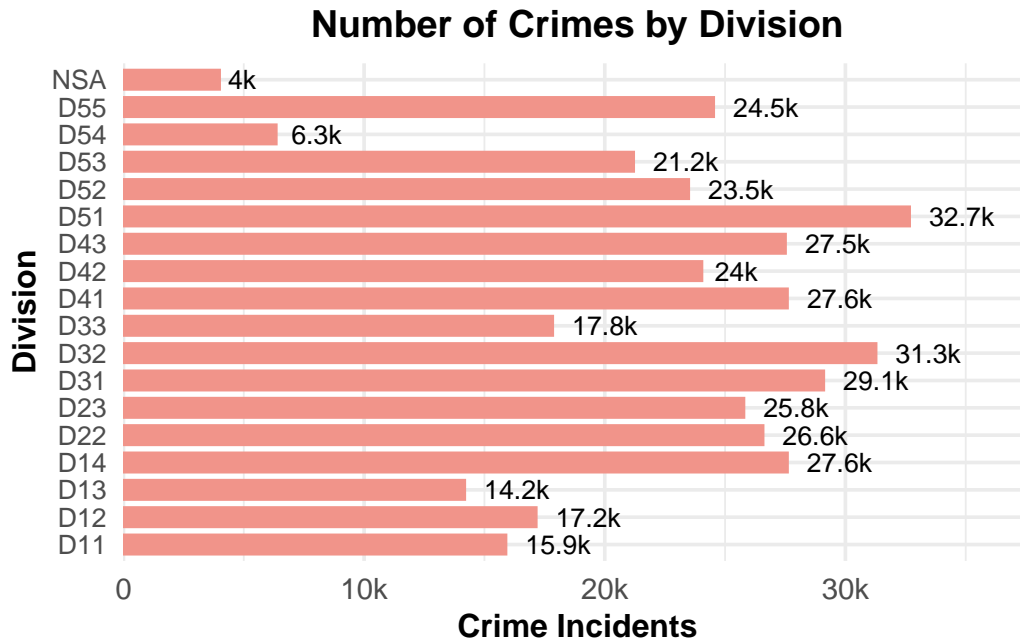
4.1 Overview of Major Crime Indicator Data

Number of Crimes by Division

Figure 3: Number of Major Crime Indicator in each Police division (2014-2024)
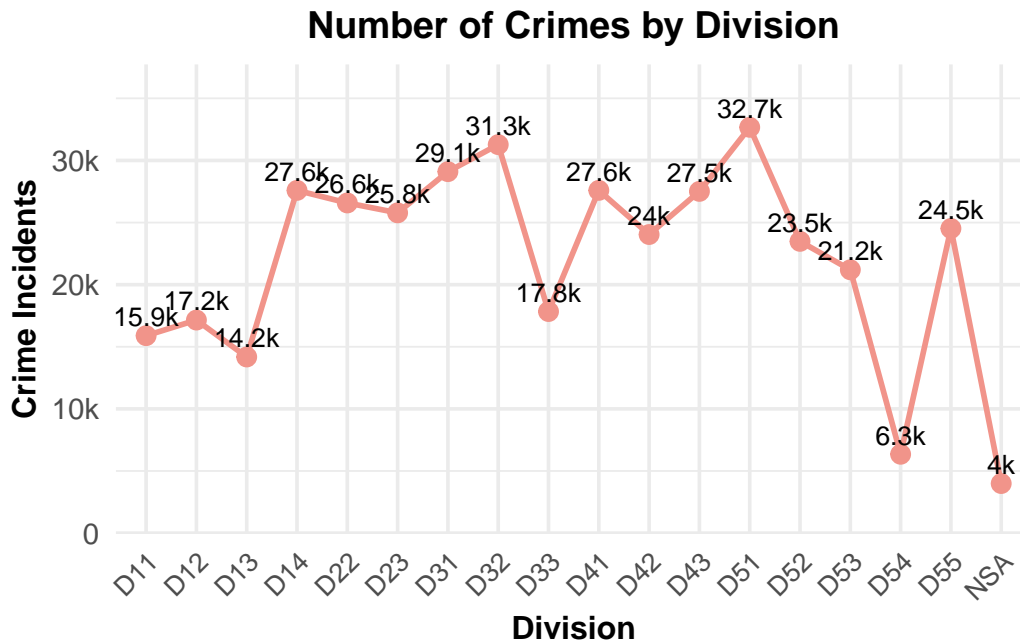
Number of Crimes by Division

Figure 4: Number of Major Crime Indicator in each Police division (2014-2024)

5.MHA reports relationship to Major Crime Indicator

5.1 Comparing two datasets

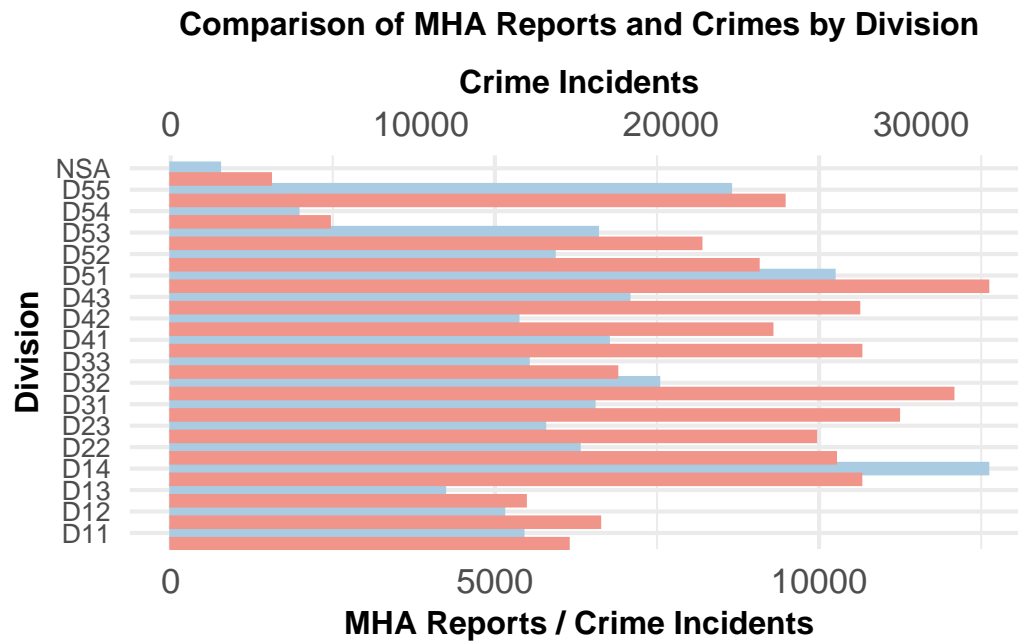**Comparison of MHA Reports and Crimes by Division**
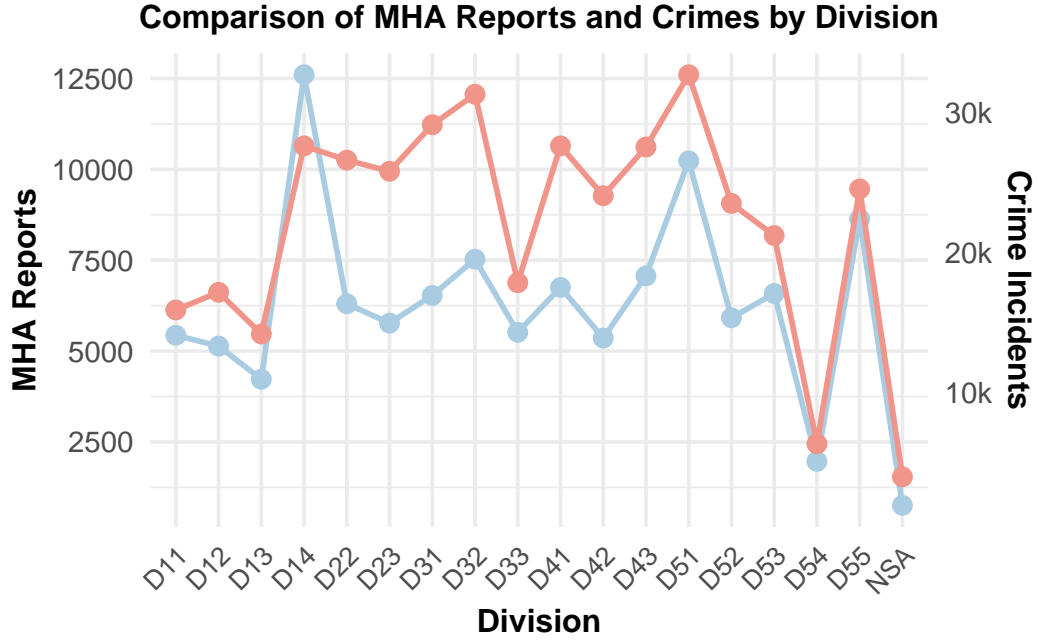
Figure 5: comparison between two data

Figure 6: comparison between two data

By comparing the two bar plots (Figure Figure 5) and line plots (Figure Figure 6),there seems to be a positive relationship between the number of MHA reports and the number of Major Crime Indicator. To check whether they are linearly related, a test for linear relationship is necessary.

5.2 Introducing linear model

In order to confirm there are linear relationship between two factors, a linear model is made to fit in this situation based on two data sets:

$$C = 6748.244 + 2.451 \times MHA \tag{1}$$

in which:

- **C**
  C stands for the predicted number of crimes, which is also the dependent variable in this model.

- **Intercept:** 6748.244
  This suggests that, even when there are no MHA reports, the baseline number of crimes in a division is approximately 6748.

9

- **MHA:** 2.451
  For each additional MHA report, the model predicts an increase of approximately 2.45 crimes in the corresponding division.

The corresponding graph of linear model is Figure 7

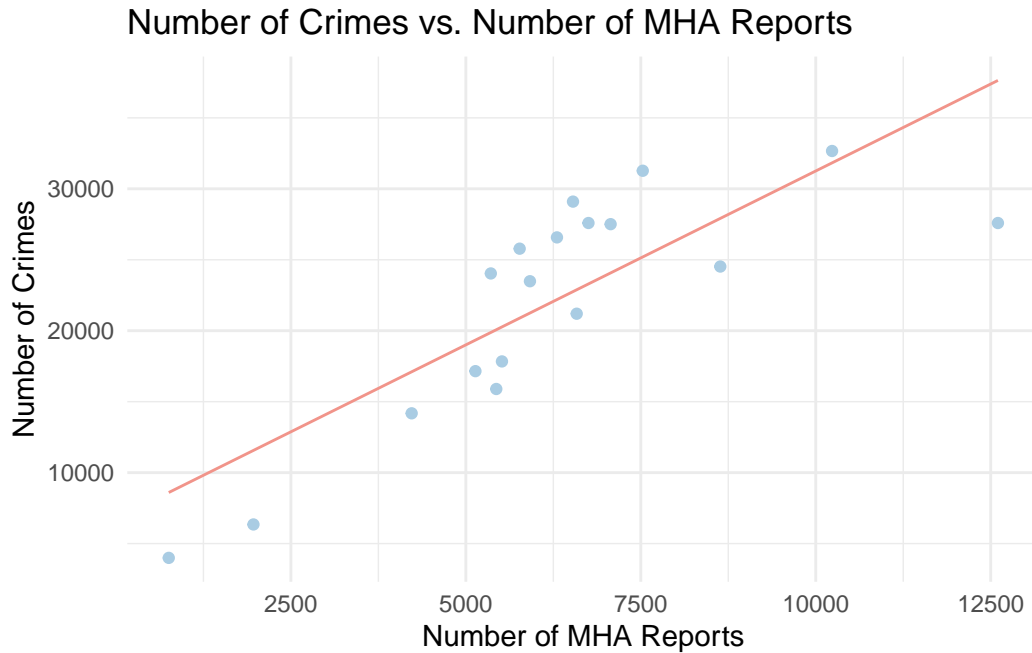## Number of Crimes vs. Number of MHA Reports

Figure 7: Linear Model

The p-values for both intercept and coefficient (MHA Reports) are below the significant level of 0.05 (Figure Figure 8), indicating a strong evidence that the relationship between MHA Reports and major crime indicator follows this linear model.

Linear Model Summary 1

term	Estimate	P-value
Intercept	$6,748.244$	0.037
num_mha_reports	2.451	0.000

Figure 8: Linear Model Summary 1

6.Discussion

This paper investigated the relationship between the number of Mental Health Act Apprehensions and the major crime indicator, according to Toronto Police Services data retrieved from OpenData Toronto. Results shows that as the number of MHA reports rises, the major crime indicator also increases, based on data from 2014 to 2024. Furthermore, there appears to be a positive linear relationship between the number of MHA reports and the number of major crime indicator, which can be expressed as a linear model $C = 6748.244 + 2.451 \times MHA$ (1).

The result of this paper shares the insight of the research by Public Safety Canada: "In the international research for both youth and adults analyzed for this report, findings suggest that certain mental health disorders, such as substance use disorder, conduct disorder, and antisocial personality disorder were shown to have a significant correlation to offending and re-offending." The p-value of our model is 4.19×10^{-5}, which is far below the significance level of 0.05, indicating a strong correlation between the number of Mental Health Act Apprehensions and the major crime indicator.(Public Safety Canada 2017)

However, other variables like population could affect the number of both MHA reports and major crime indicator. Population is not included in Major crime indicator data and MHA Apprehensions Data. Adding population as an independent variable to the model could be a way of studying the relationship between MHA reports and major crime indicator.

This paper and its model can assist the government and society better allocate resources for both mental health services and law enforcement. By understanding the correlation between mental health apprehensions and crime rates, policymakers can implement targeted interventions to address underlying issues, such as providing mental health support in high-crime areas or improving police training on handling mental health incidents. Additionally, this model can assist in predicting areas where both mental health-related incidents and crime are likely to occur, helping authorities proactively implement prevention strategies, which could potentially reducing crime and improving mental health outcomes.

7.Limitation

The limitation of this paper is split into two parts: the limitation of data (7.1) and the limitation of linear model (7.2 & 7.3)

7.1 Data outlier

Significant outliers are evident in both the Mental Health Act (MHA) reports and the Major Crime Indicator data (Figure Figure 9). These outliers may be attributable to the relatively small sample size, given that there are only 20 police divisions in Toronto. The limited number of divisions can lead to greater variability in the data, making it more susceptible to the influence of atypical observations.
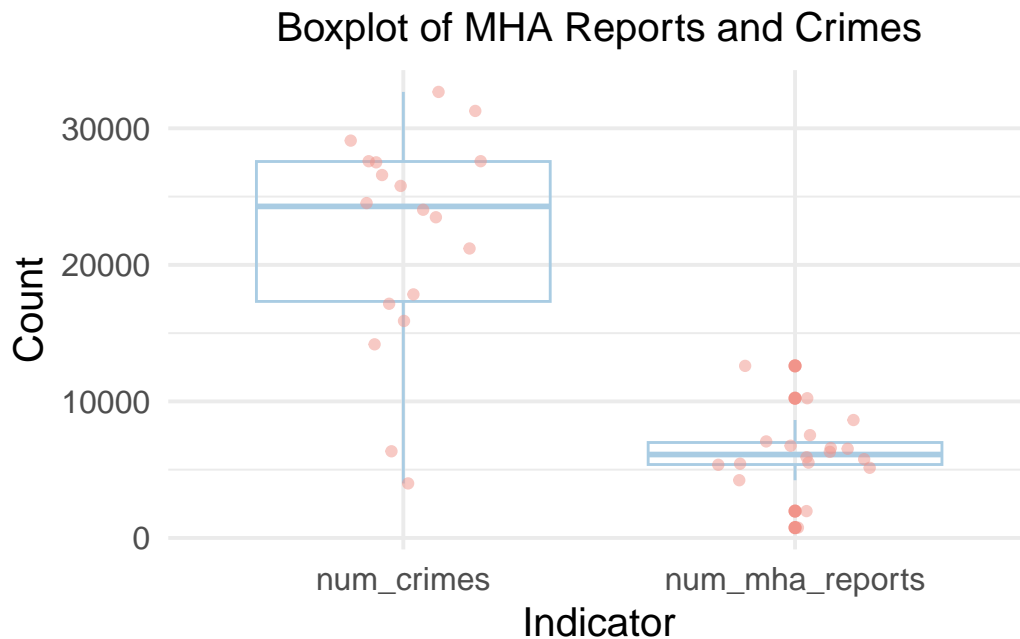
Figure 9: The box plot of two factors

7.2 Model accuracy

The linear model reveals a significant linear relationship between the number of Mental Health Act (MHA) reports and the major crime indicator. However, the adjusted R-squared value of 0.6388 indicates that approximately 36.12% of the variance in crime rates remains unexplained by the model (Figure Figure 10). This finding implies that, in addition to MHA reports, there are likely other influencing factors contributing to variations in crime rates.

Linear Model Summary 2

Statistic	Value
Residual Standard Error	4834.665
Multiple R-squared	0.66
Adjusted R-squared	0.639
F-statistic	31.07
p-value	4.19e-05

Figure 10: Linear Model Summary 2

7.3 Model residual

The residuals in this model are relatively large, leading to a complex residual pattern (Figure Figure 11). This complexity may indicate potential issues with model fit or the presence of unaccounted variability in the data.
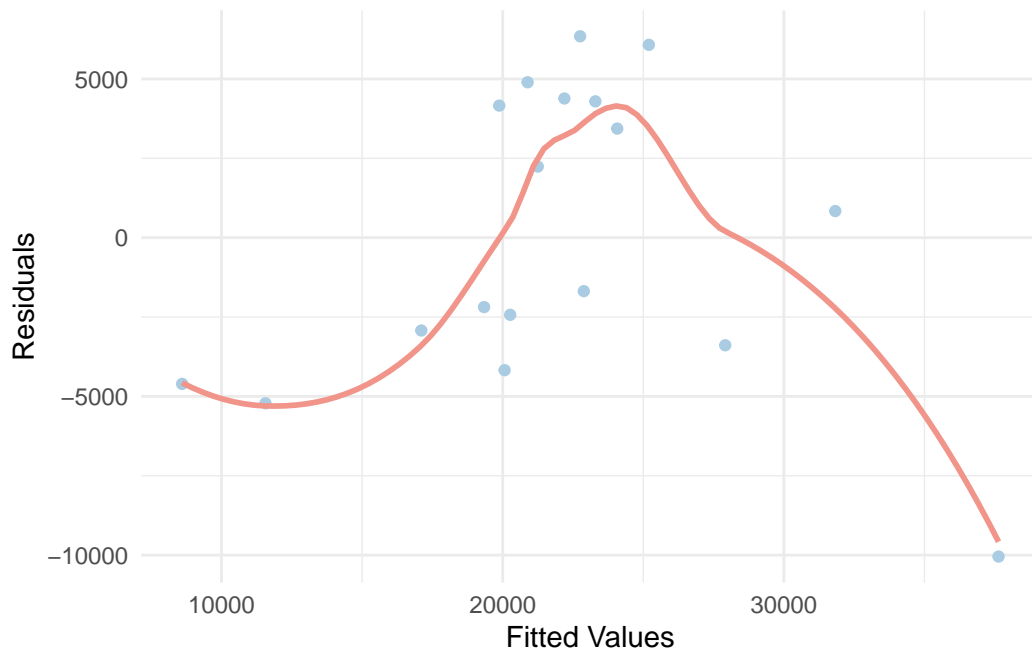

Figure 11: The Residual Vs Fitted value plot

8.Appendix

Table 1: Linear Model Summary 3

Statistic	Value
Minimum	-10046.5
1st Quartile (1Q)	-3273.8
Median	-423.9
3rd Quartile (3Q)	4260.7
Maximum	6344.1
Coefficients	
(Intercept)	6748.2438
Std. Error (Intercept)	2970.8029
t value (Intercept)	2.272
Pr(>|t|) (Intercept)	0.0373 *
num_mha_reports	2.4509
Std. Error (num_mha_reports)	0.4397
t value (num_mha_reports)	5.574
Pr(>|t|) (num_mha_reports)	4.19e-05 ***
Significance Codes	0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual Standard Error	4835 on 16 degrees of freedom
Multiple R-squared	0.6601
Adjusted R-squared	0.6388
F-statistic	31.07 on 1 and 16 DF
p-value of F-statistic	4.194e-05

Table 2: Cleaned Data

Division	Number of Crimes	Number of MHA Reports
D11	15894	5435
D12	17151	5137
D13	14180	4226
D14	27590	12603
D22	26578	6302
D23	25782	5769
D31	29099	6531
D32	31273	7528
D33	17836	5516
D41	27591	6752
D42	24037	5357
D43	27509	7069
D51	32666	10233
D52	23487	5916
D53	21199	6584
D54	6347	1965
D55	24524	8636
NSA	3992	755

9.Reference

City of Toronto. 2022. *Open Data Toronto Portal.* City of Toronto. https://opendata.toronto.ca/.

———. 2024a. *Major Crime Indicators - Open Toronto.* City of Toronto. https://open.toronto.ca/dataset/major-crime-indicators/.

———. 2024b. *Mental Health Apprehensions - Open Toronto.* City of Toronto. https://open.toronto.ca/dataset/mental-health-apprehensions/.

Graham, J. 2023. *Gt: A Grammar of Tables.* https://cran.r-project.org/web/packages/gt/index.html.

Grolemund, G. and Wickham, H. 2011. *Lubridate: Functions to Work with Dates and Times.* https://lubridate.tidyverse.org/.

Public Safety Canada. 2017. *2017 Annual Report on the State of Homelessness in Canada.* Government of Canada. https://www.publicsafety.gc.ca/cnt/rsrcs/pblctns/2017-h01-cp/index-en.aspx.

R Core Team. 2023. *R: A Language and Environment for Statistical Computing.* Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

Robinson, D. and Wickham, H. 2023. *Broom: Convert Statistical Analysis Objects into Tidy Data Frames.* https://cran.r-project.org/web/packages/broom/index.html.

Wickham, H. 2016. *Ggplot2: Create Elegant Data Visualisations Using the Grammar of Graphics.* https://ggplot2.tidyverse.org/.

Wickham, H. et al. 2019. *The Tidyverse.* https://www.tidyverse.org/.

———. 2023. *Dplyr: A Grammar of Data Manipulation.* https://dplyr.tidyverse.org/.