

# Examining the Correlation between Neighbourhood Property Crime Rates and Social Factors in Toronto, ON

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This paper reports our analysis of property crime rates in Toronto, ON and their correlation with population density, income, race, and age by neighbourhood. Data were retrieved from The City of Toronto Open Data Portal.

*Keywords:* crime, social factors, spatial analysis

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## Introduction

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## Background

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## Study area

The relationship between property crime rates and social factors were studied across the census neighbourhoods of Toronto, ON, Canada (see Figure 1). There are 140 neighbourhoods in total at the time of this study. *write more about why this area was selected after background is done.*

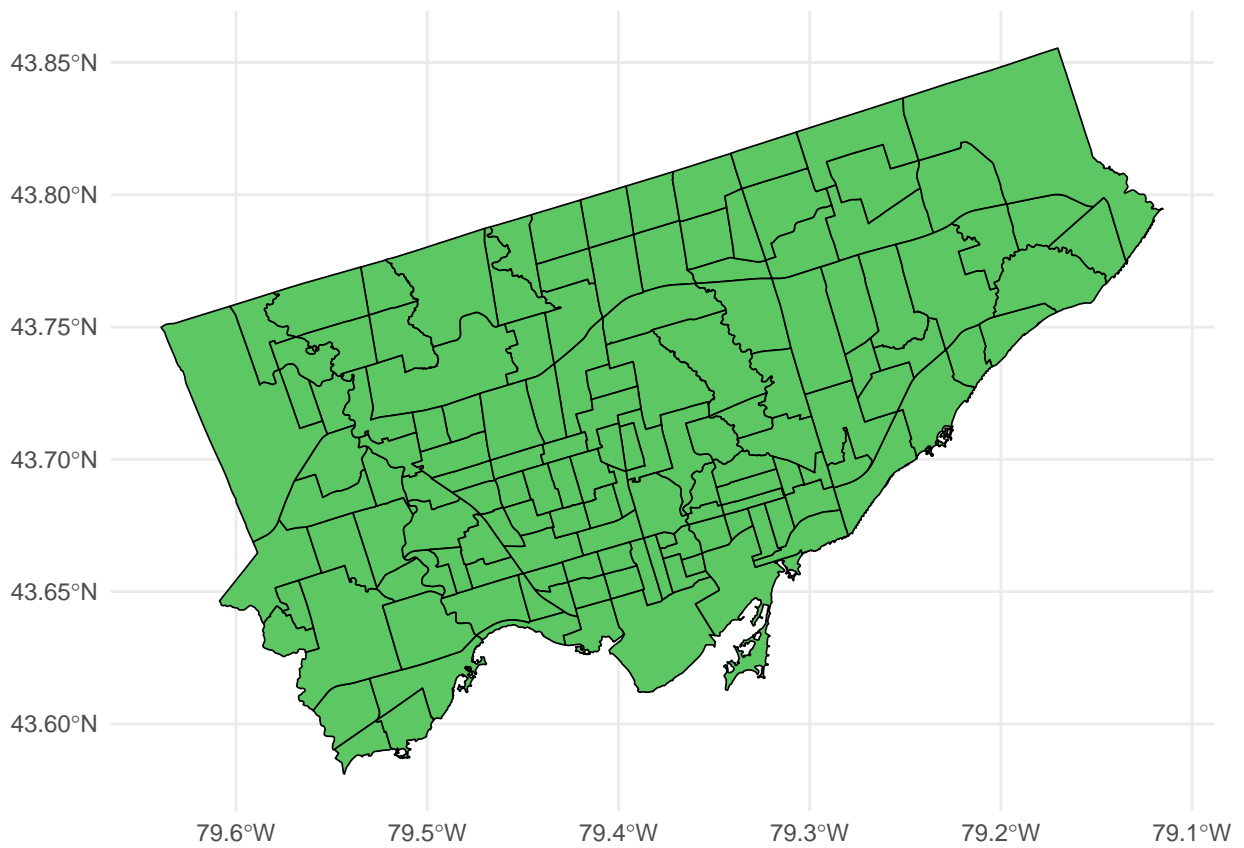


Figure 1: Census Neighbourhoods of Toronto, ON, Canada

## Data

The data used in this study comes from the City of Toronto Open Data Portal, accessed using the **open-dataportal** package in R. (Gelfand 2020). Two separate datasets were used: *Neighbourhood Crime Rates* and *Neighbourhood Profiles*. The *Neighbourhood Crime Rates* dataset reports both the raw count and rates per 100,000 of seven different types of crime within the 140 neighbourhoods of Toronto. (Toronto Police Service 2019). Of the seven types of crime, the four reported types of property crime — auto theft, breaking and entering, robbery, and theft over \$5000 — were the focus of this study. The *Neighbourhood Profiles* dataset reports the demographic, social, and economic findings of the 2016 census for each of Toronto’s 140 neighbourhoods. (Statistics Canada 2021). Select data regarding population density, income, race, and age were utilised as the social factors of interest for this study.

## Methods

This study was conducted using the open software language **R** to carry out statistical analyses of crime rates and social factors in the city of Toronto, ON, and visualise these results through the production of maps and figures. Property crime rates by neighbourhood in 2016 were used as the independent variable. This was compared against 4 other variables from 2016 census data at the neighbourhood level: population density, percentage of the population designated as ‘low income,’ percentage of the population belonging to a visible minority group, and percentage of the population aged 15-29. The areal data of this study was analysed using choropleth mapping to visualize geographic trends, boolean maps relative to a selected values, scatterplots, and regression analyses in order to evaluate the relationship between crime and selected social factors.

## Results

First the data of interest was visualised through choropleth maps to gain a general view of any potential trends and create a starting point for further analysis. Figure 2 illustrates the rates of auto theft, breaking and entering, robbery, and theft over \$5000 in Toronto’s neighbourhoods in 2016, and figure 3 shows the aggregated rate of these 4 types of property crimes.

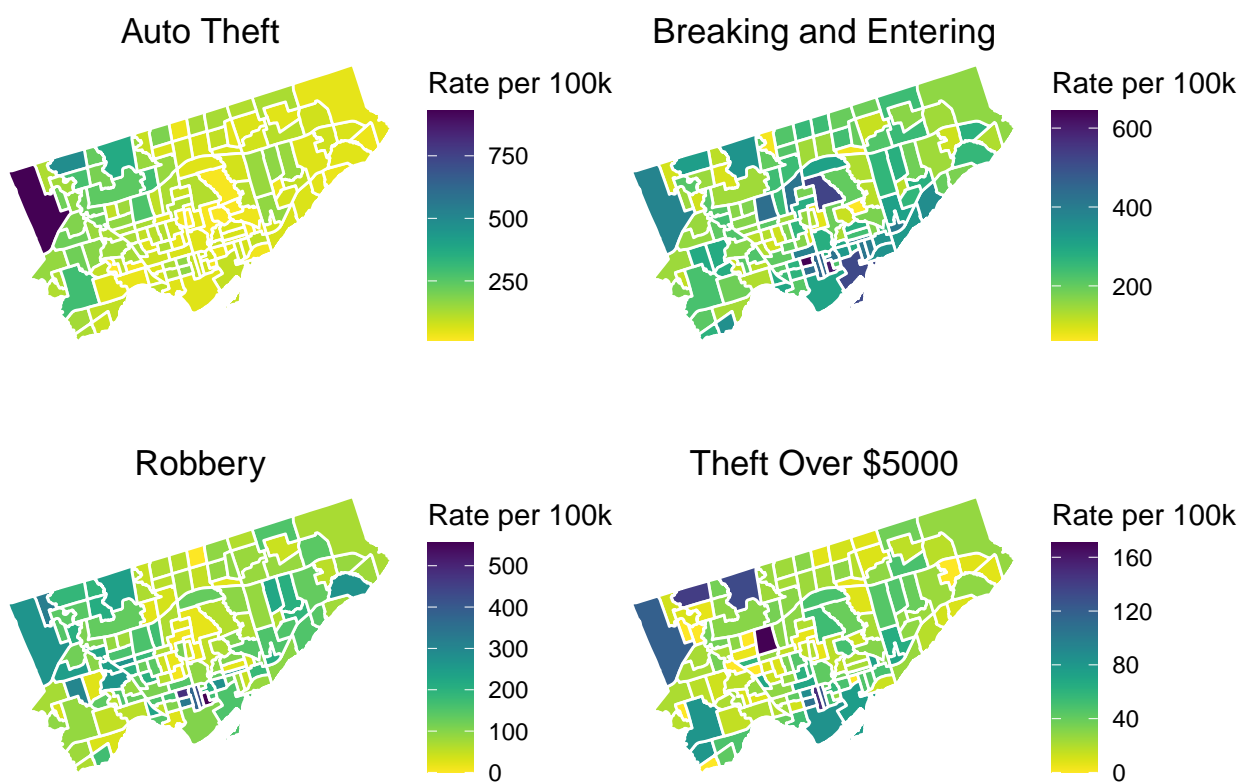


Figure 2: Four categories of property crime rates by neighbourhood (2016)

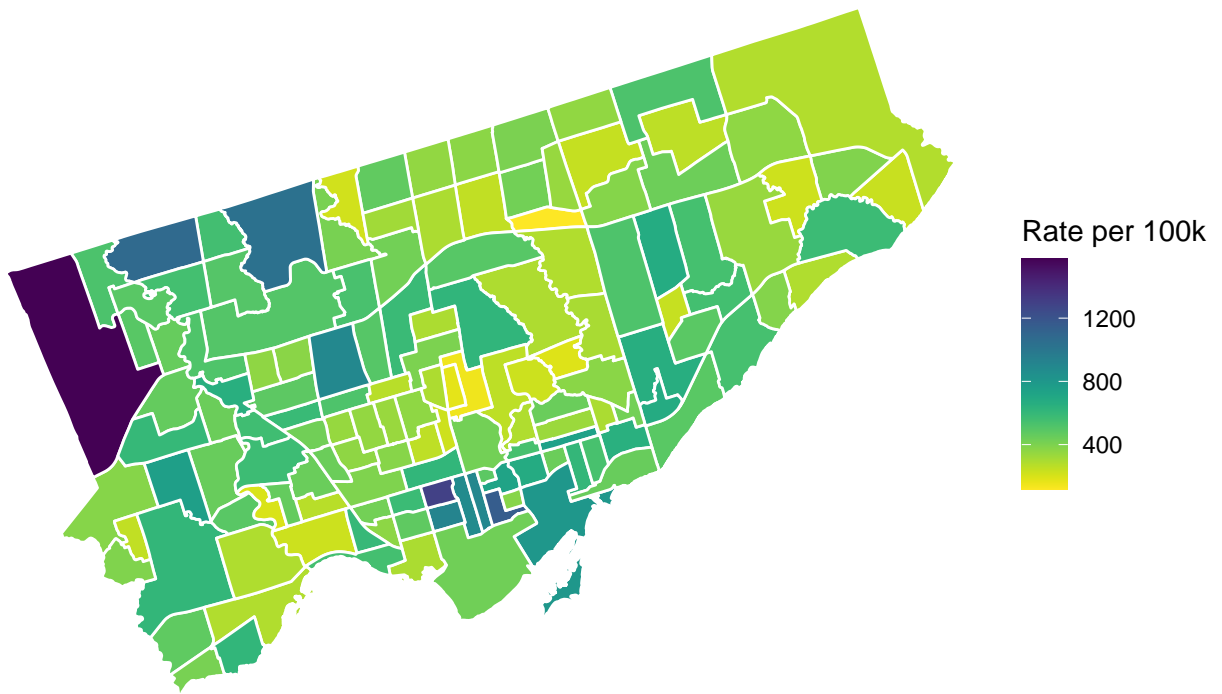


Figure 3: Aggregated property crime rates by neighbourhood (2016)

Figure 4 through figure 7 are choropleth maps denoting the social factors of interest for this study in 2016. Figure 4 denotes population density by neighbourhood. Figure 5 shows the percentage of individuals in each neighbourhood who are categorized as low income after taxation. Figure 6 illustrates the percentage of individuals in each neighbourhood who belong to a visible minority group. Finally, Figure 7 illustrates the percentage of individuals in each neighbourhood who are aged 15-29.

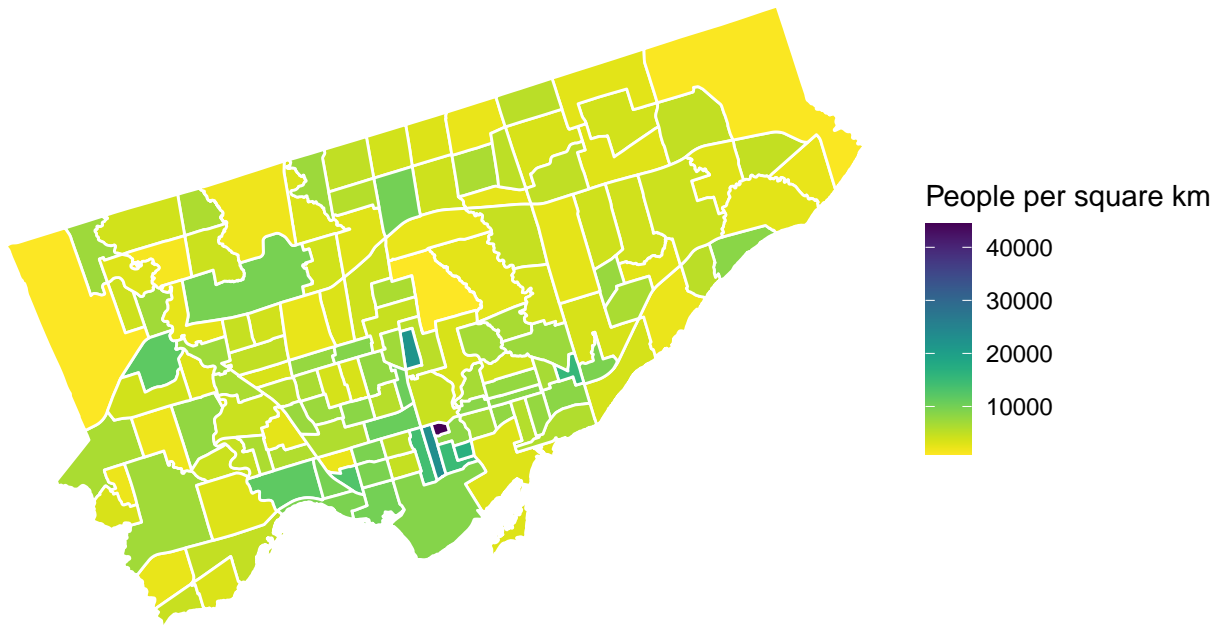


Figure 4: Population density by neighbourhood (2016)

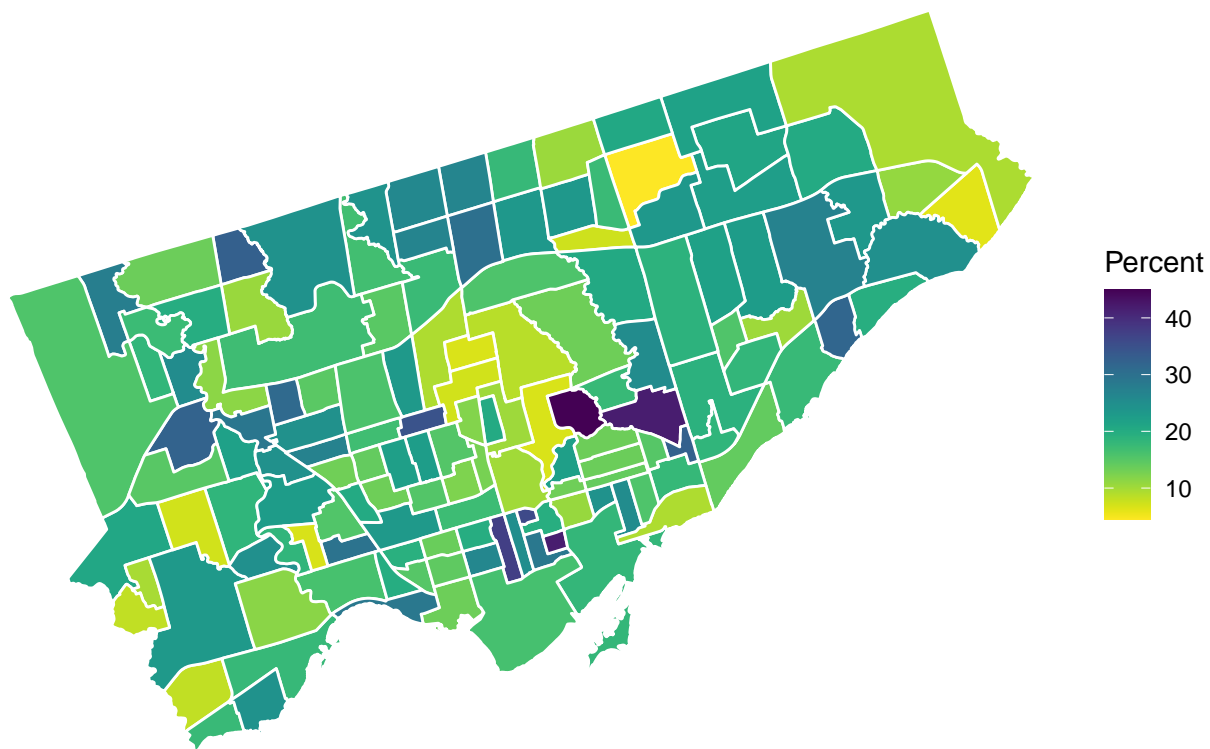


Figure 5: Percentage of inhabitants who have been identified as 'Low Income After Taxation' by neighbourhood (2016)

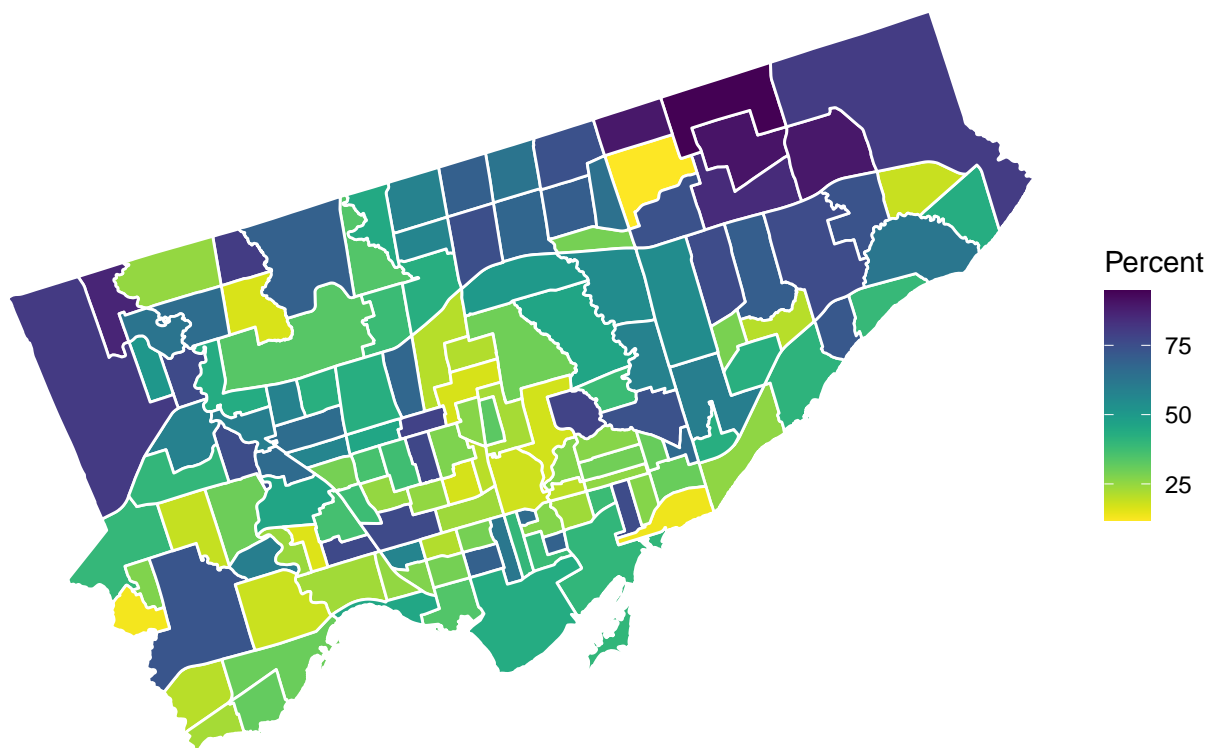


Figure 6: Percentage of inhabitants who belong to visible minority groups by neighbourhood (2016)



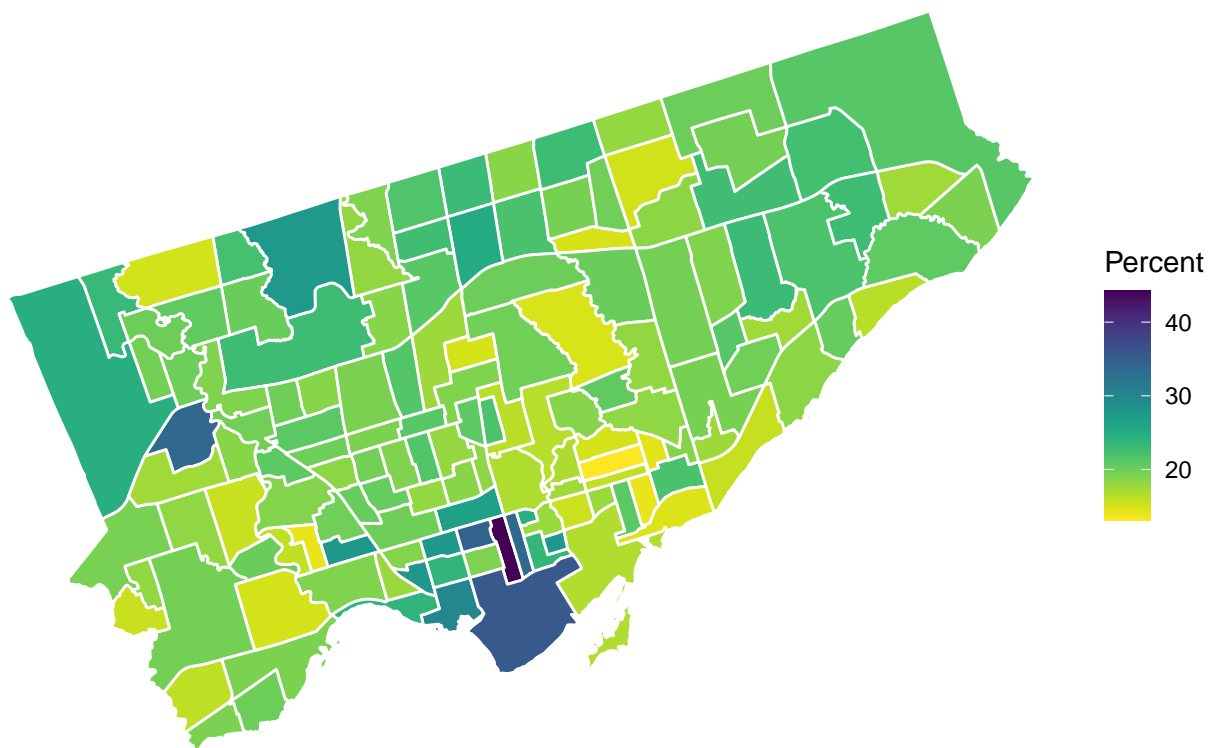


Figure 7: Percentage of inhabitants aged 15-29 by neighbourhood (2016)

Figure 8 is a boolean map indicating which neighbourhoods have property crime rates that are above and below the citywide mean in 2016. This is useful in illustrating potential trends in the data with high-crime or low-crime neighbourhoods being clustered in some form.

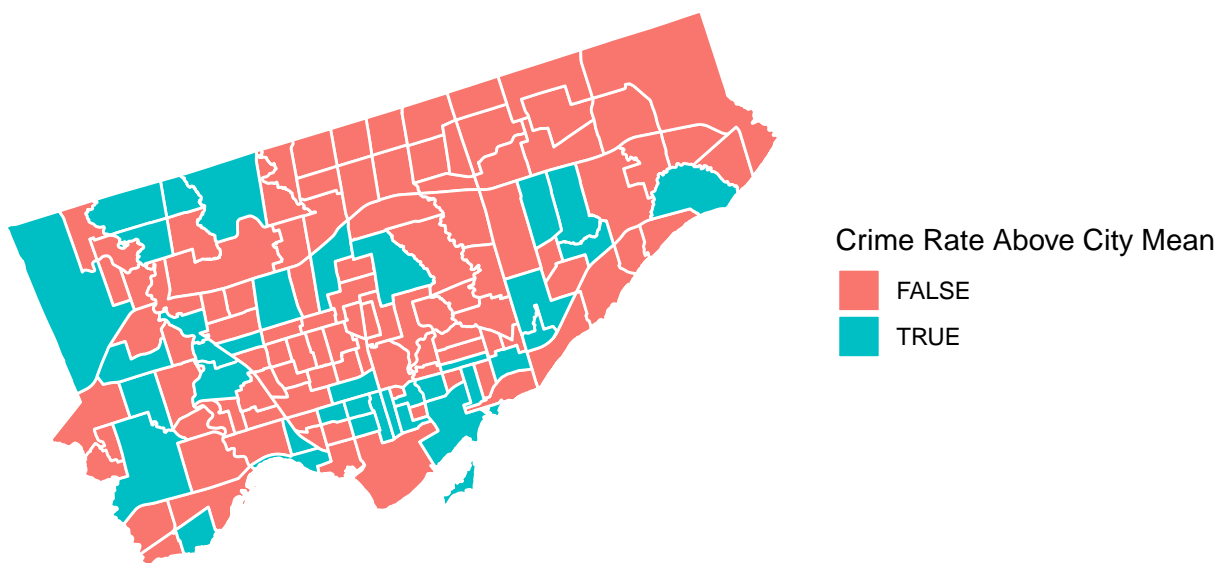


Figure 8: Neighbourhood crime rates relative to mean crime rate of the whole of Toronto (2016)

Figure 9 is a Moran scatterplot for neighbourhood property crime rate in 2016. The value of Moran's I for this dataset is 0.246 with a p-value of 6.197e-08. With these statistics, we can reject the null hypothesis of spatial independence, as Moran's I is large enough to indicate some spatial autocorrelation, and the p-value is small enough to indicate a high degree of confidence.

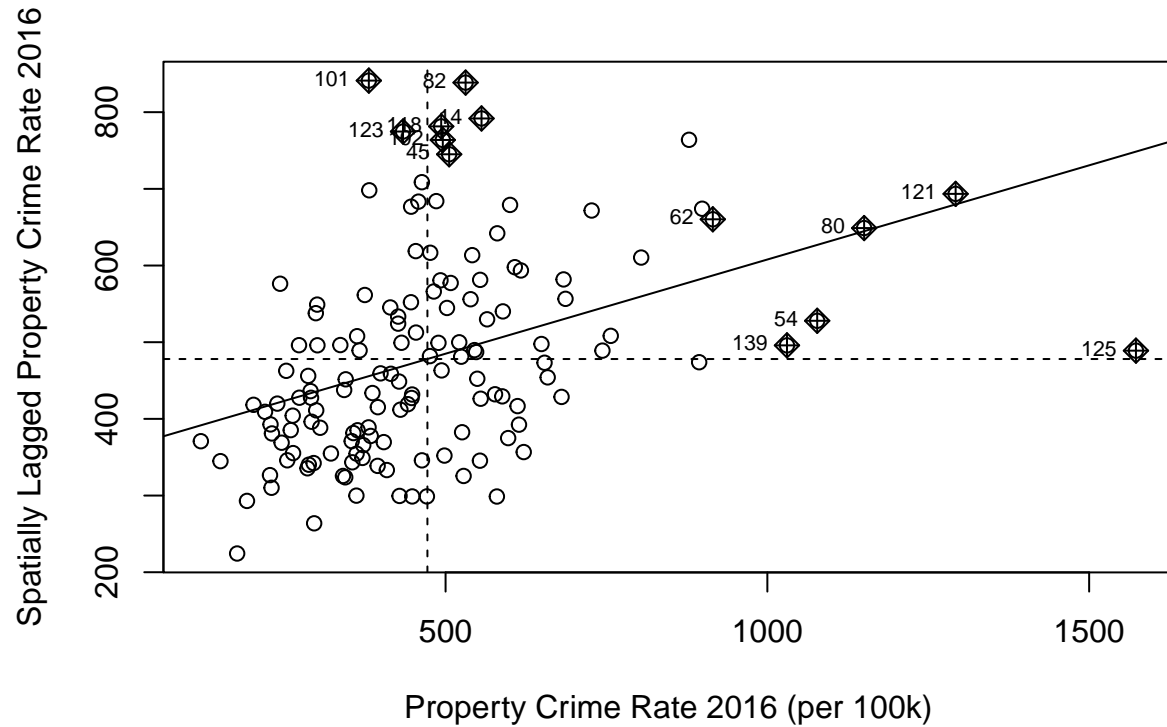


Figure 9: Moran's plot for spatial autocorrelation regarding neighbourhood property crime rates (2016)

Table 1: Property crime rate regressed on population density

	<i>Dependent variable:</i>
	propertyCrime2016
population_density	0.0004 (0.004)
Constant	469.292*** (30.192)
Observations	140
R <sup>2</sup>	0.0001
Adjusted R <sup>2</sup>	−0.007
Residual Std. Error	218.002 (df = 138)
F Statistic	0.011 (df = 1; 138)
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01

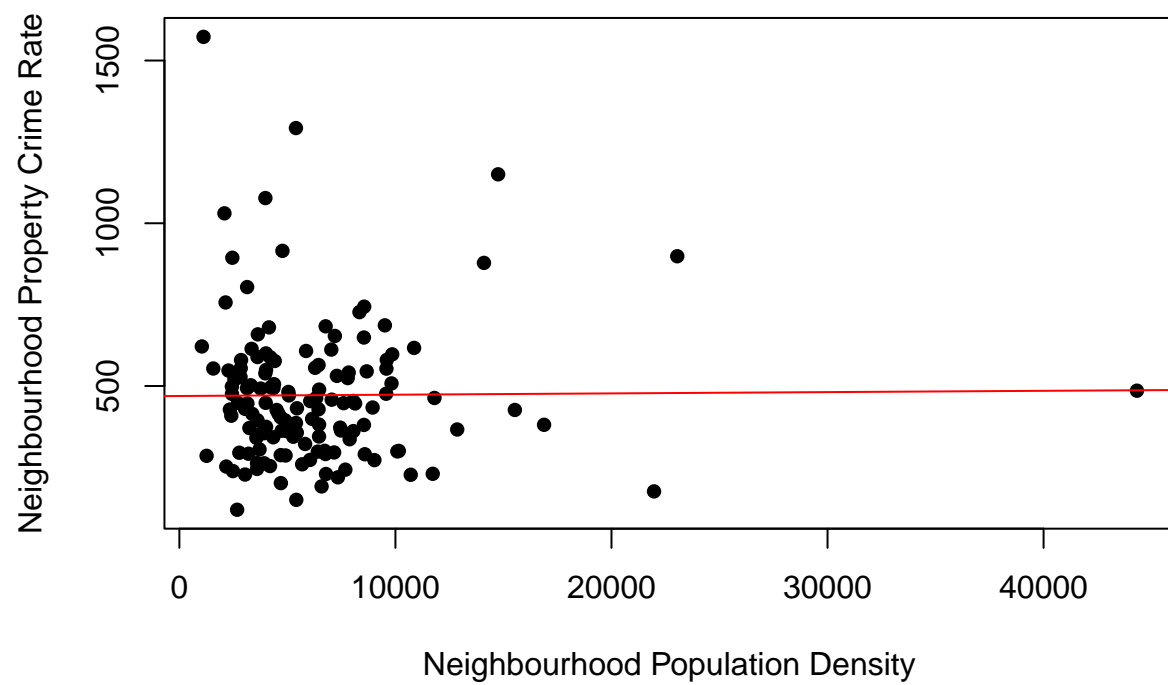


Figure 10: Regression model comparing population density and property crime rates by neighbourhood (2016)

Table 2: Property crime rate regressed on percentage of individuals designated as 'low income'

	<i>Dependent variable:</i>
	propertyCrime2016
low_income_percent	2.307 (2.379)
Constant	427.491*** (49.239)
Observations	140
R <sup>2</sup>	0.007
Adjusted R <sup>2</sup>	-0.0004
Residual Std. Error	217.272 (df = 138)
F Statistic	0.940 (df = 1; 138)
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01

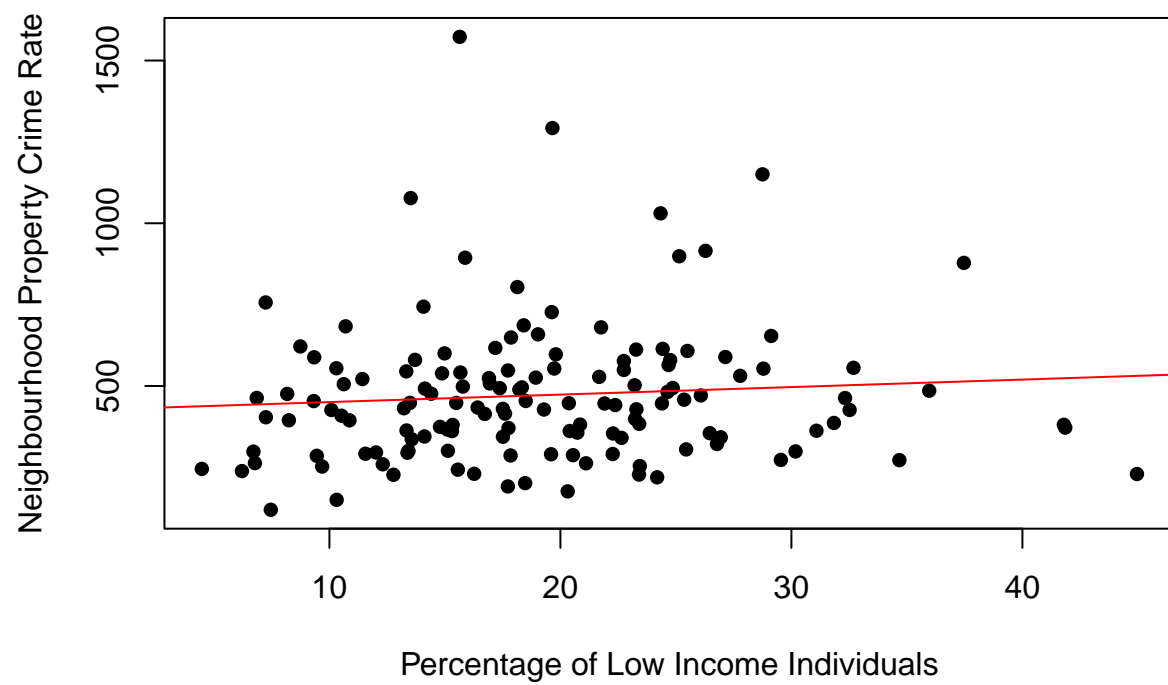


Figure 11: Regression model comparing percentage of low income individuals and property crime rates by neighbourhood (2016)

Table 3: Property crime rate regressed on percentage of individuals who are a visible minority

	<i>Dependent variable:</i>
	propertyCrime2016
total_visible_minority	0.001 (0.002)
Constant	464.169*** (28.613)
Observations	140
R <sup>2</sup>	0.001
Adjusted R <sup>2</sup>	−0.006
Residual Std. Error	217.915 (df = 138)
F Statistic	0.121 (df = 1; 138)
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01



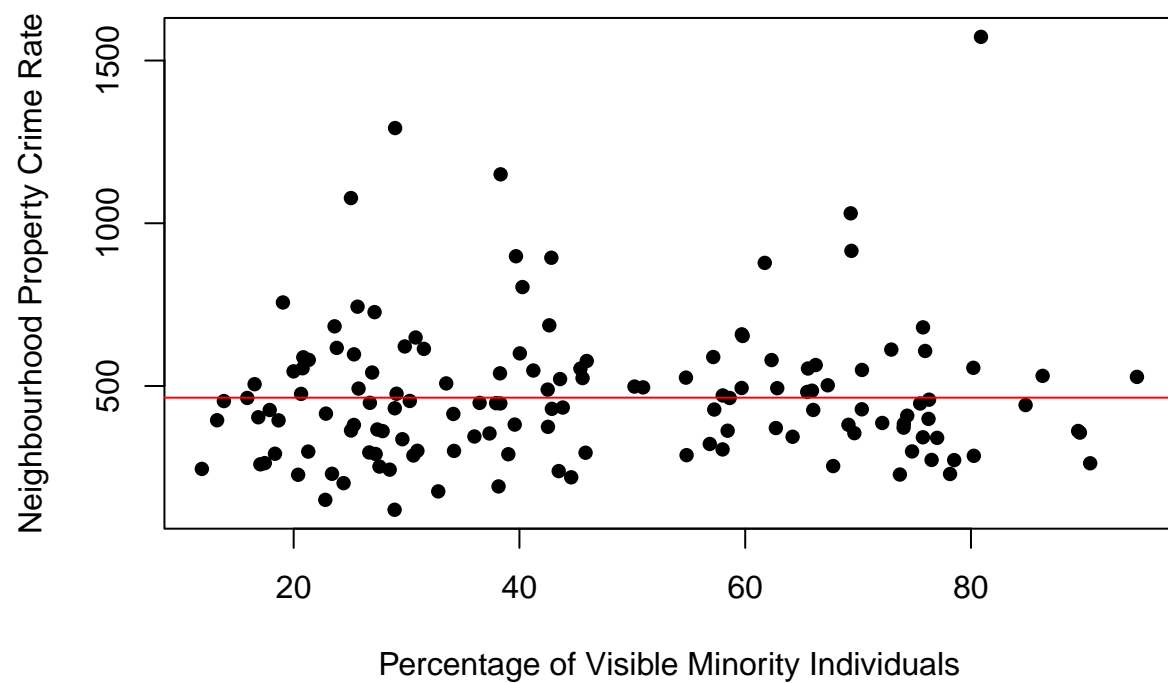


Figure 12: Regression model comparing percentage of visible minority individuals and property crime rates by neighbourhood (2016)

Table 4: Property crime rate regressed on percentage of individuals who are aged 15-29'

	<i>Dependent variable:</i>
	propertyCrime2016
percent_aged_15to29	14.014*** (3.997)
Constant	188.206** (82.790)
Observations	140
R <sup>2</sup>	0.082
Adjusted R <sup>2</sup>	0.075
Residual Std. Error	208.905 (df = 138)
F Statistic	12.292*** (df = 1; 138)
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01

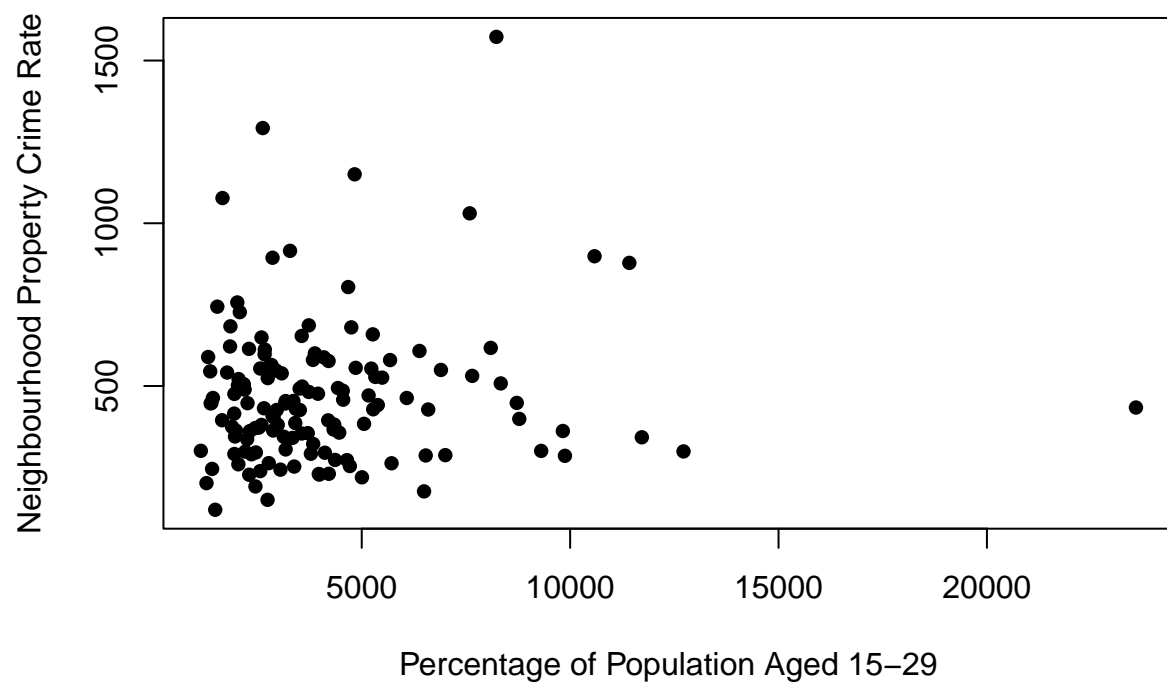


Figure 13: Regression model comparing percentage of young (aged 15-29) individuals and property crime rates by neighbourhood (2016)

Table 1 thorough table 4 summarize the determined regression models of property crime rate against the four social factors of interest, and figure 10 through figure 13 display these regression models in graphical form. These were used to quantify any potential relationship between property crime and select social factors. Table 1 and figure 10 show population density regressed against property crime rate. Table 2 and figure 11 show percentage of low income individuals regressed against property crime rate. Table 3 and figure 12 show percentage of visible minority individuals regressed against property crime rate. Table 4 and figure 13 show percentage of individuals aged 15-29 regressed against property crime rate.

## Analysis

Insert Analysis Here

## Conclusion

Insert Conclusion Here

## References

10 Gelfand, Sharla. 2020. *Opendatatoronto: Access the City of Toronto Open Data Portal*. <https://CRAN.R-project.org/package=opendatatoronto>.

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