Shooting Occurences in Toronto Have Increased Greatly All Throughout[*]

My subtitle if needed

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Abstract

First sentence. Second sentence. Third sentence. Fourth sentence.

1 Introduction

In this paper, we use R (R Core Team (2020)) to analyze a dataset from (Gelfand (2020))

You can and should cross-reference sections and sub-sections. For instance, Section 2. R Markdown automatically makes the sections lower case and adds a dash to spaces to generate labels, for instance, Section 5.1.

2 Data

The dataset being used in this paper was taken from the City of Toronto's open data portal (Gelfand (2020)). It is a subset of a larger collection of data called The Toronto's Police Services Annual Statistical Report. This report contains data based on police related topics including a variety of different types of crimes and other incidents, and administrative information. The dataset that will be analyzed draws from the "Shooting Occurrences" portion of the annual statistical report. It contains all Toronto shooting incidents between 2014 and 2019. A shooting occurrence is described as an altercation where a projectile was shot from a firearm and injured a person (*TPS Crime Statistics - Shootings & Firearm Discharges* 2022). Toronto Police Services do not count suicidal attempts or shots taken by Police in the data.

The data is collected by Policemen through the Toronto Police system. Any time a shooting is reported by an officer, it is put into the system, and is eventually added as a observation in the overall dataset. This data technically is the population of all police reported shooting incidents by their definition, but it could also be considered a sample of all shooting incidents since many go unreported. As the dataset is made up of observations that follow a specific definition, it helps to avoid many of the biases we typically see in datasets as there is less subjectivity. This does not mean there is no bias at all, and this will be touched upon later. All in all, the system Toronto Police uses allows for this dataset to be very reliable and trustworthy. Toronto Police takes their data very seriously, which is evident by their Public Data Safety Portal (*TPS Public Safety Data Portal* 2022), and thus the dataset this report is working with is very strong.

Table 1 shows an extract of 12 data points from the overall dataset which contained 96 observations. Two observations from each year are shown in the extract. The original data had 6 variables, including 3 redundant identifier variables, so it was narrowed down to the three main variables seen in the extract, plus one identifier variable was kept for organizational purposes. These three main important variables that will be worked with in the paper are Year, Geographic Division, and Number of shootings, which are occurred_year, geo_division, and num_shootings respectively in the dataset.

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[*]Code and data are available at: https://github.com/TDonofrio62/Paper-1.

Table 1: 12 Observations from dataset of shooting occurences in Toronto

Year	Geographic Division	Number of Shootings
2014	D11	2
2014	D12	20
2015	D12	36
2015	D13	4
2016	D14	23
2016	D22	15
2017	D23	44
2017	D31	68
2018	D32	23
2018	D33	12
2019	D41	23
2019	D42	35

Table 2: Number of Shootings in Toronto each year from 2014-2019

Year	Number of Shootings
2014	177
2015	288
2016	407
2017	392
2018	427
2019	492

Occurred year is fairly self explanatory, and is the year in which all the shootings in an observation took place. It is a numerical variable, but was also converted to a categorical at points for use in visulaizations seen later. Geo division is a categorical variable representing the geographically determined area boundaries for each police division. Num of shootings is a numerical variable that counts the number of shootings corresponding to each observation.

As shown in Table 1, each observation tells us the number of shootings that occur in a specific police division, based on the geographical boundaries described above, in a certain year. For example, the last observation seen in Table 1 tells us that in 2019, 35 shootings occurred within police division 42. These data points can be analyzed together in order to tell us a story about shooting incidents in Toronto.

By grouping the data by year, Table 2 shows how many shootings have occurred each year in Toronto. It can be seen that shootings have increased dramatically from 2014 to 2019, more than doubling, going from 177 to 492 shootings. For the most part, shootings have also increased each year apart from 2017. This increase in shootings is something worth analyzing, and can be better seen and understood through the use of a visual.

Figure **??** shows this relationship between the number of shootings in Toronto and the year in which they occurred, while also showing which police divisions each observation occurred in.
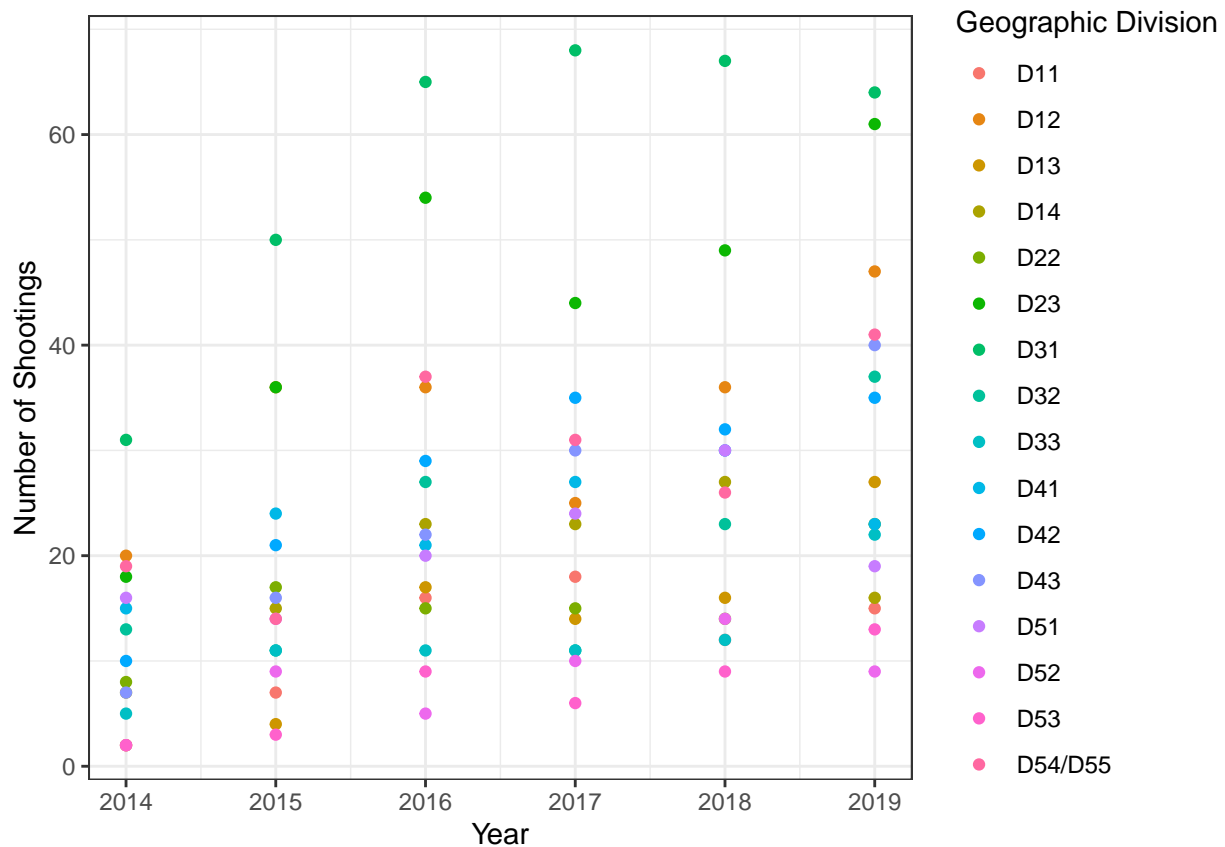
Plotting every single observation in the dataset gives us a better idea about the changes for Toronto's shooting occurrences, and also allows us to link them to each division. The plot points for each year seem to shift up as a collective year after year, suggesting that shootings are increasing all around Toronto. No police division's plot point is lower in 2019 than it was in 2014, which confirms this thought. Police Divisions that have the most shootings see much bigger yearly increases compared to the regions with less shootings when judging based on magnitude of the increases. Relative to how many shootings occur in each division, all divisions seem to increase by similar amounts.

A bar plot will make it easier to see the increasing relationship between the year and the number of shootings. Figure **??** shows this relationship.
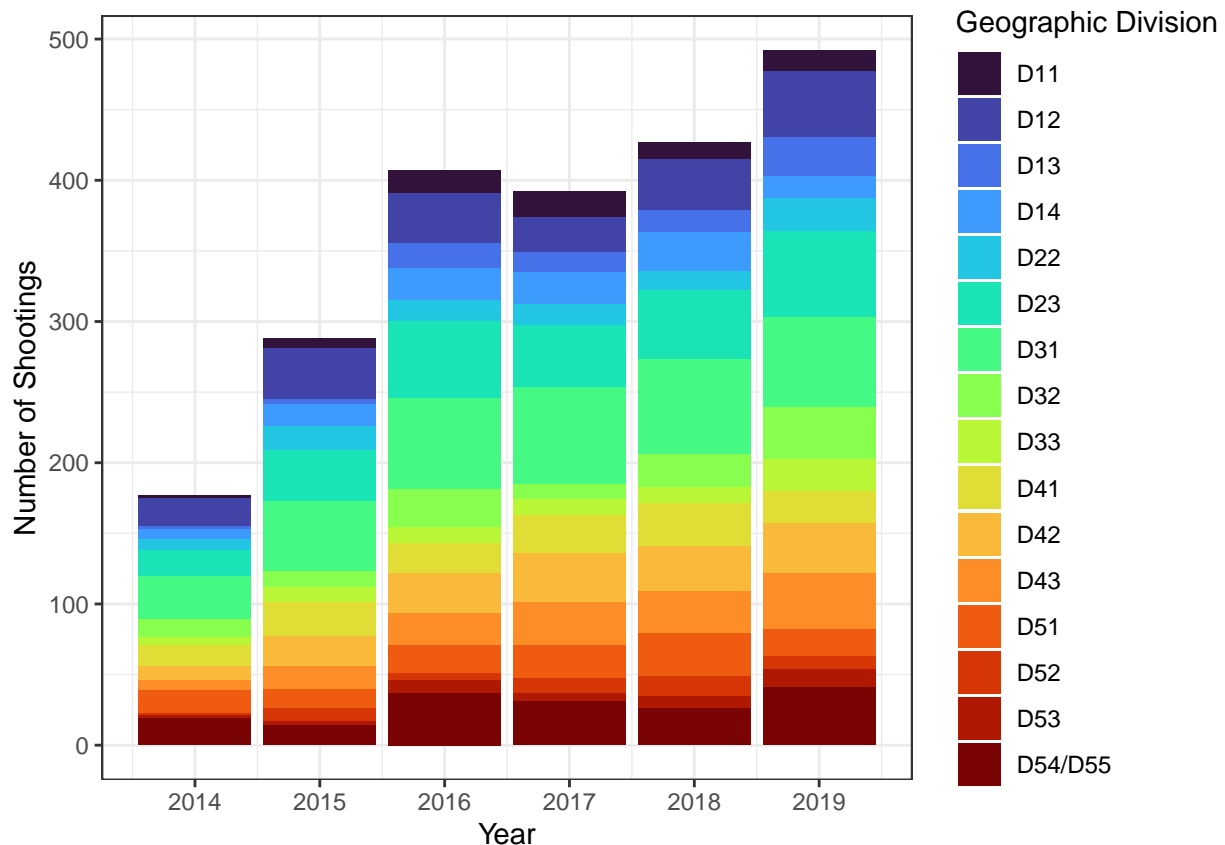
The increase in shootings per year is even more evident now. The bar for 2019 towers over the much smaller bar representing 2014 shootings, once again showing just how much worse shooting incidents have gotten over these 5 years. On a year to year basis, we see the biggest growth in shootings from 2014 to 2016, suggesting something important changes around this time period. There is then a small dip in 2017, before a steady increase in shootings starts to occur again from this point on wards. A notable increase can be seen from 2018 to 2019, as 2019 saw the biggest increase in shootings since 2016. If this is a sign of another period of large growth like there was from 2014 to 2016, Toronto should be very worried. Regardless, there is certainly no signs of the trend slowing down anytime soon, and the number of shootings should continue to increase in future years, especially once the world recovers from the COVID-19 pandemic.

Figure **??** also makes the changes in number of shootings in each police division more evident. Every single coloured section representing the divisions are larger in 2019 than 2014, and the number of shootings for most divisons increased every single year. The larger police divisions specifically saw massive growths in the size of their colour in the bars of the Figure Figure **??**, which was also, albeit slightly less, clear in Figure **??**. This can be seen in D12's, D23's, and D31's coloured parts of the bars, as their filled in areas in the bars are very large in 2019 compared to what they were in 2014. A final figure, Figure **??**, can be used to show how the number of shootings has changed in each division even further.
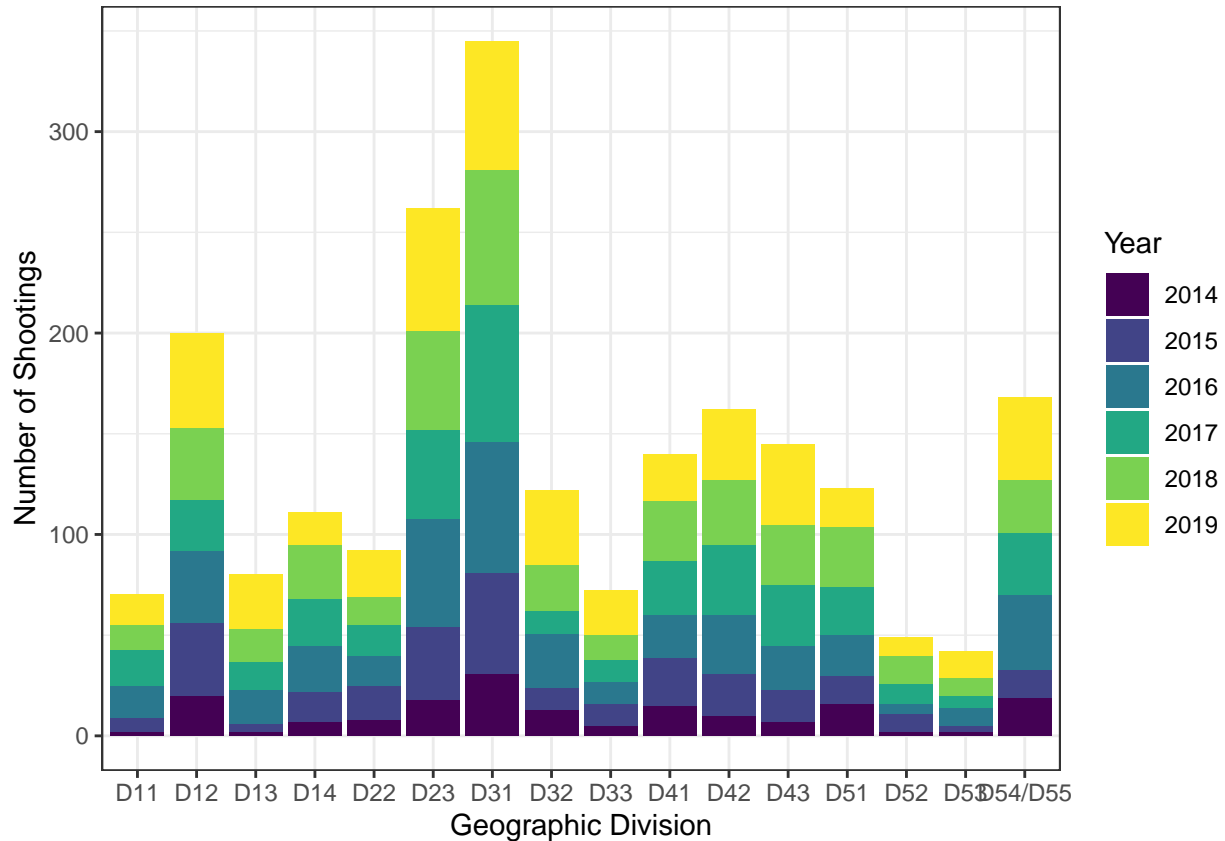
It can further be seen in Figure **??** that every police division had more shootings occur within it in 2019, the yellow part of every bar, compared to in 2014 which is shown by the dark purple parts of the bars. It is also clear how almost every police division has seen a steady increase in shootings since the size each colour representing a year are almost always increasing in size.

The divisions with much more shooting activity than the rest are very evident in Figure **??** as their overall bar size are much taller than the rest of the divisions, which is important to note as Toronto Police may opt to add more police presence to these divisions in the future. The fact that the yellow portions of the bars representing 2019 are so much larger relative to the dark purple bars representing 2014 really shows just how bad the number of shootings in these areas specifically has gotten.

3   Model

$$Pr(\theta|y) = \frac{Pr(y|\theta)Pr(\theta)}{Pr(y)} \tag{1}$$

Equation (1) seems useful, eh?

Here's a dumb example of how to use some references: In paper we run our analysis in R (R Core Team 2020). We also use the `tidyverse` which was written by (**thereferencecanbewhatever?**) If we were interested in baseball data then Friendly et al. (2020) could be useful.

We can use maths by including latex between dollar signs, for instance θ.

4 Results

5 Discussion

5.1 First discussion point

If my paper were 10 pages, then should be be at least 2.5 pages. The discussion is a chance to show off what you know and what you learnt from all this.

5.2 Second discussion point

5.3 Third discussion point

5.4 Weaknesses and next steps

Weaknesses and next steps should also be included.

Appendix

A Additional details

References

Friendly, Michael, Chris Dalzell, Martin Monkman, and Dennis Murphy. 2020. *Lahman: Sean 'Lahman' Baseball Database.* https://CRAN.R-project.org/package=Lahman.

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TPS Public Safety Data Portal. 2022. Toronto Police Services. https://data.torontopolice.on.ca/.