Analysis of shooting incidents trend in Toronto from 2004 to 2023*

Hyungsoo Park

January 23, 2024

The research analyzes the trends of shooting incidents by firearm in Toronto from 2004 to 2023.The used dataset that is from Opendatatoronto provides all shooting incidents that was happened in Toronto throughout the period. In addition, this study also shows the urban violence in Toronto. Fourth sentence.

Table of contents

1 Introduction **2**

2 Data **2**
2.1 Data Cleaning 3
2.2 Data 3

3 Model **4**
3.1 Model set-up 4
3.1.1 Model justification 5

4 Results **5**

5 Discussion **5**
5.1 First discussion point 5
5.2 Second discussion point 5
5.3 Third discussion point 5
5.4 Weaknesses and next steps 5

Appendix **6**

*https://github.com/kakaomonk/totonro_shooting_incidents

A Additional data details **6**

B Model details **6**
B.1 Posterior predictive check 6
B.2 Diagnostics 6

References **7**

1 Introduction

Owning firearm by individual has been became a major social issue in Toronto and other urban areas in North America. However, the owning firearm by individual cannot be illegalized since some citizens need the firearm inevitably. The urban violence by firearm in Toronto has been become an object of public concern and being more seriously. Beyond the controversy the study mainly focuses on the trend of firearm shooting incident in Toronto from 2004 to 2023, and there was a significant changes on the trend and the change was enought to make the issue be more controversial.

The firearm violence affect to several social community and it is directly related to the social safety in all communities in Toronto. In addition, Toronto is a large city that is multi-cultural and full of diversities. However, they might cause the hate issues because of the difference between the cultures.

The trends of firearm shooting incident in Toronto throughout the period is depended on many factors from the society, but the purpose of the study is exploring the general trends of firearm shooting incidents in Toronto. Analyzing the incident trends will significantly decrease firearm incidents in Toronto, and derive better laws and rules to the society for the citizens' safety.

Since the shooting incidents by gunfire has been become a social issue

2 Data

The used dataset contains all firearm incidents that caused death and injuries in Toronto from 2004 to 2023, and the dataset is from 'opendatatoronto' 'R' package (Sharla Gelfand, City of Toronto, n.d.). The dataset can be found on 'opendatatoronto' website named with "About Shootings & Firearm Discharges". All used technologies are done by 'R' (R Core Team 2022), 'ggplot2' (Wickham 2016), and 'knitr'(Xie 2023).

2.1 Data Cleaning

The purpose of the study is to analyze the trends of firearm incidents in Toronto from 2004 to 2023. The preserved columns are related to the date of occurrence and the area code. All columns that are not related to the future analysis were removed. For accurate result, every invalid data that contains uncertain data was omitted and it was not used for the study.

2.2 Data

Some of our data is of penguins (**?@fig-bills**), from Horst, Hill, and Gorman (2020).

OCC_YEAR	n
2004	191
2005	262
2006	215
2007	207
2008	238
2009	252
2010	259
2011	227
2012	219
2013	204
2014	177
2015	288
2016	407
2017	392
2018	427
2019	492
2020	462
2021	409
2022	380
2023	343

#“‘{r} #| label: fig-bills #| fig-cap: Bills of penguins #| echo: false

#ggplot(penguins, aes(x = island, fill = species)) + # geom_bar(alpha = 0.8) + # scale_fill_manual(values = c(“darkorange”,“purple”,“cyan4”), # guide = “none”) + # theme_minimal() + # facet_wrap(~species, ncol = 1) + # coord_flip() #“‘

Talk more about it.

And also planes (**?@fig-planes**). (You can change the height and width, but don't worry about doing that until you have finished every other aspect of the paper - Quarto will try to make it look nice and the defaults usually work well once you have enough text.)

#"'{r} #| label: fig-planes #| fig-cap: Relationship between wing length and width #| echo: false #| warning: false #| message: false

#analysis_data <- read_csv(here::here("outputs/data/analysis_data.csv"))

#analysis_data |> # ggplot(aes(x = width, y = length)) + # geom_point(alpha = 0.8) + # theme_minimal() + # labs(x = "Wing width (mm)", # y = "Wing length (mm)") #"'

Talk way more about it.

3 Model

The goal of our modelling strategy is twofold. Firstly,...

Here we briefly describe the Bayesian analysis model used to investigate... Background details and diagnostics are included in Appendix B.

3.1 Model set-up

Define y_i as the number of seconds that the plane remained aloft. Then β_i is the wing width and γ_i is the wing length, both measured in millimeters.

$$y_i|\mu_i, \sigma \sim \text{Normal}(\mu_i, \sigma) \tag{1}$$
$$\mu_i = \alpha + \beta_i + \gamma_i \tag{2}$$
$$\alpha \sim \text{Normal}(0, 2.5) \tag{3}$$
$$\beta \sim \text{Normal}(0, 2.5) \tag{4}$$
$$\gamma \sim \text{Normal}(0, 2.5) \tag{5}$$
$$\sigma \sim \text{Exponential}(1) \tag{6}$$

We run the model in R (R Core Team 2022) using the `rstanarm` package of Goodrich et al. (2022). We use the default priors from `rstanarm`.

3.1.1 Model justification

We expect a positive relationship between the size of the wings and time spent aloft. In particular...

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

4 Results

Our results are summarized in **?@tbl-modelresults**.

#“‘{r} #| echo: false #| eval: true #| warning: false #| message: false

#library(rstanarm) # #first_model <- # readRDS(file = here::here(“outputs/models/first_model.rds”)) #“‘

#“‘{r} #| echo: false #| eval: true #| label: tbl-modelresults #| tbl-cap: “Explanatory models of flight time based on wing width and wing length” #| warning: false

#modelsummary::modelsummary(# list(# “First model” = first_model #), # statistic = “mad”, # fmt = 2 #) #“‘

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 data details

B Model details

B.1 Posterior predictive check

In **?@fig-ppcheckandposteriorvsprior-1** we implement a posterior predictive check. This shows…

In **?@fig-ppcheckandposteriorvsprior-2** we compare the posterior with the prior. This shows…

Examining how the model fits, and is affected by, the data

Figure 1: **?(caption)**

B.2 Diagnostics

?@fig-stanareyouokay-1 is a trace plot. It shows… This suggests…

?@fig-stanareyouokay-2 is a Rhat plot. It shows… This suggests…

Checking the convergence of the MCMC algorithm

Figure 2: **?(caption)**

References

Goodrich, Ben, Jonah Gabry, Imad Ali, and Sam Brilleman. 2022. "Rstanarm: Bayesian Applied Regression Modeling via Stan." https://mc-stan.org/rstanarm/.

Horst, Allison Marie, Alison Presmanes Hill, and Kristen B Gorman. 2020. *Palmerpenguins: Palmer Archipelago (Antarctica) Penguin Data*. https://doi.org/10.5281/zenodo.3960218.

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

Sharla Gelfand, City of Toronto, year = 2022, organization = City of Toronto. n.d. *Opendatatoronto: Access the City of Toronto Open Data Portal*.

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

Xie, Yihui. 2023. *Knitr: A General-Purpose Package for Dynamic Report Generation in r*. https://yihui.org/knitr/.