Trends in Mortality: Analyzing the Distribution of Death Licenses in Great Toronto Area in the Past Decade*

My subtitle if needed

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September 24, 2024

Mortality in urban and non-urban settings is an important indicator of public health response. This paper analyzes death license data for Toronto and Outside City Limits from January 2011 to August 2024 to explore differences in urban and rural area. This study use different in weather cross month and public health event as factors to observe the death license change cross the events. This study suggests that urban area have a more sensitive response than rural areas.

1 Introduction

The process of urbanization is advancing rapidly in recent decade, leading to increasingly pronounced differences between urban and rural areas in terms of population density, economic development, infrastructure, and public health services. The disparity in death number between urban and non-urban environments has bring significant attention from researchers, serving as a vital indicator of socioeconomic conditions and public health response. This paper aims to analyze death license data from January 2011 to August 2024 in Toronto and Outside City Limits to explore the differences in responses the months with different climates on the number of deaths and public health events between urban and rural areas. While much of the existing research has focused on the gap in accessible health resource, income gap and community, few studies have investigated the changes in death number between urban and rural areas in response to various external factor. Climate change through month, extreme weather events, and major public health crises (COVID-19) have emerged as significant factors influencing mortality globally. In this study, we analyze death license data from Toronto and Outside

*Code and data are available at: https://github.com/Jie-jiao05/Paper-1.git

City Limits areas recorded by civic center in each region to observe the response. The findings of this study will provide valuable insights for urban planners and public health experts, allowing them to consider the differences between urban and rural settings when formulating policies aimed at enhancing the overall public health response. The paper is structured in that Section Two covers the data used to analysis the extreme climate in certain month, Cross-sectional comparison of the effect of increasing temperature on the number of deaths with each passing year. Section Three critically examines the data, compare the number of death license between urban and rural areas during COVID-19 period. Conclusions indicate that urban area are more sensible than rural area on mortality in responding to years with months and covid periods.

You can and should cross-reference sections and sub-sections. We use (**talia?**), (**opendatatorotno?**), and Wickham et al. (2019).

The remainder of this paper is structured as follows. **?@sec-mydatasection**

2 Data

2.1 Data Source and Measurement

This report utilize the data collected by City Clerk's Office published in Open Data Toronto is titled "Death Registry Statistic"(opendatatoronto 2024). This specific dataset used for the graphs and analyses in this paper, included information about the number of death linces , issued civic centres (Scarborough, North York, Toronto and Etobicoke), place of death, time period with unique id. All information is entered into the Registry Services Tracking System. The key limitation of this dataset is it only record the death that are be found but not include the death number in hospital or other institution and do not contain all the death number as the data is not fully complete and contain realistic death omission. In this dataset, no personal information is included, since the dataset is only used to count the number of death license in Toronto and Outside City Limit preserving the confidentiality of individual associated information.

The dataset was analyzed using R (R Core Team 2022) and downloaded using the R package opendatatoronto (Gelfand 2022). Additionally, the packages tidyverse (Wickham et al. 2019), lubridate (Wickham 2023a), stringr (Wickham 2023b), sf (Pebesma 2018), and tmap (Tennekes 2018) have been used in data cleaning and visualization.

2.2 Data Characteristics

The raw dataset contained 948 unique observation and 5 variable columns, all data are recorded in constant or str and all are filled with valid information. In the first cleaning step, I separate the time period column into year and month and then create a new data column by combining

Table 1: Sample of Cleaned Data of Death License in Toronto and Outside City Limits Area

id	civic_centre	death_licenses	place_of_death	year	month	date
<dbl>	<chr>	<dbl>	<chr>	<dbl>	<chr>	<date>
27767	ET	69	Outside City Limits	2011	01	2011-01-01
27768	ET	341	Toronto	2011	01	2011-01-01
27769	NY	141	Outside City Limits	2011	01	2011-01-01
27770	NY	540	Toronto	2011	01	2011-01-01
27771	SC	129	Outside City Limits	2011	01	2011-01-01
27772	SC	545	Toronto	2011	01	2011-01-01
27773	TO	297	Toronto	2011	01	2011-01-01
27774	ET	83	Outside City Limits	2011	02	2011-02-01
27775	ET	224	Toronto	2011	02	2011-02-01
27776	NY	81	Outside City Limits	2011	02	2011-02-01

the year, month into proper date format for easier to get data. A glimpse of the final cleaned dataset can be seen in Table 1.

2.3 Data trend

The histogram shows a consistent difference in the number of death license in Toronto and Outside City Limit area from 2011 to August 2024. The general difference between the two areas is generally unchanged, but the number of death licenses in Toronto fell in year 2022 and returned to the average in year 2023. Since this data set provided by OpendataToronto is updated monthly, the data from September to December 2024 cannot be obtained until the completion of this paper, so there will be some bias in this specific period. The following section will try to predict this part of data by building a prediction model.

2.4 Data trend

month	place_of_death	death_licenses
<chr>	<chr>	<dbl>
01	Outside City Limits	5713
01	Toronto	21539
02	Outside City Limits	4391
02	Toronto	15775
03	Outside City Limits	4811
03	Toronto	17997

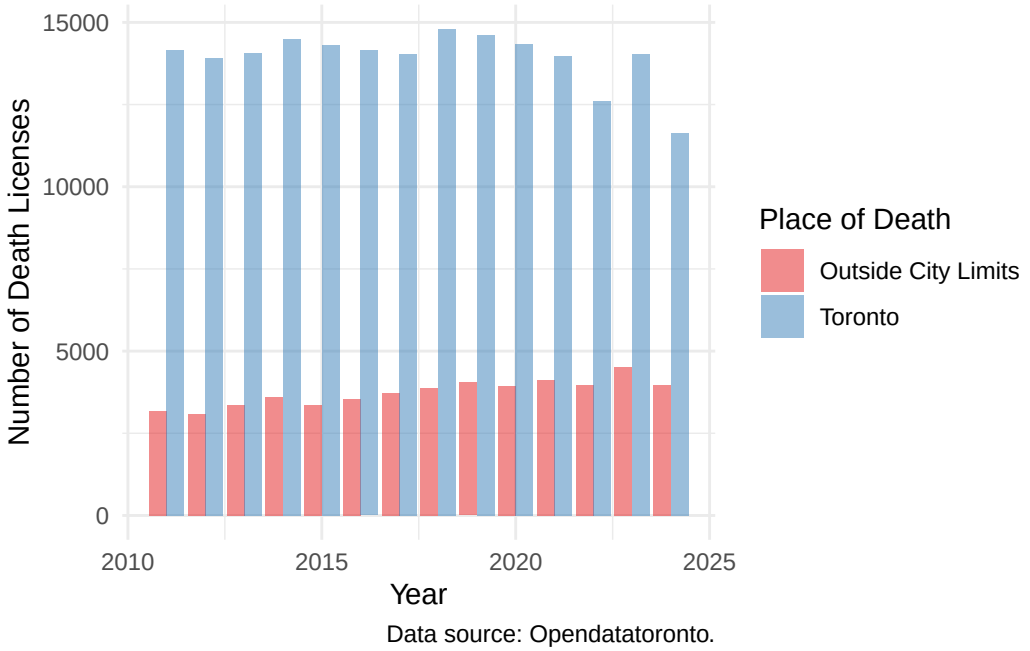

Figure 1: Over View of Total Death License in Toronto and Outside City Limits area

```
 7 04    Outside City Limits          4424
 8 04    Toronto                     16861
 9 05    Outside City Limits          5245
10 05    Toronto                     19483
# i 14 more rows
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
Warning in geom_line(bin = 100): Ignoring unknown parameters: `bin`
```

```
`geom_smooth()` using formula = 'y ~ x'
`geom_smooth()` using formula = 'y ~ x'
```

```
# A tibble: 28 x 3
    year place_of_death      death_licenses
   <dbl> <chr>                       <dbl>
 1  2011 Outside City Limits          3176
 2  2011 Toronto                     14154
 3  2012 Outside City Limits          3092
```

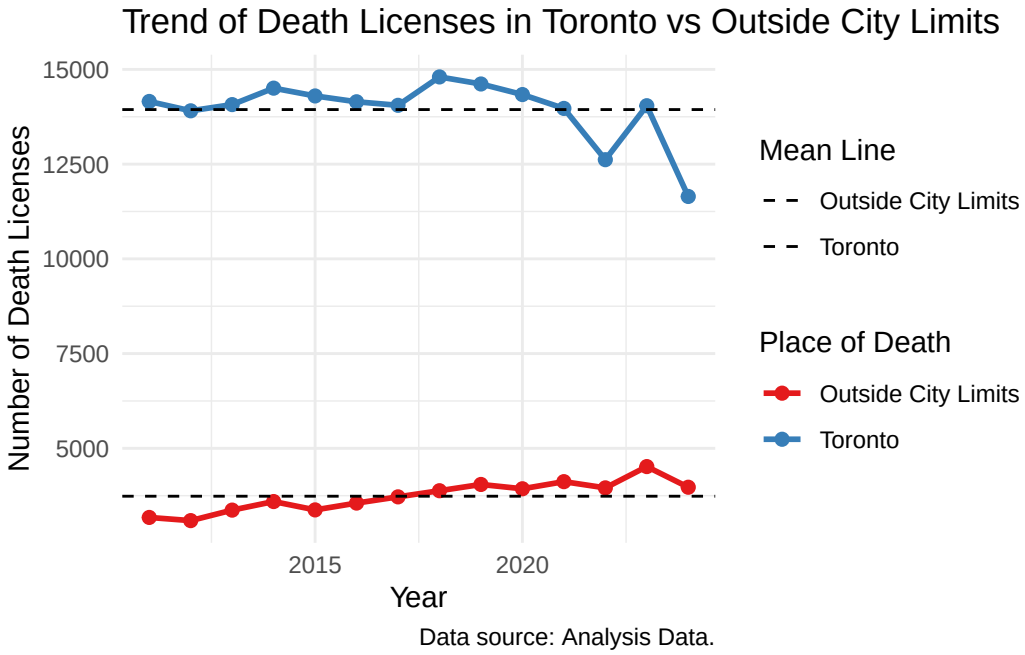

Figure 2: Over View of Total Death License in Toronto and Outside City Limits area

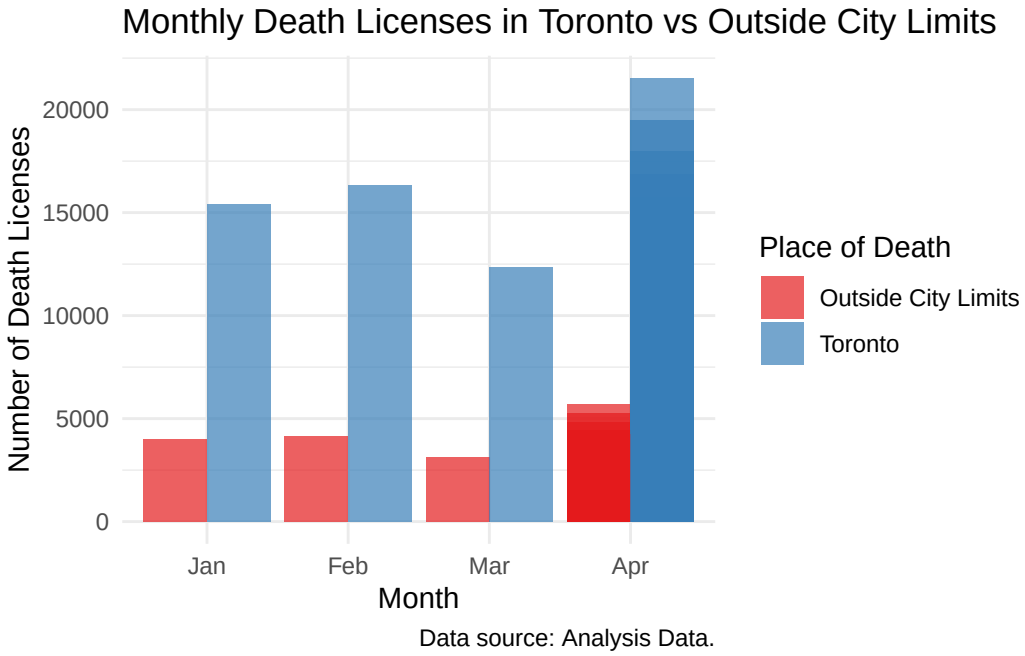

Figure 3: Over View of Total Death License in Toronto and Outside City Limits area

```
 4  2012 Toronto                    13907
 5  2013 Outside City Limits         3369
 6  2013 Toronto                    14071
 7  2014 Outside City Limits         3595
 8  2014 Toronto                    14505
 9  2015 Outside City Limits         3375
10  2015 Toronto                    14299
# i 18 more rows
```

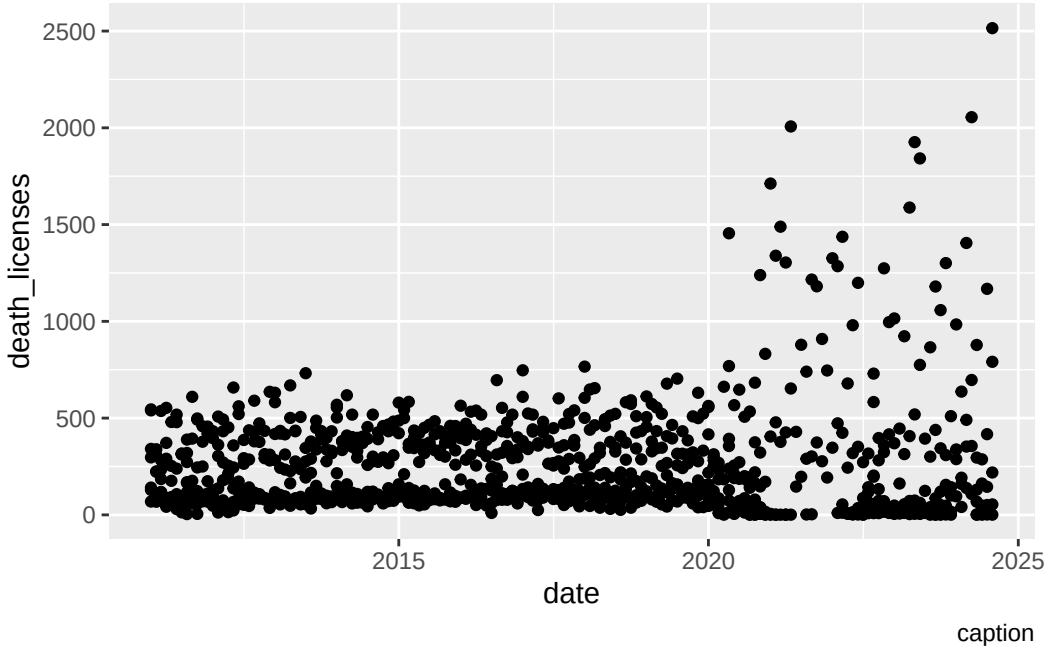

Figure 4: Bills of penguins

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.

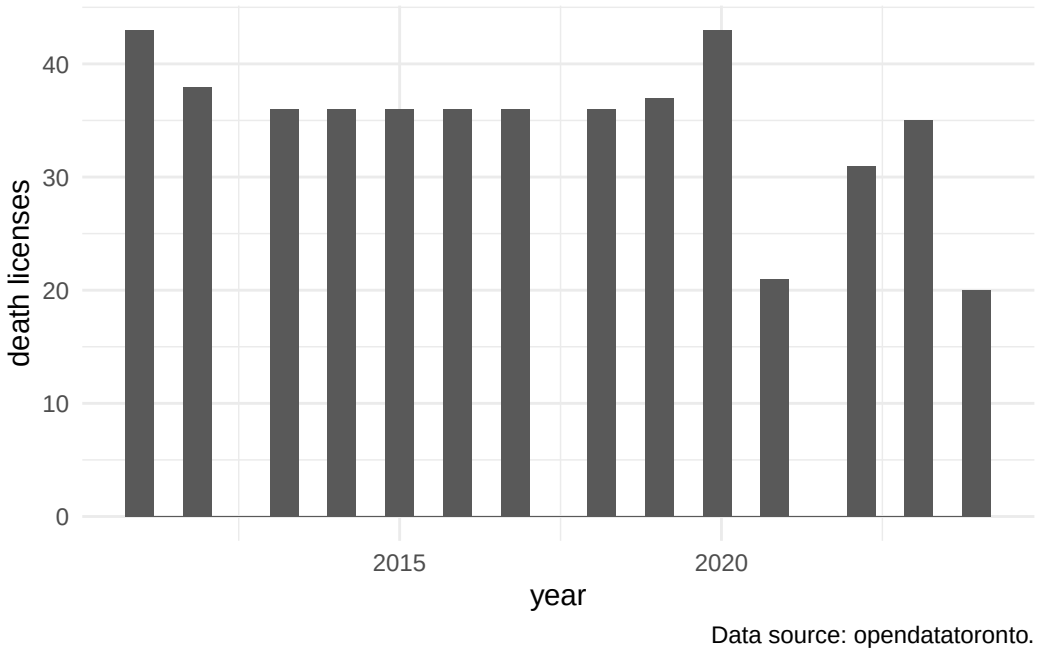

Figure 5: Bills of penguins

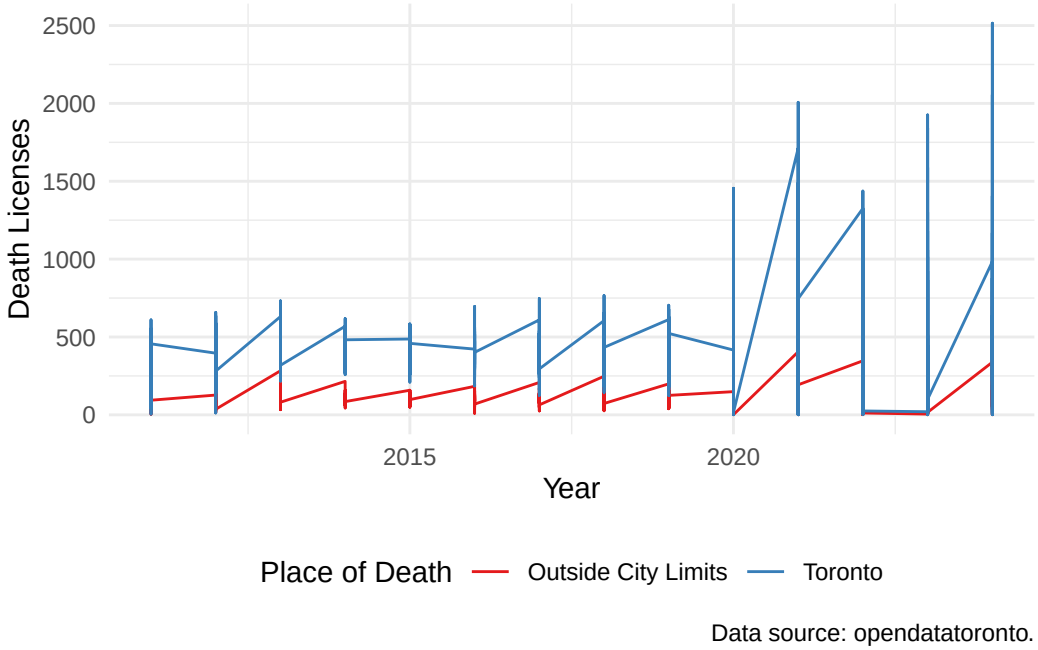

Figure 6: Bills of penguins

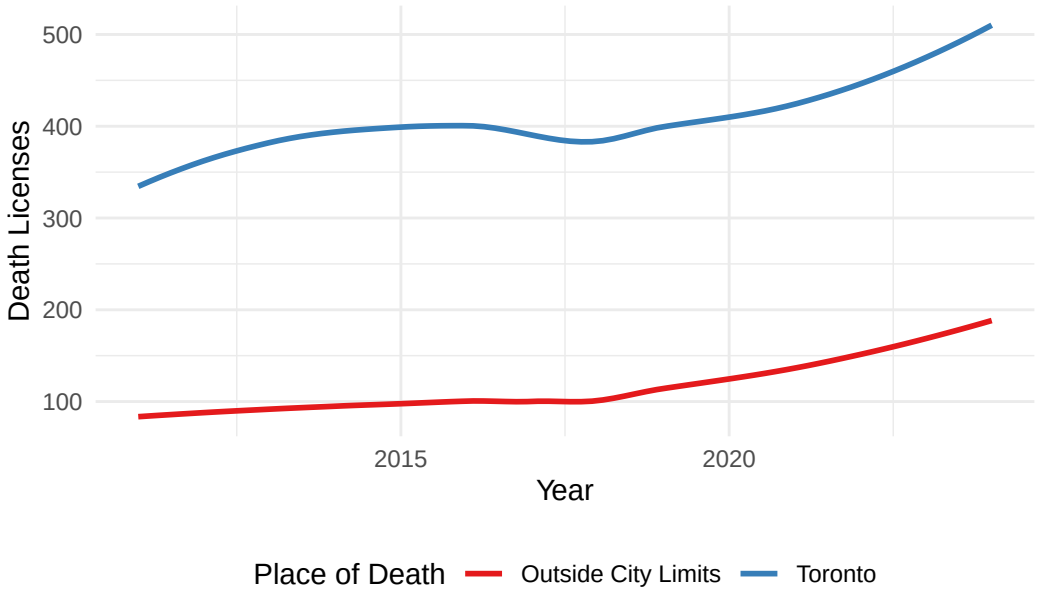

Figure 7: Bills of penguins

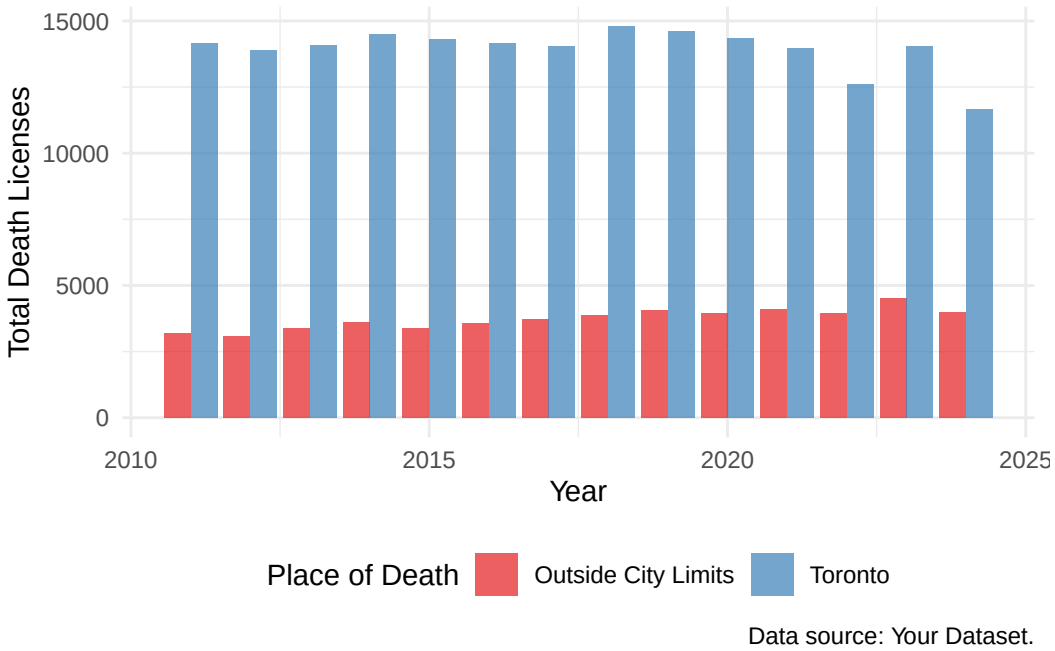

Figure 8: Bills of penguins

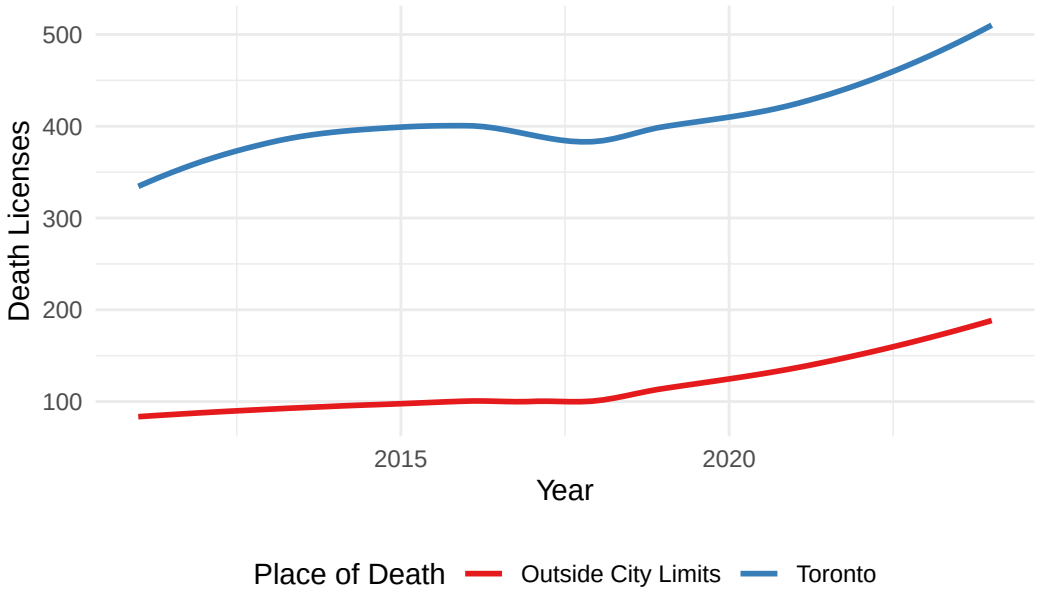

Figure 9: Bills of penguins

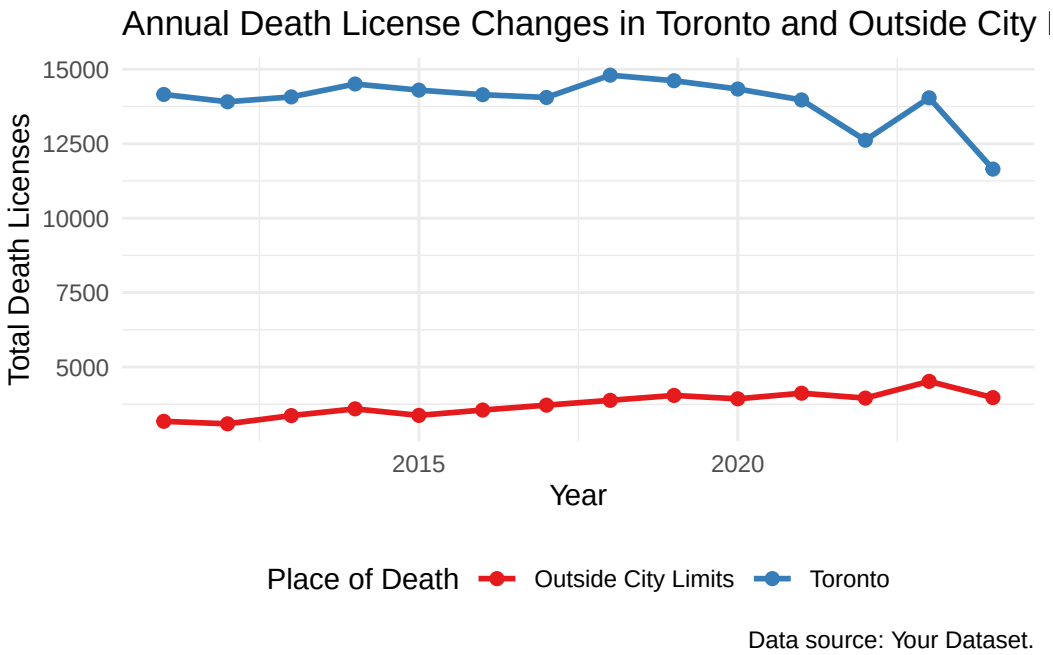

Figure 10: Bills of penguins

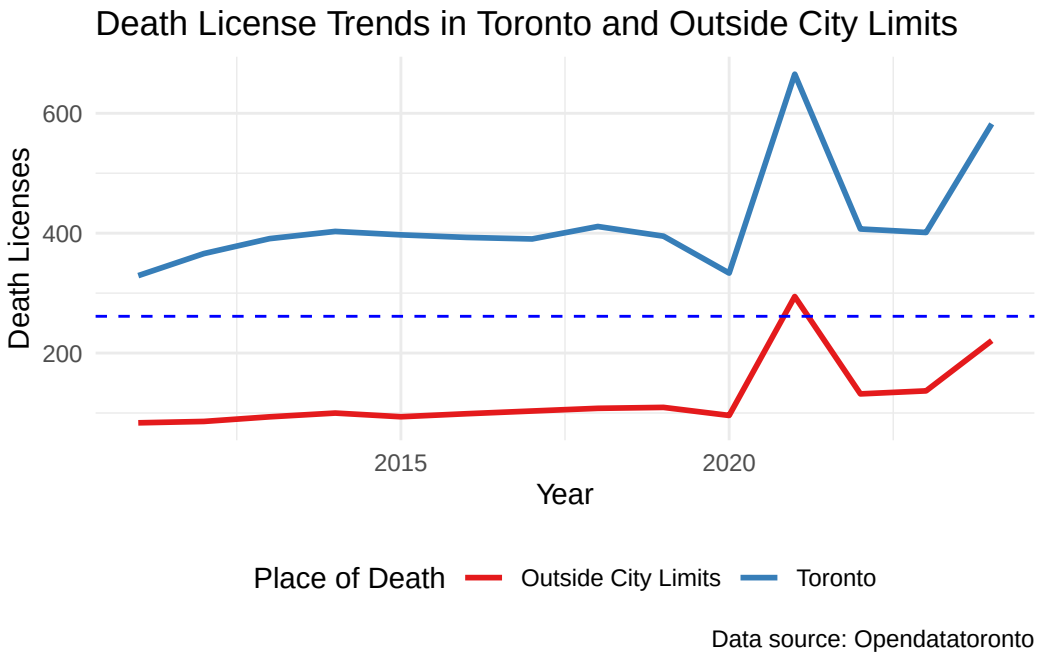

Figure 11: Bills of penguins

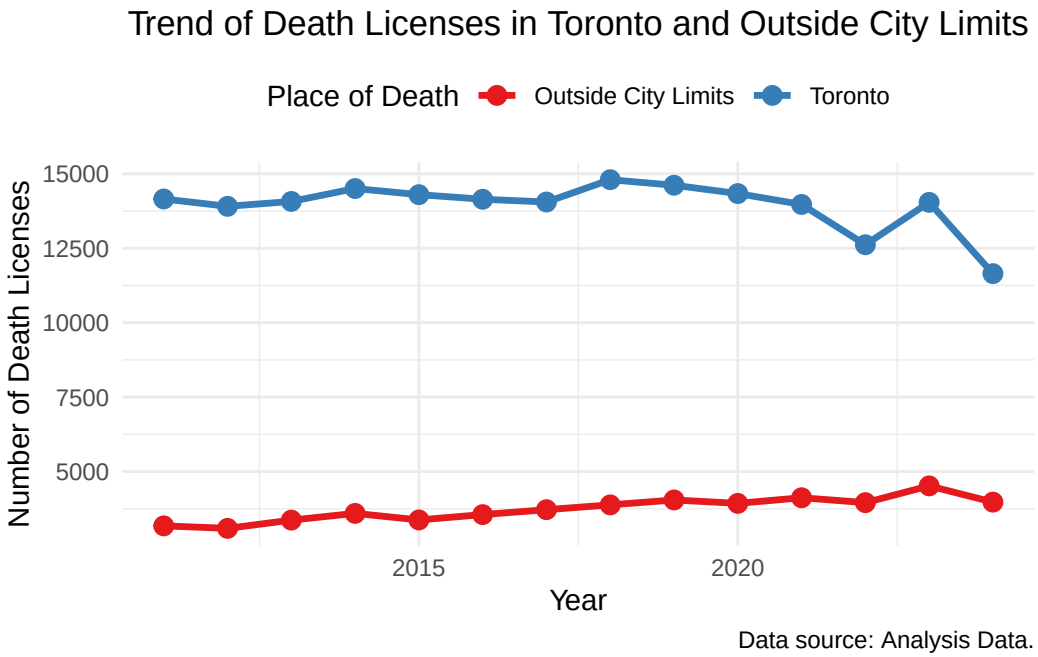

Figure 12: Bills of penguins