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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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

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*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

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.

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
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

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

In order to make the data more complete and to be able to better measure the trends in terms of years, this paper tries to use time series analysis of the data through the September to December data from 2011-2023 for forecasting and generating, by capturing the trends to generate future values to make predictions. The final output showed in fig-4 prediction model. In general, we can simulate a overall data after adding this number into the bar chart in fig-5. For the sake of the rigor of the data, the analysis of this paper will not include this part of the generated data
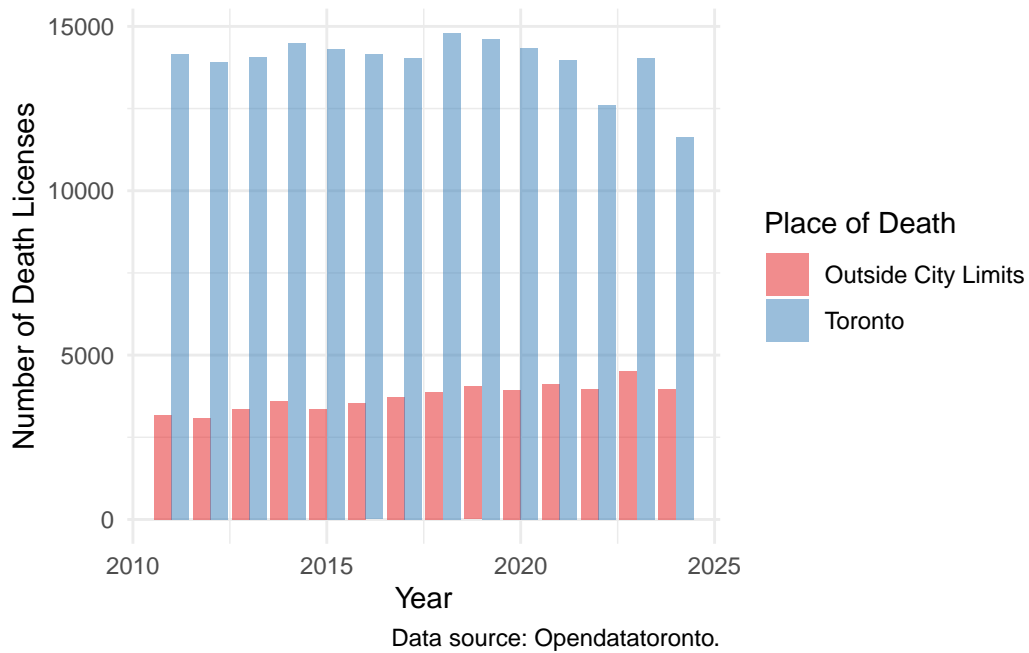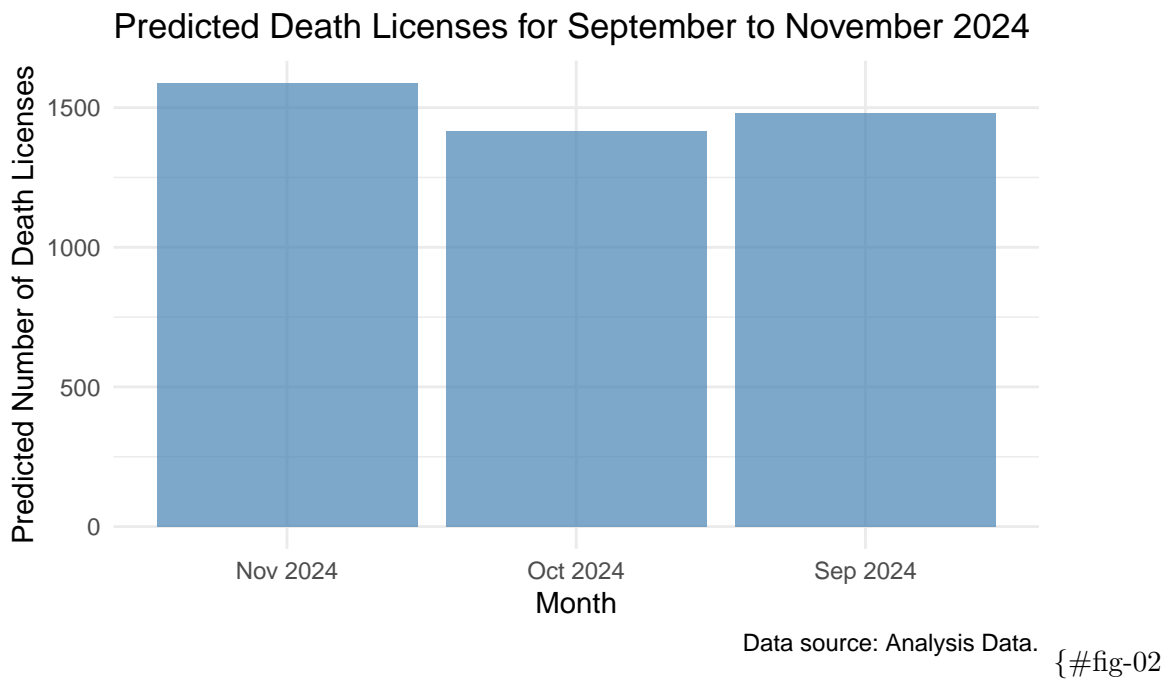
```
[1] 4484.665
```

Figure 1: Distribution of the Size of City-Owned Renewable Energy Installations in Toronto in kilowatts (kW)

{#fig-02 prediction model}

Based on the available data, there is a slow upward trend for outside city limits, and fluctuate trend for the Toronto area could be observed. But based on our prediction showed on fig-4, it is predictable the total death license in 2024 will above the mean line and will push the true mean line slightly above what this paper have simulated.
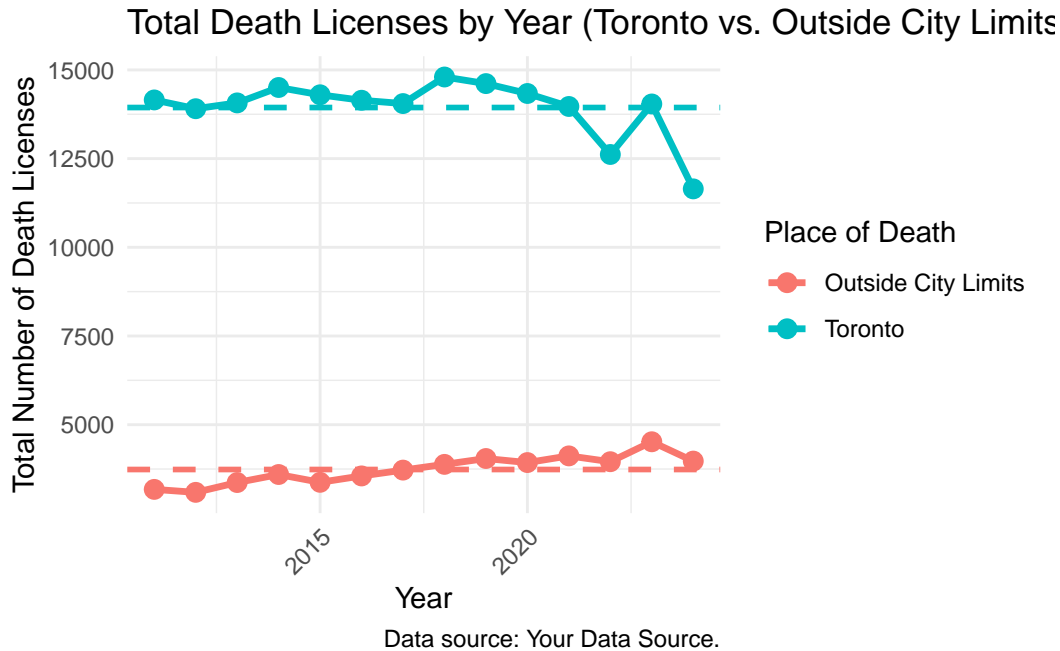

Figure 2: Distribution of the Size of City-Owned Renewable Energy Installations in Toronto in kilowatts (kW)

3 Results

3.1 Potentional relation with Weather

In recent years, with the sever climate change, there has been a higher death event that can be related to teh extreme weather. As noted by fig-6, Toronto doesn't seem to have received much of an impact. This bar chart shows the total number of death licenses by month from 2011 to 2024 (do not include 2024, 9-12), and the only peak observed is in January, while all other months are within the mean line except for March and May. Considering that Toronto's summer climate is more favorable compared to other countries in different regions, leading to a lower impact of extreme weather on deaths,but it is possible that extreme cold weather may have led to more deaths in January. By examining the national library of medicine in CMAJ Open. 2016 Jan-Mar; 4(1): E48 An article entitled "Assessment of the effect of cold and hot temperatures on mortality in Ontario, Canada: a population-based study" was published

in CMAJ Open. 2016 Jan-Mar; 4(1): E48. A population-based study An article entitled "Assessment of the effect of cold and hot temperatures on mortality in Ontario, Canada: a population-based study" cited "Across Ontario, each 5°C change in daily temperature was estimated to induce 7 excess deaths per day in cold seasons and 4 excess deaths in warm seasons. and 4 excess deaths in warm seasons." Concluded with the data this paper simulated, this suggests that there may be a positive correlation between cold weather and death license.
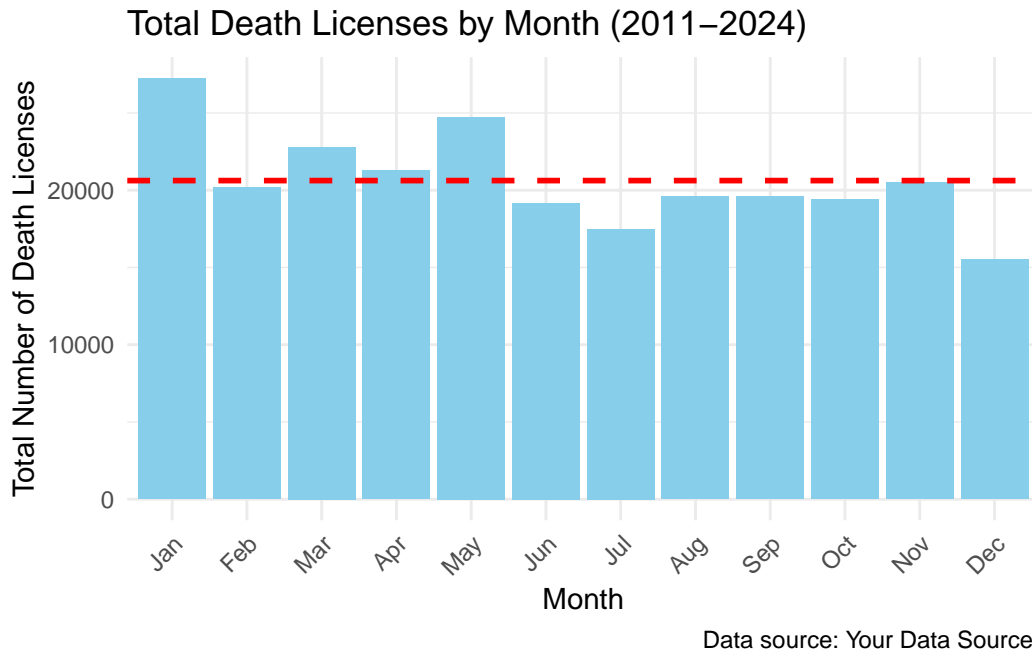

Data source: Your Data Source.

Figure 3: Distribution of the Size of City-Owned Renewable Energy Installations in Toronto in kilowatts (kW)

3.2 Covid and Death License

Fig-05 shows the dataset presented below the dot plot, in order to more visually observe the change in the number of death licenses during covid-19, this article narrows the dataset down to the period between 2017-2024 and in presents each month's data separately. From fig-05, there was not much change during the epidemic (2019-2022), the whole graph only shows extreme values in 3 months, , one of which occurred in 08-2020 but then fell back do not show a consistent trend, so in this paper it will be more proper to be treated as an outlier and is not statistically significant, and the overall distribution is more fitted with uniform distribution. In conclusipn the data proves that global wide public health is not correlated with the number of death license in Toronto and its outside city limits.

Rows: 947 Columns: 7

```
-- Column specification --------------------------------------------------------
Delimiter: ","
chr  (3): civic_centre, place_of_death, month
dbl  (3): id, death_licenses, year
date (1): date

i Use `spec()` to retrieve the full column specification for this data.
i Specify the column types or set `show_col_types = FALSE` to quiet this message.
Rows: 947 Columns: 7
-- Column specification --------------------------------------------------------
Delimiter: ","
chr  (3): civic_centre, place_of_death, month
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i Use `spec()` to retrieve the full column specification for this data.
i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```
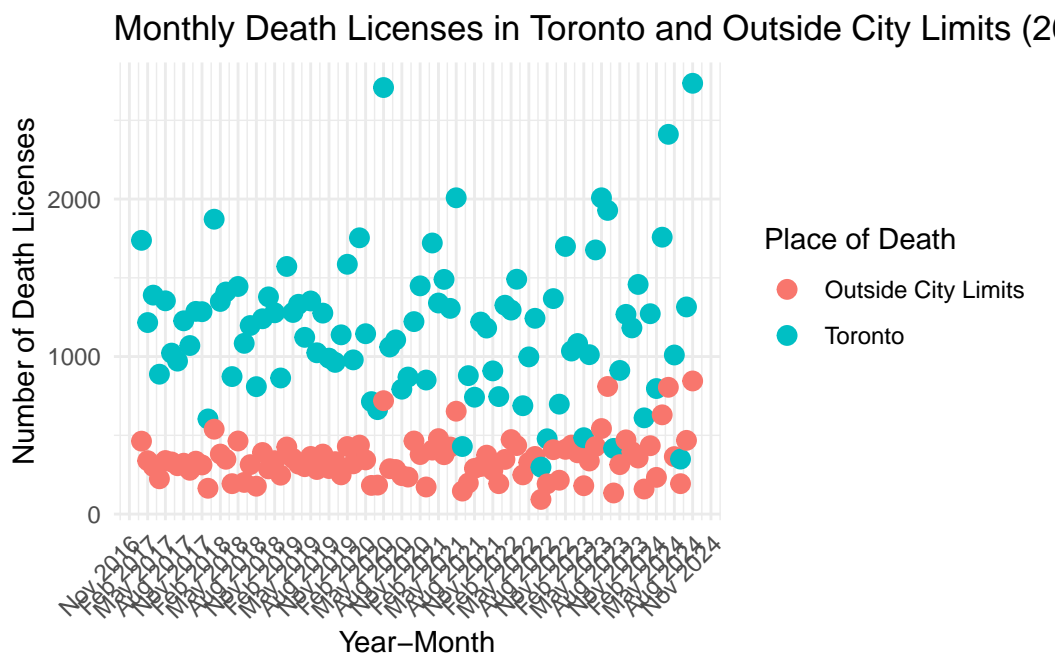

Figure 4: Bills of penguins

4 Discussion

This paper analyzes the number of death licenses registered by civic centers from 2011 to September 2024. By visualizing death licenses by year and month, and using time series for forecasting, it is concluded that there is a positive correlation between the increase in extreme weather events in Toronto and the number of death licenses. Despite the negative impact of Covid-19 on Canada's economy, society, and healthcare, but the distrbution of death license in each year could not reveal a noticiable outcome as it more likly follow uniform disributionm the dataset study was unable to conclude that there was any positive or negative correlation.

Since this dataset only includes numbers, civic centers, and localities, it is not possible to determine the cause of death, and since death licenses are not mandatory for death and the concept is not equivalent to the total number of deaths in the Toronto area, this data does not provide an analysis of the total number of deaths and the causes of deaths in Toronto area, but it is useful for the government to know how many deaths have occurred in the Toronto area and do apply for death license for furthur applicatipn. However, for government departments, the death license statistics are useful for the registration and improvement of government health policies. As of the completion of this article, the data for the period September-December 2024 is not yet available, and is therefore missing, but the main data for the analysis avoids this specific time period, and is fully described and projected in the article, so it does not bias the analysis too much.

5 References

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