Toronto's Homelessness Crisis*

A Preliminary Analysis of Deaths by Month

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There is a general sense that the Toronto Homeless situation is getting worse. Given the lack of cause of death information to help better pinpoint interventions to reduce premature death of Homeless Torontonians, we carry out a preliminary exploration of a dataset we do have: the 'Deaths of People Experiencing Homelessness' dataset published by Toronto Public Health available via Open Data Toronto. The data shows that COVID-19 lockdowns increased homeless deaths during that period. Using the data, we create a forecast of 2024 homeless deaths using the Prophet procedure. We close with a discussion of the limitations of our preliminary analysis and forecase and outline next steps.

1 Introduction

There is a general sense that the homeless crisis in Toronto is getting worse (Katawazi 2024). A recent study (Richard et al. 2024) indicates that, on average, homeless Torontonians are 17 years younger than those who have not experienced homelessness. As the lead author Lucie Richard laments in an interview about the study, there is a lack of cause of death information to help better pinpoint interventions to reduce premature death (Katawazi 2024). Given the lack of cause of death information, it is worthwhile exploring the data that does exist. Toronto Public Health (TPL) has been collecting data on homeless deaths by month since January 2017. We explore this data set and determine what stories the data tells us. These stories may help inform leadership of governmental and non-governmental agencies better utilize their scarce resource in the creation of more effective intervention initiatives reduce deaths among Toronto's homeless population.

*Code and data are available at: https://github.com/MarcusBarnes/Toronto_Homeless_Deaths.

2 Data

In this report, we explore the 'Deaths of People Experiencing Homelessness' data set (Data 2024) which was collected using the Open Data Toronto Library (Gelfand 2022) utilizing the statistical programming software R (R Core Team 2023).

2.1 Deaths of People Experiencing Homelessness Statistics

For the purposes of this dataset, Toronto Public Health (TPH), defines homelessness as "the situation of an individual or family without stable, permanent, appropriate housing, or the immediate prospect, means and ability of acquiring it" (Data 2024). Since January 2017, TPH has counted the number of deaths of people experiencing homelessness by year and month. The deaths are reported to TPH by the Shelter, Support and Housing Administration (SSH), community partner organizations and the Coroner's Office (Data 2024).

3 Analysis

3.1 Summary Statistics

In the exsiting data, the monthly death counts range from 1 to 26. The median monthly death count is 11 and the mean death count is approximately 12.7. The standard deviation is 5.06.

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
   1.00    8.00   11.00   12.17   15.00   26.00
```

```
[1] 12.16667
```

```
[1] 11
```

```
[1] 5.060676
```

3.2 Distribution of Monthly Death Counts

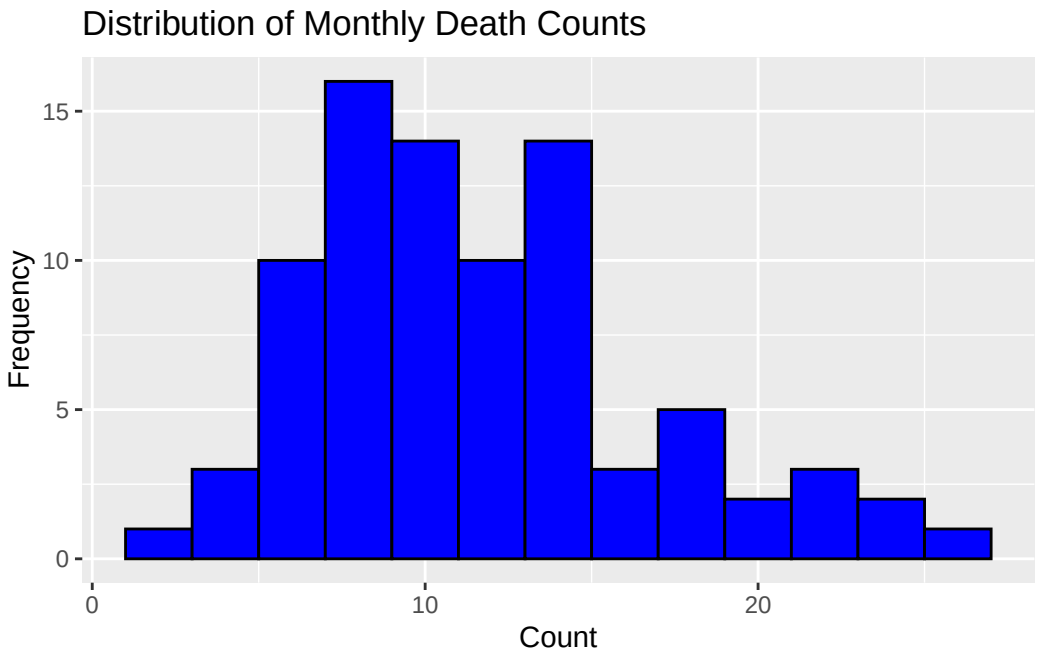

Figure 1: Distribution of Monthly Deaths

3.3

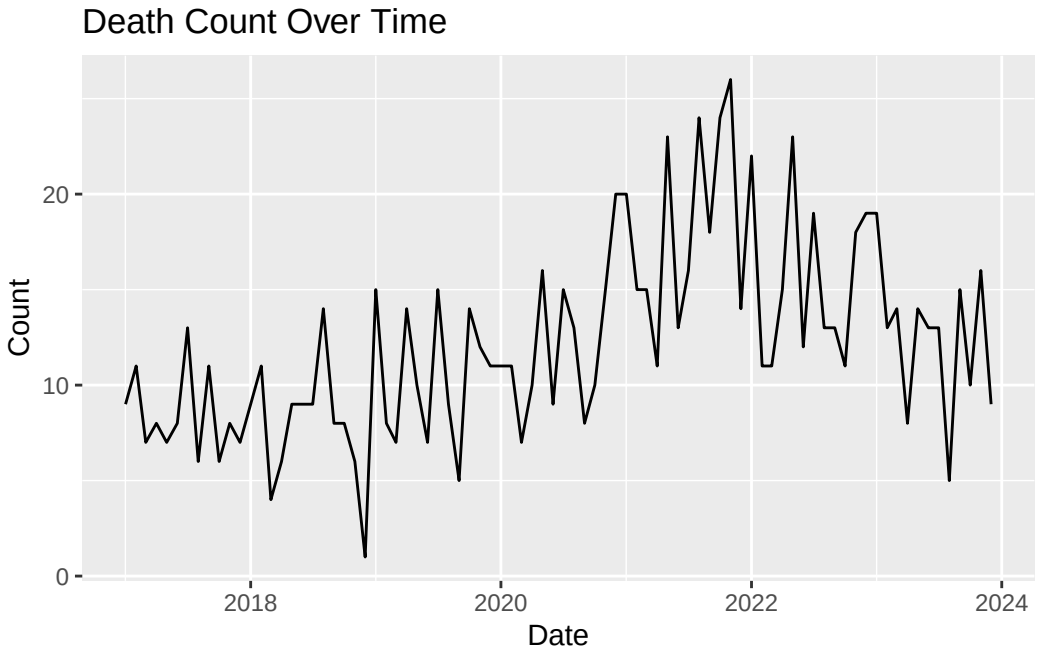

Figure 2: Death Count over Time.

3.4 Forecast Model set-up

Using the Prophet package(Taylor and Letham 2021), we can attempt to forecast what will happen over the next 12 months.

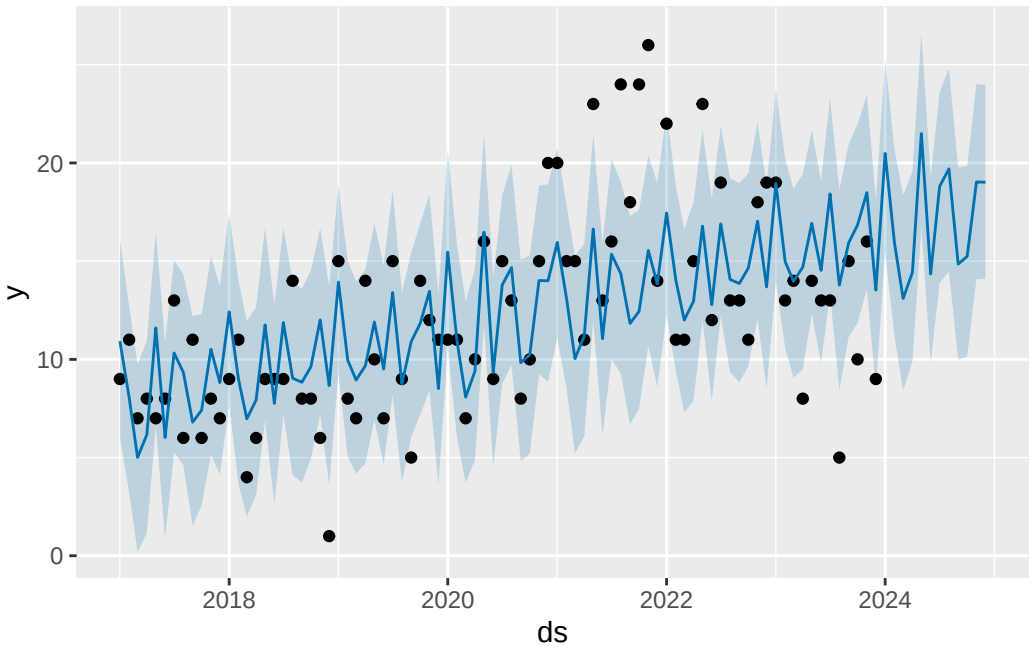

Figure 3: Forecast of the next 12 months using Prophet forecast procedure.

In particular, we have the following monthly forecast for 2024 (where we have rounded the predicted number up to a whole number):

Month	**Forecasted Deaths**
January	21
February	16
March	14
April	15
May	22
June	15
July	19
August	20
September	15
October	16
November	20
December	20

Table 1: Forecasted death counts of homeless Torontonians for 2024 by month.

3.4.1 Model justification

According to The Prophet package CRAN page, the forecasting procedure is "Prophet is robust to missing data and shifts in the trend, and typically handles outliers well" (Taylor and Letham 2021).

4 Forecasting Results

Using the Prophet forecasting procedure have the following monthly forecast for 2024 (where we have rounded the predicted number up to a whole number):

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November	20
December	20

Table 2: Forecasted death counts of homeless Torontonians for 2024 by month.

5 Discussion

5.1 Impact of COVID-19 lockdowns.

From the plot of Count over Time ((**death-count-over-time?**)), there is a clear increase in homeless dealths during that period. This can be attributed to reduces services for and increased social isolation of homeless Torontonians during this period. [Cite literature on this.]

5.2 Forecasts for Toronto Funeral Expense Budget Allocation

Our forecast of monthly deaths for 2024 does not help us in designing direct interventions to avoid these deaths, but it can assist the city of Toronto allocate appropriate funds for the funeral expenses of the deceased (Toronto 2024).

5.3 Weaknesses

5.3.1 Lack of Data

This data set only goes back to 2017. As additional data is collected each year, certainty on discernable trends will increase.

5.3.2 Forecast Models

Other time series forecasting models such as ARIMA or Holt-Winters available in the forecast package could be considered (Hyndman et al. 2024). Each has its pros and cons. Prophet was primarily selected for its ease of use.

5.4 Next Steps

5.5 Enriching and Complementing the Data

A next step is to look at how we can enrich the relatively basic dataset under study with additional data. This enrichment may provide more insight into the collected rates of deaths amongs homeless Torontonians and may provide information which can help form improved interventions.

5.5.1 Utilizing Time Series Data

Based on the time series forecast presented in this report, follow up next year to determine the accuracy of the forecasted trend. Were other forecasting techniques such as ARIMA or Holt-Winters ultimately more correct? What can we now say with an additional year of collected data?

The concept of motifs in time series data may provide additional insight into less evident patterns in the data. There is a powerful Python library created for exploring motifs in time series data called STUMPY (Law 2019). By using the `reticulate` package (Ushey, Allaire, and Tang 2024), it's possible to use STUMPY within R as demonstrated in a relevant tutorial (frankiethull 2024).

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