

# My title\*

My subtitle if needed

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## Abstract

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

## 1 Introduction

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

As part of the City of Toronto’s Vision Zero Road Safety Plan, the Mobile Watch Your Speed Program uses speed display signs which contain a radar device to detect the speeds of oncoming vehicles and an LED display to show the speed of the vehicle to the driver. The aim of the device is to “remind [motorists] to check their speeds and to obey speed limits” (“Watch Your Speed Program (WYSP)” 2017). We note that this program is distinct from automated speed enforcement.

### 2.1 TODO ADD CITATIONS

Our data is a summary of speeds recorded by the speed display signs. The data is obtained from (CITATION). The dataset as retrieved from `opendatatoronto` consists of 6517 rows each corresponding to an installation of the display, with columns indicating the location, period of installation, and a summary of speed observations made over the period of time it was installed. All displays are scheduled to be on only on weekdays between the hours of 7 AM to 9 PM, but speeds are still recorded by the device. For each row, we have speed distributed by percentiles, as well as the total count of vehicles recorded travelling at a specific speed in bins of 5 km/h increments from 0 to 100 and over.

```
## # A tibble: 6,517 x 52
##   '_id' location_id ward_no location      from_street to_street      direction
##   <dbl>         <dbl>   <dbl> <chr>         <chr>         <chr>         <chr>
## 1 91811         2074481     13 Lombard St   Victoria St   Jarvis St     WB
## 2 91812         2074482     13 River St    Gerrard St E  Shuter St     NB
## 3 91813         2074484     13 Winchester St Sumach St     Parliament St EB
```

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\*Code and data are available at: [https://github.com/chan-roy/sta304\\_paper1](https://github.com/chan-roy/sta304_paper1)

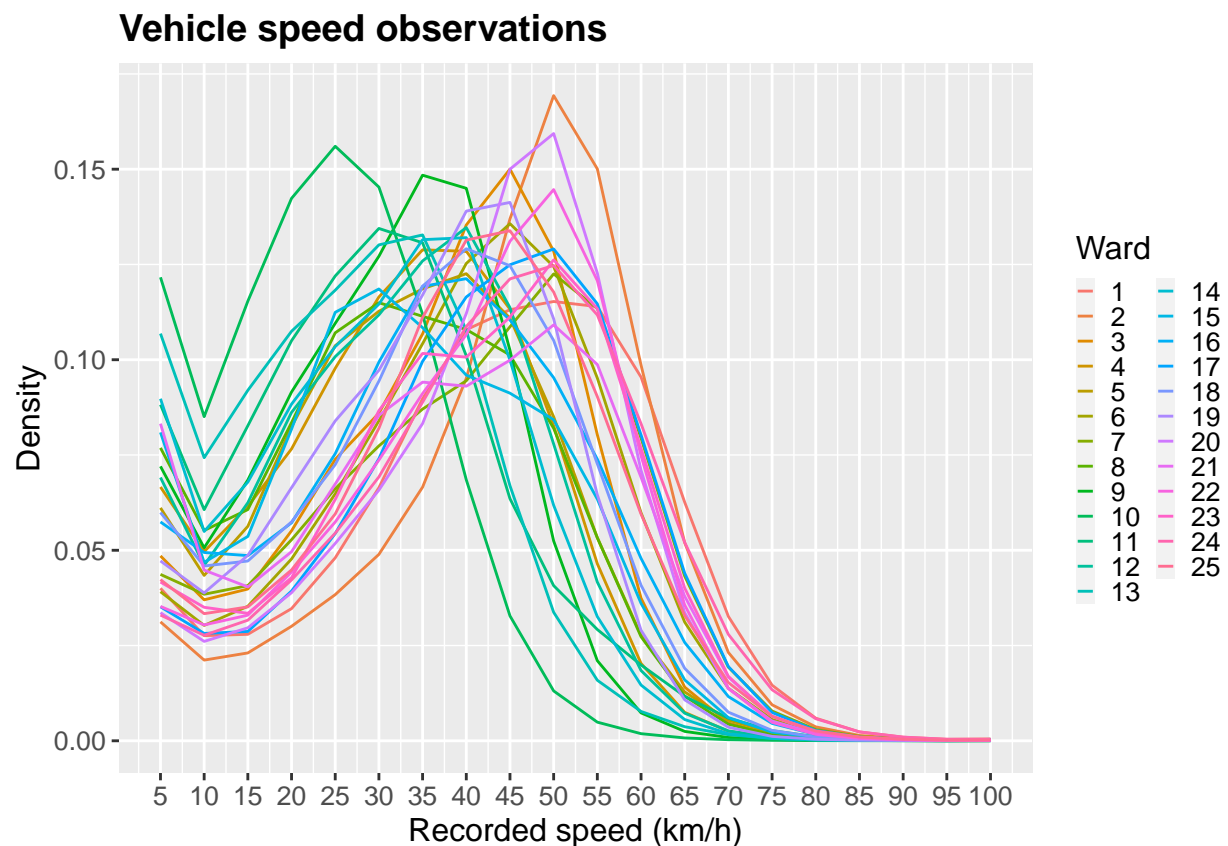
```
## # ... with 6,514 more rows, and 45 more variables: installation_date <date>,
## #   removal_date <date>, schedule <chr>, min_speed <dbl>, pct_05 <dbl>,
## #   pct_10 <dbl>, pct_15 <dbl>, pct_20 <dbl>, pct_25 <dbl>, pct_30 <dbl>,
## #   pct_35 <dbl>, pct_40 <dbl>, pct_45 <dbl>, pct_50 <dbl>, pct_55 <dbl>,
## #   pct_60 <dbl>, pct_65 <dbl>, pct_70 <dbl>, pct_75 <dbl>, pct_80 <dbl>,
## #   pct_85 <dbl>, pct_90 <dbl>, pct_95 <dbl>, spd_00 <dbl>, spd_05 <dbl>,
## #   spd_10 <dbl>, spd_15 <dbl>, spd_20 <dbl>, spd_25 <dbl>, spd_30 <dbl>, ...
```

- It would be very difficult to operate on all 6000 observations, so devise an appropriate method of summarisation
- We note that the city rotates displays throughout each ward thus will investigate vehicle speed observations on a per ward basis

## 2.2 Data issues

- Inconsistent operating period. City site specifies 2-3 weeks, but some cameras have operated for months if not years
- Criteria of how locations where displays are deployed are unknown (online form for requests)
- Speed limit of road is not specified. As stated by the City of Toronto (<https://www.toronto.ca/311/knowledgebase/kb/docs/articles/transportation-services/district-transportation-services/traffic-operations/minimum-speed-limit-on-streets.html>) the default speed limit is 50 km/h unless otherwise posted; thus we will use this as a consideration of whether we consider a vehicle to be speeding.

Some displays are located on roads which are more busy than others. Thus we will plot a graph of the density of speeds recorded in each ward.



Some immediate observations that we can make from this histogram are that it is right-skewed, which is a

positive sign for traffic compliance indicating a lack of significant speeding, when using our assumption that the speed limit is 50 km/h. In addition we see the peak of the majority of traffic speeds lie around there.

### 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 Wickham et al. (2019) 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  $\theta$ .

### 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>.
- R Core Team. 2020. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. <https://www.R-project.org/>.
- “Watch Your Speed Program (WYSP).” 2017. *City of Toronto*. <https://www.toronto.ca/services-payments/streets-parking-transportation/road-safety/vision-zero/safety-initiatives/watch-your-speed-program/>.
- Wickham, Hadley, Mara Averick, Jennifer Bryan, Winston Chang, Lucy D’Agostino McGowan, Romain François, Garrett Golemund, et al. 2019. “Welcome to the tidyverse.” *Journal of Open Source Software* 4 (43): 1686. <https://doi.org/10.21105/joss.01686>.