

Speed limit compliance in Toronto is high, but speeding is prevalent outside of downtown*

My subtitle if needed

Roy Chan

04 February 2022

Abstract

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

1 Introduction

2 Data

2.1 TODO ADD CITATIONS

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). The location of the speed displays is limited to residential roads with no more than two lanes, and as they are temporary installations, require existing infrastructure such as hydro or light poles to be affixed to. This program is distinct from automated speed enforcement; there is no consequence if a vehicle is recorded speeding.

Our primary dataset is the Mobile Watch Your Speed Program - Summary (<https://open.toronto.ca/dataset/mobile-watch-your-speed-program-speed-summary/>). The data is obtained from the Open Data Toronto portal, retrieved using the `opendatatoronto` package (Gelfand 2020). The dataset is a summary of speeds recorded by these speed display signs over the period when it was installed and operating. It 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 and only turns on at a minimum detected speed of 20 km/h, 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 km/h to 100 km/h 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
```

*Code and data are available at: https://github.com/chan-roy/sta304_paper1

```
## 3 91813      2074484      13 Winchester St Sumach St      Parliament St EB
## # ... 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>, ...
```

2.2 Data considerations and issues

We recognise that it would be very difficult to operate on all 6000 observations, so we should devise an appropriate method of summarisation. Since the data spans over the years of 2018-2021, one way is to focus on investigating trends in vehicle speeds over the time the program is operational. Additionally, we note that it is stated the city rotates displays throughout each ward; thus we can also organise the data further by ward. We will use `dplyr` (Wickham et al. 2021) to perform our data manipulations.

Some issues that were discovered with the data are: - Inconsistent operating period. City site specifies 2-3 weeks, but some cameras have operated for multiple months if not years - Criteria of how locations where displays are deployed are unknown (online form for requests) - Speed limit of road where display is located 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 - However, the WYSP program operates on residential/local streets, so we use 40km/h as the assumed speed limit.

Some displays are located on roads which are more busy than others, so to account for this we will use relative counts. The first exploratory plot we generate, using `ggplot2` (Wickham 2016), is the distribution of vehicle speeds in the entire city, grouped by year.

Some immediate observations that we can make from this histogram are that it is right-skewed, which indicates a trend of speed limit compliance with our assumption that the speed limit is 40 km/h. It is also very consistent from year to year, so there does not appear to be any significant changes in driving behaviour. One feature of our dataset is that it contains information about the municipal ward that the display is located in. We want to see if we can make any observations about speed behaviours in specific wards. The city of Toronto so is divided into 25 wards, which would be difficult to display on a single graph. As such, we will create a map plot using `ggplot2` and `sf` (Pebesma 2018), generated from the City Wards dataset also retrieved from `opendatatoronto` (<https://open.toronto.ca/dataset/city-wards/>) so that we can also take advantage of being able to see larger trends in neighbouring wards.

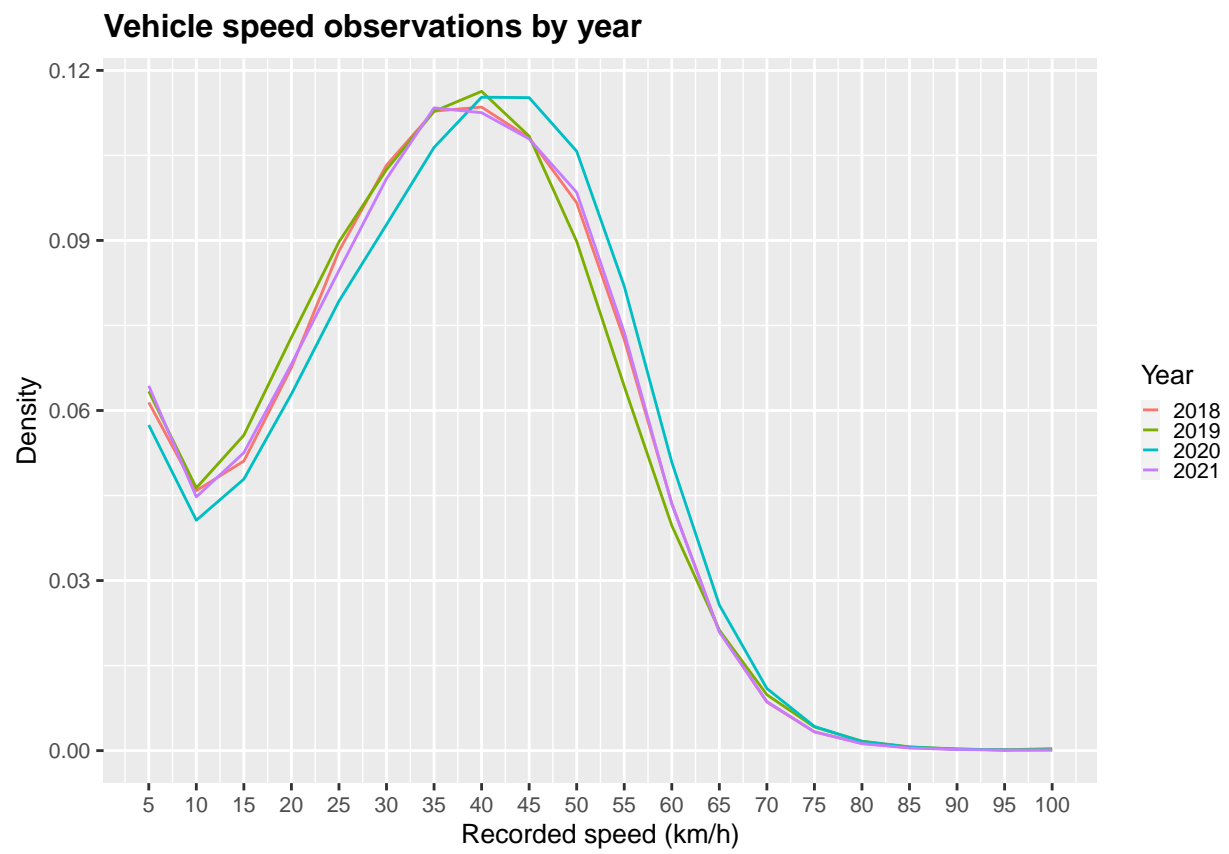
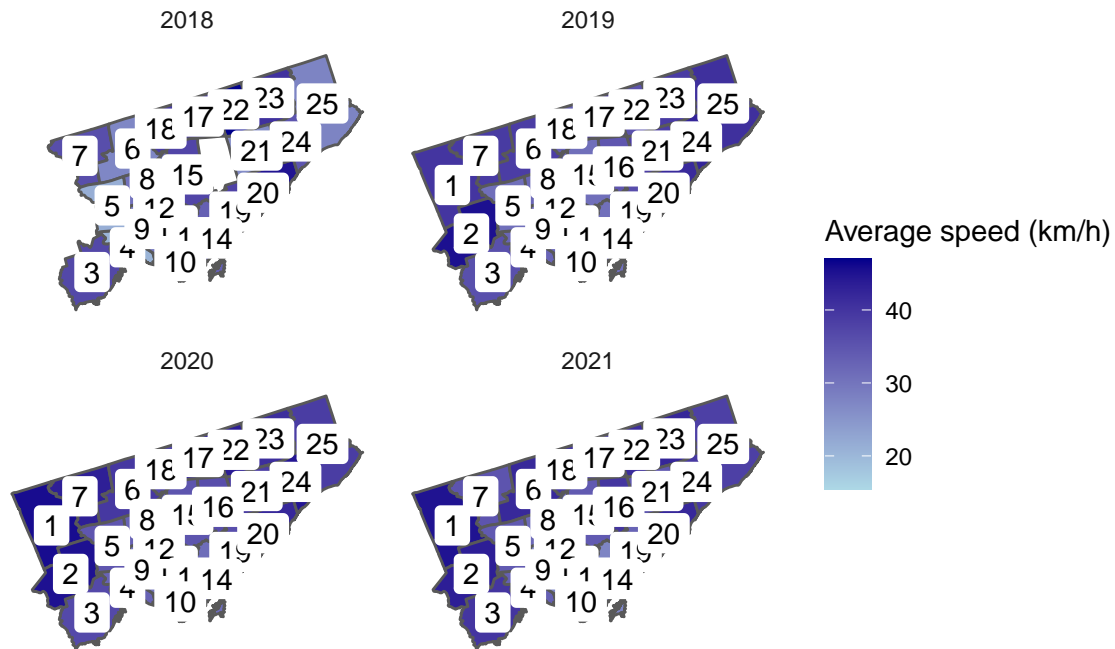


Figure 1: Histogram of vehicle speed distributions

Average recorded speeds by speed displays

Organised by year and ward*



*No speed displays were used in wards 1, 2, and 16 in 2018

Ward 10, Spadina-Fort York, stands out for its significantly low average recorded speed, consistently throughout all years. As previously discussed, there does appear to be a trend in increasing average speeds as distance from the downtown core increases, with a maximum average speed of 46.96 km/h recorded in 2018 in ward 22, Scarborough-Agincourt. For more elaborated analysis on the behaviour of speeding in Toronto, we

3 Discussion

3.1 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.

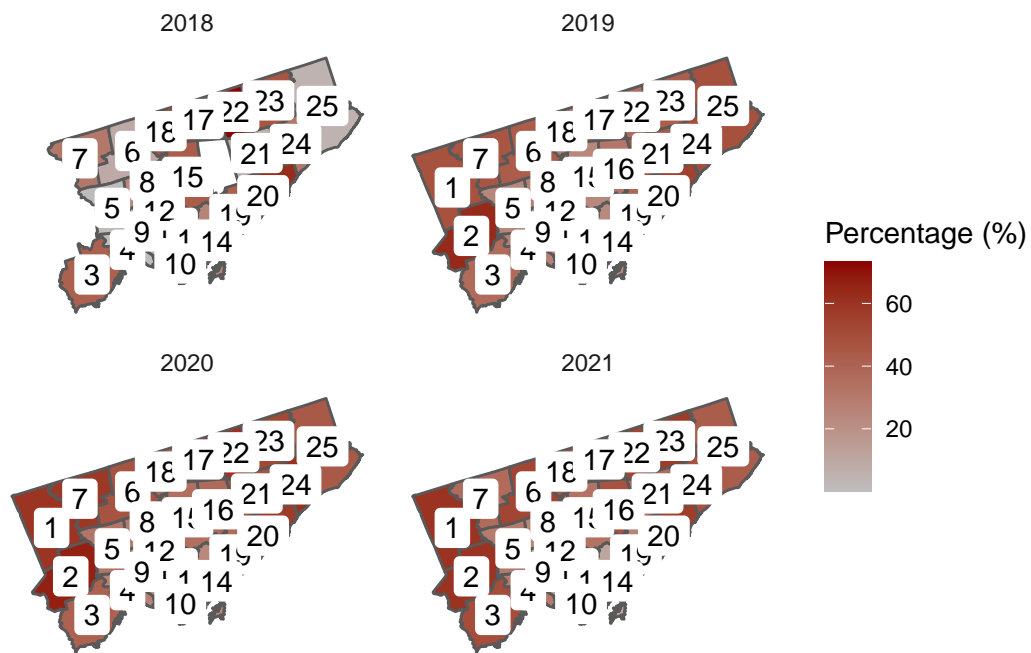
3.2 Second discussion point

3.3 Third discussion point

3.4 Weaknesses and next steps

Percentage of recorded speeds over 40km/h by ward

Organised by year and ward*



*No speed displays were used in wards 1, 2, and 16 in 2018

Figure 2: (#fig:percentage_speeds_map)Percentage of speeds recorded by speed displays over 40km/h

References

- Gelfand, Sharla. 2020. *Opendatatoronto: Access the City of Toronto Open Data Portal*. <https://CRAN.R-project.org/package=opendatatoronto>.
- Pebesma, Edzer. 2018. “Simple Features for R: Standardized Support for Spatial Vector Data.” *The R Journal* 10 (1): 439–46. <https://doi.org/10.32614/RJ-2018-009>.
- “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. 2016. *Ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. <https://ggplot2.tidyverse.org>.
- Wickham, Hadley, Romain François, Lionel Henry, and Kirill Müller. 2021. *Dplyr: A Grammar of Data Manipulation*. <https://CRAN.R-project.org/package=dplyr>.