Driving During Quarantine

Covid-19 is an infectious disease and has caused a global pandemic. In an attempt to combat and prevent its spread, Prime Minister Trudeau has advocated for social distancing and self isolation. Hence, people are now incentivized to stay home as much as possible and limit contact with others to stop the spread of the virus. We have decided to investigate how effective the call for social distancing has been in Toronto by viewing traffic data, where we investigated if there was a significant decrease in the amount of people driving in residential areas of Toronto.

The data is mainly gathered from the Open Toronto Data Catalogue, from the School Safety Zone Watch Your Speed Program's Detailed Speed Counts. In 2020, there are 444 locations scattered across Toronto, where a speed display sign was installed on a pole as part of the program, displaying the speed of oncoming vehicles and flashing lights if they violated the speed limit. The dataset contains a count of vehicles it observed each hour for a range of speeds.

First we examined the data using a heatmap, where we took into consideration the time of day, speed, and average volume. On March 12, all schools in Toronto declared closure, and on March 25, all non-essential businesses were required to remain closed. Thus, we have defined "Before Quarantine" as before March 12, while "During Quarantine" as after March 25. Viewing the two heatmaps of average volume before and during quarantine (Figure 1), we can see that there are 2 main areas of the map that feature significant decreases in average volume. The first is for vehicles travelling at a speed around 10 - 30 km/h at 8:00 a.m. and 2:00 - 4:00 p.m. which is most likely parents dropping off and picking up children from school. The second is of drivers travelling at a speed of around 30 - 60 km/h around 8:00 a.m. - 7:00 p.m., which represents the general average traffic volume within the neighborhood, not just due to the traffic around the school in which the tracking device is in close proximity to. As a result, we believe this data is a good representation of traffic flow in residential areas of Toronto.

We aggregated the volume across all speeds to get the total hourly count for each location. The hourly count data is also prone to seasonality, from the hour of day and the day of the week, so we used seasonal decomposition with a period of 168 hours to extract the trend volume for each site. The trend volume is found by removing the seasonal and residual components. We then fit a linear mixed model (Figure 2) to the trend volume of all the areas, with indicator variables for "During Quarantine" (Before March 12) , "Hoarding Season" (March 12 to March 25), and a number for datetime, as well as interaction terms between datetime and the indicators. The random effect intercept is "sign_id", which is the unique identifier for each location, to account for the differences between each location. The model predicts a significant decrease in trend traffic volume of around 56 vehicles per hour during quarantine, with a p-value smaller than 0.001.

We also viewed the trend traffic volume for all the sites before and during quarantine, averaged across the wards of Toronto, and created a heatmap of the wards by finding their average trend volume (Figure 3). There is variation in average volume between wards, but all wards experienced a decrease in average volume. As well, in Figure 2, we can see that almost all locations experienced a decrease in volume due to quarantine, of around the same amount, as predicted by our model. Differences in volume between the wards is still apparent even after social distancing was encouraged and implemented city-wide. From this we conclude that the campaign for social distancing has been effective at encouraging a significant amount of people to stay home, but areas that regularly have higher than average traffic still tend to have higher traffic during quarantine as well, and vice versa. Hence, further action would be required to encourage more social distancing in areas that tend to have higher traffic in order to decrease the amount of travelling and keep everyone safe during this pandemic.

Some limitations of our analysis stem from the nature of the data, which is counts of vehicles in primarily school safety zones. While we do believe that the dataset is effective in capturing the general traffic within residential areas, more data of traffic around urban centers and highways would give a better idea of the traffic volume of Toronto overall. Further analysis could involve looking into the effect of quarantine on driving speed, which we found, at a glance from Figure 1, to affect people driving at around 30 - 60 km/h. We can also look into how differently wards experience decreases in traffic.