Reducing Cycling Collisions in Toronto

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Introduction

The use of non motorized transport such as cycling has gained popularity around the world in recent years.

The city of Toronto introduced the ActiveTO Cycling Network Plan in 2020, which proposed 40 kilometres of expanded and accelerated routes – creating more safe space for cyclists and pedestrians to get around the city.

This study investigates factors that contributes to auto collisions with cyclists, and the impact of driving behavior and compliance with city of Toronto by-laws regulating the safe use of different cycling infrastructure throughout the City.

Data

The data for this study was generously provided by Geotab and the Toronto Police Service

The data used for this report is derived from the Toronto Police Service's Killed or Seriously Injured (KSI) dataset, Hazardous Driving Areas and the Road Impediments dataset from Geotab.

The exploratory analysis was performed on data from the KSI dataset from the years 2006 - 2019 and the up-to-date Geotab datasets. The final analysis of factors was performed on the KSI dataset from the years 2015-2019, a five-year period.

Research Question

What factors contribute to auto collisions with cyclists?

Proposed Factors

Road Condition

The KSI dataset records the road condition at the time of an incident.

The road conditions listed in the dataset are: Dry, Wet, and Other.

Light Condition

The KSI dataset records the light condition at the time of an incident.

The light conditions listed in the dataset are: Daylight, Dark (artificial lighting), Dark, Daylight (artificial light), etc.

Road Class

The KSI dataset records the road class where the incident happened.

The road classes listed in the dataset are: Major Arterial, Minor Arterial, Collector, and Local.

Visibility Condition

The KSI dataset records the visibility at the time of an incident.

The visibility conditions listed in the dataset are: Clear, Rain, and Other.

Data Cleaning & Validation

Selecting Data

The data used for this study was selected from the entire KSI dataset using the INVTYPE variable "Cyclist" to collect only cyclist collisions. Additional data was selected from the Geotab Ignition Hazardous Areas dataset and the Geotab Ignition Road Impediments dataset.

Filtering by Year & City

The study sought to examine trends in cyclist involved collisions over the previous five year period. The data was filtered by "Year" to only include incidents from 2015 to 2019. The geotab datasets were filtered by City and Country.

De-duplication

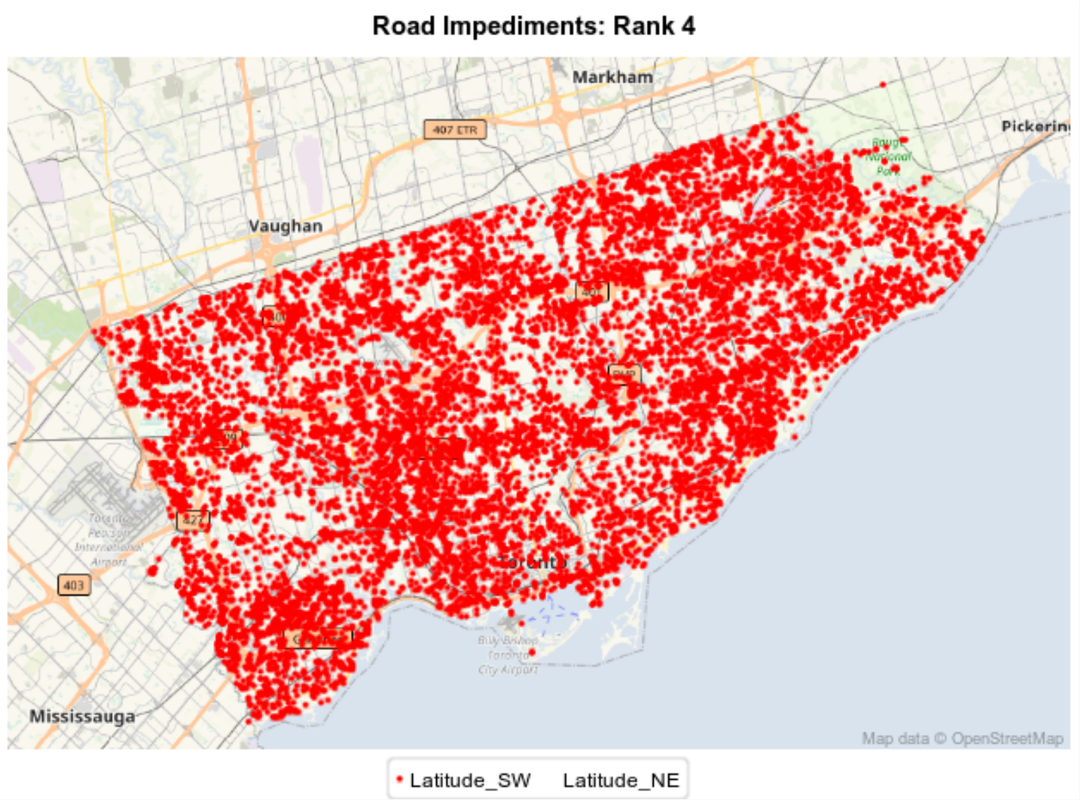
Since the KSI dataset contains one record per person involved in an incident, the data was filtered by unique accident number ("ACCNUM") to remove duplicates. The two Geotab datasets used, did not contain duplicates.

Derived Variables

The Road Impediment Rank (ri_rank) was created for the Road Impediments dataset.

Using the product of the average acceleration and percent of vehicles score to create a road impediment rank variable. The score ranges from 0-4 with 4 containing the highest weighting.

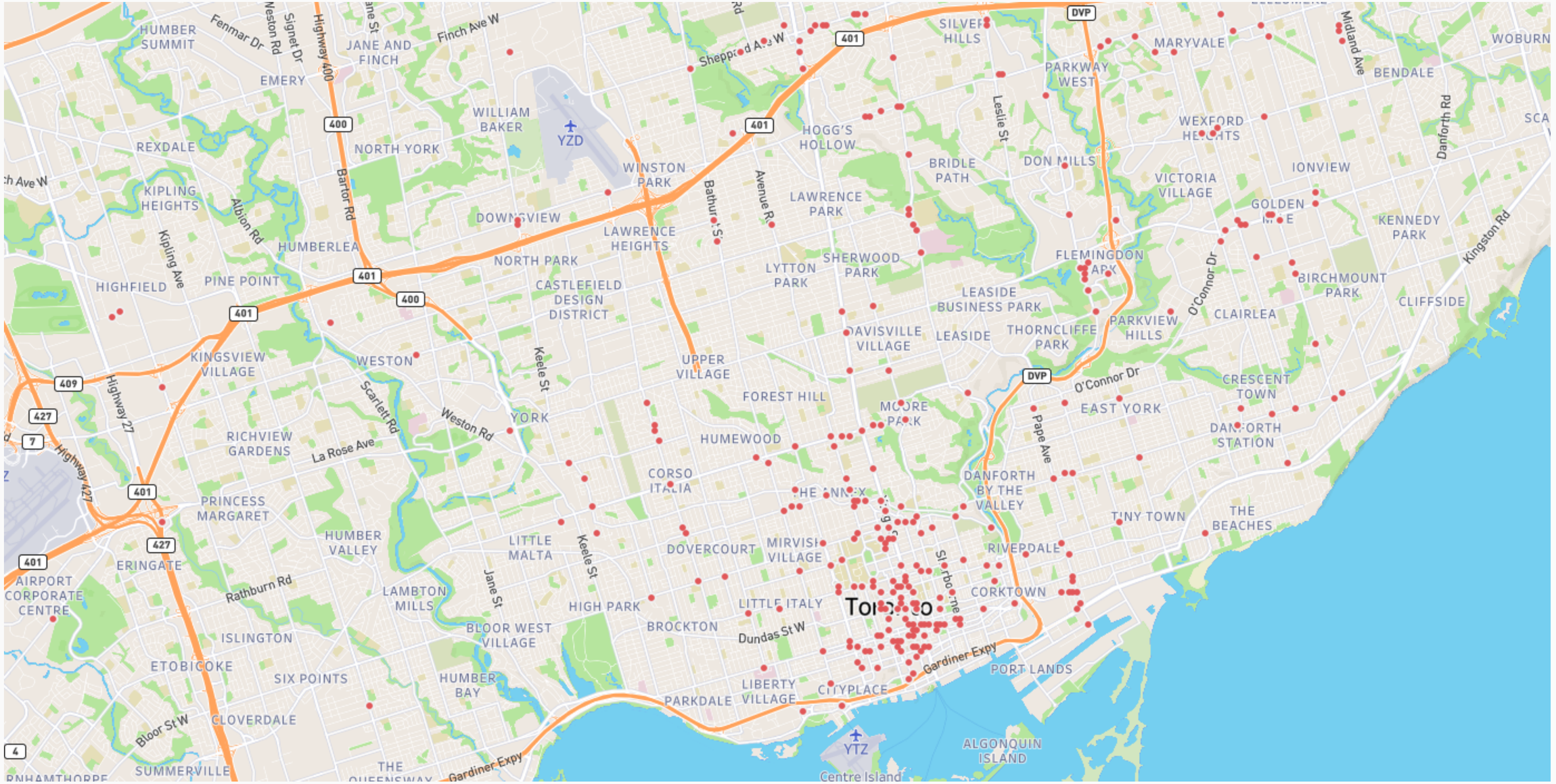
Exploratory Data Analysis: Road Impediment Score - Rank 4



Maximum Rank 4 score - 0.79755
Minimum Rank 4 score - 0.049728

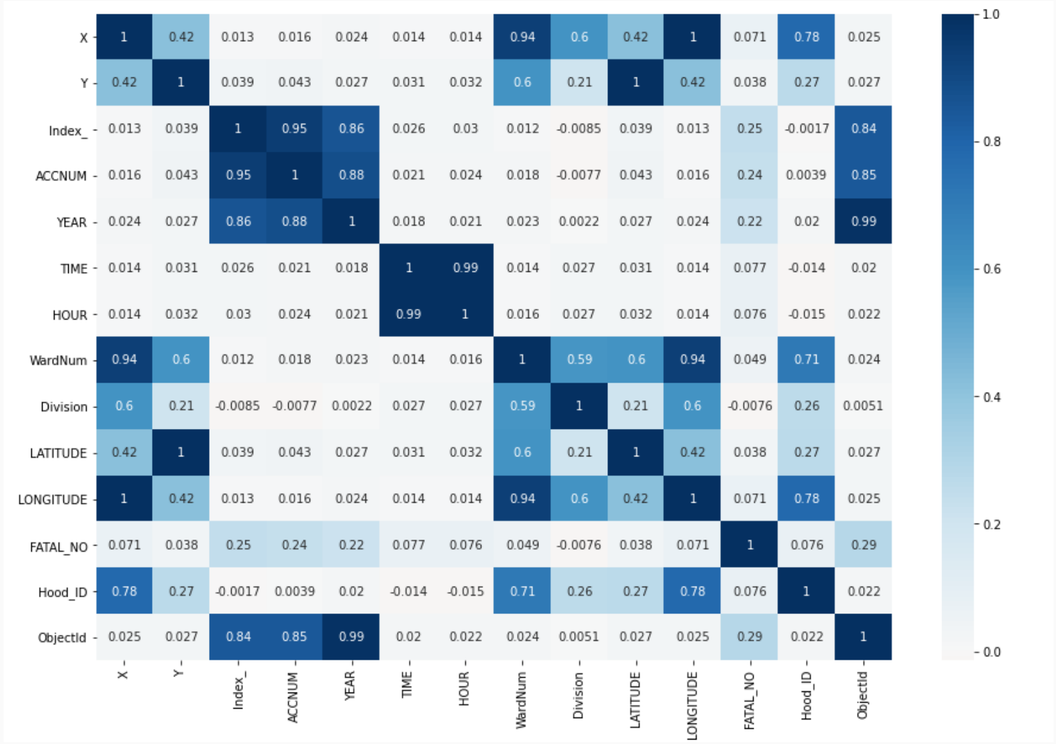
Rank 4 scores between - 0.2 & 0.79755

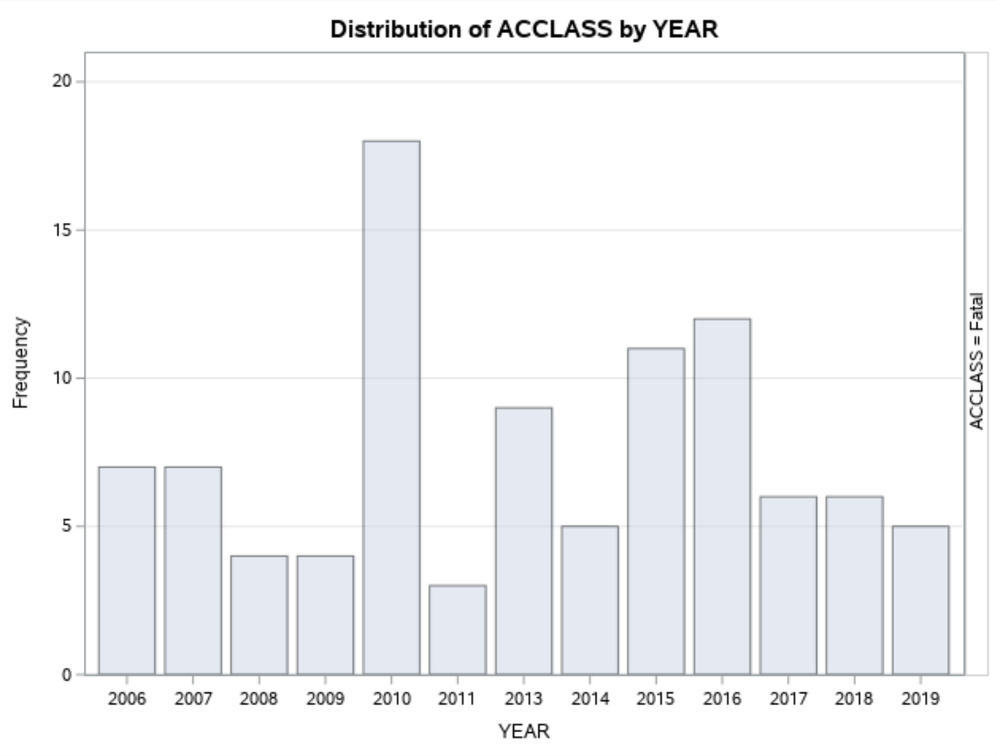
Exploratory Data Analysis: Hazardous Driving Areas

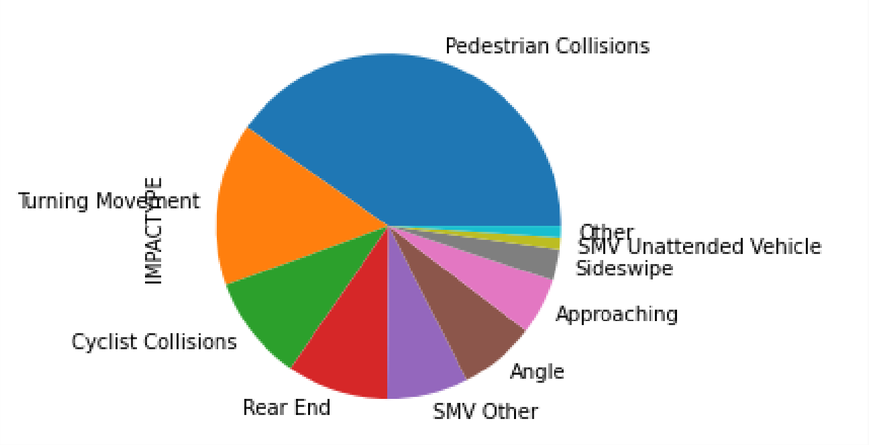


Hazardous Driving Areas- Top 10% by Severity Score

Exploratory Data Analysis: KSI datset (2006 - 2019)



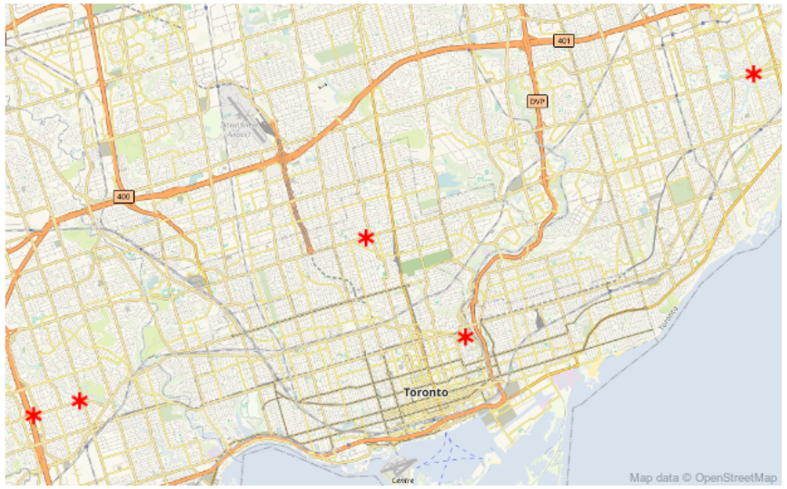




Impact Type - 9.8% cyclist collissions

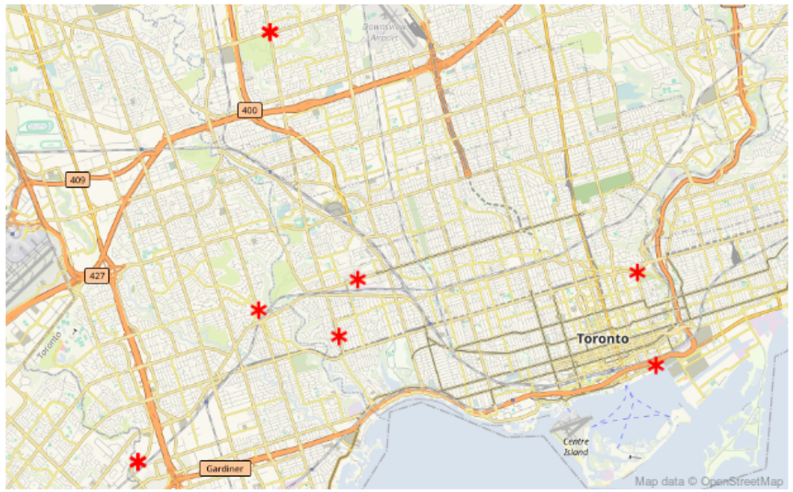
Exploratory Data Analysis: KSI Fatalities from Aggressive Driving (2015-2019)

Fatal Accidents with major injuries caused by aggressing driving - locations in the City of Toronto in 2015



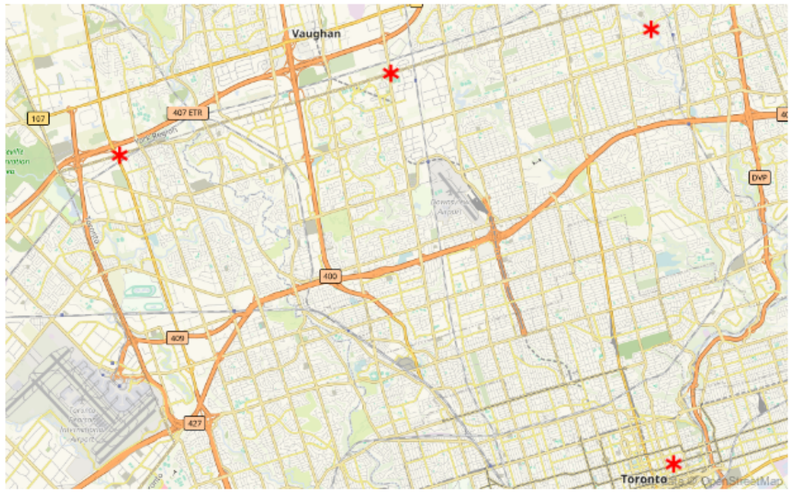
LATITUDE

Fatal Accidents with major injuries caused by aggressing driving - locations in the City of Toronto in 2016



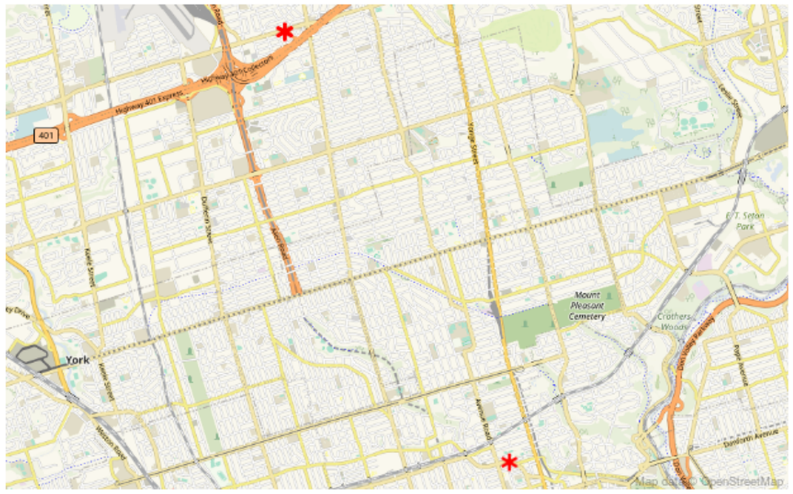
LATITUDE

Fatal Accidents with major injuries caused by aggressing driving - locations in the City of Toronto in 2017



LATITUDE

Fatal Accidents with major injuries caused by aggressing driving - locations in the City of Toronto in 2018



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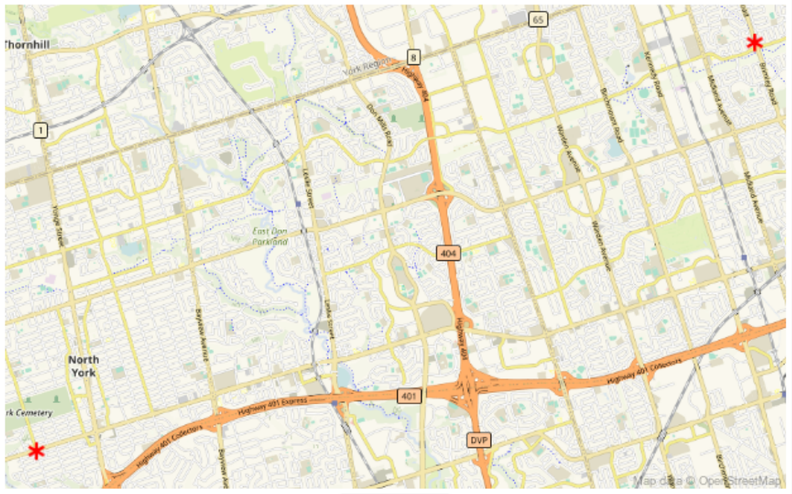
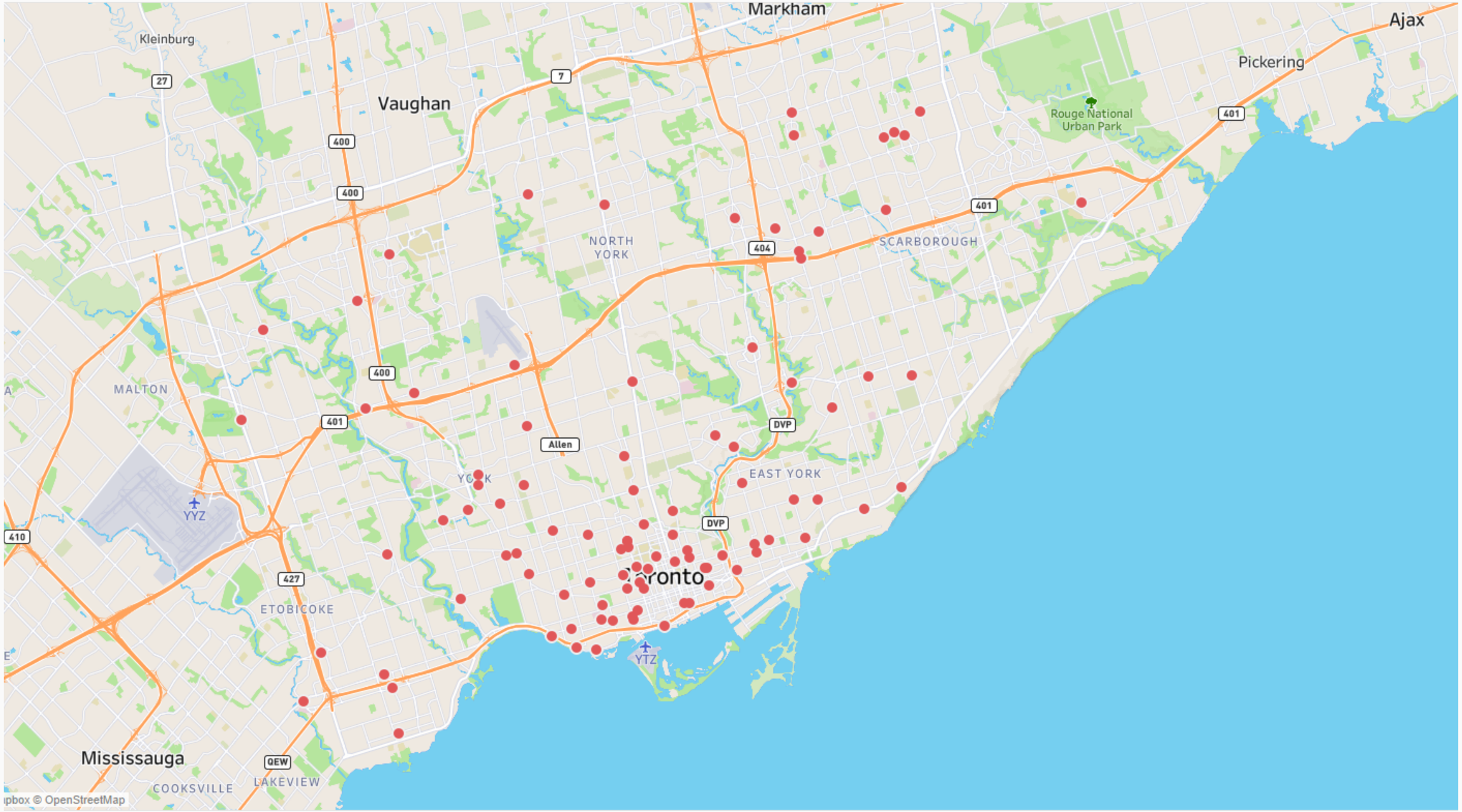
Fatal Accidents with major injuries caused by aggressing driving - locations in the City of Toronto in 2019



LATITUDE

Exploratory Data Analysis: Map of Cycling Incidents (KSI 2015 - 2019)



Analysis of Factors

61%
of collisions occured during daylight

90%
of collisions occured on dry roads

92%
of collisions occurred with clear visibility

86%
of collisions occured on major arterial roads

If most collisions occur under ideal conditions, then what other factors explain these collisions?

Analysis of Factors

55%

of collisions occured while the cyclist was going ahead of the vehicle

46%

of collisions occured because the driver either disobeyed traffic control, was driving improperly, or failed to yield right of way

Driver attitude and driving behavior has the most impact on collisions on major arterial roads.

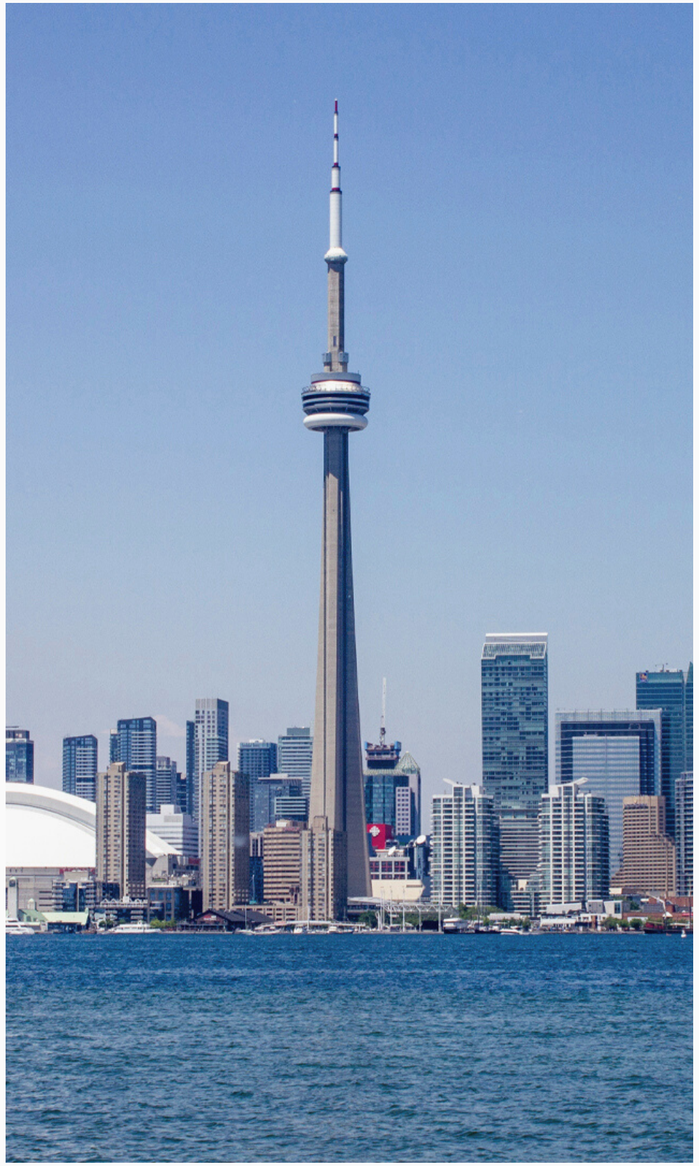
Commonality of Many Collision Sites: Blind Spots & No Bike Lanes

Top: Grange Ave., Downtown. Bottom: Brimley Road, Markham.

Top: Dundas East, Downtown. Bottom: Queensway, Etobicoke.

Generalizations and Recommendations

- Most collisions cannot be explained by inclement weather conditions
- Lack of bike lanes may be a contributing factor to collisions
- Driver attitude and driving behavior is a major contributing factor



Future Studies

- ## Adding Cycling Lanes to the KSI Dataset

The presence or absence of cycling lanes should be a variable measured in the KSI dataset. This will help future researchers examining the problem of automotive-cyclist collisions.

- ## Measuring Blind Spots to find Dangerous Intersections

A study should be conducted to measure the presence of blind spots at intersections. This measure can contribute to building a more complete picture of the causes of collisions.

- ## Testing Interventions at Dangerous Intersections

Interventions should be put in place at dangerous intersections and their effectiveness should be measured over time to determine which, if any, interventions reduce automotive-cyclist collisions.

Summary of Findings

Adverse conditions cannot explain the majority of cyclist collisions

The majority of automobile-cyclist collisions occurred during ideal weather conditions. While part of this finding can be explained by the increase in cyclists using roads during good weather, the fact remains that weather alone is not the main factor.

Bike Lanes Save Lives

A study which analyzed 13 years of data found that Bicycle Lanes resulted in a dramatic decline in fatality rates for all road users. (Marshalla & Ferenchakb, 2019).

This study supports the danger posed by a lack of cycling lanes.

Driver Education

Drivers should be educated on the need to be vigilant while sharing the road with cyclists.

An Eye-Tracking Study Found More Than Half of Drivers Don’t Look for Cyclists and Pedestrians*

- University of Toronto Faculty of Applied Science & Engineering. (2018, August 9). More than half of drivers don't look for cyclists and pedestrians before turning right: U of T Engineering researchers tracked drivers' eye movements to examine how attention is divided during turning, revealing that many fail to shoulder check -- especially those who frequently drive downtown. ScienceDaily. Retrieved March 28, 2021 from www.sciencedaily.com/releases/2018/08/180809125600.htm
- Marshalla , W. E., & Ferenchakb, N. N. (2019). Why cities with high bicycling rates are safer for all road users. Journal of Transport & Health Volume.