report_figures

August 12, 2020

1 Figures

1.1 Spearman correlations table

1.1.1 Spearman correlations table

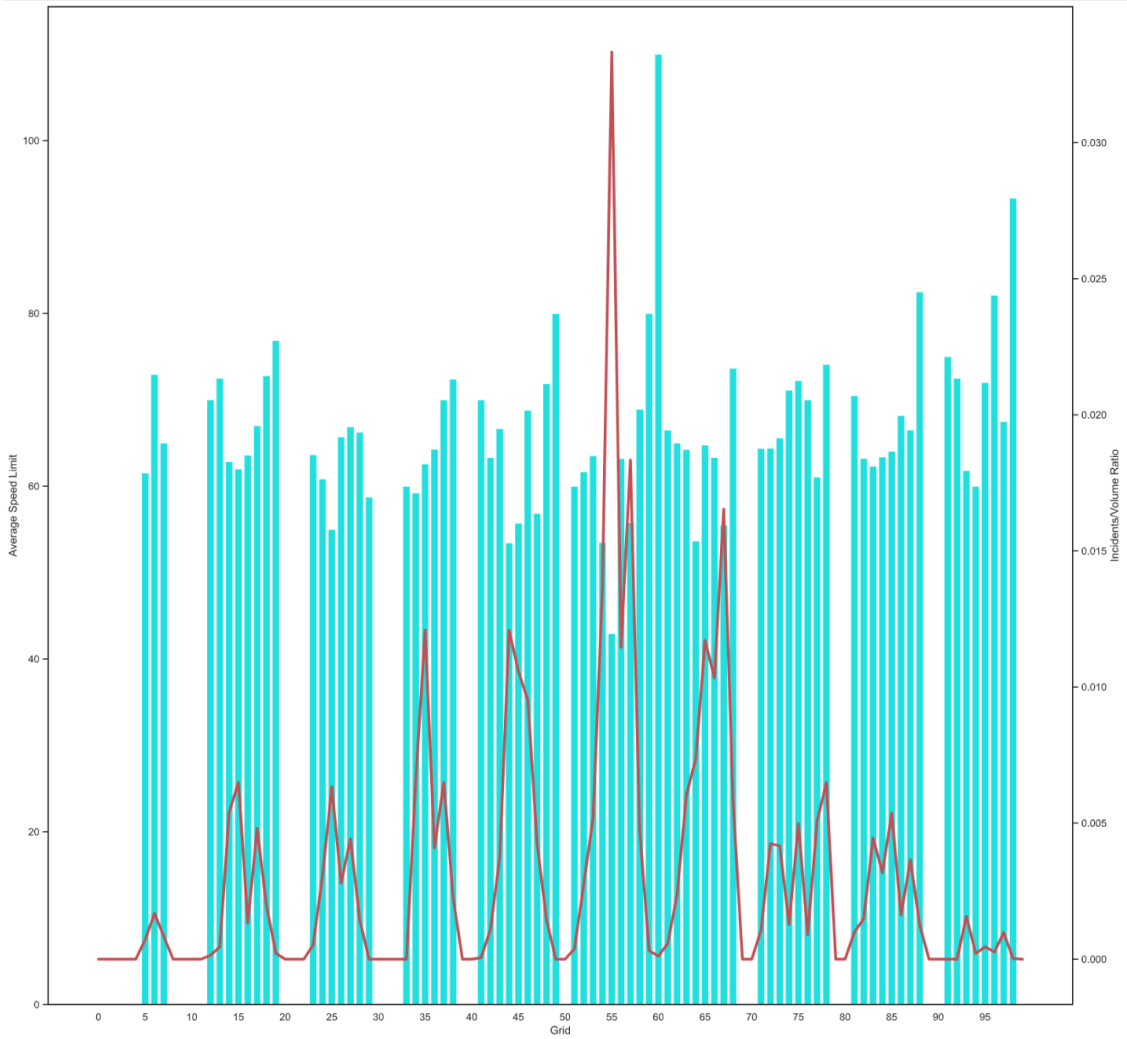
```
Grid data
Spearman correlation against incident/volume
Cameras: 0.730782361308677
Signals: 0.922076813655761
Signs: 0.8823897581792318
Speed: -0.5109218807848945

Weather data
Spearman correlation against average daily incidents
Visibility: -0.12976805363960087
Temperature: -0.02263124255039828
```

Spearman coefficients were calculated using the independent variable (cameras, signals, weather data etc.) rankings against the dependent variable (incident) rankings. The incidents were controlled for volume in the grid data, and for daily average in weather data. From the table, we can see that cameras, signals and signs have a notable positive correlation, speed (limits) have a slight negative correlation and weather data has little correlation. However, further figures will go into each variable and provide an interpretation of these correlations (i.e. the causality).

1.2 Traffic speed limit data

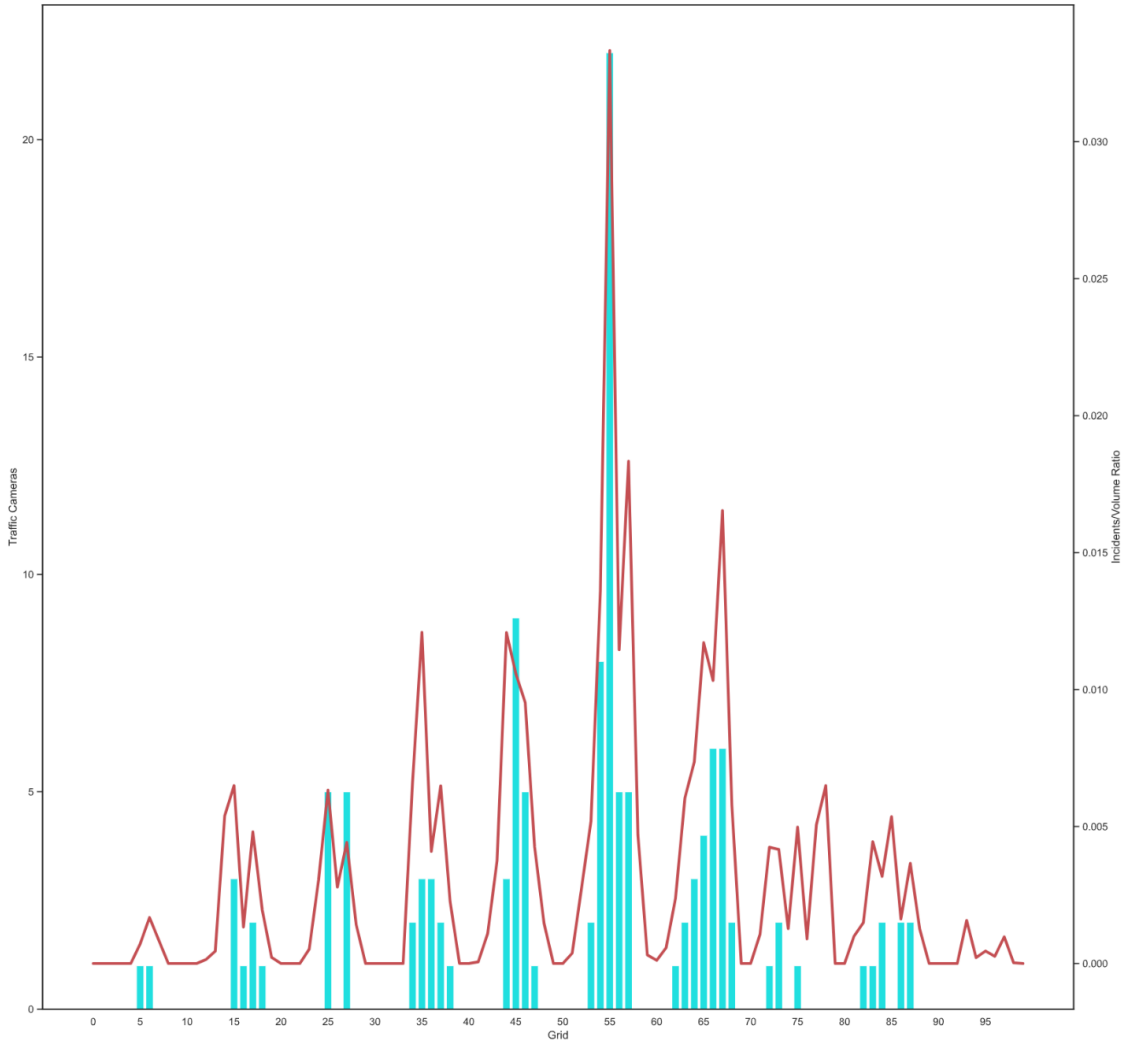
1.2.1 Average speed limit (bar graph) and traffic incident/volume ratio (line plot)



Average speed limit seems relatively consistent from grid to grid. All values range from around 50km/h to 70km/h. In fact, some grids with lower average speed corresponds to higher incident/volume ratio, such as near grids 35, 45, 55 and 65. The reason could be that these grids are from the downtown area. Grid 55 is at downtown centre. It has the highest incident/volume ration but the lowest average speed at only around 40km/h. Hence there is no clear evidence of a positive correlation between average speed limit and incidents.

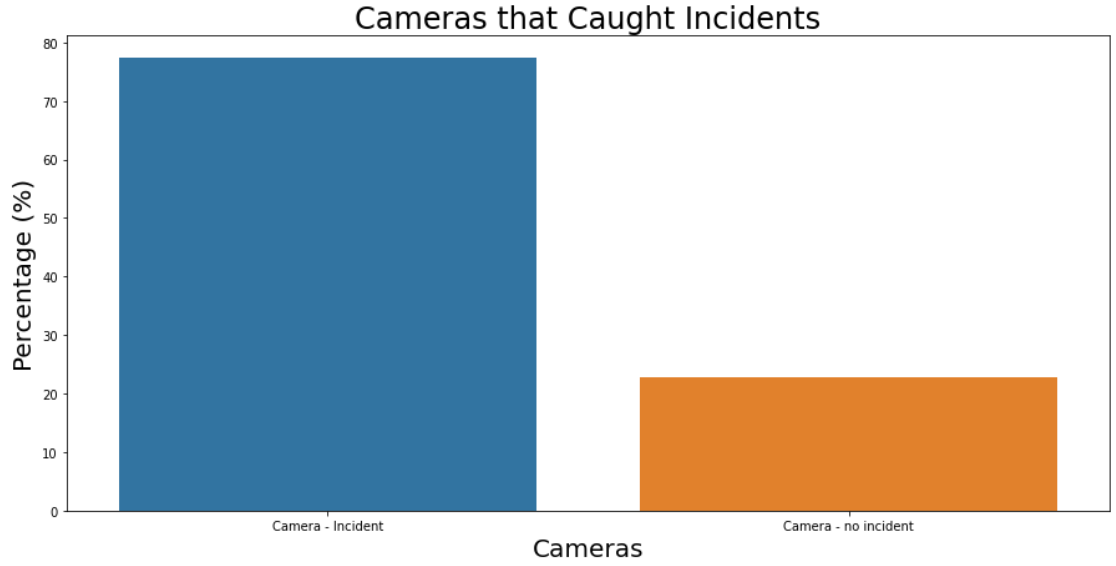
1.3 Traffic camera data

1.3.1 Traffic cameras (bar graph) and traffic incident/volume ratio (line plot)



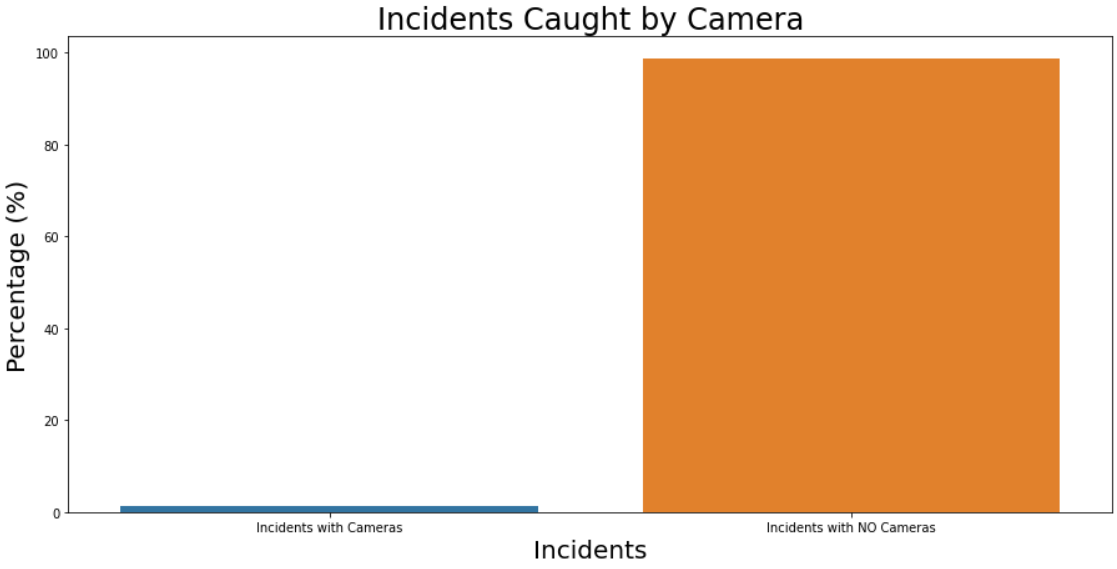
Grids with more cameras tends to have more incidents. The graph shows a relatively strong positive correlation between number of traffic cameras and incidents occurred. One reason could be that more drivers tend to brake harder to avoid red light tickets, increasing rear-end collisions and other "non-angle" collisions.

1.3.2 Cameras that caught incidents (bar graph)



The figure above shows that 77% of cameras came within range of an incident and 23% did not. The cameras are potentially well placed.

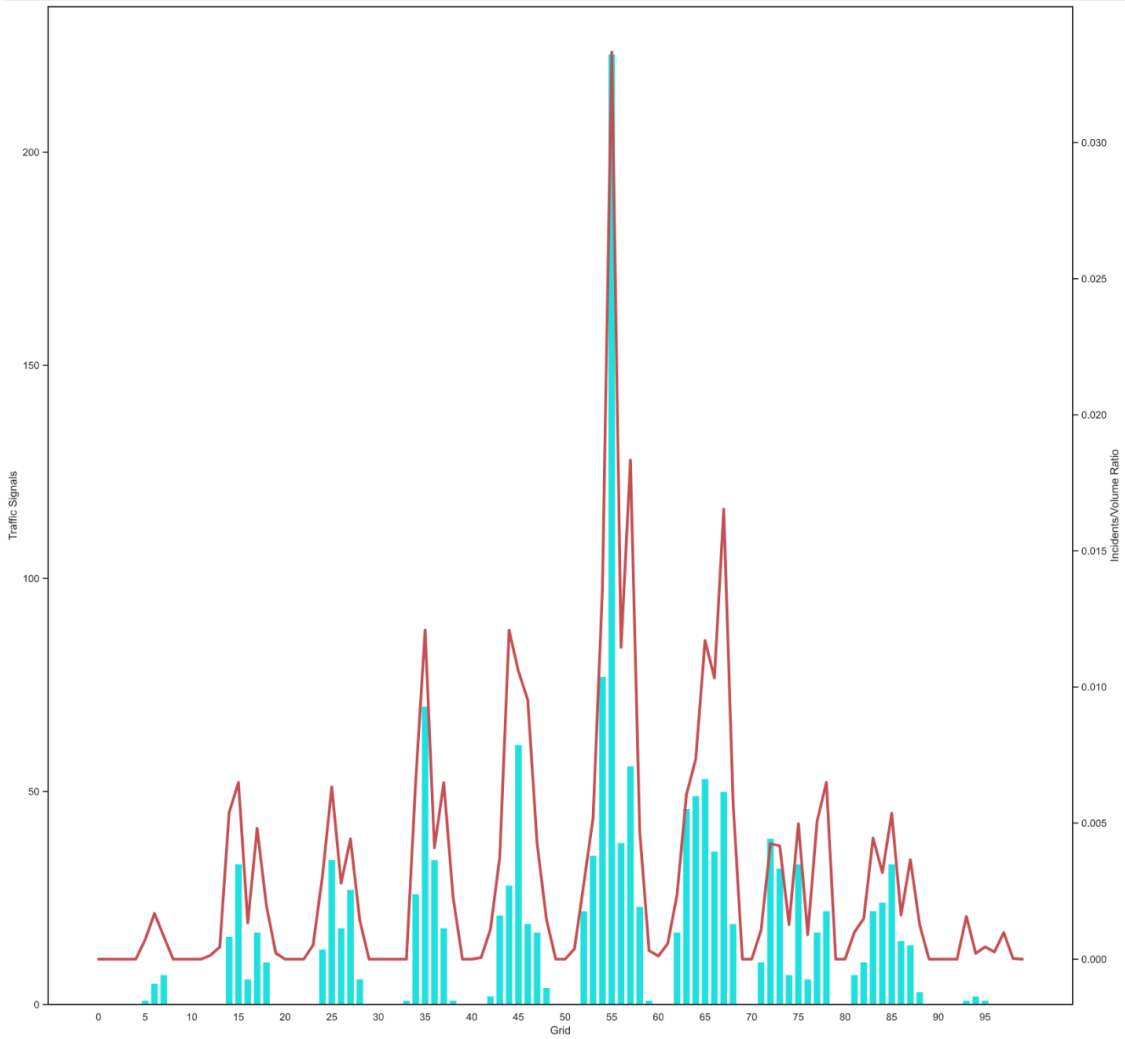
1.3.3 Incidents caught by camera (bar graph)



The figure above shows that only 1.4% of incidents occur near cameras. From looking at this data, as well as the signals data (incidents that happen near traffic signals / intersections), most incidents probably occur near locations of speed changes (slowing down/speeding up). Most cameras do not occur near incidents, because there are often "speed" cameras, that are located in the middle of highways where cars are all moving at the same speeds.

1.4 Traffic signal data

1.4.1 Traffic signals (bar graph) and traffic incident/volume ratio (line plot)



Grids with more traffic signals tends to have higher incidents. Overall, it shows a strong positive correlation between number of traffic signals and incidents occurred, meaning that traffic signals may increase the number of accidents in a given area. This may be due to the higher possibility of rear-end collisions near places with traffic signals.

1.4.2 Intersection types table

	INT_TYPE	Incidents	Signal Count	%Incidents to Signal Count
0	1/2 signal	5.0	21	23.809524
1	Traffic signal	161.0	1010	15.940594
2	Traffic signal T intersection	27.0	232	11.637931
3	Overhead Flasher	14.0	257	5.447471
4	Pedestrian RRFB	1.0	159	0.628931
5	1/4 signal	0.0	10	0.000000
6	Fire signal	0.0	7	0.000000

There is a higher ratio of incidents that occur near 1/2 signals. However, there are a lot fewer 1/2 signals than other signals, so this result should be taken with a grain of salt

1.4.3 Signals by city quadrant table

	QUADRANT_x	Incidents	Signal Count	%Incidents to Signal Count
0	S	19.0	46	41.304348
1	SW	83.0	497	16.700201
2	SE	62.0	457	13.566740
3	NE	30.0	294	10.204082
4	NW	14.0	355	3.943662
5	E	0.0	11	0.000000
6	N	0.0	36	0.000000

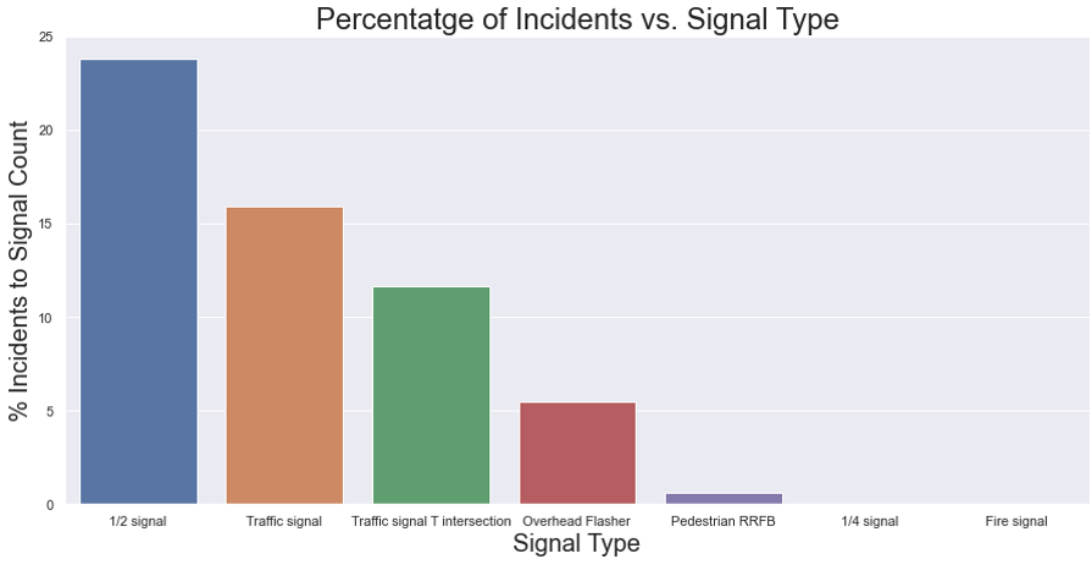
The South quadrant of calgary has the highest incident to traffic signal percent.

1.4.4 Signals with/without pedestrian button table

	PEDBUTTONS	Incidents	Signal Count	%Incidents to Signal Count
0	No	94.0	330	28.484848
1	Yes	114.0	1364	8.357771

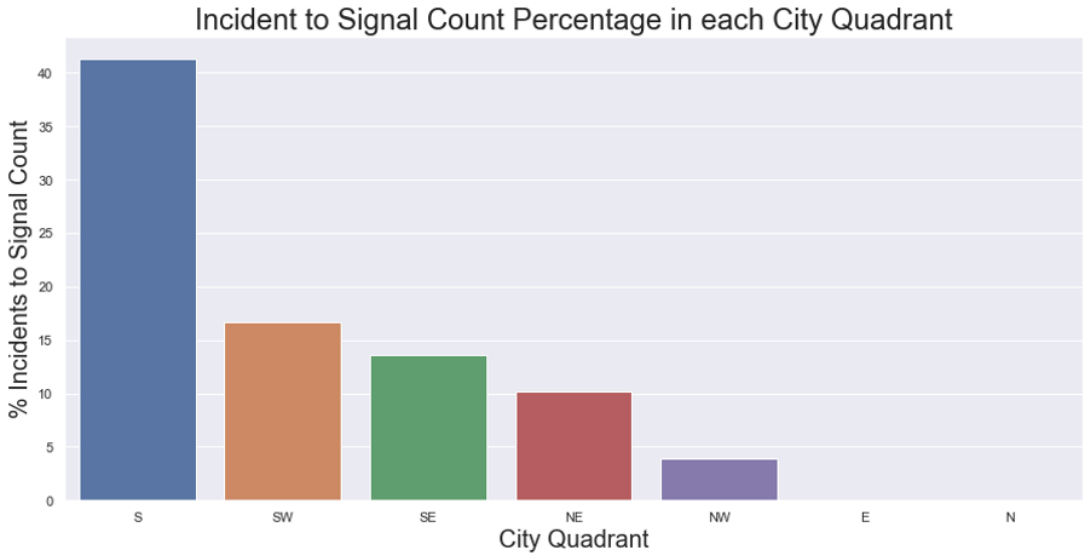
You are 20% more likely to get into an accident at intersections without a pedestrian button.

1.4.5 Percentage of incidents vs. signal type (histogram)



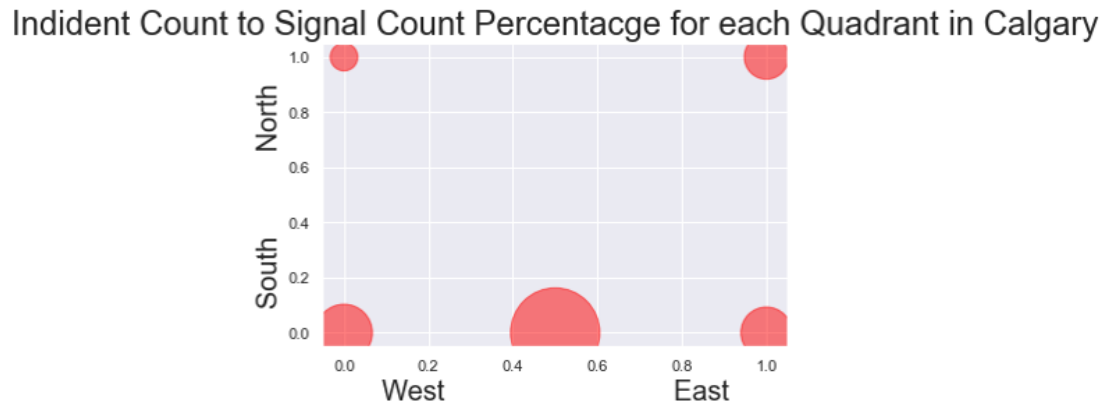
The histogram shown above indicates that the highest percentage of incidents occur by "1/2" signals, followed by the other type of intersections that have traffic signals. A "1/2 Signal" is an intersection where half of the roads have to stop at an intersection signs, where as the others can pass through most of the time. (2/4 of the roads have a traffic signal). This could be dangerous because the intersections are less noticeable and are usually found when a smaller road needs to pass through a larger/faster road.

1.4.6 Incident to signal count percentage in each city quadrant (histogram)



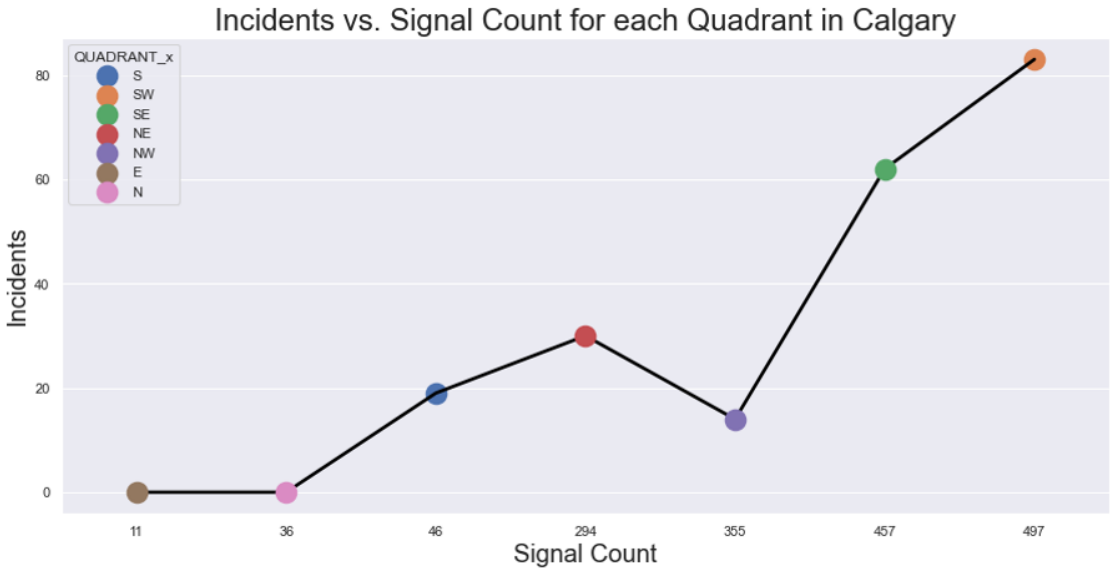
The figure above indicates that the Southern Quadrant of the city has the most accidents per signal ratio.

1.4.7 Incident count to signal count percentage in each city quadrant (bubble graph)



This figure shows the percentage incidents to signal count in each quadrant of the city. The south has the highest incident to traffic signal ratio.

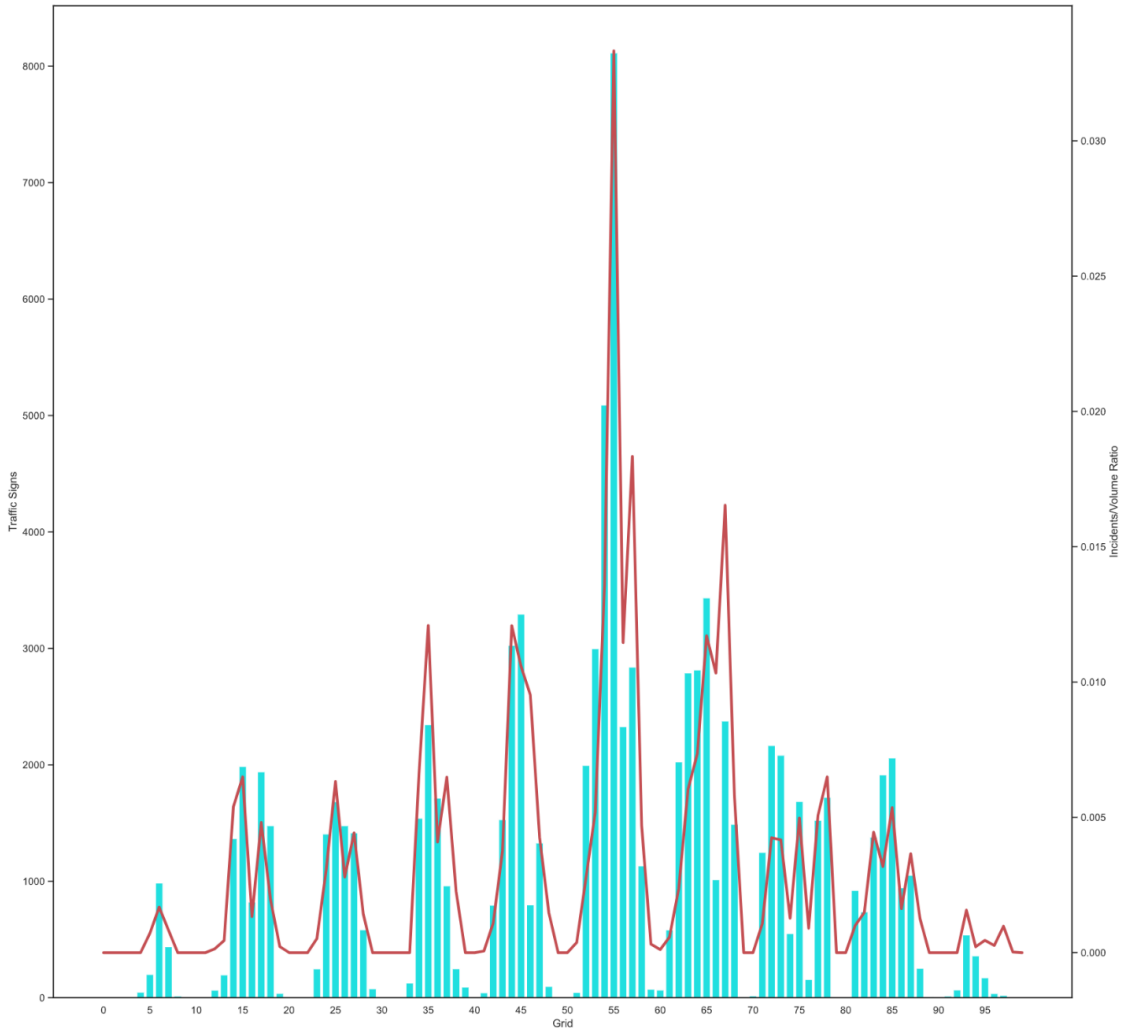
1.4.8 Incident count to signal count in each city quadrant (line plot)



The figure above shows that the SW quadrant of the city (orange marker) has the most incidents, however it also has the most signals.

1.5 Traffic sign data

1.5.1 Traffic signs (bar graph) and traffic incident/volume ratio (line plot)



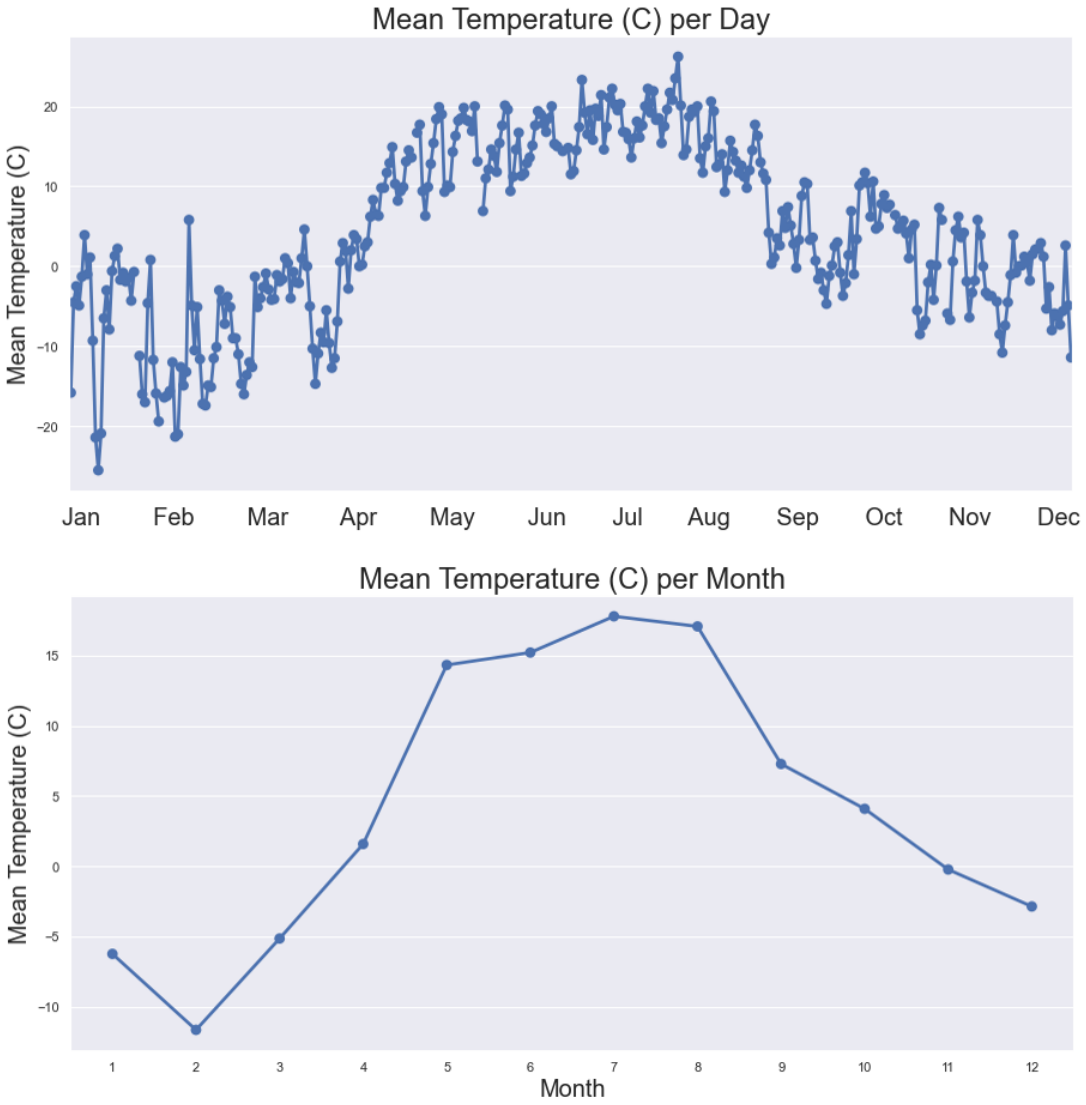
Grids with more traffic signs tends to have more incidents. The graph shows a strong positive correlation between number of traffic signs and incidents occurred. This could be due to that most traffic signs are installed at places with higher incidents, as it provides information to drivers and pedestrians to maintain order and reduce accidents.

1.6 Weather data

1.6.1 Visibility and mean temperature table

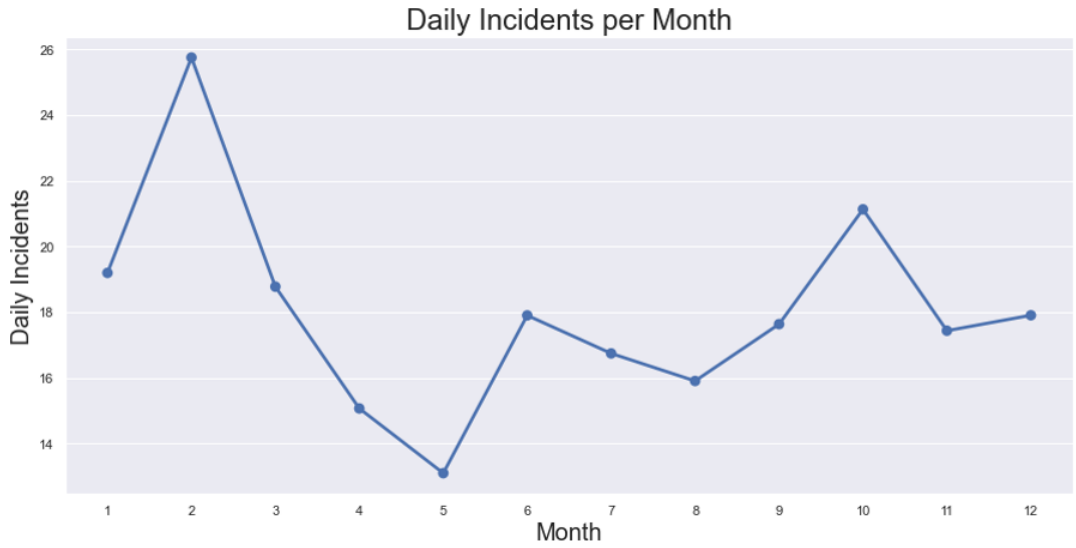
	Visibility (km)	Mean Temp (C)
count	365.000000	356.000000
mean	29.843530	4.378933
std	14.312455	10.910681
min	1.758333	-25.500000
25%	17.033333	-3.400000
50%	33.966667	3.900000
75%	41.229167	13.925000
max	53.995833	26.200000

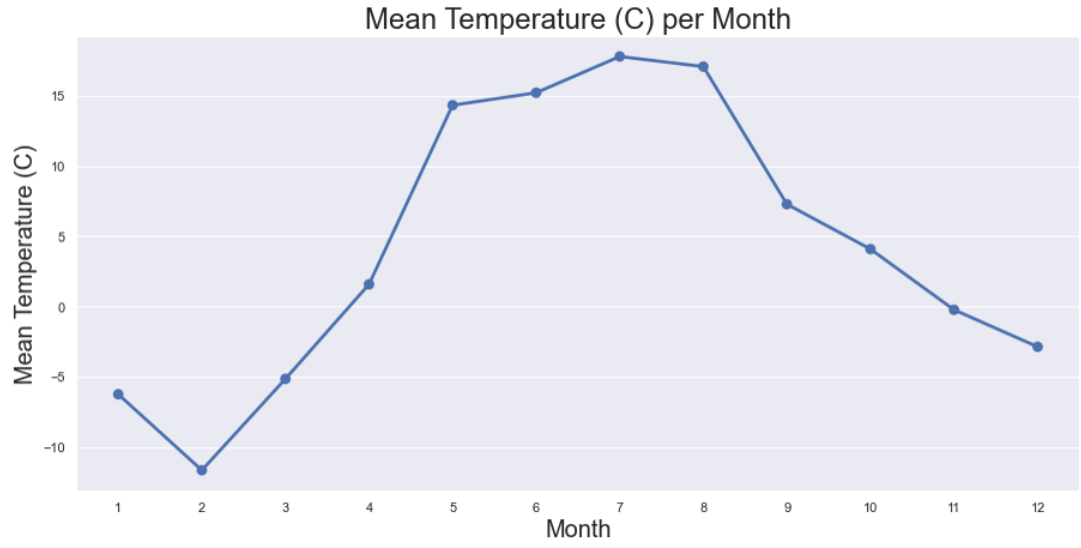
1.6.2 Mean temperature per day/month



The above figure shows the average monthly temperature in Calgary in 2018. We have the coldest weather in Jan/Feb, and the best/hottest weather from May until August.

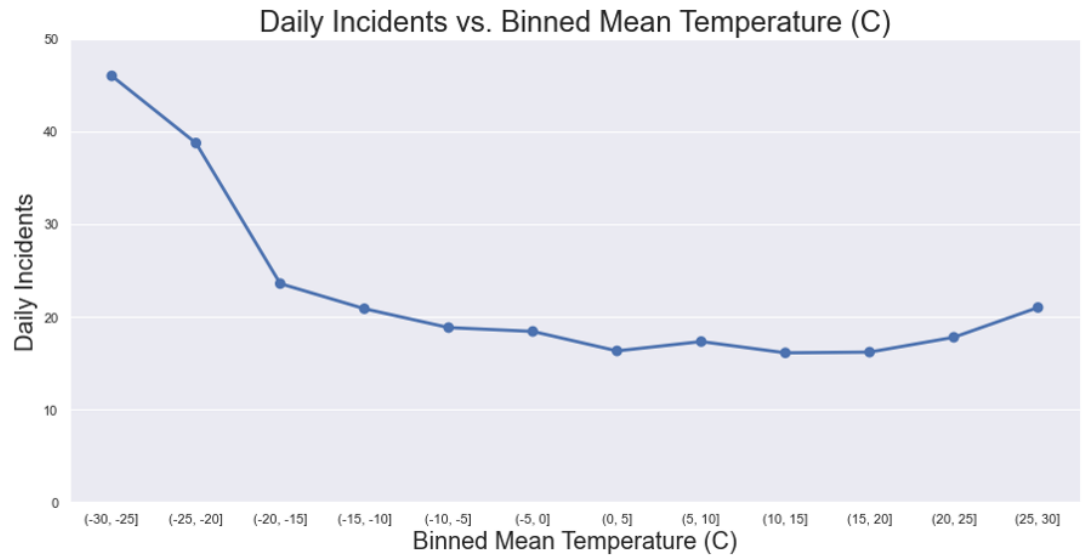
1.6.3 Comparing average daily incidents and mean temperature





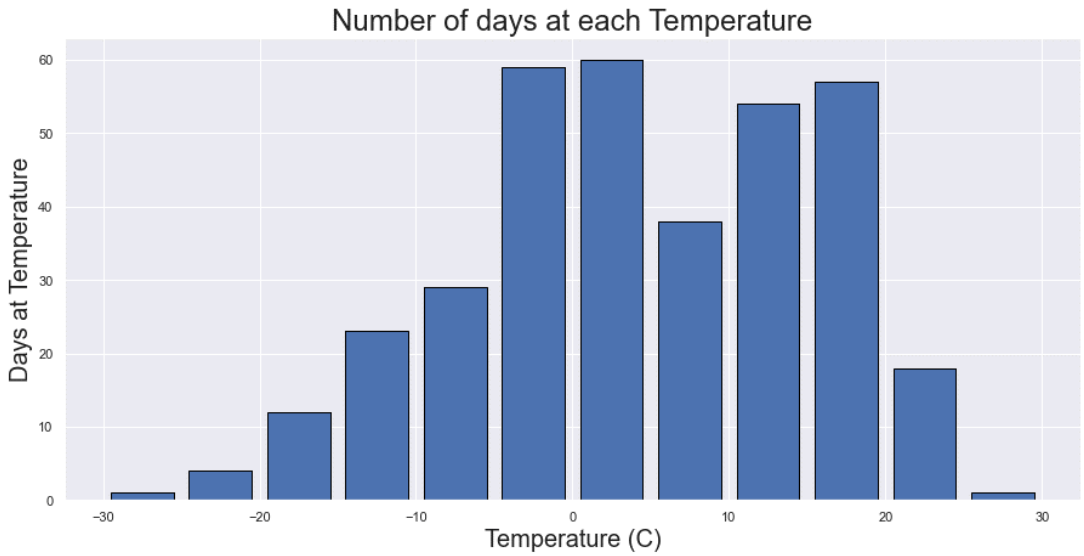
The coldest weather is in Jan/Feb. This is also the temperature and month that we see the most collision/day.

1.6.4 Daily incidents vs binned mean temperature



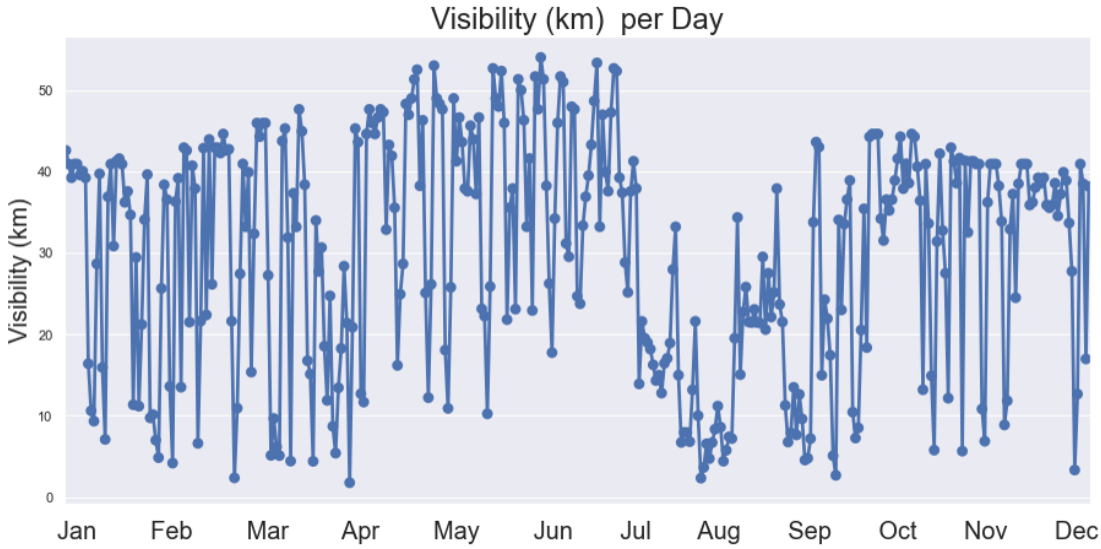
Daily incidents are relatively stable for temperature above -15C. However during bad/cold weather, the daily incidents go up.

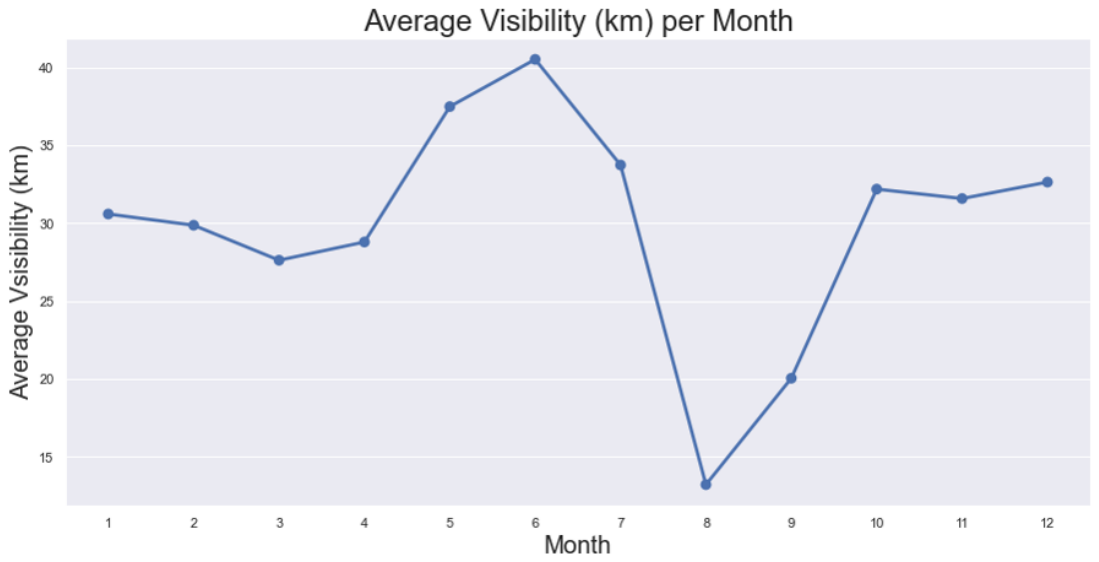
1.6.5 Number of days at each temperature (histogram)



The above figure shows that in 2018, the most common temperatures in Calgary are between -5C and +20C.

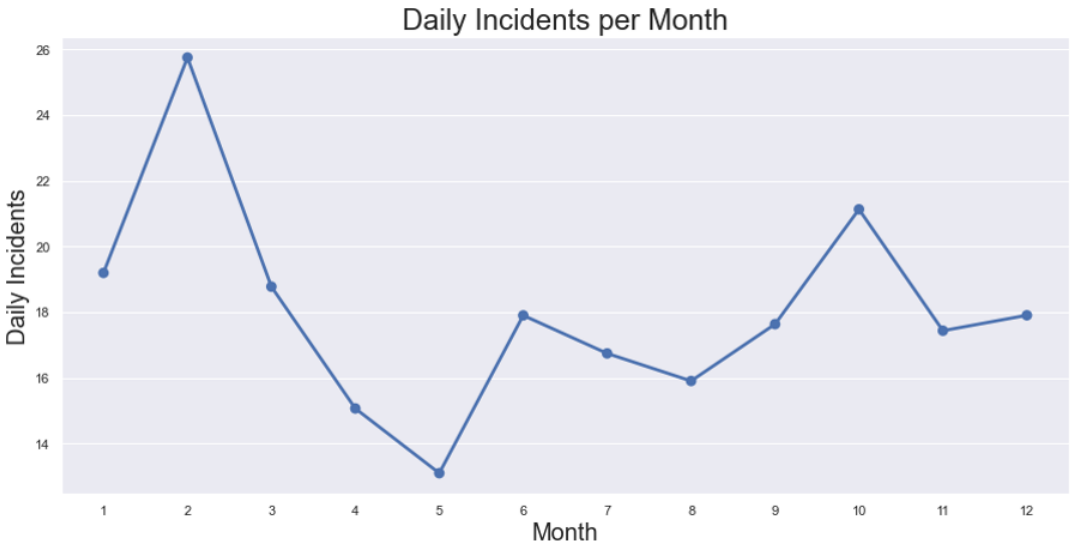
1.6.6 Average visiblity per day/month

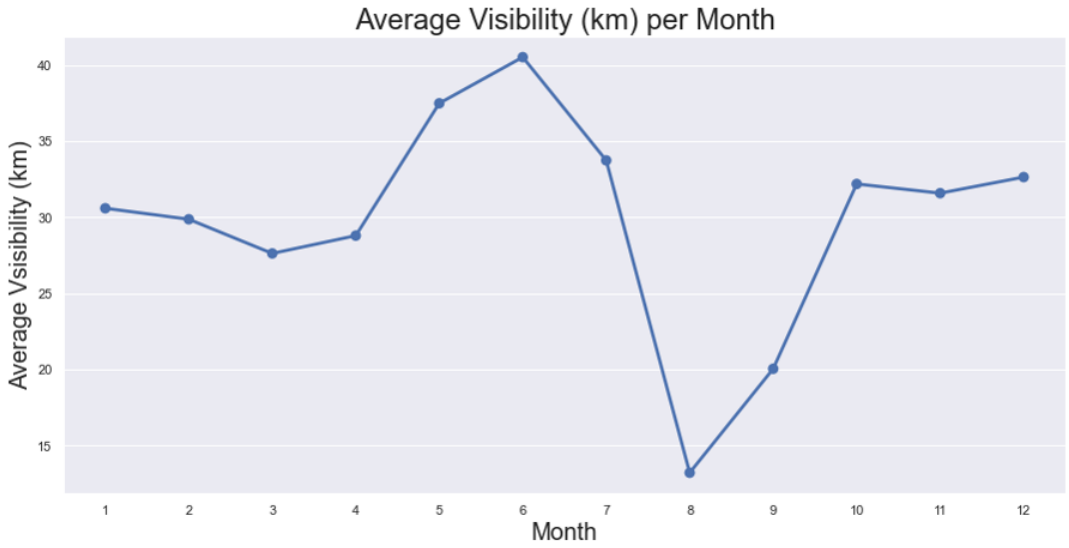




The above figure shows that the average visibility for each month can be seen in 2018. Visibility was at its lowest in August.

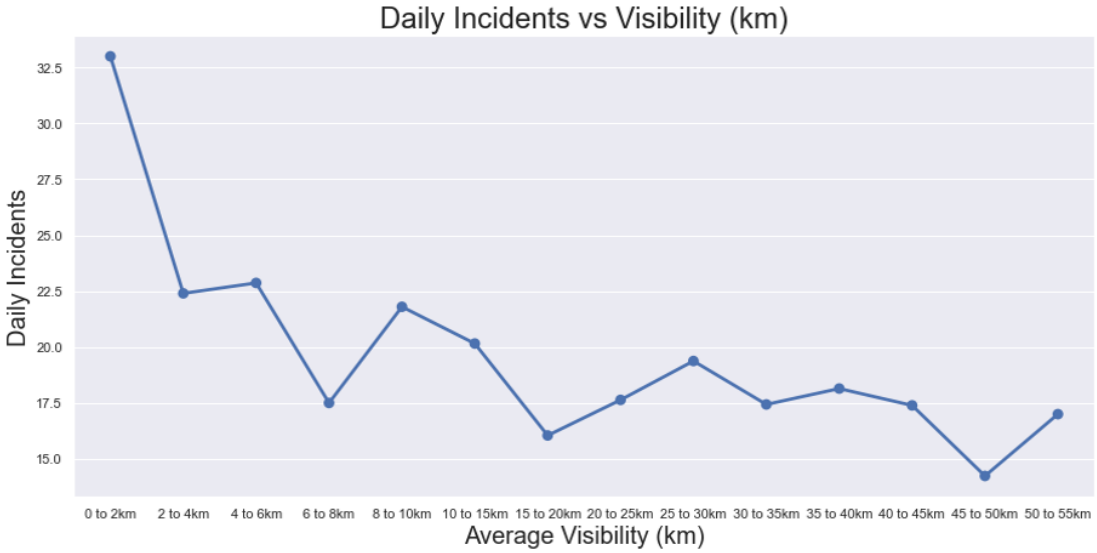
1.6.7 Comparing average daily incidents and visibility





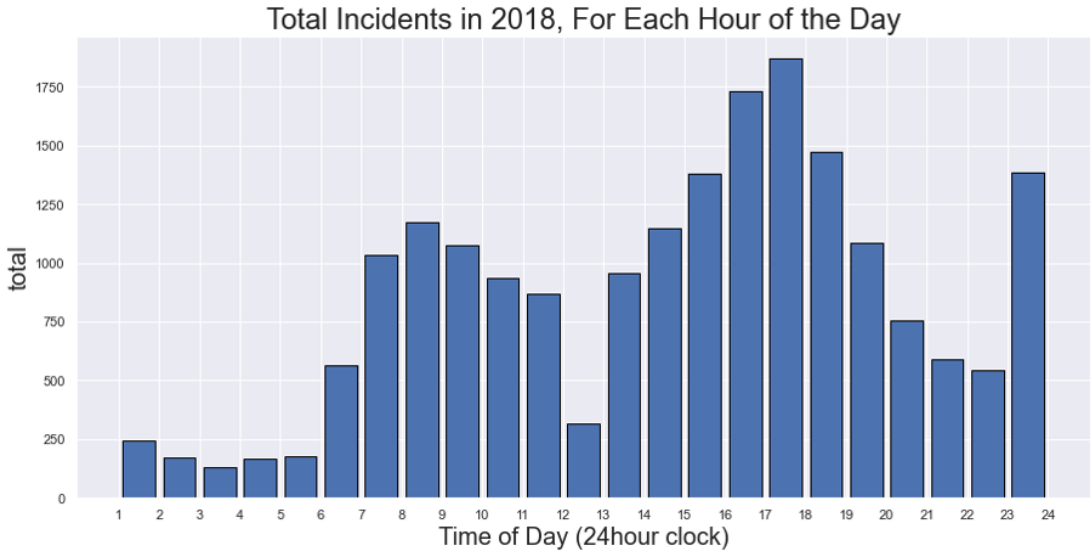
Comparing average visibility per month and average daily incident per month, not much correlation is shown. However, measuring visibility over a month average could be hiding some data. (The next figure will directly compare visibility to incidents)

1.6.8 Daily incidents vs binned visibility



Comparing average visibility per month and average daily incident per month, not much correlation is shown. However, measuring visibility over a month average could be hiding some data. (The next figure will directly compare visibility to incidents)

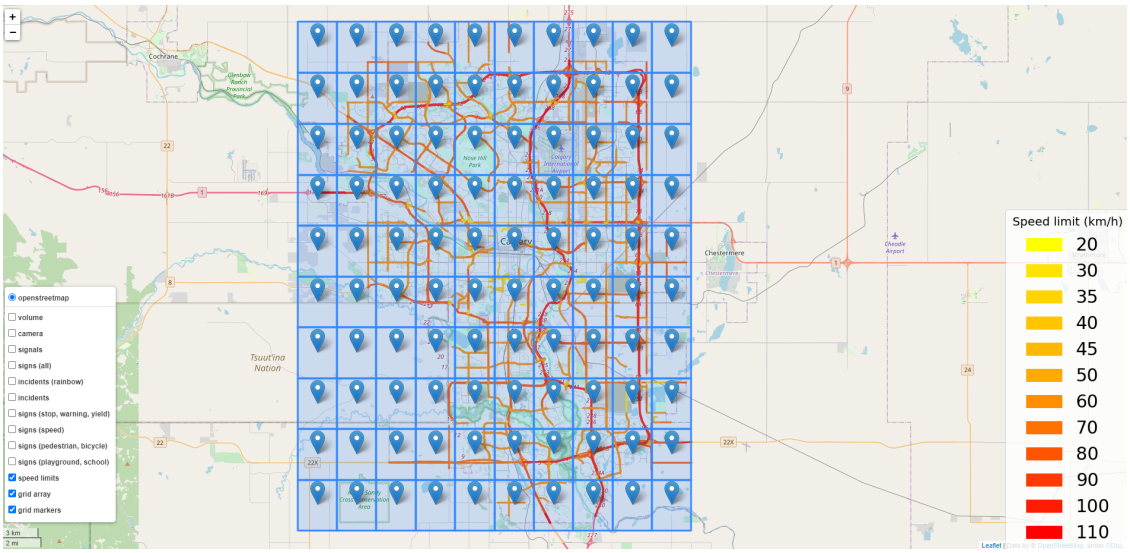
1.6.9 Total incidents per hour of the day



The above figure is very interesting. It shows that most incidents occur around 8am, and 5pm. These times correlate perfectly to rush hour times, when everyone is rushing into downtown to get to work, and traffic volumes are very high. Also, incidents are very high at midnight. This might be due to irresponsible driving during these hours or lower visibility.

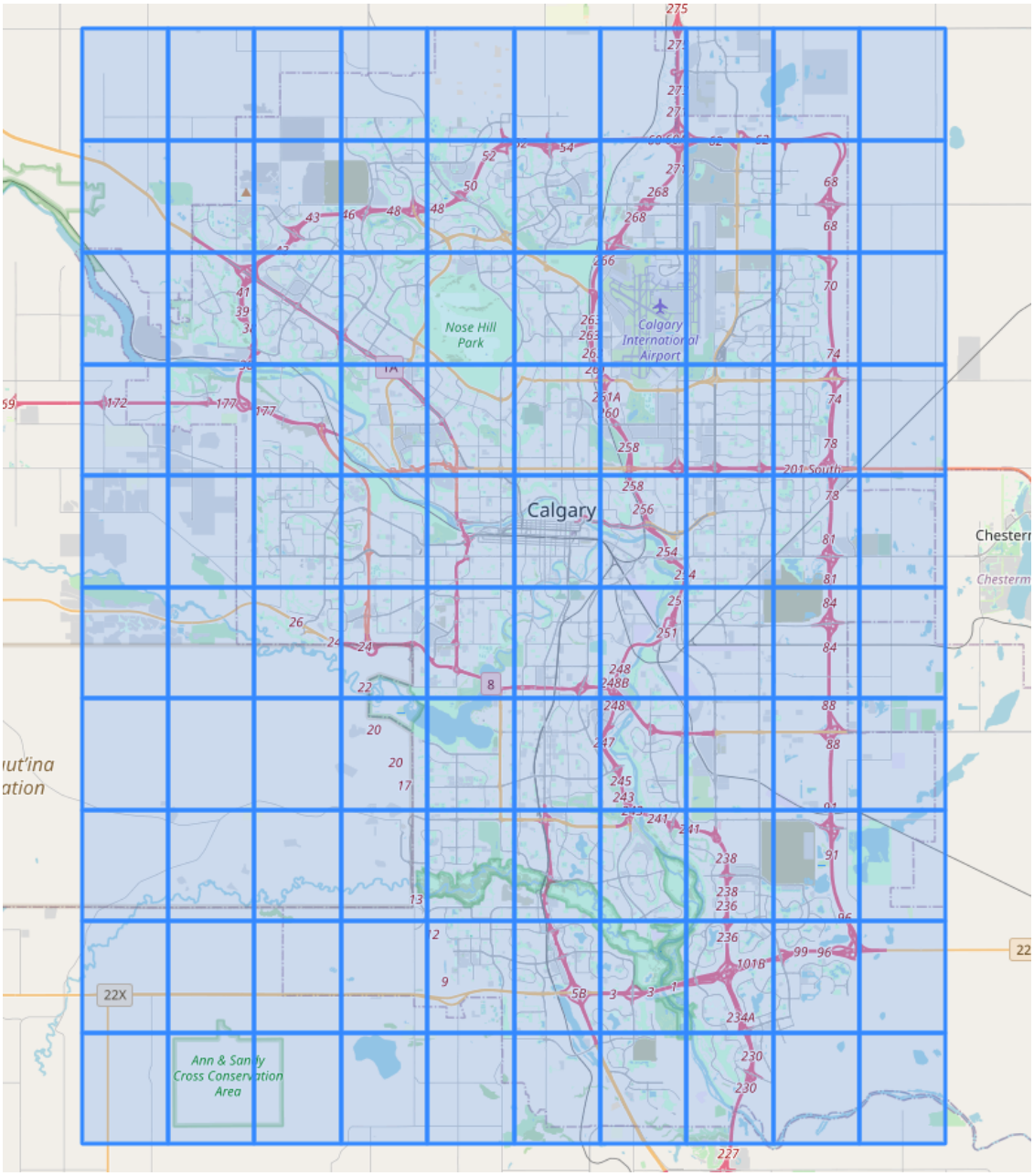
1.7 Maps

1.7.1 Full map



For full interactive map, see https://jchoi64.github.io/592_project_final/

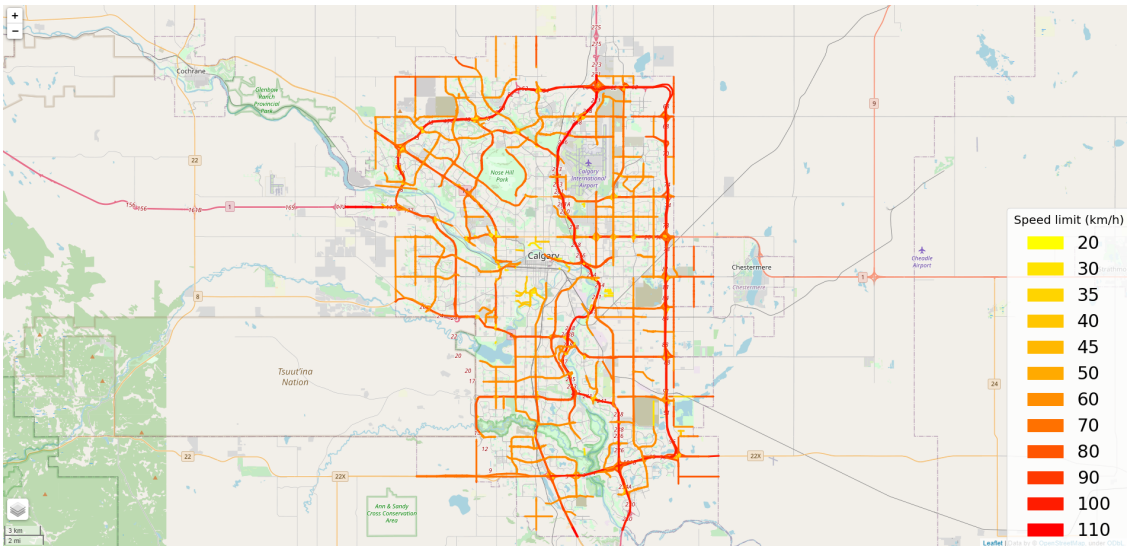
1.7.2 10x10 Grid



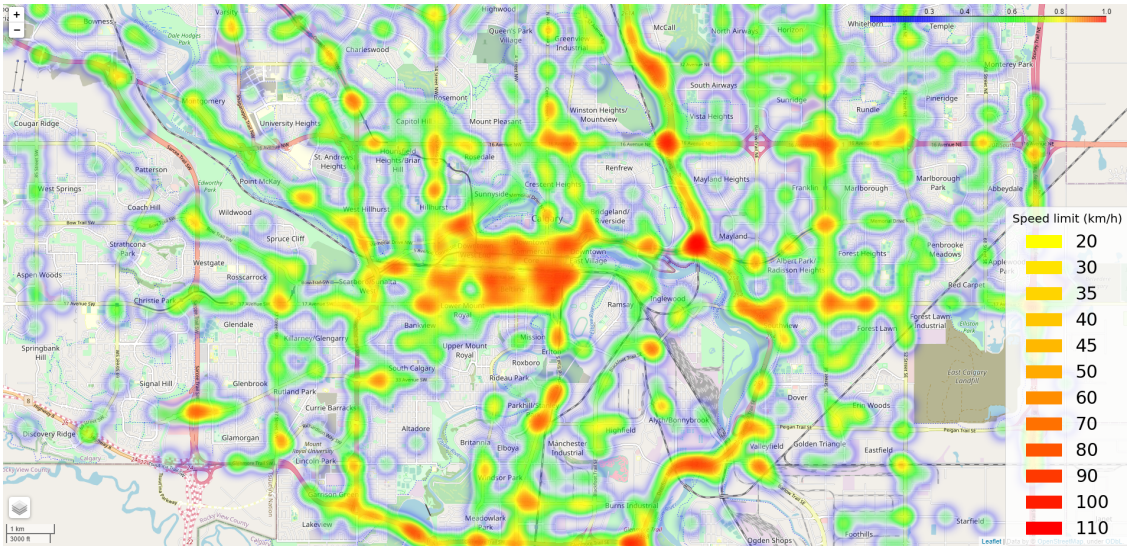
1.7.3 Markers


Grid: 55
Average Speed Limit: 42.94117647
Average Traffic Volume: 13951.75439
Total Cameras: 22
Total Signals: 223
Total Incidents: 465
Total Signs: 8114
Calgary
22X

1.7.4 Road speed limits

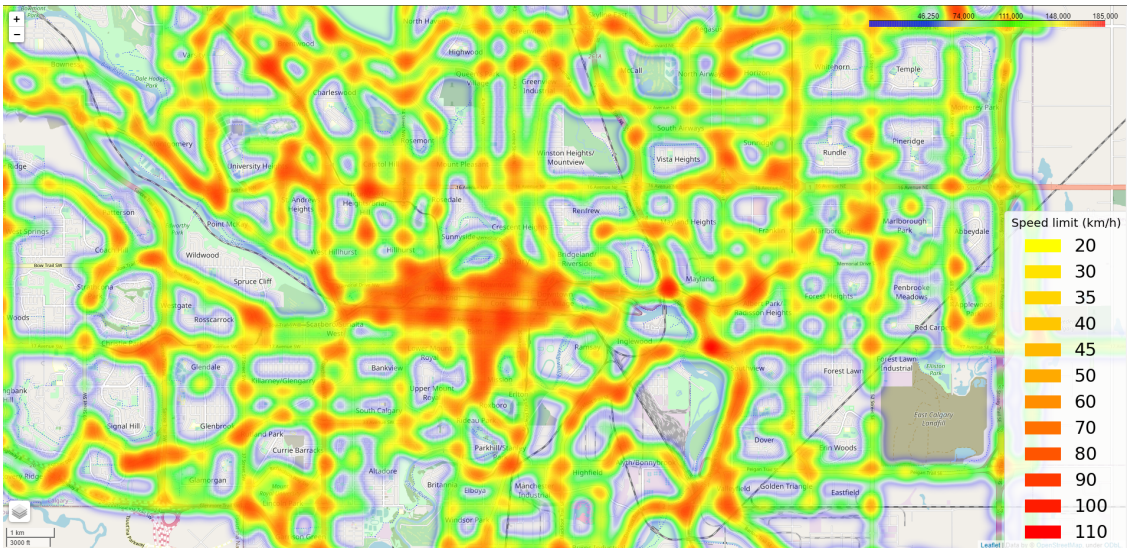


1.7.5 Incidents heat map (zoomed adjusted for best resolution)



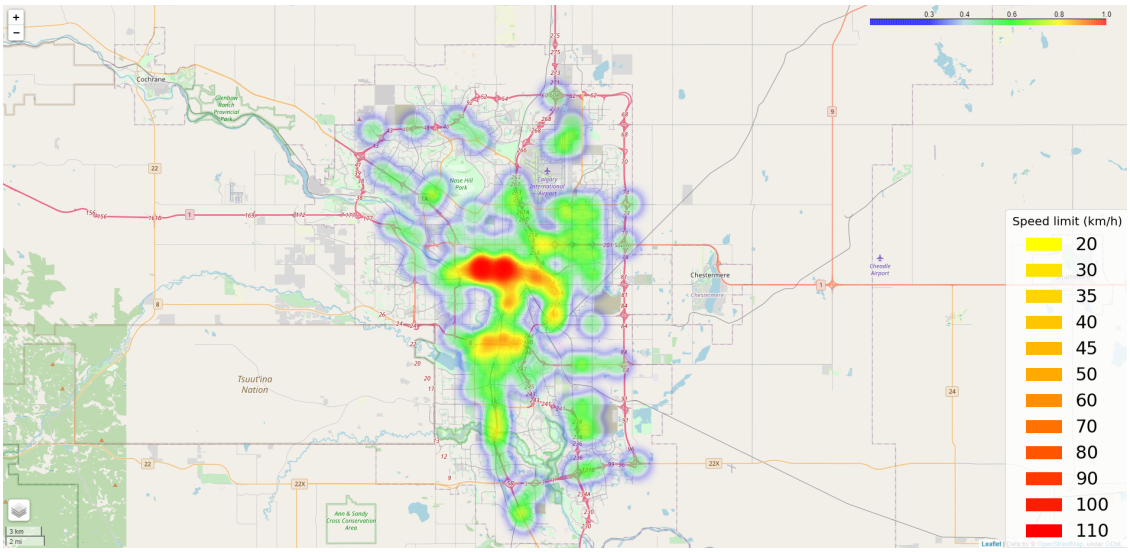
The incident heatmap shows us that most incidents occur in the downtown area, as well as intersections and merging roads. This correlates well with the volume heatmap which will be shown next. Intuitively this makes sense as more volume will generally lead to more incidents by default. (To see the full view of Calgary, please use the interactive map https://jchoi64.github.io/592_project_final/)

1.7.6 Volume heat map (zoomed adjusted for best resolution)



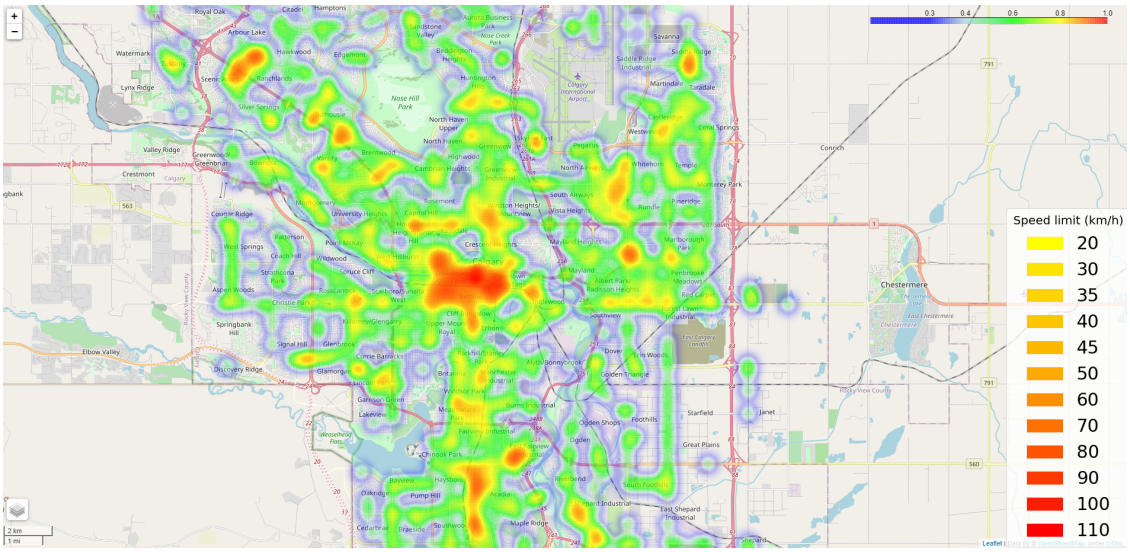
The volume heatmap shows that most traffic occurs within downtown. Other noteworthy areas of high volumes are at intersections and road merges. (To see the full view of Calgary, please use the interactive map https://jchoi64.github.io/592_project_final/)

1.7.7 Camera heat map (zoomed adjusted for best resolution)



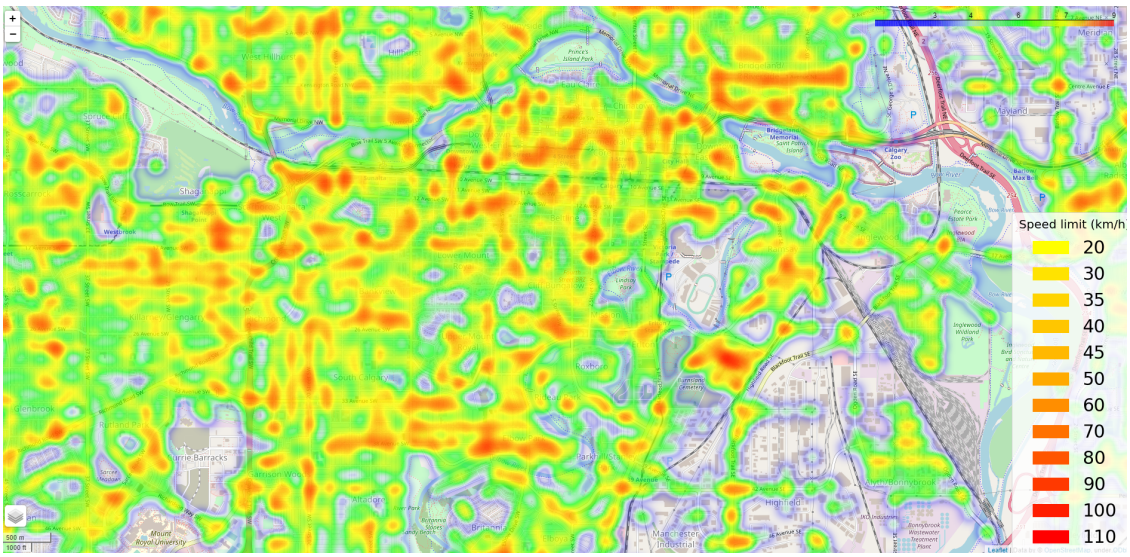
While camera data is sparse (only 126 points throughout all of Calgary), it shows that most are located within the downtown region. This also explains the high correlation between cameras and incidents because most incidents occur in downtown where the cameras are placed. This may also be deliberate by the city of Calgary, by placing cameras in high incident locations. (To see the full view of Calgary, please use the interactive map https://jchoi64.github.io/592_project_final/)

1.7.8 Signals heat map (zoomed adjusted for best resolution)



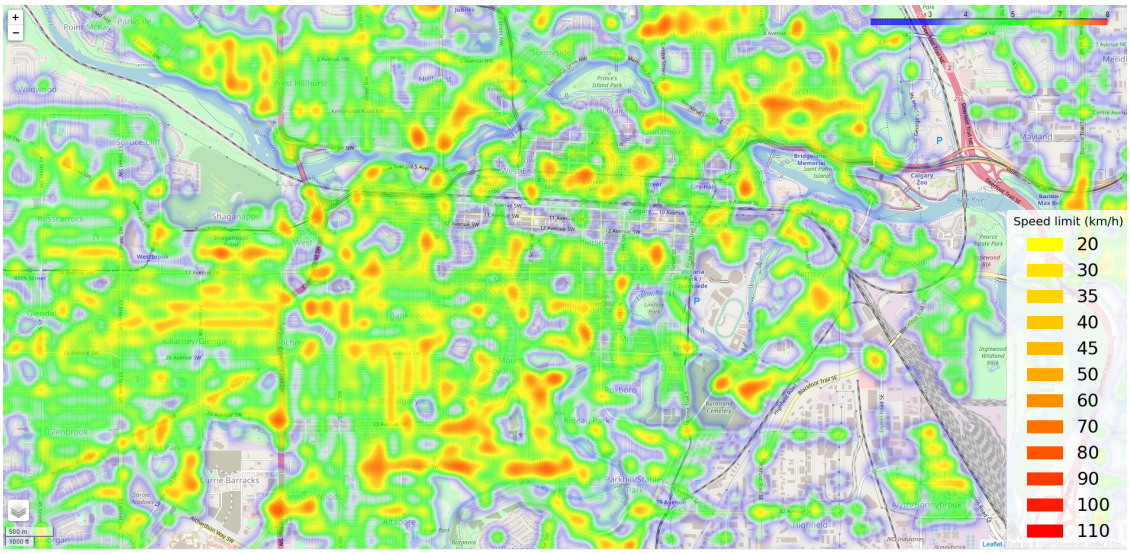
Similarily with cameras, most signals are found within downtown Calgary. This is one reason why the correlation is high with incidents. Another reason is that signals are also placed at intersections which is another area with high incident count. (To see the full view of Calgary, please use the interactive map https://jchoi64.github.io/592_project_final/)

1.7.9 Signs (all signs) heat map (zoomed adjusted for best resolution)



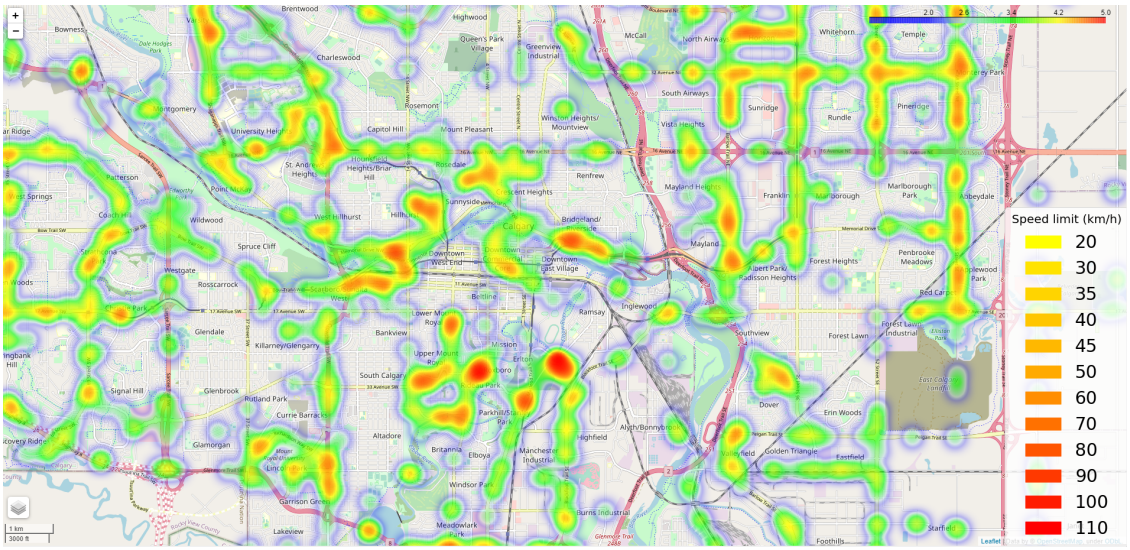
Due to the sheer number of signs, the heatmap (that includes all relevant signs) does not yield too much information. The most that can be determined from this is that since most signs occur at intersections, this would explain the high correlation between signs and incidents. Instead the next figures will show different groupings to determine if more information is available. (To see the full view of Calgary, please use the interactive map https://jchoi64.github.io/592_project_final/)

1.7.10 Signs (stop, warning, yield) heat map (zoomed adjusted for best resolution)



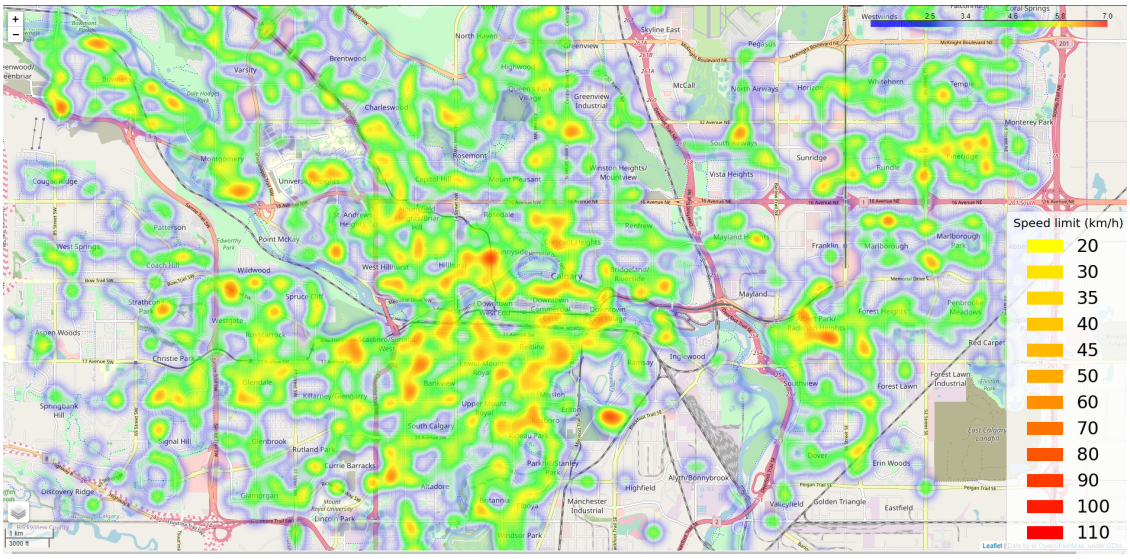
One grouping that was chosen was stop signs, warning signs and yield signs. Failure to follow these signs could lead to an incident which is why these were grouped. However if properly followed (which most driver should be doing), incidents could be lower in these areas. If layered with the incident data and ignoring the downtown region (which has a high incident count and sign count by design), we actually see that they don't overlap too much, which would mean that most people are following the rules of the road.(To see the full view of Calgary, please use the interactive map https://jchoi64.github.io/592_project_final/) (layer signs (stop, warning, yield) first, then incidents to see the overlap)

1.7.11 Signs (speed) heat map (zoomed adjusted for best resolution)



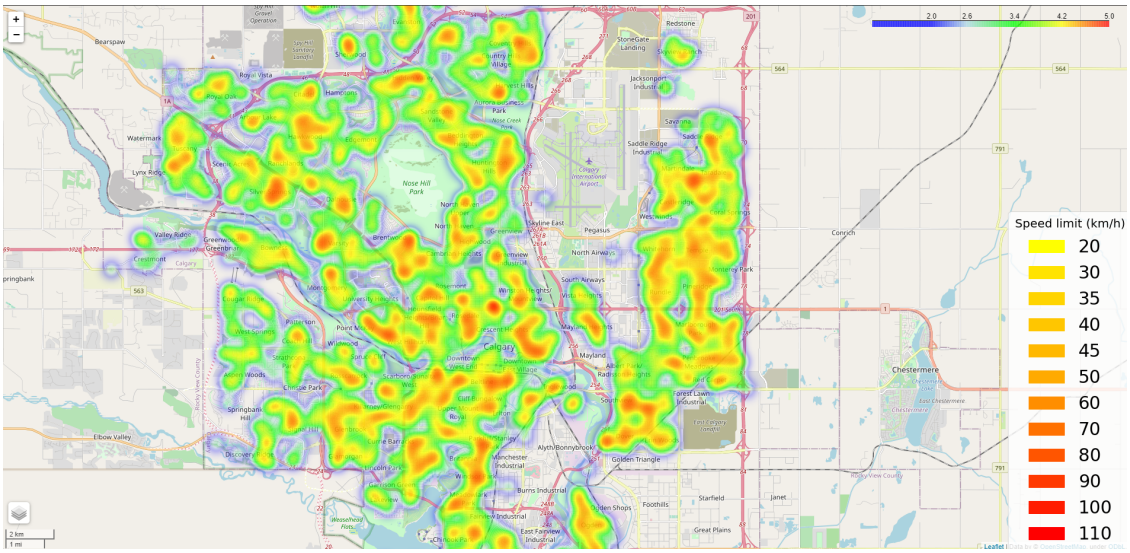
Speed signs were chosen as another grouping with the same reason for plotting the speed limit of the roads as lines. However the sparseness of the data does not yield much information. (To see the full view of Calgary, please use the interactive map https://jchoi64.github.io/592_project_final/) (layer signs (speed) first, then incidents to see the overlap)

1.7.12 Signs (pedestrian, bicycle) heat map (zoomed adjusted for best resolution)



Pedestrian and bicycle paths were chosen as a group but due to the incident data not distinguishing between pedestrian and vehicle incidents, we cannot draw any decisive conclusions from this heatmap. (To see the full view of Calgary, please use the interactive map https://jchoi64.github.io/592_project_final/) (layer signs (pedestrian, bicycle) first, then incidents to see the overlap)

1.7.13 Signs (playground, school) heat map (zoomed adjusted for best resolution)



School and playgrounds were chosen as the final grouping to see if a lower incident rate was found in these areas as drivers are generally more cautious/drive slower in these ares. If we zoom in, we can see that there is very low overlap between incidents and these areas, providing evidence that these areas have lower overall incident rates. (To see the full view of Calgary, please use the interactive map https://jchoi64.github.io/592_project_final/) (layer signs (playground, school) first, then incidents to see the overlap)