Lab 1: Summary Statistics, Spatial Queries and Joins

Connor Schultz
University of Victoria
GEOG 328 B03

February 1st, 2019

1 Introduction

In 2016 in Canada there were 334 pedestrian-vehicle collisions that resulted in fatality, and thousands more that resulted in injury (Transport Canada, 2018). In the City of Vancouver in 2015, there were 14 fatal vehicle-pedestrian collisions and 15 the year prior (Victoria Police Department). The pedestrian user group occupied more then 17% of the road user class in 2016 and the only measures to protect them from the road using majority, car users is carefully planned and executed safety features. The pedestrian groups with the greatest risk of harm are children and seniors. On average in the City of Vancouver, 40% of pedestrian-vehicle collision fatalities are seniors (Vancouver C.O, 2017). Studies have revealed that the majority of pedestrian victims in intersection collisions are either children or elderly and predominantly male (Silvermann et al, 2003). In order to determine where to allocate resources in fixing high risk areas prone to high pedestrian use, these areas must be identified through extensive analysis.

In previous studies on pedestrian safety, it was determined that higher capacity, major road networks resulted in more pedestrian-vehicle collisions (Morency et al, 2015). More specifically, the highest risk areas include major intersections, 4-way intersections and crowded areas with parked vehicles in the immediate vicinity (Morency et al, 2015). These areas often have pedestrians crossing multiple lanes and navigate through high density traffic. Increased dimension of intersection, complexity and pedestrian volume are all correlated to a higher chance of pedestrian-vehicle collision (Morency et al, 2015).

In this study, open source data and modern GIS tools were used to determine the location and severity of vehicle-pedestrian collisions in close proximity to intersections. All data was from the year 2017 and was obtained from the City of Vancouver's Open Data Catalogue.

2 Methods

2.1 Study Area and Data

2.1.1 Study Area

The study area encompasses all of the City of Vancouver in British Columbia, Canada. Neighbouring municipalities such as North Vancouver, Burnaby and Richmond were not included in the study. A small scale map of the study area is shown in Figure 1. According to

Vancouver Police Department statistics, violent crime rose 1.6% in 2017 from 2016 however most crimes are down from the previous year.

2.1.2 Data

All data used in this study was obtained from the City of Vancouver's Open Data Catalogue. The first of the three key files was a crime statistics file from 2017. This file is maintained by the Vancouver Police Department. There were 33706 incidents recorded in this file. The metadata explains that some of the crimes may be offset from their actual locations which introduces uncertainty and error into the study. The next file that was used was a data set of points located at the center of each intersection. The data is maintained by the City's Engineering Service team and claims survey accuracy. Many of the lower capacity intersections or non-public roads are not available in this data set. The final file used in the main analysis was the local area boundary data set. It has minimal metadata but claims that since most boundaries follow road networks, the data is shared between them with high accuracy. A few ancillary files were used in the study exclusively for visual clarity such as the public streets data set and some of the files generated to enhance the clarity of figures. All data was projected using a NAD 1983 UTM Zone 10 projection.

2.2 Analysis methods

The local area boundary, crime statistics and intersections files obtained from the Vancouver Open Data catalogue were first added into ArcGIS Desktop 10.5 software. A public roads file obtained from the same source was also added to increase visual clarity however it was not used in the analysis. First, a count attribute was added to the crime file in order to be able to quantify the amount of crimes that occur within a given area in later processes. An attribute query was then performed on the crime statistics file to isolate only incidents of pedestrian-vehicle collision resulting in injury. The data in this file was sorted by neighbourhood and a chart was produced showing the distribution of where collisions are occurring (Figure 6). No data was readily available for pedestrian-vehicle collisions resulting in death. Next, a 30 meter dissolved buffer was placed on all of the public road intersections, centered at the center of the intersection. 30 meter buffer distances were chosen to fully encapsulate a full two-lane intersection or a standard roundabout. The buffer was then split into multiple polygons. This approach eliminated the problem of data being counted multiple times. A spatial join was then performed on the 30 meter multiple buffer layer and the incidences of pedestrian-vehicle collisions. Finally, the intersection zones were then categorically ranked based on how many collisions were within a 30 meter radius of them and given corresponding symbology. A small scale map of the study area map of the Vancouver study was created from the data (Figure 2). The intersection zones were then sorted based on collision incidences in 2017 and the top nine were exported to a table (Table 1). A larger scale figure of these nine intersection zones was also created (Figure 4). Sorting the intersection zone data based on neighbourhood and using the count attribute added in the initial pre-processing revealed the neighbourhood with the most collisions near intersections in 2017 and additionally the single intersection with the most collision is 2017.

3 Results

The results of the analysis were able to determine that the intersection of East Hastings Street and Main Street had the highest amount of pedestrian vehicle within a 30 meter zone with 10 collisions. East Hastings and Main is a single 30 meter radius buffer clearly visible in Figures 3 and 4 and even though some areas had a larger area due to the method of dissolving and splitting the buffers, it still had the highest collision density. A satellite image of the East Hasting Street and Main Street intersection is shown in Figure 7. As shown by the image, the intersection is a high capacity 3 lane intersection on each dimension, in a pedestrian dense area of the city.

The results were also able to reveal that the Downtown district had the most pedestrian-vehicle collisions near intersections in 2017 with 93 incidents. Figure 3 shows that many intersection zones had more than 3 collisions resulting in injury.

The methods used in the analysis resulted in some large clusters that were not indicative of the true pedestrian-collision count at each individual intersection. One such example is is the large "8" cluster in top nine intersection zones (Figure 4). A scatter plot was created to show the number of collision incidents versus the total area of each intersection zones (Figure 6). A density variable was added to the table of the top nine intersection zones to show the normalized intersection zones. Table 1 shows the data from the top nine intersection zones.

4 Discussion

The results of this study revealed some details of where the majority of vehicle-pedestrian collision incidents occur in Vancouver, as well as some of the higher risk intersection zones in the city. However, the clusters that resulted from splitting the original 30 meter buffer into multiple parts introduced a larger degree of uncertainty into specific areas of collision risk. Adding a density attribute helps mitigate this however a better approach may have resulted in a more conclusive analysis. Additionally, the 2017 crime data set maintained by the Vancouver Police Department specifies in the metadata that some instances are moved from their exact locations, which further increases error and uncertainty. With only location data, it is not possible to quantify the potential danger of a specific intersection zone. There are many more factors that should be considered such as lighting conditions, crosswalks and safety features and the average pedestrian that uses that specific intersection.

The analysis revealed that the main areas of high pedestrian vehicle collisions were in densely populated urban areas, along high capacity roads and in areas with lots of parked vehicles. This was predicted as it was shown in the studies of Silvermann and Morencay using similar circumstances.

More in depth studies on intersection collisions used weighted factors to weight each intersection on socio-demographic features. (Silverman et al, 2013). These studies also used a much more quantitative and mathematical approach to determine their conclusions. With more data and a more detailed analysis taking into account other factors then just location would have resulted in a more accurate analysis.

5 Conclusion

In conclusion, the results of this study provide a general overview of where pedestrian-vehicle collisions occur in the City of Vancouver as well as some of highest risk intersection zones in the city. However, a much more involved analysis is required to quantify pedestrian-vehicle collision risk with a great degree of certainty. Many cities in Canada are transforming their urban areas to be easier to use for pedestrians. Since vehicles and pedestrians occupy the same space, identifying potential areas of risk and implementing safety features to aid pedestrians is crucial in the process of reducing fatalities and injuries from pedestrian-vehicle collisions.