FYP (BSFIYEP1KU) - Project 01 - Group 13 - ITU COPENHAGEN

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1 Introduction

The key objective of this report is to examine state of road safety in the city of Manchester as of year 2019. In the first part, the report provides a general overview of key findings. The following part has two core objectives. Firstly, to find a possible way of reducing the severity of accidents. Secondly, to identify long term problematic locations in terms of frequency of accidents and advise a suitable solution which would help reduce the number of accidents at these places. With these objectives in mind, we propose to answer the following research questions:

- Is there an association between casualty severity and junction detail?
- What are the hot spots for accidents in Manchester within the period 2015 - 2019 and how can better safety be assured at these places?

The answers to these questions should provide value to the city of Manchester by giving suggestive concepts that can be further researched and implemented into the urban transport planning thereby reducing the severity of casualties as well as the number of accidents itself.

2 Data

2.1 General overview

The data provided by the UK Department of Transport contains all recorded road collisions in Great Britain in the year 2019, separated in three different data tables corresponding to **accidents** (117,536 records), **casualties** (153,158 records) and **vehicles** (216,381 records). In addition, a variable lookup excel spreadsheet was provided which we used to identify the names of the categorical variables within the three data sets. For the last part of the analysis, we downloaded accident data for the years 2015 through 2018 from the same source, for which we used the exact same procedure as for the 2019 accident data set.

2.2 Filtering data related to Manchester

To filter out records relevant to Manchester, we used Local Authority District column from accident table. Manchester city is part of a Greater Manchester city area which is then further splitted into local authority districts, where one of them is Manchester city itself.

The above method gave us **893 records** of accidents in Manchester in 2019. We then mapped the relevant records from other the two tables using the accident indices from the accident table resulting in **1209 records** of casualties and **1676 records** of vehicles.

2.3 Dealing with missing values

The variable lookup table explicitly states that when there is a missing value or value out of range for categorical variables, "-1" is filled instead. Thus, "-1" values were filtered out and ignored throughout the report. However, in case of a variable with missing values, it is always noted that it needs to be considered that certain values are missing thus results might be impacted by lack of data. For numerical variables, same strategy was deployed as for categorical variables, i.e., to ignore missing values rather than filling them with substitute value.

3 Results and discussion

3.1 General overview of data

Drivers involved in accidents are mostly adults aged between 20 and 40 years old with a significant peak around the age 30. However, it should be noted that there were 234 missing values. Accidents usually happen around rush-hour, with peaks around 9 and in the afternoon, and in the middle of the week, suggesting that commuters might be the biggest culprits. Interestingly, there is a significant rise in accidents in May, June and October. While this might be worth further exploration, our focus in this report is what local government and city planners in Manchester can practically do to reduce the harm caused by accidents, and to decrease the number of accidents itself.

3.2 How can severity of accidents be reduced?

We chose to use casualty severity as a metric for harm, such that a variable we find to be associated with casualty severity would be a prime contender for local government to look into.

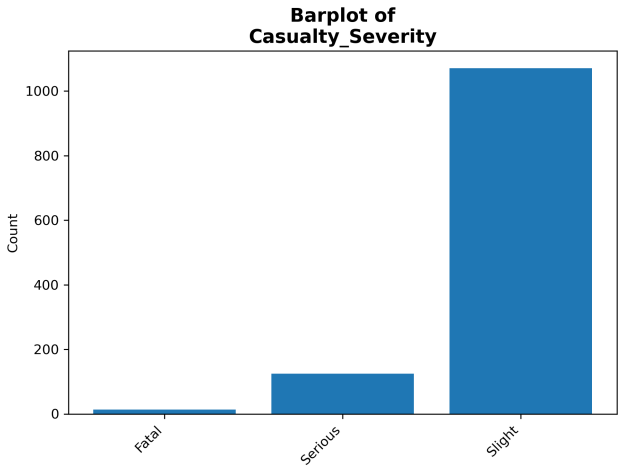

Figure 1: Barplot of the distribution of Casualty Severity in Manchester

Figure 1 shows the distribution of the three categories of casualty severity. As we can see, the vast majority of accidents do not result in severe casualties, but the amount of serious or fatal accidents is nevertheless substantial. In 2019, thirteen people died in traffic accidents, and 125 were seriously

injured, just within Manchester, so finding a way to reduce those numbers is imperative. Based on a previous study focused on factors influencing severity of injury of young male drivers in the UK, which as one of the less dangerous factors mentions to be driving at a roundabout, we decided to examine this problem more closely using the whole Manchester population. (Gray et al., 2008)

We performed a Pearson chi-square association test, to find if there was a statistically significant correlation between **junction detail** and the **severity of the casualties**. Unfortunately, multiple types of junctions, including roundabouts, did not have sufficient data points, so we had to remove these in order to minimize errors when testing. From the association test, we obtained a P-value of 0.016 which suggest that there is a statistically significant association between the selected types of junction details and casualty severity. However, when computing Cramer's V we obtained a value of 0.07 which in turn would suggest that the relationship between the two variables is not that strong.[1]

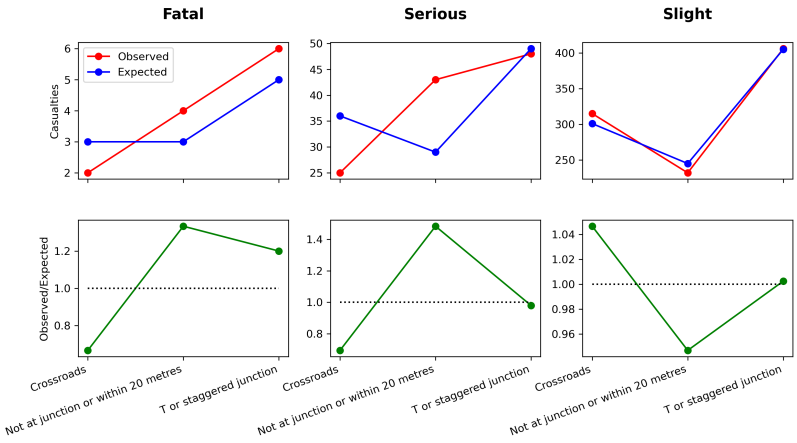

Figure 2: The observed and expected values for Junction Detail and Casualty Severity

Casualties linked to accidents in crossroads were less likely to be categorized as "serious" or "fatal" than expected, while those linked to accidents not within 20 meters of a junction were more likely to be categorized as "serious" or "fatal". In other words, accidents that do not happen at junctions are more likely to be dangerous which corresponds to the results of the Gray et al. that states that one of the dangerous factors is driving on a single carriage way. Though the effect is statistically significant, it is not a particularly large effect, as shown by the Cramer's V. Therefore, the implication for the future urban planning is that the type of junction does not **considerably** impact the casualty severity based on the the limited data set of accidents in Manchester from 2019.

3.3 Geographic Distribution

To understand how casualties are distributed across Manchester, we plotted them on a map with separate colors designating casualty severity. Figure 3 gives a nice overview of the overall distribution, but we also wanted to understand what the long term problems are. Therefore, in order to gain more insight into the overall trend of road safety in Manchester, we decided to take into account the data

[1]For complete report: $\chi^2(4, N = 1081) = 12.13$, p = 0.016, V = 0.07

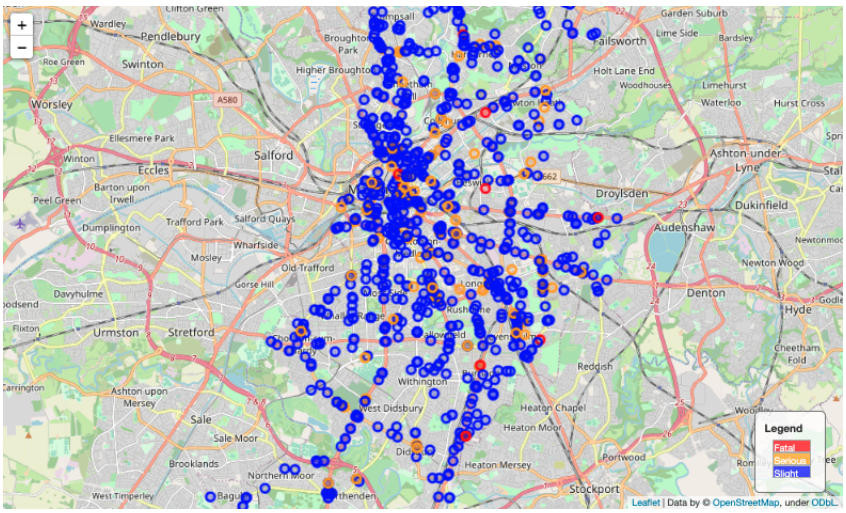

Figure 3: Plot of casualties by severity in Manchester, 2019

from the year 2015 through 2019. Figure 4 therefore shows locations where there have been accidents for at least four years.

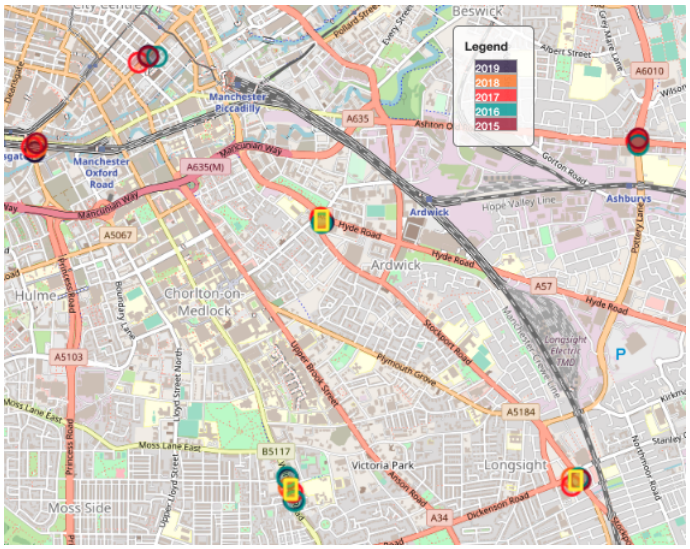

Figure 4: Plot of problematic accidents spots in Manchester over the period of at least 4 years

In total, we identified six problematic locations. The three locations highlighted by a yellow rectangle are most problematic from a perspective of total number of accidents.[2] Two of these locations are crossroads. In this case, we would suggest to implement a roundabout. This suggestion is solely based on available scientific research, as for example the one conducted by Elvik in 2003. On the other hand, the most critical location from the top three is a roundabout. However, it is important to note that after taking a closer look, it seems to be a complex roundabout connecting frequent roads compared to the previous two locations and therefore further examination of this location should be done.

[2]Take a closer look at these locations here. Click on the yellow rectangle to get a link to Google Street view.

4 Limitations

Since we did not have sufficient data regarding roundabouts, we were not able to explore it deeper and include it in our association test. Therefore, we could not do as much research on its potential as a substitute for crossroads as initially thought, and thus we had to lean more on prior research to show the benefits of roundabouts. Additionally, more data showing the number of different junctions would be needed in order to paint a clearer picture of what types of junctions pose higher risks of casualties. Another point of concern is the metric chosen to assess harm: casualty severity. Since the data available are related only to accidents, our multivariate analysis is limited to the properties of said accidents. In other words, we can for example only gather if certain factors cause accidents to be more severe, not whether they cause more accidents to occur. This can lead to a sort of illusion, where a variable that causes a lot of minor accidents to happen can seem to reduce harm, because the accidents linked to that variable are on average less severe.

All of these limitations could be addressed with more extensive data. For example, regarding the second concern, a data set that includes information about the prevalence and traffic conditions of each type of junction could help provide a better metric for harm. In any case, the limitations of this study only provides opportunity for further research.

5 Concluding remarks and future work

The report brings two important takeaways. Firstly, we found that the type of junction does not significantly impact the casualty severity. Although, there was a slight indication that accidents at crossroads are less likely to be fatal or serious. On the other hand, there was also a slight indication that accidents which do not happen at junctions (e.g. they happen at single carriageways) are more likely to be fatal or serious which is also supported by previous research in the UK. Therefore, to reduce casualty severity, city council should further assess single carriageways. Secondly, we identified critical locations where accidents have happened at least for four years within the span 2015 - 2019. From these locations, we then selected the three most critical ones by cumulative number of accidents and advised a concrete solution where possible. Given the time constraints and project size, we were not able to take full advantage of other available external data sets, which we could for example use to examine the factors influencing the severity of accidents at a greater depth.

References

Elvik, R. (2003). Effects on road safety of converting intersections to roundabouts: Review of evidence from non-us studies. *Transportation Research Record*, *1847*(1), 1–10.

Gray, R. C., Quddus, M. A., & Evans, A. (2008). Injury severity analysis of accidents involving young male drivers in great britain. *Journal of Safety Research*, *39*(5), 483–495. https://doi.org/https://doi.org/10.1016/j.jsr.2008.07.003