Status of Road Safety in Birmingham, 2019.

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Introduction

As of 2019 in regards to road safety, based on the data provided the city of Birmingham is perceived as a more dangerous city compared to the rest of the UK (*Statistics at DfT*, 2020). The road accidents in Birmingham entails an accident ratio of 2,26‰ per capita, whereas the average accident ratio of the UK is 1,76‰ (Birmingham City Council, 2019).

The following report provides an account of the state of road safety in Birmingham based on data collected from accidents that occurred in 2019 (*Statistics at DfT*, 2020). The report is conducted on the basis of the official data from the Department of Transport. In regards to road accidents, the data being processed consequently consists solely of public roads and personal injuries, therefore the report states no account on accidents on private property or property damage. Moreover, the report gives an overview of the city's challenges in regards to road accidents and explains recommendations for what measures could be considered in future city planning. A wide range of variables will be presented through key figures particularly to address the following question: How does time of day affect road accident severity in Birmingham? The null hypothesis for this investigation is as follows: There is no statistically significant relationship between time of day and accident severity. The alternative hypothesis states a statistically significant relationship is present.

Data

The data utilized in this report was obtained from three documents from the UK Department of Transport that focused on accidents, the vehicles involved in each accident, and the casualties associated with each accident in 2019. In 2019 it was shown that Birmingham had a total of 2,623 road collision accidents, consisting of 4,962 vehicles and 3,551 casualties.

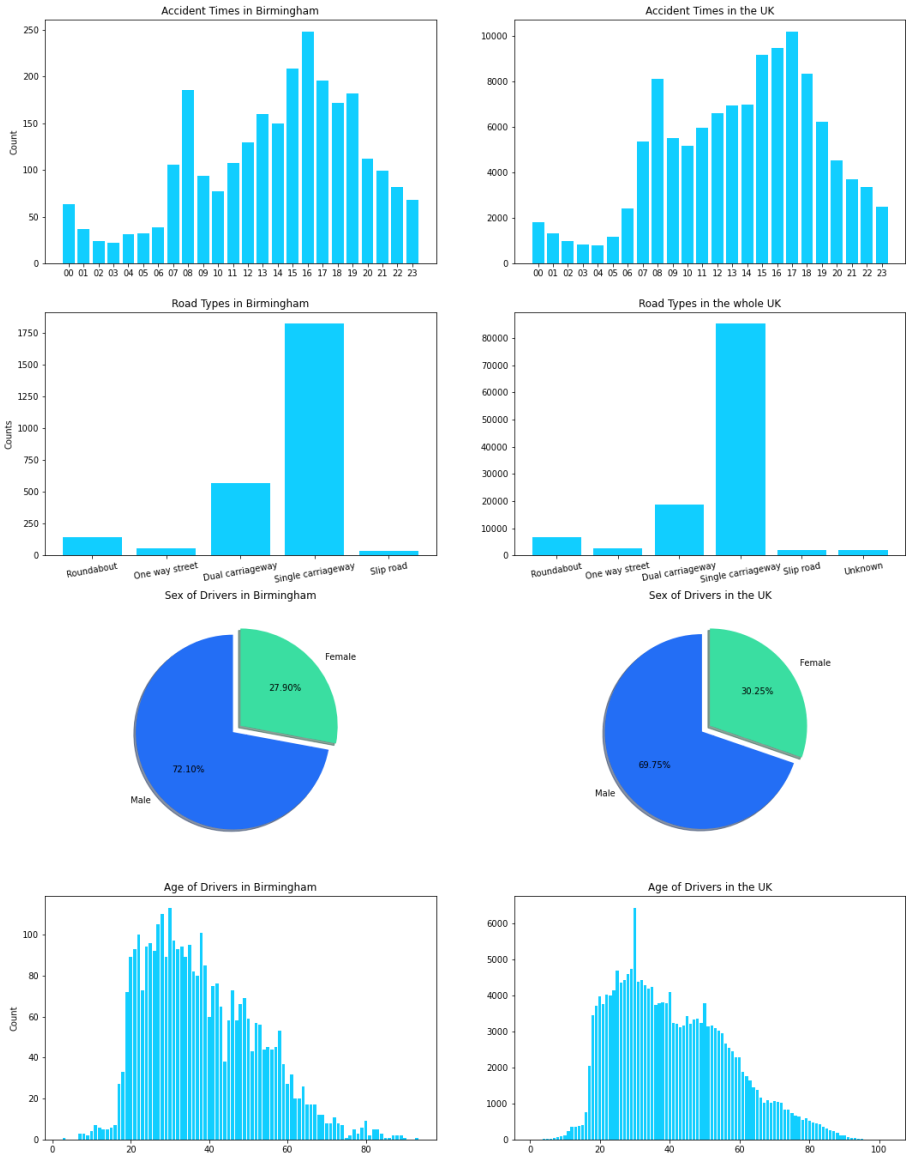
Based on the variable lookup sheet we found that the field name Local_Authority_District uses code 300 to account for the city of Birmingham, and then filtered the accidents sheet to only show records from this city. Thus the data was masked and renamed data_bir. The casualties and vehicles tables were then filtered to only show accidents that had corresponding accident indices based on those present in the filtered accident sheet. Next, the data was checked for missing values and fortunately for Birmingham it was proven that there weren't any. However, some variables had unknown values that needed to be taken into consideration. For instance, some variables contain values such as -1, which we filtered out during analysis where applicable while maintaining a sufficient sample space to draw conclusions from.

Results and Discussion

After the data was filtered and cleaned various variables were analysed in regards to accident severity of road collisions in Birmingham. To put the data in perspective, a few variables from Birmingham are compared those in the United Kingdom, including age of driver, sex of driver, road types and accident time in the form of a single variable analysis. Single variable analysis provides context of which further conclusions can be drawn from. To visualize the data, the figure below contains graphs for Birmingham

and the United Kingdom: bar plots presenting the time of the accident, road types involved in each accident, age range of drivers involved, and a pie chart which shows the gender ratio of drivers involved.

*Figure 1: Age of Driver, Sex of Driver, Road Types and Accident Time data from Birmingham is compared to that of the whole United Kingdom.**



In the first two graphs in the figure above, showing the time of the accidents, it reveals a spike at 8:00am in the morning and then again between 15:00 and 17:00pm, which can be associated with commuters.
The number of accidents per time period does not show a strong difference between that of Birmingham and that of the United Kingdom. In the next two graphs, once again following the pattern of the UK, the main road type prone to accidents in Birmingham is a single carriageway.

From the pie chart we can see that males are involved in twice as many accidents as women, although the data does not conclude that men drive more dangerously. Additionally, in respect to the age of drivers, figure: Age band of drivers in Birmingham indicates that drivers from the age of 20 to 40 are more likely to be involved in an accident. It can be argued though that this specific age range is more likely to be on the streets as commuters, since their age fits the general employment age.

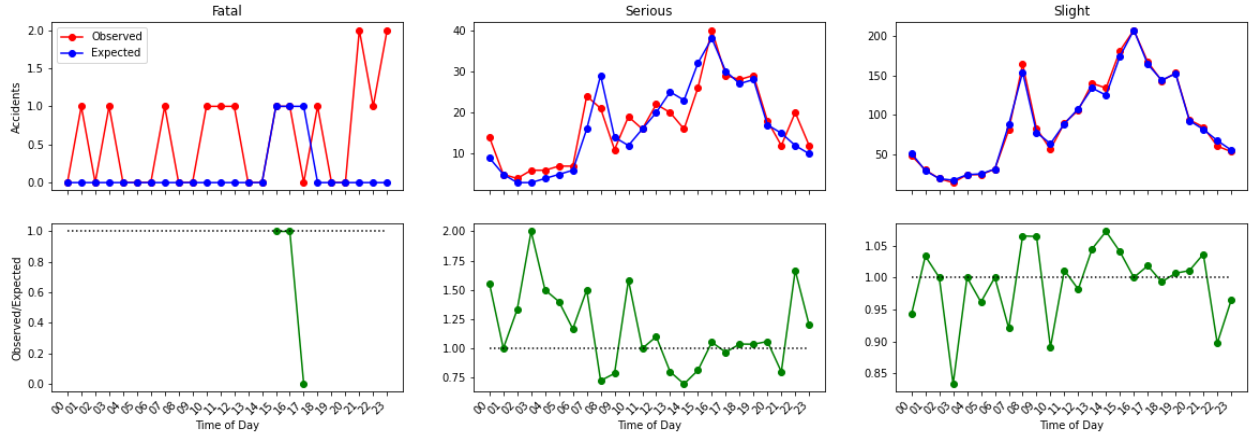
To further investigate the variables above and check for statistical associations, the Pearson Chi Squared Test of Independence was performed with a significance(alpha) level of 0.01. This statistical test provides a basis to see whether two variables have a significant association or whether it is more likely that the correlation is due to random chance, shown by the p-value. The p-value is calculated based on the

observed and expected values shown in Figure 2 below. The Chi Squared Test proved no statistically significant association between the age of the driver involved in the accidents and the accident severity, as the p-value was 0.112 which is larger than the significance level. This proves an interesting point as it is frequently thought that younger people are more likely to drive recklessly and get into an accident.

Further tests proved no statistically significant relationship between the sex of the driver and the accident severity. The p-value was 0.0008 was much lower than the significance level providing a basis for a significant correlation between the sex of the driver and accident severity, although it is interpreted as a weak correlation with a cramer value of 0.056 (Akoglu, 2020).

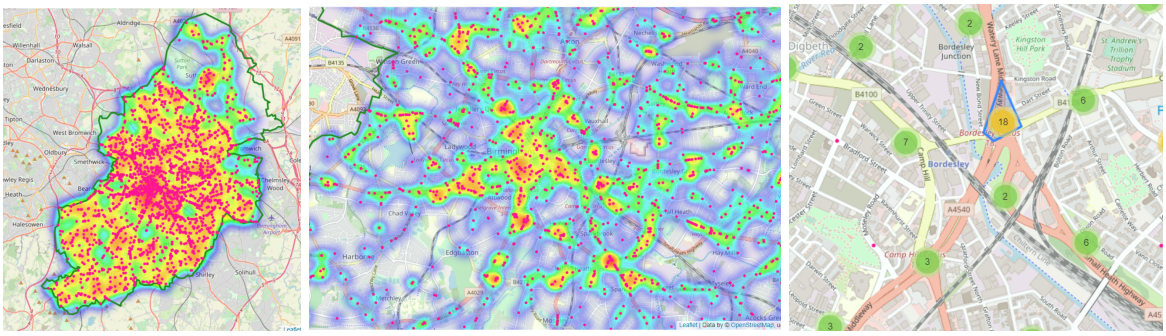
In regards to our research question it was interesting to investigate whether there is a statistically significant relationship between the time of day of accidents and accident severity. A significant relationship may be hypothesized as our graphs show differences between time of day and accident severity, as there is a general consensus that it is more dangerous to drive at night, as it is darker. Surprisingly, the test showed no statistically significant relationship between accident time and accident severity, with a p-value larger than 0.01 prompting us to accept the null hypothesis.

Figure 2: The expected values compared to the observed values of the following variables all compared to Accident Severity: Age of Driver, Sex of Driver, and Time of Day.



To further visualise the data, the maps below show the accidents in Birmingham categorized by accident severity from the range of “slight”, “serious” and “fatal” accidents.

Figure 3: Map Visualisations of Accident Severity of Accidents in Birmingham



The undergone analysis on Birmingham transportation presented various insights into potential causes of road accidents. There are more accidents in Birmingham at 08:00am-10am in the morning and then again at 15:00pm -16:00pm in the afternoon, and this brings to question whether there are simply too many cars on the road at these times. Although there is no significant correlation between time of day and accident severity, it cannot be denied that there may be a correlation between time of day and the number of accidents, which is to be expected as we can assume there are more cars on the road during the daytime.

Prior studies have shown that road congestion can cause an increase in accidents (Retallack, 2019). With more data collection and analysis of the time of day it may be proved to correlate to accident severity, but for now we can conclude that there are certain times where there are an increased number of accidents, and where they occur in Birmingham. Provided the number of accidents per severity category, the findings conclude that only 0.53% of accidents are fatal, 15.71% of accidents are serious and that 83.76% of accidents are slight, and therefore the focus is not on fatal accidents. There are some fatal accidents that have happened in the south of Birmingham, however, there have been absolutely no fatal accidents in the north or far east. This is similar for other severity types, as they too cluster around the center and south, suggesting that the area of most potential improvement is to the south and city center.

Figure 4: Frequency and Severity of Female vs. Male drivers by Time of Day

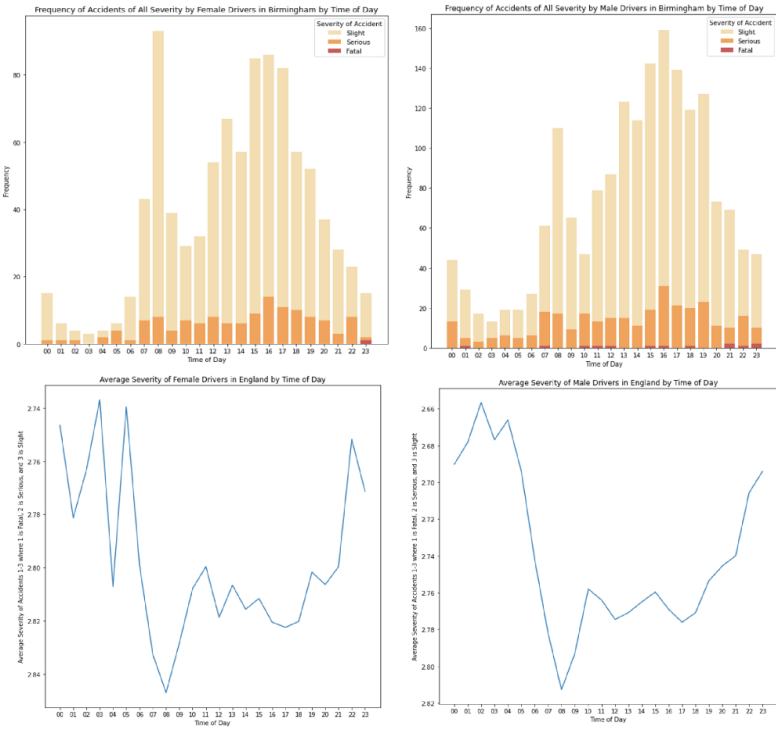


Figure 4 is an interactive graph, that takes selected parameters, allowing for 30 different graphs to be shown. The graph shows frequency of severity or average severity of accidents in UK/Birmingham by Female/Male drivers. The figure shows a large difference in the number of accidents with women as drivers compared to men. With regards to accident severity, there is only one fatal accident with a female driver in the whole of Birmingham. The plot also provides further evidence that there are more accidents during rush hour. Another interesting finding is that in the early hours of the day or late at night there is a higher percentage of accidents being fatal or serious, whereas there are less fatal or serious accidents at rush hour.

Limitations

The data in this report is only obtained from one source, therefore conclusions cannot be generalized to be true for everyone in Birmingham. The data analysis could have been benefited with data sets consisting of general driver or road information. For example, miles driven per road type, number of miles of different road types, as well as data sets of general demographic information of citizens. Furthermore, the data used

in this report may not have included all accidents in 2019, and therefore the data may be skewed with respect to the data provided. The data analysis could be more reliable by including data information from previous years. In one aspect, specifically with regards to the sex of the driver we cannot say that men are more likely to cause accidents; as we do not know the ratio of male to female drivers in general. It may be that it is purely because there are more men driving that they have a higher accident probability. Therefore, due to the limited data we are not able to draw this concrete conclusion.

Concluding Remarks and Future Work

In conclusion the analysis on Birmingham road accidents provided a large spectrum of insights into potential variables that affect accident severity. Our findings did not prove one concrete reason as to why the accidents are occuring, although we conclude that road congestion at specific times is a valid factor that can be improved. It seems simple; less cars on the road means less accidents. One improvement that could benefit Birmingham road safety could be improving accessibility and quality of public transportation and possibly increased funding, this would affect the number of cars on the road and therefore could lead to less severe accidents and less accidents in general. To outline our research question, in the morning and in the afternoon it is apparent that there is a larger number of accidents, specifically at around 8:00 am and 15:00 - 16:00 pm. As this has been associated with commuters, Birmingham may choose to implement strategies to avoid commuting congestion and reduce volume traffic, such as rideshare programs.

One aspect that became especially apparent during the analysis of the data, was that most of the fatal injuries occur near the city center. Certain junctions in particular show dense clusters of accidents, especially at Bordesley Circus (Figure 3 Right), which had 18 accidents in 2019. The junction had previously been reported to be the most dangerous in Birmingham (Goodier, 2020), and this still seems to be the case in light of the newer data. The findings suggest that improving the safety of this and other junctions could potentially lead to a decrease in accidents. Investigating the cause of these accident clusters, and improving infrastructure in areas surrounding junctions would be beneficial to the safety of drivers in birmingham.

The findings also suggest that the sex of drivers is a factor in accident frequency and severity. The statistics show there is a relationship between the the sex of a driver and the accident severity, this is also shown in the lower plots in Figure 4. Multiple figures above and statistical tests also showed that men were potentially more likely to be involved in an accident. In the future, men should be a focus of road safety; this paper suggests that this should include road safety campaigns directly targeting men.

In the future, further data analysis with regards to gender of driver could be conducted with a larger data set pertaining to information about all road users and not only the drivers involved in accidents. This would enable stronger conclusions to be drawn on what impact sex of driver has on accidents. To further explore the factor of the impact of time of day on accidents, additional data on the number of cars on the road at certain times is vital in proving whether there are times where it is more likely to get into an accident and therefore more dangerous to drive. This could for example be data from traffic cameras. Overall it is difficult to say with confidence what variable is the main cause of accidents in Birmingham, but it can be concluded that junction safety can be improved, and the sex of driver and time of day of congesition should be further investigated to see how accidents are affected.

References

Akoglu, H. (2020, November 9). *User's guide to correlation coefficients*. ResearchGate. https://www.researchgate.net/figure/nterpretation-of-Phi-and-Cramers-V_tbl2_326885374

Birmingham City Council. (2019). *Birmingham population*. Birmingham Population. https://www.birmingham.gov.uk/info/20057/about_birmingham/1294/population_and_census/2

Goodier, M., & Rodger, J. (2020, February 20). *The nightmare Birmingham junction named most dangerous in country*. BirminghamLive. https://www.birminghammail.co.uk/news/midlands-news/nightmare-birmingham-junction-named-most-17777021

Regev, S., Rolison, J. J., & Moutari, S. (2018). Crash risk by driver age, gender, and time of day using a new exposure methodology. *Journal of Safety Research*, *66*, 131–140. https://doi.org/10.1016/j.jsr.2018.07.002

Retallack, A. E., & Ostendorf, B. (2019, September 1). *Current Understanding of the Effects of Congestion on Traffic Accidents*. PubMed Central (PMC). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6766193/

Statistics at DfT. (2020, May 21). Department of Transport. GOV.UK. https://www.gov.uk/government/organisations/department-for-transport/about/statistics