Risk Analysis of Accidents involving Cyclists based on Extended Traffic Accident Data

Master‘s Thesis of Abdul-Rahman Dauda

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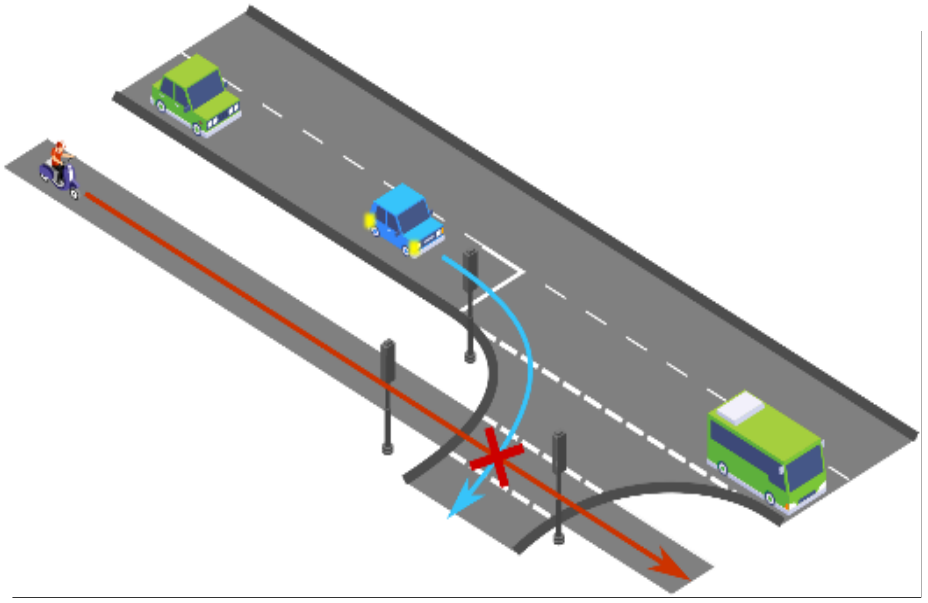

Figure 1: Illustration of a straight moving cyclist and a right-turning vehicle which could lead in a right-turning collision (Denk, et al, 2022)

Background

Right-turning collision mostly occur in urban areas when a straight moving cyclist collide with a turning vehicle at a junction/intersection or even at mid-block sections. In Munich right-turning accident at junctions have been on the rise, report from Munich Police Department indicates that, the number of right-turning accident have increased by 35% over the last five years resulting in some fatality and injuries. (Polizeipräsidium München, 2021)

Literature provides some useful materials in the prediction of collision event Rolf Moeckel et al. (2022) for example developed of mathematical and spatial models to predict collision events involving cyclists in the city of Munich, by using Poisson, Negative Binomial, and Zero-Inflated Negative Binomial models. However, what appears not well researched is the risk analysis for right-turning collisions which make up a significant share of the total number of collisions involving cyclists in Munich.

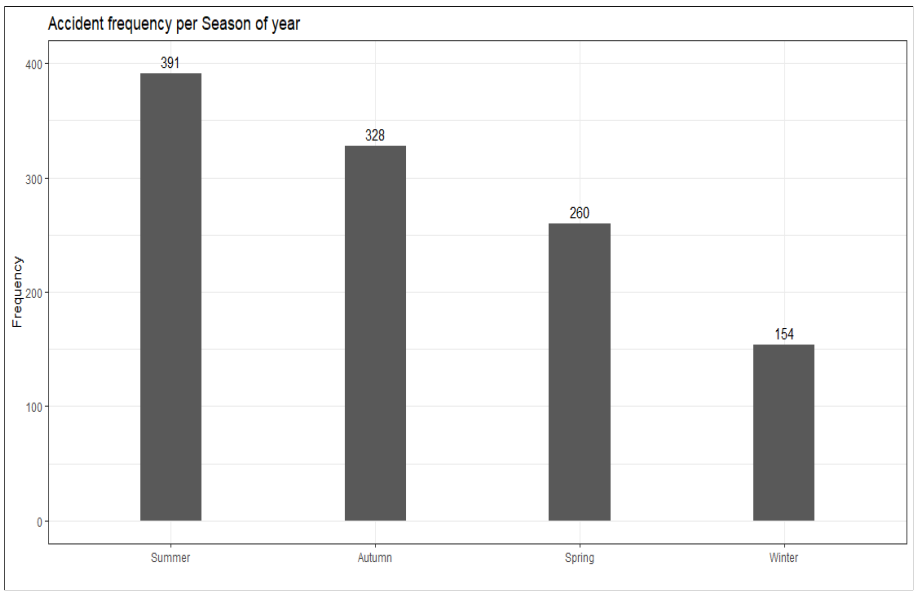

Figure 2: Seasonal distribution of total accident

Methodology

In conducting this research, a database with variables such as weather condition, severity of the collision, accident events (with its spatiotemporal dimensions), presence of any occlusion such as trees, parked vehicles along roadway, presence or absence of traffic signal at the intersection/junction, presence of a public transport stop within of the location of the accidents, and bicycle volume, number of lanes etc. was complied to cover all the locations the collisions occurred.

Data analysis was done in R programming language and QGIS., An ordinary least square regression model, poisson regression model, safety performance function regression model and a multinomial logistic regression with neural networks model was built for the prediction of accidents and determination of the impacts of these accidents on injury severity, respectively. Goodness of fit parameters appraised in ascertaining the usefulness of the model were model accuracy.

Main Findings

Injury Level	Variable	Coefficient	Odds Ratio
Slightly Injured	Temperature	-0.03	0.97
	Atmospheric condition (Fair)	2.41	11.13
	Atmospheric condition (Misty)	2.98	19.69
Seriously Injured	Temperature	-0.06	0.94
	Atmospheric condition (Snowy)	-3.97	0.02
	Atmospheric condition (Cloudy)	-0.48	0.62
	Atmospheric condition (Rainy)	-0.46	0.63

Table 1: Magnitude of the effective size on injury severity of cyclist

Significant variables in predicting right-turning collision:

- Presence of signalization
- Ave. annual daily traffic
- Approach bicycle volume

References

Denk, F., Brunner, P., Huber, W., Margreiter, M., Bogenberger, K., & Kates, R. (2022). *Assessment of traffic safety interventions using virtual randomized controlled trials*

Polizeipräsidium München. (2021). *Polizeipräsidium München SICHERHEITSREPORT2021*.

Rolf Moeckel, Shambhu Singh, P., & Llorca Garcia, C. (2022). *Bicycle Crash Analysis for the City of Munich*.