Predicting the Severity of an Accident

1. Introduction

1.1 Background

In traffic situations, passengers are prone to accidents on the roads. This can be due to different factors such as the weather conditions, the road conditions, the light conditions amongst other factors. These attributes are being stored by the traffic system in Seattle. It is highly recommended to be able to predict the severity of an accident based on the factors available to prepare for the casualty before the accident occurs.

1.2 Problem

The dataset provided for the Seattle city contains a total of 38 attributes (relating to the accidents that occur on the road) and the labelled data which describes the fatality of an incident. Given this dataset, the aim of this project is to select the necessary attributes that will be used to build a model that will help to predict the severity of an accident.

1.3 Interest

Residents of Seattle will find this helpful in predicting how severe an accident will be if they get into one based on the factors available. It will also be useful for traffic attendants and paramedic to prepare for accidents likely to happen. This will help reduce causality.

2. Data acquisition and cleaning

2.1 Data Sources

The dataset for Seattle road accidents was provided containing a total of 194673 observations and 37 attributes with many of them being categorical attributes.

2.2 Data Cleaning and Preprocessing

Out of the numerous attributes, only selected attributes were used because they relate to the severity code based on their description in the metadata. The attributes are: 'ADDRTYPE', 'COLLISIONTYPE', 'JUNCTIONTYPE', 'WEATHER','ROADCOND','LIGHTCOND', 'PERSONCOUNT','PEDCOUNT', 'VEHCOUNT', 'HITPARKEDCAR'. The other attributes were dropped either because they do no relate to the target variable or because they have a lot of missing values.

The following attributes are categorical values and needed to be changed to numerical values using the one hot encoding; 'ADDRTYPE', 'COLLISIONTYPE', 'JUNCTIONTYPE', 'WEATHER','ROADCOND','LIGHTCOND' while ‘HITPARKEDCAR’ was replace with 0 and 1 to represent its categorical values.

3. Methodology

3.1 Exploratory Analysis

1. **Relationship between ADDRTYPE and SEVERITYCODE**
   It was observed that 89% of the incidents that happened on the Alley has a severity code of 1 while the 11% has a severity code of 2. Also, majority of the incident that happened at the Block had a severity of 1. However, for incidents that occurred at intersection, half of the

incidents had severity code of 1 while the other half had the severity code of 2 as shown in the table below.

ADDRTYPE	SEVERITYCODE	
Alley	1	0.890812
	2	0.109188
Block	1	0.762885
	2	0.237115
Intersection	1	0.572476
	2	0.427524

2. **Relationship between COLLISIONTYPE and SEVERITYCODE**

   It was observed that majority of incidents that involved Cycles or pedestrians had a severity of 2. However for incidents in which the collision that involved a parked car and sideswipe, the severity code was 1.

COLLISIONTYPE	SEVERITYCODE	
Angles	1	0.607083
	2	0.392917
Cycles	2	0.876085
	1	0.123915
Head On	1	0.569170
	2	0.430830
Left Turn	1	0.605123
	2	0.394877
Other	1	0.742142
	2	0.257858
Parked Car	1	0.944527
	2	0.055473
Pedestrian	2	0.898305
	1	0.101695
Rear Ended	1	0.569639
	2	0.430361
Right Turn	1	0.793978
	2	0.206022
Sideswipe	1	0.865334
	2	0.134666

Name: SEVERITYCODE, dtype: float64

3. **Relationship between WEATHER and SEVERITYCODE**

   It was observed that when the weather was Snowing or freezing rain, majority of the incident that occurred had a severity code of 1. However most of the incidents that occurred when the weather was partly cloudy had a severity code of 2.

WEATHER	SEVERITYCODE	
Blowing Sand/Dirt	1	0.732143
	2	0.267857
Clear	1	0.677509
	2	0.322491
Fog/Smog/Smoke	1	0.671353
	2	0.328647
Other	1	0.860577
	2	0.139423
Overcast	1	0.684456
	2	0.315544
Partly Cloudy	2	0.600000
	1	0.400000
Raining	1	0.662815
	2	0.337185
Severe Crosswind	1	0.720000
	2	0.280000
Sleet/Hail/Freezing Rain	1	0.752212
	2	0.247788
Snowing	1	0.811466
	2	0.188534
Unknown	1	0.945928
	2	0.054072

Name: SEVERITYCODE, dtype: float64

4. Relationship between HITPARKEDCAR and SEVERITYCODE

The data showed that when the incident involved hitting a parked car, majority of the time, the incident tend to have a severity code of 1.

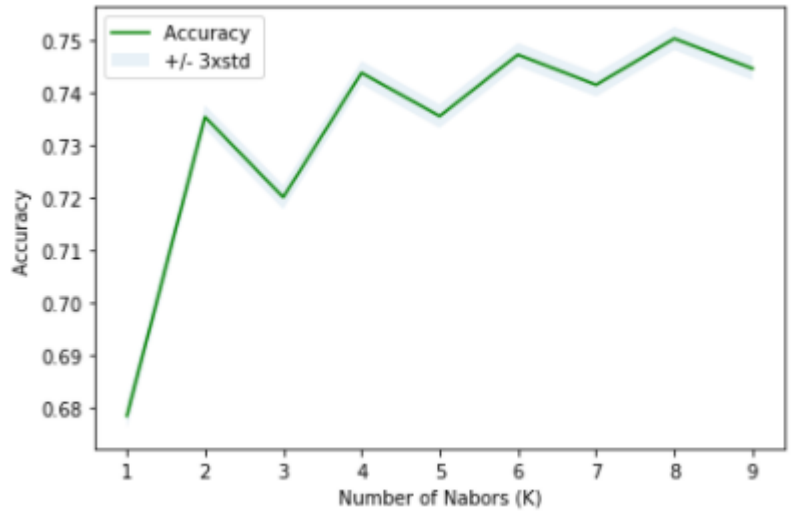
HITPARKEDCAR	SEVERITYCODE	
N	1	0.691983
	2	0.308017
Y	1	0.937916
	2	0.062084

Name: SEVERITYCODE, dtype: float64
None

3.2 Predictive Modelling

This problem is a classification problem with binary values as the target variables. The target variable; SEVERITYCODE is extracted as y while the remaining features are stored in the X data frame. The following supervised machine learning algorithms were applied to this problem to determine the best performing model that will be used to predict the severity code of an incident.

1. KNN: The optimal number of neighbours that gave the best accuracy was 8. This was then used to build the model.



2. Decision Tree: The max depth used to build this model was 4 while the criterion selected was entropy as it is the most common.
3. Logistic Regression

The following metric were used to calculate the accuracy of each of the models used.

1. Jaccard: This indicates the similarity between two datasets, the predicted severity values dataset, and the actual severity value dataset. The higher the Jaccard value, the more accurate the model is said to be
2. F1-score: This metric conveys the balance between the recall and the precision. The higher the value, the more accurate the model is said to be.
3. LogLoss: This indicates the performance of a classifier where the predicted output is a probability value between 0 and 1. The classifier with a lower log loss has better accuracy.

4. Results

The table below shows the performance of each of the model based on the performance metrics used.

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	Algorithm	Jaccard	F1-score	LogLoss
0	KNN	0.750199	0.839181	1.064561
1	Decision Tree	0.753076	0.849546	0.493511
2	Logistic Regression	0.759933	0.850052	0.481817

5. Discussion

From the table above it is observed that logistic regression has the highest Jaccard value, the highest F1-score as well as the lowest log loss value out of the other three machine learning algorithms. This implies that the logistic regression is the best model to use to predict the severity of the accident using the data provided.

6. Conclusion

In this project, I outlined the attributes that tend to affect the severity code od an incident such as weather, road condition, address type just to mention a few. I developed different classification models to predict the severity code of an incident based on the attributes

provided. The logistic regression model proved to be the best model in making this prediction. This prediction will be helpful for residents as well traffic attendants and paramedics to predict the severity of incidents and plan in terms of providing medical attention and safety guidelines.