

The Prediction of Car Accidents Severity

IBM Applied Data Science Capstone

By: Mickael Aghajarian

September 2020

1. Introduction

Motor vehicle crashes have been resulted in many deaths and injuries in the world. For example, based on the U.S. National Highway Traffic Safety Administration (NHTSA), there were 37,461 people killed in crashes on U.S. roadways during 2016, an increase from 35,485 in 2015. As another example, distracted driving caused 1.25 million deaths worldwide in 2015, with an estimated 3,477 deaths in the United States alone [1].

By analyzing some factors such as weather condition, road condition, and the speed of cars, some effective machine learning algorithms can be developed to predict the severity of car accidents before they would actually occur. Such intelligent systems can mitigate the number of deaths and injuries by warning drivers so that they would drive more carefully or even take another route if they could. As a result, the driving safety could be improved dramatically.

1.2 Business problem

Governments would be highly interested in such systems with the ability to predict the severity of car accidents ahead of time because they could save more lives by reducing the time of transporting the injured people to nearby hospitals for treatment. The faster the proper medical care is provided, the greater the chance of survival is for injured people in road accidents. Hospitals could also reap the benefits of such systems by getting prepared in advanced to admit injured people involved in accidents. Car companies would also be interested in equipping their products with such intelligent systems to alert drivers in advance and in turn increase the car safety. Thus, the main objective of this project is to train an effective machine learning model by which the severity of car accidents can be predicted.

2. Data

The dataset of car accidents in the Seattle city (from 2004 to present) can be found from the below link. All collisions have been provided by the Seattle Police Department and recorded by Traffic Records.

<https://s3.us.cloud-object-storage.appdomain.cloud/cf-courses-data/CognitiveClass/DP0701EN/version-2/Data-Collisions.csv>

The dependent variable is the accident severity in terms of 37 independent variables such as weather, road, and light conditions during the time of the collision. The target variable (SEVERITYCODE) is an integer number whose values can be either 0 (unknown), 1 (property damage), 2 (injury), 2b (serious injury), or 3(fatality).

2.1 Feature Selection

In the dataset, there are 37 independent features some of which might not be helpful to be used for the machine learning model. In this work, five features have been selected to predict the car accident severity. The first feature is “ADDRTYPE” that determines the address type of the collision (“Alley”, “Block”, and “Intersection”). The second feature is “COLLISIONTYPE” that is the collision type (e.g., sideswipe, parked car). The third feature is “WEATHER” that describes the weather condition during the time of the collision. The fourth feature is “ROADCOND” that is the condition of the road during the collision. The fifth feature is “LIGHTCOND” which describes the light conditions during the collision. The type of all independent features is *object* (i.e., text) while the type of the target variable is *int64*.

2.2 Data Preprocessing

Before using the data to train the model, the data should be prepared. First, the unnecessary columns should be dropped from the dataset. Next, we need to check whether or not the dataset is balanced. As can be seen from Figure 1, there are 136,485 samples with property damage while there are only 58,188 samples with injury. Thus, the dataset is unbalanced which means we should balance it to prevent training a biased model.

```
In [4]: df['SEVERITYCODE'].value_counts()

Out[4]: 1    136485
        2     58188
        Name: SEVERITYCODE, dtype: int64
```

Figure 1. unbalanced dataset

To balance the dataset, the samples with property damage (i.e., the majority samples) are down-sampled so that their number of samples is reduced from 136,485 to 58,188. As a result, the number of samples in both groups is equal that means the dataset is balanced. Figure 2 shows the Python code for balancing the dataset.

```
In [6]: from sklearn.utils import resample

In [12]: Major = df[df.SEVERITYCODE == 1]

In [13]: Minor = df[df.SEVERITYCODE == 2]

In [18]: De_sample = resample(Major , replace = False, n_samples = 58188 , random_state = 7)

In [19]: Balanced_df = pd.concat([De_sample , Minor])

In [20]: Balanced_df['SEVERITYCODE'].value_counts()

Out[20]: 2     58188
         1     58188
         Name: SEVERITYCODE, dtype: int64
```

Figure 2. balancing the dataset

Since the type of the independent features is *object*, we need to convert their type to numerical data types (i.e., *int64*). Also, there are some missing values among the data that can be removed from the dataset. After doing these preprocessing steps, the data is ready to be used to train the model.

References

[1] National Highway Traffic Safety Administration (NHTSA): 2015 Motor Vehicle Crashes: Overview (2016)