IBM MACHIN LEARNING CAPSTONE PROJECT
A CASE STUDY TO PREDICT THE SEVERITY OF AN ACCIDENT

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Introduction

- A public data set provided by Coursera is used to demonstrate Data Analysis and Machine Learning skills obtained in the IBM Data Science Program
- The collision data set provided by Coursera includes all collision reports in Seattle since 2004.
- The data set has 194673 records and 37 attributes, and each record is labelled by the accident's severity level.
- The objective of this project is to: understand the data, define relevant attributes that cause the accident and build a predictive model.
- This analysis will help in potential driving hazard identification and can help drivers choose the best rout based on weather and road condition.

Data Acquisition and Cleaning

- Before the modeling process, it is important to investigate the data
- 10 features were finalized for modeling purposes.

	SEVERITYCODE	ADDRTYPE	COLLISIONTYPE	PERSONCOUNT	PEDCOUNT	PEDCYLCOUNT	VEHCOUNT	WEATHER	ROADCOND	LIGHTCOND	SPEEDING
0	2	Intersection	Angles	2	0	0	2	Overcast	Wet	Daylight	NaN
1	1	Block	Sideswipe	2	0	0	2	Raining	Wet	Dark - Street Lights On	NaN
2	1	Block	Parked Car	4	0	0	3	Overcast	Dry	Daylight	NaN
3	1	Block	Other	3	0	0	3	Clear	Dry	Daylight	NaN
4	2	Intersection	Angles	2	0	0	2	Raining	Wet	Daylight	NaN

Statistical description of the data

	SEVERITYCODE	PERSONCOUNT	PEDCOUNT	PEDCYLCOUNT	VEHCOUNT
count	194673.000000	194673.000000	194673.000000	194673.000000	194673.000000
mean	1.298901	2.444427	0.037139	0.028391	1.920780
std	0.457778	1.345929	0.198150	0.167413	0.631047
min	1.000000	0.000000	0.000000	0.000000	0.000000
25%	1.000000	2.000000	0.000000	0.000000	2.000000
50%	1.000000	2.000000	0.000000	0.000000	2.000000
75%	2.000000	3.000000	0.000000	0.000000	2.000000
max	2.000000	81.000000	6.000000	2.000000	12.000000

	ADDRTYPE	COLLISIONTYPE	WEATHER	ROADCOND	LIGHTCOND	SPEEDING
count	192747	189769	189592	189661	189503	9333
unique	3	10	11	9	9	1
top	Block	Parked Car	Clear	Dry	Daylight	Y
freq	126926	47987	111135	124510	116137	9333

Distribution of accidents vs attributes

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

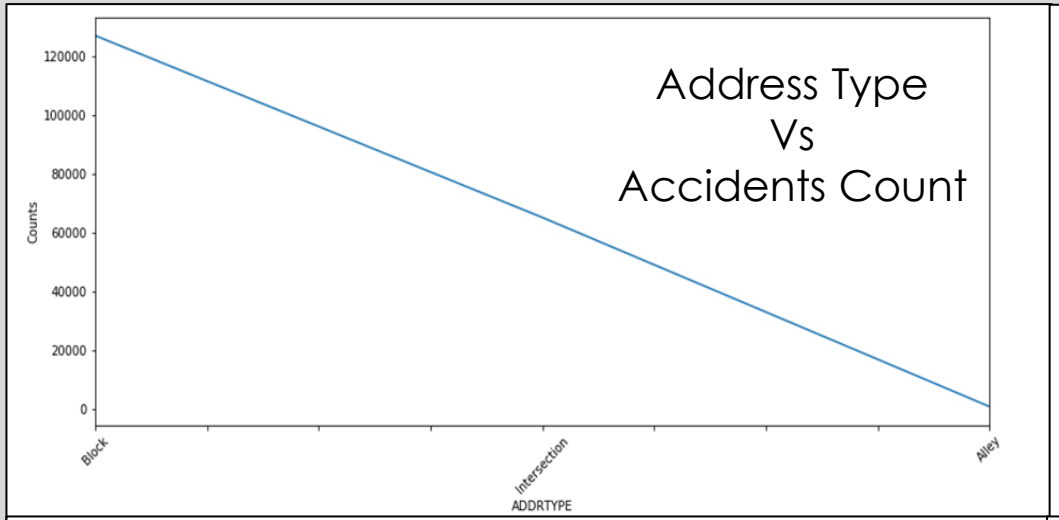
SPEEDING	SEVERITYCODE	SEVERITYCODE
N	1	0.705099
	2	0.294901
Y	1	0.621665
	2	0.378335

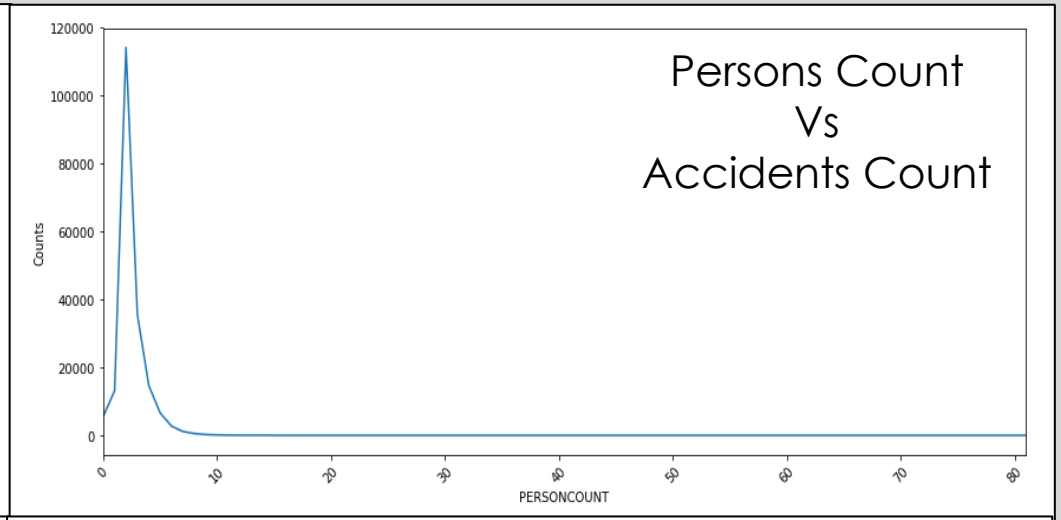
LIGHTCOND	SEVERITYCODE	SEVERITYCODE
Dark - No Street Lights	1	0.782694
	2	0.217306
Dark - Street Lights Off	1	0.736447
	2	0.263553
Dark - Street Lights On	1	0.701589
	2	0.298411
Dark - Unknown Lighting	1	0.636364
	2	0.363636
Dawn	1	0.670663
	2	0.329337
Daylight	1	0.668116
	2	0.331884
Dusk	1	0.670620
	2	0.329380
Other	1	0.778723
	2	0.221277
Unknown	1	0.955095
	2	0.044905

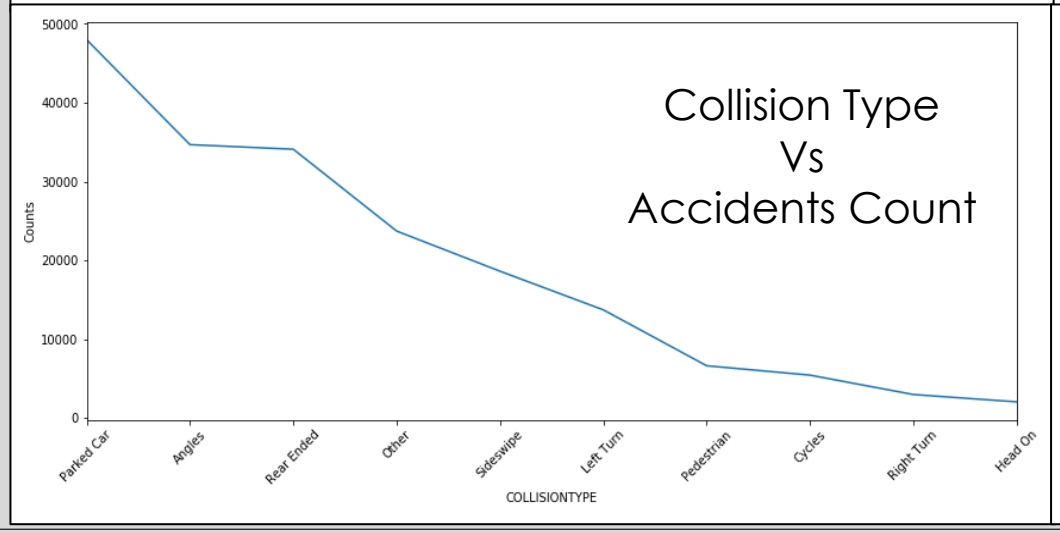
ROADCOND	SEVERITYCODE	SEVERITYCODE
Dry	1	0.678227
	2	0.321773
Ice	1	0.774194
	2	0.225806
Oil	1	0.625000
	2	0.375000
Other	1	0.674242
	2	0.325758
Sand/Mud/Dirt	1	0.693333
	2	0.306667
Snow/Slush	1	0.833665
	2	0.166335
Standing Water	1	0.739130
	2	0.260870
Unknown	1	0.950325
	2	0.049675
Wet	1	0.668134
	2	0.331866

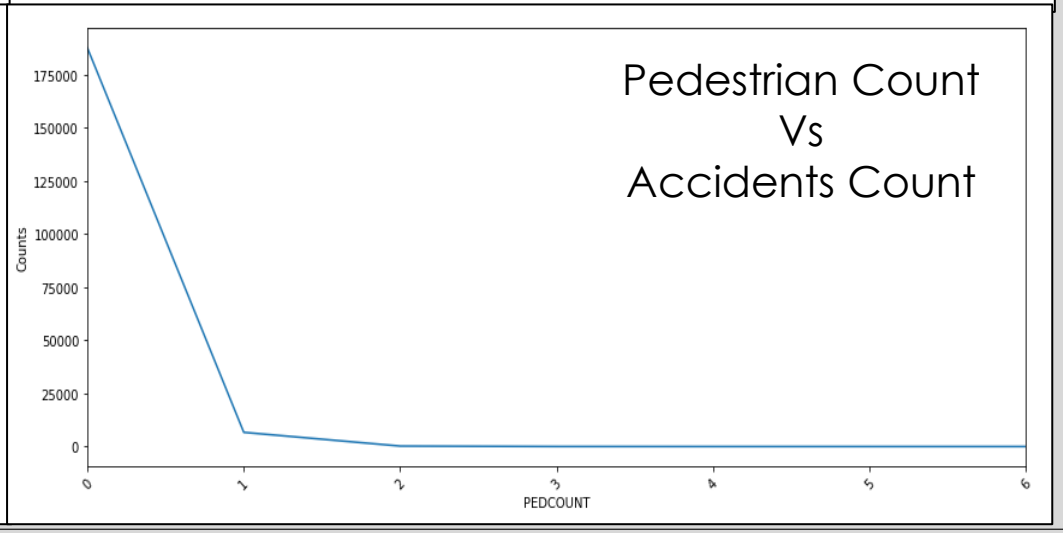
WEATHER	SEVERITYCODE	SEVERITYCODE
Blowing Sand/Dirt	1	0.732143
	2	0.267857
Clear	1	0.677509
	2	0.322491
Fog/Smog/Smoke	1	0.671353
	2	0.328647
Other	1	0.860577
	2	0.139423
Overcast	1	0.684456
	2	0.315544
Partly Cloudy	2	0.600000
	1	0.400000
Raining	1	0.662815
	2	0.337185
Severe Crosswind	1	0.720000
	2	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

Number of accidents vs attributes (cont'd)

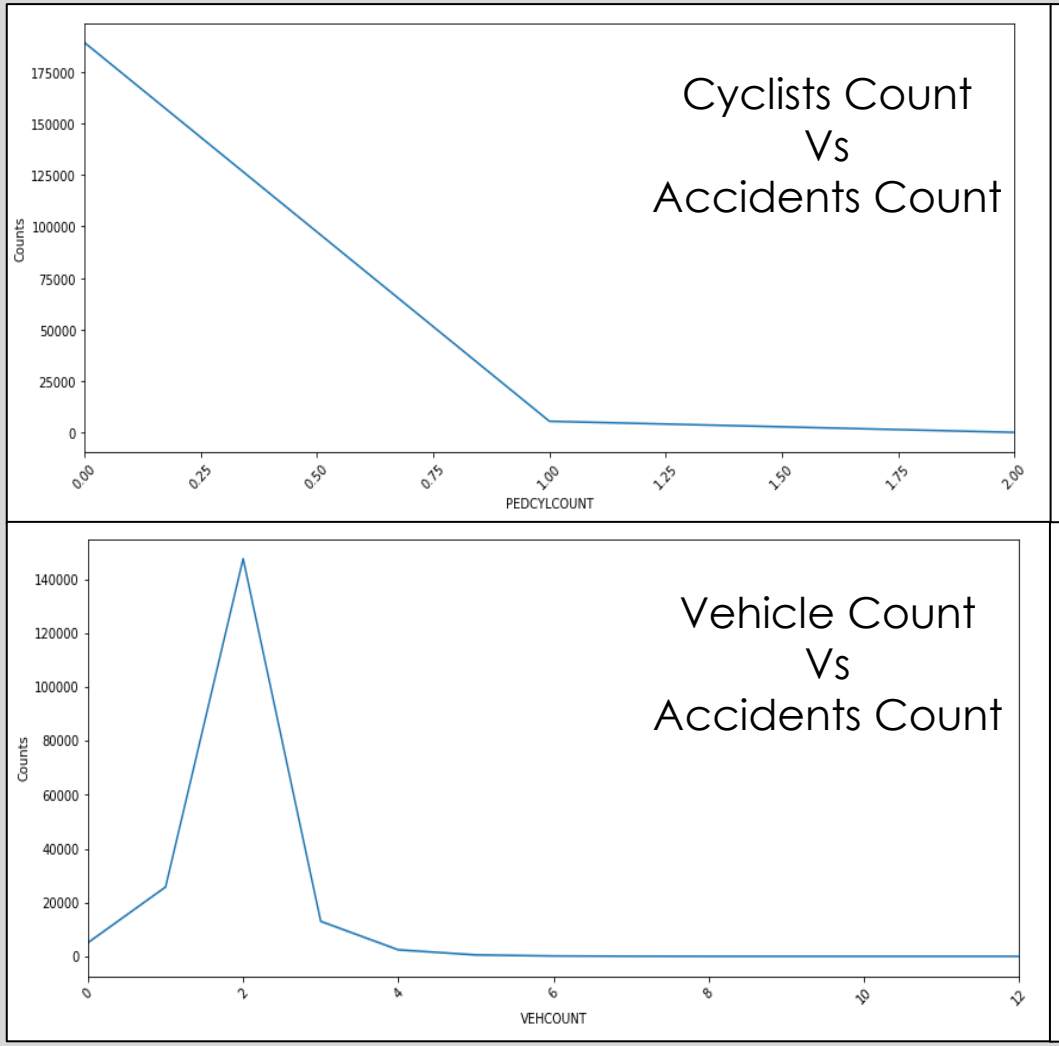


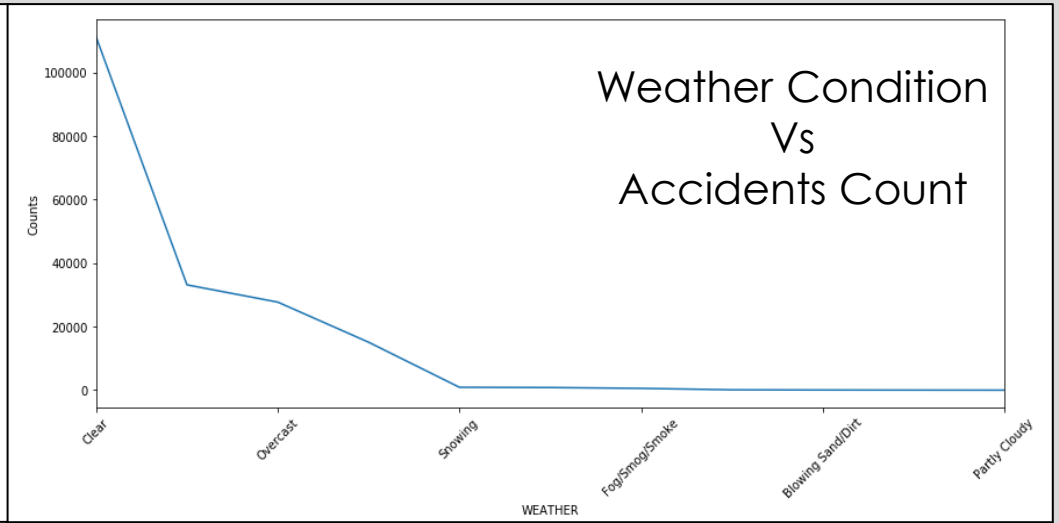


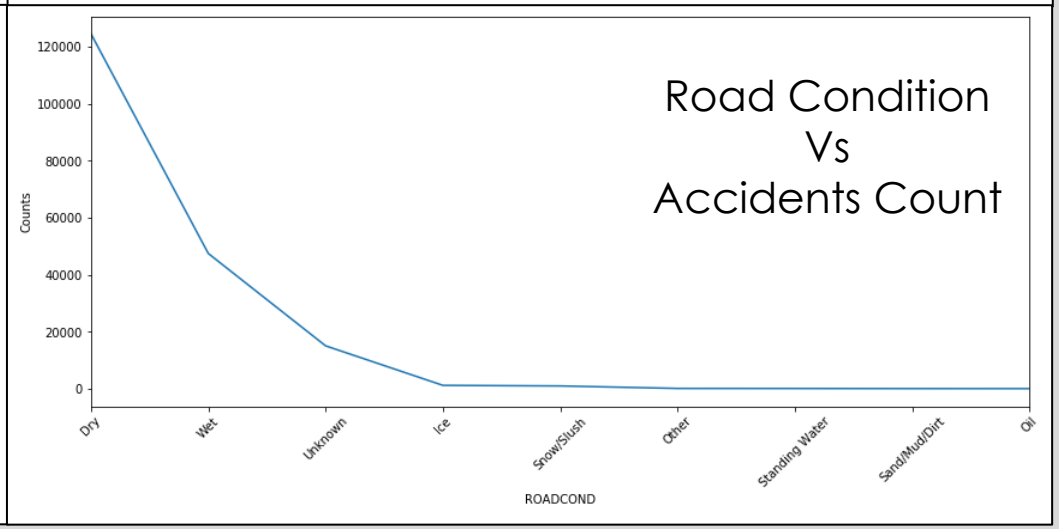




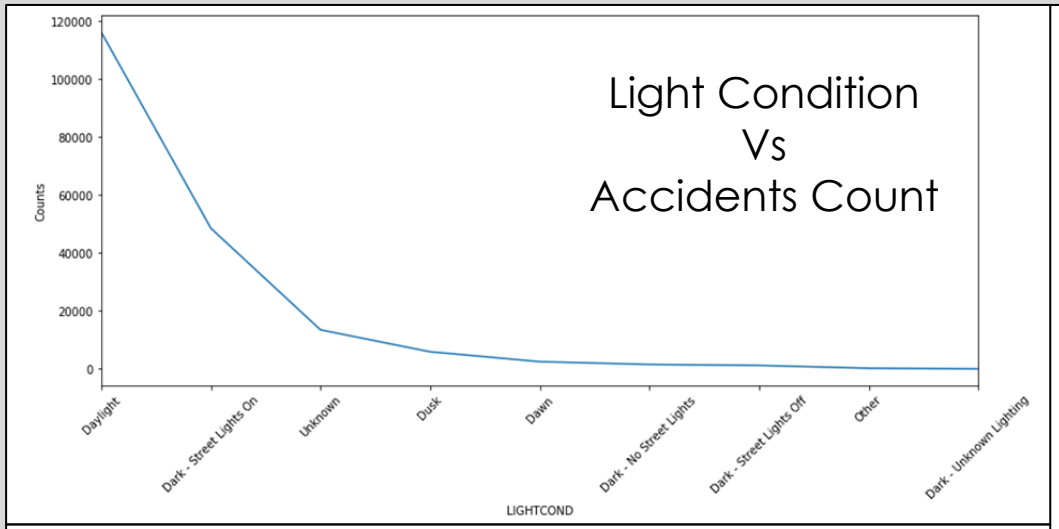
Number of accidents vs attributes (cont'd)

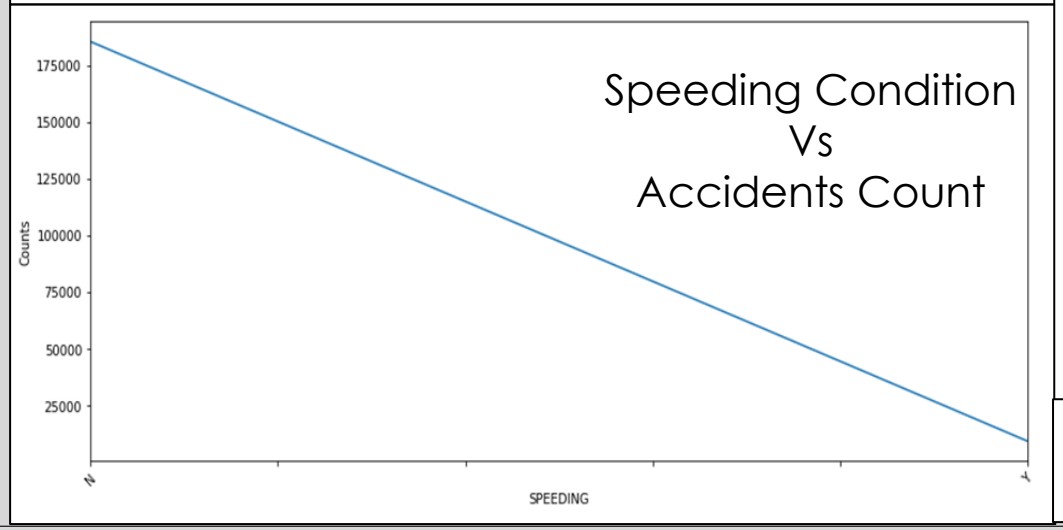


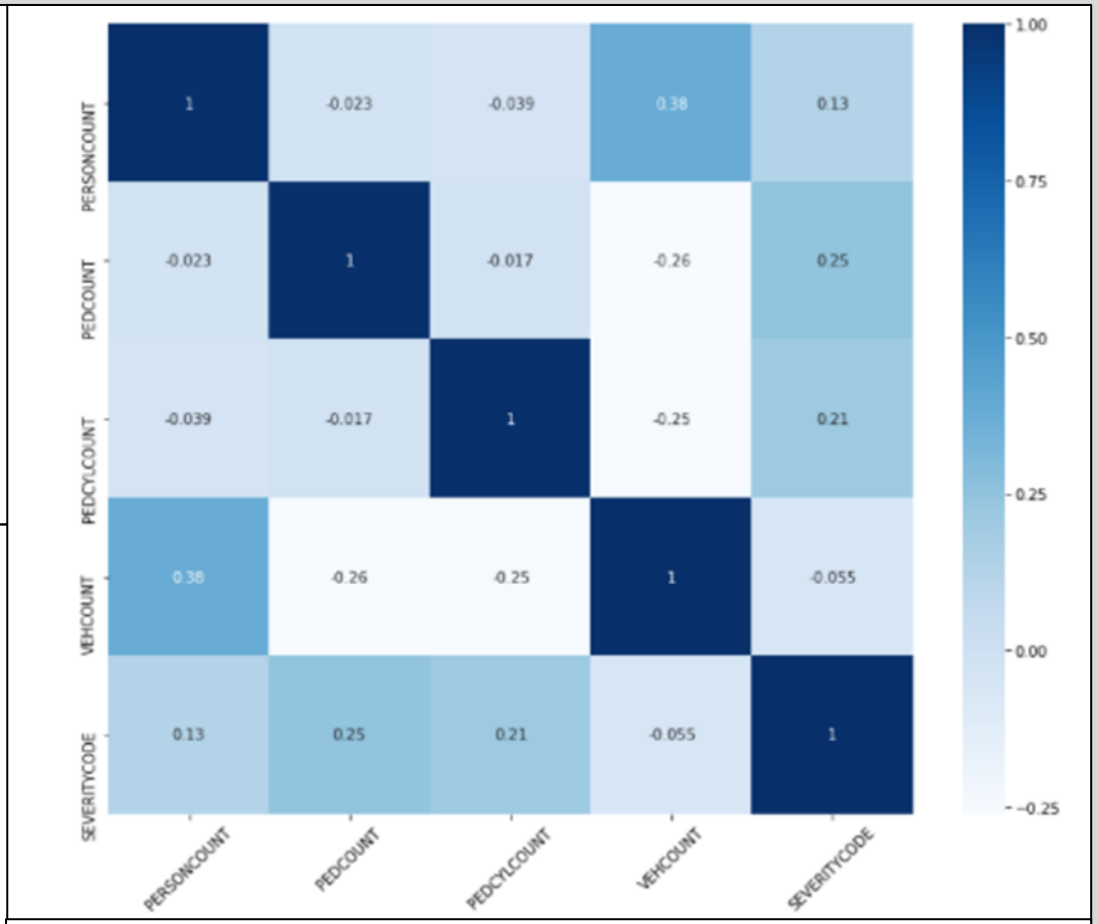




Number of accidents vs attributes





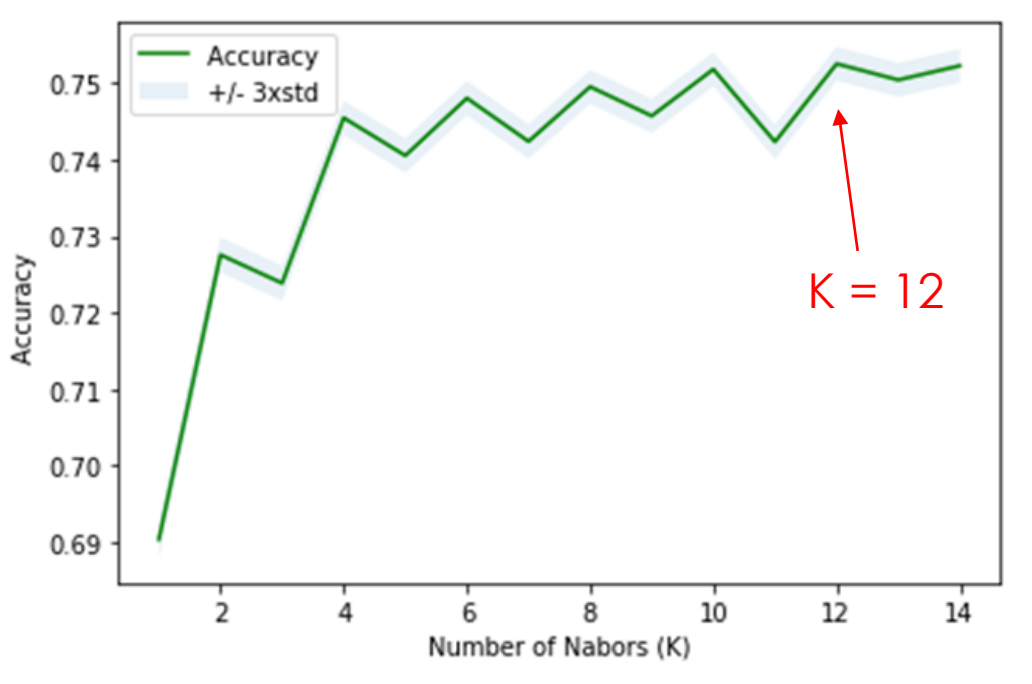


Heatmap showing the correlation between numerical values in the dataframe.

Modeling

- Four different model would be applied on the data set and will be evaluated using various metrics to find the best option:
  1. K Nearest Neighbor (KNN)
  2. Decision Tree
  3. Support Vector Machine
  4. Logistic Regression
- The train_test_split parameters:

  X, y, test_size=0.2, and random_state=4
- K value for KNN algorithm is 12.



Model Evaluation

Algorithm	Jaccard	F1-Score	Log Loss
KNN	0.75	0.72	NA
Decision Tree	0.75	0.69	NA
SVM	0.76	0.71	NA
Logistic Regression	0.76	0.72	0.48

Results

- Most accidents are labeled as category “1” or less sever accidents.
- Most accidents happen at the block type address, however, they are less severe than the accidents happening at intersections.
- Most accidents reported, did not involve speed violation.
- Number of pedestrian, cyclist, and persons involved in the accident have positive relationship with the severity level of the accident and all accidents have less than 10 people involved and mostly no pedestrian.
- Most collisions are labeled as parked car type and lastly, most accidents happen at clear weather and dry road condition during daylight hours.
- All four models predicted the severity code for the test set with relatively high accuracy score.
- KNN and SVM algorithms required longer computation time compared to the other two methods.

Discussion

- Data set was split into training and testing sets (80%, 20%) to compare the predicted data labels (severity code) with the recorded values.
- All models have similar Jaccard accuracy values, but Decision Tree and Logistic Regression have comparatively less computation times and would be the optimum models for future predictions.
- It is recommended to collect additional data with less missing information as this could help improve the model accuracy.

Conclusion

- There is no particular relationship between bad weather, light and road conditions that affect collisions.
- There were a lot more collisions that happened on dry roads and clear weather conditions during day time compared to when conditions were not ideal.
- Drivers tend to be more careful in driving in adverse weather, road and light conditions.
- Author suggests using this model to predict a possibility of sever car accidents based on the time and location of driving.
- This information could help drivers choose the safest route for their travel and reduce the number of dangerous car accidents.


Thank
you