Car Accident Severity Report

- ## Understanding the Problem

Car accidents are one of the most common issue found across the globe to be severe. Accidents might sometimes be due to our negligence or due to natural reasons or anything. Sometimes, we might be too lazy or negligent to drive costing our lives as well as the others. Whereas sometimes, due to heavy rain or heavy gales etc. We might unknowingly droop into accident with the other car. Whatever the reason maybe, car accident not only lead to property damage but cause injuries and sometimes even leading to people's death. In our project we decide how these accidents occur due to weather conditions. So, the main problem or question arising in this depressing situation is

"what is the severity of these car accidents? " "What are their causes?" and "How to curb or slow down them?"

The target audience of the project is local Seattle government, police, rescue groups, and last but not least, car insurance institutes. The model and its results are going to provide some advice for the target audience to make insightful decisions for reducing the number of accidents and injuries for the city.

- ## Data Section

We have several attributes in our dataset which will tell us about severity of these accidents. Attributes like WEATHER, ROADCOND, LIGHTCOND, JUNCTIONTYPE can tell us about the accidents which happen naturally and attributes like SEVERITYDESC and COLLISIONTYPE helps us decide how these accidents take place. Our predictor or target variable will be 'SEVERITYCODE' because it is used to measure the severity of an accident from 0 to 5 within dataset. Attributes used to weigh the severity of an accident are 'WEATHER' , 'ROADCOND' , 'LIGHTCOND'.

- 0 : Little to no Probability (Clear Weather Conditions)
- 1 : Very Low Probability - Chance of Property Damage
- 2 : Low Probability - Chance of Injury

- 3 : Mild Probability - Chance of Serious Injury
- 4 : High Probability - Chance of Fatality

So depending on these severity codes, we decide the extent of severity of accidents due to these weather conditions.

• Data Preprocessing

The dataset in the original form is not ready for data analysis. First we check the datatype of every column. After analyzing the data I decided to work only on the following four attributes because rest of the attributes are not that relevant to the problem. The following attributes are:

1. SEVERITYCODE
2. ROADCOND
3. LIGHTCOND
4. WEATHER

Now, I have applied value_counts function from pandas to all four attributes to know about these attributes. After this we notice that all these three attributes (LIGHTCOND , ROADCOND , WEATHER) have significant amount of unknown values.

```
In [5]: df["SEVERITYCODE"].value_counts()

Out[5]: 1    136485
        2     58188
        Name: SEVERITYCODE, dtype: int64

In [6]: df["ROADCOND"].value_counts()

Out[6]: Dry               124510
        Wet                47474
        Unknown            15078
        Ice                 1209
        Snow/Slush          1004
        Other                132
        Standing Water       115
        Sand/Mud/Dirt         75
        Oil                   64
        Name: ROADCOND, dtype: int64
```

```
In [7]: df["LIGHTCOND"].value_counts()
```

```
Out[7]: Daylight                    116137
        Dark - Street Lights On      48507
        Unknown                      13473
        Dusk                          5902
        Dawn                          2502
        Dark - No Street Lights       1537
        Dark - Street Lights Off      1199
        Other                          235
        Dark - Unknown Lighting         11
        Name: LIGHTCOND, dtype: int64
```

```
In [8]: df["WEATHER"].value_counts()
```

```
Out[8]: Clear                       111135
        Raining                      33145
        Overcast                     27714
        Unknown                      15091
        Snowing                        907
        Other                          832
        Fog/Smog/Smoke                 569
        Sleet/Hail/Freezing Rain       113
        Blowing Sand/Dirt               56
        Severe Crosswind                25
        Partly Cloudy                    5
        Name: WEATHER, dtype: int64
```

Now, I have created a new dataframe including only these four important attributes and remove all the rows from the dataframe which contains unknown in any of these columns.

```
In [9]: df2 = df[["SEVERITYCODE" , "ROADCOND" , "LIGHTCOND" , "WEATHER"]]
        df2.head(5)
```

Out[9]:

	SEVERITYCODE	ROADCOND	LIGHTCOND	WEATHER
0	2	Wet	Daylight	Overcast
1	1	Wet	Dark - Street Lights On	Raining
2	1	Dry	Daylight	Overcast
3	1	Dry	Daylight	Clear
4	2	Wet	Daylight	Raining

```
In [10]: df2.replace("Unknown", np.nan ,inplace=True)
         df2.head(20)
```

```
In [11]: df2.dropna(subset=["LIGHTCOND" , "ROADCOND" , "WEATHER" ] , axis= 0 , inplace = True)
         df2.reset_index(drop = True , inplace = True)
         df2.head(20)
```

After this I have changed the datatype of these three attributes from object to categorical datatype and resample the dataset because the target variable ('SEVERITYCODE') has unbalanced categorical numbers.

```
In [12]: df2["SEVERITYCODE"].value_counts()
Out[12]: 1    114659
         2     55851
         Name: SEVERITYCODE, dtype: int64

In [13]: df2["WEATHER"] = df2["WEATHER"].astype('category')
         df2["ROADCOND"] = df2["ROADCOND"].astype('category')
         df2["LIGHTCOND"] = df2["LIGHTCOND"].astype('category')

In [14]: from sklearn.utils import resample

In [15]: df2_maj = df2[df2.SEVERITYCODE==1]
         df2_min = df2[df2.SEVERITYCODE==2]

         df2_maj_resample = resample(df2_maj, replace=False, n_samples=55851, random_state=123)

         df3 = pd.concat([df2_maj_resample, df2_min])
         df3.SEVERITYCODE.value_counts()
Out[15]: 2    55851
         1    55851
         Name: SEVERITYCODE, dtype: int64
```

Now, I have added 3 new columns (LIGHTCOND_NUM , WEATHER_NUM, ROADCOND_NUM) in the dataframe which contains numerical value for each category in these columns. After this I have created an array X and y to preprocess the data.

- # Methodology

After importing all the evaluation scores from sklearn.metrics and splitting the data into train and test sets. As this is a case of classification, I have applied the following classification algorithm:

1.KNN

2.Decision Tree

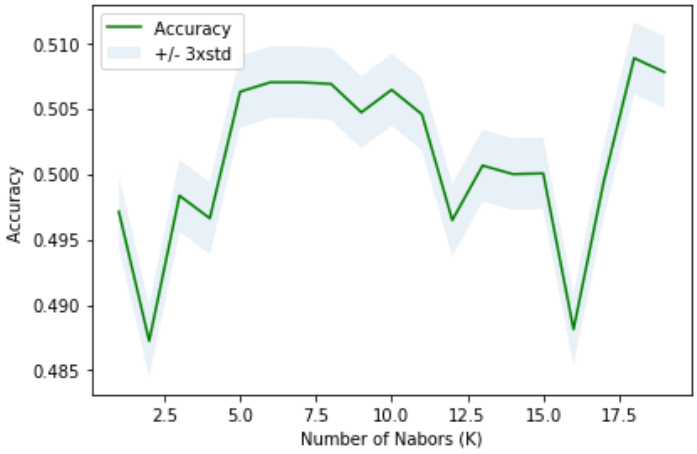
3.Logistic Regression

- KNN

Applying KNN algorithm after finding the best K and then evaluating Accuracy scores.

Plot

In [27]:
```
import matplotlib as mpl
import matplotlib.pyplot as plt
plt.plot(range(1,Ks),mean_acc,'g')
plt.fill_between(range(1,Ks),mean_acc - 1 * std_acc,mean_acc + 1 * std_acc, alph
a=0.10)
plt.legend(('Accuracy ', '+/- 3xstd'))
plt.ylabel('Accuracy ')
plt.xlabel('Number of Nabors (K)')
plt.tight_layout()
plt.show()
```



In [28]:
```
print( "The best accuracy was with", mean_acc.max(), "with k=", mean_acc.argmax
()+1)
```

```
The best accuracy was with 0.5088478410074304 with k= 18
```

In [29]:
```
#Best k is 18
k = 18
knn = KNeighborsClassifier(n_neighbors = k).fit(X_train,y_train)

knn_y_pred = knn.predict(X_test)
knn_y_pred[0:5]
```

Out[29]:
```
array([2, 2, 1, 2, 1])
```

In [30]:
```
print("KNN Jaccard index: %.2f" % jaccard_similarity_score(y_test, knn_y_pred))
print("KNN F1-score: %.2f" % f1_score(y_test, knn_y_pred, average='weighted') )
```

```
KNN Jaccard index: 0.51
KNN F1-score: 0.51
```

- Decision Tree

Applying decision tree algorithm and evaluating the accuracy scores.

In [31]:
```
from sklearn.tree import DecisionTreeClassifier
dt = DecisionTreeClassifier(criterion = "entropy", max_depth = 7)

dt.fit(X_train,y_train)
```

Out[31]:
```
DecisionTreeClassifier(class_weight=None, criterion='entropy', max_depth=7,
            max_features=None, max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, presort=False, random_state=None,
            splitter='best')
```

In [32]:
```
dt_y_pred = dt.predict(X_test)
```

In [34]:
```
print("DT Jaccard index: %.2f" % jaccard_similarity_score(y_test,dt_y_pred))
print("DT f1-score: %.2f" % f1_score(y_test, dt_y_pred, average='weighted'))
```

```
DT Jaccard index: 0.52
DT f1-score: 0.47
```

- Logistic Regression

Applying logistic regression and evaluating the scores.

In [36]:
```
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import confusion_matrix
LR = LogisticRegression(C=6, solver='liblinear').fit(X_train,y_train)
```

In [37]:
```
LR_y_pred = LR.predict(X_test)
```

In [38]:
```
LR_y_prob = LR.predict_proba(X_test)
```

In [39]:
```
print("LR Jaccard index: %.2f" % jaccard_similarity_score(y_test, LR_y_pred))
print("LR F1-score: %.2f" % f1_score(y_test, LR_y_pred, average='weighted'))
print("LR Logloss: %.2f" % log_loss(y_test, LR_y_prob))
```

```
LR Jaccard index: 0.52
LR F1-score: 0.51
LR Logloss: 0.69
```

- Result

Algorithm	Jaccard	F1-score	LogLoss	Accuracy
KNN	0.51	0.51	NA	0.51
DecisionTree	0.52	0.47	NA	0.52
LogisticRegression	0.52	0.51	0.69	0.51

- Conclusion

After seeing the result we can say that lightning conditions, weather , road condition can have an impact on the severity of an accident. From the result we can see that decision tree is the most accurate but not by much.

By seeing this government of Seattle can put various safety measures which can help in preventing accidents by judging these three parameters.