Project explore

April 26, 2018

```
In [2]: #NYPD_Motor_Vehicle_Collisions

In [3]: #Basic libraries
        import pandas as pd
        import numpy as np
        import matplotlib.pyplot as plt
        import seaborn as sns
        import scipy.io as scio
        from scipy.cluster.hierarchy import dendrogram, linkage
        import scipy
        #EDA and Preprocesing

        from sklearn.preprocessing import StandardScaler, PolynomialFeatures, Normalizer
        from sklearn.pipeline import make_pipeline

        from sklearn.manifold import TSNE

        from sklearn.model_selection import KFold, train_test_split, GridSearchCV, cross_val_sc

        #Supervised models

            #Regression
        from sklearn.linear_model import LinearRegression
        from sklearn.svm import LinearSVR, SVR
        from sklearn.ensemble import RandomForestRegressor

            #Classification
        from sklearn.linear_model import LogisticRegression
        from sklearn.svm import LinearSVC, SVC
        from sklearn.neighbors import KNeighborsClassifier, NearestCentroid, KDTree
        from sklearn.ensemble import RandomForestClassifier, IsolationForest
        from sklearn.tree import DecisionTreeClassifier
        from sklearn.neural_network import MLPClassifier

        from sklearn.metrics import make_scorer, roc_auc_score, f1_score, normalized_mutual_in
        from sklearn.metrics import zero_one_loss, classification_report, recall_score, precis
```

```
#Unsupervised Models

from sklearn.cluster import KMeans, AgglomerativeClustering, DBSCAN
from sklearn.covariance import EllipticEnvelope
from sklearn.svm import OneClassSVM
from sklearn.ensemble import IsolationForest

    #Dimensionality Reduction
from sklearn.decomposition import PCA, NMF, TruncatedSVD, LatentDirichletAllocation


#IMBLEARN

from imblearn.under_sampling import RandomUnderSampler
from imblearn.over_sampling import RandomOverSampler, SMOTE

#Text

from sklearn.feature_extraction.text import CountVectorizer, TfidfVectorizer

import warnings
from scipy.stats import zscore

path = '\srinidhi\Documents\Courses\Spring_2018\EDA\Project'

from datetime import datetime
from astral import Astral
```

0.1 1. Collisions data from the NYC open data website:

```
In [4]: df= pd.read_csv("NYPD_Motor_Vehicle_Collisions.csv")
```

```
/Users/srinidhi/anaconda/lib/python3.6/site-packages/IPython/core/interactiveshell.py:2717: Dty
  interactivity=interactivity, compiler=compiler, result=result)
```

0.2 2. Weather data for NYC(JFK Airport) from the NOAA website

```
In [11]: df_weather= pd.read_csv("jfk_weather_info.csv")
```

```
In [13]: #identifier_cols(df)
```

```
Out[13]: [('DATE', 'Date/Time saved as string'),
          ('TIME', 'Date/Time saved as string'),
          ('BOROUGH', 'String/Object'),
          ('ZIP CODE', 'String/Object'),
          ('LATITUDE', 'Real Value'),
          ('LONGITUDE', 'Real Value'),
          ('LOCATION', 'String/Object'),
          ('ON STREET NAME', 'String/Object'),
          ('CROSS STREET NAME', 'String/Object'),
          ('OFF STREET NAME', 'String/Object'),
          ('NUMBER OF PERSONS INJURED', 'Integer'),
          ('NUMBER OF PERSONS KILLED', 'Integer'),
          ('NUMBER OF PEDESTRIANS INJURED', 'Integer'),
          ('NUMBER OF PEDESTRIANS KILLED', 'Integer'),
          ('NUMBER OF CYCLIST INJURED', 'Integer'),
          ('NUMBER OF CYCLIST KILLED', 'Integer'),
          ('NUMBER OF MOTORIST INJURED', 'Integer'),
          ('NUMBER OF MOTORIST KILLED', 'Integer'),
          ('CONTRIBUTING FACTOR VEHICLE 1', 'String/Object'),
          ('CONTRIBUTING FACTOR VEHICLE 2', 'String/Object'),
          ('CONTRIBUTING FACTOR VEHICLE 3', 'String/Object'),
          ('CONTRIBUTING FACTOR VEHICLE 4', 'String/Object'),
          ('CONTRIBUTING FACTOR VEHICLE 5', 'String/Object'),
          ('UNIQUE KEY', 'Integer'),
          ('VEHICLE TYPE CODE 1', 'String/Object'),
          ('VEHICLE TYPE CODE 2', 'String/Object'),
          ('VEHICLE TYPE CODE 3', 'String/Object'),
          ('VEHICLE TYPE CODE 4', 'String/Object'),
          ('VEHICLE TYPE CODE 5', 'String/Object')]
```

```
In [11]: #shudhi_stats(df) - function defined and removed
```

```
Out[11]:                           Feature    count  # Unique  # Missing #Outliers  \
          0                             DATE  1245254      2114          0
          1                             TIME  1245254      1440          0
          2                          BOROUGH  1245254         5     356613
          3                         ZIP CODE  1245254       417     356711
          4                         LATITUDE  1245254    121221     217065         0
          5                        LONGITUDE  1245254    107278     217065         0
          6                         LOCATION  1245254    156597     217065
          7                   ON STREET NAME  1245254     10404     244953
          8                CROSS STREET NAME  1245254     16564     317016
          9                  OFF STREET NAME  1245254     99018    1048226
          10       NUMBER OF PERSONS INJURED  1245254        25          0         0
          11        NUMBER OF PERSONS KILLED  1245254         7          0         0
          12   NUMBER OF PEDESTRIANS INJURED  1245254        13          0         0
          13    NUMBER OF PEDESTRIANS KILLED  1245254         4          0         0
          14       NUMBER OF CYCLIST INJURED  1245254         5          0         0
          15        NUMBER OF CYCLIST KILLED  1245254         3          0         0
          16      NUMBER OF MOTORIST INJURED  1245254        25          0         0
          17       NUMBER OF MOTORIST KILLED  1245254         6          0         0
          18   CONTRIBUTING FACTOR VEHICLE 1  1245254        48       6759
          19   CONTRIBUTING FACTOR VEHICLE 2  1245254        48     176082
          20   CONTRIBUTING FACTOR VEHICLE 3  1245254        43    1164932
          21   CONTRIBUTING FACTOR VEHICLE 4  1245254        42    1227984
```

```
22  CONTRIBUTING FACTOR VEHICLE 5  1245254        32    1240976
23                       UNIQUE KEY  1245254   1245254          0         0
24             VEHICLE TYPE CODE 1  1245254       274     10077
25             VEHICLE TYPE CODE 2  1245254       268    206205
26             VEHICLE TYPE CODE 3  1245254        60    1167357
27             VEHICLE TYPE CODE 4  1245254        37    1228605
28             VEHICLE TYPE CODE 5  1245254        19    1241099

           mean       median     min          max
0
1
2
3
4         40.71        40.72       0      41.1262
5        -73.92       -73.93 -201.36            0
6
7
8
9
10         0.26            0       0           43
11            0            0       0            8
12         0.05            0       0           27
13            0            0       0            8
14         0.02            0       0            4
15            0            0       0            2
16         0.19            0       0           43
17            0            0       0            5
18
19
20
21
22
23  2.40149e+06  3.25875e+06      22  3.88248e+06
24
25
26
27
28
```

0.2.1 Add frequently used values as features

```
In [5]: df['date_time']= pd.to_datetime(df['DATE'] + ' ' + df['TIME'])
```

```
In [7]: df[df['date_time'] > pd.to_datetime('01/01/2016')]['CONTRIBUTING FACTOR VEHICLE 1'].val
```

```
Out[7]: Unspecified                                              204778
        Driver Inattention/Distraction                            97331
        Following Too Closely                                     35680
```

```
Failure to Yield Right-of-Way                             29209
Backing Unsafely                                          19757
Passing or Lane Usage Improper                            16573
Unsafe Lane Changing                                      13960
Other Vehicular                                           12220
Turning Improperly                                        11685
Traffic Control Disregarded                                7718
Driver Inexperience                                        7332
Reaction to Other Uninvolved Vehicle                       5884
Unsafe Speed                                               5682
Fatigued/Drowsy                                            5650
Pavement Slippery                                          5054
Alcohol Involvement                                        4675
View Obstructed/Limited                                    3163
Oversized Vehicle                                          2979
Lost Consciousness                                         2703
Pedestrian/Bicyclist/Other Pedestrian Error/Confusion      2365
Aggressive Driving/Road Rage                               1761
Outside Car Distraction                                    1693
Passenger Distraction                                      1663
Prescription Medication                                    1583
Brakes Defective                                           1430
Fell Asleep                                                1258
Glare                                                      1167
Physical Disability                                        1009
Obstruction/Debris                                          973
Failure to Keep Right                                       696
Illness                                                     620
Steering Failure                                            534
Tire Failure/Inadequate                                     510
Pavement Defective                                          504
Animals Action                                              396
Driverless/Runaway Vehicle                                  388
Other Electronic Device                                     272
Drugs (Illegal)                                             243
Accelerator Defective                                       235
Lane Marking Improper/Inadequate                            222
Traffic Control Device Improper/Non-Working                 205
Cell Phone (hand-held)                                      143
Other Lighting Defects                                       40
Cell Phone (hands-free)                                      36
Tow Hitch Defective                                          34
Headlights Defective                                         20
Shoulders Defective/Improper                                 19
Windshield Inadequate                                        19
Name: CONTRIBUTING FACTOR VEHICLE 1, dtype: int64
```

```
In [6]: df['DATE']=df['date_time'].dt.date
In [7]: df['Day of week']= df['date_time'].dt.dayofweek
```

```
In [8]: df['weekend'] = np.where(df['Day of week']>=5, 1, 0)
```

```
In [9]: df['hour']= df['date_time'].dt.hour
```

```
In [10]: df['hour'].value_counts()
```

```
Out[10]: 16    92966
         17    90190
         14    85191
         18    79134
         15    77561
         13    73908
         8     70330
         12    69913
         9     69406
         11    66126
         19    64330
         10    64001
         20    53431
         21    44029
         22    39636
         7     35066
         0     33745
         23    32189
         6     25628
         1     19525
         5     16322
         4     14940
         2     14909
         3     12778
         Name: hour, dtype: int64
```

```
In [59]: df['DATE'].min()
```

```
Out[59]: '01/01/2013'
```

```
In [12]: df_weather['DATE']= pd.to_datetime(df.l/_weather['DATE']).dt.date
```

```
        ---------------------------------------------------------------------------

        AttributeError                            Traceback (most recent call last)

        <ipython-input-12-24d9c2339d30> in <module>()
    ----> 1 df_weather['DATE']= pd.to_datetime(df.l/_weather['DATE']).dt.date
        /Users/srinidhi/anaconda/lib/python3.6/site-packages/pandas/core/generic.py in __getatt
       3079             if name in self._info_axis:
       3080                 return self[name]
    -> 3081             return object.__getattribute__(self, name)
       3082 
       3083     def __setattr__(self, name, value):


        AttributeError: 'DataFrame' object has no attribute 'l'
```

0.2.2 Data Sanity Check

```
In [17]: shudhi_stats(df_weather)
```

```
Out[17]:      Feature  count  # Unique  # Missing #Outliers   mean median   min    max
         0       DATE   1826      1826          0
         1     AWND_m_s   1826       106          0         0   5.05    4.8   0.9   12.9
         2       PRCP   1826       130          0         0   2.84      0     0  118.9
         3       SNOW   1826        39          0         0   2.53      0     0    770
         4       SNWD   1826        21          0         0    8.6      0     0    710
         5       TAVG   1826       363         90         0   13.5   14.1 -13.1   30.8
         6       TMAX   1826        89          0         0  17.13   17.8  -8.2   37.8
         7       TMIN   1826        96          0         0   9.01    8.9 -17.1   27.8
         8       WT01   1826         1       1324         0      1      1     1      1
         9       WT02   1826         1       1742         0      1      1     1      1
         10      WT03   1826         1       1751         0      1      1     1      1
         11      WT04   1826         1       1808         0      1      1     1      1
         12      WT06   1826         1       1819         0      1      1     1      1
         13      WT08   1826         1       1710         0      1      1     1      1
         14      WT09   1826         1       1816         0      1      1     1      1
         15      WT13   1826         1       1797         0      1      1     1      1
         16      WT14   1826         1       1815         0      1      1     1      1
         17      WT15   1826         1       1825         0      1      1     1      1
         18      WT16   1826         1       1795         0      1      1     1      1
         19      WT18   1826         1       1799         0      1      1     1      1
         20      WT22   1826         1       1824         0      1      1     1      1
```

```
In [ ]: df_final = df.merge(df_weather, on='DATE', how='left')
```

```
In [ ]: df_final['TAVG']= (df_final['TMAX']+df_final['TMIN'])/2
```

```
In [ ]: # Creating weather fields:

        df_final['hot'] = np.where(df_final['TMAX']>25, 1, 0)
        df_final['fog'] = np.where((df_final['WT01'] ==1.0) | (df_final['WT02'] ==1.0) | (df_fi
        df_final['rain']= np.where((df_final['WT15'] ==1.0) | (df_final['WT16'] ==1.0) , 1, 0)
```

```
In [19]: shudhi_stats(df_final)
```

```
Out[19]:                          Feature    count  # Unique  # Missing #Outliers  \
0                             DATE  1245254      2114          0
1                             TIME  1245254      1440          0
2                          BOROUGH  1245254         5     356613
3                         ZIP CODE  1245254       417     356711
4                         LATITUDE  1245254    121221     217065         0
5                        LONGITUDE  1245254    107278     217065         0
6                         LOCATION  1245254    156597     217065
7                   ON STREET NAME  1245254     10404     244953
8                CROSS STREET NAME  1245254     16564     317016
9                  OFF STREET NAME  1245254     99018    1048226
10       NUMBER OF PERSONS INJURED  1245254        25          0         0
11        NUMBER OF PERSONS KILLED  1245254         7          0         0
12   NUMBER OF PEDESTRIANS INJURED  1245254        13          0         0
13    NUMBER OF PEDESTRIANS KILLED  1245254         4          0         0
14       NUMBER OF CYCLIST INJURED  1245254         5          0         0
15        NUMBER OF CYCLIST KILLED  1245254         3          0         0
16      NUMBER OF MOTORIST INJURED  1245254        25          0         0
17       NUMBER OF MOTORIST KILLED  1245254         6          0         0
18   CONTRIBUTING FACTOR VEHICLE 1  1245254        48       6759
19   CONTRIBUTING FACTOR VEHICLE 2  1245254        48     176082
20   CONTRIBUTING FACTOR VEHICLE 3  1245254        43    1164932
21   CONTRIBUTING FACTOR VEHICLE 4  1245254        42    1227984
22   CONTRIBUTING FACTOR VEHICLE 5  1245254        32    1240976
23                      UNIQUE KEY  1245254   1245254          0         0
24             VEHICLE TYPE CODE 1  1245254       274      10077
25             VEHICLE TYPE CODE 2  1245254       268     206205
26             VEHICLE TYPE CODE 3  1245254        60    1167357
27             VEHICLE TYPE CODE 4  1245254        37    1228605
28             VEHICLE TYPE CODE 5  1245254        19    1241099
29                       date_time  1245254    588005          0
30                     Day of week  1245254         7          0         0
31                         weekend  1245254         2          0         0
32                            hour  1245254        24          0         0
33                        AWND_m_s  1245254       106     160704         0
34                            PRCP  1245254       130     160704         0
35                            SNOW  1245254        39     160704         0
36                            SNWD  1245254        21     160704         0
37                            TAVG  1245254       363     207252         0
38                            TMAX  1245254        89     160704         0
39                            TMIN  1245254        96     160704         0
40                            WT01  1245254         1     937834         0
41                            WT02  1245254         1    1194456         0
42                            WT03  1245254         1    1197121         0
43                            WT04  1245254         1    1234957         0
44                            WT06  1245254         1    1241243         0
45                            WT08  1245254         1    1174567         0
46                            WT09  1245254         1    1240478         0
```

```
47                           WT13  1245254          1    1229836         0
48                           WT14  1245254          1    1239844         0
49                           WT15  1245254          1    1244688         0
50                           WT16  1245254          1    1228294         0
51                           WT18  1245254          1    1230672         0
52                           WT22  1245254          1    1244000         0

           mean       median     min           max
0
1
2
3
4         40.71        40.72       0       41.1262
5        -73.92       -73.93 -201.36             0
6
7
8
9
10         0.26            0       0            43
11            0            0       0             8
12         0.05            0       0            27
13            0            0       0             8
14         0.02            0       0             4
15            0            0       0             2
16         0.19            0       0            43
17            0            0       0             5
18
19
20
21
22
23  2.40149e+06  3.25875e+06      22   3.88248e+06
24
25
26
27
28
29
30         2.91            3       0             6
31         0.25            0       0             1
32        13.34           14       0            23
33         5.05          4.8     0.9          12.9
34         2.99            0       0         118.9
35         2.48            0       0           770
36          8.2            0       0           710
37        13.78         14.6   -13.1          30.8
38        17.49         18.3    -8.2          37.8
39         9.34           10   -17.1          27.8
```

```
40            1            1       1            1
41            1            1       1            1
42            1            1       1            1
43            1            1       1            1
44            1            1       1            1
45            1            1       1            1
46            1            1       1            1
47            1            1       1            1
48            1            1       1            1
49            1            1       1            1
50            1            1       1            1
51            1            1       1            1
52            1            1       1            1
```

0.3 Hypothesis:

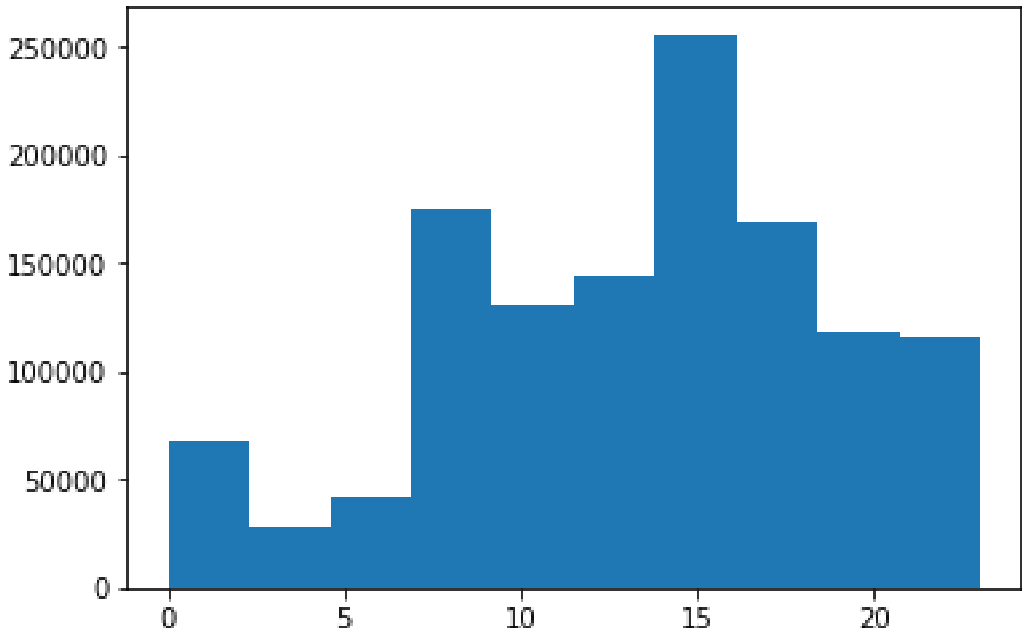
1. Factors possibly affecting accidents:

    1. Location
    2. Daylight: Yes/ No
    3. Time of Day: Hour of day, EMorn: 4-8; Morn: 8-12; Aft: 12-16; Eve: 16-20; Night: 20-24; L Night: 0-4
    4. Weather: Temp, Rain, Prec, Snow, Fog Extreme weather
    5. Day of week
    6. Presence of Offices(morn), Pubs(late night)

```
In [ ]: #[(np.abs(zscore(df_final)) > 2).all(axis=1)]
```

```
In [ ]: plt.hist(df_weather['TMAX'])
        plt.boxplot(df_weather['TMAX'])
        plt.show()
```

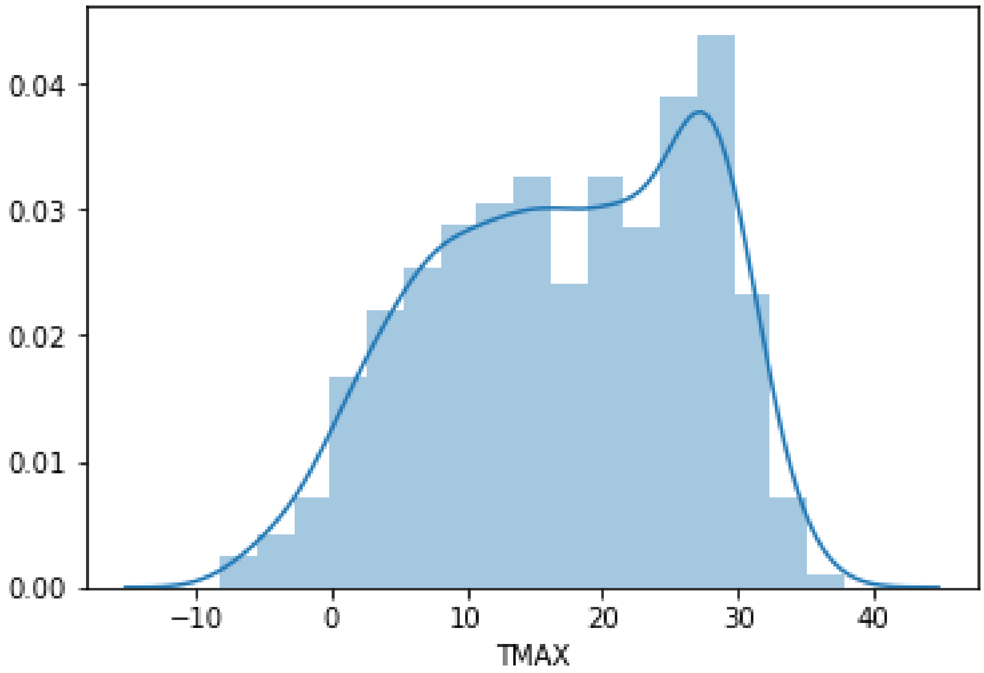
```
In [33]: plt.hist(df_final['hour'])
         plt.show()
```



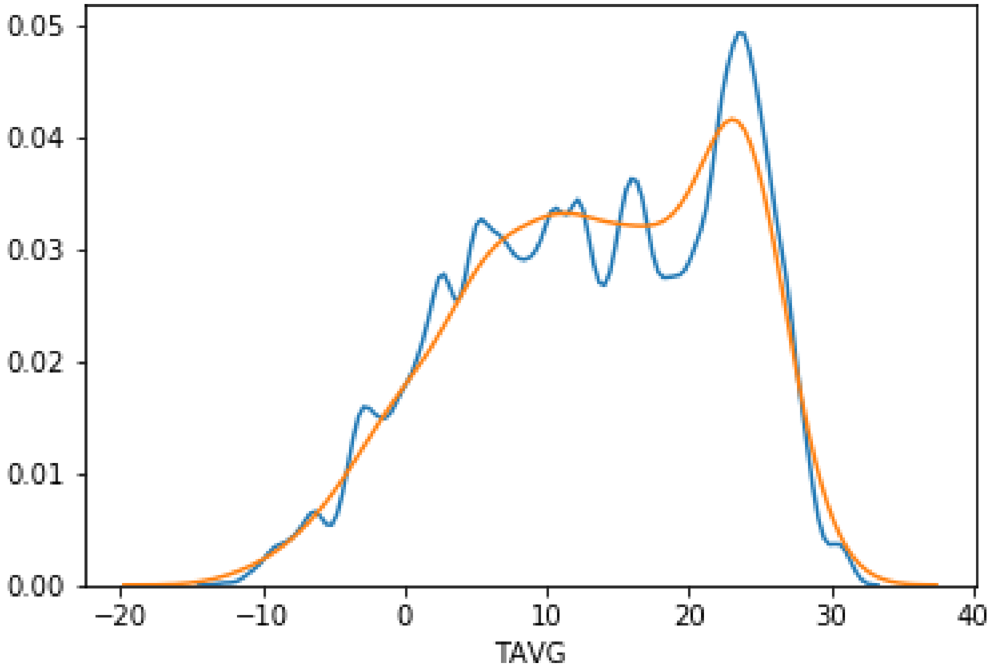
```
In [55]: pd.DataFrame.to_csv(df_final)
```

```
IOPub data rate exceeded.
The notebook server will temporarily stop sending output
to the client in order to avoid crashing it.
To change this limit, set the config variable
`--NotebookApp.iopub_data_rate_limit`.
```

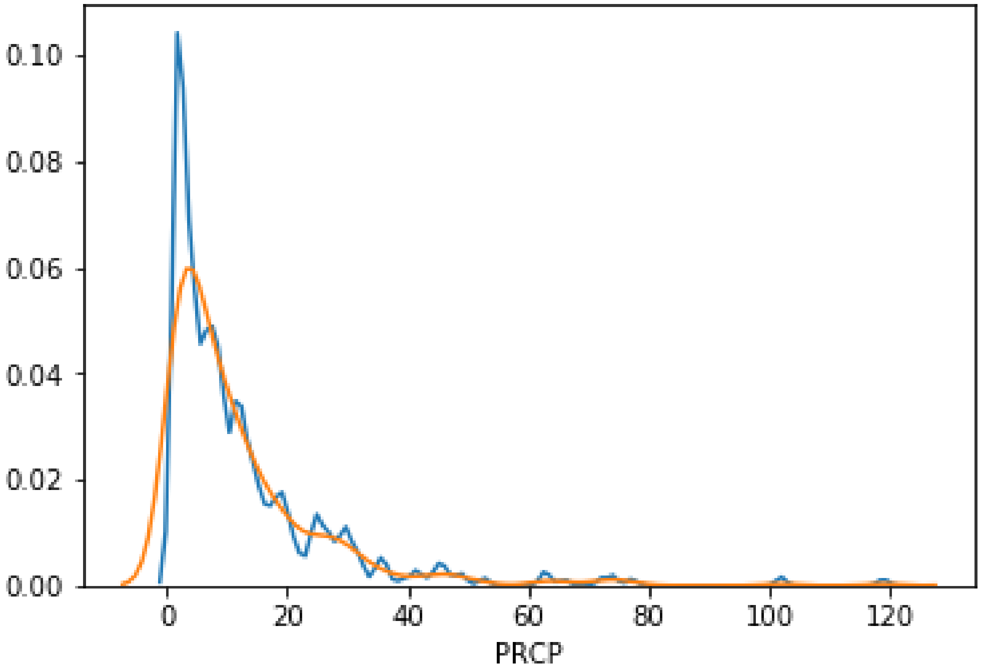
```
In [15]: sns.distplot(df_weather['TMAX'])
         #plt.boxplot(df_weather['TMAX'])
         plt.show()
```



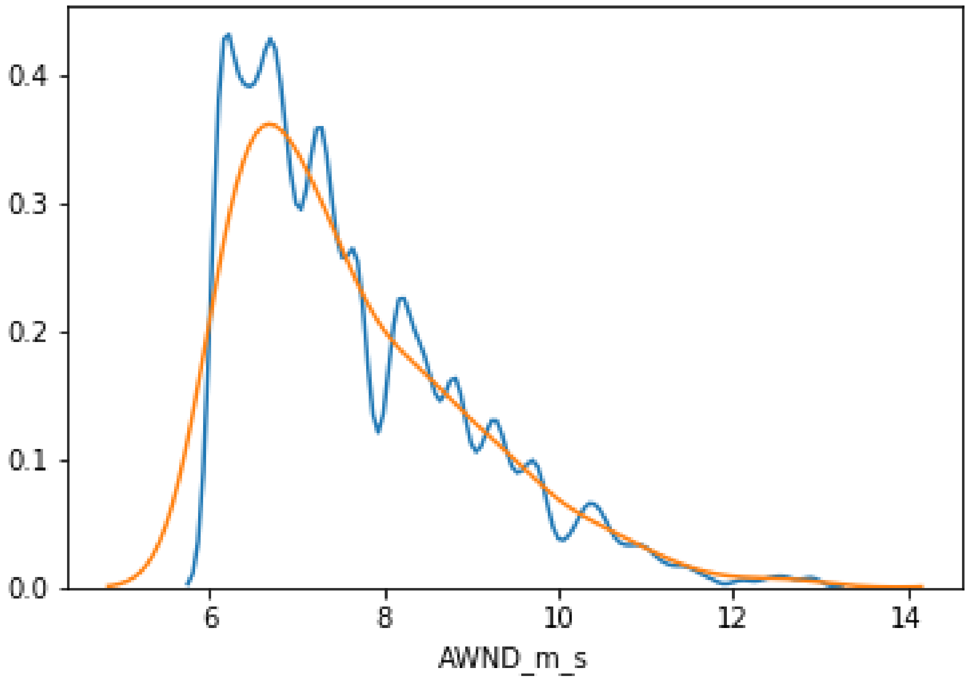
```
In [191]: sns.distplot(df_final['TAVG'].dropna(), hist=False, kde=True)
          sns.distplot(df_weather['TAVG'].dropna(), hist=False)

          plt.show()
```



```
In [139]: sns.distplot(df_final[df_final['PRCP']>1]['PRCP'].dropna(), hist=False)
          sns.distplot(df_weather[df_weather['PRCP']>1]['PRCP'].dropna(), hist=False)

          plt.show()
```



```
In [192]: sns.distplot(df_final[df_final['AWND_m_s']>6]['AWND_m_s'].dropna(), hist=False, kde='
          sns.distplot(df_weather[df_weather['AWND_m_s']>6]['AWND_m_s'].dropna(), hist=False)

          plt.show()
```



```
In [171]: df_final[(df_final['hour']<5)]['CONTRIBUTING FACTOR VEHICLE 1'].value_counts()
```

```
Out[171]: Unspecified                                              44662
          Driver Inattention/Distraction                           13355
          Alcohol Involvement                                       4205
          Failure to Yield Right-of-Way                             2922
          Other Vehicular                                           2722
          Fatigued/Drowsy                                           2511
          Traffic Control Disregarded                               2334
          Backing Unsafely                                          2194
          Following Too Closely                                     2189
          Turning Improperly                                        2033
          Pavement Slippery                                         1540
          Driver Inexperience                                       1325
          Passing or Lane Usage Improper                            1232
          Unsafe Speed                                              1212
          Lost Consciousness                                        1174
          Prescription Medication                                   1050
          Unsafe Lane Changing                                       977
          Physical Disability                                        961
          Outside Car Distraction                                    933
          Reaction to Other Uninvolved Vehicle                       669
          Failure to Keep Right                                      522
          Passenger Distraction                                      509
          Aggressive Driving/Road Rage                               476
```

```
Fell Asleep                                                446
View Obstructed/Limited                                    405
Obstruction/Debris                                         300
Oversized Vehicle                                          292
Illness                                                    286
Brakes Defective                                           279
Other Electronic Device                                    250
Tire Failure/Inadequate                                    241
Steering Failure                                           219
Pavement Defective                                         203
Pedestrian/Bicyclist/Other Pedestrian Error/Confusion      174
Animals Action                                             159
Drugs (Illegal)                                            111
Traffic Control Device Improper/Non-Working                 57
Lane Marking Improper/Inadequate                            45
Driverless/Runaway Vehicle                                  41
Accelerator Defective                                       30
Glare                                                       29
Cell Phone (hand-held)                                      23
Cell Phone (hands-free)                                     21
Other Lighting Defects                                      18
Tow Hitch Defective                                         10
Headlights Defective                                        10
Shoulders Defective/Improper                                 8
Windshield Inadequate                                        6
Name: CONTRIBUTING FACTOR VEHICLE 1, dtype: int64
```

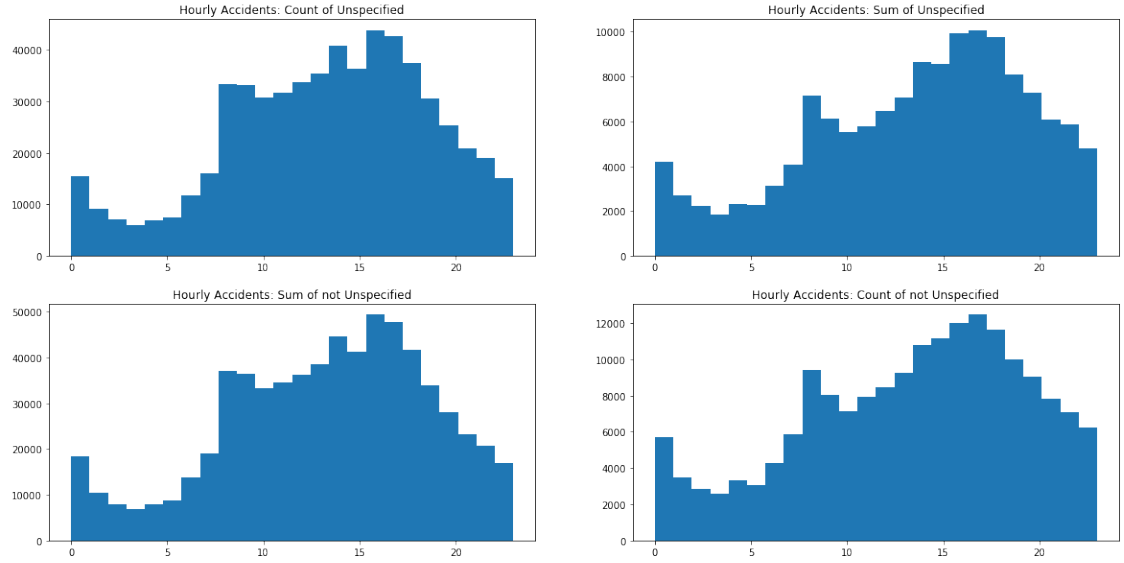
```
In [204]: df_final.columns
```

```
Out[204]: Index(['DATE', 'TIME', 'BOROUGH', 'ZIP CODE', 'LATITUDE', 'LONGITUDE',
                 'LOCATION', 'ON STREET NAME', 'CROSS STREET NAME', 'OFF STREET NAME',
                 'NUMBER OF PERSONS INJURED', 'NUMBER OF PERSONS KILLED',
                 'NUMBER OF PEDESTRIANS INJURED', 'NUMBER OF PEDESTRIANS KILLED',
                 'NUMBER OF CYCLIST INJURED', 'NUMBER OF CYCLIST KILLED',
                 'NUMBER OF MOTORIST INJURED', 'NUMBER OF MOTORIST KILLED',
                 'CONTRIBUTING FACTOR VEHICLE 1', 'CONTRIBUTING FACTOR VEHICLE 2',
                 'CONTRIBUTING FACTOR VEHICLE 3', 'CONTRIBUTING FACTOR VEHICLE 4',
                 'CONTRIBUTING FACTOR VEHICLE 5', 'UNIQUE KEY', 'VEHICLE TYPE CODE 1',
                 'VEHICLE TYPE CODE 2', 'VEHICLE TYPE CODE 3', 'VEHICLE TYPE CODE 4',
                 'VEHICLE TYPE CODE 5', 'date_time', 'Day of week', 'weekend', 'hour',
                 'AWND_m_s', 'PRCP', 'SNOW', 'SNWD', 'TAVG', 'TMAX', 'TMIN', 'WT01',
                 'WT02', 'WT03', 'WT04', 'WT06', 'WT08', 'WT09', 'WT13', 'WT14', 'WT15',
                 'WT16', 'WT18', 'WT22', 'hot', 'fog', 'rain'],
                dtype='object')
```

0.3.1 Exploring "Unspecified"

Reason "Unspecified": Same number of injuries either way. "Minor" accidents are not being ignored and time of day is not likely a factor

```
In [230]: plt.subplots(2, 2, figsize=(20, 10))

          plt.subplot(2, 2 , 1)
          plt.hist(np.arange(24), weights=pd.DataFrame(df_final[(df_final['CONTRIBUTING FACTOR
          plt.title("Hourly Accidents: Count of Unspecified")

          plt.subplot(2, 2 , 2)
          plt.hist(np.arange(24), weights=pd.DataFrame(df_final[(df_final['CONTRIBUTING FACTOR
          plt.title("Hourly Accidents: Sum of Unspecified")

          plt.subplot(2, 2 , 3)
          plt.hist(np.arange(24), weights=pd.DataFrame(df_final[(df_final['CONTRIBUTING FACTOR
          plt.title("Hourly Accidents: Sum of not Unspecified")

          plt.subplot(2, 2 , 4)
          plt.hist(np.arange(24), weights=pd.DataFrame(df_final[(df_final['CONTRIBUTING FACTOR
          plt.title("Hourly Accidents: Count of not Unspecified")

          plt.show()
```



Hourly Accidents: Count of Unspecified

Hourly Accidents: Sum of Unspecified

Hourly Accidents: Sum of not Unspecified

Hourly Accidents: Count of not Unspecified

0.4 Exploratory Data Analysis

0.4.1 Time and Reason Study

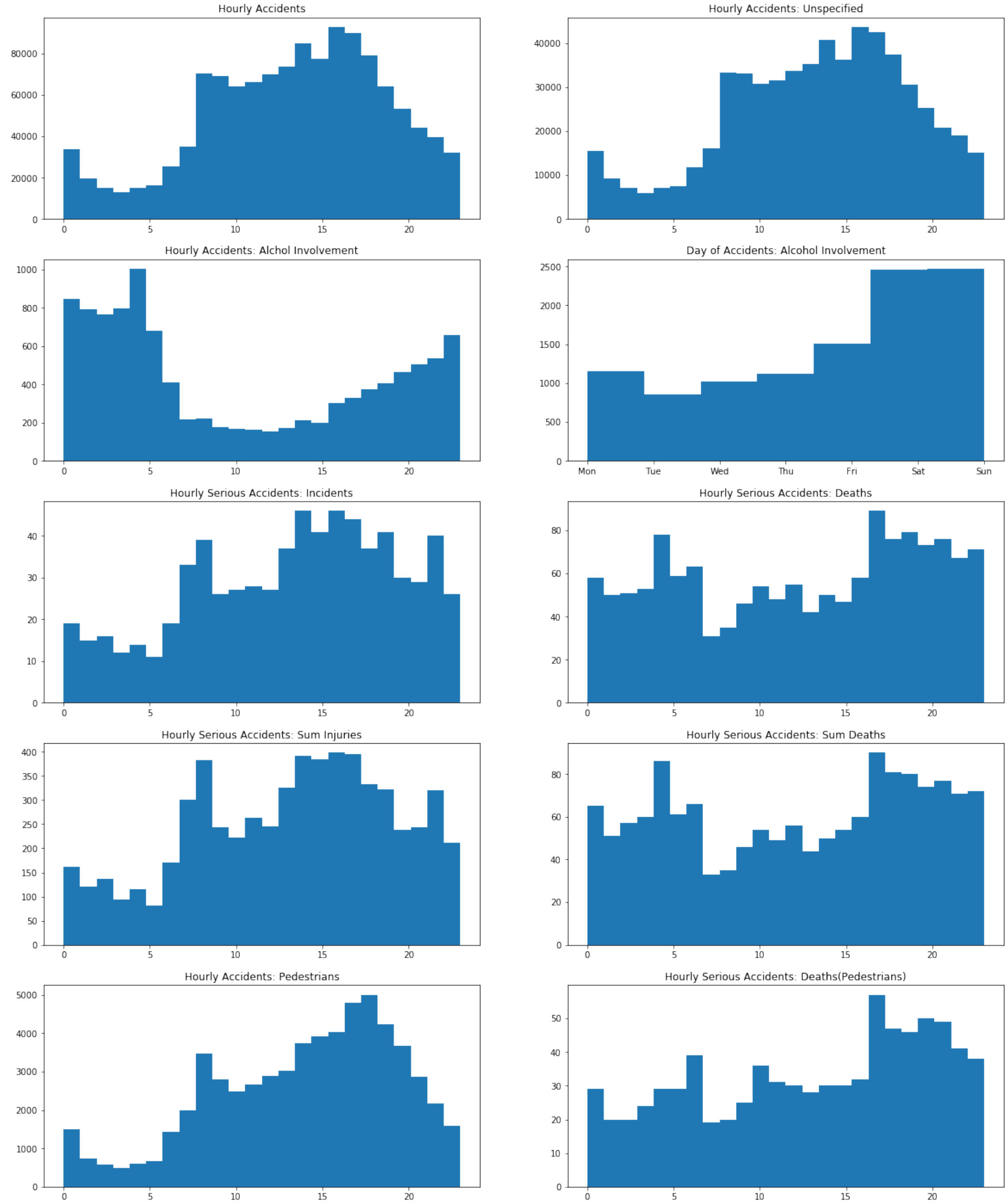
-Alcohol involvement: Peak around 3-4 AM on weekends

-Deaths in an accident more likely to occur in the night!

-Serious accidents (more injuries) happen in the night too

-Pedestrians get injured round the clock, but, again, more likely to die in the night

```
In [221]: #Time and Reason for accident

          plt.subplots(5, 2, figsize=(20, 25))
          plt.subplot(5, 2 , 1)
          plt.hist(df_final['hour'], bins=24)
          plt.title("Hourly Accidents")

          plt.subplot(5, 2, 2)
          plt.hist(df_final[(df_final['CONTRIBUTING FACTOR VEHICLE 1']=='Unspecified')]['hour'
          plt.title("Hourly Accidents: Unspecified")

          #Study of Alcohol Involvement
          plt.subplot(5, 2, 3)
          plt.hist(df_final[(df_final['CONTRIBUTING FACTOR VEHICLE 1']=='Alcohol Involvement')
          plt.title("Hourly Accidents: Alchol Involvement")


          plt.subplot(5, 2, 4)
          plt.hist(df_final[(df_final['CONTRIBUTING FACTOR VEHICLE 1']=='Alcohol Involvement')
          plt.xticks(np.arange(7), ('Mon', 'Tue', 'Wed', 'Thu', 'Fri', 'Sat', 'Sun'))
          plt.title("Day of Accidents: Alcohol Involvement")

          #Study of Gruesome Accidents

          plt.subplot(5, 2, 5)
          plt.hist(df_final[(df_final['NUMBER OF PERSONS INJURED']> 6)]['hour'], bins=24)
          plt.title("Hourly Serious Accidents: Incidents")

          plt.subplot(5, 2, 6)
          plt.hist(df_final[(df_final['NUMBER OF PERSONS KILLED']> 0)]['hour'], bins=24)
          plt.title("Hourly Serious Accidents: Deaths")

          plt.subplot(5, 2, 7)
          plt.hist(np.arange(24), bins=24, weights= pd.DataFrame(df_final[(df_final['NUMBER OF
          plt.title("Hourly Serious Accidents: Sum Injuries")


          plt.subplot(5, 2, 8)
          plt.hist(np.arange(24), bins=24, weights= pd.DataFrame(df_final.groupby(['hour'])['NU
          plt.title("Hourly Serious Accidents: Sum Deaths")


          plt.subplot(5, 2, 9)
          plt.hist(df_final[(df_final['NUMBER OF PEDESTRIANS INJURED']> 0)]['hour'], bins=24)
          plt.title("Hourly Accidents: Pedestrians")
          plt.subplot(5, 2, 10)
          plt.hist(df_final[(df_final['NUMBER OF PEDESTRIANS KILLED']> 0)]['hour'], bins=24)
          plt.title("Hourly Serious Accidents: Deaths(Pedestrians)")

          plt.show()
```



0.5 Weather Study

```
In [243]: df_temp= pd.DataFrame(df_final.groupby(['TAVG'])['NUMBER OF PERSONS INJURED', 'NUMBE
```

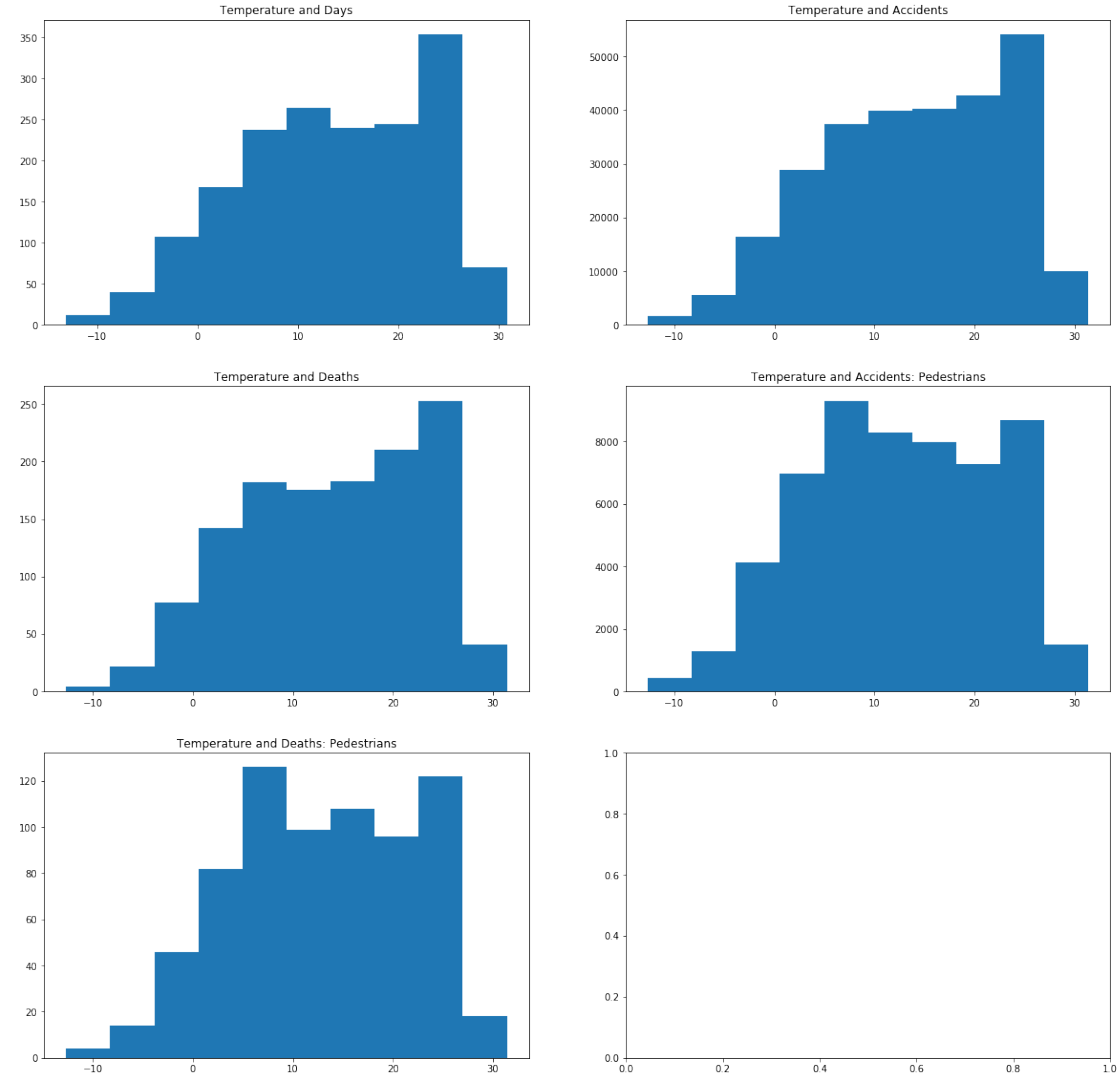
```
In [284]: df_snow= pd.DataFrame(df_final[(df_final['SNOW']>8) & (df_final['SNOW']< 200) ].grou
```

```
In [275]: df_wind= pd.DataFrame(df_final.groupby(['AWND_m_s'])['NUMBER OF PERSONS INJURED', 'NU
```

```
In [308]: df_prcp= pd.DataFrame(df_final[df_final['PRCP']>5].groupby(['PRCP'])['NUMBER OF PERS
```

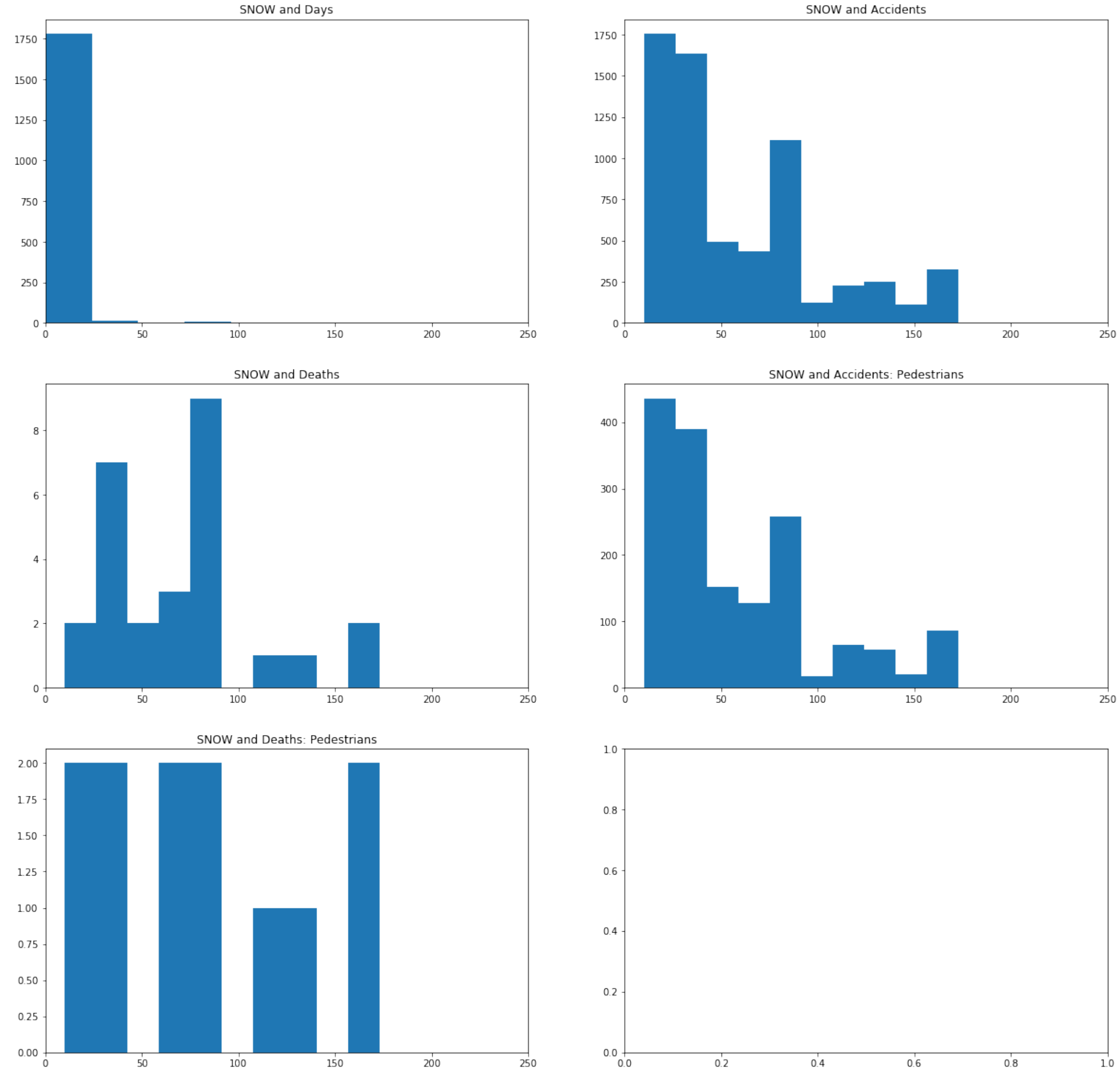
Higher temperature has no effect. Lower temperature tends to increase in Passenger related incidents!

```
In [262]: plt.subplots(3, 2, figsize=(20, 20))

          plt.subplot(3, 2, 1)
          plt.hist(df_weather['TAVG'].dropna())
          plt.title("Temperature and Days")

          plt.subplot(3, 2, 2)
          plt.hist(df_temp['TAVG'], weights=df_temp['NUMBER OF PERSONS INJURED'])
          plt.title("Temperature and Accidents")

          plt.subplot(3, 2, 3)
          plt.hist(df_temp['TAVG'], weights=df_temp['NUMBER OF PERSONS KILLED'])
          plt.title("Temperature and Deaths")

          plt.subplot(3, 2, 4)
          plt.hist(df_temp['TAVG'], weights=df_temp['NUMBER OF PEDESTRIANS INJURED'])
          plt.title("Temperature and Accidents: Pedestrians")

          plt.subplot(3, 2, 5)
          plt.hist(df_temp['TAVG'], weights=df_temp['NUMBER OF PEDESTRIANS KILLED'])
          plt.title("Temperature and Deaths: Pedestrians")

          plt.show()
```



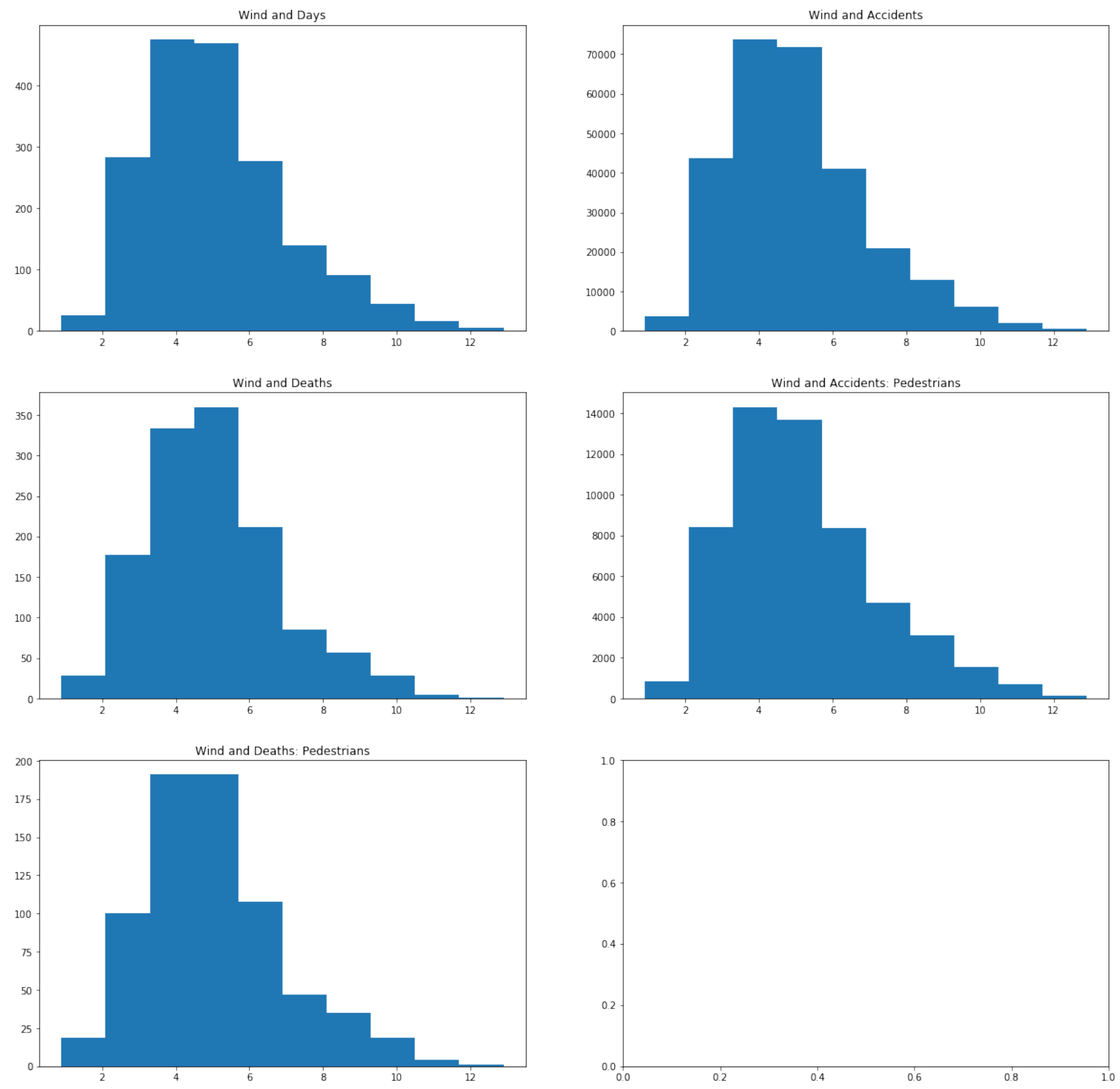
0.5.1 More snow leads to more accidents and more passenger related accidents

```
In [310]: plt.subplots(3, 2, figsize=(20, 20))

          plt.subplot(3, 2, 1)
          plt.hist(df_weather['SNOW'].dropna(), bins=32)
          plt.title("SNOW and Days")
          plt.xlim((0,250))

          plt.subplot(3, 2, 2)
          plt.hist(df_snow['SNOW'], weights=df_snow['NUMBER OF PERSONS INJURED'])
          plt.title("SNOW and Accidents")
          plt.xlim((0,250))
          plt.subplot(3, 2, 3)
          plt.hist(df_snow['SNOW'], weights=df_snow['NUMBER OF PERSONS KILLED'])
          plt.title("SNOW and Deaths")
          plt.xlim((0,250))

          plt.subplot(3, 2, 4)
          plt.hist(df_snow['SNOW'], weights=df_snow['NUMBER OF PEDESTRIANS INJURED'])
          plt.title("SNOW and Accidents: Pedestrians")
          plt.xlim((0,250))

          plt.subplot(3, 2, 5)
          plt.hist(df_snow['SNOW'], weights=df_snow['NUMBER OF PEDESTRIANS KILLED'])
          plt.title("SNOW and Deaths: Pedestrians")

          plt.xlim((0,250))
          plt.show()
```



0.5.2 Wind has no effect

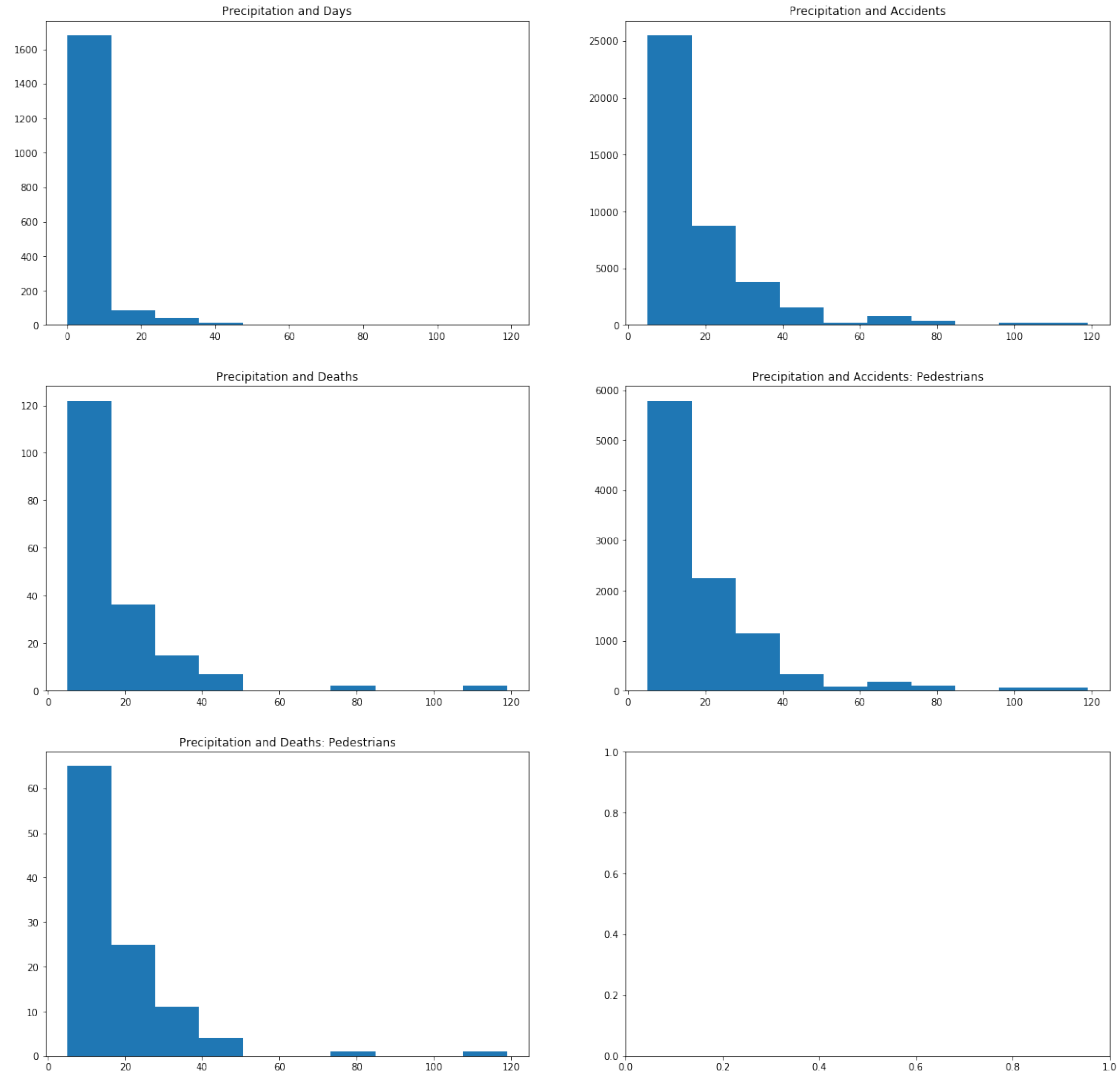
```
In [283]: plt.subplots(3, 2, figsize=(20, 20))

          plt.subplot(3, 2, 1)
          plt.hist(df_weather['AWND_m_s'].dropna())
          plt.title("Wind and Days")

          plt.subplot(3, 2, 2)
          plt.hist(df_wind['AWND_m_s'], weights=df_wind['NUMBER OF PERSONS INJURED'])
          plt.title("Wind and Accidents")

          plt.subplot(3, 2, 3)
          plt.hist(df_wind['AWND_m_s'], weights=df_wind['NUMBER OF PERSONS KILLED'])
          plt.title("Wind and Deaths")

          plt.subplot(3, 2, 4)
          plt.hist(df_wind['AWND_m_s'], weights=df_wind['NUMBER OF PEDESTRIANS INJURED'])
          plt.title("Wind and Accidents: Pedestrians")

          plt.subplot(3, 2, 5)
          plt.hist(df_wind['AWND_m_s'], weights=df_wind['NUMBER OF PEDESTRIANS KILLED'])
          plt.title("Wind and Deaths: Pedestrians")

          plt.show()
```



0.5.3 Precipitation definitely affects accidents and pedestrian involvement

```
In [312]: plt.subplots(3, 2, figsize=(20, 20))

          plt.subplot(3, 2, 1)
          plt.hist(df_weather['PRCP'].dropna())
          plt.title("Precipitation and Days")

          plt.subplot(3, 2, 2)
          plt.hist(df_prcp['PRCP'], weights=df_prcp['NUMBER OF PERSONS INJURED'])
          plt.title("Precipitation and Accidents")

          plt.subplot(3, 2, 3)
          plt.hist(df_prcp['PRCP'], weights=df_prcp['NUMBER OF PERSONS KILLED'])
```

```
        plt.title("Precipitation and Deaths")

        plt.subplot(3, 2, 4)
        plt.hist(df_prcp['PRCP'], weights=df_prcp['NUMBER OF PEDESTRIANS INJURED'])
        plt.title("Precipitation and Accidents: Pedestrians")

        plt.subplot(3, 2, 5)
        plt.hist(df_prcp['PRCP'], weights=df_prcp['NUMBER OF PEDESTRIANS KILLED'])
        plt.title("Precipitation and Deaths: Pedestrians")

        plt.show()
```



0.5.4 Fog: No corr

```
In [293]: df_final[df_final['fog']==0][['NUMBER OF PERSONS INJURED', 'NUMBER OF PERSONS KILLED
```

```
Out[293]:        NUMBER OF PERSONS INJURED  NUMBER OF PERSONS KILLED  \
          count              935544.000000             935544.000000
          mean                    0.255692                  0.001217
          std                     0.657475                  0.037271
          min                     0.000000                  0.000000
          25%                     0.000000                  0.000000
          50%                     0.000000                  0.000000
          75%                     0.000000                  0.000000
          max                    43.000000                  8.000000

                 NUMBER OF PEDESTRIANS INJURED  NUMBER OF PEDESTRIANS KILLED
          count                  935544.000000                 935544.000000
          mean                        0.051207                      0.000663
          std                         0.236296                      0.027071
          min                         0.000000                      0.000000
          25%                         0.000000                      0.000000
          50%                         0.000000                      0.000000
          75%                         0.000000                      0.000000
          max                        27.000000                      8.000000
```

```
In [294]: df_final[df_final['fog']==1][['NUMBER OF PERSONS INJURED', 'NUMBER OF PERSONS KILLED
```

```
Out[294]:        NUMBER OF PERSONS INJURED  NUMBER OF PERSONS KILLED  \
          count              309710.000000             309710.000000
          mean                    0.258093                  0.001075
          std                     0.649671                  0.034594
          min                     0.000000                  0.000000
          25%                     0.000000                  0.000000
          50%                     0.000000                  0.000000
          75%                     0.000000                  0.000000
          max                    32.000000                  3.000000

                 NUMBER OF PEDESTRIANS INJURED  NUMBER OF PEDESTRIANS KILLED
          count                  309710.000000                 309710.000000
          mean                        0.055029                      0.000630
          std                         0.245677                      0.025594
          min                         0.000000                      0.000000
          25%                         0.000000                      0.000000
          50%                         0.000000                      0.000000
          75%                         0.000000                      0.000000
          max                         6.000000                      2.000000
```