NYC Traffic Accidents Analysis (2020)

May 26, 2025

1 NYC Traffic Accidents Analysis (2020)

1.1 Project Overview

Objective: Identify key patterns across accidents across New York City, including data about accident frequency by time, location, and potential contributing factors and aims to find the period of time when the least amount of accidents occur.

Completed by Reyhan Quayum on February 27, 2023

Scope:

- **Population:** NYC residents and commuters involved in traffic accidents
- **Discipline:** Transportation Safety, Data Analysis, Urban Planning
- **Geographic Focus:** New York City
- **Time Frame:** January 2020 – December 2020
- **Data Requirements:** Dataset containing detailed records of at least 10,000 reported traffic accidents, including demographic details, location, and contributing factors

Data Sources: The analysis uses publicly available data from NYC Open Data and official NYC Department of Transportation (DOT)

1.2 Data Set Description

Name: NYC Motor Vehicle Collisions **Source & Access:** NYC Motor Vehicle Collisions Dataset on NYC Open Data

Details:

- **Author / Creator:** New York Police Department (NYPD)
- **Publication Date:** Originally published January 2020; latest update December 2020
- **Publisher:** NYC Open Data
- **Data Accessed:** May 26, 2023
- **Format:** csv
- **Size:** 1,420 KB
- **Number of Records:** 7,480
- **License:** *[To be confirmed]*

Usage: This dataset is suitable for analyzing traffic accident trends in NYC, including accident frequency by location and time, types of vehicles involved, contributing factors, and demographic information of involved parties. It supports research in transportation safety, urban planning, and public policy.

1.3 Data Extraction and Transformation

1.3.1 Columns Used

The analysis focuses on key columns from the dataset, including but not limited to:

- **Date and Time:** To analyze accident trends over time
- **Borough / Location:** To identify geographic hotspots for accidents
- **Contributing Factors:** To understand causes of accidents (e.g., speeding, distracted driving)
- **Persons Injured / Killed:** To assess accident severity
- **Vehicle Type(s) Involved:** To identify which types of vehicles are most frequently involved
- **Victim Demographics:** Age, gender, and if available, race/ethnicity (depending on dataset availability)

1.3.2 Data Types and Conversion

- Date and time fields will be converted to datetime types for chronological analysis.
- Numerical fields such as number of injuries or fatalities will be stored as integers.
- Categorical fields (vehicle type, borough, contributing factors) will be processed as strings or categorical variables.

1.3.3 Data Cleaning and Normalization

- Check for missing or inconsistent values in critical columns (e.g., location, injury counts).
- Standardize labels for contributing factors and vehicle types to ensure uniform grouping.
- Handle any erroneous or outlier data points by verification or exclusion.

1.3.4 Additional Processing

- Aggregate accidents by year, month, borough, and time of day to identify peak accident periods.
- Identify demographic groups most affected by traffic accidents (e.g., by age or gender).
- Analyze correlations between contributing factors and accident severity.

1.4 Process and Code

[19]:
```
import pandas as pd
import matplotlib.pyplot as plt
import calendar
```

Header row had to be specified to line number 4 of the csv file to fix the issue

[20]:
```
df = pd.read_csv('../data/raw/NYC_Accidents_2020.csv', header=3)
print(df)
```

```
      CRASH DATE CRASH TIME    BOROUGH  ZIP CODE   LATITUDE  LONGITUDE  \
0        8/29/20   15:40:00      BRONX   10466.0  40.892100 -73.833760
1        8/29/20   21:00:00   BROOKLYN   11221.0  40.690500 -73.919914
2        8/29/20   18:20:00        NaN       NaN  40.816500 -73.946556
3        8/29/20    0:00:00      BRONX   10459.0  40.824720 -73.892960
```

```
4        8/29/20   17:10:00   BROOKLYN   11203.0  40.649890 -73.933890
…          …         …        …          …        …
74876     1/1/20   15:13:00      BRONX   10459.0  40.826810 -73.896510
74877     1/1/20    8:00:00   BROOKLYN   11235.0  40.582935 -73.959210
74878     1/1/20   11:36:00      BRONX   10461.0  40.848553 -73.830055
74879     1/1/20    1:45:00  MANHATTAN   10017.0  40.753624 -73.969440
74880     1/1/20   18:00:00     QUEENS   11367.0  40.726875 -73.830960

                          LOCATION   ON STREET NAME CROSS STREET NAME  \
0         POINT (-73.83376 40.8921)     PRATT AVENUE     STRANG AVENUE
1        POINT (-73.919914 40.6905)  BUSHWICK AVENUE   PALMETTO STREET
2        POINT (-73.946556 40.8165)         8 AVENUE              NaN
3        POINT (-73.89296 40.82472)              NaN              NaN
4        POINT (-73.93389 40.64989)              NaN              NaN
…                              …              …               …
74876    POINT (-73.89651 40.82681)              NaN              NaN
74877   POINT (-73.95921 40.582935)              NaN              NaN
74878  POINT (-73.830055 40.848553)              NaN              NaN
74879   POINT (-73.96944 40.753624)   EAST 48 STREET          2 AVENUE
74880   POINT (-73.83096 40.726875)              NaN              NaN

             OFF STREET NAME  …   CONTRIBUTING FACTOR VEHICLE 2  \
0                        NaN  …                     Unspecified
1                        NaN  …                     Unspecified
2                        NaN  …                             NaN
3        1047 SIMPSON STREET  …                     Unspecified
4         4609 SNYDER AVENUE  …                     Unspecified
…                       …  …                          …
74876  1122 INTERVALE AVENUE  …                             NaN
74877     3401 GUIDER AVENUE  …                     Unspecified
74878      1810 MAHAN AVENUE  …                     Unspecified
74879                    NaN  …  Driver Inattention/Distraction
74880  70-25 PARK DRIVE EAST  …  Driver Inattention/Distraction

       CONTRIBUTING FACTOR VEHICLE 3  CONTRIBUTING FACTOR VEHICLE 4  \
0                                NaN                            NaN
1                                NaN                            NaN
2                                NaN                            NaN
3                        Unspecified                    Unspecified
4                                NaN                            NaN
…                                …                              …
74876                            NaN                            NaN
74877                    Unspecified                            NaN
74878                            NaN                            NaN
74879                            NaN                            NaN
74880                            NaN                            NaN

       CONTRIBUTING FACTOR VEHICLE 5  COLLISION_ID  \
```

```
0                                NaN       4342908
1                                NaN       4343555
2                                NaN       4343142
3                                NaN       4343588
4                                NaN       4342953
…                                …         …
74876                            NaN       4268088
74877                            NaN       4267756
74878                            NaN       4269230
74879                            NaN       4267482
74880                            NaN       4268376

                     VEHICLE TYPE CODE 1  \
0                                  Sedan
1                                  Sedan
2      Station Wagon/Sport Utility Vehicle
3      Station Wagon/Sport Utility Vehicle
4                                  Sedan
…                                  …
74876                              Sedan
74877  Station Wagon/Sport Utility Vehicle
74878                              Sedan
74879                              Sedan
74880                              Sedan

                     VEHICLE TYPE CODE 2  \
0      Station Wagon/Sport Utility Vehicle
1                                  Sedan
2                                    NaN
3      Station Wagon/Sport Utility Vehicle
4                                  Sedan
…                                  …
74876                                NaN
74877  Station Wagon/Sport Utility Vehicle
74878                      Pick-up Truck
74879                               Taxi
74880  Station Wagon/Sport Utility Vehicle

                     VEHICLE TYPE CODE 3 VEHICLE TYPE CODE 4  \
0                                    NaN                 NaN
1                                    NaN                 NaN
2                                    NaN                 NaN
3                                  Sedan          Motorcycle
4                                    NaN                 NaN
…                                    …                   …
74876                                NaN                 NaN
74877  Station Wagon/Sport Utility Vehicle                 NaN
74878                                NaN                 NaN
```

```
74879                                  NaN                NaN
74880                                  NaN                NaN

      VEHICLE TYPE CODE 5
0                     NaN
1                     NaN
2                     NaN
3                     NaN
4                     NaN
…                     …
74876                 NaN
74877                 NaN
74878                 NaN
74879                 NaN
74880                 NaN

[74881 rows x 29 columns]
```

1.5 Data Sampling

[21]:
```
print(df.columns)
```

```
Index(['CRASH DATE', 'CRASH 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',
       'COLLISION_ID', 'VEHICLE TYPE CODE 1', 'VEHICLE TYPE CODE 2',
       'VEHICLE TYPE CODE 3', 'VEHICLE TYPE CODE 4', 'VEHICLE TYPE CODE 5'],
      dtype='object')
```

[22]:
```
print(df.head(5))
```

```
  CRASH DATE CRASH TIME   BOROUGH  ZIP CODE  LATITUDE  LONGITUDE  \
0    8/29/20   15:40:00     BRONX   10466.0  40.89210 -73.833760
1    8/29/20   21:00:00  BROOKLYN   11221.0  40.69050 -73.919914
2    8/29/20   18:20:00       NaN       NaN  40.81650 -73.946556
3    8/29/20    0:00:00     BRONX   10459.0  40.82472 -73.892960
4    8/29/20   17:10:00  BROOKLYN   11203.0  40.64989 -73.933890

                     LOCATION   ON STREET NAME CROSS STREET NAME  \
0   POINT (-73.83376 40.8921)     PRATT AVENUE     STRANG AVENUE
1  POINT (-73.919914 40.6905)  BUSHWICK AVENUE   PALMETTO STREET
2  POINT (-73.946556 40.8165)         8 AVENUE              NaN
```

```
3  POINT (-73.89296 40.82472)              NaN               NaN
4  POINT (-73.93389 40.64989)              NaN               NaN

       OFF STREET NAME  …  CONTRIBUTING FACTOR VEHICLE 2  \
0                  NaN  …                    Unspecified
1                  NaN  …                    Unspecified
2                  NaN  …                            NaN
3  1047 SIMPSON STREET  …                    Unspecified
4   4609 SNYDER AVENUE  …                    Unspecified

   CONTRIBUTING FACTOR VEHICLE 3  CONTRIBUTING FACTOR VEHICLE 4  \
0                            NaN                            NaN
1                            NaN                            NaN
2                            NaN                            NaN
3                    Unspecified                    Unspecified
4                            NaN                            NaN

   CONTRIBUTING FACTOR VEHICLE 5  COLLISION_ID  \
0                            NaN       4342908
1                            NaN       4343555
2                            NaN       4343142
3                            NaN       4343588
4                            NaN       4342953

                  VEHICLE TYPE CODE 1                   VEHICLE TYPE CODE 2  \
0                               Sedan  Station Wagon/Sport Utility Vehicle
1                               Sedan                                 Sedan
2  Station Wagon/Sport Utility Vehicle                                   NaN
3  Station Wagon/Sport Utility Vehicle  Station Wagon/Sport Utility Vehicle
4                               Sedan                                 Sedan

   VEHICLE TYPE CODE 3 VEHICLE TYPE CODE 4 VEHICLE TYPE CODE 5
0                  NaN                 NaN                 NaN
1                  NaN                 NaN                 NaN
2                  NaN                 NaN                 NaN
3                Sedan          Motorcycle                 NaN
4                  NaN                 NaN                 NaN

[5 rows x 29 columns]
```

[23]:
```
print(df.sample(n=5))
```

```
      CRASH DATE CRASH TIME   BOROUGH  ZIP CODE   LATITUDE  LONGITUDE  \
71060    1/10/20   18:30:00  BROOKLYN   11220.0  40.634167  -74.02073
33366    4/19/20   12:40:00     BRONX   10451.0  40.824970  -73.92228
21416    6/18/20   23:00:00  BROOKLYN   11221.0  40.691822  -73.92223
5747      8/9/20   17:30:00       NaN       NaN  40.808956  -73.94041
52850    2/17/20   14:30:00    QUEENS   11434.0  40.686516  -73.78883
```

```
                        LOCATION          ON STREET NAME CROSS STREET NAME  \
71060  POINT (-74.02073 40.634167)              68 STREET          5 AVENUE
33366   POINT (-73.92228 40.82497)  CONCOURSE VILLAGE WEST   EAST 158 STREET
21416  POINT (-73.92223 40.691822)            GROVE STREET   BUSHWICK AVENUE
5747   POINT (-73.94041 40.808956)         WEST 129 STREET               NaN
52850  POINT (-73.78883 40.686516)              157 STREET        115 AVENUE

      OFF STREET NAME  …  CONTRIBUTING FACTOR VEHICLE 2  \
71060             NaN  …                           NaN
33366             NaN  …                   Unspecified
21416             NaN  …                   Unspecified
5747              NaN  …    Traffic Control Disregarded
52850             NaN  …                   Unspecified

       CONTRIBUTING FACTOR VEHICLE 3  CONTRIBUTING FACTOR VEHICLE 4  \
71060                            NaN                            NaN
33366                            NaN                            NaN
21416                            NaN                            NaN
5747                             NaN                            NaN
52850                            NaN                            NaN

       CONTRIBUTING FACTOR VEHICLE 5  COLLISION_ID  \
71060                            NaN       4271449
33366                            NaN       4309686
21416                            NaN       4321288
5747                             NaN       4336813
52850                            NaN       4289966

                    VEHICLE TYPE CODE 1  \
71060                              Bike
33366  Station Wagon/Sport Utility Vehicle
21416                             Sedan
5747   Station Wagon/Sport Utility Vehicle
52850                             Sedan

                    VEHICLE TYPE CODE 2  VEHICLE TYPE CODE 3  \
71060                               NaN                  NaN
33366                             Sedan                  NaN
21416                              Bike                  NaN
5747   Station Wagon/Sport Utility Vehicle                  NaN
52850                             Sedan                  NaN

      VEHICLE TYPE CODE 4 VEHICLE TYPE CODE 5
71060                 NaN                 NaN
33366                 NaN                 NaN
21416                 NaN                 NaN
5747                  NaN                 NaN
```

```
52850                NaN                NaN

[5 rows x 29 columns]
```

[24]:
```
print(df.tail(5))
```

```
      CRASH DATE CRASH TIME    BOROUGH  ZIP CODE   LATITUDE  LONGITUDE  \
74876     1/1/20   15:13:00      BRONX   10459.0  40.826810 -73.896510
74877     1/1/20    8:00:00   BROOKLYN   11235.0  40.582935 -73.959210
74878     1/1/20   11:36:00      BRONX   10461.0  40.848553 -73.830055
74879     1/1/20    1:45:00  MANHATTAN   10017.0  40.753624 -73.969440
74880     1/1/20   18:00:00     QUEENS   11367.0  40.726875 -73.830960

                          LOCATION  ON STREET NAME CROSS STREET NAME  \
74876    POINT (-73.89651 40.82681)             NaN               NaN
74877   POINT (-73.95921 40.582935)             NaN               NaN
74878  POINT (-73.830055 40.848553)             NaN               NaN
74879   POINT (-73.96944 40.753624)  EAST 48 STREET          2 AVENUE
74880   POINT (-73.83096 40.726875)             NaN               NaN

             OFF STREET NAME  …   CONTRIBUTING FACTOR VEHICLE 2  \
74876  1122 INTERVALE AVENUE  …                             NaN
74877     3401 GUIDER AVENUE  …                     Unspecified
74878      1810 MAHAN AVENUE  …                     Unspecified
74879                    NaN  …  Driver Inattention/Distraction
74880  70-25 PARK DRIVE EAST  …  Driver Inattention/Distraction

       CONTRIBUTING FACTOR VEHICLE 3  CONTRIBUTING FACTOR VEHICLE 4  \
74876                            NaN                            NaN
74877                    Unspecified                            NaN
74878                            NaN                            NaN
74879                            NaN                            NaN
74880                            NaN                            NaN

       CONTRIBUTING FACTOR VEHICLE 5  COLLISION_ID  \
74876                            NaN       4268088
74877                            NaN       4267756
74878                            NaN       4269230
74879                            NaN       4267482
74880                            NaN       4268376

                     VEHICLE TYPE CODE 1  \
74876                              Sedan
74877  Station Wagon/Sport Utility Vehicle
74878                              Sedan
74879                              Sedan
74880                              Sedan
```

```
                       VEHICLE TYPE CODE 2  \
74876                                  NaN
74877  Station Wagon/Sport Utility Vehicle
74878                          Pick-up Truck
74879                                  Taxi
74880  Station Wagon/Sport Utility Vehicle

                       VEHICLE TYPE CODE 3 VEHICLE TYPE CODE 4  \
74876                                  NaN                 NaN
74877  Station Wagon/Sport Utility Vehicle                 NaN
74878                                  NaN                 NaN
74879                                  NaN                 NaN
74880                                  NaN                 NaN

      VEHICLE TYPE CODE 5
74876                 NaN
74877                 NaN
74878                 NaN
74879                 NaN
74880                 NaN

[5 rows x 29 columns]
```

2 Data Description

[25]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 74881 entries, 0 to 74880
Data columns (total 29 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   CRASH DATE                      74881 non-null  object
 1   CRASH TIME                      74881 non-null  object
 2   BOROUGH                         49140 non-null  object
 3   ZIP CODE                        49134 non-null  float64
 4   LATITUDE                        68935 non-null  float64
 5   LONGITUDE                       68935 non-null  float64
 6   LOCATION                        68935 non-null  object
 7   ON STREET NAME                  55444 non-null  object
 8   CROSS STREET NAME               35681 non-null  object
 9   OFF STREET NAME                 19437 non-null  object
 10  NUMBER OF PERSONS INJURED       74881 non-null  int64
 11  NUMBER OF PERSONS KILLED        74881 non-null  int64
 12  NUMBER OF PEDESTRIANS INJURED   74881 non-null  int64
 13  NUMBER OF PEDESTRIANS KILLED    74881 non-null  int64
 14  NUMBER OF CYCLIST INJURED       74881 non-null  int64
```

```
 15  NUMBER OF CYCLIST KILLED       74881 non-null  int64
 16  NUMBER OF MOTORIST INJURED     74881 non-null  int64
 17  NUMBER OF MOTORIST KILLED      74881 non-null  int64
 18  CONTRIBUTING FACTOR VEHICLE 1  74577 non-null  object
 19  CONTRIBUTING FACTOR VEHICLE 2  59285 non-null  object
 20  CONTRIBUTING FACTOR VEHICLE 3  6765 non-null   object
 21  CONTRIBUTING FACTOR VEHICLE 4  1851 non-null   object
 22  CONTRIBUTING FACTOR VEHICLE 5  523 non-null    object
 23  COLLISION_ID                   74881 non-null  int64
 24  VEHICLE TYPE CODE 1            74246 non-null  object
 25  VEHICLE TYPE CODE 2            53638 non-null  object
 26  VEHICLE TYPE CODE 3            6424 non-null   object
 27  VEHICLE TYPE CODE 4            1771 non-null   object
 28  VEHICLE TYPE CODE 5            503 non-null    object
dtypes: float64(3), int64(9), object(17)
memory usage: 16.6+ MB
```

2.1 Data Types of Columns

```
ON STREET NAME - str
CROSS STREET NAME - str
OFF STREET NAME - str
CONTRIBUTING FACTOR VEHICLE (1-5) - str
VEHICLE TYPE CODE (1-5) - str
```

Cleaning removing empty rows and rows with missing data will be necessary to complete

2.2 Data Cleaning

The following columns were removed because they have the highest amount of `null` (empty) entries. this is shown previously with `df.info()`

The `LOCATION` column was renamed to `COORDINATES` because it is a more specific inidicator of what the data represents.

Any row with a null street name was removed.

[26]:
```
df.drop(['CONTRIBUTING FACTOR VEHICLE 5', 'VEHICLE TYPE CODE 5'], axis=1,␣
↪inplace=True)
df.rename(columns={'LOCATION': 'COORDINATES'}, inplace=True)
df.dropna(subset=['ON STREET NAME'], inplace=True)
```

2.3 Determine the top three streets that had the most accidents

group dataframe by street name, then count members of each group

sort each street name group by count in descending order and sleect top 3

[27]:
```
accidents_by_street = df.groupby('ON STREET NAME')['ON STREET NAME'].count()
top_streets = accidents_by_street.sort_values(ascending=False)[:3]
print(top_streets)
```

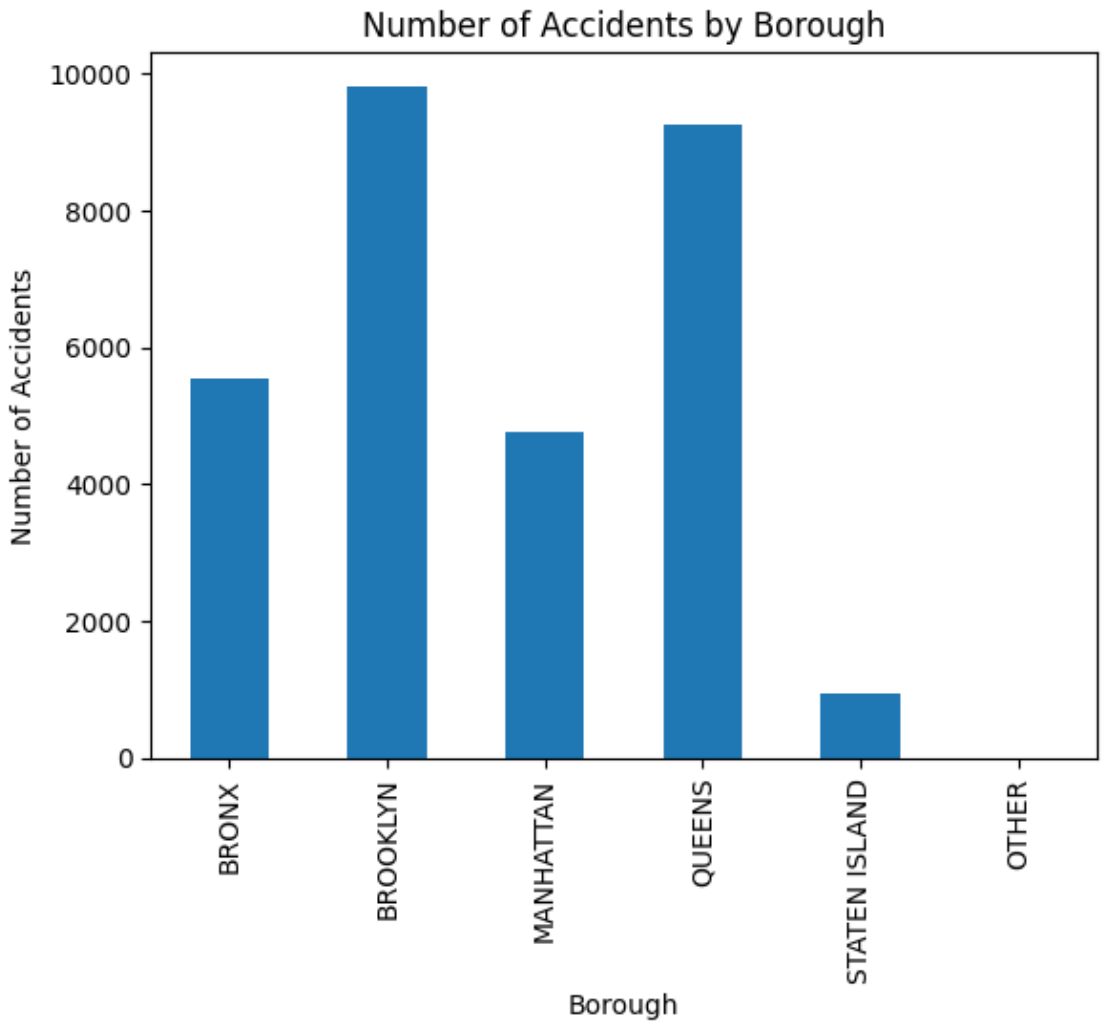
```
ON STREET NAME
BELT PARKWAY                   1241
LONG ISLAND EXPRESSWAY          745
BROOKLYN QUEENS EXPRESSWAY      738
Name: ON STREET NAME, dtype: int64
```

2.4 Visualiztion: Number of Accidents per Borough

remove any rows with no value recorded for persons injured or persons killed or borough replace null values for borough with `OTHER`

[28]:
```
df = df[['BOROUGH', 'NUMBER OF PERSONS INJURED', 'NUMBER OF PERSONS KILLED']].
 ↪dropna()
df['BOROUGH'] = df['BOROUGH'].fillna('OTHER')

accidents_by_borough = df.groupby('BOROUGH')['BOROUGH'].count().
 ↪reindex(['BRONX', 'BROOKLYN', 'MANHATTAN', 'QUEENS', 'STATEN ISLAND',␣
 ↪'OTHER'], fill_value=0)

ax = accidents_by_borough.plot(kind='bar')
ax.set_title('Number of Accidents by Borough')
ax.set_xlabel('Borough')
ax.set_ylabel('Number of Accidents')
```

[28]:
```
Text(0, 0.5, 'Number of Accidents')
```



2.5 Summary Statistics for Traffic Accident Injuries

[29]:
```
all_injuries_summary = df['NUMBER OF PERSONS INJURED'].describe()
print('Summary statistics for number of persons injured in all NYC:')
print(all_injuries_summary)
print()


manhattan_injuries_summary = df.loc[df['BOROUGH'] == 'MANHATTAN', 'NUMBER OF␣
 ↪PERSONS INJURED'].describe()
print('Summary statistics for number of persons injured in Manhattan:')
print(manhattan_injuries_summary)

queens_injuries_summary = df.loc[df['BOROUGH'] == 'BROOKLYN', 'NUMBER OF␣
 ↪PERSONS INJURED'].describe()
```

```
print('Summary statistics for number of persons injured in brooklyn:')
print(queens_injuries_summary)
print()
```

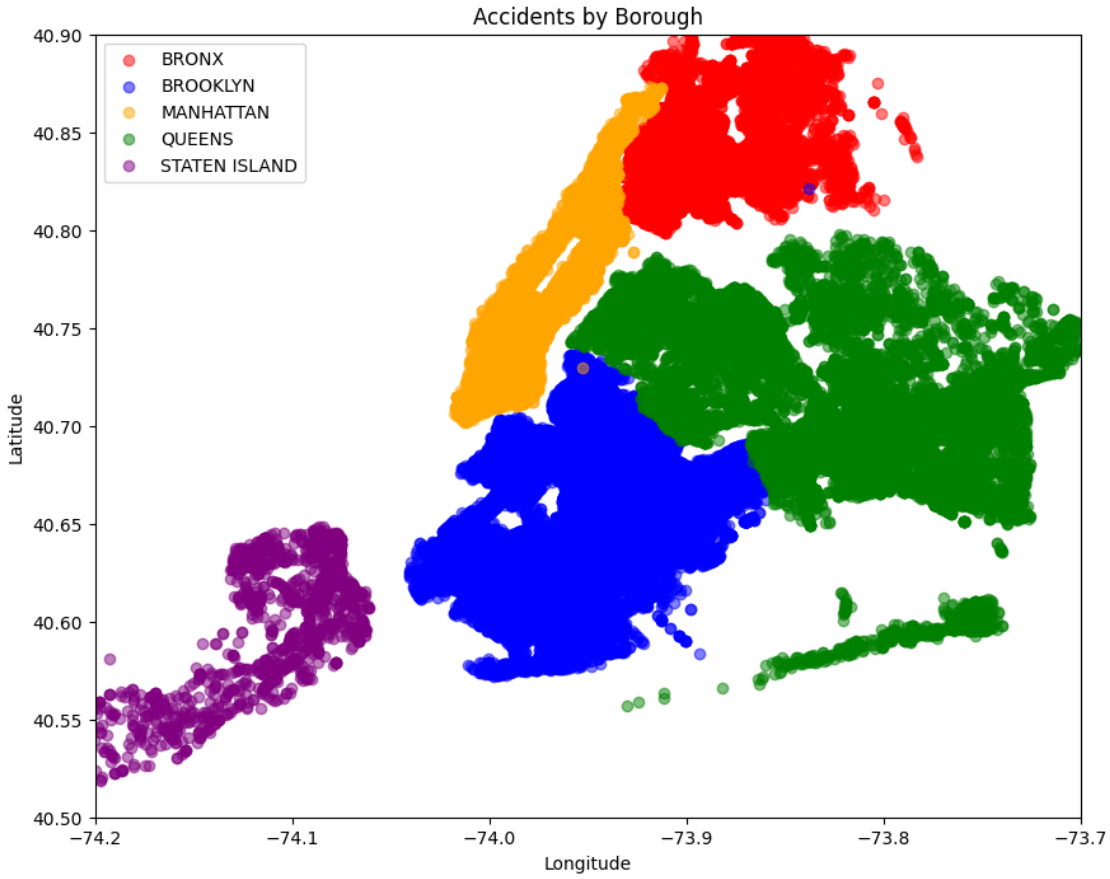
```
Summary statistics for number of persons injured in all NYC:
count    30305.000000
mean         0.416697
std          0.745320
min          0.000000
25%          0.000000
50%          0.000000
75%          1.000000
max         15.000000
Name: NUMBER OF PERSONS INJURED, dtype: float64

Summary statistics for number of persons injured in Manhattan:
count    4757.000000
mean        0.341602
std         0.630707
min         0.000000
25%         0.000000
50%         0.000000
75%         1.000000
max         5.000000
Name: NUMBER OF PERSONS INJURED, dtype: float64
Summary statistics for number of persons injured in brooklyn:
count    9823.000000
mean        0.451186
std         0.785893
min         0.000000
25%         0.000000
50%         0.000000
75%         1.000000
max        15.000000
Name: NUMBER OF PERSONS INJURED, dtype: float64
```

2.6 Visualization: Geographic Distribution of Accidents

We will do this by:

1. Reading data and use only 3 columns of borough, latitude, longitude
2. Dropping rows with missing/null vals for latitude or longitude
3. Set up scatter plot
4. Set longitude and latitude limits

[30]:
```
df = pd.read_csv('../data/raw/NYC_Accidents_2020.csv', header=3,␣
 ↪usecols=['BOROUGH', 'LATITUDE', 'LONGITUDE'])

df = df.dropna(subset=['LATITUDE', 'LONGITUDE'])
groups = df.groupby('BOROUGH')
fig, ax = plt.subplots(figsize=(10, 8))


borough_colors = {
    'BRONX': 'red',
    'BROOKLYN': 'blue',
    'QUEENS': 'green',
    'MANHATTAN': 'orange',
    'STATEN ISLAND': 'purple'
}

for borough, group in df.groupby('BOROUGH'):
    ax.scatter(group['LONGITUDE'], group['LATITUDE'], label=borough,␣
 ↪color=borough_colors[borough], alpha=0.5)

ax.set_xlim(-74.2, -73.7)
ax.set_ylim(40.5, 40.9)
ax.set_xlabel('Longitude')
ax.set_ylabel('Latitude')
ax.set_title('Accidents by Borough')

ax.legend()
plt.show()
```



2.7 Covariance between each pair of the columns

Covariance was chosen between persons injured and persons killed, motorists killed and motorists injured, pedestrians killed and injured, cyclists killed and injured because these stats are closely related

drop rows with missing values of the columns we're interested in

calculate covariance with new dataframe of only selected columns

[31]:
```
df = pd.read_csv('../data/raw/NYC_Accidents_2020.csv', header=3)


cols = ['NUMBER OF PERSONS INJURED', 'NUMBER OF PERSONS KILLED',
        'NUMBER OF PEDESTRIANS INJURED', 'NUMBER OF PEDESTRIANS KILLED',␣
 ↪'NUMBER OF MOTORIST INJURED',
        'NUMBER OF MOTORIST KILLED', 'NUMBER OF CYCLIST INJURED', 'NUMBER OF␣
 ↪CYCLIST KILLED']
```

```
df = df.dropna(subset=cols)
df_selected = df.loc[:, cols]
cov = df_selected.cov()
print(cov)
```

```
                              NUMBER OF PERSONS INJURED  \
NUMBER OF PERSONS INJURED                      0.527334
NUMBER OF PERSONS KILLED                       0.000617
NUMBER OF PEDESTRIANS INJURED                  0.042047
NUMBER OF PEDESTRIANS KILLED                  -0.000047
NUMBER OF MOTORIST INJURED                     0.454301
NUMBER OF MOTORIST KILLED                      0.000708
NUMBER OF CYCLIST INJURED                      0.030986
NUMBER OF CYCLIST KILLED                      -0.000044

                              NUMBER OF PERSONS KILLED  \
NUMBER OF PERSONS INJURED                      0.000617
NUMBER OF PERSONS KILLED                       0.002267
NUMBER OF PEDESTRIANS INJURED                 -0.000052
NUMBER OF PEDESTRIANS KILLED                   0.000760
NUMBER OF MOTORIST INJURED                     0.000740
NUMBER OF MOTORIST KILLED                      0.001387
NUMBER OF CYCLIST INJURED                     -0.000071
NUMBER OF CYCLIST KILLED                       0.000120

                              NUMBER OF PEDESTRIANS INJURED  \
NUMBER OF PERSONS INJURED                      4.204716e-02
NUMBER OF PERSONS KILLED                      -5.185079e-05
NUMBER OF PEDESTRIANS INJURED                  5.644525e-02
NUMBER OF PEDESTRIANS KILLED                  -8.740720e-07
NUMBER OF MOTORIST INJURED                    -1.257965e-02
NUMBER OF MOTORIST KILLED                     -4.439737e-05
NUMBER OF CYCLIST INJURED                     -1.818438e-03
NUMBER OF CYCLIST KILLED                      -6.579349e-06

                              NUMBER OF PEDESTRIANS KILLED  \
NUMBER OF PERSONS INJURED                    -4.710305e-05
NUMBER OF PERSONS KILLED                      7.597798e-04
NUMBER OF PEDESTRIANS INJURED                -8.740720e-07
NUMBER OF PEDESTRIANS KILLED                  7.473040e-04
NUMBER OF MOTORIST INJURED                   -2.689506e-05
NUMBER OF MOTORIST KILLED                     1.256570e-05
NUMBER OF CYCLIST INJURED                    -1.933392e-05
NUMBER OF CYCLIST KILLED                     -8.988621e-08

                              NUMBER OF MOTORIST INJURED  \
NUMBER OF PERSONS INJURED                       0.454301
NUMBER OF PERSONS KILLED                        0.000740
```

```
NUMBER OF PEDESTRIANS INJURED                  -0.012580
NUMBER OF PEDESTRIANS KILLED                   -0.000027
NUMBER OF MOTORIST INJURED                      0.478065
NUMBER OF MOTORIST KILLED                       0.000799
NUMBER OF CYCLIST INJURED                      -0.011185
NUMBER OF CYCLIST KILLED                       -0.000032

                            NUMBER OF MOTORIST KILLED  \
NUMBER OF PERSONS INJURED                 7.083622e-04
NUMBER OF PERSONS KILLED                  1.386860e-03
NUMBER OF PEDESTRIANS INJURED            -4.439737e-05
NUMBER OF PEDESTRIANS KILLED              1.256570e-05
NUMBER OF MOTORIST INJURED                7.988738e-04
NUMBER OF MOTORIST KILLED                 1.374421e-03
NUMBER OF CYCLIST INJURED                -4.611430e-05
NUMBER OF CYCLIST KILLED                 -1.268038e-07

                            NUMBER OF CYCLIST INJURED  \
NUMBER OF PERSONS INJURED                    0.030986
NUMBER OF PERSONS KILLED                    -0.000071
NUMBER OF PEDESTRIANS INJURED               -0.001818
NUMBER OF PEDESTRIANS KILLED                -0.000019
NUMBER OF MOTORIST INJURED                  -0.011185
NUMBER OF MOTORIST KILLED                   -0.000046
NUMBER OF CYCLIST INJURED                    0.043990
NUMBER OF CYCLIST KILLED                    -0.000005

                            NUMBER OF CYCLIST KILLED
NUMBER OF PERSONS INJURED                -4.405708e-05
NUMBER OF PERSONS KILLED                  1.199612e-04
NUMBER OF PEDESTRIANS INJURED            -6.579349e-06
NUMBER OF PEDESTRIANS KILLED             -8.988621e-08
NUMBER OF MOTORIST INJURED               -3.222421e-05
NUMBER OF MOTORIST KILLED                -1.268038e-07
NUMBER OF CYCLIST INJURED                -5.253528e-06
NUMBER OF CYCLIST KILLED                  1.201779e-04
```

2.8 Which month did the most number of accidents occur?

[32]:
```
df = pd.read_csv('../data/raw/NYC_Accidents_2020.csv', header=3)
df['CRASH DATE'] = pd.to_datetime(df['CRASH DATE'], format='%m/%d/%y')
df['MONTH'] = df['CRASH DATE'].dt.month
df['MONTH'] = df['MONTH'].apply(lambda x: calendar.month_abbr[x])

month_counts = df['MONTH'].value_counts()
max_count = month_counts.max()
min_count = month_counts.min()
```

```
print("The following month had the most accidents with", max_count, "accidents:
 ↪")
for month, count in month_counts.items():
    if count == max_count:
        print(month)

print("The following month had the most accidents with", min_count, "accidents:
 ↪")
for month, count in month_counts.items():
    if count == min_count:
        print(month)
```

```
The following month had the most accidents with 14287 accidents:
Jan
The following month had the most accidents with 4116 accidents:
Apr
```

2.9 Conclusion:

Accidents reach a lull in April perhaps due to weather conditions becoming more favorable in NYC