Project_01_Customer_Service_Requests_Analysis

April 6, 2021

1 Project 2 - Perform Facial Recognition with Deep Learning in Keras Using CNN

[1]:
```
import pandas as pd
import numpy as np
import zipfile
import datetime
import matplotlib.pyplot as plt
import scipy.stats as stats
from scipy.stats import chi2_contingency
```

1.1 Task 1 - Import a 311 NYC service request.

[2]:
```
with zipfile.ZipFile('Data Science with Python Two.zip','r') as zip_ref:
    zip_ref.extractall('Project 01 - Customer Service Requests Analysis')
```

[3]:
```
nycsr = pd.read_csv('Project 01 - Customer Service Requests Analysis/
 ↪311_Service_Requests_from_2010_to_Present.csv',parse_dates=['Created␣
 ↪Date','Closed Date','Due Date','Resolution Action Updated Date'])
nycsr.head(3)
```

```
c:\users\jude\appdata\local\programs\python\python39\lib\site-
packages\IPython\core\interactiveshell.py:3155: DtypeWarning: Columns (48,49)
have mixed types.Specify dtype option on import or set low_memory=False.
  has_raised = await self.run_ast_nodes(code_ast.body, cell_name,
```

[3]:
```
   Unique Key        Created Date         Closed Date Agency  \
0    32310363 2015-12-31 23:59:45 2016-01-01 00:55:00   NYPD
1    32309934 2015-12-31 23:59:44 2016-01-01 01:26:00   NYPD
2    32309159 2015-12-31 23:59:29 2016-01-01 04:51:00   NYPD

                       Agency Name           Complaint Type        Descriptor  \
0  New York City Police Department  Noise - Street/Sidewalk  Loud Music/Party
1  New York City Police Department         Blocked Driveway         No Access
2  New York City Police Department         Blocked Driveway         No Access

     Location Type  Incident Zip       Incident Address  …  \
0  Street/Sidewalk       10034.0    71 VERMILYEA AVENUE  …
1  Street/Sidewalk       11105.0        27-07 23 AVENUE  …
2  Street/Sidewalk       10458.0  2897 VALENTINE AVENUE  …

  Bridge Highway Name Bridge Highway Direction Road Ramp  \
0                 NaN                      NaN       NaN
1                 NaN                      NaN       NaN
2                 NaN                      NaN       NaN

  Bridge Highway Segment Garage Lot Name Ferry Direction Ferry Terminal Name  \
0                    NaN             NaN             NaN                 NaN
1                    NaN             NaN             NaN                 NaN
2                    NaN             NaN             NaN                 NaN

    Latitude  Longitude                                  Location
0  40.865682 -73.923501   (40.86568153633767, -73.92350095571744)
1  40.775945 -73.915094  (40.775945312321085, -73.91509393898605)
2  40.870325 -73.888525  (40.870324522111424, -73.88852464418646)

[3 rows x 53 columns]
```

[4]:
```
nycsr['Agency'].value_counts()
```

[4]:
```
NYPD    300698
Name: Agency, dtype: int64
```

[5]:
```
nycsr = nycsr[['Created Date','Closed Date','Agency Name','Complaint␣
 ↪Type','Descriptor','City','Status','Borough','Location␣
 ↪Type','Location','Latitude','Longitude']]
nycsr.head(3)
```

[5]:
```
          Created Date         Closed Date                      Agency Name  \
0 2015-12-31 23:59:45 2016-01-01 00:55:00  New York City Police Department
1 2015-12-31 23:59:44 2016-01-01 01:26:00  New York City Police Department
2 2015-12-31 23:59:29 2016-01-01 04:51:00  New York City Police Department

             Complaint Type        Descriptor     City  Status    Borough  \
0  Noise - Street/Sidewalk  Loud Music/Party  NEW YORK  Closed  MANHATTAN
1          Blocked Driveway         No Access   ASTORIA  Closed     QUEENS
2          Blocked Driveway         No Access     BRONX  Closed      BRONX

    Location Type                                  Location   Latitude  \
0  Street/Sidewalk   (40.86568153633767, -73.92350095571744)  40.865682
1  Street/Sidewalk  (40.775945312321085, -73.91509393898605)  40.775945
2  Street/Sidewalk  (40.870324522111424, -73.88852464418646)  40.870325

   Longitude
```

```
0 -73.923501
1 -73.915094
2 -73.888525
```

[6]:
```
nycsr.shape
```

[6]:
```
(300698, 12)
```

[7]:
```
nycsr.dtypes
```

[7]:
```
Created Date      datetime64[ns]
Closed Date       datetime64[ns]
Agency Name               object
Complaint Type            object
Descriptor                object
City                      object
Status                    object
Borough                   object
Location Type             object
Location                  object
Latitude                 float64
Longitude                float64
dtype: object
```

[8]:
```
nycsr.isnull().sum()
```

[8]:
```
Created Date         0
Closed Date       2164
Agency Name          0
Complaint Type       0
Descriptor        5914
City              2614
Status               0
Borough              0
Location Type      131
Location          3540
Latitude          3540
Longitude         3540
dtype: int64
```

[9]:
```
nycsr['Descriptor'] = nycsr['Descriptor'].fillna('Unspecified')
```

[10]:
```
# since there are around 4500 null values in the dataset, in the interest of␣
 ↪accuracy, it would be better to delete observations with these null values,␣
 ↪which would be roughly 1% of the total dataset of 364558 observations
nycsr = nycsr.dropna()
nycsr.shape
```

```
[10]: (296939, 12)
```

```
[11]: nycsr.isnull().sum()
```

```
[11]: Created Date      0
      Closed Date       0
      Agency Name       0
      Complaint Type    0
      Descriptor        0
      City              0
      Status            0
      Borough           0
      Location Type     0
      Location          0
      Latitude          0
      Longitude         0
      dtype: int64
```

```
[12]: nycsr['Complaint Type'].unique()
```

```
[12]: array(['Noise - Street/Sidewalk', 'Blocked Driveway', 'Illegal Parking',
             'Derelict Vehicle', 'Noise - Commercial',
             'Noise - House of Worship', 'Posting Advertisement',
             'Noise - Vehicle', 'Animal Abuse', 'Vending', 'Traffic',
             'Drinking', 'Bike/Roller/Skate Chronic', 'Panhandling',
             'Noise - Park', 'Homeless Encampment', 'Urinating in Public',
             'Graffiti', 'Disorderly Youth', 'Illegal Fireworks', 'Squeegee'],
            dtype=object)
```

```
[13]: nycsr['Location Type'].unique()
```

```
[13]: array(['Street/Sidewalk', 'Club/Bar/Restaurant', 'Store/Commercial',
             'House of Worship', 'Residential Building/House',
             'Residential Building', 'Park/Playground', 'Vacant Lot',
             'House and Store', 'Highway', 'Commercial', 'Roadway Tunnel',
             'Subway Station', 'Parking Lot', 'Bridge'], dtype=object)
```

```
[14]: nycsr['City'].unique()
```

```
[14]: array(['NEW YORK', 'ASTORIA', 'BRONX', 'ELMHURST', 'BROOKLYN',
             'KEW GARDENS', 'JACKSON HEIGHTS', 'MIDDLE VILLAGE', 'REGO PARK',
             'SAINT ALBANS', 'JAMAICA', 'SOUTH RICHMOND HILL', 'RIDGEWOOD',
             'HOWARD BEACH', 'FOREST HILLS', 'STATEN ISLAND', 'OZONE PARK',
             'RICHMOND HILL', 'WOODHAVEN', 'FLUSHING', 'CORONA',
             'QUEENS VILLAGE', 'OAKLAND GARDENS', 'HOLLIS', 'MASPETH',
             'EAST ELMHURST', 'SOUTH OZONE PARK', 'WOODSIDE', 'FRESH MEADOWS',
             'LONG ISLAND CITY', 'ROCKAWAY PARK', 'SPRINGFIELD GARDENS',
             'COLLEGE POINT', 'BAYSIDE', 'GLEN OAKS', 'FAR ROCKAWAY',
             'BELLEROSE', 'LITTLE NECK', 'CAMBRIA HEIGHTS', 'ROSEDALE',
             'SUNNYSIDE', 'WHITESTONE', 'ARVERNE', 'FLORAL PARK',
             'NEW HYDE PARK', 'CENTRAL PARK', 'BREEZY POINT', 'QUEENS',
             'Astoria', 'Long Island City', 'Woodside', 'East Elmhurst',
             'Howard Beach'], dtype=object)
```

```
[15]: nycsr.describe()
```

```
[15]:             Latitude      Longitude
      count  296939.000000  296939.000000
      mean       40.725887     -73.925623
      std         0.082018       0.078444
      min        40.499135     -74.254937
      25%        40.669789     -73.972114
      50%        40.718663     -73.931780
      75%        40.781875     -73.876805
      max        40.912869     -73.700760
```

1.2 Task 2 - Read or convert the columns ‘Created Date’ and Closed Date’ to datetime datatype and create a new column ‘Request_Closing_Time’ as the time elapsed between request creation and request closing. (Hint: Explore the package/module datetime)

```
[16]: nycsr['Closed Date'].value_counts()
```

```
[16]: 2015-11-08 07:34:00    24
      2015-10-11 07:03:00    22
      2015-12-08 07:44:00    18
      2015-05-10 07:01:00    18
      2015-12-07 23:17:00    17
                             ..
      2015-09-27 22:00:47     1
      2015-12-15 00:33:44     1
      2015-04-11 02:36:00     1
      2015-09-21 17:28:16     1
      2015-05-06 16:47:00     1
      Name: Closed Date, Length: 236021, dtype: int64
```

```
[17]: max(nycsr['Closed Date'])
```

```
[17]: Timestamp('2016-01-03 16:22:00')
```

```
[18]: #since there are a lot of closed date with null values, it would be better to␣
       ↪replace the null values with the last closed date or max of closed date,␣
       ↪which, coincidentally has the highest frequency
      nycsr['Closed Date'] = nycsr['Closed Date'].fillna(max(nycsr['Closed Date']))
      nycsr['Closed Date'].value_counts()
```

```
[18]: 2015-11-08 07:34:00    24
      2015-10-11 07:03:00    22
      2015-12-08 07:44:00    18
      2015-05-10 07:01:00    18
      2015-12-07 23:17:00    17
                             ..
      2015-09-27 22:00:47     1
      2015-12-15 00:33:44     1
      2015-04-11 02:36:00     1
      2015-09-21 17:28:16     1
      2015-05-06 16:47:00     1
      Name: Closed Date, Length: 236021, dtype: int64
```

```
[19]: nycsr['Request_Closing_Time'] = nycsr['Closed Date']-nycsr['Created Date']
      nycsr['Request_Closing_Time'].head()
```

```
[19]: 0   0 days 00:55:15
      1   0 days 01:26:16
      2   0 days 04:51:31
      3   0 days 07:45:14
      4   0 days 03:27:02
      Name: Request_Closing_Time, dtype: timedelta64[ns]
```

```
[20]: nycsr['Created_Time'] = nycsr['Created Date'].dt.hour
      nycsr['Created_Time'].head()
```

```
[20]: 0    23
      1    23
      2    23
      3    23
      4    23
      Name: Created_Time, dtype: int64
```

```
[21]: nycsr['Descriptor'].value_counts()
```

```
[21]: Loud Music/Party                  60445
      No Access                         56725
      Posted Parking Sign Violation     22103
      Loud Talking                      21254
      Partial Access                    19951
      With License Plate                17506
      Blocked Hydrant                   15837
      Commercial Overnight Parking      11908
      Car/Truck Music                   11114
      Blocked Sidewalk                  10930
      Unspecified                        5830
      Double Parked Blocking Traffic     5558
      Double Parked Blocking Vehicle     4147
```

```
Engine Idling                      4134
Banging/Pounding                   4090
Neglected                          3771
Car/Truck Horn                     3477
Congestion/Gridlock                2737
In Prohibited Area                 2017
Other (complaint details)          1961
Unlicensed                         1756
Overnight Commercial Storage       1746
Unauthorized Bus Layover           1333
Truck Route Violation              1010
In Public                           923
Tortured                            849
Vehicle                             587
Chained                             534
Detached Trailer                    459
No Shelter                          381
Chronic Stoplight Violation         280
Underage - Licensed Est             270
Chronic Speeding                    266
In Car                              248
Playing in Unsuitable Place         245
Drag Racing                         174
Loud Television                      93
Police Report Requested              90
After Hours - Licensed Est           77
Building                             60
Nuisance/Truant                      40
Police Report Not Requested          23
Name: Descriptor, dtype: int64
```

[22]:

```
#since there are lot of null values in descriptors variable, it would make␣
 ↪sense to replace it with the complaint having highest frequency 'No Access'
nycsr['Descriptor'] = nycsr['Descriptor'].fillna('No Access')
nycsr['Descriptor'].isnull().sum()
```

[22]:

```
0
```

[23]:

```
nycsr['Location Type'].value_counts()
```

[23]:

```
Street/Sidewalk               246265
Store/Commercial               20116
Club/Bar/Restaurant            17194
Residential Building/House      6943
Park/Playground                 4645
House of Worship                 920
Residential Building             226
```

```
Highway                          211
Parking Lot                      116
House and Store                   93
Vacant Lot                        77
Commercial                        62
Roadway Tunnel                    35
Subway Station                    34
Bridge                             2
Name: Location Type, dtype: int64
```

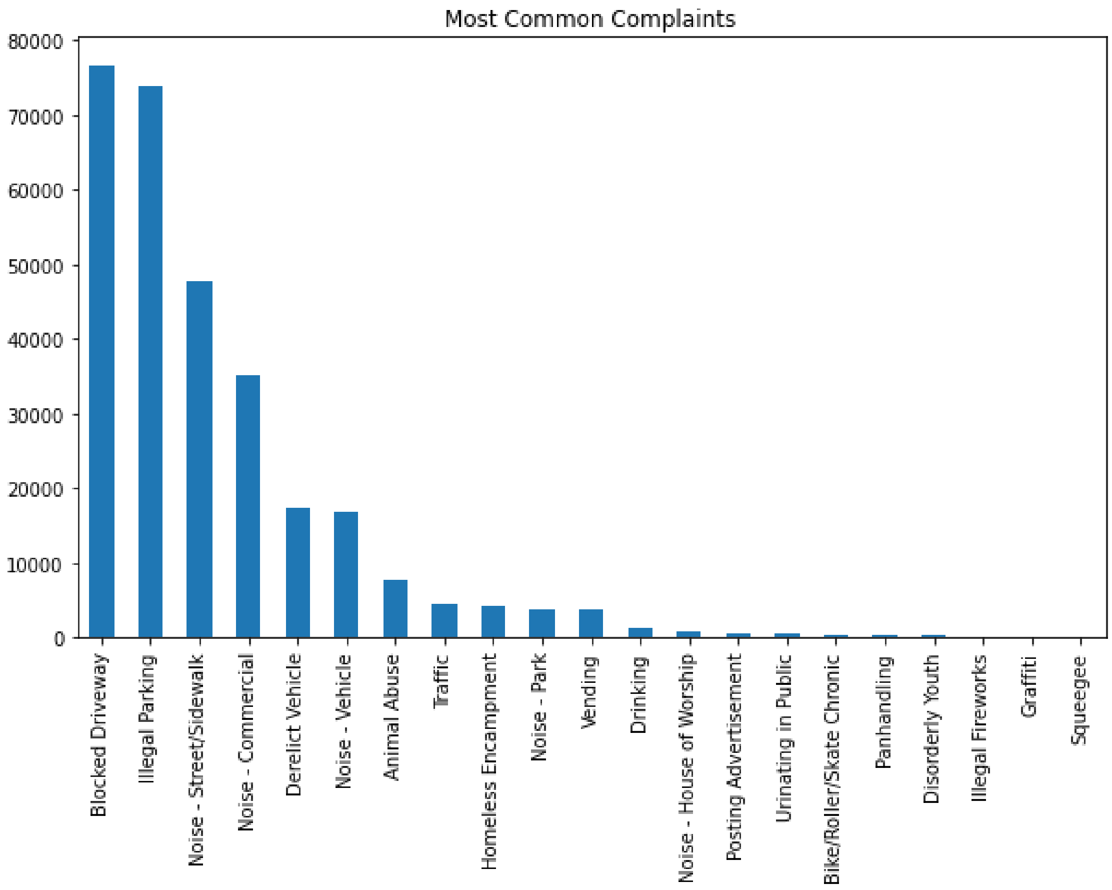
1.3 Task 3 - Provide major insights/patterns that you can offer in a visual format (graphs or tables); at least 4 major conclusions that you can come up with after generic data mining.

[24]:

```
# What are different type of Complaints? Which is most/least frequent?
(nycsr['Complaint Type'].value_counts()).plot(kind='bar',figsize=(10,6),title =␣
↪'Most Common Complaints')
```

[24]:

```
<AxesSubplot:title={'center':'Most Common Complaints'}>
```

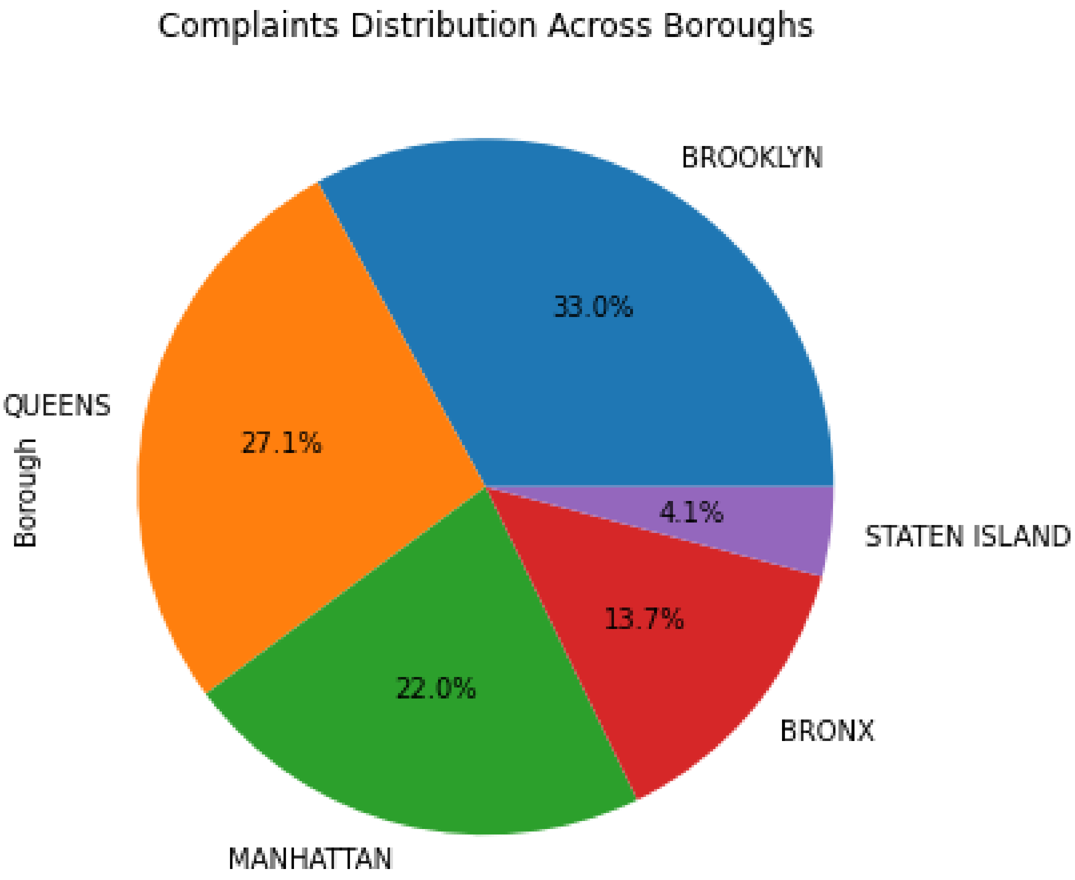


[25]:

```
# From which borough most complaints come from?
(nycsr['Borough'].value_counts()).plot(kind='pie',autopct='%1.
 ↪1f%%',figsize=(10,6),title='Complaints Distribution Across Boroughs')
```

[25]:

```
<AxesSubplot:title={'center':'Complaints Distribution Across Boroughs'},
ylabel='Borough'>
```

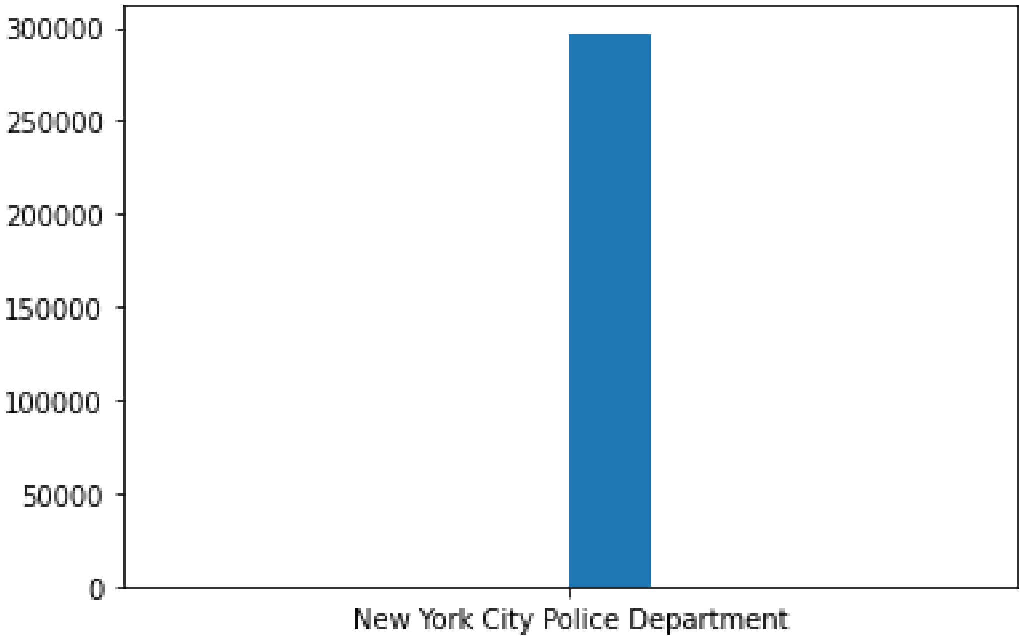


[26]:

```
# Which agencies are more efficient in solving complaints?
nycsr['Agency Name'] = nycsr['Agency Name'].replace('NYPD','New York City␣
 ↪Police Department')
plt.hist(nycsr['Agency Name'])
```

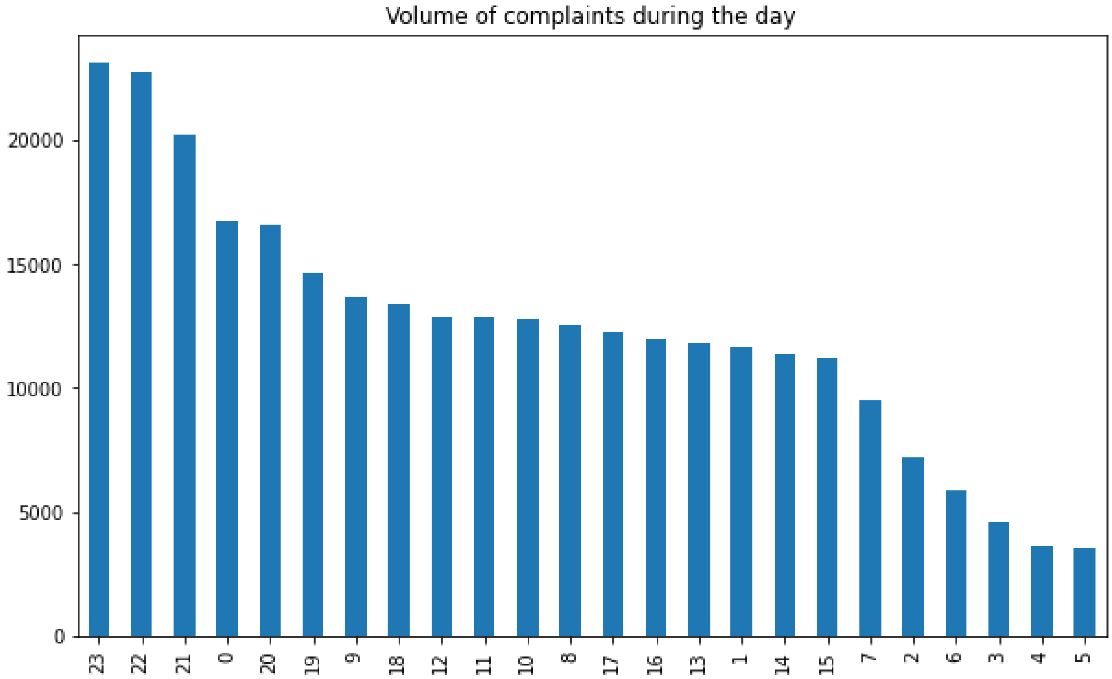
[26]:

```
(array([     0.,      0.,      0.,      0.,      0., 296939.,      0.,
             0.,      0.,      0.]),
 array([-0.5, -0.4, -0.3, -0.2, -0.1,  0. ,  0.1,  0.2,  0.3,  0.4,  0.5]),
 <BarContainer object of 10 artists>)
```



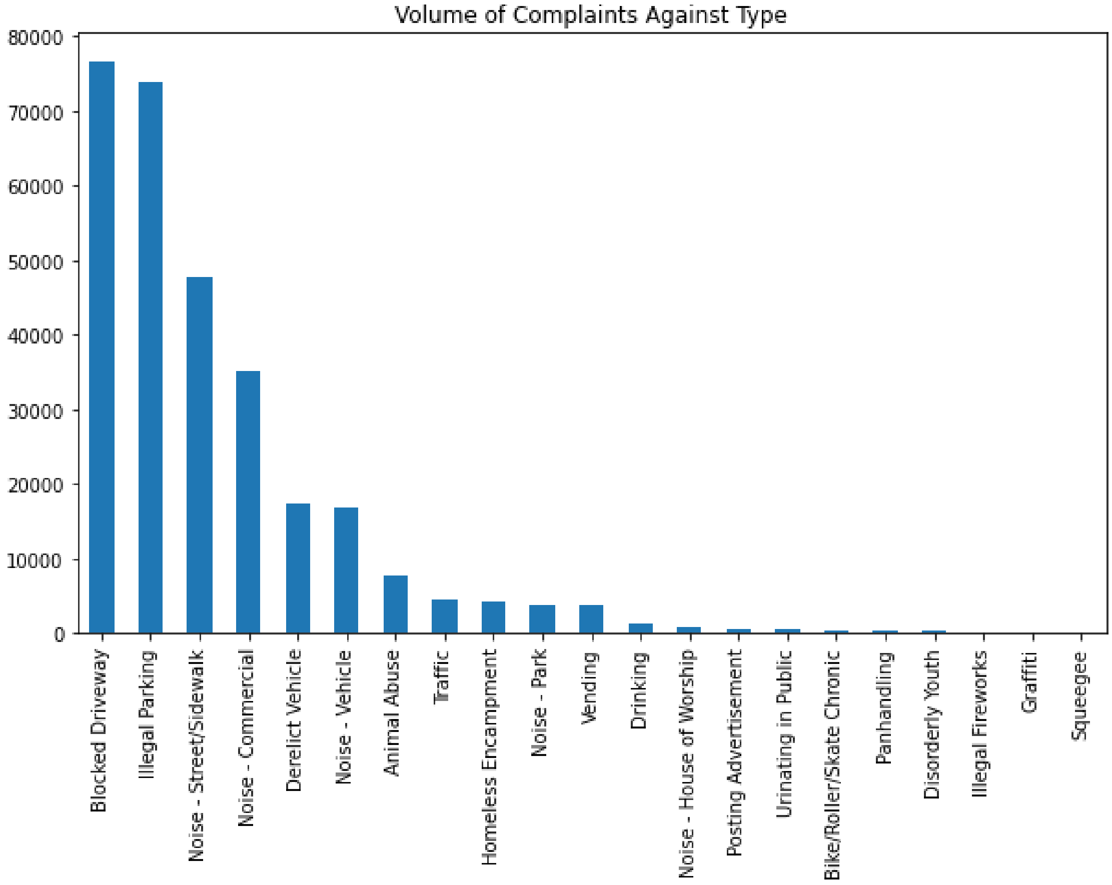
```
[27]: # Which complaints peaks at what time of day?
      nycsr['Created_Time'].value_counts().
       ↪plot(kind='bar',figsize=(10,6),title='Volume of complaints during the day')
```

```
[27]: <AxesSubplot:title={'center':'Volume of complaints during the day'}>
```



[28]:
```
# From which type of location we get most number of complaints?
nycsr['Complaint Type'].value_counts().
↪plot(kind='bar',figsize=(10,6),title='Volume of Complaints Against Type')
```

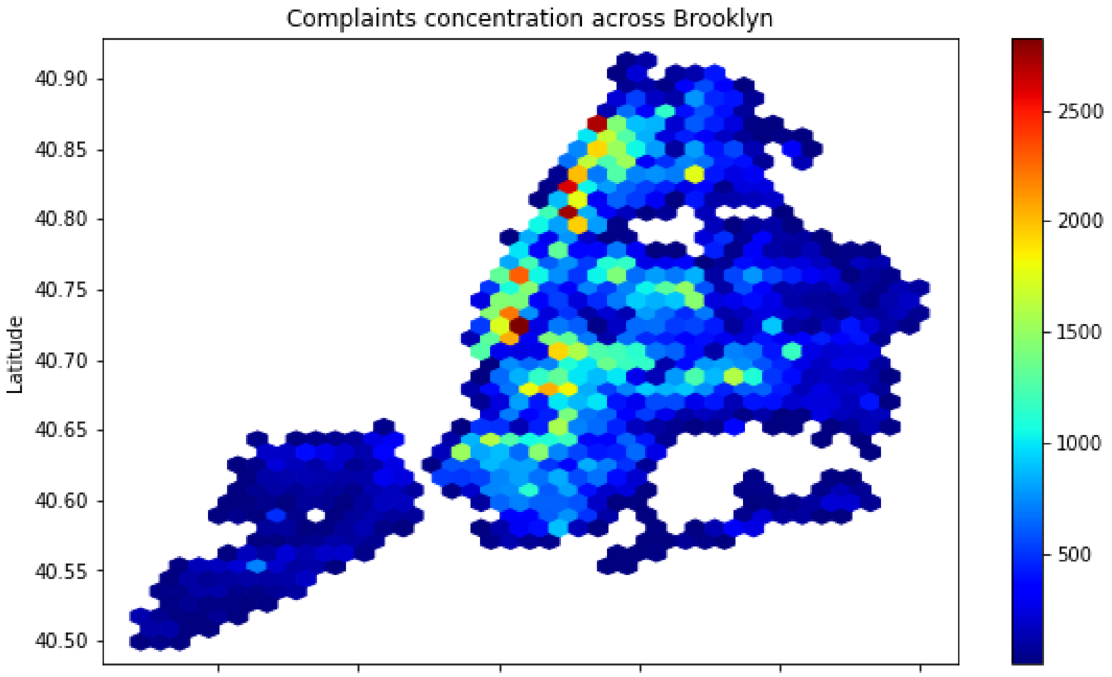
[28]:
```
<AxesSubplot:title={'center':'Volume of Complaints Against Type'}>
```



[29]:
```
nycsr.
↪plot(kind='hexbin',x='Longitude',y='Latitude',gridsize=40,colormap='jet',mincnt=1,title='Co
↪concentration across Brooklyn',figsize=(10,6)).axis('equal')
```

```
c:\users\jude\appdata\local\programs\python\python39\lib\site-
packages\pandas\plotting\_matplotlib\tools.py:400: MatplotlibDeprecationWarning:
The is_first_col function was deprecated in Matplotlib 3.4 and will be removed
two minor releases later. Use ax.get_subplotspec().is_first_col() instead.
  if ax.is_first_col():
```

[29]:
```
(-74.2826460631096, -73.6730515268904, 40.478447910999996, 40.933555509)
```



1.4 Task 4 - Order the complaint types based on the average 'Request_Closing_Time', grouping them for different locations.

```
[30]: nycsr['Request_Closing_Time_secs'] = nycsr['Request_Closing_Time'].dt.
       ↪total_seconds()
      nycsr['Request_Closing_Time_hrs'] = nycsr['Request_Closing_Time_secs']/60#*(2.
       ↪77778e-13)
      nycsr['Request_Closing_Time_hrs'].head()
```

```
[30]: 0     55.250000
      1     86.266667
      2    291.516667
      3    465.233333
      4    207.033333
      Name: Request_Closing_Time_hrs, dtype: float64
```

```
[31]: nycsr_group = pd.DataFrame(nycsr.groupby(['City','Complaint␣
       ↪Type'])['Request_Closing_Time_hrs'].mean()).reset_index()
      nycsr_group['Request_Closing_Time_hrs'] =␣
       ↪nycsr_group['Request_Closing_Time_hrs'].astype(int)
      nycsr_group
```

```
[31]:          City           Complaint Type  Request_Closing_Time_hrs
      0     ARVERNE            Animal Abuse                       129
```

```
1     ARVERNE         Blocked Driveway                       151
2     ARVERNE         Derelict Vehicle                       178
3     ARVERNE         Disorderly Youth                       215
4     ARVERNE                 Drinking                        14
..        …                        …                    …
758   Woodside        Blocked Driveway                       384
759   Woodside        Derelict Vehicle                       298
760   Woodside         Illegal Parking                       313
761   Woodside      Noise - Commercial                       143
762   Woodside  Noise - Street/Sidewalk                      204

[763 rows x 3 columns]
```

1.5 Task 5 - Perform a statistical test for the following:

1. Whether the average response time across complaint types is similar or not (overall)
2. Are the type of complaint or service requested and location related

1.6 Is the average response time across complaint types similar or not (overall)?

1. Null Hypothesis : The average response time across complaint types is similar
2. Alternate Hypothesis : The average response time across complaint types is not similar

[32]:

```
top_5_complaint_type = nycsr['Complaint Type'].value_counts().head()
top_5_complaint_type
```

[32]:

```
Blocked Driveway           76676
Illegal Parking            74021
Noise - Street/Sidewalk    47747
Noise - Commercial         35145
Derelict Vehicle           17506
Name: Complaint Type, dtype: int64
```

[33]:

```
top_5_complaint_type_names = top_5_complaint_type.index
top_5_complaint_type_names
```

[33]:

```
Index(['Blocked Driveway', 'Illegal Parking', 'Noise - Street/Sidewalk',
       'Noise - Commercial', 'Derelict Vehicle'],
      dtype='object')
```

[34]:

```
sample_data_customer_type = nycsr.loc[nycsr['Complaint Type'].
 ↪isin(top_5_complaint_type_names),['Complaint␣
 ↪Type','Request_Closing_Time_hrs']]
sample_data_customer_type.head()
```

[34]:

```
            Complaint Type  Request_Closing_Time_hrs
0  Noise - Street/Sidewalk                 55.250000
1         Blocked Driveway                 86.266667
```

```
2         Blocked Driveway                291.516667
3          Illegal Parking                465.233333
4          Illegal Parking                207.033333
```

[35]:
```
sample_data_customer_type.shape
```

[35]:
```
(251095, 2)
```

[36]:
```
s1 = sample_data_customer_type[sample_data_customer_type['Complaint␣
 ↪Type']==top_5_complaint_type_names[0]].Request_Closing_Time_hrs
s1.head()
```

[36]:
```
1       86.266667
2      291.516667
7      107.916667
9       83.033333
10     468.033333
Name: Request_Closing_Time_hrs, dtype: float64
```

[37]:
```
s2 = sample_data_customer_type[sample_data_customer_type['Complaint␣
 ↪Type']==top_5_complaint_type_names[1]].Request_Closing_Time_hrs
s2.head()
```

[37]:
```
3    465.233333
4    207.033333
5    113.500000
6    117.466667
8    513.033333
Name: Request_Closing_Time_hrs, dtype: float64
```

[38]:
```
s3 = sample_data_customer_type[sample_data_customer_type['Complaint␣
 ↪Type']==top_5_complaint_type_names[2]].Request_Closing_Time_hrs
s3.head()
```

[38]:
```
0       55.250000
12     148.950000
19      47.083333
38      29.466667
54      89.733333
Name: Request_Closing_Time_hrs, dtype: float64
```

[39]:
```
s4 = sample_data_customer_type[sample_data_customer_type['Complaint␣
 ↪Type']==top_5_complaint_type_names[3]].Request_Closing_Time_hrs
s4.head()
```

[39]:
```
17      51.133333
18     176.016667
22      75.700000
```

```
29    149.983333
30    119.150000
Name: Request_Closing_Time_hrs, dtype: float64
```

[40]:

```
s5 = sample_data_customer_type[sample_data_customer_type['Complaint␣
 ↪Type']==top_5_complaint_type_names[4]].Request_Closing_Time_hrs
s5.head()
```

[40]:

```
14     629.383333
151    237.016667
255     81.883333
256    247.983333
295     45.200000
Name: Request_Closing_Time_hrs, dtype: float64
```

[41]:

```
stats.f_oneway(s1, s2, s3, s4, s5)
```

[41]:

```
F_onewayResult(statistic=1789.8760711625562, pvalue=0.0)
```

Since the p-value is less than 0.05, null hypothesis is rejected. Hence the average response time across complaint types is not similar.

1.7 Are the type of complaint or service requested and location related?

1. Null Hypothesis : The complaint type and location are related
2. Alternate Hypothesis : The complaint type and location are not related

[42]:

```
#chi square
top_5_location = nycsr['City'].value_counts().head()
top_5_location
```

[42]:

```
BROOKLYN         98057
NEW YORK         65365
BRONX            40576
STATEN ISLAND    12324
JAMAICA           7276
Name: City, dtype: int64
```

[43]:

```
top_5_location_names = top_5_location.index
top_5_location_names
```

[43]:

```
Index(['BROOKLYN', 'NEW YORK', 'BRONX', 'STATEN ISLAND', 'JAMAICA'],
dtype='object')
```

[44]:

```
sample_data_location_type = nycsr.loc[(nycsr['Complaint Type'].
 ↪isin(top_5_complaint_type_names))&(nycsr['City'].
 ↪isin(top_5_location_names)),['Complaint Type','City']]
sample_data_location_type
```

```
[44]:                    Complaint Type      City
        0       Noise - Street/Sidewalk  NEW YORK
        2              Blocked Driveway     BRONX
        3                Illegal Parking     BRONX
        5                Illegal Parking  BROOKLYN
        6                Illegal Parking  NEW YORK
        …                            …         …
        300691       Noise - Commercial  NEW YORK
        300692       Noise - Commercial  NEW YORK
        300695       Noise - Commercial  BROOKLYN
        300696       Noise - Commercial     BRONX
        300697       Noise - Commercial  NEW YORK

        [184826 rows x 2 columns]
```

```
[45]: table = pd.crosstab(sample_data_location_type['Complaint Type'],sample_data_location_type['City'],margins=True)
      table
```

```
[45]: City                     BRONX  BROOKLYN  JAMAICA  NEW YORK  STATEN ISLAND  \
      Complaint Type
      Blocked Driveway         12740     28119     2815      2055           2141
      Derelict Vehicle          1948      5164      953       530           1762
      Illegal Parking           7829     27386     1419     11979           4881
      Noise - Commercial        2431     11451      427     14529            677
      Noise - Street/Sidewalk   8865     13316      328     20266            815
      All                      33813     85436     5942     49359          10276

      City                        All
      Complaint Type
      Blocked Driveway          47870
      Derelict Vehicle          10357
      Illegal Parking           53494
      Noise - Commercial        29515
      Noise - Street/Sidewalk   43590
      All                      184826
```

```
[46]: ch2,p_value,df,exp_frq = chi2_contingency(table)
      print("ch2 = {}\np-value = {}" .format(ch2,p_value))
```

```
ch2 = 40498.5539022086
p-value = 0.0
```

Since the p-value is less than 0.05, null hypothesis is rejected. Hence the complaint type and location are not related.

2 —X—