Customer Service Requests Analysis

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DESCRIPTION

Background of Problem Statement :

NYC 311's mission is to provide the public with quick and easy access to all New York City government services and information while offering the best customer service. Each day, NYC311 receives thousands of requests related to several hundred types of non-emergency services, including noise complaints, plumbing issues, and illegally parked cars. These requests are received by NYC311 and forwarded to the relevant agencies such as the police, buildings, or transportation. The agency responds to the request, addresses it, and then closes it.

Problem Objective :

Perform a service request data analysis of New York City 311 calls. You will focus on the data wrangling techniques to understand the pattern in the data and also visualize the major complaint types. Domain: Customer Service

Analysis Tasks to be performed:

(Perform a service request data analysis of New York City 311 calls)

Import a 311 NYC service request. 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) 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. Order the complaint types based on the average ‘Request_Closing_Time’, grouping them for different locations. Perform a statistical test for the following: Please note: For the below statements you need to state the Null and Alternate and then provide a statistical test to accept or reject the Null Hypothesis along with the corresponding ‘p-value’.

Whether the average response time across complaint types is similar or not (overall) Are the type of complaint or service requested and location related? Dataset Description :

Field Description Unique Key (Plain text) - Unique identifier for the complaints Created Date (Date and Time) - The date and time on which the complaint is raised Closed Date (Date and Time) - The date and time on which the complaint is closed Agency (Plain text) - Agency code Agency Name (Plain text) - Name of the agency Complaint Type (Plain text) - Type of the complaint Descriptor (Plain text) - Complaint type label (Heating - Heat, Traffic Signal Condition - Controller) Location Type (Plain text) - Type of the location (Residential, Restaurant, Bakery, etc) Incident Zip (Plain text) - Zip code for the location Incident Address (Plain text) - Address of the location Street Name (Plain text) - Name of the street Cross Street 1 (Plain text) - Detail of cross street Cross Street 2 (Plain text) - Detail of another cross street Intersection Street 1 (Plain text) - Detail of intersection street if any Intersection Street 2 (Plain text) - Detail of another intersection street if any Address Type (Plain text) - Categorical (Address or Intersection) City (Plain text) - City for the location Landmark (Plain text) - Empty field Facility Type (Plain text) - N/A Status (Plain text) - Categorical (Closed or Pending) Due Date (Date and Time) - Date and time for the pending complaints Resolution Action Updated Date (Date and Time) - Date and time when the resolution was provided Community Board (Plain text) - Categorical field (specifies the community board with its code) Borough (Plain text) - Categorical field (specifies the community board) X Coordinate (State Plane) (Number) Y Coordinate (State Plane) (Number) Park Facility Name (Plain text) - Unspecified Park Borough (Plain text) - Categorical (Unspecified, Queens, Brooklyn etc) School Name (Plain text) - Unspecified School Number (Plain text) - Unspecified School Region (Plain text) - Unspecified School Code (Plain text) - Unspecified School Phone Number (Plain text) - Unspecified School Address (Plain text) - Unspecified School City (Plain text) - Unspecified School State (Plain text) - Unspecified School Zip (Plain text) - Unspecified School Not Found (Plain text) - Empty Field School or Citywide Complaint (Plain text) - Empty Field Vehicle Type (Plain text) - Empty Field Taxi Company Borough (Plain text) - Empty Field Taxi Pick Up Location (Plain text) - Empty Field Bridge Highway Name (Plain text) - Empty Field Bridge Highway Direction (Plain text) - Empty Field Road Ramp (Plain text) - Empty Field Bridge Highway Segment (Plain text) - Empty Field Garage Lot Name (Plain text) - Empty Field

Ferry Direction (Plain text) - Empty Field Ferry Terminal Name (Plain text) - Empty Field Latitude (Number) - Latitude of the location Longitude (Number) - Longitude of the location Location (Location) - Coordinates (Latitude, Longitude)

In [1]:

```
import pandas as pd # pandas is a python package to manipulate data, data operation, data handling, data wrangling
import numpy as np  # numpy is a math library to perform numerical operation using pre-defined function
import matplotlib.pyplot as plt #matplotlib is a library for graphic or data visualization
import seaborn as sns #Seaborn is a library for making statistical graphics in Python
import warnings # to hide the warning message if any
warnings.filterwarnings("ignore")
```

In [2]:

```
### 1. Import a 311 NYC service request
```

In [3]:

```
#To read or fetch the data from csv file to dataframe named 'df_311' import csv file.
df_311=pd.read_csv('311_Service_Requests_from_2010_to_Present.csv')
```

In [4]:

```
#shape function outputs number of rows and columns in dataframe(rows=300698 and columns=53)
df_311.shape
```

Out[4]:

```
(300698, 53)
```

In [5]:

```
#head & tail function results in displaying first & last 5 rows of dataframe respectively
df_311.head()
```

Out[5]:

	Unique Key	Created Date	Closed Date	Agency	Agency Name	Complaint Type	Descriptor	Location Type	Incident Zip	Incident Address	...	Bridge Highway Name	Bridge Highway Direction	F
0	32310363	12/31/2015 11:59:45 PM	01-01-16 0:55	NYPD	New York City Police Department	Noise - Street/Sidewalk	Loud Music/Party	Street/Sidewalk	10034.0	71 VERMILYEA AVENUE	...	NaN	NaN	
1	32309934	12/31/2015 11:59:44 PM	01-01-16 1:26	NYPD	New York City Police Department	Blocked Driveway	No Access	Street/Sidewalk	11105.0	27-07 23 AVENUE	...	NaN	NaN	
2	32309159	12/31/2015 11:59:29 PM	01-01-16 4:51	NYPD	New York City Police Department	Blocked Driveway	No Access	Street/Sidewalk	10458.0	2897 VALENTINE AVENUE	...	NaN	NaN	
3	32305098	12/31/2015 11:57:46 PM	01-01-16 7:43	NYPD	New York City Police Department	Illegal Parking	Commercial Overnight Parking	Street/Sidewalk	10461.0	2940 BAISLEY AVENUE	...	NaN	NaN	
4	32306529	12/31/2015 11:56:58 PM	01-01-16 3:24	NYPD	New York City Police Department	Illegal Parking	Blocked Sidewalk	Street/Sidewalk	11373.0	87-14 57 ROAD	...	NaN	NaN	

5 rows × 53 columns

In [6]:

```
#info outputs non null count and datatypes of columns in dataframe
df_311.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 300698 entries, 0 to 300697
Data columns (total 53 columns):
 #   Column                          Non-Null Count   Dtype  
---  ------                          --------------   -----  
 0   Unique Key                      300698 non-null  int64  
 1   Created Date                    300698 non-null  object 
 2   Closed Date                     298534 non-null  object 
 3   Agency                          300698 non-null  object 
 4   Agency Name                     300698 non-null  object 
 5   Complaint Type                  300698 non-null  object 
 6   Descriptor                      294784 non-null  object 
 7   Location Type                   300567 non-null  object 
 8   Incident Zip                    298083 non-null  float64
 9   Incident Address                256288 non-null  object 
 10  Street Name                     256288 non-null  object 
 11  Cross Street 1                  251419 non-null  object 
 12  Cross Street 2                  250919 non-null  object 
 13  Intersection Street 1           43858 non-null   object 
 14  Intersection Street 2           43362 non-null   object 
 15  Address Type                    297883 non-null  object 
 16  City                            298084 non-null  object 
 17  Landmark                        349 non-null     object 
 18  Facility Type                   298527 non-null  object 
 19  Status                          300698 non-null  object 
 20  Due Date                        300695 non-null  object 
 21  Resolution Description          300698 non-null  object 
 22  Resolution Action Updated Date  298511 non-null  object 
 23  Community Board                 300698 non-null  object 
 24  Borough                         300698 non-null  object 
 25  X Coordinate (State Plane)      297158 non-null  float64
 26  Y Coordinate (State Plane)      297158 non-null  float64
 27  Park Facility Name              300698 non-null  object 
 28  Park Borough                    300698 non-null  object 
 29  School Name                     300698 non-null  object 
 30  School Number                   300698 non-null  object 
 31  School Region                   300697 non-null  object 
 32  School Code                     300697 non-null  object 
 33  School Phone Number             300698 non-null  object 
 34  School Address                  300698 non-null  object 
 35  School City                     300698 non-null  object 
 36  School State                    300698 non-null  object 
 37  School Zip                      300697 non-null  object 
 38  School Not Found                300698 non-null  object 
 39  School or Citywide Complaint    0 non-null       float64
 40  Vehicle Type                    0 non-null       float64
 41  Taxi Company Borough            0 non-null       float64
 42  Taxi Pick Up Location           0 non-null       float64
 43  Bridge Highway Name             243 non-null     object 
 44  Bridge Highway Direction        243 non-null     object 
 45  Road Ramp                       213 non-null     object 
 46  Bridge Highway Segment          213 non-null     object 
 47  Garage Lot Name                 0 non-null       float64
 48  Ferry Direction                 1 non-null       object 
 49  Ferry Terminal Name             2 non-null       object 
 50  Latitude                        297158 non-null  float64
 51  Longitude                       297158 non-null  float64
 52  Location                        297158 non-null  object 
dtypes: float64(10), int64(1), object(42)
memory usage: 121.6+ MB
```

In [7]:

```
# to findout number of null value in the respective column
df_311.isna().sum()
```

Out[7]:

```
Unique Key                          0
Created Date                        0
Closed Date                      2164
Agency                              0
Agency Name                         0
Complaint Type                      0
Descriptor                       5914
Location Type                     131
Incident Zip                     2615
Incident Address                44410
Street Name                     44410
Cross Street 1                  49279
Cross Street 2                  49779
Intersection Street 1          256840
Intersection Street 2          257336
Address Type                     2815
City                             2614
Landmark                       300349
Facility Type                    2171
Status                              0
Due Date                            3
Resolution Description              0
Resolution Action Updated Date   2187
Community Board                     0
Borough                             0
X Coordinate (State Plane)       3540
Y Coordinate (State Plane)       3540
Park Facility Name                  0
Park Borough                        0
School Name                         0
School Number                       0
School Region                       1
School Code                         1
School Phone Number                 0
School Address                      0
School City                         0
School State                        0
School Zip                          1
School Not Found                    0
School or Citywide Complaint   300698
Vehicle Type                   300698
Taxi Company Borough           300698
Taxi Pick Up Location          300698
Bridge Highway Name            300455
Bridge Highway Direction       300455
Road Ramp                      300485
Bridge Highway Segment         300485
Garage Lot Name                300698
Ferry Direction                300697
Ferry Terminal Name            300696
Latitude                         3540
Longitude                        3540
Location                         3540
dtype: int64
```

In [8]:

```
#Data Wrangling
#from info cell we found there are few non null values in columns from 39 to 49, drop function is used to remove these columns.
#axis=1 is for selecting columns, inplace=True for permanent change in dataframe df_311

df_311.drop(df_311.iloc[:,39:50],axis=1,inplace=True)
```

In [9]:

```
df_311.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 300698 entries, 0 to 300697
Data columns (total 42 columns):
 #   Column                          Non-Null Count   Dtype  
---  ------                          --------------   -----  
 0   Unique Key                      300698 non-null  int64  
 1   Created Date                    300698 non-null  object 
 2   Closed Date                     298534 non-null  object 
 3   Agency                          300698 non-null  object 
 4   Agency Name                     300698 non-null  object 
 5   Complaint Type                  300698 non-null  object 
 6   Descriptor                      294784 non-null  object 
 7   Location Type                   300567 non-null  object 
 8   Incident Zip                    298083 non-null  float64
 9   Incident Address                256288 non-null  object 
 10  Street Name                     256288 non-null  object 
 11  Cross Street 1                  251419 non-null  object 
 12  Cross Street 2                  250919 non-null  object 
 13  Intersection Street 1           43858 non-null   object 
 14  Intersection Street 2           43362 non-null   object 
 15  Address Type                    297883 non-null  object 
 16  City                            298084 non-null  object 
 17  Landmark                        349 non-null     object 
 18  Facility Type                   298527 non-null  object 
 19  Status                          300698 non-null  object 
 20  Due Date                        300695 non-null  object 
 21  Resolution Description          300698 non-null  object 
 22  Resolution Action Updated Date  298511 non-null  object 
 23  Community Board                 300698 non-null  object 
 24  Borough                         300698 non-null  object 
 25  X Coordinate (State Plane)      297158 non-null  float64
 26  Y Coordinate (State Plane)      297158 non-null  float64
 27  Park Facility Name              300698 non-null  object 
 28  Park Borough                    300698 non-null  object 
 29  School Name                     300698 non-null  object 
 30  School Number                   300698 non-null  object 
 31  School Region                   300697 non-null  object 
 32  School Code                     300697 non-null  object 
 33  School Phone Number             300698 non-null  object 
 34  School Address                  300698 non-null  object 
 35  School City                     300698 non-null  object 
 36  School State                    300698 non-null  object 
 37  School Zip                      300697 non-null  object 
 38  School Not Found                300698 non-null  object 
 39  Latitude                        297158 non-null  float64
 40  Longitude                       297158 non-null  float64
 41  Location                        297158 non-null  object 
dtypes: float64(5), int64(1), object(36)
memory usage: 96.4+ MB
```

In [10]:

```
df_311.columns
```

Out[10]:

```
Index(['Unique Key', 'Created Date', 'Closed Date', 'Agency', 'Agency Name',
       'Complaint Type', 'Descriptor', 'Location Type', 'Incident Zip',
       'Incident Address', 'Street Name', 'Cross Street 1', 'Cross Street 2',
       'Intersection Street 1', 'Intersection Street 2', 'Address Type',
       'City', 'Landmark', 'Facility Type', 'Status', 'Due Date',
       'Resolution Description', 'Resolution Action Updated Date',
       'Community Board', 'Borough', 'X Coordinate (State Plane)',
       'Y Coordinate (State Plane)', 'Park Facility Name', 'Park Borough',
       'School Name', 'School Number', 'School Region', 'School Code',
       'School Phone Number', 'School Address', 'School City', 'School State',
       'School Zip', 'School Not Found', 'Latitude', 'Longitude', 'Location'],
      dtype='object')
```

In [11]:

```
#By analysis, these columns assigned in variable are not required for insights,hence these can be eliminated
del_col=['Incident Zip','Incident Address','Street Name','Cross Street 1','Cross Street 2','Intersection Street 1',
         'Intersection Street 2','Address Type','Landmark','Resolution Description','Resolution Action Updated Date',
         'Community Board','X Coordinate (State Plane)','Y Coordinate (State Plane)','Park Facility Name','Park Borough',
         'School Name', 'School Number', 'School Region', 'School Code','School Phone Number','School Address', 'School City',
         'School State','School Zip','School Not Found']
```

In [12]:

```
#Removing columns mentioned in del_col using drop method
df_311.drop(del_col,axis=1,inplace = True)
```

In [13]:

```
df_311.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 300698 entries, 0 to 300697
Data columns (total 16 columns):
 #   Column          Non-Null Count   Dtype  
---  ------          --------------   -----  
 0   Unique Key      300698 non-null  int64  
 1   Created Date    300698 non-null  object 
 2   Closed Date     298534 non-null  object 
 3   Agency          300698 non-null  object 
 4   Agency Name     300698 non-null  object 
 5   Complaint Type  300698 non-null  object 
 6   Descriptor      294784 non-null  object 
 7   Location Type   300567 non-null  object 
 8   City            298084 non-null  object 
 9   Facility Type   298527 non-null  object 
 10  Status          300698 non-null  object 
 11  Due Date        300695 non-null  object 
 12  Borough         300698 non-null  object 
 13  Latitude        297158 non-null  float64
 14  Longitude       297158 non-null  float64
 15  Location        297158 non-null  object 
dtypes: float64(2), int64(1), object(13)
memory usage: 36.7+ MB
```

In [14]:

```
df_311.isna().sum()
```

Out[14]:

```
Unique Key           0
Created Date         0
Closed Date       2164
Agency               0
Agency Name          0
Complaint Type       0
Descriptor        5914
Location Type      131
City              2614
Facility Type     2171
Status               0
Due Date             3
Borough              0
Latitude          3540
Longitude         3540
Location          3540
dtype: int64
```

In [15]:

```
#New dataframe to retain open case for further insight.
df_311_Open=pd.DataFrame(df_311)
```

In [16]:

```
df_311.dropna(subset=['Closed Date','Descriptor','Location Type','City','Facility Type','Latitude','Longitude','Location'],inplace
=True)
```

In [17]:

```
df_311.isna().sum()
```

Out[17]:

```
Unique Key        0
Created Date      0
Closed Date       0
Agency            0
Agency Name       0
Complaint Type    0
Descriptor        0
Location Type     0
City              0
Facility Type     0
Status            0
Due Date          0
Borough           0
Latitude          0
Longitude         0
Location          0
dtype: int64
```

In [18]:

```
df_311['City']=df_311['City'].str.upper()
df_311['Borough']=df_311['Borough'].str.upper()
```

In [19]:

```
df_311.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 291105 entries, 0 to 300697
Data columns (total 16 columns):
 #   Column          Non-Null Count   Dtype  
---  ------          --------------   -----  
 0   Unique Key      291105 non-null  int64  
 1   Created Date    291105 non-null  object 
 2   Closed Date     291105 non-null  object 
 3   Agency          291105 non-null  object 
 4   Agency Name     291105 non-null  object 
 5   Complaint Type  291105 non-null  object 
 6   Descriptor      291105 non-null  object 
 7   Location Type   291105 non-null  object 
 8   City            291105 non-null  object 
 9   Facility Type   291105 non-null  object 
 10  Status          291105 non-null  object 
 11  Due Date        291105 non-null  object 
 12  Borough         291105 non-null  object 
 13  Latitude        291105 non-null  float64
 14  Longitude       291105 non-null  float64
 15  Location        291105 non-null  object 
dtypes: float64(2), int64(1), object(13)
memory usage: 37.8+ MB
```

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.

In [20]:

```
# As seen in df_311.info, Dtype of Created Date and Closed Date is object type and same to be changed to date_time format
#This can be done using to_datetime function from pandas
df_311['Created Date']=pd.to_datetime(df_311['Created Date'])
```

In [21]:

```
df_311['Closed Date']=pd.to_datetime(df_311['Closed Date'])
```

In [22]:

```
df_311.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 291105 entries, 0 to 300697
Data columns (total 16 columns):
 #   Column          Non-Null Count   Dtype         
---  ------          --------------   -----         
 0   Unique Key      291105 non-null  int64         
 1   Created Date    291105 non-null  datetime64[ns]
 2   Closed Date     291105 non-null  datetime64[ns]
 3   Agency          291105 non-null  object        
 4   Agency Name     291105 non-null  object        
 5   Complaint Type  291105 non-null  object        
 6   Descriptor      291105 non-null  object        
 7   Location Type   291105 non-null  object        
 8   City            291105 non-null  object        
 9   Facility Type   291105 non-null  object        
 10  Status          291105 non-null  object        
 11  Due Date        291105 non-null  object        
 12  Borough         291105 non-null  object        
 13  Latitude        291105 non-null  float64       
 14  Longitude       291105 non-null  float64       
 15  Location        291105 non-null  object        
dtypes: datetime64[ns](2), float64(2), int64(1), object(11)
memory usage: 37.8+ MB
```

In [23]:

```
# creating a new column ‘Request_Closing_Time’ as the time elapsed between request creation and request closing.
df_311['Request_Closing_Time']=df_311['Closed Date']-df_311['Created Date']
```

In [24]:

```
df_311[['Closed Date','Created Date','Request_Closing_Time']]
```

Out[24]:

	Closed Date	Created Date	Request_Closing_Time
0	2016-01-01 00:55:00	2015-12-31 23:59:45	00:55:15
1	2016-01-01 01:26:00	2015-12-31 23:59:44	01:26:16
2	2016-01-01 04:51:00	2015-12-31 23:59:29	04:51:31
3	2016-01-01 07:43:00	2015-12-31 23:57:46	07:45:14
4	2016-01-01 03:24:00	2015-12-31 23:56:58	03:27:02
...	...	...	...
300692	2015-03-29 01:13:01	2015-03-29 00:34:32	00:38:29
300694	2015-03-29 02:33:59	2015-03-29 00:33:28	02:00:31
300695	2015-03-29 03:40:20	2015-03-29 00:33:03	03:07:17
300696	2015-03-29 04:38:35	2015-03-29 00:33:02	04:05:33
300697	2015-03-29 04:41:50	2015-03-29 00:33:01	04:08:49

291105 rows × 3 columns

Above table shown outputs the time taken to close the complaint once opened.

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.

a.From the data analysis, Complaint type is important input and different types & counts of complaints received is found below

In [25]:

```
df_311_comp_count=df_311['Complaint Type'].value_counts().reset_index()
df_311_comp_count.rename(columns={'index':'Complaint Type', 'Complaint Type':'Count'},inplace=True)
df_311_comp_count.head()
```

Out[25]:

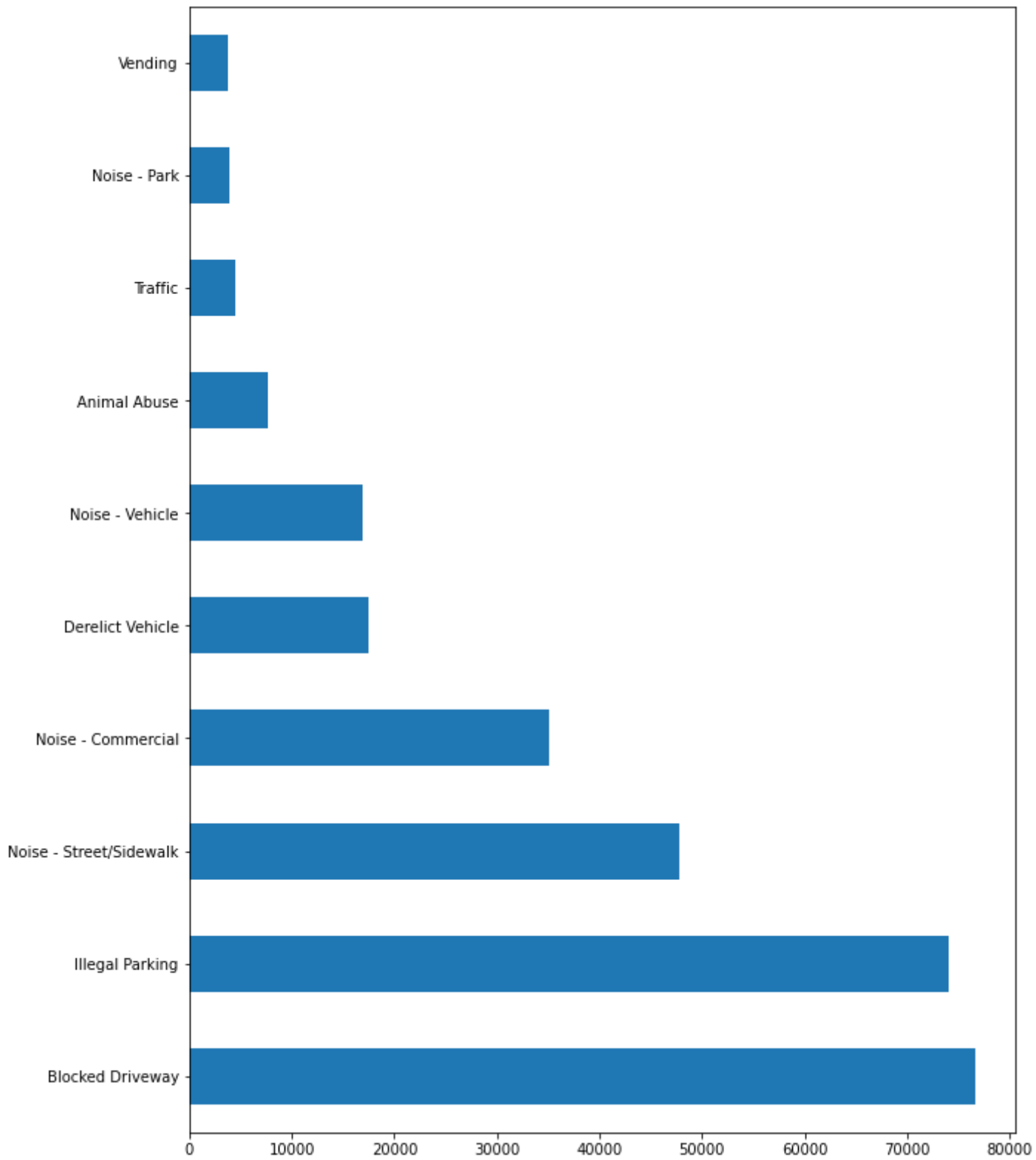
	Complaint Type	Count
0	Blocked Driveway	76676
1	Illegal Parking	74021
2	Noise - Street/Sidewalk	47745
3	Noise - Commercial	35145
4	Derelict Vehicle	17506

In [26]:

```
plt.figure(figsize=(10,14))
df_311['Complaint Type'].value_counts()[:10].plot.barh()
```

Out[26]:

<AxesSubplot:>



In [27]:

```
df_311_bloc=df_311[df_311['Complaint Type']=='Blocked Driveway']['Location Type'].reset_index()
```

In [28]:

```
df_311_bloc['Location Type'].value_counts()
```

Out[28]:

```
Street/Sidewalk    76676
Name: Location Type, dtype: int64
```

Conclusion: As osbserved from the dataframe and graph, maximum complaints received on blocked driveway and illegal parking with blocked driveway the most. All complaints on blocked driveway were related to street/sidewalk.

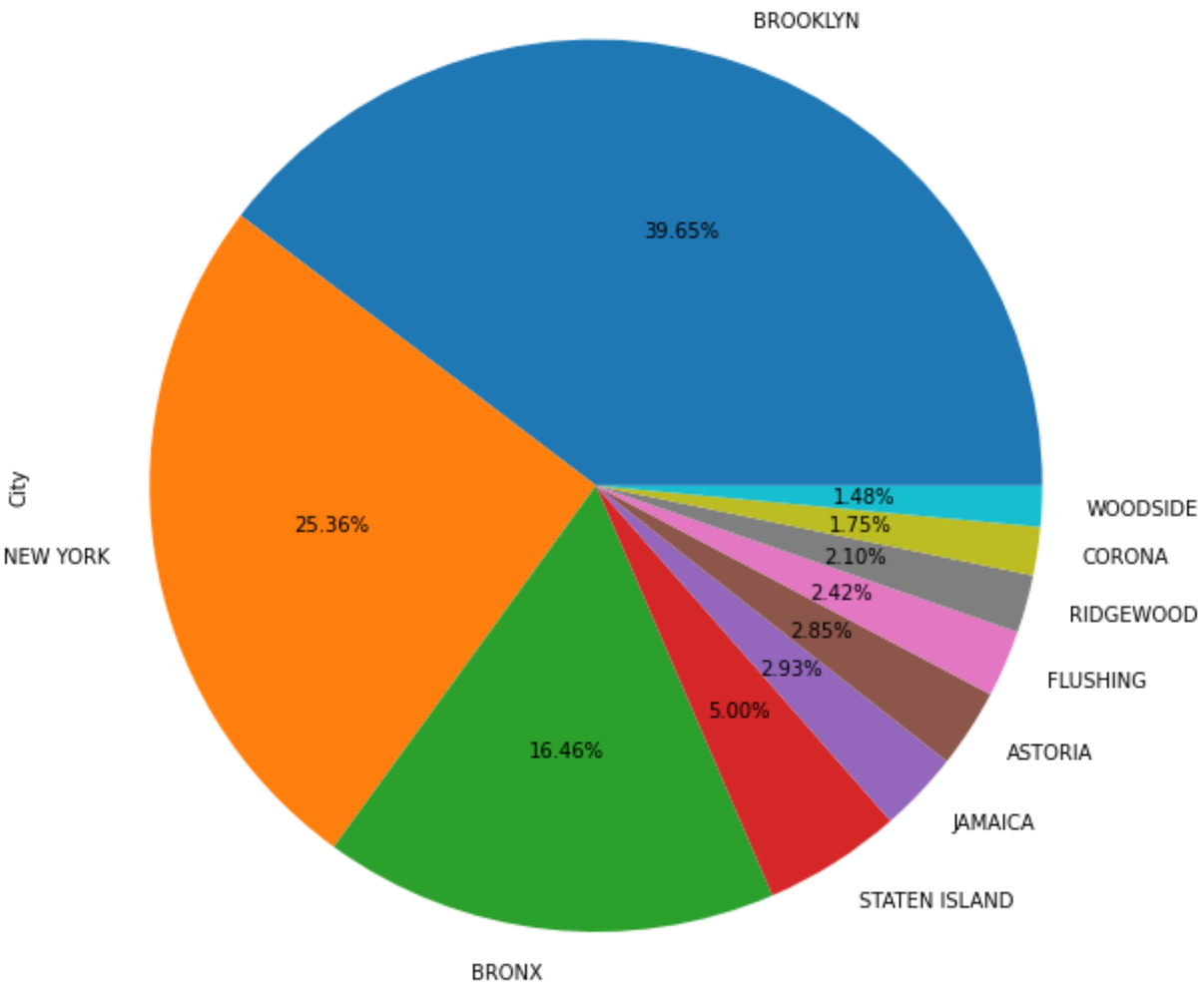
b.Top 10 city from where most complaints received

In [29]:

```
plt.figure(figsize=(10,15))
df_311['City'].value_counts()[:10].plot.pie(autopct="%0.2f%%")
#Pieplot outputs City in % with autopct set to 0.2f represent 2 decimal number
```

Out[29]:

```
<AxesSubplot:ylabel='City'>
```



Conclusion: City Brooklyn raised more complaints than anyother city followed by Newyork city.

c. From top complaints of different types, finding the count received from different borough

In [30]:

```
comp_max = ['Blocked Driveway','Illegal Parking','Noise - Commercial','Noise - Street/Sidewalk','Derelict Vehicle','Animal Abuse']
comp_city = df_311.groupby(['Borough','Complaint Type']).size().unstack()
comp_city = comp_city[comp_max]
comp_city
```

Out[30]:

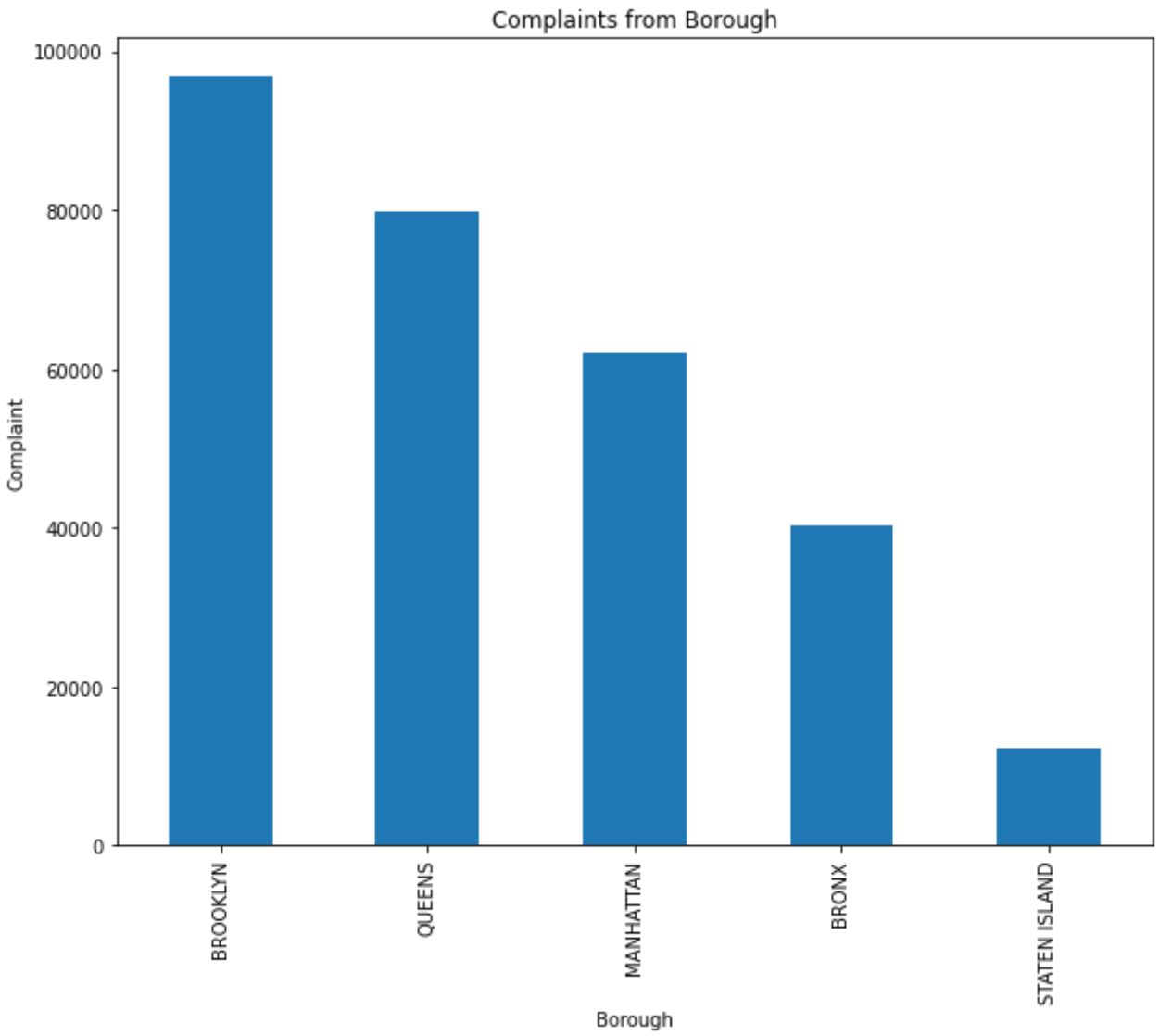
Complaint Type Borough	Blocked Driveway	Illegal Parking	Noise - Commercial	Noise - Street/Sidewalk	Derelict Vehicle	Animal Abuse
BRONX	12740	7829	2431	8864	1948	1411
BROOKLYN	28119	27386	11451	13315	5164	2390
MANHATTAN	2055	11981	14529	20360	530	1511
QUEENS	31621	21944	6057	4391	8102	1874
STATEN ISLAND	2141	4881	677	815	1762	557

In [31]:

```
plt.figure(figsize=(10,8))
df_311['Borough'].value_counts()[:6].plot.bar()
plt.xlabel('Borough')
plt.ylabel('Complaint')
plt.title('Complaints from Borough')
```

Out[31]:

```
Text(0.5, 1.0, 'Complaints from Borough')
```



Conclusion: As per observation by Borough, Brooklyn raised more complaints than anyother city followed by Queen and least my State Island

d. From data received, to find out request open and closed with complaint type.

In [32]:

```
df_311.groupby(['Location Type','Complaint Type']).size().unstack().fillna(0)[:10]
```

Out[32]:

Complaint Type	Animal Abuse	Blocked Driveway	Derelict Vehicle	Disorderly Youth	Drinking	Graffiti	Illegal Parking	Noise - Commercial	Noise - House of Worship	Noise - Park	Noise - Street/Sidewalk	Noise - Vehicle	Ac
Location Type													
Club/Bar/Restaurant	0.0	0.0	0.0	0.0	365.0	0.0	0.0	16808.0	0.0	0.0	0.0	0.0	
Commercial	62.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Highway	0.0	0.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
House and Store	93.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
House of Worship	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	920.0	0.0	0.0	0.0	
Park/Playground	120.0	0.0	0.0	0.0	96.0	0.0	0.0	0.0	0.0	3927.0	0.0	0.0	
Parking Lot	109.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Residential Building	226.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Residential Building/House	5075.0	0.0	0.0	77.0	289.0	56.0	0.0	0.0	0.0	0.0	0.0	0.0	
Roadway Tunnel	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

In [33]:

```
df_311_Open['Status'].value_counts()
```

Out[33]:

```
Closed      298471
Open          1439
Assigned       786
Draft            2
Name: Status, dtype: int64
```

In [34]:

```
df_311_Open['New_Status']=['Open' if x==('Open'or'Assigned' or 'Draft') else 'Closed' for x in df_311_Open['Status']]
df_311_Open['New_Status'].value_counts()
```

Out[34]:

```
Closed    299259
Open        1439
Name: New_Status, dtype: int64
```

In [35]:

```
#Sorted complaints still open based on type
Comp_type_sts=df_311_Open.groupby(['Complaint Type','New_Status']).size().unstack()
Comp_type_sts=pd.DataFrame(Comp_type_sts['Open'].fillna(0).sort_values(ascending=False))
Comp_type_sts
```

Out[35]:

Complaint Type	Open
Illegal Parking	589.0
Noise - Street/Sidewalk	342.0
Noise - Commercial	176.0
Blocked Driveway	152.0
Derelict Vehicle	106.0
Noise - Vehicle	31.0
Noise - Park	10.0
Animal Abuse	8.0
Vending	6.0
Drinking	5.0
Traffic	3.0
Posting Advertisement	2.0
Homeless Encampment	2.0
Bike/Roller/Skate Chronic	2.0
Ferry Complaint	2.0
Noise - House of Worship	2.0
Panhandling	1.0
Animal in a Park	0.0
Illegal Fireworks	0.0
Disorderly Youth	0.0
Graffiti	0.0
Urinating in Public	0.0
Squeegee	0.0
Agency Issues	0.0

Conclusion: Maximum cases of illegal parking are open eventhough blocked driveway complaint received more.By this, NYPD is doing good job in unblocking driveway whereas they have to focus into open cases of illegal parking as well as Noise - Street/Sidewalk.

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

In [36]:

```
#Grouping the columns by complaint type and location type to find average request closing time by considering aggregation method.
Avg_T=df_311.groupby(['Complaint Type','Location Type'])['Request_Closing_Time'].agg(['sum','count']).reset_index()
Avg_T['Avg_Req_Close_Time']=Avg_T['sum']/Avg_T['count']
```

In [37]:

```
df_comp_order=Avg_T.rename(columns={'sum':'Total_time','count':'Complaint_Count_Loc'})
df_comp_order
```

Out[37]:

	Complaint Type	Location Type	Total_time	Complaint_Count_Loc	Avg_Req_Close_Time
0	Animal Abuse	Commercial	13 days 19:15:06	62	05:20:33.967741
1	Animal Abuse	House and Store	19 days 10:14:00	93	05:00:47.741935
2	Animal Abuse	Park/Playground	18 days 08:02:12	120	03:40:01.100000
3	Animal Abuse	Parking Lot	25 days 04:36:00	109	05:32:48.440366
4	Animal Abuse	Residential Building	45 days 10:41:31	226	04:49:33.853982
5	Animal Abuse	Residential Building/House	1140 days 06:36:34	5075	05:23:32.767290
6	Animal Abuse	Store/Commercial	92 days 17:24:58	520	04:16:46.726923
7	Animal Abuse	Street/Sidewalk	323 days 22:18:38	1516	05:07:41.423482
8	Animal Abuse	Subway Station	2 days 18:47:00	22	03:02:08.181818
9	Blocked Driveway	Street/Sidewalk	15136 days 20:44:55	76676	04:44:16.511750
10	Derelict Vehicle	Highway	4 days 10:32:39	13	08:11:44.538461
11	Derelict Vehicle	Roadway Tunnel	3 days 17:49:15	5	17:57:51
12	Derelict Vehicle	Street/Sidewalk	5327 days 03:04:57	17411	07:20:35.236172
13	Derelict Vehicle	Vacant Lot	23 days 23:29:32	77	07:28:26.129870
14	Disorderly Youth	Residential Building/House	12 days 08:47:41	77	03:51:16.116883
15	Disorderly Youth	Store/Commercial	0 days 22:42:57	8	02:50:22.125000
16	Disorderly Youth	Street/Sidewalk	29 days 01:36:06	200	03:29:16.830000
17	Drinking	Club/Bar/Restaurant	69 days 03:13:17	365	04:32:44.923287
18	Drinking	Park/Playground	13 days 10:11:56	96	03:21:22.458333
19	Drinking	Residential Building/House	44 days 07:01:24	289	03:40:41.813148
20	Drinking	Store/Commercial	12 days 04:44:01	90	03:15:09.344444
21	Drinking	Street/Sidewalk	65 days 01:28:25	430	03:37:52.802325
22	Graffiti	Residential Building/House	13 days 17:12:46	56	05:52:43.678571
23	Graffiti	Store/Commercial	7 days 09:56:26	32	05:33:38.312500
24	Graffiti	Street/Sidewalk	12 days 12:56:17	25	12:02:15.080000
25	Illegal Parking	Street/Sidewalk	13827 days 21:36:03	74021	04:29:00.427216
26	Noise - Commercial	Club/Bar/Restaurant	2144 days 18:03:11	16808	03:03:44.904271
27	Noise - Commercial	Store/Commercial	2449 days 05:35:16	18337	03:12:20.258275
28	Noise - House of Worship	House of Worship	122 days 15:46:27	920	03:11:59.116304
29	Noise - Park	Park/Playground	556 days 18:17:01	3927	03:24:09.610644
30	Noise - Street/Sidewalk	Street/Sidewalk	6846 days 15:11:40	47745	03:26:29.760184
31	Noise - Vehicle	Street/Sidewalk	2527 days 14:35:04	16867	03:35:47.489417
32	Posting Advertisement	Parking Lot	0 days 14:48:37	7	02:06:56.714285
33	Posting Advertisement	Residential Building/House	8 days 02:25:39	54	03:36:01.833333
34	Posting Advertisement	Store/Commercial	0 days 14:12:54	6	02:22:09
35	Posting Advertisement	Street/Sidewalk	43 days 23:00:58	580	01:49:08.375862
36	Traffic	Highway	25 days 23:48:51	184	03:23:25.059782
37	Traffic	Roadway Tunnel	2 days 15:08:04	29	02:10:37.379310
38	Traffic	Street/Sidewalk	613 days 16:33:10	4254	03:27:44.219558
39	Vending	Park/Playground	14 days 21:53:19	103	03:28:28.728155
40	Vending	Residential Building/House	35 days 03:36:50	201	04:11:49.502487
41	Vending	Store/Commercial	71 days 12:41:53	432	03:58:25.817129
42	Vending	Street/Sidewalk	509 days 02:08:02	3037	04:01:23.135330

In [38]:

```
df_comp_order[df_comp_order['Complaint Type']=='Vending']
```

Out[38]:

	Complaint Type	Location Type	Total_time	Complaint_Count_Loc	Avg_Req_Close_Time
39	Vending	Park/Playground	14 days 21:53:19	103	03:28:28.728155
40	Vending	Residential Building/House	35 days 03:36:50	201	04:11:49.502487
41	Vending	Store/Commercial	71 days 12:41:53	432	03:58:25.817129
42	Vending	Street/Sidewalk	509 days 02:08:02	3037	04:01:23.135330

In [39]:

```
#Since many complaint received from same location there are duplicates , so location by cordinates will have less rows calculation average
df_311.duplicated(['Location']).value_counts()
```

Out[39]:

```
True     167180
False    123925
dtype: int64
```

In [40]:

```
df_311_loc=df_311.groupby(['Location','Complaint Type','City'])['Request_Closing_Time'].agg({'sum','count'}).reset_index()
df_311_loc['Avg_Req_Close_Time']=df_311_loc['sum']/df_311_loc['count']
df_311_loc.rename(columns=({'Location':'Location_by_coordinates','count':'Complaint_count_loc','sum':'Total_Time_Cls'}),inplace=True)
df_311_loc.sort_values('Complaint Type',ascending=True)
```

Out[40]:

	Location_by_coordinates	Complaint Type	City	Complaint_count_loc	Total_Time_Cls	Avg_Req_Close_Time
111216	(40.772844017618496, -73.94783337202271)	Animal Abuse	NEW YORK	1	02:38:00	02:38:00
109632	(40.76903689089537, -73.91521466252065)	Animal Abuse	ASTORIA	1	04:58:41	04:58:41
40942	(40.669761708316564, -73.93660568292005)	Animal Abuse	BROOKLYN	1	03:38:05	03:38:05
65016	(40.69948417076257, -73.9181341608447)	Animal Abuse	BROOKLYN	1	01:18:26	01:18:26
65019	(40.69949132674228, -73.77943084483749)	Animal Abuse	JAMAICA	1	00:48:00	00:48:00
...	...	...	...	...	...	...
43021	(40.67318266749815, -74.00260641636596)	Vending	BROOKLYN	1	00:36:38	00:36:38
108012	(40.76602954830418, -73.99496040160967)	Vending	NEW YORK	1	00:26:00	00:26:00
69325	(40.70579324370505, -74.00387005930732)	Vending	NEW YORK	1	00:09:00	00:09:00
107913	(40.76588240978881, -73.97976223037516)	Vending	NEW YORK	1	06:00:00	06:00:00
77834	(40.718144572527, -73.99382768071642)	Vending	NEW YORK	2	03:40:20	01:50:10

147504 rows × 6 columns

In [41]:

```
df_311_loc.sort_values('Complaint Type',ascending=True)
```

Out[41]:

	Location_by_coordinates	Complaint Type	City	Complaint_count_loc	Total_Time_Cls	Avg_Req_Close_Time
111216	(40.772844017618496, -73.94783337202271)	Animal Abuse	NEW YORK	1	02:38:00	02:38:00
109632	(40.76903689089537, -73.91521466252065)	Animal Abuse	ASTORIA	1	04:58:41	04:58:41
40942	(40.669761708316564, -73.93660568292005)	Animal Abuse	BROOKLYN	1	03:38:05	03:38:05
65016	(40.69948417076257, -73.9181341608447)	Animal Abuse	BROOKLYN	1	01:18:26	01:18:26
65019	(40.69949132674228, -73.77943084483749)	Animal Abuse	JAMAICA	1	00:48:00	00:48:00
...	...	...	...	...	...	...
43021	(40.67318266749815, -74.00260641636596)	Vending	BROOKLYN	1	00:36:38	00:36:38
108012	(40.76602954830418, -73.99496040160967)	Vending	NEW YORK	1	00:26:00	00:26:00
69325	(40.70579324370505, -74.00387005930732)	Vending	NEW YORK	1	00:09:00	00:09:00
107913	(40.76588240978881, -73.97976223037516)	Vending	NEW YORK	1	06:00:00	06:00:00
77834	(40.718144572527, -73.99382768071642)	Vending	NEW YORK	2	03:40:20	01:50:10

147504 rows × 6 columns

5 Perform a statistical test for the following:Please note: For the below statements you need to state the Null and Alternate and then provide a statistical test to accept or reject #the Null Hypothesis along with the corresponding 'p-value'.#Whether the average response time across complaint types is similar or not (overall) #Are the type of complaint or service requested and location related?

In [42]:

```
df_311['Request_Closing_Time'].value_counts()
```

Out[42]:

```
00:36:00    480
00:51:00    463
00:44:00    462
00:32:00    455
00:46:00    453
           ...
19:53:09      1
07:45:17      1
07:38:11      1
06:24:28      1
12:12:46      1
Name: Request_Closing_Time, Length: 47131, dtype: int64
```

In [43]:

```
#Convert time to minute format for all
df_311['Req_Close_Min']= df_311['Request_Closing_Time'].astype('timedelta64[m]')+1
df_311[['Request_Closing_Time','Req_Close_Min']].head()
```

Out[43]:

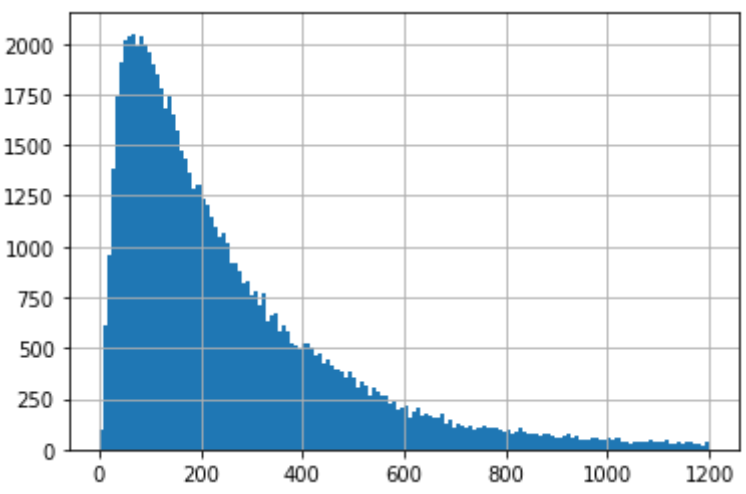
	Request_Closing_Time	Req_Close_Min
0	00:55:15	56.0
1	01:26:16	87.0
2	04:51:31	292.0
3	07:45:14	466.0
4	03:27:02	208.0

In [44]:

```
#consider complaint of blocked driveway
df_311_dist= df_311[df_311['Complaint Type']=='Blocked Driveway']['Req_Close_Min']
df_311_dist.hist(bins=150,range=(0,1200))
# we can see there is positive skewness and many outliers and we can limit to 1200
```

Out[44]:

```
<AxesSubplot:>
```



In [45]:

```
df_311_dist.describe()
```

Out[45]:

```
count    76676.000000
mean       284.969039
std        334.324277
min          3.000000
25%         97.000000
50%        190.000000
75%        359.000000
max       8898.000000
Name: Req_Close_Min, dtype: float64
```

In [46]:

```
#to remove skewness will perform log transformation
df_comp_keys = {}
for x in df_311['Complaint Type'].unique():
    df_comp_keys[x] = np.log(df_311[df_311['Complaint Type']==x]['Req_Close_Min'])
df_comp_keys.keys()
```

Out[46]:

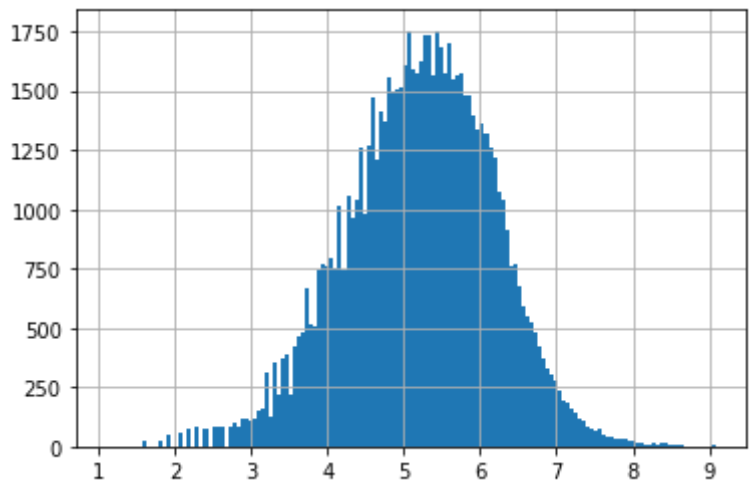
```
dict_keys(['Noise - Street/Sidewalk', 'Blocked Driveway', 'Illegal Parking', 'Derelict Vehicle', 'Noise - Commercia
l', 'Noise - House of Worship', 'Posting Advertisement', 'Noise - Vehicle', 'Animal Abuse', 'Vending', 'Traffic', 'Dr
inking', 'Noise - Park', 'Graffiti', 'Disorderly Youth'])
```

In [47]:

```
df_comp_keys['Blocked Driveway'].hist(bins=150)
```

Out[47]:

```
<AxesSubplot:>
```



In [48]:

```
Compl_std={}
for x in df_comp_keys.keys():
    Compl_std[x]=df_comp_keys[x].std()
df_1=Compl_std
df_1
```

Out[48]:

```
{'Noise - Street/Sidewalk': 1.088306637145675,
 'Blocked Driveway': 0.9690316373869476,
 'Illegal Parking': 1.067144017372268,
 'Derelict Vehicle': 1.2472516029661278,
 'Noise - Commercial': 1.074052018094978,
 'Noise - House of Worship': 1.1601294447020027,
 'Posting Advertisement': 1.1947703475310807,
 'Noise - Vehicle': 1.0640723492297113,
 'Animal Abuse': 1.035709417470126,
 'Vending': 1.0995431178584425,
 'Traffic': 1.1703694713267516,
 'Drinking': 1.0362177868265494,
 'Noise - Park': 1.1061328713039125,
 'Graffiti': 1.0581967861803852,
 'Disorderly Youth': 1.026822302225286}
```

>After log transformation blocked drivway with request time is normally distributed with removal of skewness

scipy is library of python to perform scientific calculation, here we are going to use ANOVA test(analysis of variance). To perform ANOVA , standard deviation should be same and normal distribution of curve which is seen above

In [49]:

```
from scipy.stats import f_oneway

stat, p = f_oneway(df_comp_keys['Noise - Street/Sidewalk'],df_comp_keys['Blocked Driveway'],df_comp_keys['Illegal Parking'],
                   df_comp_keys['Derelict Vehicle'],
                   df_comp_keys['Noise - Commercial'])
print('Statistics=%.3f, p=%.3f' % (stat, p))
```

```
Statistics=2455.209, p=0.000
```

Null Hypothesis: Average response time for all the complaints type is same.

Alternate Hypothesis: Average response time for all the complaints type is not same and theres is some difference among the groups.

Below We conduct ANOVA test for top 5 type of complaints For a 95% of confidence interval we choose our alpha as 0.05 for 5% Alpha(0.05) is the critical p-value, if our calculated p-value is less than alpha, it will give us strong evidence to reject Null Hypothesis.

if p < alpha(0.05) : Reject Null Hypothesis, Average response time for all the complaints type is not same.

if p > alpha(0.05) : Fail to reject Null Hypothesis, Average response time for all the complaints type is same.

In [50]:

```
# import f_oneway from scipy.stats library
from scipy.stats import f_oneway

stat, p = f_oneway(df_comp_keys['Noise - Street/Sidewalk'],df_comp_keys['Blocked Driveway'],df_comp_keys['Illegal Parking'],df_com
p_keys['Derelict Vehicle'],
                   df_comp_keys['Noise - Commercial'])
print('Statistics=%.3f, p=%.3f' % (stat, p))
# interpret
alpha = 0.05
if p > alpha:
    print('Same distributions (fail to reject H0)')
else:
    print('Different distributions (reject H0)')
```

```
Statistics=2455.209, p=0.000
Different distributions (reject H0)
```

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

In [51]:

```
#converting object to integer
s1 = df_311[['Longitude','Latitude']]
s_corr = df_311[['Complaint Type','Location Type','Borough','Longitude','Latitude','City']]

for x in s_corr:
    if x not in s1:
        s_corr[x]=s_corr[x].astype('category').cat.codes
s_corr.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 291105 entries, 0 to 300697
Data columns (total 6 columns):
 #   Column          Non-Null Count   Dtype
---  ------          --------------   -----
 0   Complaint Type  291105 non-null  int8
 1   Location Type   291105 non-null  int8
 2   Borough         291105 non-null  int8
 3   Longitude       291105 non-null  float64
 4   Latitude        291105 non-null  float64
 5   City            291105 non-null  int8
dtypes: float64(2), int8(4)
memory usage: 17.8 MB
```

In [52]:

```
s_corr.head()
```

Out[52]:

	Complaint Type	Location Type	Borough	Longitude	Latitude	City
0	10	11	2	-73.923501	40.865682	29
1	1	11	3	-73.915094	40.775945	1
2	1	11	0	-73.888525	40.870325	5
3	6	11	0	-73.828379	40.835994	5
4	6	11	3	-73.874170	40.733060	12

In [53]:

```
s_corr.corr()
```

Out[53]:

	Complaint Type	Location Type	Borough	Longitude	Latitude	City
Complaint Type	1.000000	-0.096244	-0.076875	-0.181780	0.170215	0.086666
Location Type	-0.096244	1.000000	-0.024143	0.069311	-0.027275	-0.043936
Borough	-0.076875	-0.024143	1.000000	0.022122	-0.250856	0.725402
Longitude	-0.181780	0.069311	0.022122	1.000000	0.368823	-0.119900
Latitude	0.170215	-0.027275	-0.250856	0.368823	1.000000	-0.015106
City	0.086666	-0.043936	0.725402	-0.119900	-0.015106	1.000000

Correlation ranges from -1 to +1, where -1 is strong negative correlation or inversely related, 1 as strong positive and 0 means there is no relation.

From above table,correlation value is near to zero and we can conclude there is no correlation between complaint type and Location.

In [ ]: