```
#Importing libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
sns.set()

from scipy import stats
from scipy.stats import chi2_contingency
import statsmodels.api as sm
from statsmodels.formula.api import ols

#Importing the dataset
df=pd.read_csv("311_Service_Requests_from_2010_to_Present.csv")
```

```
/tmp/ipykernel_39979/2134542247.py:2: DtypeWarning: Columns (48,49)
have mixed types. Specify dtype option on import or set
low_memory=False.
  df=pd.read_csv("311_Service_Requests_from_2010_to_Present.csv")
```

```
df.head()
```

```
   Unique Key            Created Date             Closed Date
Agency  \
0    32310363  12/31/2015 11:59:45 PM  01/01/2016 12:55:15 AM   NYPD

1    32309934  12/31/2015 11:59:44 PM  01/01/2016 01:26:57 AM   NYPD

2    32309159  12/31/2015 11:59:29 PM  01/01/2016 04:51:03 AM   NYPD

3    32305098  12/31/2015 11:57:46 PM  01/01/2016 07:43:13 AM   NYPD

4    32306529  12/31/2015 11:56:58 PM  01/01/2016 03:24:42 AM   NYPD


                      Agency Name           Complaint Type  \
0  New York City Police Department  Noise - Street/Sidewalk
1  New York City Police Department         Blocked Driveway
2  New York City Police Department         Blocked Driveway
3  New York City Police Department          Illegal Parking
4  New York City Police Department          Illegal Parking

                     Descriptor    Location Type  Incident Zip  \
0              Loud Music/Party  Street/Sidewalk       10034.0
1                     No Access  Street/Sidewalk       11105.0
2                     No Access  Street/Sidewalk       10458.0
3  Commercial Overnight Parking  Street/Sidewalk       10461.0
4              Blocked Sidewalk  Street/Sidewalk       11373.0

        Incident Address  ... Bridge Highway Name Bridge Highway
```

```
Direction  \
0    71 VERMILYEA AVENUE  ...                 NaN
NaN
1        27-07 23 AVENUE  ...                 NaN
NaN
2  2897 VALENTINE AVENUE  ...                 NaN
NaN
3    2940 BAISLEY AVENUE  ...                 NaN
NaN
4          87-14 57 ROAD  ...                 NaN
NaN

  Road Ramp Bridge Highway Segment Garage Lot Name Ferry Direction  \
0       NaN                     NaN              NaN             NaN
1       NaN                     NaN              NaN             NaN
2       NaN                     NaN              NaN             NaN
3       NaN                     NaN              NaN             NaN
4       NaN                     NaN              NaN             NaN

  Ferry Terminal Name   Latitude  Longitude  \
0                 NaN  40.865682 -73.923501
1                 NaN  40.775945 -73.915094
2                 NaN  40.870325 -73.888525
3                 NaN  40.835994 -73.828379
4                 NaN  40.733060 -73.874170

                                  Location
0   (40.86568153633767, -73.92350095571744)
1  (40.775945312321085, -73.91509393898605)
2  (40.870324522111424, -73.88852464418646)
3   (40.83599404683083, -73.82837939584206)
4  (40.733059618956815, -73.87416975810375)

[5 rows x 53 columns]
```

```
#Understanding the data
df.describe()
```

```
         Unique Key   Incident Zip  X Coordinate (State Plane)  \
count  3.645580e+05  361560.000000                3.605280e+05
mean   3.106595e+07   10858.496659                1.005043e+06
std    7.331531e+05     578.263114                2.196362e+04
min    2.960737e+07      83.000000                9.133570e+05
25%    3.049938e+07   10314.000000                9.919460e+05
50%    3.108795e+07   11209.000000                1.003470e+06
75%    3.167433e+07   11238.000000                1.019134e+06
max    3.231065e+07   11697.000000                1.067186e+06

       Y Coordinate (State Plane)  School or Citywide Complaint
Vehicle Type  \
```

```
count               360528.000000                          0.0
0.0
mean                203425.305782                          NaN
NaN
std                  29842.192857                          NaN
NaN
min                 121185.000000                          NaN
NaN
25%                 182945.000000                          NaN
NaN
50%                 201023.000000                          NaN
NaN
75%                 222790.000000                          NaN
NaN
max                 271876.000000                          NaN
NaN

       Taxi Company Borough  Taxi Pick Up Location  Garage Lot Name  \
count                    0.0                    0.0              0.0
mean                     NaN                    NaN              NaN
std                      NaN                    NaN              NaN
min                      NaN                    NaN              NaN
25%                      NaN                    NaN              NaN
50%                      NaN                    NaN              NaN
75%                      NaN                    NaN              NaN
max                      NaN                    NaN              NaN

            Latitude      Longitude
count  360528.000000  360528.000000
mean       40.724980     -73.924946
std         0.081907       0.079213
min        40.499040     -74.254937
25%        40.668742     -73.972253
50%        40.718406     -73.930643
75%        40.778166     -73.874098
max        40.912869     -73.700715
```

```
df.shape
```

```
(364558, 53)
```

```
#Conversion to datetime format
df["Created Date"]=pd.to_datetime(df["Created Date"])
df["Closed Date"]=pd.to_datetime(df["Closed Date"])

#Creating a new column 'Request_Closing_Time' as the time elapsed
between request creation and request closing
df["Request_Closing_Time"]=(df["Closed Date"]-df["Created Date"])
Request_Closing_Time=[]
for x in (df["Closed Date"]-df["Created Date"]):
    close=x.total_seconds()/60
```

```
    Request_Closing_Time.append(close)
df["Request_Closing_Time"]=Request_Closing_Time

df.head()
```

```
   Unique Key        Created Date         Closed Date Agency  \
0    32310363 2015-12-31 23:59:45 2016-01-01 00:55:15   NYPD
1    32309934 2015-12-31 23:59:44 2016-01-01 01:26:57   NYPD
2    32309159 2015-12-31 23:59:29 2016-01-01 04:51:03   NYPD
3    32305098 2015-12-31 23:57:46 2016-01-01 07:43:13   NYPD
4    32306529 2015-12-31 23:56:58 2016-01-01 03:24:42   NYPD

                      Agency Name           Complaint Type  \
0  New York City Police Department  Noise - Street/Sidewalk
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2  New York City Police Department         Blocked Driveway
3  New York City Police Department          Illegal Parking
4  New York City Police Department          Illegal Parking

                    Descriptor    Location Type  Incident Zip  \
0              Loud Music/Party  Street/Sidewalk       10034.0
1                    No Access  Street/Sidewalk       11105.0
2                    No Access  Street/Sidewalk       10458.0
3  Commercial Overnight Parking  Street/Sidewalk       10461.0
4              Blocked Sidewalk  Street/Sidewalk       11373.0

        Incident Address  ... Bridge Highway Direction Road Ramp  \
0    71 VERMILYEA AVENUE  ...                       NaN       NaN
1        27-07 23 AVENUE  ...                       NaN       NaN
2  2897 VALENTINE AVENUE  ...                       NaN       NaN
3    2940 BAISLEY AVENUE  ...                       NaN       NaN
4          87-14 57 ROAD  ...                       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
3                    NaN             NaN              NaN
NaN
4                    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  40.835994 -73.828379   (40.83599404683083, -73.82837939584206)
4  40.733060 -73.874170  (40.733059618956815, -73.87416975810375)

  Request_Closing_Time
0            55.500000
1            87.216667
2           291.566667
3           465.450000
4           207.733333

[5 rows x 54 columns]
```

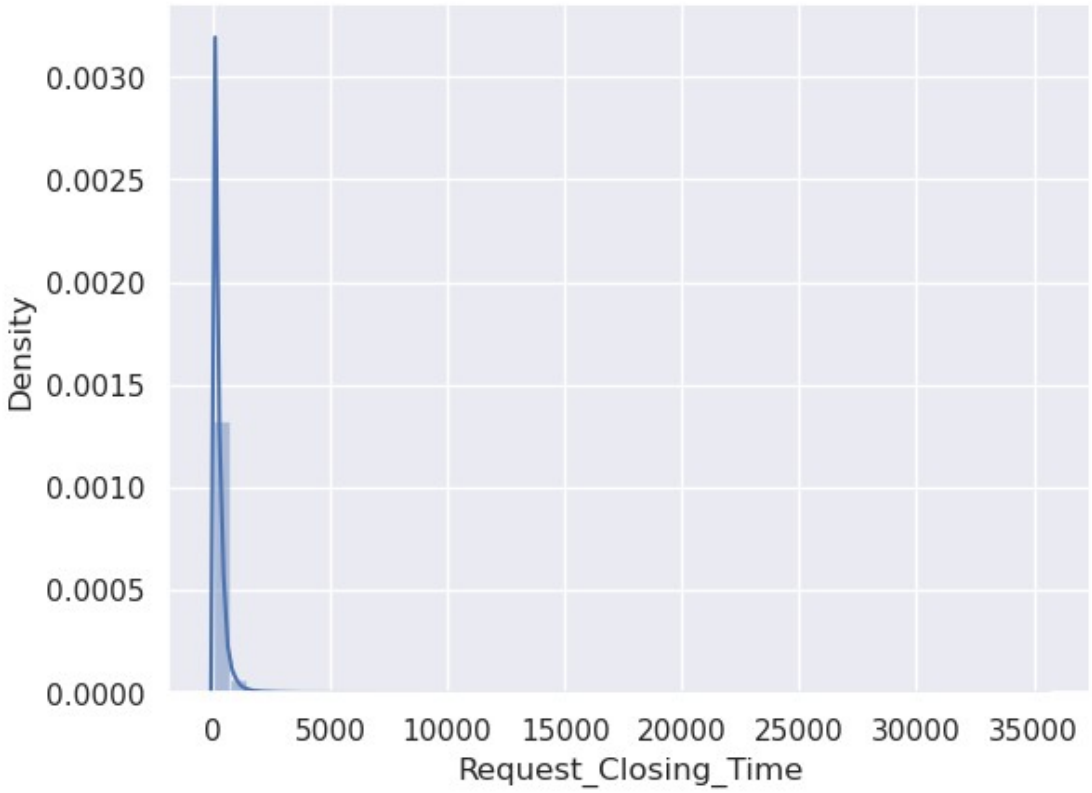
```
#EDA
df["Agency"].unique()
```

```
array(['NYPD'], dtype=object)
```

We can see the above data belongs to the NYPD.

```
sns.distplot(df["Request_Closing_Time"])
plt.show
```

```
/home/nemesis/anaconda3/lib/python3.9/site-packages/seaborn/
distributions.py:2619: FutureWarning: `distplot` is a deprecated
function and will be removed in a future version. Please adapt your
code to use either `displot` (a figure-level function with similar
flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)

<function matplotlib.pyplot.show(close=None, block=None)>
```




```
print("Total Number of Complaints : ",len(df),"\n")
print("Percentage of complaints that took 99 hours or less :
",round((len(df)-(df["Request_Closing_Time"]>=99).sum())/len(df)*100,2
),"%")
print("Percentage of complaints that took 999 hours or less :
",round((len(df)-(df["Request_Closing_Time"]>=999).sum())/len(df)*100,
2),"%")
```

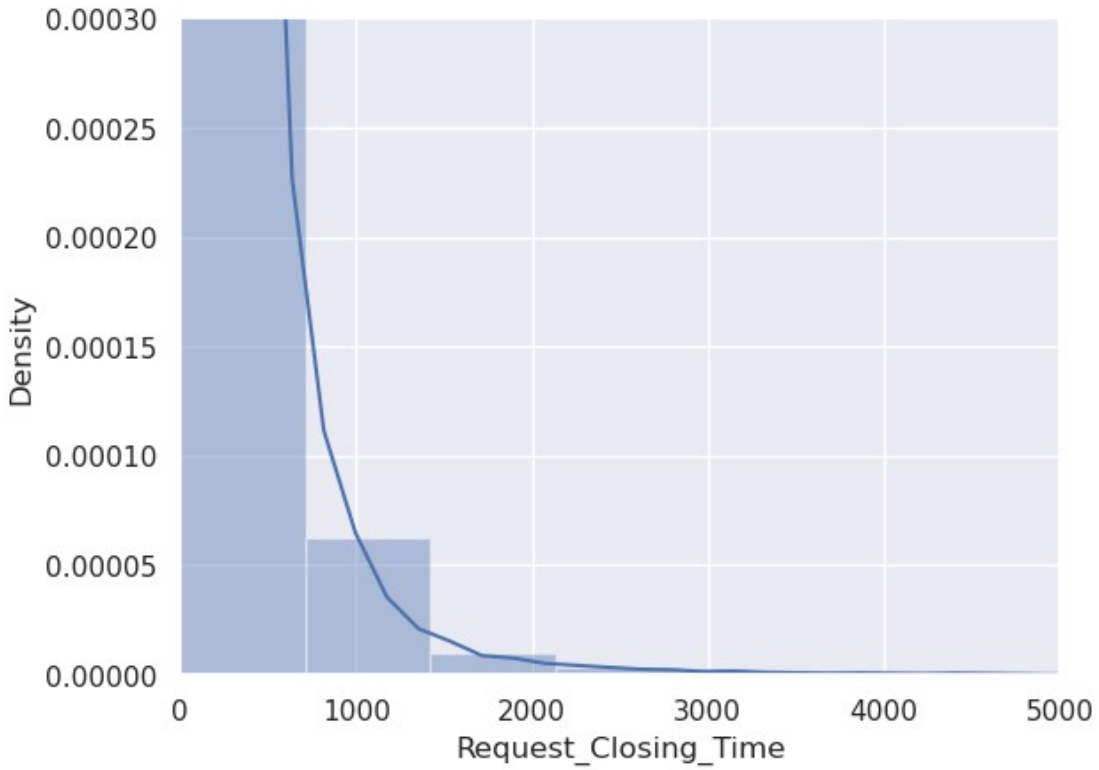
```
Total Number of Complaints :  364558

Percentage of complaints that took 99 hours or less :  33.32 %
Percentage of complaints that took 999 hours or less :  97.43 %
```

From the above data we can see that majority of the complaints needed more than 99 hours to be dealt with.

```
sns.distplot(df["Request_Closing_Time"])
plt.xlim((0,5000))
plt.ylim((0,0.0003))
plt.show()
```

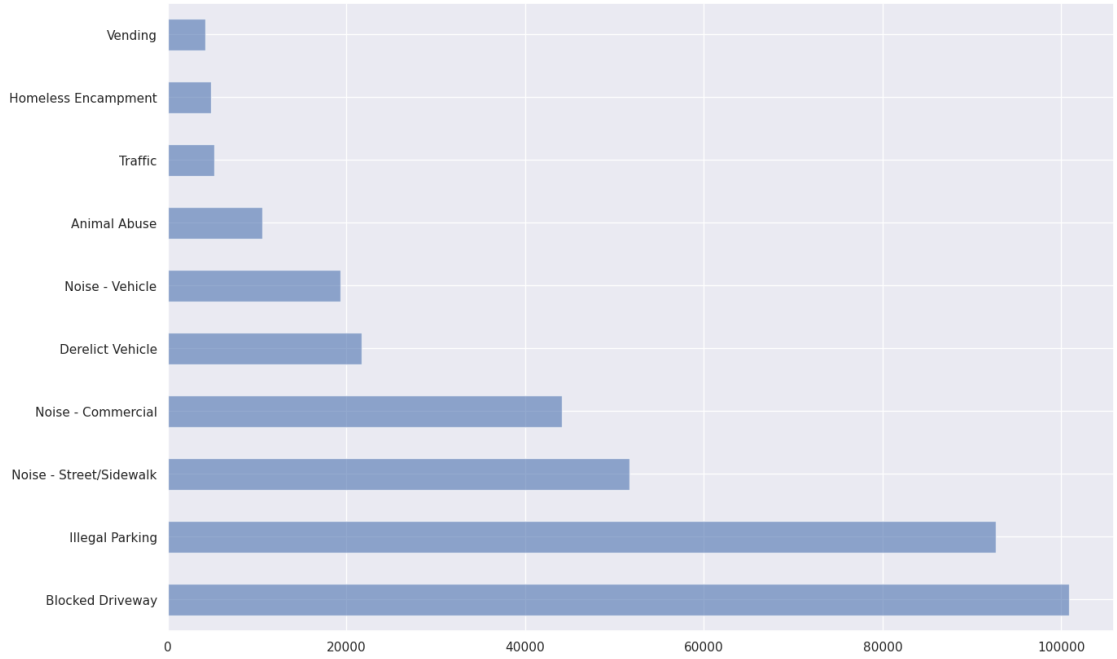
```
/home/nemesis/anaconda3/lib/python3.9/site-packages/seaborn/
distributions.py:2619: FutureWarning: `distplot` is a deprecated
function and will be removed in a future version. Please adapt your
code to use either `displot` (a figure-level function with similar
```

```
flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```



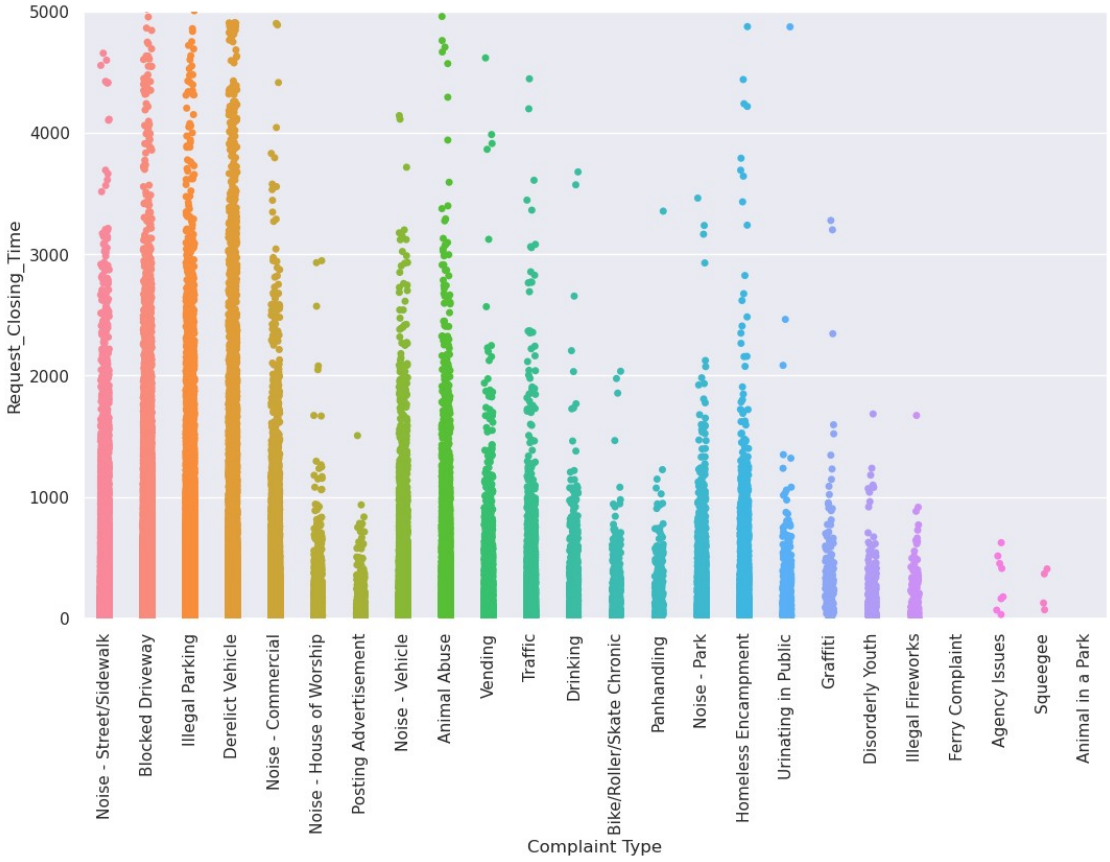
Now let us try to understand the major complaint types

```
df['Complaint Type'].value_counts()
[:10].plot(kind='barh',alpha=0.6,figsize=(15,10))
plt.show()
```



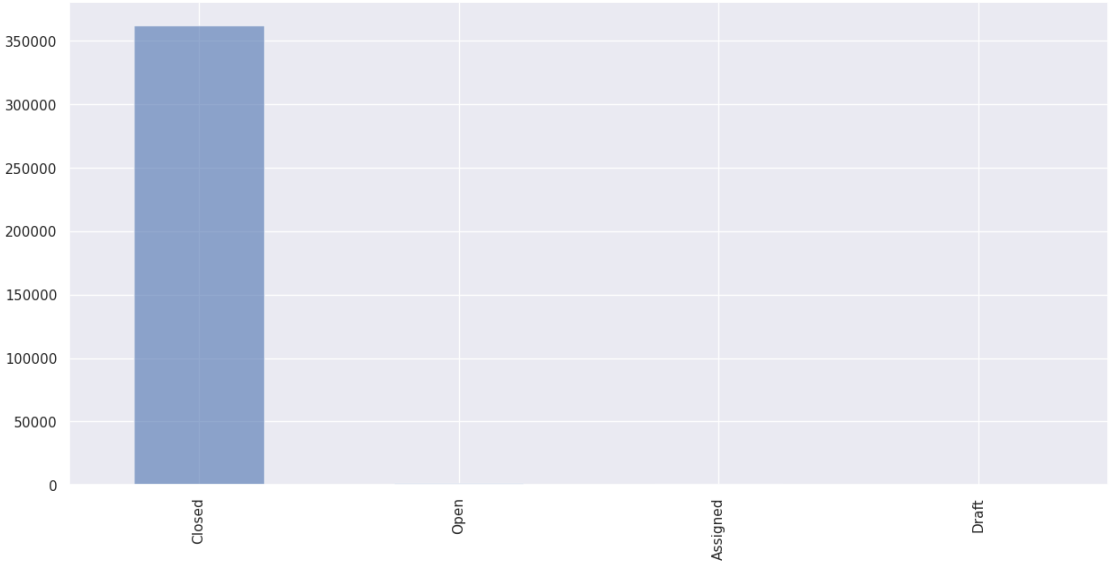
From the above graph we can see that majority of complaints are related to that of transporttion and parking and as such it needed more time to be resolved.

```
crt = sns.catplot(x='Complaint Type',
y="Request_Closing_Time",data=df)
crt.fig.set_figwidth(15)
crt.fig.set_figheight(7)
plt.xticks(rotation=90)
plt.ylim((0,5000))
plt.show()
```



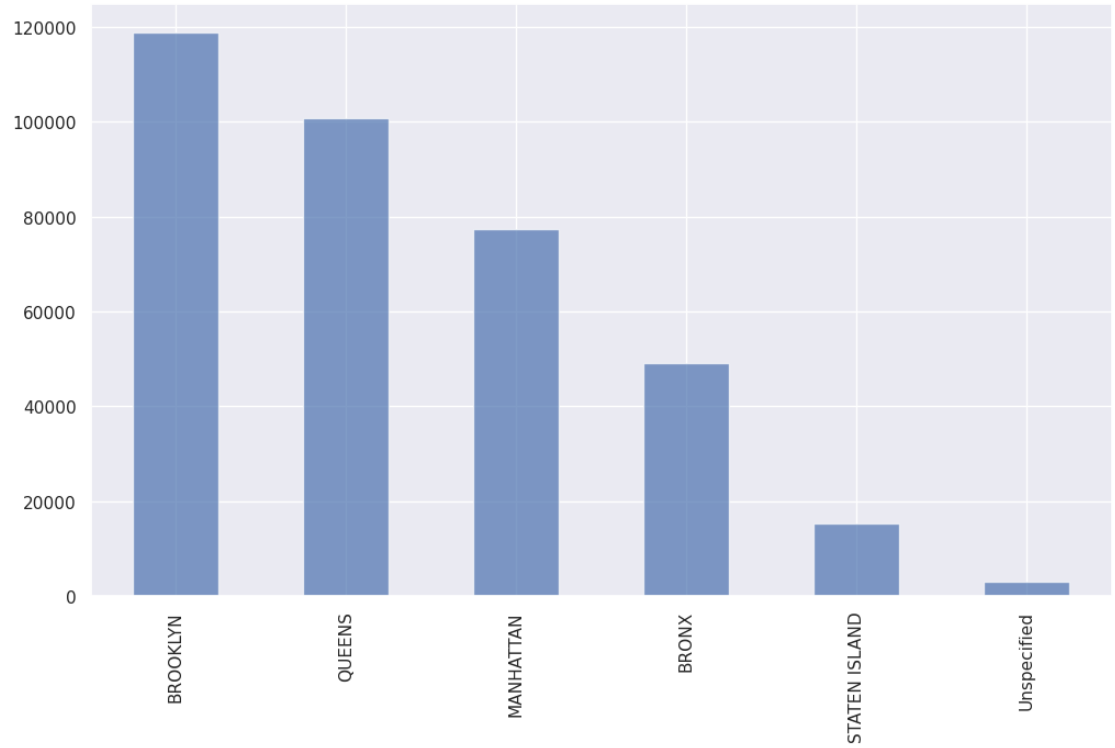
We can see from the above lot that major complaints arises from transport and take up huge time to be resolved and as such the government should take steps to improve the transport system and implement stricter vehicle laws.

```
df['Status'].value_counts().plot(kind='bar',alpha=0.6,figsize=(15,7))
plt.show()
```



From the above plot we can see all complaints are now closed that is they are resolved.

```
plt.figure(figsize=(12,7))
df['Borough'].value_counts().plot(kind='bar',alpha=0.7)
plt.show()
```




```
for x in df["Borough"].unique():
    print("Percentage of complaints from ",x," :
",round((df["Borough"]==x).sum()/len(df)*100,2))
```

```
Percentage of complaints from  MANHATTAN  :  21.25
Percentage of complaints from  QUEENS  :  27.64
Percentage of complaints from  BRONX  :  13.49
Percentage of complaints from  BROOKLYN  :  32.6
Percentage of complaints from  Unspecified  :  0.81
Percentage of complaints from  STATEN ISLAND  :  4.21
```

```
#All unique locations
df["Location Type"].unique()
```

```
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', 'Terminal', nan,
       'Ferry', 'Park'], dtype=object)
```

```
pd.DataFrame(df.groupby("Location Type")
["Request_Closing_Time"].mean()).sort_values("Request_Closing_Time")
```

Location Type	Request_Closing_Time
Subway Station	145.120000
Club/Bar/Restaurant	183.492218
House of Worship	190.052861
Store/Commercial	192.928792
Highway	204.372348
Park/Playground	206.594724
Bridge	229.458333
Street/Sidewalk	261.052945
Residential Building	267.260350
Commercial	270.649846
Roadway Tunnel	283.486047
House and Store	291.750204
Parking Lot	296.526747
Residential Building/House	300.233145
Vacant Lot	404.561930
Park	20210.566667
Ferry	NaN
Terminal	NaN

Conclusion : Maximum time taken to resolved a complaint is in park and vacant lots whereas complaints from subway or club/bar/restaurant take the lowest.

```
#losing time of complaints with respect to city
pd.DataFrame(df.groupby("City")
["Request_Closing_Time"].mean()).sort_values("Request_Closing_Time")
```

City	Request_Closing_Time
ARVERNE	137.840605
ROCKAWAY PARK	139.602908
LITTLE NECK	155.031437
OAKLAND GARDENS	156.240167
BAYSIDE	160.062978
FAR ROCKAWAY	161.193068
NEW YORK	175.343723
FLUSHING	177.446478
FOREST HILLS	184.097636
WHITESTONE	187.976467
CORONA	188.984584
COLLEGE POINT	190.393782
JACKSON HEIGHTS	190.885368
ELMHURST	194.108392
FRESH MEADOWS	200.741045
REGO PARK	202.462138
BREEZY POINT	205.197849
EAST ELMHURST	206.801481
CENTRAL PARK	206.921364
STATEN ISLAND	228.038305
BROOKLYN	236.607935

```
Howard Beach                    241.750000
Astoria                         242.452302
Long Island City                245.388922
ASTORIA                         265.236501
RIDGEWOOD                       268.285547
SAINT ALBANS                    271.040767
East Elmhurst                   273.630556
Woodside                        281.455622
KEW GARDENS                     283.319775
JAMAICA                         305.346459
SOUTH OZONE PARK                308.283046
SOUTH RICHMOND HILL             318.020470
WOODHAVEN                       321.714469
RICHMOND HILL                   321.749064
MIDDLE VILLAGE                  323.290492
OZONE PARK                      328.309146
MASPETH                         328.997706
HOLLIS                          332.061427
HOWARD BEACH                    346.959615
BRONX                           353.116425
LONG ISLAND CITY                367.326726
SUNNYSIDE                       380.744297
WOODSIDE                        389.758733
NEW HYDE PARK                   423.396512
GLEN OAKS                       501.653463
SPRINGFIELD GARDENS             510.113239
CAMBRIA HEIGHTS                 542.883117
ROSEDALE                        569.194745
BELLEROSE                       576.173614
QUEENS VILLAGE                  593.920472
FLORAL PARK                     609.812160
QUEENS                          717.171171
```

```
#Percentage of missing values
pd.DataFrame((df.isnull().sum()/df.shape[0]*100)).sort_values(0,ascend
ing=False)[:20]
```

```
                                     0
School or Citywide Complaint  100.000000
Garage Lot Name               100.000000
Vehicle Type                  100.000000
Taxi Pick Up Location         100.000000
Taxi Company Borough          100.000000
Ferry Direction                99.999726
Ferry Terminal Name            99.999451
Road Ramp                      99.928132
Bridge Highway Segment         99.928132
Bridge Highway Direction       99.918531
Bridge Highway Name            99.918531
Landmark                       99.897136
Intersection Street 2          86.144317
```

```
Intersection Street 1          85.977540
Cross Street 2                 15.856187
Cross Street 1                 15.686941
Street Name                    14.181283
Incident Address               14.181283
Descriptor                      1.783255
Latitude                        1.105448
```

We can see that school or city wide complaint, garage lot name, vehicle type, taxi pickup location, taxi company borough have 100% missing values, that could mean there are no complaints from those sectors.

```
#We will now drop the missing values
dfn=df.loc[:,(df.isnull().sum()/df.shape[0]*100)<=50]

print("Old df shape :",df.shape)
print("New df shape: ",dfn.shape)
```

```
Old df shape : (364558, 54)
New df shape:  (364558, 40)
```

```
rem=[]
for x in new_df.columns.tolist():
    if new_df[x].nunique()<=3:
        print(x+ " "*10+" : ",new_df[x].unique())
        rem.append(x)
```

```
Agency           :  ['NYPD']
Agency Name           :  ['New York City Police Department' 'NYPD'
'Internal Affairs Bureau']
Facility Type           :  ['Precinct' nan]
Park Facility Name           :  ['Unspecified' 'Alley Pond Park -
Nature Center']
School Name           :  ['Unspecified' 'Alley Pond Park - Nature
Center']
School Number           :  ['Unspecified' 'Q001']
School Region           :  ['Unspecified' nan]
School Code           :  ['Unspecified' nan]
School Phone Number           :  ['Unspecified' '7182176034']
School Address           :  ['Unspecified' 'Grand Central Parkway,
near the soccer field']
School City           :  ['Unspecified' 'QUEENS']
School State           :  ['Unspecified' 'NY']
School Zip           :  ['Unspecified' nan]
School Not Found           :  ['N']
```

We can remove the unspecified data

```
dfn.drop(rem,axis=1,inplace=True)
```

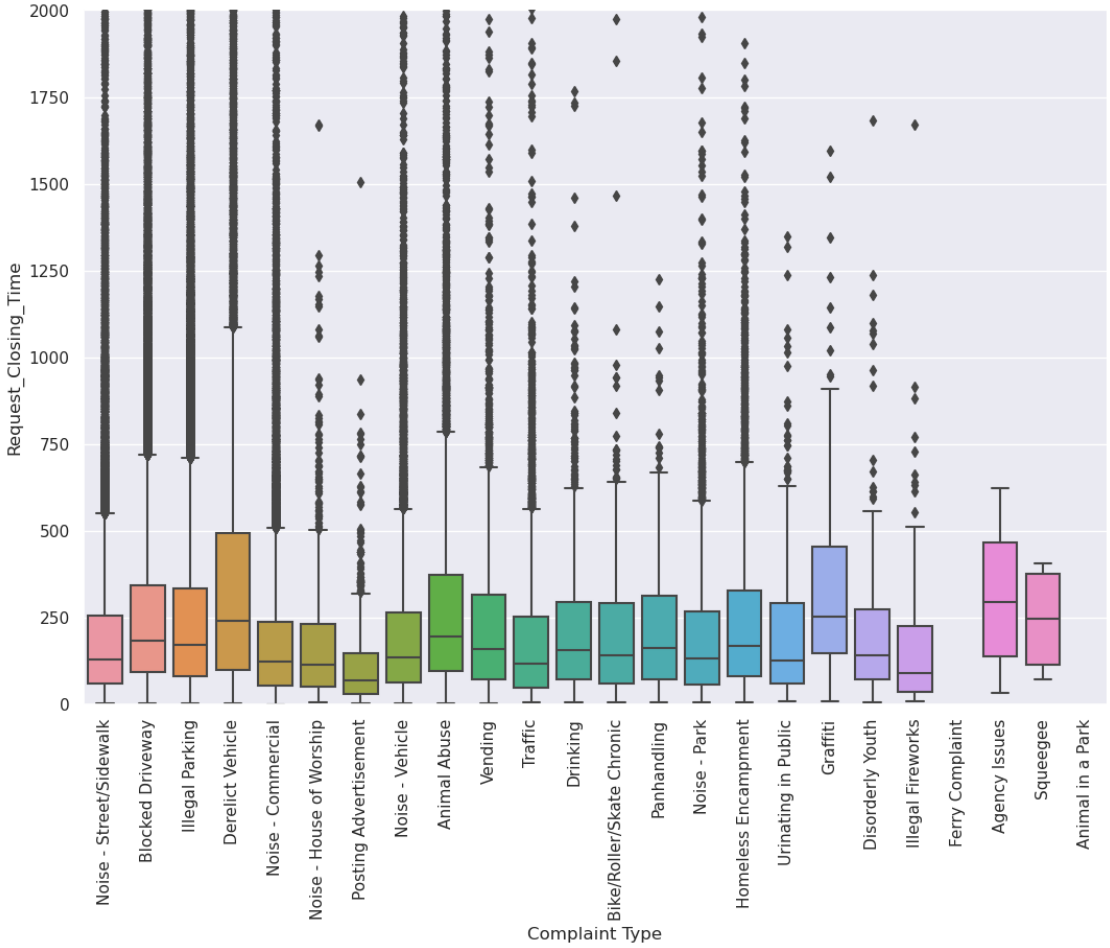
```
/tmp/ipykernel_39979/3503437274.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame
```

```
See the caveats in the documentation:
https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#
returning-a-view-versus-a-copy
  dfn.drop(rem,axis=1,inplace=True)

dfn.shape

(364558, 26)

dfn.head()

   Unique Key        Created Date         Closed Date  \
0    32310363 2015-12-31 23:59:45 2016-01-01 00:55:15
1    32309934 2015-12-31 23:59:44 2016-01-01 01:26:57
2    32309159 2015-12-31 23:59:29 2016-01-01 04:51:03
3    32305098 2015-12-31 23:57:46 2016-01-01 07:43:13
4    32306529 2015-12-31 23:56:58 2016-01-01 03:24:42

            Complaint Type                     Descriptor    Location
Type  \
0  Noise - Street/Sidewalk              Loud Music/Party
Street/Sidewalk
1         Blocked Driveway                       No Access
Street/Sidewalk
2         Blocked Driveway                       No Access
Street/Sidewalk
3          Illegal Parking  Commercial Overnight Parking
Street/Sidewalk
4          Illegal Parking              Blocked Sidewalk
Street/Sidewalk

   Incident Zip       Incident Address       Street Name   Cross
Street 1  \
0       10034.0    71 VERMILYEA AVENUE  VERMILYEA AVENUE   ACADEMY
STREET
1       11105.0        27-07 23 AVENUE         23 AVENUE        27
STREET
2       10458.0  2897 VALENTINE AVENUE  VALENTINE AVENUE  EAST 198
STREET
3       10461.0    2940 BAISLEY AVENUE    BAISLEY AVENUE    EDISON
AVENUE
4       11373.0          87-14 57 ROAD           57 ROAD   SEABURY
STREET

   ... Resolution Action Updated Date Community Board    Borough  \
0  ...         01/01/2016 12:55:15 AM    12 MANHATTAN  MANHATTAN
1  ...         01/01/2016 01:26:57 AM       01 QUEENS     QUEENS
2  ...         01/01/2016 04:51:03 AM        07 BRONX      BRONX
3  ...         01/01/2016 07:43:13 AM        10 BRONX      BRONX
4  ...         01/01/2016 03:24:42 AM       04 QUEENS     QUEENS
```

```
  X Coordinate (State Plane) Y Coordinate (State Plane) Park
Borough  \
0                  1005409.0                   254678.0    MANHATTAN

1                  1007766.0                   221986.0       QUEENS

2                  1015081.0                   256380.0        BRONX

3                  1031740.0                   243899.0        BRONX

4                  1019123.0                   206375.0       QUEENS


    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  40.835994 -73.828379   (40.83599404683083, -73.82837939584206)
4  40.733060 -73.874170  (40.733059618956815, -73.87416975810375)

   Request_Closing_Time
0             55.500000
1             87.216667
2            291.566667
3            465.450000
4            207.733333

[5 rows x 26 columns]
```

```
#Hypothesis testing
crt=sns.catplot(x="Complaint
Type",y="Request_Closing_Time",kind="box",data=new_df)
crt.fig.set_figheight(8)
crt.fig.set_figwidth(15)
plt.xticks(rotation=90)
plt.ylim((0,2000))
```

```
(0.0, 2000.0)
```



H0: There is no significant different in mean of Request_Closing_Time for different Complaint

H1: There is signficant different in mean of Request_Closing_Time for different Complaint

```
anova_df=pd.DataFrame()
anova_df["Request_Closing_Time"]=new_df["Request_Closing_Time"]
anova_df["Complaint"]=new_df["Complaint Type"]

anova_df.dropna(inplace=True)
anova_df.head()
```

```
   Request_Closing_Time                Complaint
0             55.500000  Noise - Street/Sidewalk
1             87.216667          Blocked Driveway
2            291.566667          Blocked Driveway
3            465.450000           Illegal Parking
4            207.733333           Illegal Parking
```

```
lm=ols("Request_Closing_Time~Complaint",data=anova_df).fit()
table=sm.stats.anova_lm(lm)
table
```

```
                 df        sum_sq       mean_sq          F  PR(>F)
Complaint      22.0  1.487316e+09  6.760526e+07  565.26157     0.0
Residual   362154.0  4.331361e+10  1.196000e+05        NaN     NaN
```

```
chi_sq=pd.DataFrame()
chi_sq["Location Type"]=new_df["Location Type"]
chi_sq["Complaint Type"]=new_df["Complaint Type"]
chi_sq.dropna(inplace=True)
```

```
data_crosstab = pd.crosstab( chi_sq["Location Type"],chi_sq["Complaint
Type"])
```

```
stat, p, dof, expected = chi2_contingency(data_crosstab)
```

```
alpha = 0.05
if p <= alpha:
    print('Dependent (reject H0)')
else:
    print('Independent (H0 holds true)')
```

```
Dependent (reject H0)
```

Conclusions : 1. Different complaints last for different duration. 2. Complaints are different in different locations. 3. Majority complaints are from transport sector. 4. School sector has the lowest number of complaints(next to none).