```
#impoting of libraries required
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np

# for Staistical testing
from scipy import stats
from scipy.stats import chi2_contingency
from scipy.stats import f_oneway
import statsmodels.api as sm
from statsmodels.formula.api import ols
```

```
#reading the dataset available in csv format
df=pd.read_csv("/content/311_Service_Requests_from_2010_to_Present.csv")
```

```
#viewing of first 5 rows of the dataset
df.head()
```

	Unique Key	Created Date	Closed Date	Agency	Agency Name	Complaint Type	Descriptor	L
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/
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/
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/
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/
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/

5 rows × 53 columns

```
#shape of the dataset
df.shape
```

```
    (26862, 53)
```

```
#to check total number of null values for each column
df.isnull().sum()
```

```
Unique Key                         0
Created Date                       0
Closed Date                      164
Agency                             0
Agency Name                        1
Complaint Type                     1
Descriptor                       390
Location Type                      1
Incident Zip                     180
Incident Address                3123
Street Name                     3123
Cross Street 1                  3526
Cross Street 2                  3564
Intersection Street 1          23762
Intersection Street 2          23802
Address Type                     197
City                             180
Landmark                       26847
Facility Type                    161
Status                             1
Due Date                           1
Resolution Description             1
Resolution Action Updated Date   161
Community Board                    1
Borough                            1
X Coordinate (State Plane)       231
Y Coordinate (State Plane)       231
Park Facility Name                 1
Park Borough                       1
School Name                        1
School Number                      1
School Region                      1
School Code                        1
School Phone Number                1
School Address                     1
School City                        1
School State                       1
School Zip                         1
School Not Found                   1
School or Citywide Complaint   26862
Vehicle Type                   26862
Taxi Company Borough           26862
Taxi Pick Up Location          26862
Bridge Highway Name            26844
Bridge Highway Direction       26844
Road Ramp                      26846
Bridge Highway Segment         26846
Garage Lot Name                26862
Ferry Direction                26862
Ferry Terminal Name            26862
Latitude                         231
Longitude                        231
Location                         231
dtype: int64
```

```
#check datatypes of columns
```

```
df.dtypes
```

```
Unique Key                          int64
Created Date                       object
Closed Date                        object
Agency                             object
Agency Name                        object
Complaint Type                     object
Descriptor                         object
Location Type                      object
Incident Zip                      float64
Incident Address                   object
Street Name                        object
Cross Street 1                     object
Cross Street 2                     object
Intersection Street 1              object
Intersection Street 2              object
Address Type                       object
City                               object
Landmark                           object
Facility Type                      object
Status                             object
Due Date                           object
Resolution Description             object
Resolution Action Updated Date     object
Community Board                    object
Borough                            object
X Coordinate (State Plane)        float64
Y Coordinate (State Plane)        float64
Park Facility Name                 object
Park Borough                       object
School Name                        object
School Number                      object
School Region                      object
School Code                        object
School Phone Number                object
School Address                     object
School City                        object
School State                       object
School Zip                         object
School Not Found                   object
School or Citywide Complaint      float64
Vehicle Type                      float64
Taxi Company Borough              float64
Taxi Pick Up Location             float64
Bridge Highway Name                object
Bridge Highway Direction           object
Road Ramp                          object
Bridge Highway Segment             object
Garage Lot Name                   float64
Ferry Direction                   float64
Ferry Terminal Name               float64
Latitude                          float64
Longitude                         float64
Location                           object
dtype: object
```

```
# converting created date column into datetime datatype
df["Created Date"]=pd.to_datetime(df["Created Date"])
```

```
df["Created Date"]
```

```
0       2015-12-31 23:59:45
1       2015-12-31 23:59:44
2       2015-12-31 23:59:29
3       2015-12-31 23:57:46
4       2015-12-31 23:56:58
                ...
55512   2015-11-06 12:38:00
55513   2015-11-06 12:37:00
55514   2015-11-06 12:37:00
55515   2015-11-06 12:37:00
55516   2015-11-06 12:36:00
Name: Created Date, Length: 55517, dtype: datetime64[ns]
```

```
# converting closed date column to datetime datatype
df["Closed Date"]=pd.to_datetime(df["Closed Date"])
```

```
#creating a new column ‘Request_Closing_Time’ as the time elapsed between request creation
df["Request_Closing_Time"]=df["Closed Date"]-df["Created Date"]
```

```
df["Request_Closing_Time"]
```

```
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
              ...
55512   0 days 13:35:00
55513   0 days 02:53:00
55514   0 days 05:46:00
55515   0 days 02:14:00
55516   0 days 00:12:00
Name: Request_Closing_Time, Length: 55517, dtype: timedelta64[ns]
```

```
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	Agency Name	Complaint Type	Descriptor	Lo
0	32310363	2015-12-31 23:59:45	2016-01-01 00:55:00	NYPD	New York City Police Department	Noise - Street/Sidewalk	Loud Music/Party	Street/Si
1	32309934	2015-12-31 23:59:44	2016-01-01 01:26:00	NYPD	New York City Police Department	Blocked Driveway	No Access	Street/Si
2	32309159	2015-12-31 23:59:29	2016-01-01 04:51:00	NYPD	New York City Police Department	Blocked Driveway	No Access	Street/Si
3	32305098	2015-12-31 23:57:46	2016-01-01 07:43:00	NYPD	New York City Police Department	Illegal Parking	Commercial Overnight Parking	Street/Si

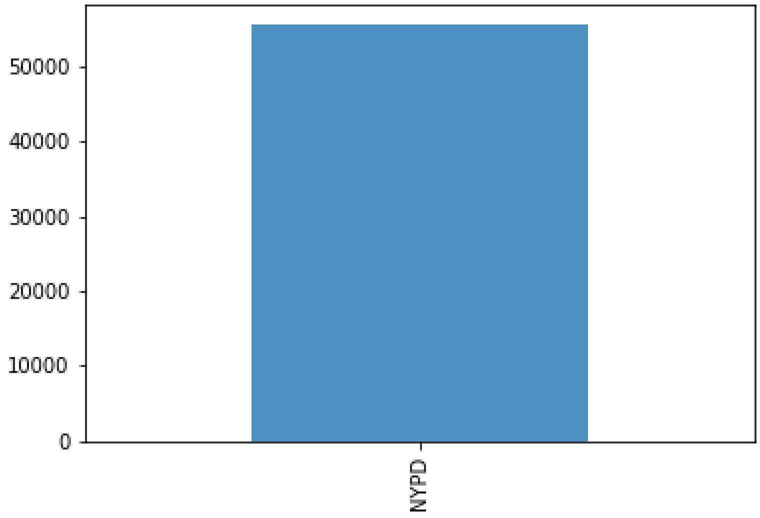
```
df.info()
```

```
Data columns (total 54 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   Unique Key                      26862 non-null  int64
 1   Created Date                    26862 non-null  datetime64[ns]
 2   Closed Date                     26698 non-null  datetime64[ns]
 3   Agency                          26862 non-null  object
 4   Agency Name                     26861 non-null  object
 5   Complaint Type                  26861 non-null  object
 6   Descriptor                      26472 non-null  object
 7   Location Type                   26861 non-null  object
 8   Incident Zip                    26682 non-null  float64
 9   Incident Address                23739 non-null  object
 10  Street Name                     23739 non-null  object
 11  Cross Street 1                  23336 non-null  object
 12  Cross Street 2                  23298 non-null  object
 13  Intersection Street 1           3100 non-null   object
 14  Intersection Street 2           3060 non-null   object
 15  Address Type                    26665 non-null  object
 16  City                            26682 non-null  object
 17  Landmark                        15 non-null     object
 18  Facility Type                   26701 non-null  object
 19  Status                          26861 non-null  object
 20  Due Date                        26861 non-null  object
 21  Resolution Description          26861 non-null  object
 22  Resolution Action Updated Date  26701 non-null  object
 23  Community Board                 26861 non-null  object
 24  Borough                         26861 non-null  object
 25  X Coordinate (State Plane)      26631 non-null  float64
 26  Y Coordinate (State Plane)      26631 non-null  float64
 27  Park Facility Name              26861 non-null  object
 28  Park Borough                    26861 non-null  object
 29  School Name                     26861 non-null  object
 30  School Number                   26861 non-null  object
 31  School Region                   26861 non-null  object
 32  School Code                     26861 non-null  object

 33  School Phone Number             26861 non-null  object
 34  School Address                  26861 non-null  object
 35  School City                     26861 non-null  object
 35  School City                     26861 non-null  object
 36  School State                    26861 non-null  object
 37  School Zip                      26861 non-null  object
 38  School Not Found                26861 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             18 non-null     object
 44  Bridge Highway Direction        18 non-null     object
 45  Road Ramp                       16 non-null     object
 46  Bridge Highway Segment          16 non-null     object
 47  Garage Lot Name                 0 non-null      float64
 48  Ferry Direction                 0 non-null      float64
 49  Ferry Terminal Name             0 non-null      float64
 50  Latitude                        26631 non-null  float64
 51  Longitude                       26631 non-null  float64
 52  Location                        26631 non-null  object
 53  Request_Closing_Time            26698 non-null  timedelta64[ns]
dtypes: datetime64[ns](2), float64(12), int64(1), object(38), timedelta64[ns](1)
```

```
#major insights from the data
df["Agency"].value_counts().plot(kind="bar",alpha=0.8)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f19f6df8650>
```



Insight 1: From the code we can conclude that there is only one agency working towards customer service i.e NYPD.

```
df["Complaint Type"].unique()
```

```
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', nan],
      dtype=object)
```

```
num_of_complaints=df["Complaint Type"].value_counts()
num_of_complaints
```

```
num_of_complaints
```

```
Blocked Driveway             17453
Illegal Parking              15843
Noise - Commercial            7436
Noise - Street/Sidewalk       4935
Derelict Vehicle              3287
Noise - Vehicle               2288
Animal Abuse                  1355
Traffic                        753
Homeless Encampment            633
Vending                        544
Posting Advertisement          281
Noise - Park                   231
Drinking                       185
Noise - House of Worship       102
Urinating in Public             57
Panhandling                     55
Bike/Roller/Skate Chronic       50
Graffiti                        14
Disorderly Youth                12
Illegal Fireworks                3
Name: Complaint Type, dtype: int64
```

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

Insight 2: From the above plot we can see that top 3 most frequent complaint types are: 1)Blocked driveway 2)Illegal Parking 3)Noise-Commercial

```
df['City'].unique().size
```

```
49
```

```
df1=df.groupby(['City','Complaint Type']).size().unstack().fillna(0)
df1.head()
```

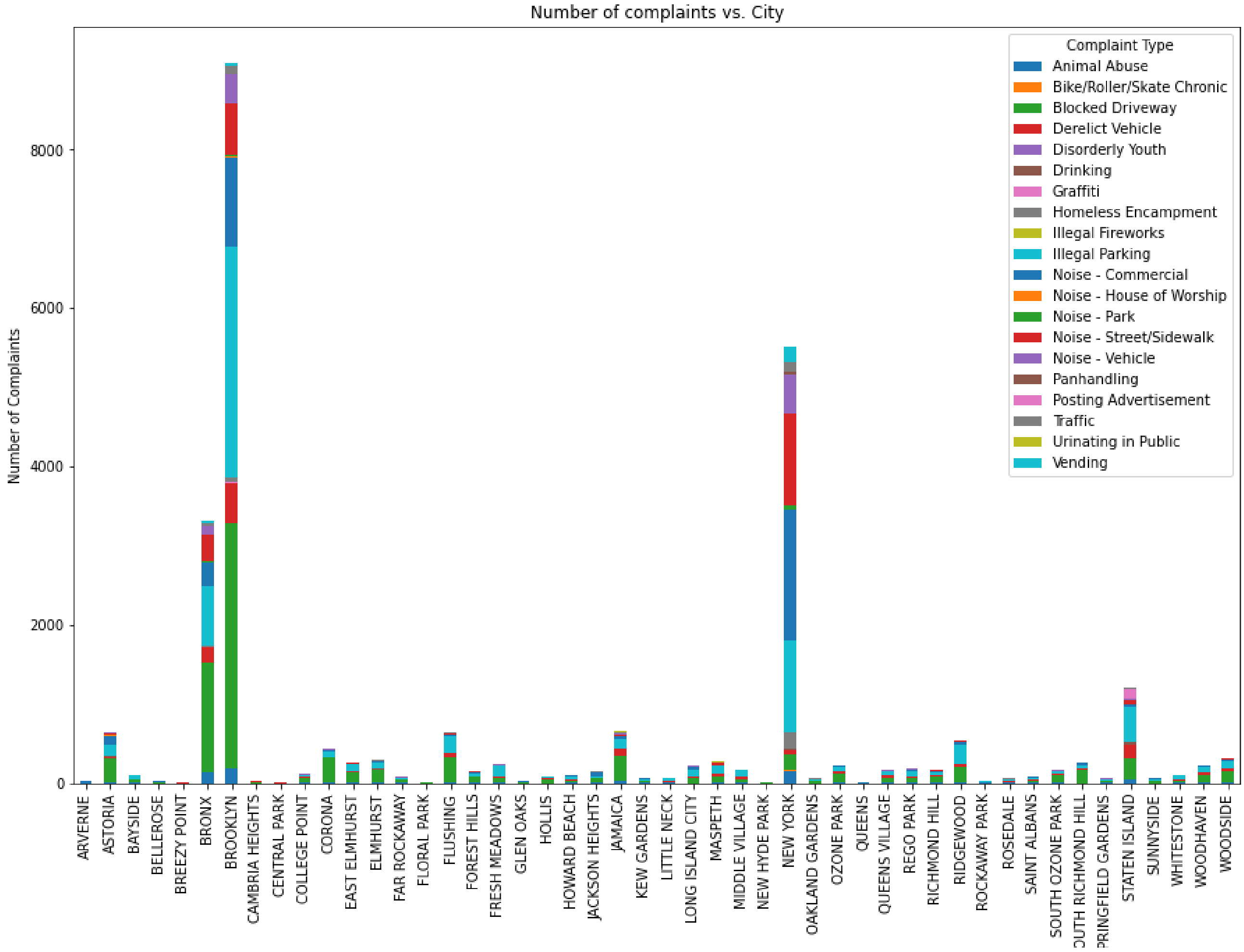
Derelict Vehicle	Disorderly Youth	Drinking	Graffiti	Homeless Encampment	Illegal Fireworks	Illegal Parking	Noise - Commercial
7.0	0.0	0.0	0.0	1.0	0.0	15.0	2.0
65.0	0.0	4.0	0.0	5.0	0.0	273.0	216.0
36.0	0.0	0.0	2.0	1.0	0.0	103.0	5.0
8.0	0.0	0.0	0.0	0.0	0.0	10.0	4.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

```
df1.shape
```

```
(48, 20)
```

```
df1.plot.bar(figsize=(15,10), stacked=True)
plt.ylabel('Number of Complaints')
plt.title('Number of complaints vs. City')
```

```
Text(0.5, 1.0, 'Number of complaints vs. City')
```



Insight 3: Most complaints are registered in Brooklyn

```
#df.loc[(df['City']=='BROOKLYN')]['Complaint Type'].value_counts()
plot_1= sns.countplot(x=df.loc[df.City=='BROOKLYN']['Complaint Type'], palette='YlOrRd_r')
plt.xticks(rotation=90)

#plot_1.set_xticklabels(plot_1.get_xticklabels(), rotation=90)
```

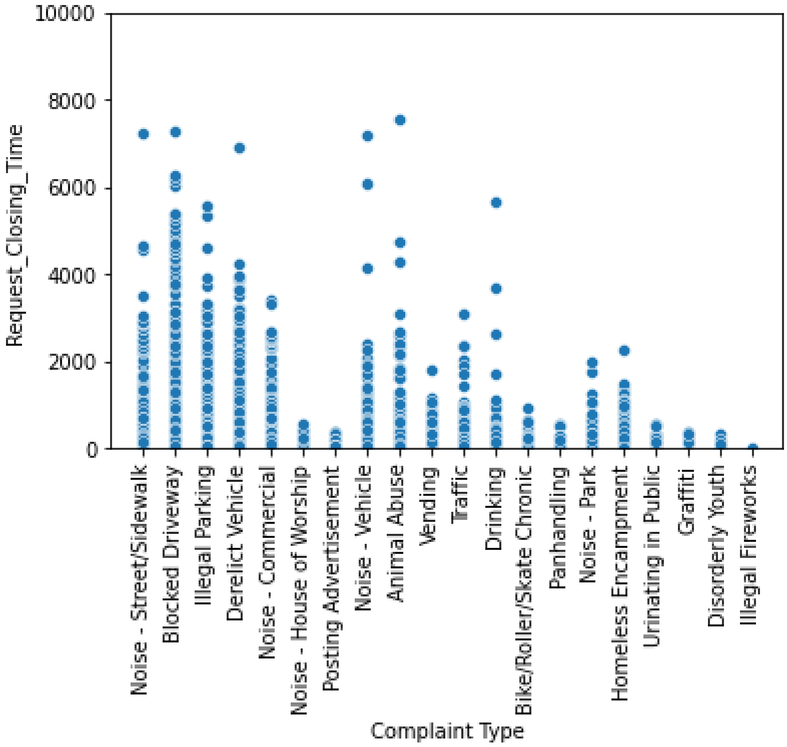
```
(array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
        17, 18, 19]), <a list of 20 Text major ticklabel objects>)
```

Insight 4: Since maximum number of complaints were filed in Brooklyn, hence after analysing the complaint data for this city, it was found that Blocked Driveway was the most frequent complaint lodged to NYPD in the city of Brooklyn.

```
df["Request_Closing_Time"].fillna(0)
```

```
0         55.250000
1         86.266667
2        291.516667
3        465.233333
4        207.033333
            ...
26857     78.000000
26858     66.000000
26859     77.000000
26860    131.000000
26861    294.000000
Name: Request_Closing_Time, Length: 26862, dtype: float64
```

```
#Categorical Scatter Plot to understand which type of complaints are taking more time to g
g=sns.scatterplot(x='Complaint Type',y="Request_Closing_Time",data=df)
plt.xticks(rotation=90)
plt.ylim((0,10000))
plt.show()
```



Insight 5: From the above visualization we can clearly see that Blocked Driveway and Noise-

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

```
Street/Sidewalk               22170
Store/Commercial               2151
Club/Bar/Restaurant            1701
Residential Building/House      583
Park/Playground                 132
House of Worship                 45
Residential Building             26
Highway                          16
House and Store                  15
Vacant Lot                        8
Commercial                        5
Parking Lot                       5
Roadway Tunnel                    2
Subway Station                    2
Name: Location Type, dtype: int64
```

```
df['Location Type'].fillna(value='Street/Sidewalk',inplace=True)
```

```
plt.figure(figsize=(10,5))
plot=sns.countplot(df['Location Type'])
plot.set_xticklabels(plot.get_xticklabels(), rotation=90)
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: Pass
  FutureWarning
[Text(0, 0, 'Street/Sidewalk'),
 Text(0, 0, 'Club/Bar/Restaurant'),
 Text(0, 0, 'Store/Commercial'),
 Text(0, 0, 'House of Worship'),
 Text(0, 0, 'Residential Building/House'),
 Text(0, 0, 'Residential Building'),
 Text(0, 0, 'Park/Playground'),
 Text(0, 0, 'Vacant Lot'),
 Text(0, 0, 'House and Store'),
 Text(0, 0, 'Highway'),
 Text(0, 0, 'Commercial'),
```

Insight 6: we can conclude that Street/Sidewalk is the most number of complaints

```
 Text(0, 0, 'Parking Lot')]
```

```
#Order the complaint types based on the average ‘Request_Closing_Time’, grouping them for
df2=pd.DataFrame(df.groupby("Location Type")["Request_Closing_Time"].mean()).sort_values("
df2.tail()
```

Location Type	Request_Closing_Time
Residential Building	309.873718
Residential Building/House	353.225115
Commercial	433.013333
Parking Lot	681.503333
Vacant Lot	1591.933333

From the above visualization we can see that vacant lot location complaints took most of the time to get closed.

```
#Order the complaint types based on the average ‘Request_Closing_Time’, grouping them for

df3=pd.DataFrame(df.groupby("City")["Request_Closing_Time"].mean()).sort_values("Request_C
df3.tail()
```

City	Request_Closing_Time
ROSEDALE	505.566369
KEW GARDENS	507.401643
WOODHAVEN	514.261689
QUEENS VILLAGE	636.234560
NEW HYDE PARK	824.266667

From the above code we can say that New Hyde Park city took highest average time to close the complaint

```
#Performing the statistical test to check Whether the average response time across complai
```

1.Null Hypothesis: The average response time across complaint types is not different

2. Alternate Hypothesis: The average response time across complaint types is different

```
# First step is to handle missing values
pd.DataFrame((df.isnull().sum()/df.shape[0]*100)).sort_values(0,ascending=False)[:20]    #
```

	0
School or Citywide Complaint	100.000000
Taxi Pick Up Location	100.000000
Ferry Terminal Name	100.000000
Garage Lot Name	100.000000
Ferry Direction	100.000000
Taxi Company Borough	100.000000
Vehicle Type	100.000000
Landmark	99.949565
Road Ramp	99.926149
Bridge Highway Segment	99.926149
Bridge Highway Name	99.909937
Bridge Highway Direction	99.909937
Intersection Street 2	88.506223
Intersection Street 1	88.376533
Cross Street 2	13.329250
Cross Street 1	13.208567
Street Name	11.717132
Incident Address	11.717132
Descriptor	1.437398
Latitude	0.879010

```
#removing colums with high percenatge of missing values
new_df=df.loc[:,(df.isnull().sum()/df.shape[0]*100)<=50]
```

```
new_df.shape
```

```
(55517, 40)
```

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

```
Agency           :  ['NYPD']
Agency Name           :  ['New York City Police Department' 'NYPD']
Facility Type           :  ['Precinct' nan]
Park Facility Name           :  ['Unspecified']
School Name           :  ['Unspecified']
School Number           :  ['Unspecified']
School Region           :  ['Unspecified']
School Code           :  ['Unspecified']
School Phone Number           :  ['Unspecified']
School Address           :  ['Unspecified']
School City           :  ['Unspecified']
School State           :  ['Unspecified']
School Zip           :  ['Unspecified' 'Unspec']
School Not Found           :  ['N' nan]
```

```
# drop_column gives the list of columns that doesn't have much significant information tha
new_df.drop(drop_column,axis=1,inplace=True)
```

```
/usr/local/lib/python3.7/dist-packages/pandas/core/frame.py:4913: SettingWithCopyWarn
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/us
  errors=errors,
```

```
new_df.shape
```

```
(55517, 26)
```

```
new_df
```

```
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	55.250000	Noise - Street/Sidewalk
1	86.266667	Blocked Driveway
2	291.516667	Blocked Driveway

```
lm=ols("Request_Closing_Time~Complaint",data=anova_df).fit()          #here we are usin
anova_table=sm.stats.anova_lm(lm)
anova_table
```

	df	sum_sq	mean_sq	F	PR(>F)
Complaint	19.0	2.397540e+08	1.261863e+07	54.789447	1.017025e-206
Residual	55182.0	1.270904e+10	2.303114e+05	NaN	NaN

From the above results we can clearly see that p-value is very low so we will reject Null hypothesis which means we conclude that the average response time across complaint types is different

Second: H0:Complaint Type and Location Type are independent

H1:Complaint Type and Location Type are related

```
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)
print("statistics:",stat,"\n","p-value",p)

alpha = 0.05
if p <= alpha:
    print('Reject Null hypothesis)')
else:
    print('Accept Null Hypothesis')
```

```
statistics: 191889.29754983488
 p-value 0.0
Reject Null hypothesis)
```

✓ 0s completed at 10:46 PM ● ×