Notebook

June 1, 2025

1 Airbnb Data analysis

Suppose you are working in the data driven domain at Aibnb. You have a dataset and need to derive insights from it to answe key business questions,as a company officials aim to grow the business

What is the distribution of listing prices?

How are different room types distributed ?

How are listings distributed across different neighborhoods?

What are the relationship between price and room type?

How has the number of review changed over time ?

[1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

[3]:
```
df=pd.read_csv('compressed_data.csv',lineterminator='\n')
```

[4]:
```
df.shape
```

[4]:
```
(102599, 26)
```

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

[5]:
```
        id                                              NAME      host id  \
0  1001254                Clean & quiet apt home by the park  80014485718
1  1002102                             Skylit Midtown Castle  52335172823
2  1002403               THE VILLAGE OF HARLEM…NEW YORK !  78829239556
3  1002755                                               NaN  85098326012
4  1003689  Entire Apt: Spacious Studio/Loft by central park  92037596077

  host_identity_verified host name neighbourhood group neighbourhood  \
0            unconfirmed  Madaline            Brooklyn    Kensington
1               verified     Jenna           Manhattan       Midtown
2                    NaN     Elise           Manhattan        Harlem
3            unconfirmed     Garry            Brooklyn  Clinton Hill
```

```
4               verified    Lyndon           Manhattan   East Harlem

        lat      long        country  … service fee minimum nights  \
0  40.64749 -73.97237  United States  …       $193            10.0
1  40.75362 -73.98377  United States  …        $28            30.0
2  40.80902 -73.94190  United States  …       $124             3.0
3  40.68514 -73.95976  United States  …        $74            30.0
4  40.79851 -73.94399  United States  …        $41            10.0

  number of reviews last review  reviews per month review rate number  \
0               9.0  10/19/2021               0.21                4.0
1              45.0   5/21/2022               0.38                4.0
2               0.0         NaN                NaN                5.0
3             270.0    7/5/2019               4.64                4.0
4               9.0  11/19/2018               0.10                3.0

  calculated host listings count  availability 365  \
0                            6.0             286.0
1                            2.0             228.0
2                            1.0             352.0
3                            1.0             322.0
4                            1.0             289.0

                                        house_rules license\r
0  Clean up and treat the home the way you'd like…        \r
1  Pet friendly but please confirm with me if the…        \r
2  I encourage you to use my kitchen, cooking and…        \r
3                                              NaN        \r
4  Please no smoking in the house, porch or on th…        \r

[5 rows x 26 columns]
```

[9]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 102599 entries, 0 to 102598
Data columns (total 26 columns):
 #   Column                          Non-Null Count   Dtype
---  ------                          --------------   -----
 0   id                              102599 non-null  int64
 1   NAME                            102349 non-null  object
 2   host id                         102599 non-null  int64
 3   host_identity_verified          102310 non-null  object
 4   host name                       102193 non-null  object
 5   neighbourhood group             102570 non-null  object
 6   neighbourhood                   102583 non-null  object
 7   lat                             102591 non-null  float64
 8   long                            102591 non-null  float64
```

```
 9   country                         102067 non-null  object
 10  country code                    102468 non-null  object
 11  instant_bookable                102494 non-null  object
 12  cancellation_policy             102523 non-null  object
 13  room type                       102599 non-null  object
 14  Construction year               102385 non-null  float64
 15  price                           102352 non-null  object
 16  service fee                     102326 non-null  object
 17  minimum nights                  102190 non-null  float64
 18  number of reviews               102416 non-null  float64
 19  last review                     86706 non-null   object
 20  reviews per month               86720 non-null   float64
 21  review rate number              102273 non-null  float64
 22  calculated host listings count  102280 non-null  float64
 23  availability 365                102151 non-null  float64
 24  house_rules                     50468 non-null   object
                         102599 non-null  object
dtypes: float64(9), int64(2), object(15)
memory usage: 20.4+ MB
```

[11]:
```
# checking duplicated vlues
df.duplicated().sum()
```

[11]:
```
541
```

[13]:
```
# checking null values
df.isnull().sum()
```

[13]:
```
id                                0
NAME                            250
host id                           0
host_identity_verified          289
host name                       406
neighbourhood group              29
neighbourhood                    16
lat                               8
long                              8
country                         532
country code                    131
instant_bookable                105
cancellation_policy              76
room type                         0
Construction year               214
price                           247
service fee                     273
minimum nights                  409
number of reviews               183
last review                   15893
```

```
reviews per month                 15879
review rate number                  326
calculated host listings count      319
availability 365                    448
house_rules                       52131
license\r                             0
dtype: int64
```

[15]:
```
df.isnull().sum().sum()
```

[15]:
```
88172
```

2 Handaling missing values

[18]:
```
# converting last review column data type to date time format
df['last review']= pd.to_datetime(df['last review'],errors='coerce')
df.columns
```

[18]:
```
Index(['id', 'NAME', 'host id', 'host_identity_verified', 'host name',
       'neighbourhood group', 'neighbourhood', 'lat', 'long', 'country',
       'country code', 'instant_bookable', 'cancellation_policy', 'room type',
       'Construction year', 'price', 'service fee', 'minimum nights',
       'number of reviews', 'last review', 'reviews per month',
       'review rate number', 'calculated host listings count',
       'availability 365', 'house_rules', 'license\r'],
      dtype='object')
```

[20]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 102599 entries, 0 to 102598
Data columns (total 26 columns):
 #   Column                          Non-Null Count   Dtype
---  ------                          --------------   -----
 0   id                              102599 non-null  int64
 1   NAME                            102349 non-null  object
 2   host id                         102599 non-null  int64
 3   host_identity_verified          102310 non-null  object
 4   host name                       102193 non-null  object
 5   neighbourhood group             102570 non-null  object
 6   neighbourhood                   102583 non-null  object
 7   lat                             102591 non-null  float64
 8   long                            102591 non-null  float64
 9   country                         102067 non-null  object
 10  country code                    102468 non-null  object
 11  instant_bookable                102494 non-null  object
 12  cancellation_policy             102523 non-null  object
```

```
 13  room type                        102599 non-null  object
 14  Construction year                102385 non-null  float64
 15  price                            102352 non-null  object
 16  service fee                      102326 non-null  object
 17  minimum nights                   102190 non-null  float64
 18  number of reviews                102416 non-null  float64
 19  last review                      86706 non-null   datetime64[ns]
 20  reviews per month                86720 non-null   float64
 21  review rate number               102273 non-null  float64
 22  calculated host listings count   102280 non-null  float64
 23  availability 365                 102151 non-null  float64
 24  house_rules                      50468 non-null   object
                         102599 non-null  object
dtypes: datetime64[ns](1), float64(9), int64(2), object(14)
memory usage: 20.4+ MB
```

[ ]:
```
# fill values in last
```

[33]:
```
df.fillna({
    'reviews per month': 0,
    'last review': df['last review'].min()
}, inplace=True)
```

[35]:
```
df.head()
```

[35]:

```
        id                                              NAME      host id  \
0  1001254                Clean & quiet apt home by the park  80014485718
1  1002102                             Skylit Midtown Castle  52335172823
2  1002403               THE VILLAGE OF HARLEM…NEW YORK !  78829239556
3  1002755                                             NaN  85098326012
4  1003689  Entire Apt: Spacious Studio/Loft by central park  92037596077

  host_identity_verified host name neighbourhood group neighbourhood  \
0            unconfirmed  Madaline            Brooklyn    Kensington
1               verified     Jenna           Manhattan       Midtown
2                    NaN     Elise           Manhattan        Harlem
3            unconfirmed     Garry            Brooklyn  Clinton Hill
4               verified    Lyndon           Manhattan   East Harlem

        lat      long        country  … service fee minimum nights  \
0  40.64749 -73.97237  United States  …       $193            10.0
1  40.75362 -73.98377  United States  …        $28            30.0
2  40.80902 -73.94190  United States  …       $124             3.0
3  40.68514 -73.95976  United States  …        $74            30.0
4  40.79851 -73.94399  United States  …        $41            10.0

  number of reviews last review  reviews per month review rate number  \
0               9.0  2021-10-19               0.21                4.0
```

```
1              45.0  2022-05-21              0.38                4.0
2               0.0  2012-07-11              0.00                5.0
3             270.0  2019-07-05              4.64                4.0
4               9.0  2018-11-19              0.10                3.0

  calculated host listings count  availability 365  \
0                            6.0             286.0
1                            2.0             228.0
2                            1.0             352.0
3                            1.0             322.0
4                            1.0             289.0

                                        house_rules license\r
0  Clean up and treat the home the way you'd like…        \r
1  Pet friendly but please confirm with me if the…        \r
2  I encourage you to use my kitchen, cooking and…        \r
3                                              NaN        \r
4  Please no smoking in the house, porch or on th…        \r

[5 rows x 26 columns]
```

[39]:
```
df.dropna(subset=['NAME','host name'],inplace=True)
```

[45]:
```
df.isnull().sum()
```

[45]:
```
id                                0
NAME                              0
host id                           0
host_identity_verified          276
host name                         0
neighbourhood group              26
neighbourhood                    16
lat                               8
long                              8
country                         526
country code                    122
instant_bookable                 96
cancellation_policy              70
room type                         0
Construction year               200
price                           239
service fee                     268
minimum nights                  403
number of reviews               182
last review                       0
reviews per month                 0
review rate number              314
```

```
calculated host listings count      318
availability 365                    420
house_rules                       51867
license\r                             0
dtype: int64
```

[51]:
```
# there are no use of cols house_rules  and  license\r so we drop it
df.drop(columns=['house_rules','license\r'],errors='ignore')
```

[51]:

	id	NAME	\
0	1001254	Clean & quiet apt home by the park	
1	1002102	Skylit Midtown Castle	
2	1002403	THE VILLAGE OF HARLEM…NEW YORK !	
4	1003689	Entire Apt: Spacious Studio/Loft by central park	
5	1004098	Large Cozy 1 BR Apartment In Midtown East	
…	…	…	
102594	6092437	Spare room in Williamsburg	
102595	6092990	Best Location near Columbia U	
102596	6093542	Comfy, bright room in Brooklyn	
102597	6094094	Big Studio-One Stop from Midtown	
102598	6094647	585 sf Luxury Studio	

	host id	host_identity_verified	host name	neighbourhood group	\
0	80014485718	unconfirmed	Madaline	Brooklyn	
1	52335172823	verified	Jenna	Manhattan	
2	78829239556	NaN	Elise	Manhattan	
4	92037596077	verified	Lyndon	Manhattan	
5	45498551794	verified	Michelle	Manhattan	
…	…	…	…	…	
102594	12312296767	verified	Krik	Brooklyn	
102595	77864383453	unconfirmed	Mifan	Manhattan	
102596	69050334417	unconfirmed	Megan	Brooklyn	
102597	11160591270	unconfirmed	Christopher	Queens	
102598	68170633372	unconfirmed	Rebecca	Manhattan	

	neighbourhood	lat	long	country	…	\
0	Kensington	40.64749	-73.97237	United States	…	
1	Midtown	40.75362	-73.98377	United States	…	
2	Harlem	40.80902	-73.94190	United States	…	
4	East Harlem	40.79851	-73.94399	United States	…	
5	Murray Hill	40.74767	-73.97500	United States	…	
…	…	…	…	…	…	
102594	Williamsburg	40.70862	-73.94651	United States	…	
102595	Morningside Heights	40.80460	-73.96545	United States	…	
102596	Park Slope	40.67505	-73.98045	United States	…	
102597	Long Island City	40.74989	-73.93777	United States	…	
102598	Upper West Side	40.76807	-73.98342	United States	…	

```
       Construction year    price service fee minimum nights  \
0                 2020.0    $966        $193            10.0
1                 2007.0    $142         $28            30.0
2                 2005.0    $620        $124             3.0
4                 2009.0    $204         $41            10.0
5                 2013.0    $577        $115             3.0
…                  …      …          …             …
102594            2003.0    $844        $169             1.0
102595            2016.0    $837        $167             1.0
102596            2009.0    $988        $198             3.0
102597            2015.0    $546        $109             2.0
102598            2010.0  $1,032        $206             1.0

        number of reviews last review reviews per month  review rate number  \
0                     9.0  2021-10-19              0.21                 4.0
1                    45.0  2022-05-21              0.38                 4.0
2                     0.0  2012-07-11              0.00                 5.0
4                     9.0  2018-11-19              0.10                 3.0
5                    74.0  2019-06-22              0.59                 3.0
…                     …         …                …                   …
102594                0.0  2012-07-11              0.00                 3.0
102595                1.0  2015-07-06              0.02                 2.0
102596                0.0  2012-07-11              0.00                 5.0
102597                5.0  2015-10-11              0.10                 3.0
102598                0.0  2012-07-11              0.00                 3.0

        calculated host listings count availability 365
0                                   6.0            286.0
1                                   2.0            228.0
2                                   1.0            352.0
4                                   1.0            289.0
5                                   1.0            374.0
…                                   …              …
102594                              1.0            227.0
102595                              2.0            395.0
102596                              1.0            342.0
102597                              1.0            386.0
102598                              1.0             69.0

[101949 rows x 24 columns]
```

[53]:
```
# remove dollar signs and convert to float
df['price']=df['price'].replace('[\$,]','',regex=True).astype(float)
df['service fee']=df['service fee'].replace('[\$,]','',regex=True).astype(float)
```

```
<>:2: SyntaxWarning: invalid escape sequence '\$'
<>:3: SyntaxWarning: invalid escape sequence '\$'
```

```
<>:2: SyntaxWarning: invalid escape sequence '\$'
<>:3: SyntaxWarning: invalid escape sequence '\$'
C:\Users\Keshav\AppData\Local\Temp\ipykernel_10960\2405041511.py:2:
SyntaxWarning: invalid escape sequence '\$'
  df['price']=df['price'].replace('[\$,]','',regex=True).astype(float)
C:\Users\Keshav\AppData\Local\Temp\ipykernel_10960\2405041511.py:3:
SyntaxWarning: invalid escape sequence '\$'
  df['service fee']=df['service
fee'].replace('[\$,]','',regex=True).astype(float)
```

[57]:
```
df['price']
```

[57]:
```
0          966.0
1          142.0
2          620.0
4          204.0
5          577.0
           ...
102594     844.0
102595     837.0
102596     988.0
102597     546.0
102598    1032.0
Name: price, Length: 101949, dtype: float64
```

3 remove duplicates

[60]:
```
df.drop_duplicates(inplace=True)
```

[62]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 101410 entries, 0 to 102057
Data columns (total 26 columns):
 #   Column                          Non-Null Count   Dtype
---  ------                          --------------   -----
 0   id                              101410 non-null  int64
 1   NAME                            101410 non-null  object
 2   host id                         101410 non-null  int64
 3   host_identity_verified          101134 non-null  object
 4   host name                       101410 non-null  object
 5   neighbourhood group             101384 non-null  object
 6   neighbourhood                   101394 non-null  object
 7   lat                             101402 non-null  float64
 8   long                            101402 non-null  float64
 9   country                         100884 non-null  object
 10  country code                    101288 non-null  object
```

```
 11  instant_bookable                101314 non-null  object
 12  cancellation_policy             101340 non-null  object
 13  room type                       101410 non-null  object
 14  Construction year               101210 non-null  float64
 15  price                           101171 non-null  float64
 16  service fee                     101142 non-null  float64
 17  minimum nights                  101016 non-null  float64
 18  number of reviews               101228 non-null  float64
 19  last review                     101410 non-null  datetime64[ns]
 20  reviews per month               101410 non-null  float64
 21  review rate number              101103 non-null  float64
 22  calculated host listings count  101092 non-null  float64
 23  availability 365                100990 non-null  float64
 24  house_rules                     49831 non-null   object
                         101410 non-null  object
dtypes: datetime64[ns](1), float64(11), int64(2), object(12)
memory usage: 20.9+ MB
```

[64]:
```
df.duplicated().sum()
```

[64]:
```
0
```

[66]:
```
df.describe()
```

[66]:

	id	host id	lat	long
count	1.014100e+05	1.014100e+05	101402.000000	101402.000000
mean	2.920959e+07	4.926155e+10	40.728082	-73.949663
min	1.001254e+06	1.236005e+08	40.499790	-74.249840
25%	1.507574e+07	2.459183e+10	40.688730	-73.982570
50%	2.922911e+07	4.912069e+10	40.722300	-73.954440
75%	4.328308e+07	7.399747e+10	40.762750	-73.932340
max	5.736742e+07	9.876313e+10	40.916970	-73.705220
std	1.626820e+07	2.853703e+10	0.055850	0.049474

	Construction year	price	service fee	minimum nights
count	101210.000000	101171.000000	101142.000000	101016.000000
mean	2012.486908	625.381008	125.043998	8.113744
min	2003.000000	50.000000	10.000000	-1223.000000
25%	2007.000000	340.000000	68.000000	2.000000
50%	2012.000000	625.000000	125.000000	3.000000
75%	2017.000000	913.000000	183.000000	5.000000
max	2022.000000	1200.000000	240.000000	5645.000000
std	5.765130	331.609111	66.313374	30.378014

	number of reviews	last review	reviews per month
count	101228.000000	101410	101410.000000
mean	27.511854	2018-05-15 21:26:08.721033728	1.163207
min	0.000000	2012-07-11 00:00:00	0.000000

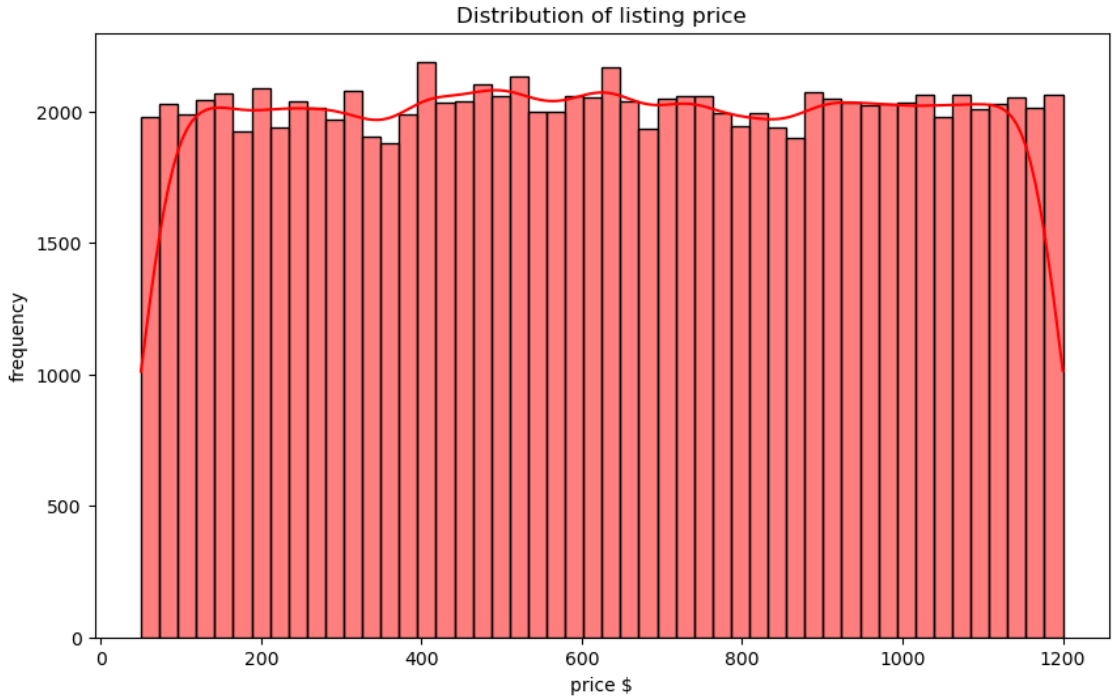
25%	1.000000	2017-07-30 00:00:00	0.090000
50%	7.000000	2019-05-23 00:00:00	0.480000
75%	31.000000	2019-07-01 00:00:00	1.710000
max	1024.000000	2058-06-16 00:00:00	90.000000
std	49.549258	NaN	1.683708

	review rate number	calculated host listings count	availability 365
count	101103.000000	101092.000000	100990.000000
mean	3.278558	7.948463	141.164660
min	1.000000	1.000000	-10.000000
25%	2.000000	1.000000	3.000000
50%	3.000000	1.000000	96.000000
75%	4.000000	2.000000	269.000000
max	5.000000	332.000000	3677.000000
std	1.285369	32.328974	135.419199

4 Visualization

4.0.1 Q1) What is the distribution of listing prices?

[82]:
```
plt.figure(figsize=(10,6))
sns.histplot(df['price'],bins=50,kde=True,color='red')  # kde matalab ek curve␣
 ↪aaye hamare graph
plt.title("Distribution of listing price")
plt.xlabel("price $")
plt.ylabel("frequency")
plt.show()
```

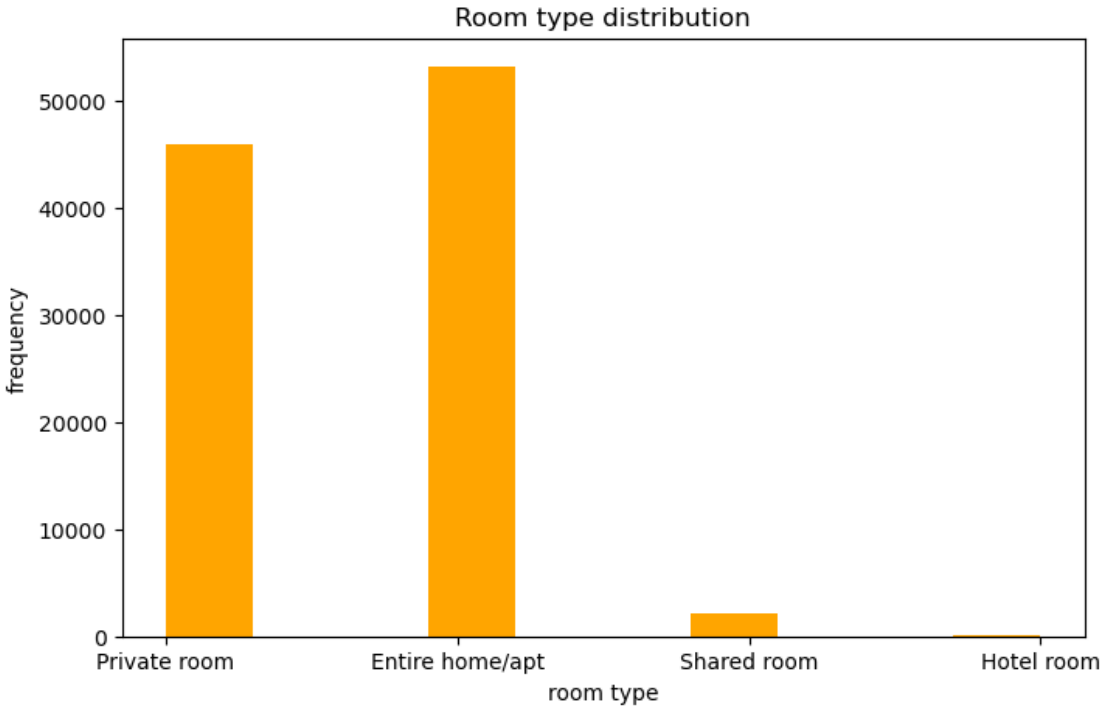


Q2 How are different room types distributed ?

[85]:
```
df.columns
```

[85]:
```
Index(['id', 'NAME', 'host id', 'host_identity_verified', 'host name',
       'neighbourhood group', 'neighbourhood', 'lat', 'long', 'country',
       'country code', 'instant_bookable', 'cancellation_policy', 'room type',
       'Construction year', 'price', 'service fee', 'minimum nights',
       'number of reviews', 'last review', 'reviews per month',
       'review rate number', 'calculated host listings count',
       'availability 365', 'house_rules', 'license\r'],
      dtype='object')
```

[96]:
```
plt.figure(figsize=(8,5))
plt.hist(df['room type'],color='orange')
plt.title("Room type distribution")
plt.xlabel("room type")
plt.ylabel("frequency")
plt.show()
```

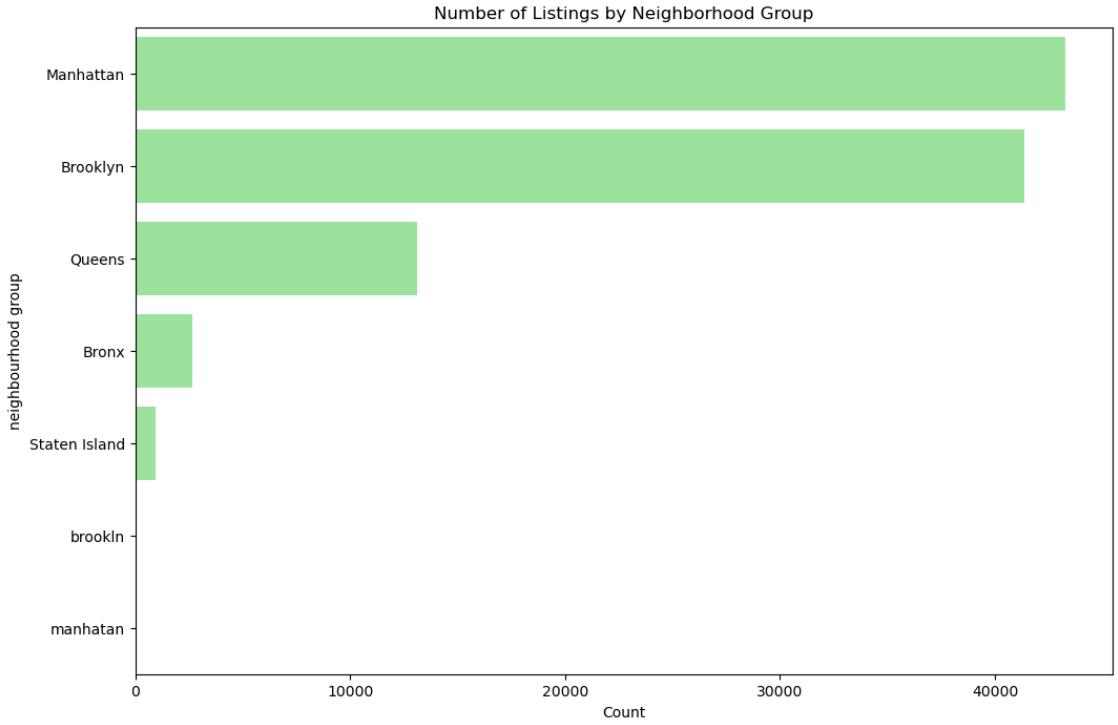


4.0.2 Q3) How are listings distributed across different neighborhoods?

[98]:
```
df.columns
```

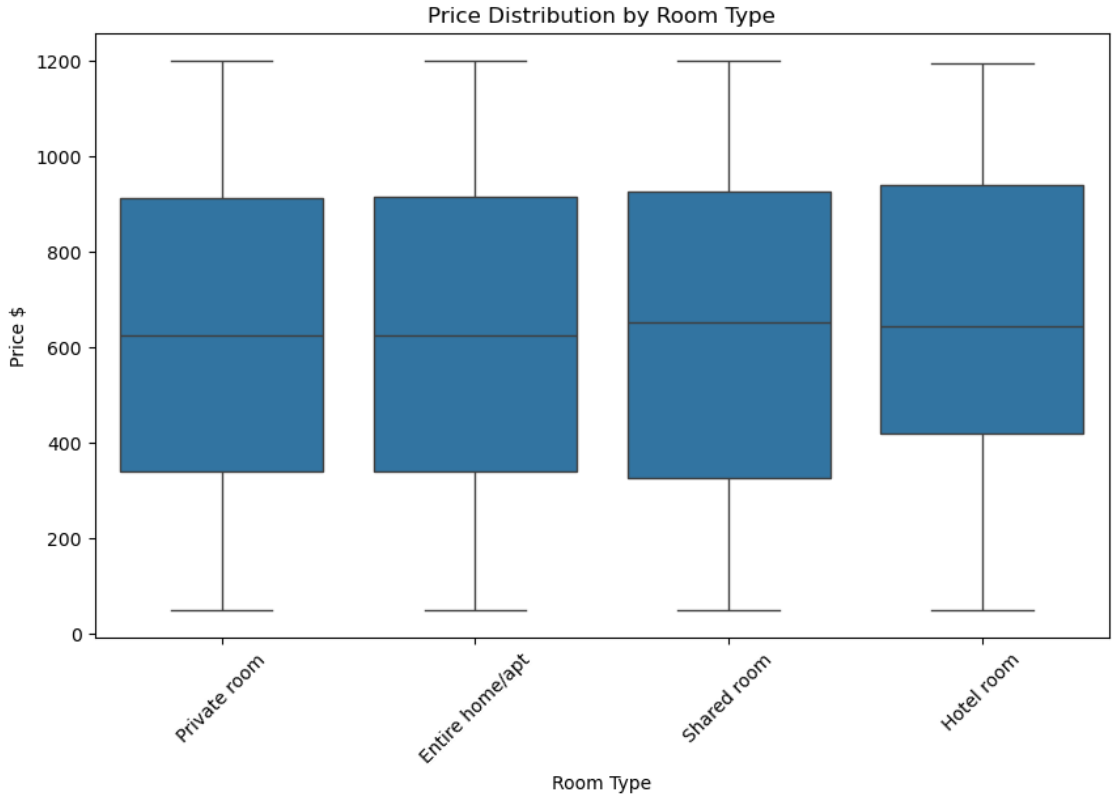
[98]:
```
Index(['id', 'NAME', 'host id', 'host_identity_verified', 'host name',
       'neighbourhood group', 'neighbourhood', 'lat', 'long', 'country',
       'country code', 'instant_bookable', 'cancellation_policy', 'room type',
       'Construction year', 'price', 'service fee', 'minimum nights',
       'number of reviews', 'last review', 'reviews per month',
       'review rate number', 'calculated host listings count',
       'availability 365', 'house_rules', 'license\r'],
      dtype='object')
```

[100]:
```
plt.figure(figsize=(12,8))
sns.countplot(y='neighbourhood␣
 ↪group',data=df,color='lightgreen',order=df['neighbourhood group'].
 ↪value_counts().index)
plt.title("Number of Listings by Neighborhood Group")
plt.xlabel("Count")
plt.ylabel("neighbourhood group")
plt.show()
```



4.0.3 Q4) What are the relationship between price and room type?

[111]:
```
plt.figure(figsize=(10, 6))
sns.boxplot(x='room type', y='price', data=df)
plt.title('Price Distribution by Room Type')
plt.ylabel('Price $')
plt.xticks(rotation=45)
# plt.tight_layout()
plt.xlabel('Room Type')
plt.show()
```



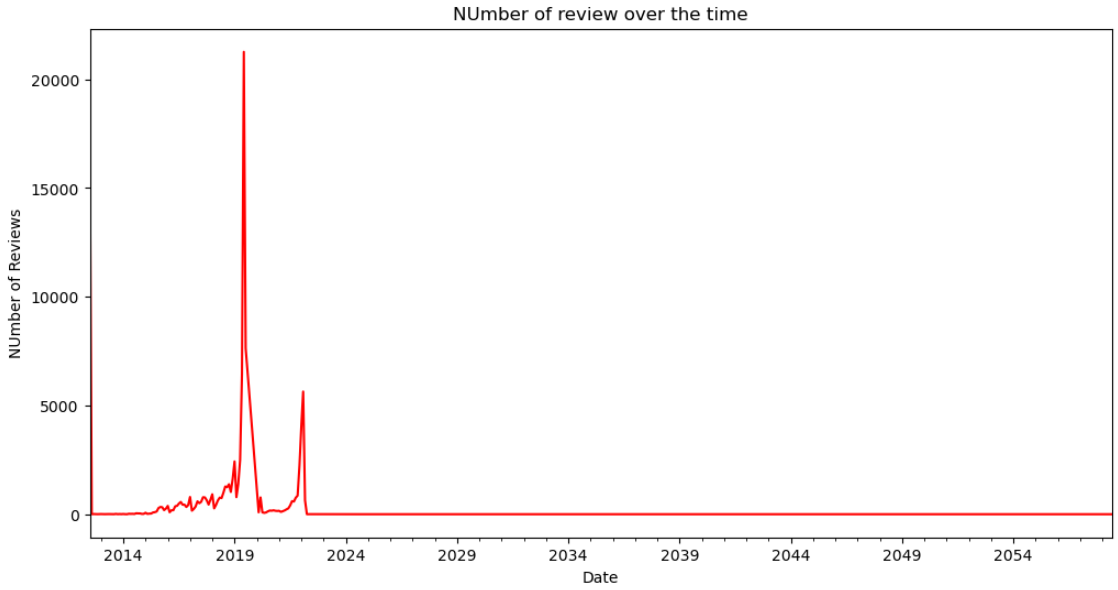
4.0.4 Q5) How has the number of review changed over time ?

[114]:
```
df.columns
```

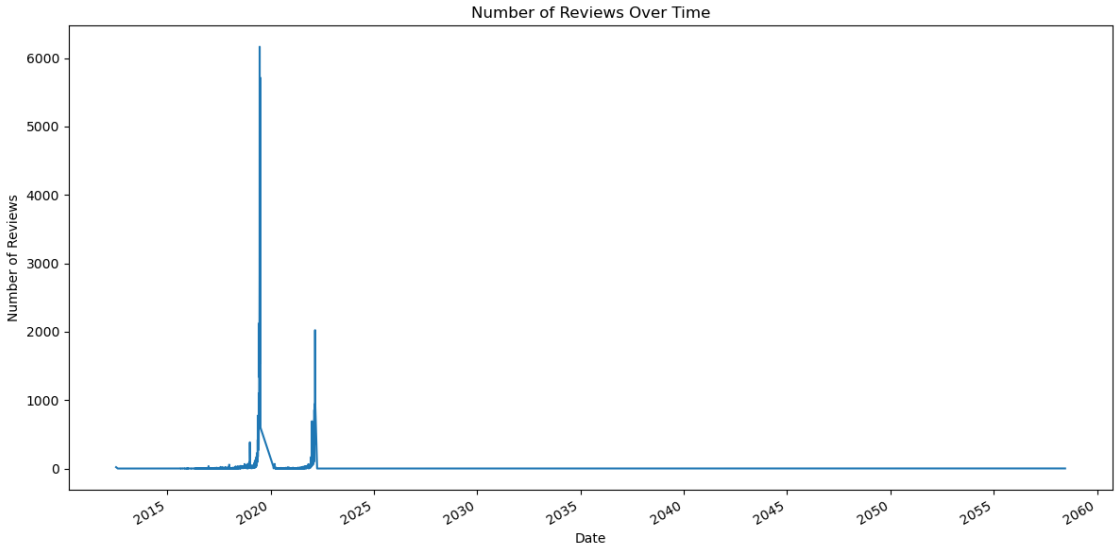
[114]:
```
Index(['id', 'NAME', 'host id', 'host_identity_verified', 'host name',
       'neighbourhood group', 'neighbourhood', 'lat', 'long', 'country',
       'country code', 'instant_bookable', 'cancellation_policy', 'room type',
       'Construction year', 'price', 'service fee', 'minimum nights',
       'number of reviews', 'last review', 'reviews per month',
       'review rate number', 'calculated host listings count',
       'availability 365', 'house_rules', 'license\r'],
      dtype='object')
```

[116]:
```
# reviews_over_time = df.groupby('last review')['number_of_reviews'].sum()
# plt.figure(figsize=(12, 6))
# reviews_over_time.plot()
# plt.title('Number of Reviews Over Time')
# plt.xlabel('Date')
# plt.ylabel('Number of Reviews')
# plt.tight_layout()
# plt.show()
```

```
review_over_time=df.groupby(df['last review'].dt.to_period('M')).size()
plt.figure(figsize=(12,6))
review_over_time.plot(kind='line',color='red')
plt.title("NUmber of review over the time")
plt.xlabel("Date")
plt.ylabel("NUmber of Reviews")
plt.show()
```



[120]:
```
# both graphs are valid
reviews_over_time = df.groupby('last review')['reviews per month'].sum()
plt.figure(figsize=(12, 6))
reviews_over_time.plot()
plt.title('Number of Reviews Over Time')
plt.xlabel('Date')
plt.ylabel('Number of Reviews')
plt.tight_layout()
plt.show()
```



[ ]:

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