Airbnb

May 2, 2025

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

```
[5]: df = pd.read_csv("Airbnb_Project.csv")
```

```
C:\Users\91868\AppData\Local\Temp\ipykernel_26824\2125341550.py:1: DtypeWarning:
Columns (25) have mixed types. Specify dtype option on import or set
low_memory=False.
  df = pd.read_csv("Airbnb_Project.csv")
```

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

```
[6]:        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   07-05-2019               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
0  Clean up and treat the home the way you'd like…     NaN
1  Pet friendly but please confirm with me if the…     NaN
2  I encourage you to use my kitchen, cooking and…     NaN
3                                                NaN     NaN
4  Please no smoking in the house, porch or on th…     NaN

[5 rows x 26 columns]
```

[7]:
```
df.columns
```

[7]:
```
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'],
      dtype='object')
```

1 Checking missing values

[9]:
```
print (df.isnull().sum())
```

```
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                           102597
dtype: int64
```

[11]:
```
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 
 25  license                         2 non-null       object
dtypes: float64(9), int64(2), object(15)
memory usage: 20.4+ MB
```

2 Handling Missing values

[15]:

```
df['last review'] = pd.to_datetime(df['last review'], errors='coerce')
```

[19]:

```
df.head(5)
```

[19]:

```
        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         NaT                NaN                5.0
3             270.0         NaT               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
0  Clean up and treat the home the way you'd like…     NaN
```

```
1  Pet friendly but please confirm with me if the…     NaN
2  I encourage you to use my kitchen, cooking and…     NaN
3                                                NaN     NaN
4  Please no smoking in the house, porch or on th…     NaN

[5 rows x 26 columns]
```

[20]:
```
df.fillna({'reviews per month' : 0, 'last review' : df['last review'].min()},␣
  ↪inplace = True)
```

[21]:
```
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                     102599 non-null  datetime64[ns]
 20  reviews per month               102599 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
 25  license                         2 non-null       object
dtypes: datetime64[ns](1), float64(9), int64(2), object(14)
memory usage: 20.4+ MB
```

[24]:
```
df.fillna({'reviews per month' : 0 , 'last review' : df['last review'].min()},␣
  ↪inplace = True)
```

[25]:

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

[26]:

```python
print(df.isnull().sum())
```

```
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                           101947
dtype: int64
```

[27]:

```python
df = df.drop(columns = ["license", "house_rules"], errors= 'ignore')
```

[28]:

```python
df.head()
```

[28]:

```
        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
4  1003689  Entire Apt: Spacious Studio/Loft by central park  92037596077
5  1004098         Large Cozy 1 BR Apartment In Midtown East  45498551794

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

```
5               verified  Michelle          Manhattan   Murray Hill

        lat      long        country  … Construction year  price  \
0  40.64749 -73.97237  United States  …            2020.0  $966
1  40.75362 -73.98377  United States  …            2007.0  $142
2  40.80902 -73.94190  United States  …            2005.0  $620
4  40.79851 -73.94399  United States  …            2009.0  $204
5  40.74767 -73.97500  United States  …            2013.0  $577

  service fee minimum nights  number of reviews last review reviews per month  \
0      $193            10.0                9.0  2021-10-19              0.21
1       $28            30.0               45.0  2022-05-21              0.38
2      $124             3.0                0.0  2012-08-25              0.00
4       $41            10.0                9.0  2018-11-19              0.10
5      $115             3.0               74.0  2019-06-22              0.59

   review rate number  calculated host listings count availability 365
0                 4.0                             6.0            286.0
1                 4.0                             2.0            228.0
2                 5.0                             1.0            352.0
4                 3.0                             1.0            289.0
5                 3.0                             1.0            374.0

[5 rows x 24 columns]
```

[29]:

```
df['price'] = df['price'].replace('[\$,]','',regex = True).astype(float)
df['service fee'] = df['service fee'].replace('[\$,]','',regex = True).
 ↪astype(float)
```

```
<>:1: SyntaxWarning: invalid escape sequence '\$'
<>:2: SyntaxWarning: invalid escape sequence '\$'
<>:1: SyntaxWarning: invalid escape sequence '\$'
<>:2: SyntaxWarning: invalid escape sequence '\$'
C:\Users\91868\AppData\Local\Temp\ipykernel_26824\887639469.py:1: SyntaxWarning:
invalid escape sequence '\$'
  df['price'] = df['price'].replace('[\$,]','',regex = True).astype(float)
C:\Users\91868\AppData\Local\Temp\ipykernel_26824\887639469.py:2: SyntaxWarning:
invalid escape sequence '\$'
  df['service fee'] = df['service fee'].replace('[\$,]','',regex =
True).astype(float)
```

[30]:

```
df.head()
```

[30]:

```
        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
4  1003689  Entire Apt: Spacious Studio/Loft by central park  92037596077
```

```
5  1004098         Large Cozy 1 BR Apartment In Midtown East  45498551794

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

        lat      long        country  … Construction year  price  \
0  40.64749 -73.97237  United States  …            2020.0  966.0
1  40.75362 -73.98377  United States  …            2007.0  142.0
2  40.80902 -73.94190  United States  …            2005.0  620.0
4  40.79851 -73.94399  United States  …            2009.0  204.0
5  40.74767 -73.97500  United States  …            2013.0  577.0

  service fee minimum nights  number of reviews  last review  \
0       193.0           10.0                9.0   2021-10-19
1        28.0           30.0               45.0   2022-05-21
2       124.0            3.0                0.0   2012-08-25
4        41.0           10.0                9.0   2018-11-19
5       115.0            3.0               74.0   2019-06-22

   reviews per month  review rate number  calculated host listings count  \
0               0.21                 4.0                             6.0
1               0.38                 4.0                             2.0
2               0.00                 5.0                             1.0
4               0.10                 3.0                             1.0
5               0.59                 3.0                             1.0

  availability 365
0            286.0
1            228.0
2            352.0
4            289.0
5            374.0

[5 rows x 24 columns]
```

[31]:

```
df.head()
```

[31]:

```
        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
4  1003689  Entire Apt: Spacious Studio/Loft by central park  92037596077
5  1004098         Large Cozy 1 BR Apartment In Midtown East  45498551794
```

```
  host_identity_verified host name neighbourhood group neighbourhood  \
0            unconfirmed  Madaline            Brooklyn    Kensington
1               verified     Jenna           Manhattan       Midtown
2                    NaN     Elise           Manhattan        Harlem
4               verified    Lyndon           Manhattan   East Harlem
5               verified  Michelle           Manhattan   Murray Hill

        lat      long        country  … Construction year  price  \
0  40.64749 -73.97237  United States  …            2020.0  966.0
1  40.75362 -73.98377  United States  …            2007.0  142.0
2  40.80902 -73.94190  United States  …            2005.0  620.0
4  40.79851 -73.94399  United States  …            2009.0  204.0
5  40.74767 -73.97500  United States  …            2013.0  577.0

  service fee minimum nights  number of reviews  last review  \
0       193.0           10.0                9.0   2021-10-19
1        28.0           30.0               45.0   2022-05-21
2       124.0            3.0                0.0   2012-08-25
4        41.0           10.0                9.0   2018-11-19
5       115.0            3.0               74.0   2019-06-22

   reviews per month  review rate number  calculated host listings count  \
0               0.21                 4.0                             6.0
1               0.38                 4.0                             2.0
2               0.00                 5.0                             1.0
4               0.10                 3.0                             1.0
5               0.59                 3.0                             1.0

  availability 365
0            286.0
1            228.0
2            352.0
4            289.0
5            374.0

[5 rows x 24 columns]
```

3 Remove Duplicates

[32]:

```
df.drop_duplicates(inplace=True)
```

[34]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 101410 entries, 0 to 102057
Data columns (total 24 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
dtypes: datetime64[ns](1), float64(11), int64(2), object(10)
memory usage: 19.3+ MB
```

4 Descriptive Statistics

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

[35]:
```
                 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
```

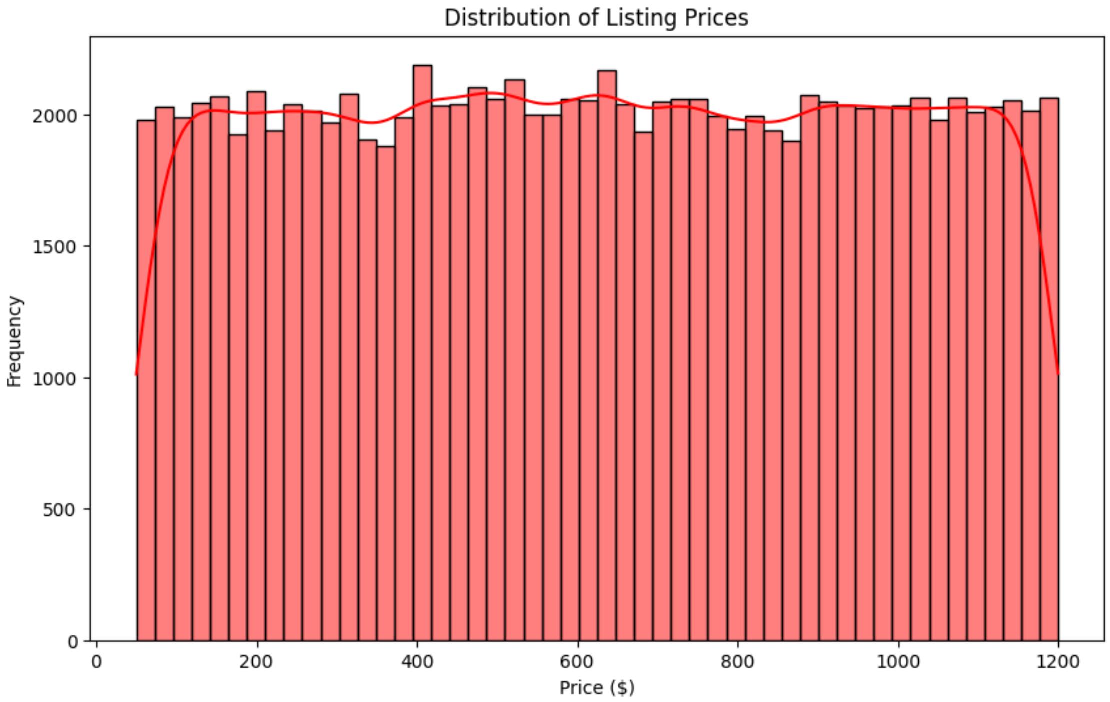
```
25%          2007.000000      340.000000       68.000000        2.000000
50%          2012.000000      625.000000      125.000000        3.000000
75%          2017.000000      913.000000      183.000000        5.000000
max          2022.000000     1200.000000      240.000000     5645.000000
std             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  2016-02-20 18:00:47.285277440           1.163207
min             0.000000            2012-08-25 00:00:00           0.000000
25%             1.000000            2012-08-25 00:00:00           0.090000
50%             7.000000            2015-12-14 00:00:00           0.480000
75%            31.000000            2019-06-17 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
```

5 Visualization

Question 1 : what is distribution of listing prices ?

[43]:

```
plt.figure(figsize=(10, 6))
sns.histplot(df['price'], bins=50, kde=True, color='red')  # Set histogram color
plt.title('Distribution of Listing Prices')
plt.xlabel('Price ($)')
plt.ylabel('Frequency')
plt.show()
```

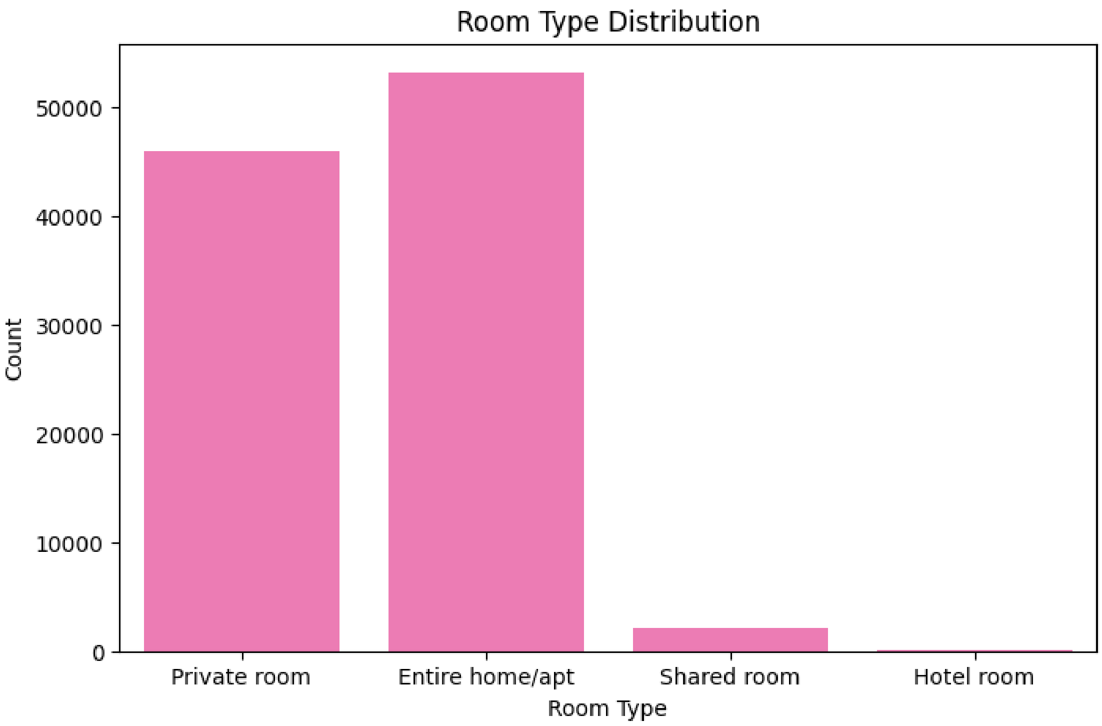


The histogram shows a fairly even distribution of listing prices across different price ranges, indicating no particular concentration of listings in any specific price range. The KDE line helps visualize this even spread more clearly, confirming that the dataset contains listings with a wide variety of prices.

Question 2 : How are different room types distributed ?

[50]:

```
plt.figure(figsize = (8,5))
sns.countplot(x='room type',data=df ,color = 'hotpink')
plt.title('Room Type Distribution')
plt.xlabel('Room Type')
plt.ylabel('Count')
plt.show()
```

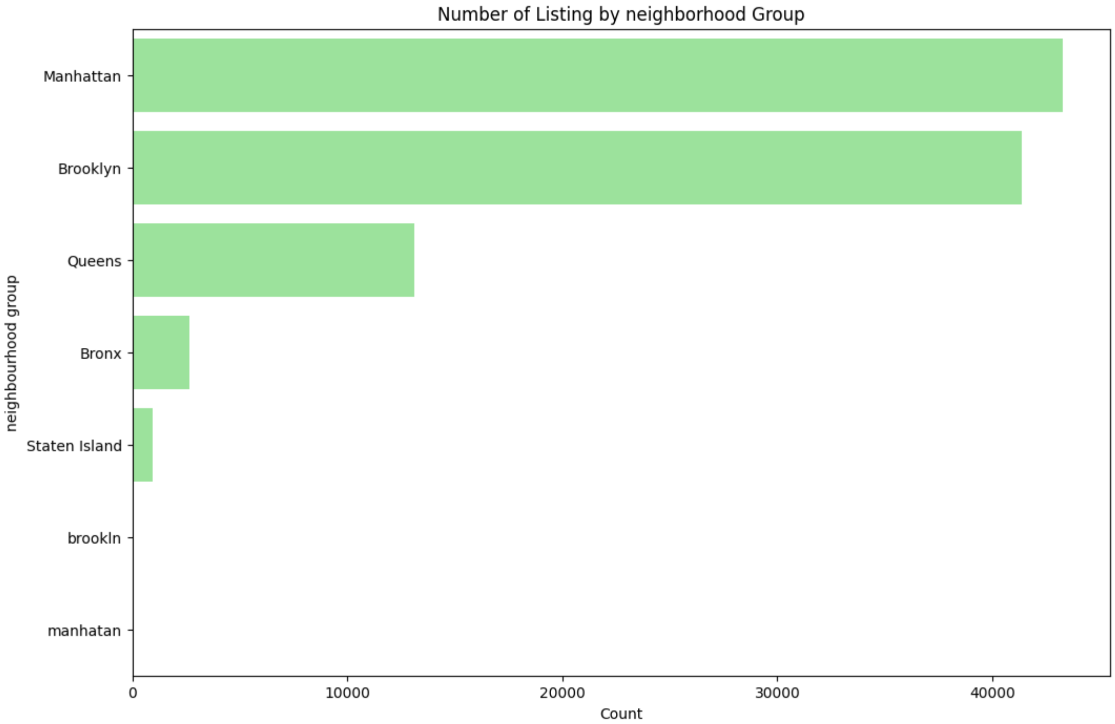


The count plot shows a clear distribution of the different room types available in the Airbnb dataset. The majority of listings are for 'Entire home/apt' and 'Private room', with 'Shared room' and 'Hotel room' being much less common. This insight can be useful for understanding the availability and popularity of different types of accommodations on Airbnb.

Question 3 : How are listing distributed across different neighborhoods

[54]:

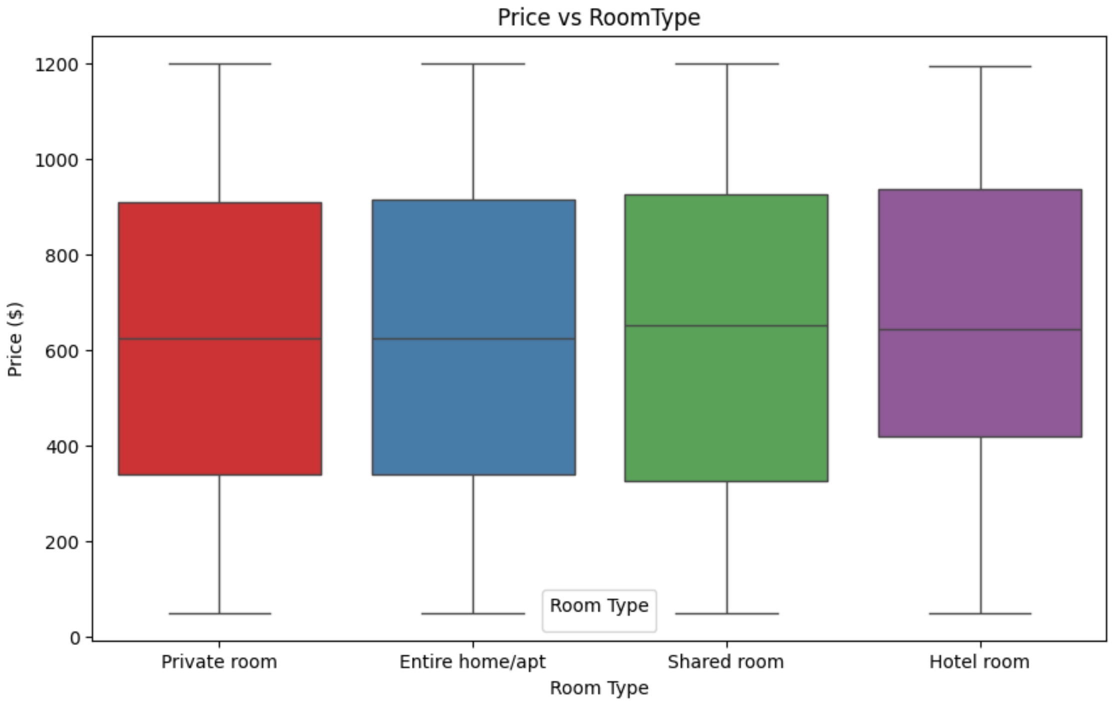
```python
plt.figure(figsize = (12,8))
sns.countplot(y='neighbourhood group', data = df, color = 'lightgreen', order=df['neighbourhood group'].value_counts().index)
plt.title('Number of Listing by neighborhood Group')
plt.xlabel('Count')
plt.ylabel('neighbourhood group')
plt.show()
```



Question 4 : what is the relationship between price and room type

```
[58]: plt.figure(figsize=(10, 6))
sns.boxplot(
    x='room type',
    y='price',
    hue='room type',
    data=df,
    palette='Set1'  # Use 'Set1' with a capital "S" (case-sensitive)
)
plt.title('Price vs RoomType')
plt.xlabel('Room Type')
plt.ylabel('Price ($)')
plt.legend(title='Room Type')
plt.show()
```

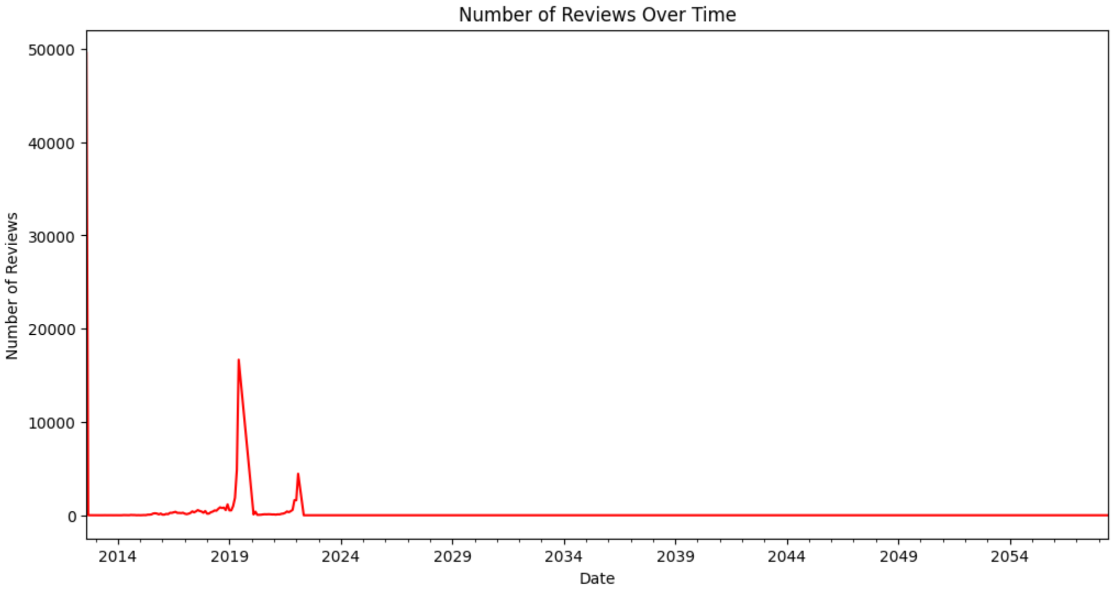
```
C:\Users\91868\AppData\Local\Temp\ipykernel_26824\1323814939.py:12: UserWarning:
No artists with labels found to put in legend.  Note that artists whose label
start with an underscore are ignored when legend() is called with no argument.
  plt.legend(title='Room Type')
```



Price vs. Room Type The box plot provides a detailed view of how prices vary across different room types in the Airbnb dataset. It shows that while 'Shared room' tends to have lower prices, 'Private room', 'Entire home/apt', and 'Hotel room' have higher and more varied price ranges. This visualization helps in understanding the pricing dynamics for different types of accommodations on Airbnb.

Question 5 : How has the number of review change over with time

[62]:
```python
# Convert 'last review' column to datetime format
df['last review'] = pd.to_datetime(df['last review'])

# Group data by month and calculate the number of reviews
reviews_over_time = df.groupby(df['last review'].dt.to_period('M')).size()

# Plot the data
plt.figure(figsize=(12, 6))
reviews_over_time.plot(kind='line', color='red')
plt.title('Number of Reviews Over Time')
plt.xlabel('Date')
plt.ylabel('Number of Reviews')
plt.show()
```



The line plot provides a clear visualization of the number of reviews over time. It helps identify trends and patterns in review activity, such as periods of high or low activity. This information can be useful for understanding the dynamics of user engagement and the popularity of Airbnb listings over time. The significant spikes and drops in reviews might be worth further investigation to understand the underlying causes, such as changes in Airbnb policies, market conditions, or external events.