Code to import CSV File :

In [1]:

```
from google.colab import files
uploaded = files.upload()
```

Choose Files No file chosen

Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving AB_NYC_2019.csv to AB_NYC_2019.csv
```

Import all libraries :

In [4]:

```
import numpy as np
from scipy import stats
import pandas as pd

import matplotlib
import matplotlib.pyplot as plt
import seaborn as sns

import sklearn
from sklearn import preprocessing
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import MinMaxScaler
from sklearn.preprocessing import LabelEncoder
from sklearn.preprocessing import OneHotEncoder
from sklearn.preprocessing import PolynomialFeatures

from sklearn.model_selection import train_test_split
from sklearn.model_selection import KFold
from sklearn.model_selection import GridSearchCV

from sklearn import metrics
from sklearn.metrics import mean_squared_error
from sklearn.metrics import mean_absolute_error
from sklearn.metrics import r2_score
from sklearn.metrics import mean_absolute_error

from sklearn.linear_model import LinearRegression
from sklearn.linear_model import LogisticRegression
from sklearn.linear_model import Ridge
from sklearn.linear_model import Lasso
from sklearn.linear_model import ElasticNet

from sklearn.ensemble import RandomForestRegressor
from sklearn.ensemble import GradientBoostingRegressor
from sklearn.ensemble import ExtraTreesClassifier
from sklearn.tree import DecisionTreeRegressor
from sklearn import svm

import warnings
warnings.filterwarnings('ignore')
```

In [5]:
```
df = pd.read_csv("AB_NYC_2019.csv")
```

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

Out[6]:

	id	name	host_id	host_name	neighbourhood_group	neighbourhood	latitude	longitude	room_type	price	minimum_nights	num
0	2539	Clean & quiet apt home by the park	2787	John	Brooklyn	Kensington	40.64749	-73.97237	Private room	149	1	
1	2595	Skylit Midtown Castle	2845	Jennifer	Manhattan	Midtown	40.75362	-73.98377	Entire home/apt	225	1	
2	3647	THE VILLAGE OF HARLEM....NEW YORK !	4632	Elisabeth	Manhattan	Harlem	40.80902	-73.94190	Private room	150	3	
3	3831	Cozy Entire Floor of Brownstone	4869	LisaRoxanne	Brooklyn	Clinton Hill	40.68514	-73.95976	Entire home/apt	89	1	
4	5022	Entire Apt: Spacious Studio/Loft by central park	7192	Laura	Manhattan	East Harlem	40.79851	-73.94399	Entire home/apt	80	10	

In [7]:
```
df.tail()
```

Out[7]:

	id	name	host_id	host_name	neighbourhood_group	neighbourhood	latitude	longitude	room_type	price	minimum_night
48890	36484665	Charming one bedroom - newly renovated rowhouse	8232441	Sabrina	Brooklyn	Bedford-Stuyvesant	40.67853	-73.94995	Private room	70	
48891	36485057	Affordable room in Bushwick/East Williamsburg	6570630	Marisol	Brooklyn	Bushwick	40.70184	-73.93317	Private room	40	
48892	36485431	Sunny Studio at Historical Neighborhood	23492952	Ilgar & Aysel	Manhattan	Harlem	40.81475	-73.94867	Entire home/apt	115	1
48893	36485609	43rd St. Time Square-cozy single bed	30985759	Taz	Manhattan	Hell's Kitchen	40.75751	-73.99112	Shared room	55	
48894	36487245	Trendy duplex in the very heart of Hell's Kitchen	68119814	Christophe	Manhattan	Hell's Kitchen	40.76404	-73.98933	Private room	90	

Column information :

In [8]:

```
#id: listing ID
#name: name of the listing
#host_id: host ID
#host_name: name of the host
#neighbourhood_group: location
#neighbourhood: area
#latitude: latitude coordinates
#longitude: longitude coordinates
#room_type: listing space type
#price: price in dollars
#number_of_reviews: number of reviews
#last_review: latest review
#reviews_per_month: number of reviews per month
#calculated_host_listings_count: amount of listing per host
#availability_365: number of days when listing is available for booking
```

Data Type :

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

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 48895 entries, 0 to 48894
Data columns (total 16 columns):
 #   Column                          Non-Null Count  Dtype  
---  ------                          --------------  -----  
 0   id                              48895 non-null  int64  
 1   name                            48879 non-null  object 
 2   host_id                         48895 non-null  int64  
 3   host_name                       48874 non-null  object 
 4   neighbourhood_group             48895 non-null  object 
 5   neighbourhood                   48895 non-null  object 
 6   latitude                        48895 non-null  float64
 7   longitude                       48895 non-null  float64
 8   room_type                       48895 non-null  object 
 9   price                           48895 non-null  int64  
 10  minimum_nights                  48895 non-null  int64  
 11  number_of_reviews               48895 non-null  int64  
 12  last_review                     38843 non-null  object 
 13  reviews_per_month               38843 non-null  float64
 14  calculated_host_listings_count  48895 non-null  int64  
 15  availability_365                48895 non-null  int64  
dtypes: float64(3), int64(7), object(6)
memory usage: 6.0+ MB
```

Checking for missing value :

In [10]:

```
df.isnull().sum()
```

Out[10]:

```
id                                    0
name                                 16
host_id                               0
host_name                            21
neighbourhood_group                   0
neighbourhood                         0
latitude                              0
longitude                             0
room_type                             0
price                                 0
minimum_nights                        0
number_of_reviews                     0
last_review                       10052
reviews_per_month                 10052
calculated_host_listings_count        0
availability_365                      0
dtype: int64
```

Replacing missing values :

In [11]:

```
df.fillna({'reviews_per_month':0}, inplace=True)
df.fillna({'name':"NoName"}, inplace=True)
df.fillna({'host_name':"NoName"}, inplace=True)
df.fillna({'last_review':"NotReviewed"}, inplace=True)
```

Again check for missing value :

In [12]:
```
df.isnull().sum()
```

Out[12]:
```
id                                0
name                              0
host_id                           0
host_name                         0
neighbourhood_group               0
neighbourhood                     0
latitude                          0
longitude                         0
room_type                         0
price                             0
minimum_nights                    0
number_of_reviews                 0
last_review                       0
reviews_per_month                 0
calculated_host_listings_count    0
availability_365                  0
dtype: int64
```

Drop unwanted columns :

In [13]:
```
df.drop(['name','id','host_name','last_review'], axis=1, inplace=True)
```

Shape of the dataset :

In [14]:
```
df.shape
```

Out[14]:
```
(48895, 12)
```

All details of the dataset :

In [15]:

```
df.describe()
```

Out[15]:

	host_id	latitude	longitude	price	minimum_nights	number_of_reviews	reviews_per_month	calculated_host_listings_co
count	4.889500e+04	48895.000000	48895.000000	48895.000000	48895.000000	48895.000000	48895.000000	48895.000
mean	6.762001e+07	40.728949	-73.952170	152.720687	7.029962	23.274466	1.090910	7.143
std	7.861097e+07	0.054530	0.046157	240.154170	20.510550	44.550582	1.597283	32.952
min	2.438000e+03	40.499790	-74.244420	0.000000	1.000000	0.000000	0.000000	1.000
25%	7.822033e+06	40.690100	-73.983070	69.000000	1.000000	1.000000	0.040000	1.000
50%	3.079382e+07	40.723070	-73.955680	106.000000	3.000000	5.000000	0.370000	1.000
75%	1.074344e+08	40.763115	-73.936275	175.000000	5.000000	24.000000	1.580000	2.000
max	2.743213e+08	40.913060	-73.712990	10000.000000	1250.000000	629.000000	58.500000	327.000

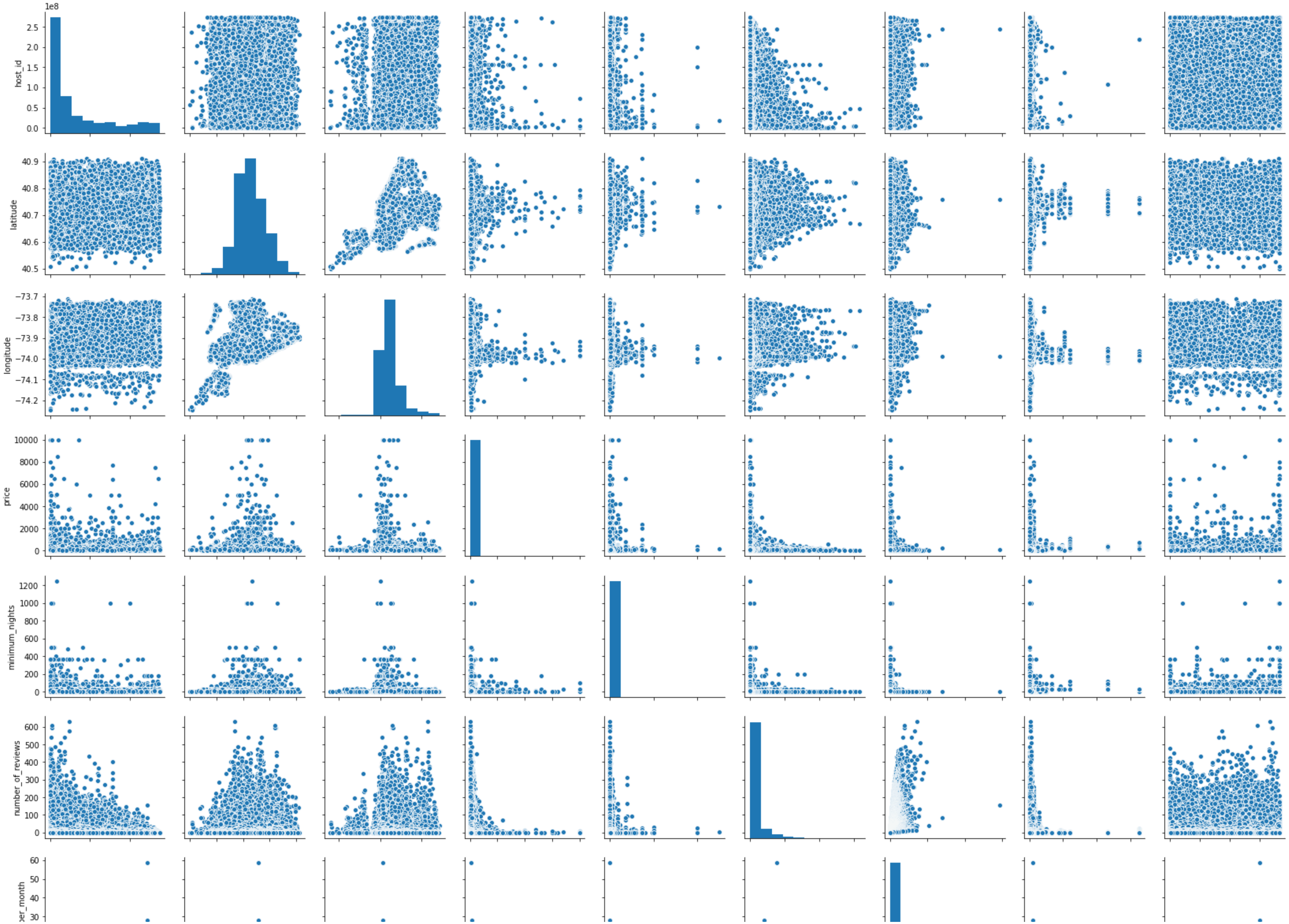
In [17]:

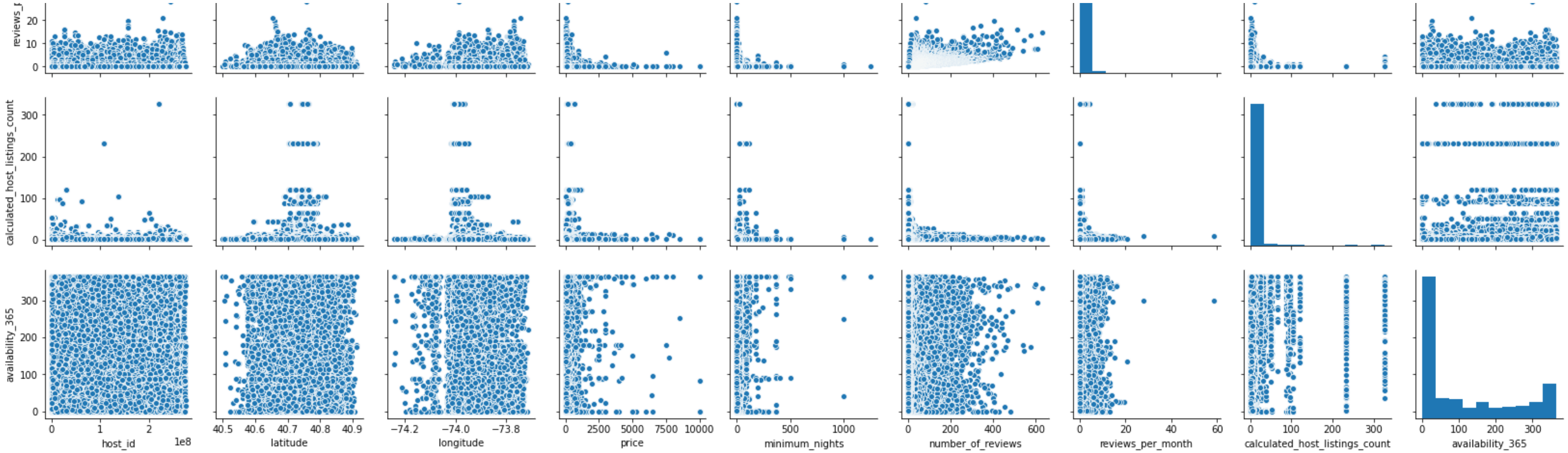
```
print('Rows     :',df.shape[0])
print('Columns  :',df.shape[1])
print('\nFeatures :\n     :',df.columns.tolist())
print('\nMissing values    :',df.isnull().values.sum())
print('\nUnique values :  \n',df.nunique())
```

```
Rows     : 48895
Columns  : 12

Features :
     : ['host_id', 'neighbourhood_group', 'neighbourhood', 'latitude', 'longitude', 'room_type', 'price', 'minimum_nigh
ts', 'number_of_reviews', 'reviews_per_month', 'calculated_host_listings_count', 'availability_365']

Missing values    : 0

Unique values :
 host_id                           37457
neighbourhood_group                   5
neighbourhood                       221
latitude                          19048
longitude                         14718
room_type                             3
price                               674
minimum_nights                      109
number_of_reviews                   394
reviews_per_month                   938
calculated_host_listings_count       47
availability_365                    366
dtype: int64
```

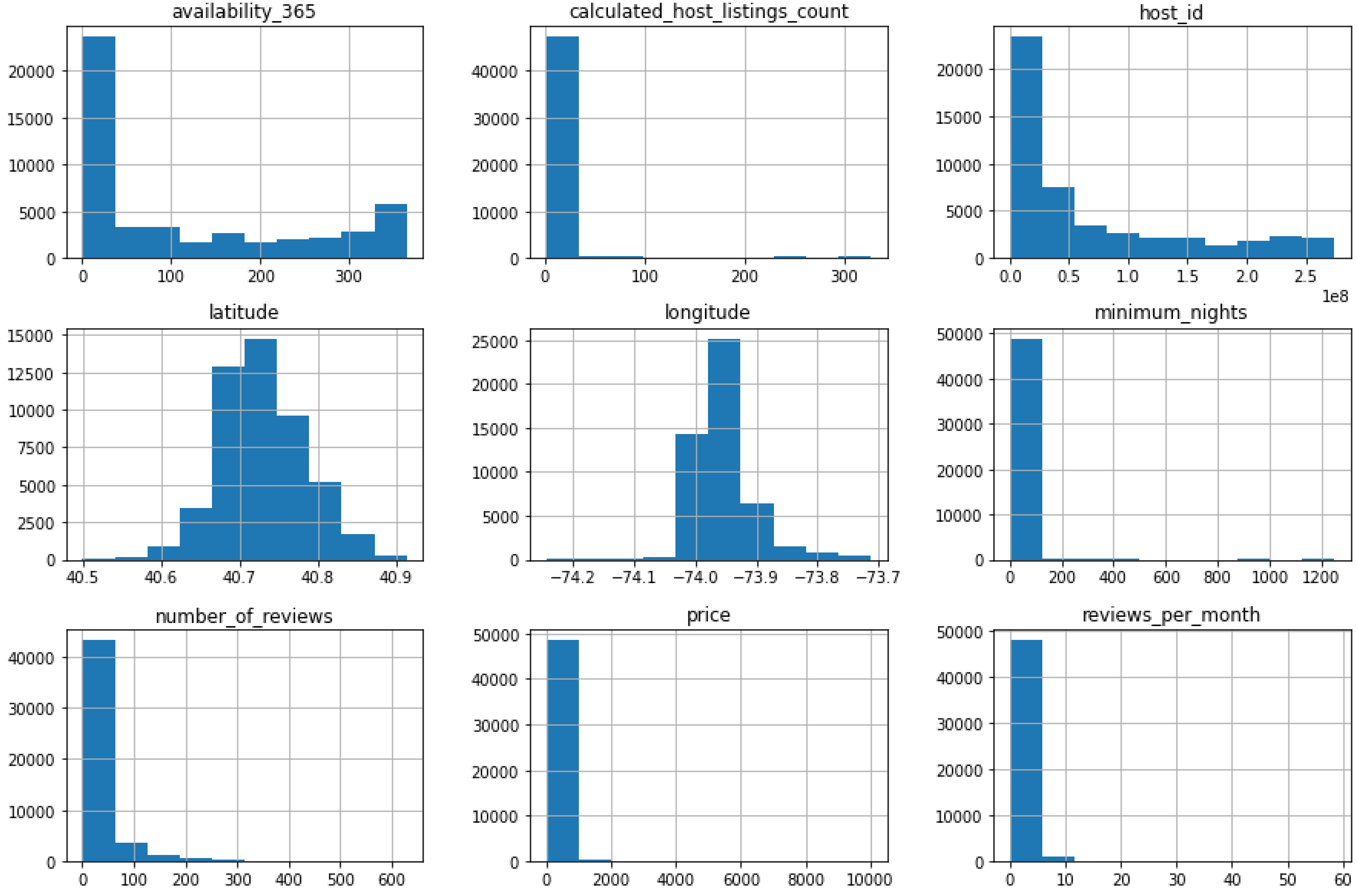
Visualization :

In [18]:
```
sns.pairplot(df)
plt.show()
```




reviews_p
20
10
0
calculated_host_listings_count
300
200
100
0
availability_365
300
200
100
0
0
1
2
1e8
host_id
40.5
40.6
40.7
40.8
40.9
latitude
−74.2
−74.0
−73.8
longitude
0
2500
5000
7500
10000
price
0
500
1000
minimum_nights
0
200
400
600
number_of_reviews
0
20
40
60
reviews_per_month
0
100
200
300
calculated_host_listings_count
0
100
200
300
availability_365

In [19]:
```
fig = plt.figure(figsize = (15,10))
ax = fig.gca()
df.hist(ax=ax)
plt.show()
```

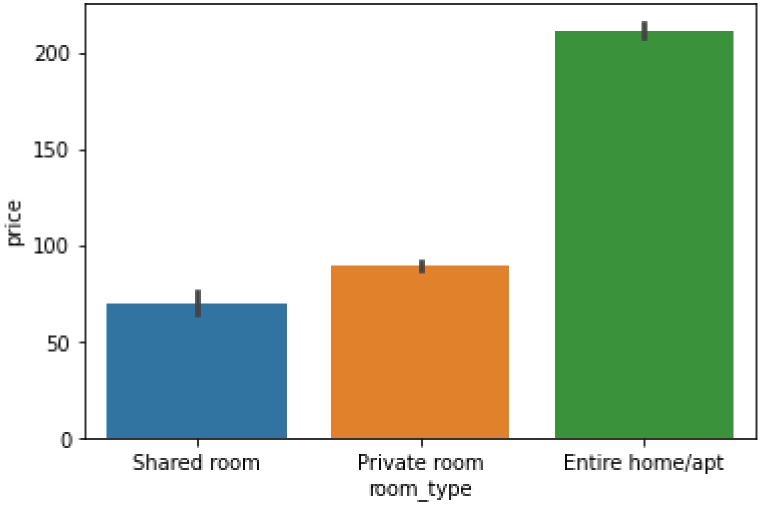


In [21]:

```
#room_type - price
result = df.groupby(["room_type"])['price'].aggregate(np.median).reset_index().sort_values('price')
sns.barplot(x='room_type', y="price", data=df, order=result['room_type'])
```

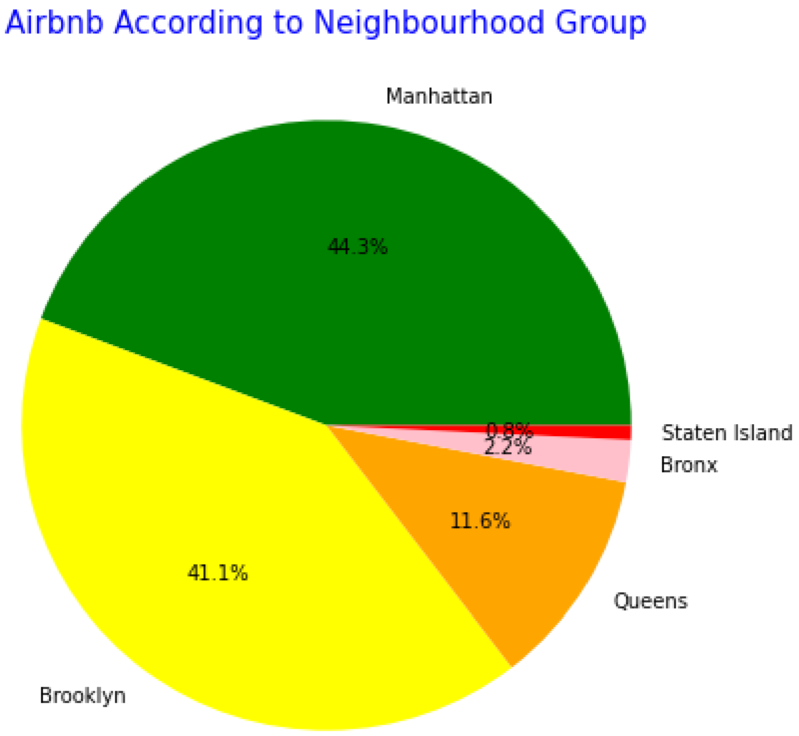
Out[21]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f81f9164dd8>
```

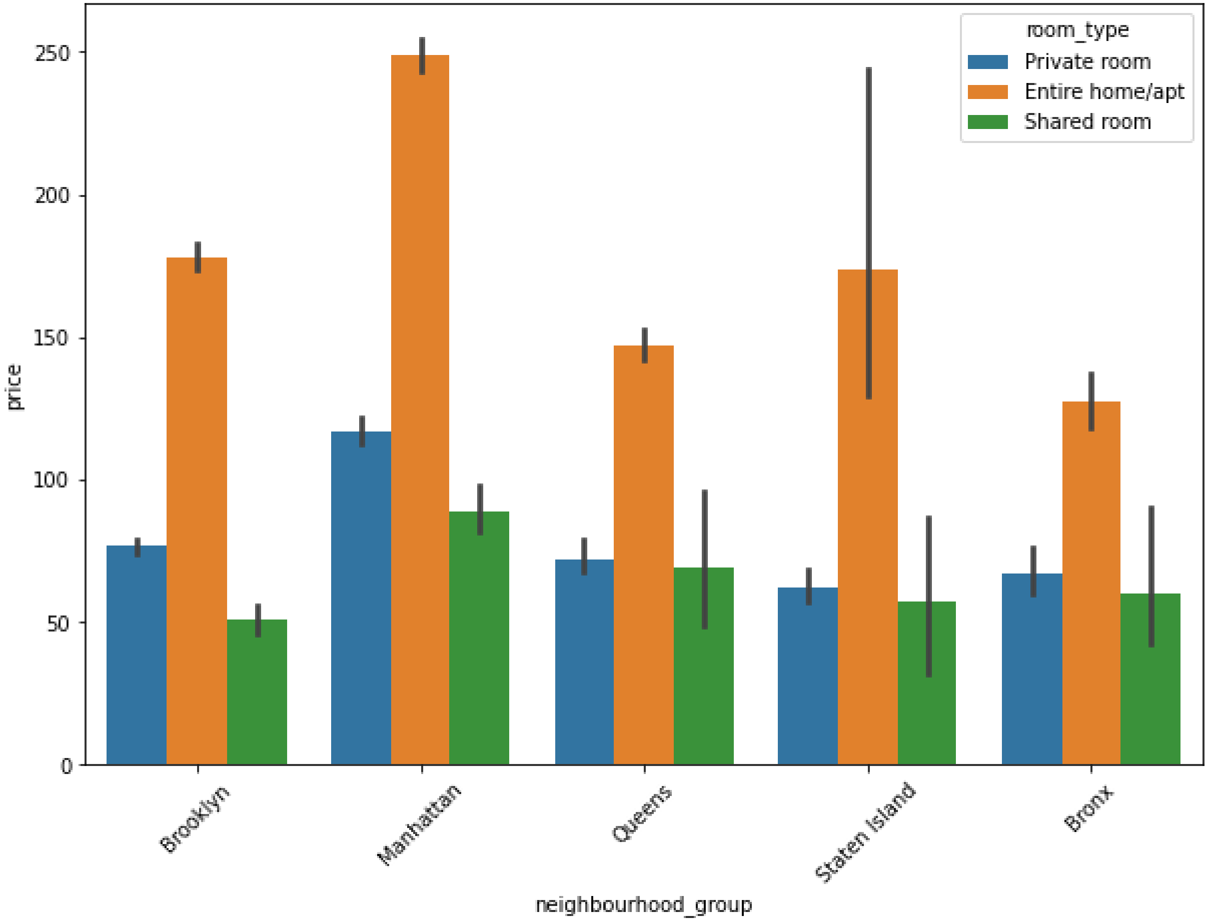


In [22]:

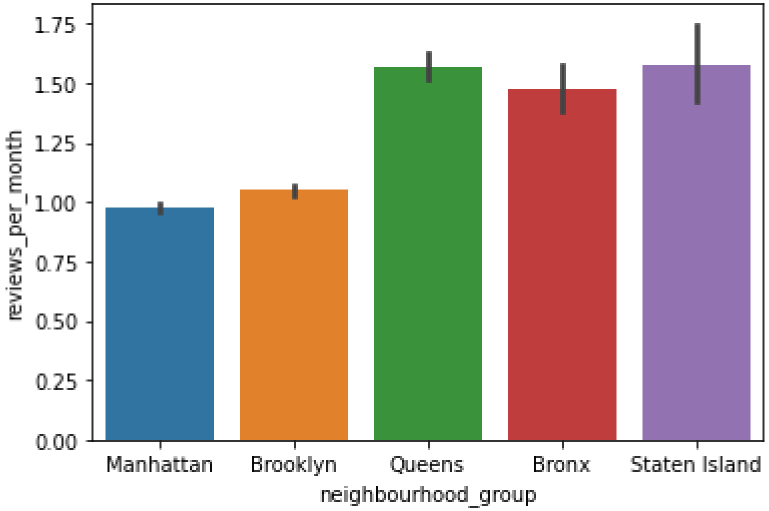
```
labels = df.neighbourhood_group.value_counts().index
colors = ['green','yellow','orange','pink','red']
explode = [0,0,0,0,0]
sizes = df.neighbourhood_group.value_counts().values

plt.figure(0,figsize = (7,7))
plt.pie(sizes, explode=explode, labels=labels, colors=colors, autopct='%1.1f%%')
plt.title('Airbnb According to Neighbourhood Group',color = 'blue',fontsize = 15)
plt.show()
```



In [23]:
```
plt.figure(figsize=(10,7))
sns.barplot(x = "neighbourhood_group", y = "price", hue = "room_type", data = df)
plt.xticks(rotation=45)
plt.show()
```

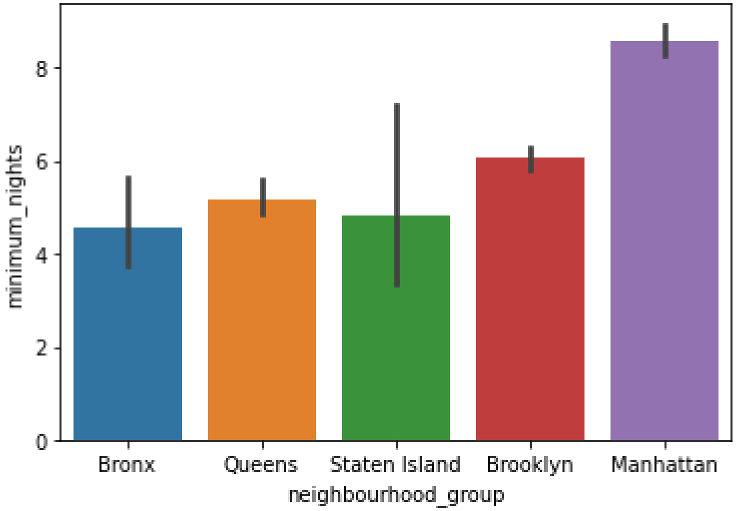


In [25]:
```
#neighbourhood_group - reviews_per_month
result = df.groupby(["neighbourhood_group"])['reviews_per_month'].aggregate(np.median).reset_index().sort_values('review
sns.barplot(x='neighbourhood_group', y="reviews_per_month", data=df, order=result['neighbourhood_group'])
plt.show()
```



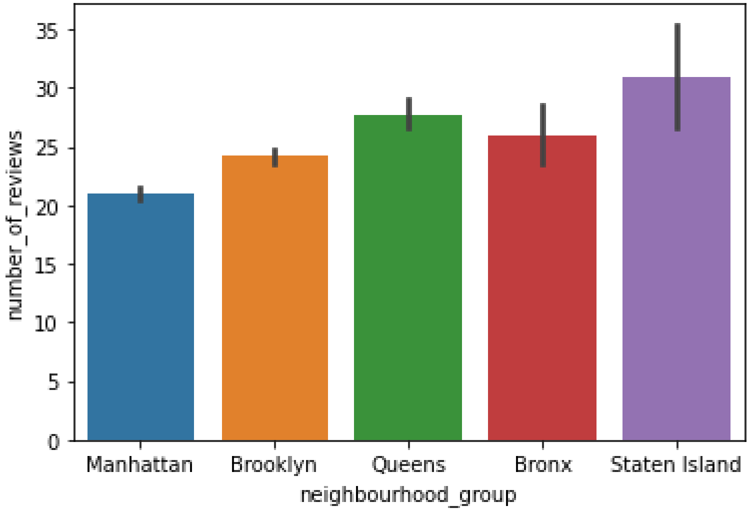
In [26]:

```
#neighbourhood_group - minimum_nights
result = df.groupby(["neighbourhood_group"])['minimum_nights'].aggregate(np.median).reset_index().sort_values('minimum_n
sns.barplot(x='neighbourhood_group', y="minimum_nights", data=df, order=result['neighbourhood_group'])
plt.show()
```

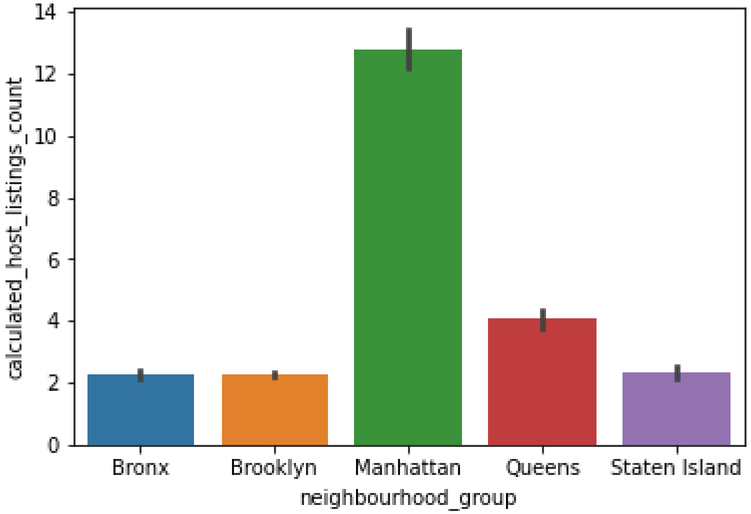


In [27]:

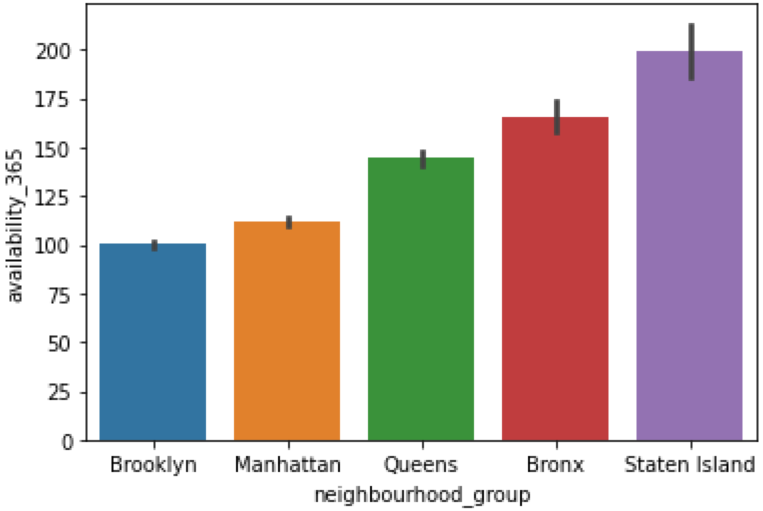
```
#neighbourhood_group - number_of_reviews
result = df.groupby(["neighbourhood_group"])['number_of_reviews'].aggregate(np.median).reset_index().sort_values('number
sns.barplot(x='neighbourhood_group', y="number_of_reviews", data=df, order=result['neighbourhood_group'])
plt.show()
```



```
In [29]: #neighbourhood_group - calculated_host_listings_count
         result = df.groupby(["neighbourhood_group"])['calculated_host_listings_count'].aggregate(np.median).reset_index().sort_va
         sns.barplot(x='neighbourhood_group', y="calculated_host_listings_count", data=df, order=result['neighbourhood_group'])
         plt.show()
```



In [30]:
```
#neighbourhood_group - availability_365
result = df.groupby(["neighbourhood_group"])['availability_365'].aggregate(np.median).reset_index().sort_values('availab
sns.barplot(x='neighbourhood_group', y="availability_365", data=df, order=result['neighbourhood_group'])
plt.show()
```



Corrleation :

In [32]:
```
corr=df.corr()
```

In [33]:

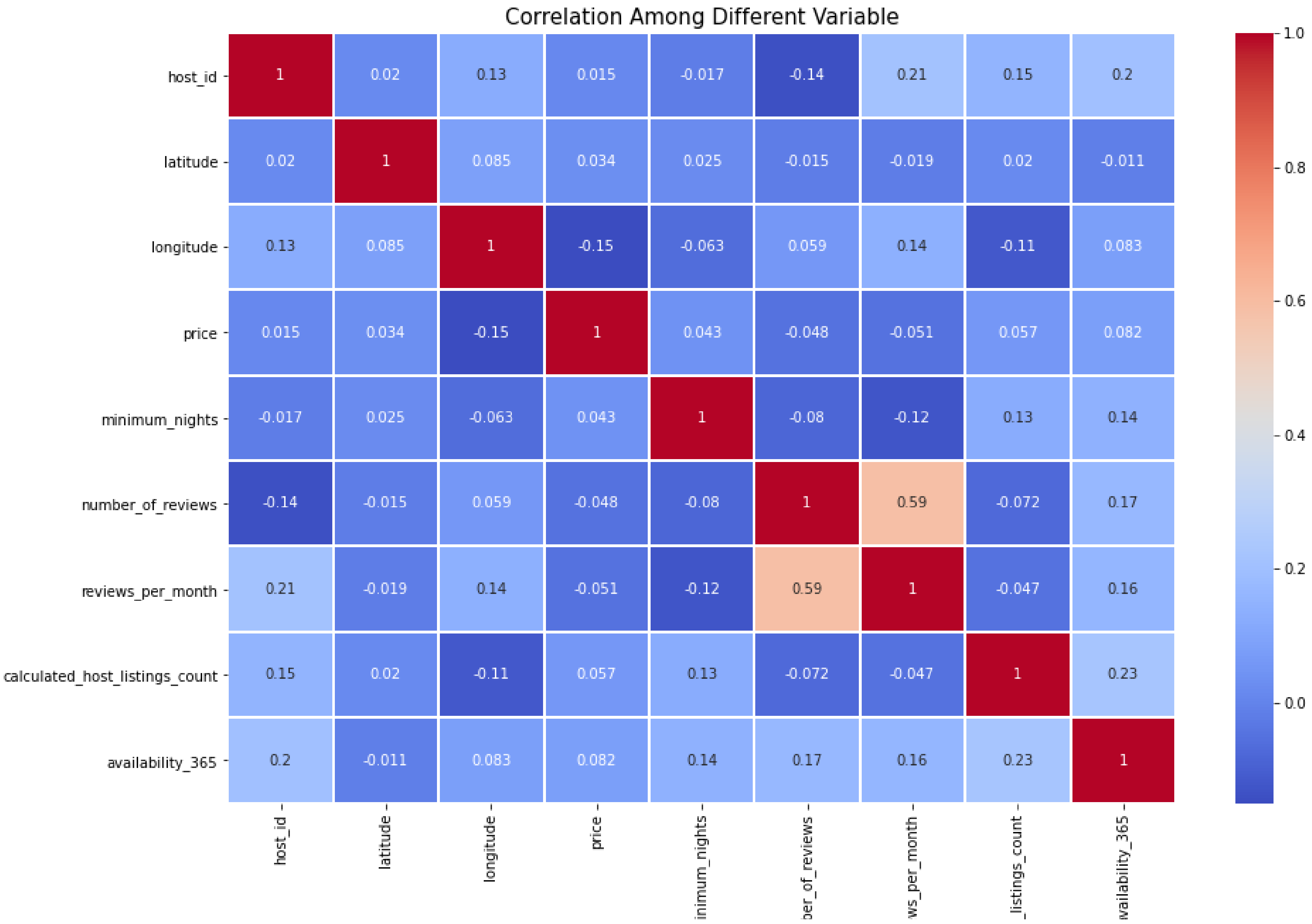
```
corr
```

Out[33]:

	host_id	latitude	longitude	price	minimum_nights	number_of_reviews	reviews_per_month	calculated_host_l
host_id	1.000000	0.020224	0.127055	0.015309	-0.017364	-0.140106	0.209783	
latitude	0.020224	1.000000	0.084788	0.033939	0.024869	-0.015389	-0.018758	
longitude	0.127055	0.084788	1.000000	-0.150019	-0.062747	0.059094	0.138516	
price	0.015309	0.033939	-0.150019	1.000000	0.042799	-0.047954	-0.050564	
minimum_nights	-0.017364	0.024869	-0.062747	0.042799	1.000000	-0.080116	-0.124905	
number_of_reviews	-0.140106	-0.015389	0.059094	-0.047954	-0.080116	1.000000	0.589407	
reviews_per_month	0.209783	-0.018758	0.138516	-0.050564	-0.124905	0.589407	1.000000	
calculated_host_listings_count	0.154950	0.019517	-0.114713	0.057472	0.127960	-0.072376	-0.047312	
availability_365	0.203492	-0.010983	0.082731	0.081829	0.144303	0.172028	0.163732	

Corrleation using heatmap :

In [34]:
```
fig,ax=plt.subplots(figsize=(15,10))
sns.heatmap(corr,annot=True,cmap = 'coolwarm',linewidth = 1)
plt.title("Correlation Among Different Variable",size=15);
```



Seprating numarical and categorical data :

In [35]:
```
df_num = df.select_dtypes(["float64","int64"])
```

In [37]:
```
df_num.head()
```

Out[37]:

	host_id	latitude	longitude	price	minimum_nights	number_of_reviews	reviews_per_month	calculated_host_listings_count	availability_365
0	2787	40.64749	-73.97237	149	1	9	0.21	6	365
1	2845	40.75362	-73.98377	225	1	45	0.38	2	355
2	4632	40.80902	-73.94190	150	3	0	0.00	1	365
3	4869	40.68514	-73.95976	89	1	270	4.64	1	194
4	7192	40.79851	-73.94399	80	10	9	0.10	1	0

In [38]:
```
df_cat = df.select_dtypes(object)
```

In [39]:
```
df_cat.head()
```

Out[39]:

	neighbourhood_group	neighbourhood	room_type
0	Brooklyn	Kensington	Private room
1	Manhattan	Midtown	Entire home/apt
2	Manhattan	Harlem	Private room
3	Brooklyn	Clinton Hill	Entire home/apt
4	Manhattan	East Harlem	Entire home/apt

In [40]:
```
le = LabelEncoder()
```

In [41]:
```
for col in df_cat:
    le = LabelEncoder()
    df_cat[col] = le.fit_transform(df_cat[col])
```

In [42]:
```
df_cat.head()
```

Out[42]:

	neighbourhood_group	neighbourhood	room_type
0	1	108	1
1	2	127	0
2	2	94	1
3	1	41	0
4	2	61	0

New Dataset :

In [43]:
```
df_new = pd.concat([df_cat,df_num],axis=1)
```

In [44]:
```
df_new.head()
```

Out[44]:

	neighbourhood_group	neighbourhood	room_type	host_id	latitude	longitude	price	minimum_nights	number_of_reviews	reviews_per_month
0	1	108	1	2787	40.64749	-73.97237	149	1	9	0.21
1	2	127	0	2845	40.75362	-73.98377	225	1	45	0.38
2	2	94	1	4632	40.80902	-73.94190	150	3	0	0.00
3	1	41	0	4869	40.68514	-73.95976	89	1	270	4.64
4	2	61	0	7192	40.79851	-73.94399	80	10	9	0.10

Defining X and y variable :

```
In [45]: X = df_new.drop("price",axis=1)
         y = df_new["price"]
```

Spliting into training and testing models :

```
In [48]: X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.3,random_state=1)
```

Linear Regression :

```
In [49]: model1 = LinearRegression()
         model1.fit(X_train,y_train)

         print(model1.intercept_)
         print(model1.coef_)

         y_pred = model1.predict(X_test)
         mse = mean_squared_error(y_test,y_pred)
         rmse = np.sqrt(mse)

         r2 = r2_score(y_test,y_pred)

         print("mse: {}, rmse: {}, r2: {}".format(mse,rmse,r2))
```

```
-52453.284982196
[ 1.00478724e+01  1.00290934e-01 -1.04161241e+02  1.01280664e-07
  1.44188287e+02 -6.32042610e+02 -1.10410313e-01 -2.03606765e-01
 -4.67034755e+00 -1.30186785e-01  1.97577285e-01]
mse: 54332.28488107933, rmse: 233.09286750366115, r2: 0.078823975910572
```

Random Forest Regressor :

In [76]:

```
model4=RandomForestRegressor(n_estimators = 30, random_state = 42)

model4.fit(X_train,y_train)

y_pred = model4.predict(X_test)
mse = mean_squared_error(y_test,y_pred)
rmse = np.sqrt(mse)
r2 = r2_score(y_test,y_pred)

print("mse: {}, rmse: {}, r2: {}".format(mse,rmse,r2))
```

```
mse: 53034.02687542975, rmse: 230.29117845768593, r2: 0.10083527454276009
```

With particular features and need to preprocesss the data :

In [78]:

```
# We will make model to only use listings which has price set up. Their are multiple listings with no prices.
# We will also use listings which has availability_365>0
df=df[df.price>0]
df=df[df.availability_365>0]
```

In [79]:

```
from sklearn.preprocessing import LabelEncoder
# Fit label encoder
le = LabelEncoder()
# Transform labels to normalized encoding.
le.fit(df['neighbourhood_group'])
df['neighbourhood_group']=le.transform(df['neighbourhood_group'])

le = LabelEncoder()
le.fit(df['neighbourhood'])
df['neighbourhood']=le.transform(df['neighbourhood'])

le =LabelEncoder()
le.fit(df['room_type'])
df['room_type']=le.transform(df['room_type'])

df.sort_values(by='price',ascending=True,inplace=True)

df.head()
```

Out[79]:

	host_id	neighbourhood_group	neighbourhood	latitude	longitude	room_type	price	minimum_nights	number_of_reviews	reviews_per_r
22835	97001292	3	104	40.69085	-73.79916	0	10	1	43	
31407	91034542	2	111	40.74408	-73.97803	1	10	5	42	
32810	167570251	1	188	40.66242	-73.99464	0	10	1	14	
33225	197169969	3	104	40.68939	-73.79886	0	10	2	22	
35386	47516406	3	215	40.69139	-73.86086	1	10	7	4	

In [80]:

```
X = df[['neighbourhood_group','neighbourhood','room_type','number_of_reviews','reviews_per_month','availability_365']]
#The np.log10() method returns base-10 logarithm of x for x > 0
y=np.log10(df.price)

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=101)
```

Linear Regression :

In [81]:

```
model6 = LinearRegression()
model6.fit(X_train,y_train)

y_predicts = model6.predict(X_test)

print("""
        Mean Squared Error: {}
        R2 Score: {}
        Mean Absolute Error: {}
     """.format(
        np.sqrt(metrics.mean_squared_error(y_test, y_predicts)),
        r2_score(y_test,y_predicts) * 100,
        mean_absolute_error(y_test,y_predicts)
        ))
```

```
        Mean Squared Error: 0.23578065291490327
        R2 Score: 41.0461361498634
        Mean Absolute Error: 0.17640746161192752
```

Random Forest Regressor :

In [84]:

```
### Initially, lets build a tree without any constraints.
model8 = RandomForestRegressor(n_estimators=300)
model8.fit(X_train,y_train)
```

Out[84]:

```
RandomForestRegressor(bootstrap=True, ccp_alpha=0.0, criterion='mse',
                      max_depth=None, max_features='auto', max_leaf_nodes=None,
                      max_samples=None, min_impurity_decrease=0.0,
                      min_impurity_split=None, min_samples_leaf=1,
                      min_samples_split=2, min_weight_fraction_leaf=0.0,
                      n_estimators=300, n_jobs=None, oob_score=False,
                      random_state=None, verbose=0, warm_start=False)
```

In [85]:

```
y_predicts = model8.predict(X_test)
# score() method to determine model accuracy
print(model8.score(X_train,y_train))
```

```
0.9194667585671353
```

In [86]:

```
y_predicts = model8.predict(X_test)

print("""
        Mean Squared Error: {}
        Mean Absolute Error: {}
        R2 Score: {}

     """.format(
        np.sqrt(metrics.mean_squared_error(y_test, y_predicts)),
        mean_absolute_error(y_test,y_predicts),
        r2_score(y_test,y_predicts) * 100

        ))
```

```

        Mean Squared Error: 0.21102322866253126
        Mean Absolute Error: 0.15217152904010087
        R2 Score: 52.77668516342187
```

Prediction :

In [89]:

```
df = pd.DataFrame({'Actual': np.round(10 ** y_test, 0),
                   'Predicted': np.round(10 ** y_predicts, 0)})
df
```

Out[89]:

```
       Actual  Predicted
34969    69.0       45.0
36826   149.0      115.0
 5146   195.0      142.0
28125    50.0       92.0
 9134    75.0       81.0
  ...     ...        ...
28481    55.0       45.0
48152    99.0      134.0
48802   150.0      182.0
33827    65.0       67.0
  611   135.0      207.0

6271 rows × 2 columns
```