Data cleaning

In [1]:

```
import pandas as pd
import numpy as np
from matplotlib import pyplot as plt
%matplotlib inline
import matplotlib
matplotlib.rcParams["figure.figsize"] = (20,10)
```

Importing the Data Set

In [2]:

```
df= pd.read_csv('datasets_20710_26737_Bengaluru_House_Data.csv')
df.head()
```

Out[2]:

	area_type	availability	location	size	society	total_sqft	bath	balcony	price
0	Super built-up Area	19-Dec	Electronic City Phase II	2 BHK	Coomee	1056	2.0	1.0	39.07
1	Plot Area	Ready To Move	Chikka Tirupathi	4 Bedroom	Theanmp	2600	5.0	3.0	120.00
2	Built-up Area	Ready To Move	Uttarahalli	3 BHK	NaN	1440	2.0	3.0	62.00
3	Super built-up Area	Ready To Move	Lingadheeranahalli	3 BHK	Soiewre	1521	3.0	1.0	95.00
4	Super built-up Area	Ready To Move	Kothanur	2 BHK	NaN	1200	2.0	1.0	51.00

In [3]:

```
df.shape #size of the data set to get to know how may data point we are having
```

Out[3]:

```
(13320, 9)
```

In [4]:

```
df.groupby('area_type')['area_type'].agg('count')
#so we are grouping the data
#This a catogorical variable as we can see they are divided into various catogories
 and the respective count is displayed
```

Out[4]:

```
area_type
Built-up  Area          2418
Carpet  Area              87
Plot  Area              2025
Super built-up  Area    8790
Name: area_type, dtype: int64
```

Now Analyse what variables will be dependent on the dependent variable X i.e price

In [5]:

```
df1= df.drop(['availability','area_type','society','balcony',], axis='columns')
df1.head()
#so here we have removed a few variables to make our code easy but we can still depen
d on few variables
#but they are being dropped here
```

Out[5]:

	location	size	total_sqft	bath	price
0	Electronic City Phase II	2 BHK	1056	2.0	39.07
1	Chikka Tirupathi	4 Bedroom	2600	5.0	120.00
2	Uttarahalli	3 BHK	1440	2.0	62.00
3	Lingadheeranahalli	3 BHK	1521	3.0	95.00
4	Kothanur	2 BHK	1200	2.0	51.00

In [6]:

```
df1.isnull().sum() # this showes the sum of he null values in the data set
```

Out[6]:

```
location        1
size           16
total_sqft      0
bath           73
price           0
dtype: int64
```

In [7]:

```
df2=df1.dropna()
# here we are dropping the null values
```

In [8]:

```
df2.isnull().sum()
```

Out[8]:

```
location      0
size          0
total_sqft    0
bath          0
price         0
dtype: int64
```

In [9]:

```
df3 = df2
```

In [10]:

```
df3['size'].unique() #this coloumn is useless unless and untill we take the integer v
alues and catogrise them properly
```

Out[10]:

```
array(['2 BHK', '4 Bedroom', '3 BHK', '4 BHK', '6 Bedroom', '3 Bedroom',
       '1 BHK', '1 RK', '1 Bedroom', '8 Bedroom', '2 Bedroom',
       '7 Bedroom', '5 BHK', '7 BHK', '6 BHK', '5 Bedroom', '11 BHK',
       '9 BHK', '9 Bedroom', '27 BHK', '10 Bedroom', '11 Bedroom',
       '10 BHK', '19 BHK', '16 BHK', '43 Bedroom', '14 BHK', '8 BHK',
       '12 Bedroom', '13 BHK', '18 Bedroom'], dtype=object)
```

In [11]:

```
df3['Bhk']= df3['size'].apply(lambda x: int(x.split(' ')[0]))
# here we are aquireing the '4' from '4 bhk' which is divided by a space i.e ' ' and
 then placing them in a column and also converting them into integers
```

```
D:\New folder\lib\site-packages\ipykernel_launcher.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/u
ser_guide/indexing.html#returning-a-view-versus-a-copy
  """Entry point for launching an IPython kernel.
```

In [12]:

```
df3['Bhk'].unique()# now we can see we have a unique column of no. of bedrooms
```

Out[12]:

```
array([ 2,  4,  3,  6,  1,  8,  7,  5, 11,  9, 27, 10, 19, 16, 43, 14, 12,
       13, 18], dtype=int64)
```

In [13]:

```
df3.head()
```

Out[13]:

	location	size	total_sqft	bath	price	Bhk
0	Electronic City Phase II	2 BHK	1056	2.0	39.07	2
1	Chikka Tirupathi	4 Bedroom	2600	5.0	120.00	4
2	Uttarahalli	3 BHK	1440	2.0	62.00	3
3	Lingadheeranahalli	3 BHK	1521	3.0	95.00	3
4	Kothanur	2 BHK	1200	2.0	51.00	2

In [14]:

```
df3['total_sqft'].unique()
```

Out[14]:

```
array(['1056', '2600', '1440', ..., '1133 - 1384', '774', '4689'],
      dtype=object)
```

In [15]:

```
def is_float(x):
    try:
     float(x)
    except:
        return False
    return True
```

In [16]:

```
df3[~df3['total_sqft'].apply(is_float)]
```

Out[16]:

	location	size	total_sqft	bath	price	Bhk
30	Yelahanka	4 BHK	2100 - 2850	4.0	186.000	4
122	Hebbal	4 BHK	3067 - 8156	4.0	477.000	4
137	8th Phase JP Nagar	2 BHK	1042 - 1105	2.0	54.005	2
165	Sarjapur	2 BHK	1145 - 1340	2.0	43.490	2
188	KR Puram	2 BHK	1015 - 1540	2.0	56.800	2
...	...	...	...	...	...	...
12975	Whitefield	2 BHK	850 - 1060	2.0	38.190	2
12990	Talaghattapura	3 BHK	1804 - 2273	3.0	122.000	3
13059	Harlur	2 BHK	1200 - 1470	2.0	72.760	2
13265	Hoodi	2 BHK	1133 - 1384	2.0	59.135	2
13299	Whitefield	4 BHK	2830 - 2882	5.0	154.500	4

190 rows × 6 columns

In [17]:

```
def convert_sqft_to_num(x):
    tokens=x.split('-')
    if len(tokens) == 2:
        return (float(tokens[0])+float(tokens[1]))/2
    try:
      return float(x)
    except:
      return None
```

In [18]:
```
convert_sqft_to_num('2166')
```

Out[18]:
```
2166.0
```

In [19]:
```
convert_sqft_to_num('1145 - 1340')
```

Out[19]:
```
1242.5
```

In [20]:
```
df4 = df3.copy()
df4['total_sqft'] = df4['total_sqft'].apply(convert_sqft_to_num)
```

In [21]:
```
df4.head(5)
```

Out[21]:

	location	size	total_sqft	bath	price	Bhk
0	Electronic City Phase II	2 BHK	1056.0	2.0	39.07	2
1	Chikka Tirupathi	4 Bedroom	2600.0	5.0	120.00	4
2	Uttarahalli	3 BHK	1440.0	2.0	62.00	3
3	Lingadheeranahalli	3 BHK	1521.0	3.0	95.00	3
4	Kothanur	2 BHK	1200.0	2.0	51.00	2

In [22]:
```
df4.loc[30]
```

Out[22]:
```
location      Yelahanka
size              4 BHK
total_sqft         2475
bath                  4
price               186
Bhk                   4
Name: 30, dtype: object
```

Feature Enginering

In [23]:
```
df5 = df4.copy()
df5['price_per_sqft'] = df5['price']*100000/df5['total_sqft']
df5.head()
```

Out[23]:

	location	size	total_sqft	bath	price	Bhk	price_per_sqft
0	Electronic City Phase II	2 BHK	1056.0	2.0	39.07	2	3699.810606
1	Chikka Tirupathi	4 Bedroom	2600.0	5.0	120.00	4	4615.384615
2	Uttarahalli	3 BHK	1440.0	2.0	62.00	3	4305.555556
3	Lingadheeranahalli	3 BHK	1521.0	3.0	95.00	3	6245.890861
4	Kothanur	2 BHK	1200.0	2.0	51.00	2	4250.000000

In [24]:
```
df5.location.unique()
```

Out[24]:
```
array(['Electronic City Phase II', 'Chikka Tirupathi', 'Uttarahalli', ...,
       '12th cross srinivas nagar banshankari 3rd stage',
       'Havanur extension', 'Abshot Layout'], dtype=object)
```

In [25]:
```
len(df5.location.unique())
```

Out[25]:
```
1304
```

In [26]:
```
df5['location'] = df5['location'].apply( lambda x: x.strip() )
location_stats  = df5.groupby('location')['location'].agg('count').sort_values (ascending = False)
location_stats
```

Out[26]:
```
location
Whitefield           535
Sarjapur  Road       392
Electronic City      304
Kanakpura Road       266
Thanisandra          236
                    ...
LIC Colony             1
Kuvempu Layout         1
Kumbhena Agrahara      1
Kudlu Village,         1
1 Annasandrapalya      1
Name: location, Length: 1293, dtype: int64
```

In [27]:
```
len(location_stats[location_stats<=10])
```

Out[27]:
```
1052
```

In [28]:
```
location_stats_less_than_10 = location_stats[location_stats<=10]
location_stats_less_than_10
```

Out[28]:
```
location
BTM 1st Stage          10
Basapura               10
Sector 1 HSR Layout    10
Naganathapura          10
Kalkere                10
                       ..
LIC Colony              1
Kuvempu Layout          1
Kumbhena Agrahara       1
Kudlu Village,          1
1 Annasandrapalya       1
Name: location, Length: 1052, dtype: int64
```

In [29]:
```
len(df5.location.unique())
```

Out[29]:
```
1293
```

In [30]:
```
df5.location = df5.location.apply(lambda x: 'other' if x in location_stats_less_than_10 else x)
len(df5.location.unique())
```

Out[30]:
```
242
```

In [31]:

```
df5.head(10)
```

Out[31]:

	location	size	total_sqft	bath	price	Bhk	price_per_sqft
0	Electronic City Phase II	2 BHK	1056.0	2.0	39.07	2	3699.810606
1	Chikka Tirupathi	4 Bedroom	2600.0	5.0	120.00	4	4615.384615
2	Uttarahalli	3 BHK	1440.0	2.0	62.00	3	4305.555556
3	Lingadheeranahalli	3 BHK	1521.0	3.0	95.00	3	6245.890861
4	Kothanur	2 BHK	1200.0	2.0	51.00	2	4250.000000
5	Whitefield	2 BHK	1170.0	2.0	38.00	2	3247.863248
6	Old Airport Road	4 BHK	2732.0	4.0	204.00	4	7467.057101
7	Rajaji Nagar	4 BHK	3300.0	4.0	600.00	4	18181.818182
8	Marathahalli	3 BHK	1310.0	3.0	63.25	3	4828.244275
9	other	6 Bedroom	1020.0	6.0	370.00	6	36274.509804

In [32]:

```
df5[df5.total_sqft/df5.Bhk > 300].head()
df5.shape
```

Out[32]:

```
(13246, 7)
```

In [33]:

```
df6 = df5[~(df5.total_sqft/df5.Bhk < 300)]
df6.shape
```

Out[33]:

```
(12502, 7)
```

In [34]:

```
df6.price_per_sqft.describe()
```

Out[34]:

```
count     12456.000000
mean       6308.502826
std        4168.127339
min         267.829813
25%        4210.526316
50%        5294.117647
75%        6916.666667
max      176470.588235
Name: price_per_sqft, dtype: float64
```

In [35]:

```
def remove_pps_outliers(df):
    df_out = pd.DataFrame()
    for key, subdf in df.groupby('location'):
        m = np.mean(subdf.price_per_sqft)
        st = np.std(subdf.price_per_sqft)
        reduced_df = subdf[(subdf.price_per_sqft>(m-st)) & (subdf.price_per_sqft<(m+s
t))]
        df_out = pd.concat([df_out,reduced_df],ignore_index = True)
    return df_out
```

In [36]:

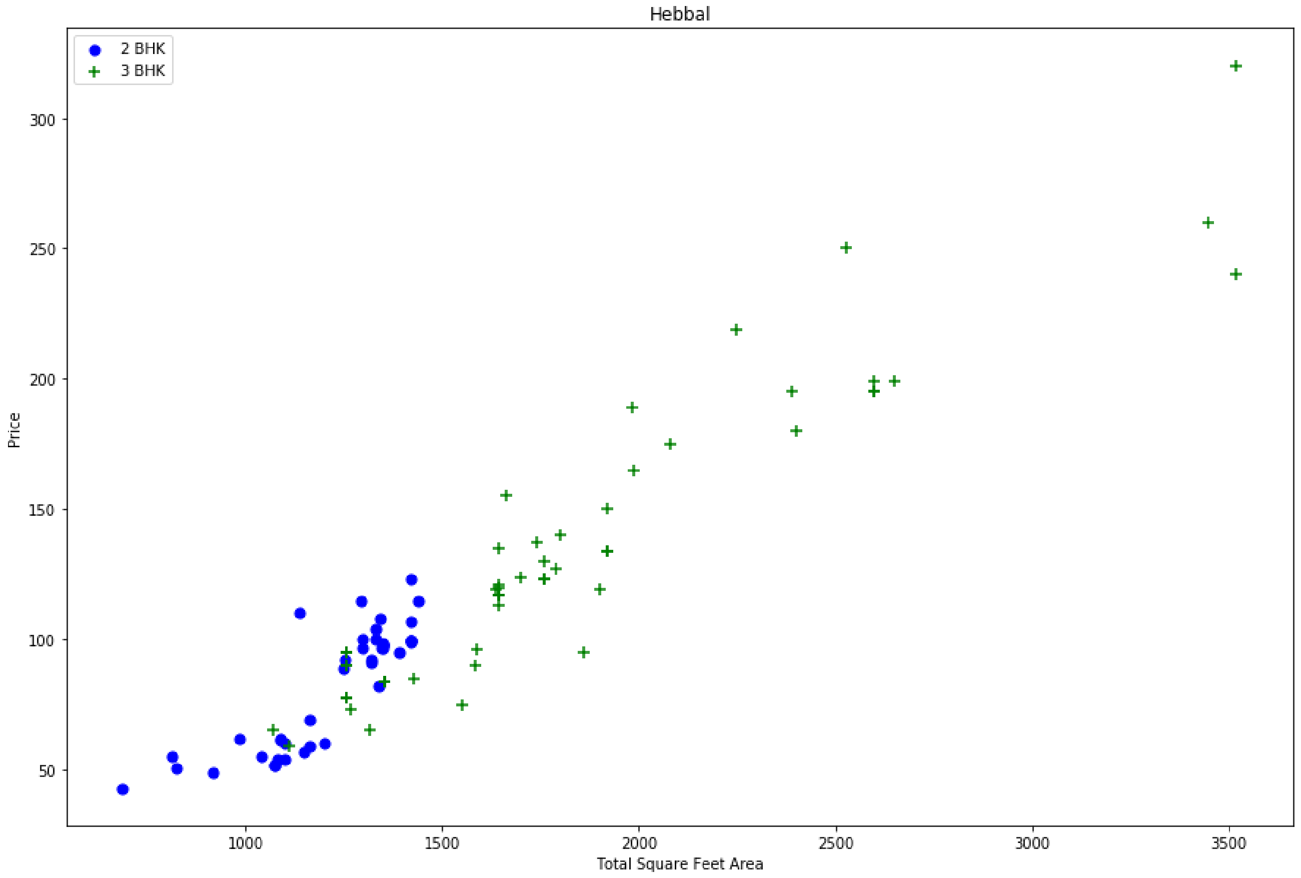
```
df7 = remove_pps_outliers(df6)
df7.shape
```

Out[36]:

```
(10241, 7)
```

In [37]:

```
def plot_scatter_chart(df,location):
    bhk2 = df[(df.location==location) & (df.Bhk==2)]
    bhk3 = df[(df.location==location) & (df.Bhk==3)]
    matplotlib.rcParams['figure.figsize'] = (15,10)
    plt.scatter(bhk2.total_sqft,bhk2.price,color='blue' ,label='2 BHK',s=50)
    plt.scatter(bhk3.total_sqft,bhk3.price,marker= '+',color='green' ,label='3 BHK',s
=50)
    plt.xlabel("Total Square Feet Area")
    plt.ylabel("Price")
    plt.title(location)
    plt.legend()
plot_scatter_chart(df7,"Hebbal")
```



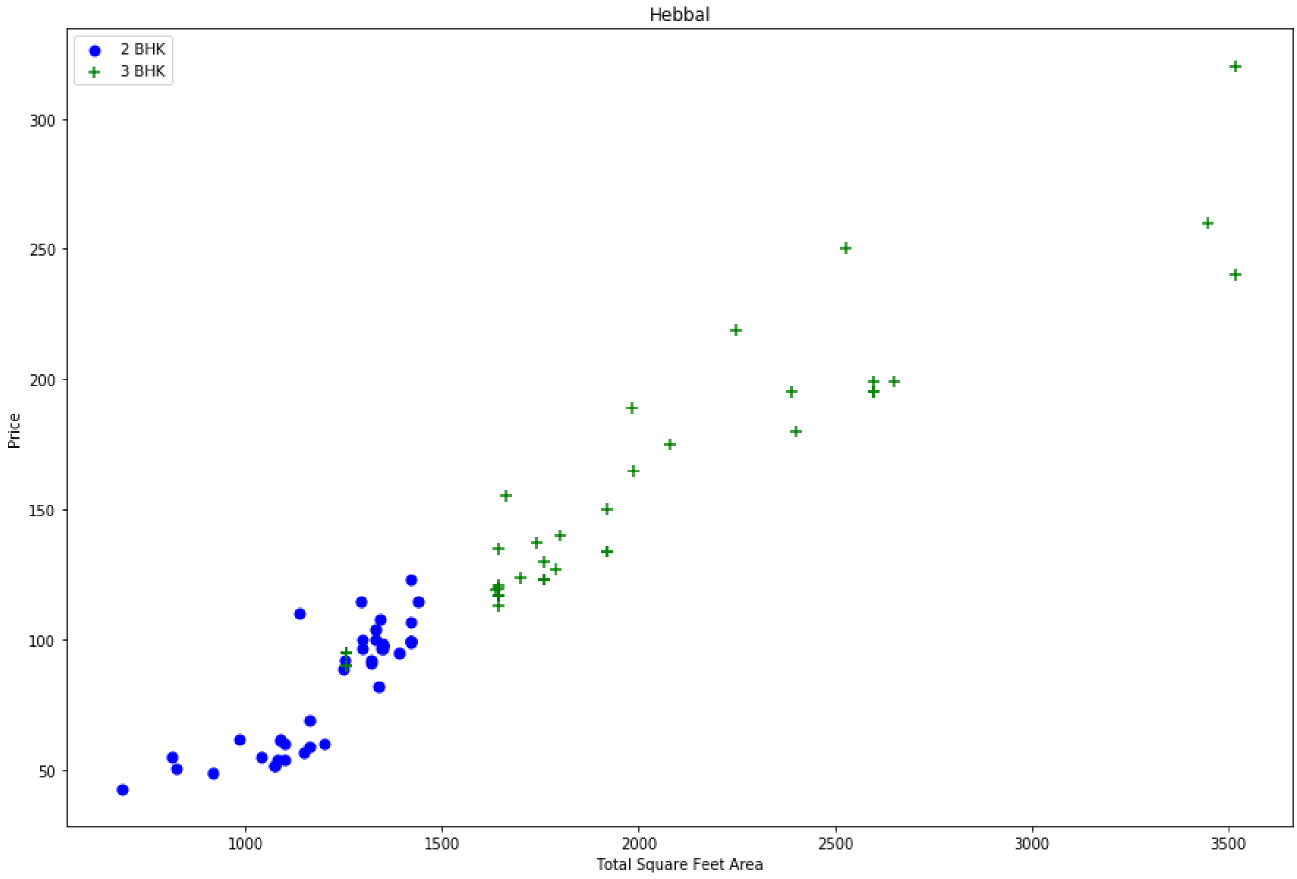
In [38]:

```
def remove_bhk_outliners(df):
    exclude_indices = np.array([])
    for location,location_df in df.groupby('location'):
        bhk_stats = {}
        for Bhk, bhk_df in location_df.groupby('Bhk'):
            bhk_stats[Bhk] = {
                'mean': np.mean(bhk_df.price_per_sqft),
                'std': np.std(bhk_df.price_per_sqft),
                'count': bhk_df.shape[0]
            }
        for Bhk, bhk_df in location_df.groupby('Bhk'):
            stats = bhk_stats.get(Bhk-1)
            if stats and stats['count']> 5:
                exclude_indices = np.append(exclude_indices,bhk_df[bhk_df.price_per_s
qft<(stats['mean'])].index.values)
    return df.drop(exclude_indices,axis='index')
df8 = remove_bhk_outliners(df7)
df8.shape
```

Out[38]:

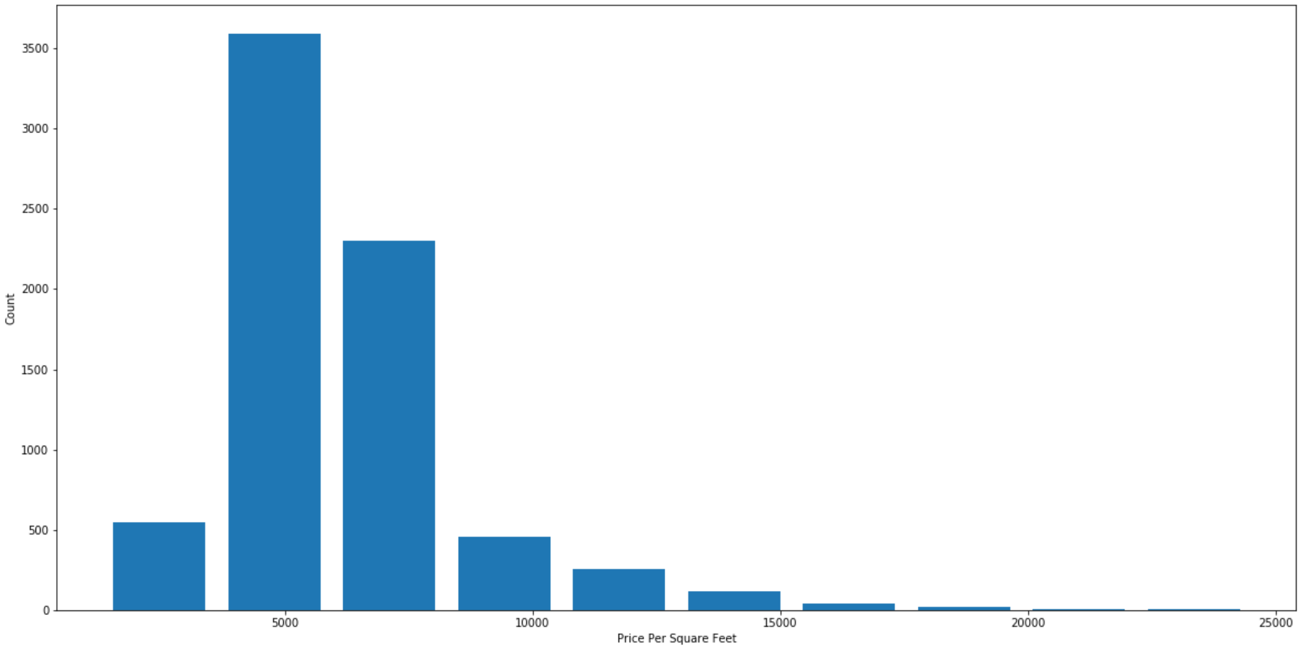
```
(7329, 7)
```

```
In [39]: plot_scatter_chart(df8,"Hebbal")
```



```
In [40]: import matplotlib
         matplotlib.rcParams["figure.figsize"] = (20,10)
         plt.hist(df8.price_per_sqft,rwidth=0.8)
         plt.xlabel("Price Per Square Feet")
         plt.ylabel("Count")
```

```
Out[40]: Text(0, 0.5, 'Count')
```



```
In [41]: df8.bath.unique()
```

```
Out[41]: array([ 4.,  3.,  2.,  5.,  8.,  1.,  6.,  7.,  9., 12., 16., 13.])
```

In [42]:

```
df8[df8.bath>10]
```

Out[42]:

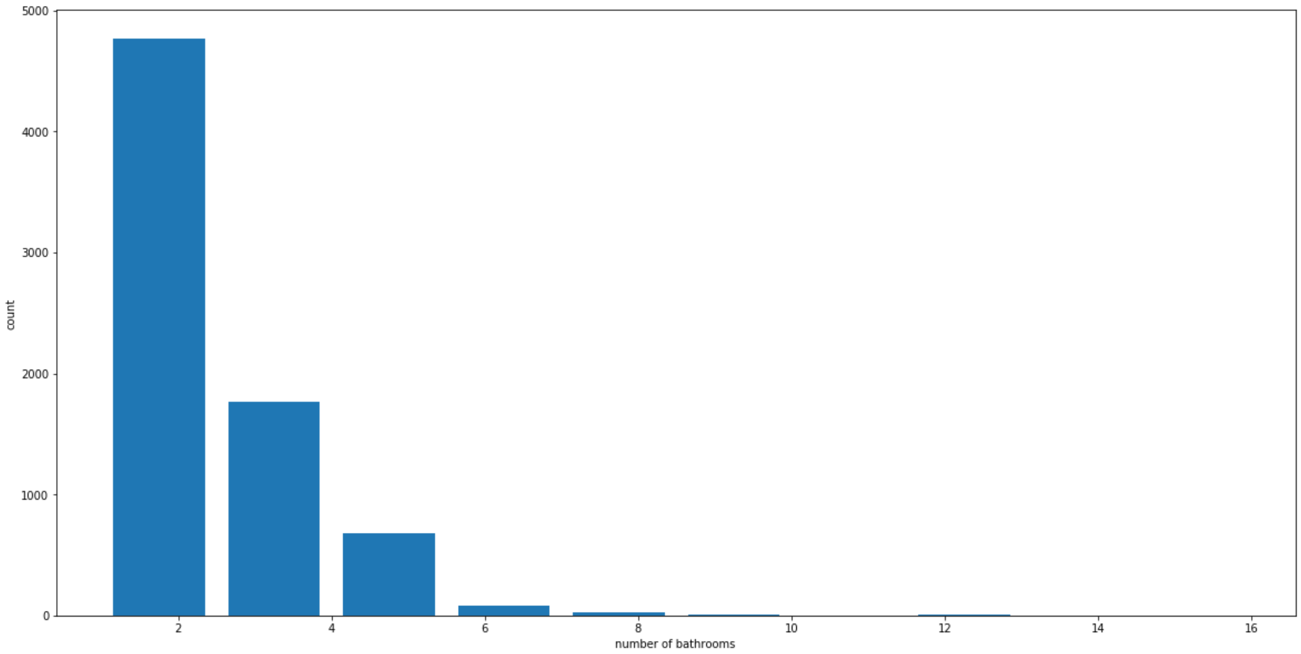
	location	size	total_sqft	bath	price	Bhk	price_per_sqft
5277	Neeladri Nagar	10 BHK	4000.0	12.0	160.0	10	4000.000000
8486	other	10 BHK	12000.0	12.0	525.0	10	4375.000000
8575	other	16 BHK	10000.0	16.0	550.0	16	5500.000000
9308	other	11 BHK	6000.0	12.0	150.0	11	2500.000000
9639	other	13 BHK	5425.0	13.0	275.0	13	5069.124424

In [43]:

```
import matplotlib
matplotlib.rcParams["figure.figsize"]= (20,10)
plt.hist(df8.bath,rwidth=0.8)
plt.xlabel('number of bathrooms ')
plt.ylabel('count')
```

Out[43]:

```
Text(0, 0.5, 'count')
```



In [44]:

```
df8[df8.bath>df8.Bhk+2]
```

Out[44]:

	location	size	total_sqft	bath	price	Bhk	price_per_sqft
1626	Chikkabanavar	4 Bedroom	2460.0	7.0	80.0	4	3252.032520
5238	Nagasandra	4 Bedroom	7000.0	8.0	450.0	4	6428.571429
6711	Thanisandra	3 BHK	1806.0	6.0	116.0	3	6423.034330
8411	other	6 BHK	11338.0	9.0	1000.0	6	8819.897689

In [45]:

```
df9= df8[df8.bath<df8.Bhk+2]
df9.shape
```

Out[45]:

```
(7251, 7)
```

In [46]:
```
df10= df9.drop(['size','price_per_sqft'],axis="columns")
df10.head(3)
```

Out[46]:

	location	total_sqft	bath	price	Bhk
0	1st Block Jayanagar	2850.0	4.0	428.0	4
1	1st Block Jayanagar	1630.0	3.0	194.0	3
2	1st Block Jayanagar	1875.0	2.0	235.0	3

Applying the model

In [47]:
```
dummies = pd.get_dummies(df10.location)
dummies.head()
```

Out[47]:

	1st Block Jayanagar	1st Phase JP Nagar	2nd Phase Judicial Layout	2nd Stage Nagarbhavi	5th Block Hbr Layout	5th Phase JP Nagar	6th Phase JP Nagar	7th Phase JP Nagar	8th Phase JP Nagar	9th Phase JP Nagar	...	Vishveshw La
0	1	0	0	0	0	0	0	0	0	0	...	
1	1	0	0	0	0	0	0	0	0	0	...	
2	1	0	0	0	0	0	0	0	0	0	...	
3	1	0	0	0	0	0	0	0	0	0	...	
4	1	0	0	0	0	0	0	0	0	0	...	

5 rows × 242 columns

In [48]:
```
df11 = pd.concat([df10,dummies], axis = 'columns')
```

In [49]:
```
df11.drop(['1st Block Jayanagar','location'],axis='columns')
```

Out[49]:

	total_sqft	bath	price	Bhk	1st Phase JP Nagar	2nd Phase Judicial Layout	2nd Stage Nagarbhavi	5th Block Hbr Layout	5th Phase JP Nagar	6th Phase JP Nagar	...	Vishveshwa Lay
0	2850.0	4.0	428.0	4	0	0	0	0	0	0	...	
1	1630.0	3.0	194.0	3	0	0	0	0	0	0	...	
2	1875.0	2.0	235.0	3	0	0	0	0	0	0	...	
3	1200.0	2.0	130.0	3	0	0	0	0	0	0	...	
4	1235.0	2.0	148.0	2	0	0	0	0	0	0	...	
...	...	...	...	...	...	...	...	...	...	...	...	
10232	1200.0	2.0	70.0	2	0	0	0	0	0	0	...	
10233	1800.0	1.0	200.0	1	0	0	0	0	0	0	...	
10236	1353.0	2.0	110.0	2	0	0	0	0	0	0	...	
10237	812.0	1.0	26.0	1	0	0	0	0	0	0	...	
10240	3600.0	5.0	400.0	4	0	0	0	0	0	0	...	

7251 rows × 245 columns

In [50]:

```
df11.shape
```

Out[50]:

```
(7251, 247)
```

In [51]:

```
X = df11.drop(['price','location'], axis='columns')
```

In [52]:

```
X.head()
```

Out[52]:

	total_sqft	bath	Bhk	1st Block Jayanagar	1st Phase JP Nagar	2nd Phase Judicial Layout	2nd Stage Nagarbhavi	5th Block Hbr Layout	5th Phase JP Nagar	6th Phase JP Nagar	...	Vishveshwa Lay
0	2850.0	4.0	4	1	0	0	0	0	0	0	...	
1	1630.0	3.0	3	1	0	0	0	0	0	0	...	
2	1875.0	2.0	3	1	0	0	0	0	0	0	...	
3	1200.0	2.0	3	1	0	0	0	0	0	0	...	
4	1235.0	2.0	2	1	0	0	0	0	0	0	...	

5 rows × 245 columns

In [53]:

```
y= df11.price
y.head()
```

Out[53]:

```
0    428.0
1    194.0
2    235.0
3    130.0
4    148.0
Name: price, dtype: float64
```

In [54]:

```
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.2,random_state=10)
```

In [55]:

```
from sklearn.linear_model import LinearRegression
lr = LinearRegression()
lr.fit(X_train,y_train)
lr.score(X_test,y_test)
```

Out[55]:

```
0.845227769787358
```

In [56]:

```
from sklearn.neighbors import KNeighborsRegressor
knn = KNeighborsRegressor(n_neighbors=3)
knn.fit(X_train,y_train)
knn.score(X_test,y_test)
```

Out[56]:

```
0.7211004574660052
```

In [57]:

```
from sklearn.model_selection import ShuffleSplit
from sklearn.model_selection import cross_val_score
cv =ShuffleSplit(n_splits=5, test_size=0.2,random_state =0)
cross_val_score(LinearRegression(),X,y,cv=cv)
```

Out[57]:

```
array([0.82433489, 0.77166234, 0.85089567, 0.80836261, 0.83653286])
```

In [58]:

```
from sklearn.model_selection import GridSearchCV

#from sklearn.linear_model import Lasso
from sklearn.tree import DecisionTreeRegressor

def find_best_model_using_gridsearchcv(X,y):
    algos = {
        'linear_regression' : {
            'model': LinearRegression(),
            'params': {
                'normalize': [True, False]
            }
        },

        'KNN_regressor':{
            'model': KNeighborsRegressor(),
            'params':{
                'weights':['uniform', 'distance'],
                'algorithm':['auto']
            }
        },

        'decision_tree': {
            'model': DecisionTreeRegressor(),
            'params': {
                'criterion' : ['mse','friedman_mse'],
                'splitter': ['best','random']
            }
        }
    }
    scores = []
    cv = ShuffleSplit(n_splits=5, test_size=0.2, random_state=0)
    for algo_name, config in algos.items():
        gs =  GridSearchCV(config['model'], config['params'], cv=cv, return_train_sco
re=False)
        gs.fit(X,y)
        scores.append({
            'model': algo_name,
            'best_score': gs.best_score_,

        })

    return pd.DataFrame(scores,columns=['model','best_score'])

find_best_model_using_gridsearchcv(X,y)
```

Out[58]:

	model	best_score
0	linear_regression	0.818362
1	KNN_regressor	0.714367
2	decision_tree	0.768092

In [59]:

```
def predict_price(model,location,sqft,bath,bhk):
    loc_index = np.where(X.columns==location)[0][0]

    x = np.zeros(len(X.columns))
    x[0] = sqft
    x[1] = bath
    x[2] = bhk
    if loc_index >= 0:
        x[loc_index] = 1

    return model.predict([x])[0]
```

In [60]:

```
predict_price(lr,'1st Phase JP Nagar',1000, 2, 2)
```

Out[60]:

```
83.49904676985425
```

In [61]:

```
predict_price(knn,'1st Phase JP Nagar',1000, 2, 2)
```

Out[61]:

```
38.526666666666664
```

In [ ]: