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)
```

In [2]:
```
df1 = pd.read_csv("Bengaluru_House_Data.csv")
df1.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]:
```
df1.shape
```

Out[3]:
```
(13320, 9)
```

In [4]:
```
df1.groupby('area_type')['area_type'].agg('count')
```

Out[4]:
```
area_type
Built-up  Area          2418
Carpet  Area              87
Plot  Area              2025
Super built-up  Area    8790
Name: area_type, dtype: int64
```

In [5]:
```
df2 = df1.drop(['area_type','society','balcony','availability'],axis='columns')
df2.shape
```

Out[5]:
```
(13320, 5)
```

In [6]:
```
df2.isnull().sum()
```

Out[6]:
```
location       1
size          16
total_sqft     0
bath          73
price          0
dtype: int64
```

In [7]:
```
df3 = df2.dropna()
df3.isnull().sum()
```

Out[7]:

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

In [8]:

```
df3.shape
```

Out[8]:

```
(13246, 5)
```

In [9]:

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

Out[9]:

```
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 [10]:

```
df3['bhk'] = df3['size'].apply(lambda x: int(x.split(' ')[0]))
```

```
C:\Users\Vishn\AppData\Local\Temp\ipykernel_17012\2222900254.py:1: SettingWithCopy
Warning:
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/stabl
e/user_guide/indexing.html#returning-a-view-versus-a-copy
  df3['bhk'] = df3['size'].apply(lambda x: int(x.split(' ')[0]))
```

In [11]:

```
df3.head()
```

Out[11]:

	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 [12]:

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

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[df3.bhk>20]
```

Out[13]:

	location	size	total_sqft	bath	price	bhk
1718	2Electronic City Phase II	27 BHK	8000	27.0	230.0	27
4684	Munnekollal	43 Bedroom	2400	40.0	660.0	43

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)].head(10)
```

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
410	Kengeri	1 BHK	34.46Sq. Meter	1.0	18.500	1
549	Hennur Road	2 BHK	1195 - 1440	2.0	63.770	2
648	Arekere	9 Bedroom	4125Perch	9.0	265.000	9
661	Yelahanka	2 BHK	1120 - 1145	2.0	48.130	2
672	Bettahalsoor	4 Bedroom	3090 - 5002	4.0	445.000	4

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('2100 - 2850')
```

Out[19]:
```
2475.0
```

In [20]:
```
convert_sqft_to_num('34.46Sq. Meter')
```

In [21]:
```
df4 = df3.copy()
df4['total_sqft'] = df4['total_sqft'].apply(convert_sqft_to_num)
df4.head(3)
```

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

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

Out[22]:
```
location      Yelahanka
size              4 BHK
total_sqft       2475.0
bath                4.0
price             186.0
bhk                   4
Name: 30, dtype: object
```

In [23]:
```
df4.head(3)
```

Out[23]:

	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

In [24]:
```
df5 = df4.copy()
df5['price_per_sqft'] = df5['price']*100000/df5['total_sqft']
df5.head()
```

Out[24]:

	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 [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(asce
location_stats
```

Out[26]:
```
location
Whitefield               535
Sarjapur  Road           392
Electronic City          304
Kanakpura Road           266
Thanisandra              236
                        ... 
1 Giri Nagar               1
Kanakapura Road,           1
Kanakapura main  Road      1
Karnataka Shabarimala      1
whitefiled                 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
Basapura                 10
1st Block Koramangala    10
Gunjur Palya             10
Kalkere                  10
Sector 1 HSR Layout      10
                         ..
1 Giri Nagar              1
Kanakapura Road,          1
Kanakapura main  Road     1
Karnataka Shabarimala     1
whitefiled                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_tha
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()
```

Out[32]:

	location	size	total_sqft	bath	price	bhk	price_per_sqft
9	other	6 Bedroom	1020.0	6.0	370.0	6	36274.509804
45	HSR Layout	8 Bedroom	600.0	9.0	200.0	8	33333.333333
58	Murugeshpalya	6 Bedroom	1407.0	4.0	150.0	6	10660.980810
68	Devarachikkanahalli	8 Bedroom	1350.0	7.0	85.0	8	6296.296296
70	other	3 Bedroom	500.0	3.0	100.0	3	20000.000000

In [33]:
```
df5.shape
```

Out[33]:
```
(13246, 7)
```

In [34]:
```
df6 = df5[~(df5.total_sqft/df5.bhk<300)]
df6.shape
```

Out[34]:
```
(12502, 7)
```

In [35]:
```
df6.price_per_sqft.describe()
```

Out[35]:
```
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
```

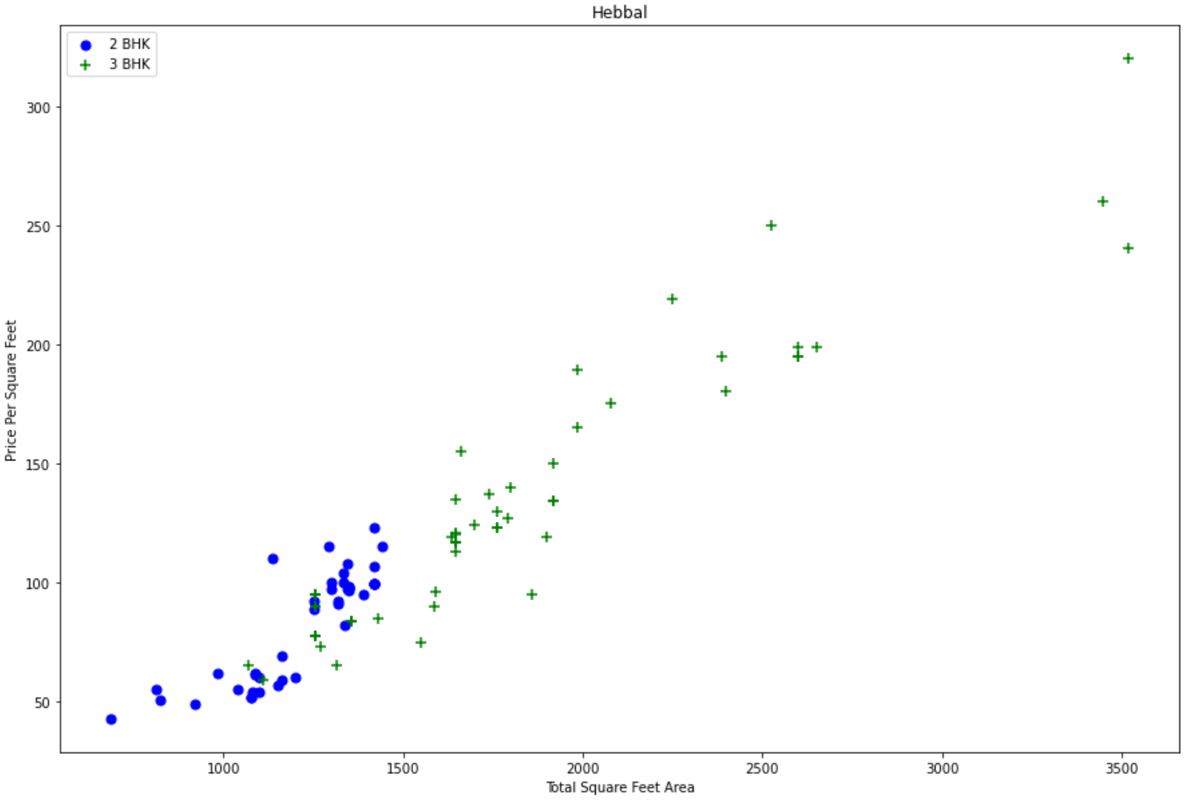
In [36]:
```
def remove_pps_outliers(df):
    df_out = pd.DataFrame()
    for key, subdf in df.groupby('location'):
        m = np.mean(subdf.price_per_sqft)
        st = np.std(subdf.price_per_sqft)
        reduced_df = subdf[(subdf.price_per_sqft>(m-st)) & (subdf.price_per_sqft<=
        df_out = pd.concat([df_out,reduced_df],ignore_index=True)
    return df_out

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',
    plt.xlabel("Total Square Feet Area")
    plt.ylabel("Price Per Square Feet")
    plt.title(location)
    plt.legend()

plot_scatter_chart(df7,"Hebbal")
```

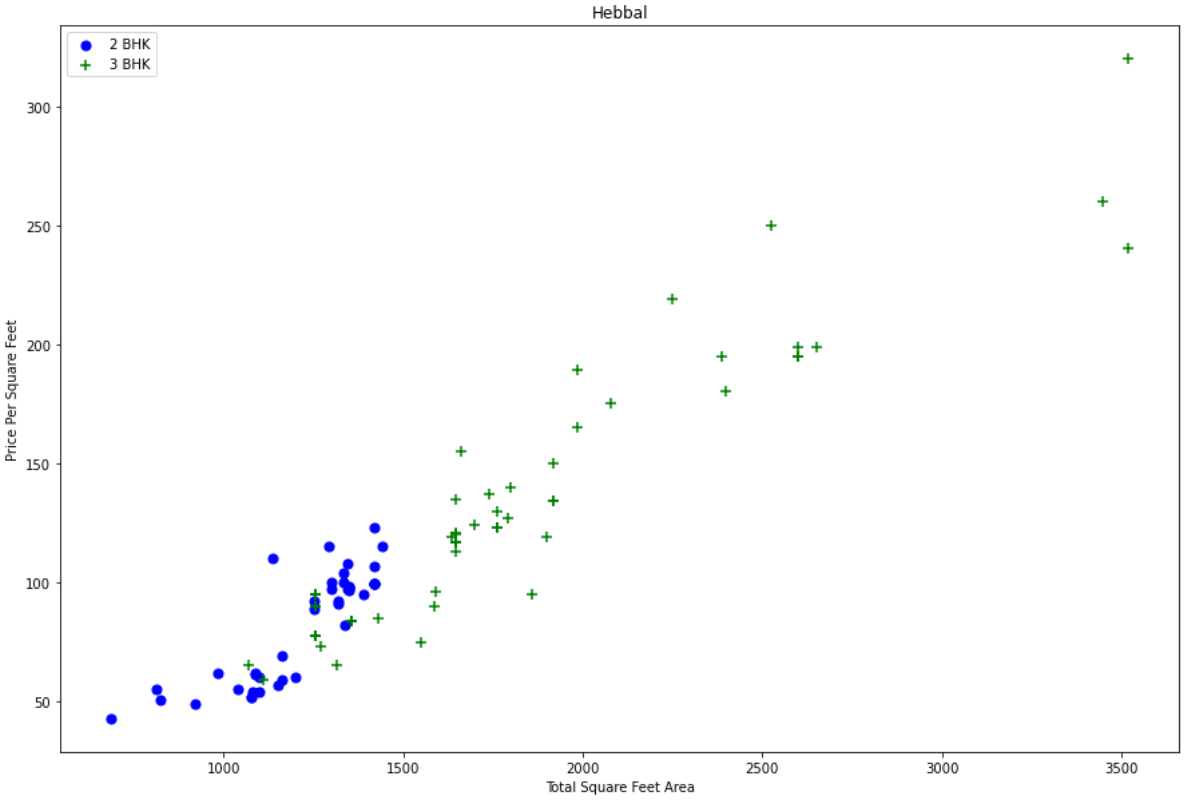


In [38]:
```
def remove_bhk_outliers(df):
    exclude_indicies = np.array([])
    for location, location_df in df.groupby('location'):
        bhk_stats = {}
        for bhk, bhk_df in location_df.groupby('bhk'):
            bhk_stats[bhk] = {
                'mean': np.mean(bhk_df.price_per_sqft),
                '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_indicies, bhk_df[bhk_df.price_
    return df.drop(exclude_indices,axis='index')

df8  = remove_bhk_outliers(df7)
df8.shape
```

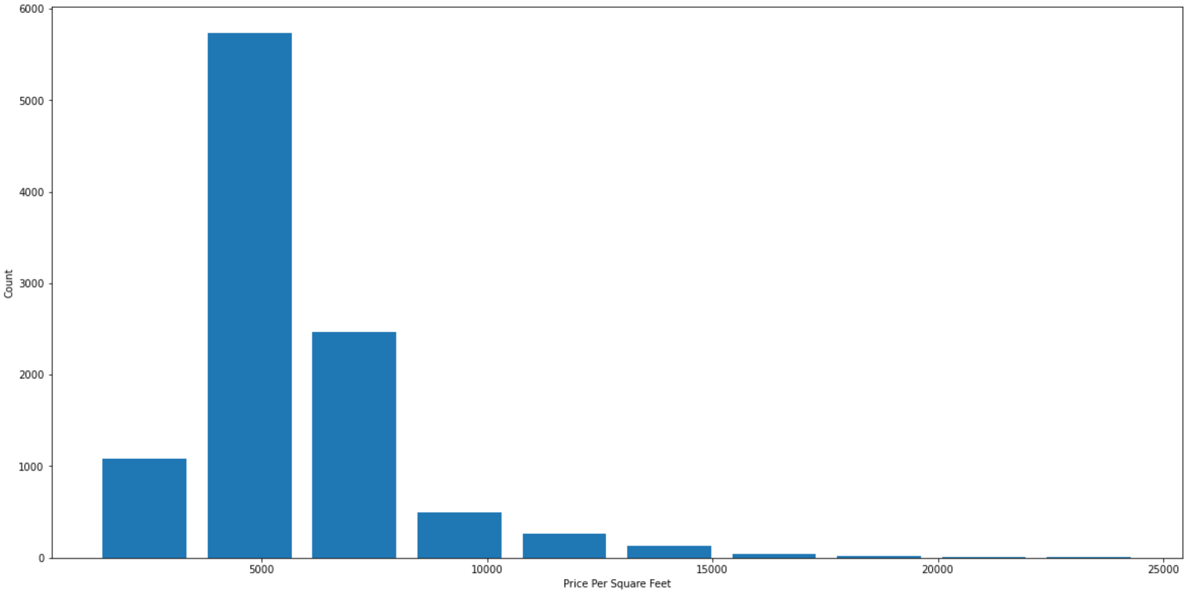
Out[38]:
```
(10238, 7)
```

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]:

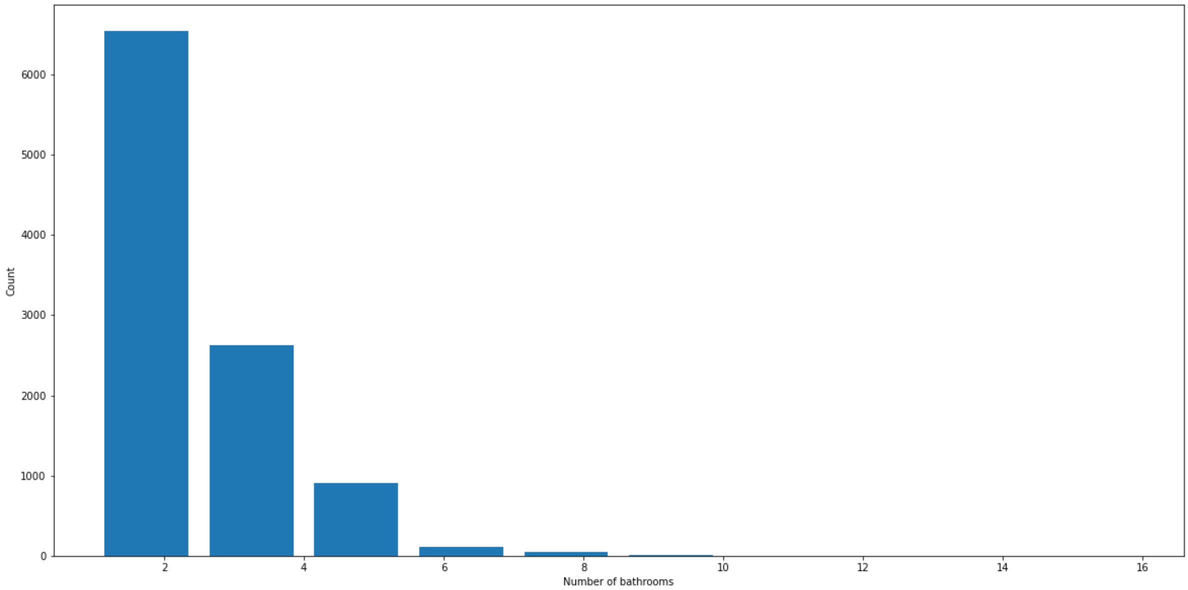
	location	size	total_sqft	bath	price	bhk	price_per_sqft
5277	Neeladri Nagar	10 BHK	4000.0	12.0	160.0	10	4000.000000
8486	other	10 BHK	12000.0	12.0	525.0	10	4375.000000
8575	other	16 BHK	10000.0	16.0	550.0	16	5500.000000
9308	other	11 BHK	6000.0	12.0	150.0	11	2500.000000
9639	other	13 BHK	5425.0	13.0	275.0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

In [43]:

```
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]:

```
(10144, 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

In [47]:

```python
dummies = pd.get_dummies(df10.location)
dummies.head(3)
```

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	...	Vis
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 rows × 242 columns

In [48]:

```python
df11 = pd.concat([df10, dummies.drop('other',axis='columns')],axis='columns')
df11.head(3)
```

Out[48]:

	location	total_sqft	bath	price	bhk	1st Block Jayanagar	1st Phase JP Nagar	2nd Phase Judicial Layout	2nd Stage Nagarbhavi	5th Block Hbr Layout	...	V
0	1st Block Jayanagar	2850.0	4.0	428.0	4	1	0	0	0	0	...	
1	1st Block Jayanagar	1630.0	3.0	194.0	3	1	0	0	0	0	...	
2	1st Block Jayanagar	1875.0	2.0	235.0	3	1	0	0	0	0	...	

3 rows × 246 columns

In [49]:

```python
df12 = df11.drop('location',axis='columns')
df12.head(3)
```

Out[49]:

	total_sqft	bath	price	bhk	1st Block Jayanagar	1st Phase JP Nagar	2nd Phase Judicial Layout	2nd Stage Nagarbhavi	5th Block Hbr Layout	5th Phase JP Nagar	...	Vijay
0	2850.0	4.0	428.0	4	1	0	0	0	0	0	...	
1	1630.0	3.0	194.0	3	1	0	0	0	0	0	...	
2	1875.0	2.0	235.0	3	1	0	0	0	0	0	...	

3 rows × 245 columns

In [50]:

```
df12.shape
```

Out[50]:

```
(10144, 245)
```

In [51]:

```
X = df12.drop('price',axis='columns')
X.head()
```

Out[51]:

	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	...	Vija
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 × 244 columns

In [52]:

```
y = df12.price
y.head()
```

Out[52]:

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

In [53]:

```
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
```

In [54]:

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

Out[54]:

```
0.78158278521613
```

In [55]:

```
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[55]:

```
array([0.85105353, 0.76745185, 0.81498857, 0.80138389, 0.79145399])
```

In [59]:

```
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]
            }
        },
        'lasso': {
            'model': Lasso(),
            'params': {
                'alpha': [1,2],
                'selection': ['random','cyclic']
            }
        },
        '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_sc
        gs.fit(X,y)
        scores.append({
            'model': algo_name,
            'best_score': gs.best_score_,
            'best_params': gs.best_params_
        })

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

find_best_model_using_gridsearchcv(X,y)
```

```
C:\Users\Vishn\anaconda3\lib\site-packages\sklearn\linear_model\_base.py:141: Futu
reWarning: 'normalize' was deprecated in version 1.0 and will be removed in 1.2.
If you wish to scale the data, use Pipeline with a StandardScaler in a preprocessi
ng stage. To reproduce the previous behavior:

from sklearn.pipeline import make_pipeline

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If you wish to pass a sample_weight parameter, you need to pass it as a fit parame
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```

Out[59]:

	model	best_score	best_params
0	linear_regression	0.805266	{'normalize': False}
1	lasso	0.659634	{'alpha': 1, 'selection': 'random'}
2	decision_tree	0.706818	{'criterion': 'mse', 'splitter': 'random'}

In [61]:

```
X.columns
```

Out[61]:

```
Index(['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',
       ...
       'Vijayanagar', 'Vishveshwarya Layout', 'Vishwapriya Layout',
       'Vittasandra', 'Whitefield', 'Yelachenahalli', 'Yelahanka',
       'Yelahanka New Town', 'Yelenahalli', 'Yeshwanthpur'],
      dtype='object', length=244)
```

In [62]:

```
np.where(X.columns=='2nd Phase Judicial Layout')[0][0]
```

Out[62]:

```
5
```

In [63]:

```
def predict_price(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 lr_clf.predict([x])[0]
```

In [64]:
```
predict_price('1st Phase JP Nagar',1000, 2, 2)
```

```
C:\Users\Vishn\anaconda3\lib\site-packages\sklearn\base.py:450: UserWarning: X doe
s not have valid feature names, but LinearRegression was fitted with feature names
  warnings.warn(
```

Out[64]:
```
86.2333823636869
```

In [65]:
```
predict_price('1st Phase JP Nagar',1000, 3, 3)
```

```
C:\Users\Vishn\anaconda3\lib\site-packages\sklearn\base.py:450: UserWarning: X doe
s not have valid feature names, but LinearRegression was fitted with feature names
  warnings.warn(
```

Out[65]:
```
89.0409686406249
```

In [67]:
```
predict_price('Indira Nagar',1000, 2, 2)
```

```
C:\Users\Vishn\anaconda3\lib\site-packages\sklearn\base.py:450: UserWarning: X doe
s not have valid feature names, but LinearRegression was fitted with feature names
  warnings.warn(
```

Out[67]:
```
182.4553274516854
```

In [69]:
```
predict_price('Indira Nagar',1000, 3, 3)
```

```
C:\Users\Vishn\anaconda3\lib\site-packages\sklearn\base.py:450: UserWarning: X doe
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  warnings.warn(
```

Out[69]:
```
185.2629137286234
```

In [70]:

In [72]:

In [ ]: