In [41]:
```
import pandas as pd
import numpy as np
from matplotlib import pyplot as plt
import matplotlib
matplotlib.rcParams["figure.figsize"] = (20,10)

```

In [42]:
```
df1 = pd.read_csv("C:\\Users\\Navina Bane\\Downloads\\Bengaluru_House_Data.c
```

In [43]:
```
df1.head()
```

Out[43]:

	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 [44]:
```
df1.shape
```

Out[44]:
```
(13320, 9)
```

In [45]:
```
df1.groupby('area_type')["area_type"].agg('count')
```

Out[45]:
```
area_type
Built-up  Area          2418
Carpet  Area              87
Plot  Area              2025
Super built-up  Area    8790
Name: area_type, dtype: int64
```

In [46]:
```
df2 = df1.drop(["area_type",'society','balcony','availability'],axis=1)
```

In [47]:
```
1 df2.head()
```

Out[47]:

	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 [48]:
```
1 df2.isnull().sum()
```

Out[48]:
```
location       1
size          16
total_sqft     0
bath          73
price          0
dtype: int64
```

In [49]:
```
1 df3 = df2.dropna()
2 df3.isnull().sum()
```

Out[49]:
```
location      0
size          0
total_sqft    0
bath          0
price         0
dtype: int64
```

In [50]:
```
1 df3['size'].unique()
```

Out[50]:
```
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 [51]:
```
1 df3['bhk']=df3['size'].apply(lambda x: int(x.split(' ')[0]))
```

```
<ipython-input-51-c379116b8702>: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/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
  df3['bhk']=df3['size'].apply(lambda x: int(x.split(' ')[0]))
```

In [52]:
```
1 df3.head()
```

Out[52]:

	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 [53]:
```
1 df3['bhk'].unique()
```

Out[53]:
```
array([ 2,  4,  3,  6,  1,  8,  7,  5, 11,  9, 27, 10, 19, 16, 43, 14, 12,
       13, 18], dtype=int64)
```

In [54]:
```
1 df3[df3.bhk>20]
```

Out[54]:

	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 [55]:
```
1 df3.total_sqft.unique()
```

Out[55]:
```
array(['1056', '2600', '1440', ..., '1133 - 1384', '774', '4689'],
      dtype=object)
```

In [56]:
```
1 def is_float(x):
2     try:
3         float(x)
4     except:
5         return False
6     return True
```

In [57]:
```
1 df3[df3['total_sqft'].apply(is_float)].head()
```

Out[57]:

	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 [58]:
```
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 [59]:
```
convert_sqft_to_num('2166')
```

Out[59]:
```
2166.0
```

In [60]:
```
convert_sqft_to_num('2100 - 2850')
```

Out[60]:
```
2475.0
```

In [61]:
```
convert_sqft_to_num('34.46Sq. Meter')
```

In [62]:
```
df4 = df3.copy()
df4['total_sqft'] = df4['total_sqft'].apply(convert_sqft_to_num)
df4.head()
```

Out[62]:

	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 [63]:
```
df4.loc[30]
```

Out[63]:
```
location      Yelahanka
size              4 BHK
total_sqft       2475.0
bath                4.0
price             186.0
bhk                   4
Name: 30, dtype: object
```

In [64]:
```
1 df4.head()
```

Out[64]:

	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 [65]:
```
1 df5 = df4.copy()
```

In [66]:
```
1 #Feature Enginnering
```

In [67]:
```
1 df5['price_per_sqft'] = df5['price']*100000/df5['total_sqft']
```

In [68]:
```
1 df5.head()
```

Out[68]:

	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 [69]:
```
1 len(df5.location.unique())
```

Out[69]: 1304

In [70]:
```
df5.location = df5.location.apply(lambda x: x.strip())

location_stats = df5.groupby('location')['location'].agg('count').sort_value
location_stats
```

Out[70]:
```
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 [71]:
```
len(location_stats[location_stats<=10])
```

Out[71]:
```
1052
```

In [72]:
```

```

In [92]:
```
location_stats_less_than_10 = location_stats[location_stats<=10]
location_stats_less_than_10
```

Out[92]:
```
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 [93]:
```
len(df5.location.unique())
```

Out[93]:
```
1293
```

In [94]:
```
df5.location = df5.location.apply(lambda x: 'other' if x in location_stats_l
```

In [95]:
```
len(df5.location.unique())
```

Out[95]:
```
242
```

In [96]:
```
df5.head(10)
```

Out[96]:

	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 [97]:
```
#Outlier Removal
```

In [98]:
```
df5[df5.total_sqft/df5.bhk<300].head()
```

Out[98]:

	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 [99]:
```
df5.shape
```

Out[99]:
```
(13246, 7)
```

In [100]:
```
df6=df5[~(df5.total_sqft/df5.bhk<300)]
```

In [101]:
```
df6.shape
```

Out[101]:
```
(12502, 7)
```

In [102]:
```
df6.price_per_sqft.describe()
```

Out[102]:
```
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 [103]:
```
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_
        df_out = pd.concat([df_out,reduced_df],ignore_index = True)
    return df_out


```

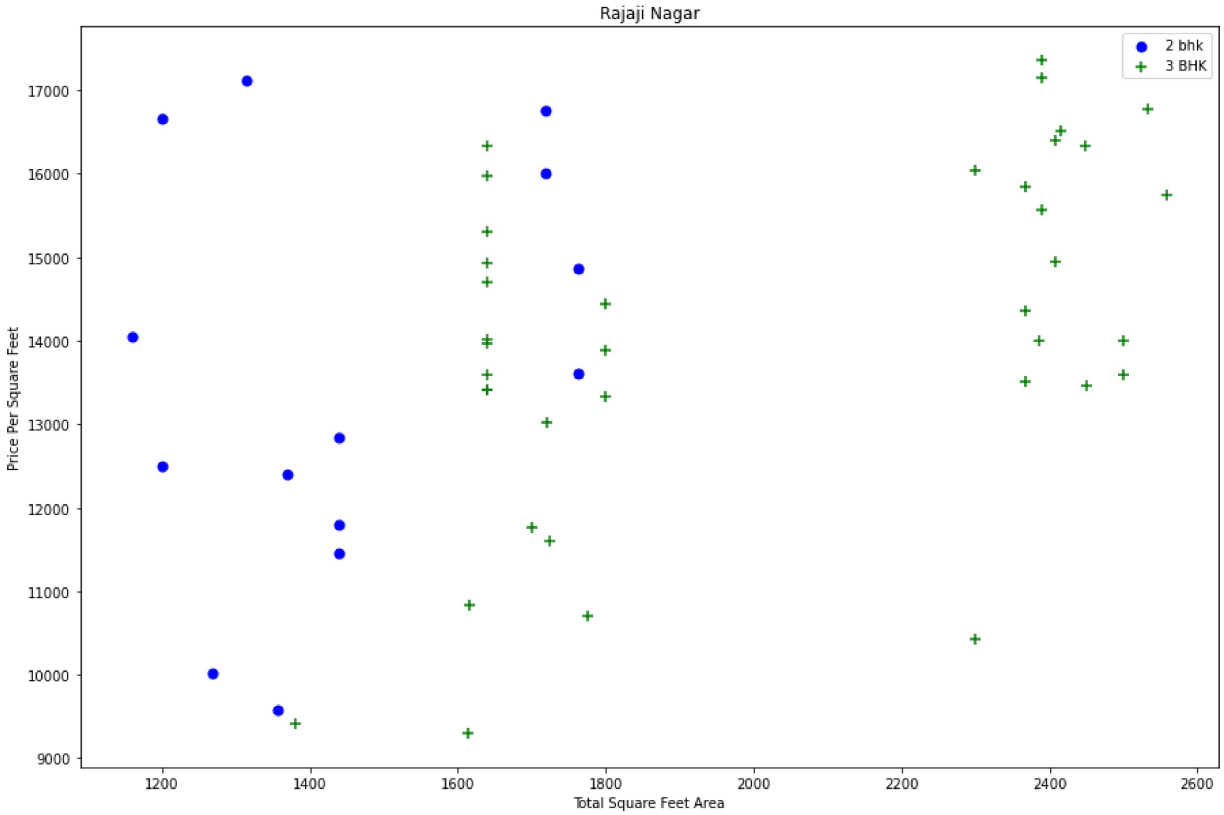
In [104]:
```
df7 = remove_pps_outliers(df6)
```

In [105]:
```
df7.shape

```

Out[105]:
```
(10241, 7)
```

In [106]:

```
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_per_sqft,color='blue',label='2 bh
    plt.scatter(bhk3.total_sqft,bhk3.price_per_sqft,marker = '+',color='gree
    plt.xlabel("Total Square Feet Area")
    plt.ylabel("Price Per Square Feet")
    plt.title(location)
    plt.legend()

plot_scatter_chart(df7,"Rajaji Nagar")
```



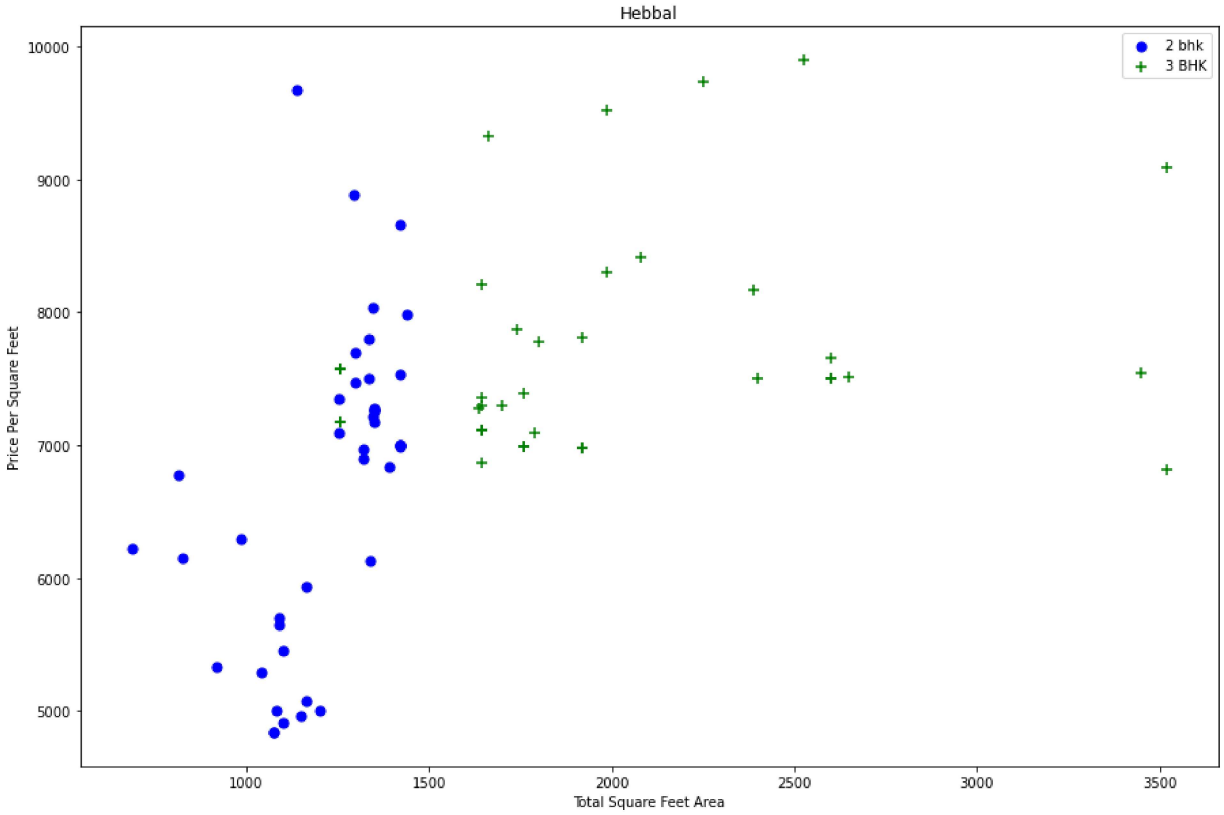
Now we can remove thoe 2 BHK apartment whose price_per_sqft is leass than mean price_per_sqft of 1 BHK apartment

In [108]:
```
def remove_bhk_outlier(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.p
    return df.drop(exclude_indices,axis = 'index')


```

In [110]:
```
df8 = remove_bhk_outlier(df7)
df8.shape
```

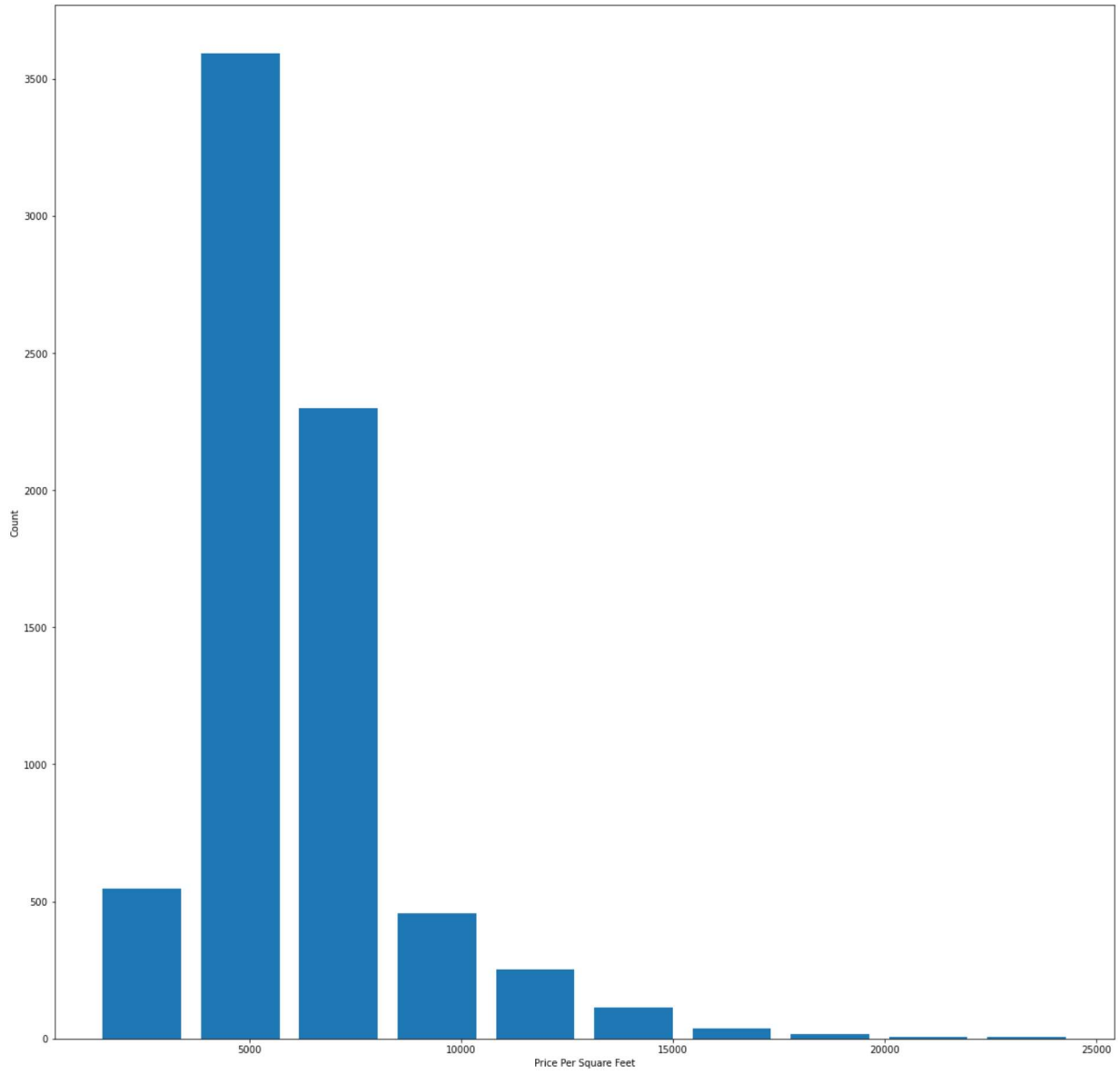
Out[110]: (7329, 7)

In [111]:
```
1 plot_scatter_chart(df8,'Hebbal')
```



In [112]:
```
import matplotlib
matplotlib.rcParams["figure.figsize"] = (20,20)
plt.hist(df8.price_per_sqft,rwidth=0.8)
plt.xlabel("Price Per Square Feet")
plt.ylabel("Count")
```

Out[112]: Text(0, 0.5, 'Count')



In [113]:
```
df8.bath.unique()
```

Out[113]: array([4., 3., 2., 5., 8., 1., 6., 7., 9., 12., 16., 13.])

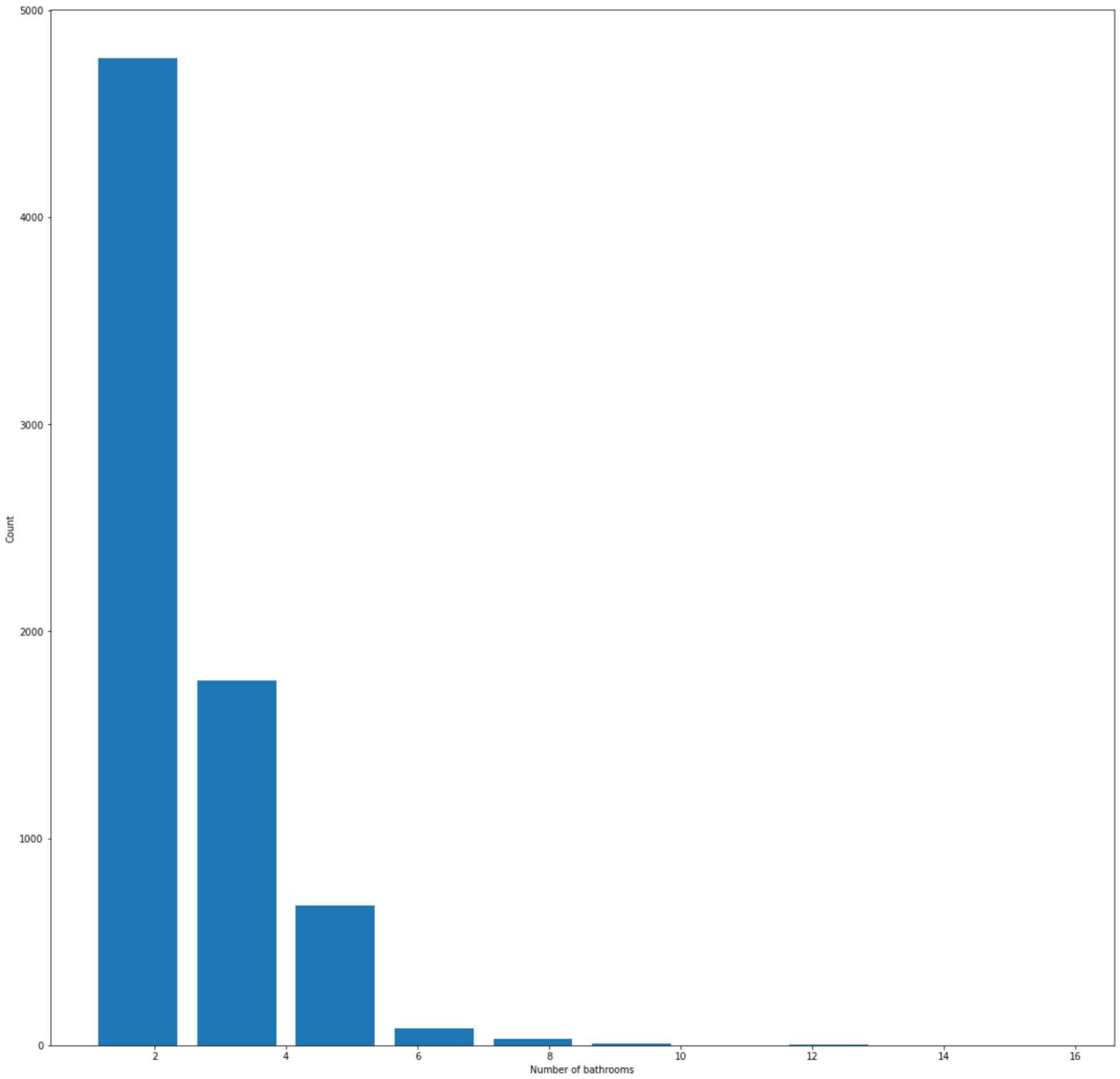
In [114]:
```
df8[df8.bath>10]
```

Out[114]:

	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 [115]:
```
plt.hist(df8.bath,rwidth=0.8)
plt.xlabel("Number of bathrooms")
plt.ylabel("Count")
```

Out[115]:
```
Text(0, 0.5, 'Count')
```



In [116]:
```
df8[df8.bath>df8.bhk+2]
```

Out[116]:

	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 [118]:
```
df9 = df8[df8.bath<df8.bhk+2]
df9.shape
```

Out[118]: (7251, 7)

In [120]:
```
df10 = df9.drop(['size','price_per_sqft'],axis = 'columns')
```

In [121]:
```
df10.head()
```

Out[121]:

	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
3	1st Block Jayanagar	1200.0	2.0	130.0	3
4	1st Block Jayanagar	1235.0	2.0	148.0	2

Machine Training

In [123]:
```
dummies = pd.get_dummies(df10.location)
dummies.head(10)
```

Out[123]:

	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	1	0	0	0	0	0	0	0	0	0	...	
4	1	0	0	0	0	0	0	0	0	0	...	
5	1	0	0	0	0	0	0	0	0	0	...	
6	1	0	0	0	0	0	0	0	0	0	...	
8	0	1	0	0	0	0	0	0	0	0	...	
9	0	1	0	0	0	0	0	0	0	0	...	
10	0	1	0	0	0	0	0	0	0	0	...	

10 rows × 242 columns

In [124]:
```
df11 = pd.concat([df10,dummies.drop('other',axis='columns')],axis='columns')
```

In [125]:
```
1 df11.head()
```

Out[125]:

	location	total_sqft	bath	price	bhk	1st Block Jayanagar	1st Phase JP Nagar	2nd Phase Judicial Layout	2nd Stage Nagarbhavi	5th Block Hbr Layout	...	Vij
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	1st Block Jayanagar	1200.0	2.0	130.0	3	1	0	0	0	0	...	
4	1st Block Jayanagar	1235.0	2.0	148.0	2	1	0	0	0	0	...	

5 rows × 246 columns

In [126]:
```
1 df12 = df11.drop('location',axis='columns')
```

In [127]:
```
1 df12.head()
```

Out[127]:

	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	...	Vijaya
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	1200.0	2.0	130.0	3	1	0	0	0	0	0	...	
4	1235.0	2.0	148.0	2	1	0	0	0	0	0	...	

5 rows × 245 columns

In [128]:
```
1 df12.shape
```

Out[128]: (7251, 245)

In [130]:
```
X = df12.drop('price',axis='columns')
X.head()
```

Out[130]:

	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	...	Vijaya
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 [131]:
```
y=df12.price
y.head()
```

Out[131]:
```
0    428.0
1    194.0
2    235.0
3    130.0
4    148.0
Name: price, dtype: float64
```

In [132]:
```
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_st
```

In [135]:
```
from sklearn.linear_model import LinearRegression
lr_clf = LinearRegression()
lr_clf.fit(X_train,y_train)
lr_clf.score(X_test,y_test)
```

Out[135]:
```
0.845227769787429
```

In [136]:
```
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[136]:
```
array([0.82430186, 0.77166234, 0.85089567, 0.80837764, 0.83653286])
```

In [161]:

```
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']
            }
        },
        'decissio_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_
        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_param


find_best_model_using_gridsearchcv(X,y)
```

Out[161]:

	model	best_score	best_params
0	linear_regression	0.818354	{'normalize': True}

In [162]:
```
1 X.columns
```

Out[162]:
```
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 [163]:
```
1 np.where(X.columns=='2nd Phase Judicial Layout')[0][0]
```

Out[163]:
```
5
```

In [164]:
```
1  def predict_price(location,sqft,bath,bhk):
2      loc_index = np.where(X.columns==location)[0][0]
3
4      x = np.zeros(len(X.columns))
5      x[0] = sqft
6      x[1] = bath
7      x[2] = bhk
8      if loc_index >= 0:
9          x[loc_index] = 1
10
11     return lr_clf.predict([x])[0]
12
```

In [165]:
```
1 predict_price('1st Phase JP Nagar',1000,2,2)
```

Out[165]:
```
83.49904677172407
```

In [169]:
```
1 predict_price('1st Phase JP Nagar',1000,3,2)
```

Out[169]:
```
88.57807171623566
```

In [167]:
```
1 predict_price('Indira Nagar',1000,3,3)
```

Out[167]:
```
184.58430202033554
```

In [ ]:
```
1
```