In [1]:

```
#importing libraries
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

In [2]:

```
#Get the dataset and its information
dataset=pd.read_csv('Bengaluru_House_Data.csv')
dataset.shape
```

Out[2]:

```
(13320, 9)
```

In [3]:

```
dataset.head()
```

Out[3]:

	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 [4]:

```
dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 13320 entries, 0 to 13319
Data columns (total 9 columns):
 #   Column        Non-Null Count  Dtype  
---  ------        --------------  -----  
 0   area_type     13320 non-null  object 
 1   availability  13320 non-null  object 
 2   location      13319 non-null  object 
 3   size          13304 non-null  object 
 4   society       7818 non-null   object 
 5   total_sqft    13320 non-null  object 
 6   bath          13247 non-null  float64
 7   balcony       12711 non-null  float64
 8   price         13320 non-null  float64
dtypes: float64(3), object(6)
memory usage: 936.7+ KB
```

In [5]:

```
#removing of feacture that doesnot effect to price
dataset=dataset.drop('availability',axis='columns')
dataset.head()
```

Out[5]:

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

In [6]:

```
dataset.isnull().sum()
```

Out[6]:

```
area_type        0
location         1
size            16
society       5502
total_sqft       0
bath            73
balcony        609
price            0
dtype: int64
```

In [7]:

```
dataset=dataset.drop('society',axis='columns')
dataset.head()
```

Out[7]:

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

In [8]:

```
#numerical features
numerical_features = [feature for feature in dataset.columns if dataset[feature].dtype != 'O']
numerical_features
```

Out[8]:

```
['bath', 'balcony', 'price']
```

In [9]:

```
dataset[numerical_features].isnull().sum()
```

Out[9]:

```
bath        73
balcony    609
price        0
dtype: int64
```

In [10]:

```
for feature in numerical_features:
    dataset[feature]=dataset[feature].fillna(dataset[feature].mode()[0])
dataset[numerical_features].isnull().sum()
```

Out[10]:

```
bath       0
balcony    0
price      0
dtype: int64
```

In [11]:

```
#Categorical features
categorical_features = [feature for feature in dataset.columns if dataset[feature].dtype == 'O']
categorical_features
```

Out[11]:

```
['area_type', 'location', 'size', 'total_sqft']
```

In [12]:

```
dataset[categorical_features].isnull().sum()
```

Out[12]:

```
area_type      0
location       1
size          16
total_sqft     0
dtype: int64
```

In [13]:

```
for feature in categorical_features:
    dataset[feature]=dataset[feature].fillna(dataset[feature].mode()[0])
dataset[categorical_features].isnull().sum()
```

Out[13]:

```
area_type     0
location      0
size          0
total_sqft    0
dtype: int64
```

In [14]:

```
dataset['area_type'].unique()
```

Out[14]:

```
array(['Super built-up  Area', 'Plot  Area', 'Built-up  Area',
       'Carpet  Area'], dtype=object)
```

In [15]:

```
dataset['location'].unique()
```

Out[15]:

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

In [16]:

```
def consider_only_bhk_number(x):
    token=x.split(" ")
    try:
        return float(token[0])
    except:
        return None
```

In [17]:

```
df1=dataset.copy()
df1['size']=df1['size'].apply(consider_only_bhk_number)
df1.head(10)
```

Out[17]:

	area_type	location	size	total_sqft	bath	balcony	price
0	Super built-up Area	Electronic City Phase II	2.0	1056	2.0	1.0	39.07
1	Plot Area	Chikka Tirupathi	4.0	2600	5.0	3.0	120.00
2	Built-up Area	Uttarahalli	3.0	1440	2.0	3.0	62.00
3	Super built-up Area	Lingadheeranahalli	3.0	1521	3.0	1.0	95.00
4	Super built-up Area	Kothanur	2.0	1200	2.0	1.0	51.00
5	Super built-up Area	Whitefield	2.0	1170	2.0	1.0	38.00
6	Super built-up Area	Old Airport Road	4.0	2732	4.0	2.0	204.00
7	Super built-up Area	Rajaji Nagar	4.0	3300	4.0	2.0	600.00
8	Super built-up Area	Marathahalli	3.0	1310	3.0	1.0	63.25
9	Plot Area	Gandhi Bazar	6.0	1020	6.0	2.0	370.00

In [18]:

```
df1['total_sqft'].unique()
```

Out[18]:

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

In [19]:

```
#convert range to its mean value
def convert_range_to_float(x):
    tokens = x.split(" - ")
    if len(tokens) == 2:
        return (float(tokens[0]) + float(tokens[1]))/2
    try:
        return float(x)
    except:
        return None
```

In [20]:

```
print(convert_range_to_float('3-4'))
```

```
None
```

In [21]:

```
print(convert_range_to_float('34.46Sq. Meter'))
```

```
None
```

In [22]:

```
df1['total_sqft'] = df1['total_sqft'].apply(convert_range_to_float)
```

In [23]:

```
df1.head()
```

Out[23]:

	area_type	location	size	total_sqft	bath	balcony	price
0	Super built-up Area	Electronic City Phase II	2.0	1056.0	2.0	1.0	39.07
1	Plot Area	Chikka Tirupathi	4.0	2600.0	5.0	3.0	120.00
2	Built-up Area	Uttarahalli	3.0	1440.0	2.0	3.0	62.00
3	Super built-up Area	Lingadheeranahalli	3.0	1521.0	3.0	1.0	95.00
4	Super built-up Area	Kothanur	2.0	1200.0	2.0	1.0	51.00

In [24]:

```
df1.isnull().sum()
```

Out[24]:

```
area_type      0
location       0
size           0
total_sqft    46
bath           0
balcony        0
price          0
dtype: int64
```

In [25]:

```
#remove null values. this null values are for total_sqft like 34.46Sq. Meter, for which convert_range_to_float func
#returns Null. replace this null values with mean
df1['total_sqft'] = df1['total_sqft'].fillna(df1['total_sqft'].mean())
```

In [26]:

```
df1.isnull().sum()
```

Out[26]:

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

In [27]:

```
#Introduce price per sq ft feature, which is a very important feature
#Price is in lakh, so multiply with 1 lakh and then divide price with total_sqft to get price per sqft
df1['price per sqft'] = (df1['price']*100000)/df1['total_sqft']
df1.head()
```

Out[27]:

	area_type	location	size	total_sqft	bath	balcony	price	price per sqft
0	Super built-up Area	Electronic City Phase II	2.0	1056.0	2.0	1.0	39.07	3699.810606
1	Plot Area	Chikka Tirupathi	4.0	2600.0	5.0	3.0	120.00	4615.384615
2	Built-up Area	Uttarahalli	3.0	1440.0	2.0	3.0	62.00	4305.555556
3	Super built-up Area	Lingadheeranahalli	3.0	1521.0	3.0	1.0	95.00	6245.890861
4	Super built-up Area	Kothanur	2.0	1200.0	2.0	1.0	51.00	4250.000000

In [28]:

```
df2 = df1.copy()
#Check how many unique area_types are there
len(df2['area_type'].unique())
```

Out[28]:

```
4
```

In [29]:

```
#check how many unique location are there
len(df2['location'].unique())
```

Out[29]:

```
1305
```

In [30]:

```
#Remove leading and ending spaces from the location so that no ambiguity is created
df2['location'] = df2['location'].apply(lambda x: x.strip())
```

In [31]:

```
temp = df2['location'].value_counts()
temp
```

Out[31]:

```
Whitefield                       542
Sarjapur  Road                   399
Electronic City                  304
Kanakpura Road                   273
Thanisandra                      237
                                ...
Bapuji Layout                      1
1st Stage Radha Krishna Layout     1
BEML Layout 5th stage              1
singapura paradise                 1
Abshot Layout                      1
Name: location, Length: 1294, dtype: int64
```

In [32]:

```
len(temp[temp >= 30])
```

Out[32]:

```
100
```

In [33]:

```
location_less_than_30 = temp[temp < 30]
location_less_than_30
```

Out[33]:

```
Dodda Nekkundi                    29
Kudlu                             29
Kammasandra                       29
BTM 2nd Stage                     29
Horamavu Banaswadi                28
                                  ..
Bapuji Layout                      1
1st Stage Radha Krishna Layout     1
BEML Layout 5th stage              1
singapura paradise                 1
Abshot Layout                      1
Name: location, Length: 1194, dtype: int64
```

In [34]:

```
locations_considered = temp[temp >= 30]
locations_considered
```

Out[34]:

```
Whitefield            542
Sarjapur  Road        399
Electronic City       304
Kanakpura Road        273
Thanisandra           237
                     ...
Mahadevpura            31
Doddathoguru           30
Kumaraswami Layout     30
Ananth Nagar           30
Chikkalasandra         30
Name: location, Length: 100, dtype: int64
```

In [35]:

```
df2['location'] = df2['location'].apply(lambda x: 'other_loc' if x in location_less_than_30 else x )
df2['location'].value_counts()
```

Out[35]:

```
other_loc             5379
Whitefield             542
Sarjapur  Road         399
Electronic City        304
Kanakpura Road         273
                      ...
Mahadevpura             31
Kumaraswami Layout      30
Doddathoguru            30
Chikkalasandra          30
Ananth Nagar            30
Name: location, Length: 101, dtype: int64
```

In [36]:

```
df2[df2['total_sqft']/df2['size'] < 300].head()
```

Out[36]:

	area_type	location	size	total_sqft	bath	balcony	price	price per sqft
9	Plot Area	other_loc	6.0	1020.0	6.0	2.0	370.0	36274.509804
45	Plot Area	HSR Layout	8.0	600.0	9.0	2.0	200.0	33333.333333
58	Plot Area	other_loc	6.0	1407.0	4.0	1.0	150.0	10660.980810
68	Plot Area	other_loc	8.0	1350.0	7.0	0.0	85.0	6296.296296
70	Plot Area	other_loc	3.0	500.0	3.0	2.0	100.0	20000.000000

In [37]:

```
df2.shape
```

Out[37]:

```
(13320, 8)
```

In [38]:

```
df3 = df2[~(df2['total_sqft']/df2['size'] < 300)]
df3.shape
```

Out[38]:

```
(12572, 8)
```

In [39]:

```
df2 = df3
df2.shape
```

Out[39]:

```
(12572, 8)
```

In [40]:

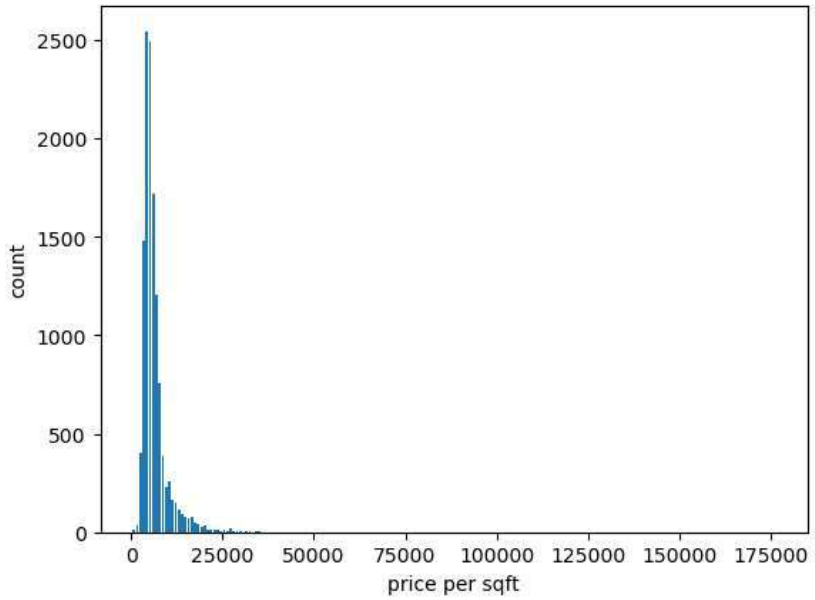
```
#Now consider price per sq. ft. Price per sq. ft can be too low or too high. 1st we need to check the description of
#this feature price per sq ft
df2['price per sqft'].describe()
```

Out[40]:

```
count     12572.000000
mean       6312.185150
std        4177.946702
min         267.829813
25%        4209.344773
50%        5294.736984
75%        6927.325006
max      176470.588235
Name: price per sqft, dtype: float64
```

In [41]:

```
plt.hist(df2['price per sqft'], bins = 200, rwidth = 0.8)
plt.xlabel('price per sqft')
plt.ylabel('count')
plt.show()
```



In [42]:

```
def remove_pps_outliers(df):
    final_df = pd.DataFrame()
    for key, subdf in df.groupby('location'):
         upper_limit = subdf['price per sqft'].mean() + 1*subdf['price per sqft'].std()
         lower_limit = subdf['price per sqft'].mean() - 1*subdf['price per sqft'].std()
         subdf_without_outliers = subdf[(subdf['price per sqft'] >= lower_limit) & (subdf['price per sqft'] <= upper_limit)]
         final_df = pd.concat([final_df , subdf_without_outliers], ignore_index = True)
    return final_df

df3 = remove_pps_outliers(df2)
df3.shape
```

Out[42]:

```
(10657, 8)
```

In [43]:

```
#No. of outlier records removed
df2.shape[0] - df3.shape[0]
```

Out[43]:

```
1915
```

In [44]:

```
#Bathrooms: Its unusual that a 2 BHK house has 5 or 6 bathrooms, so those are outliers
#For bathroom , if no. of bathrooms greater than no. of bed rooms + 2, then it is an outlier and remove them
df3 = df3[df3['bath'] < df3['size'] + 2]
df3.shape
```

Out[44]:

```
(10561, 8)
```

In [45]:

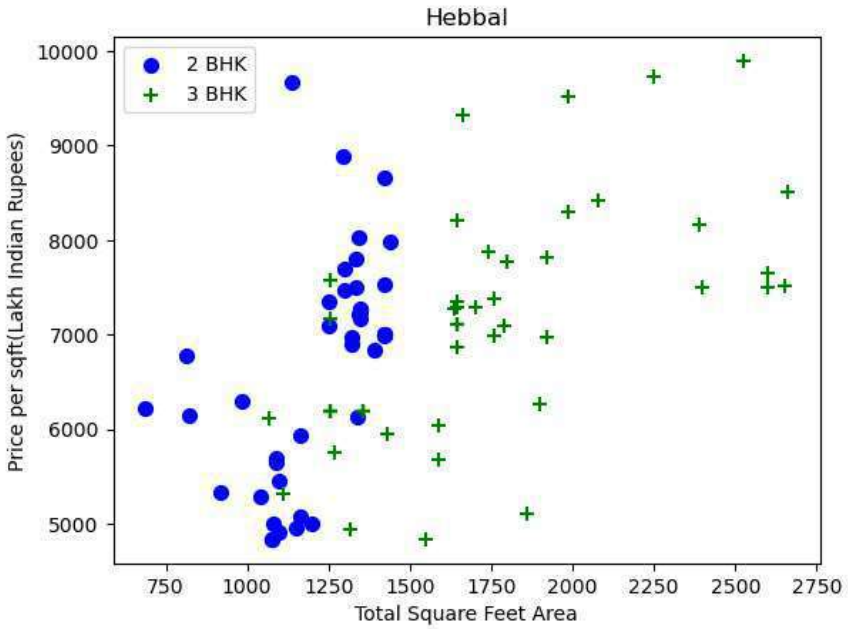
```
#Balcony : Its unusual that a 2 BHK house has 5 or 6 balcony, so those are outliers
#For balcony, if no. of balcony is greater than no of bed rooms + 2, then it is an outlier and remove them
df3 = df3[df3['balcony'] < df3['size'] + 2]
df3.shape
```

Out[45]:

```
(10561, 8)
```

In [46]:

```
def plot_scatter_chart(df,location):
    bhk2 = df[(df['location']==location) & (df['size']==2)]
    bhk3 = df[(df['location']==location) & (df['size']==3)]
    plt.scatter(bhk2['total_sqft'],bhk2['price per sqft'],color='blue',label='2 BHK', s=50)
    plt.scatter(bhk3['total_sqft'],bhk3['price per sqft'],marker='+', color='green',label='3 BHK', s=50)
    plt.xlabel("Total Square Feet Area")
    plt.ylabel("Price per sqft(Lakh Indian Rupees)")
    plt.title(location)
    plt.legend()

plot_scatter_chart(df3,"Hebbal")
```



In [47]:

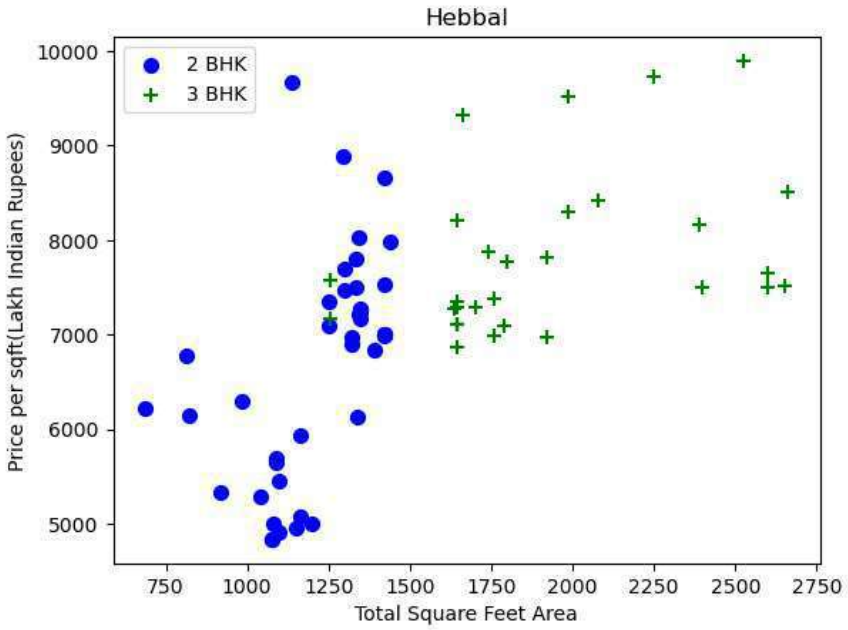
```
def remove_bhk_outliers(df):
    exclude_indices = np.array([])
    for location, location_df in df.groupby('location'):
        bhk_dict = {}
        for bhk, bhk_df in location_df.groupby('size'):
            bhk_dict[bhk] = bhk_df['price per sqft'].mean()

        for bhk, bhk_df in location_df.groupby('size'):
            prev_bhk_mean = bhk_dict.get(bhk-1)
            if prev_bhk_mean:
                exclude_indices = np.append(exclude_indices, bhk_df[bhk_df['price per sqft']< prev_bhk_mean].index.values)
    return df.drop(exclude_indices,axis='index')

df4 = remove_bhk_outliers(df3)
df4.shape
```

Out[47]:

```
(5800, 8)
```

In [48]:

```
plot_scatter_chart(df4,"Hebbal")
```



In [49]:

```
#Now all outliers removed
#Since price per sqft column is only for removing outliers, so we can delete it
df4.drop(['price per sqft'], axis = 'columns', inplace = True)
df4.shape
```

Out[49]:

```
(5800, 7)
```

In [50]:

```
#Convert categorical data into numerical data using one hot encoding

#For area type
dum = pd.get_dummies(df4['area_type'])
dum.head()
```

Out[50]:

	Built-up Area	Carpet Area	Plot Area	Super built-up Area
0	0	0	0	1
2	1	0	0	0
3	0	0	0	1
4	1	0	0	0
6	1	0	0	0

In [51]:

```
df5 = pd.concat([df4,dum], axis = 'columns')
```

In [52]:

```
#Drop area_type as dummy columns have already been created
df5.drop(['area_type'] , axis = 1, inplace = True)
df5.head()
```

Out[52]:

	location	size	total_sqft	bath	balcony	price	Built-up Area	Carpet Area	Plot Area	Super built-up Area
0	5th Phase JP Nagar	2.0	1075.0	2.0	2.0	60.0	0	0	0	1
2	5th Phase JP Nagar	2.0	1256.0	2.0	1.0	62.8	1	0	0	0
3	5th Phase JP Nagar	2.0	1207.0	2.0	2.0	63.0	0	0	0	1
4	5th Phase JP Nagar	3.0	1725.0	2.0	2.0	100.0	1	0	0	0
6	5th Phase JP Nagar	3.0	1700.0	2.0	3.0	100.0	1	0	0	0

In [53]:

```
#Do one hot encoding for location
location_dummy = pd.get_dummies(df5['location'])
df6 = pd.concat([df5,location_dummy], axis = 'columns')
df6.drop(['location'], axis = 1, inplace = True)
df6.shape
```

Out[53]:

```
(5800, 110)
```

In [54]:

```
#Now the model is ready to be trained
X = df6.drop('price' , axis = 'columns')
X.shape
```

Out[54]:

```
(5800, 109)
```

In [55]:

```
y = df6['price']
```

In [56]:

```
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 [57]:

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

Out[57]:

```
0.8561848351348708
```

In [58]:

```
from sklearn.tree import DecisionTreeRegressor
dt = DecisionTreeRegressor()
dt.fit(X_train,y_train)
dt.score(X_test,y_test)
```

Out[58]:

```
0.7986420544795725
```

In [59]:

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

Out[59]:

```
0.781706098234469
```

In [60]:

```
#Use K-fold cross validation
#Shuffle split will randomize the dataset so that each of the fold will have equal distribution
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(lr,X,y,cv=cv)
```

Out[60]:

```
array([0.86961856, 0.87787611, 0.86923611, 0.85743499, 0.86443647])
```

In [61]:

```
#Model prediction
X.head()
```

Out[61]:

	size	total_sqft	bath	balcony	Built-up Area	Carpet Area	Plot Area	Super built-up Area	5th Phase JP Nagar	7th Phase JP Nagar	...	Uttarahalli	Varthur	Vidyaranyapura	Vijayanagar	Vittasandra
0	2.0	1075.0	2.0	2.0	0	0	0	1	1	0	...	0	0	0	0	0
2	2.0	1256.0	2.0	1.0	1	0	0	0	1	0	...	0	0	0	0	0
3	2.0	1207.0	2.0	2.0	0	0	0	1	1	0	...	0	0	0	0	0
4	3.0	1725.0	2.0	2.0	1	0	0	0	1	0	...	0	0	0	0	0
6	3.0	1700.0	2.0	3.0	1	0	0	0	1	0	...	0	0	0	0	0

5 rows × 109 columns

In [62]:

```
def predict_val(area_type , location, size, total_sqft, bath, balcony):
    area_type_ind = np.where(X.columns == area_type)[0][0]

    if location not in locations_considered:
        location = 'other_loc'
    location_ind = np.where(X.columns == location)[0][0]

    data = np.zeros(len(X.columns))
    data[0] = size
    data[1] = total_sqft
    data[2] = bath
    data[3] = balcony
    data[area_type_ind] = 1
    data[location_ind] = 1

    return lr.predict([data])[0]
```

In [63]:

```
predict_val('Built-up  Area','1st Phase JP Nagar',3,2000,4,2)
```

```
C:\Users\91900\anaconda3\lib\site-packages\sklearn\base.py:450: UserWarning: X does not have valid feature names, b
ut LinearRegression was fitted with feature names
  warnings.warn(
```

Out[63]:

```
153.82213592529297
```

In [ ]:

```

```