In [1]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import random

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

Load Data and Basic Info

In [2]:
```
data=pd.read_csv("Housing.csv")
data
```

Out[2]:

	price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	prefare
0	13300000	7420	4	2	3	yes	no	no	no	yes	2	y
1	12250000	8960	4	4	4	yes	no	no	no	yes	3	r
2	12250000	9960	3	2	2	yes	no	yes	no	no	2	y
3	12215000	7500	4	2	2	yes	no	yes	no	yes	3	y
4	11410000	7420	4	1	2	yes	yes	yes	no	yes	2	r
...	...	...	...	...	...	...	...	...	...	...	...	
540	1820000	3000	2	1	1	yes	no	yes	no	no	2	r
541	1767150	2400	3	1	1	no	no	no	no	no	0	r
542	1750000	3620	2	1	1	yes	no	no	no	no	0	r
543	1750000	2910	3	1	1	no	no	no	no	no	0	r
544	1750000	3850	3	1	2	yes	no	no	no	no	0	r

545 rows × 13 columns

In [3]:
```
data.shape
```

Out[3]:
```
(545, 13)
```

In [4]:
```
data.columns
```

Out[4]:
```
Index(['price', 'area', 'bedrooms', 'bathrooms', 'stories', 'mainroad',
       'guestroom', 'basement', 'hotwaterheating', 'airconditioning',
       'parking', 'prefarea', 'furnishingstatus'],
      dtype='object')
```

In [5]:
```
data.head(3)
```

Out[5]:

	price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	prefarea
0	13300000	7420	4	2	3	yes	no	no	no	yes	2	yes
1	12250000	8960	4	4	4	yes	no	no	no	yes	3	no
2	12250000	9960	3	2	2	yes	no	yes	no	no	2	yes

In [6]:
```
data.sample(5)
```

Out[6]:

	price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	prefarea
250	4515000	3510	3	1	3	yes	no	no	no	no	0	no
355	3773000	8250	3	1	1	yes	no	no	no	no	2	no
225	4753000	6440	2	1	1	yes	no	no	no	yes	3	no
544	1750000	3850	3	1	2	yes	no	no	no	no	0	no
265	4403000	2880	3	1	2	yes	no	no	no	no	0	yes

Basic Information and Summary

In [7]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 545 entries, 0 to 544
Data columns (total 13 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   price             545 non-null    int64
 1   area              545 non-null    int64
 2   bedrooms          545 non-null    int64
 3   bathrooms         545 non-null    int64
 4   stories           545 non-null    int64
 5   mainroad          545 non-null    object
 6   guestroom         545 non-null    object
 7   basement          545 non-null    object
 8   hotwaterheating   545 non-null    object
 9   airconditioning   545 non-null    object
 10  parking           545 non-null    int64
 11  prefarea          545 non-null    object
 12  furnishingstatus  545 non-null    object
dtypes: int64(6), object(7)
memory usage: 55.5+ KB
```

In [8]:
```
data.describe()
```

Out[8]:

	price	area	bedrooms	bathrooms	stories	parking
count	5.450000e+02	545.000000	545.000000	545.000000	545.000000	545.000000
mean	4.766729e+06	5150.541284	2.965138	1.286239	1.805505	0.693578
std	1.870440e+06	2170.141023	0.738064	0.502470	0.867492	0.861586
min	1.750000e+06	1650.000000	1.000000	1.000000	1.000000	0.000000
25%	3.430000e+06	3600.000000	2.000000	1.000000	1.000000	0.000000
50%	4.340000e+06	4600.000000	3.000000	1.000000	2.000000	0.000000
75%	5.740000e+06	6360.000000	3.000000	2.000000	2.000000	1.000000
max	1.330000e+07	16200.000000	6.000000	4.000000	4.000000	3.000000

In [9]:
```
data.describe(include='object')
```

Out[9]:

	mainroad	guestroom	basement	hotwaterheating	airconditioning	prefarea	furnishingstatus
count	545	545	545	545	545	545	545
unique	2	2	2	2	2	2	3
top	yes	no	no	no	no	no	semi-furnished
freq	468	448	354	520	373	417	227

Unique Data Identification

In [10]:
```
data.nunique()
```

Out[10]:
```
price               219
area                284
bedrooms              6
bathrooms             4
stories               4
mainroad              2
guestroom             2
basement              2
hotwaterheating       2
airconditioning       2
parking               4
prefarea              2
furnishingstatus      3
dtype: int64
```

In [11]:
```
data["furnishingstatus"].unique()
```

Out[11]:
```
array(['furnished', 'semi-furnished', 'unfurnished'], dtype=object)
```

In [12]:
```
data["parking"].unique()
```

Out[12]:
```
array([2, 3, 0, 1], dtype=int64)
```

In [13]:
```
data["bedrooms"].value_counts()
```

Out[13]:
```
bedrooms
3    300
2    136
4     95
5     10
6      2
1      2
Name: count, dtype: int64
```

Missing Data

In [14]:
```
data.isnull().any()
```

Out[14]:
```
price               False
area                False
bedrooms            False
bathrooms           False
stories             False
mainroad            False
guestroom           False
basement            False
hotwaterheating     False
airconditioning     False
parking             False
prefarea            False
furnishingstatus    False
dtype: bool
```

In [15]:
```
data.isnull().sum()
```

Out[15]:
```
price               0
area                0
bedrooms            0
bathrooms           0
stories             0
mainroad            0
guestroom           0
basement            0
hotwaterheating     0
airconditioning     0
parking             0
prefarea            0
furnishingstatus    0
dtype: int64
```

Duplicate

In [16]:
```
data.duplicated().sum()
```

Out[16]:
```
0
```

In [17]:
```
data[data.duplicated()]
```

Out[17]:

price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	prefarea	furn

In [18]:
```
data
```

Out[18]:

	price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	prefare
0	13300000	7420	4	2	3	yes	no	no	no	yes	2	y
1	12250000	8960	4	4	4	yes	no	no	no	yes	3	r
2	12250000	9960	3	2	2	yes	no	yes	no	no	2	y
3	12215000	7500	4	2	2	yes	no	yes	no	yes	3	y
4	11410000	7420	4	1	2	yes	yes	yes	no	yes	2	r
...	...	...	...	...	...	...	...	...	...	...	...	
540	1820000	3000	2	1	1	yes	no	yes	no	no	2	r
541	1767150	2400	3	1	1	no	no	no	no	no	0	r
542	1750000	3620	2	1	1	yes	no	no	no	no	0	r
543	1750000	2910	3	1	1	no	no	no	no	no	0	r
544	1750000	3850	3	1	2	yes	no	no	no	no	0	r

545 rows × 13 columns

set_index() and reset_index()

In [19]:
```
data.set_index("price",inplace=True)
```

In [20]:
```
data.head()
```

Out[20]:

price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	prefarea	fu
13300000	7420	4	2	3	yes	no	no	no	yes	2	yes	
12250000	8960	4	4	4	yes	no	no	no	yes	3	no	
12250000	9960	3	2	2	yes	no	yes	no	no	2	yes	
12215000	7500	4	2	2	yes	no	yes	no	yes	3	yes	
11410000	7420	4	1	2	yes	yes	yes	no	yes	2	no	

In [21]:
```
data.reset_index(inplace=True)
```

In [22]:
```
data.head()
```

Out[22]:

	price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	prefarea
0	13300000	7420	4	2	3	yes	no	no	no	yes	2	yes
1	12250000	8960	4	4	4	yes	no	no	no	yes	3	no
2	12250000	9960	3	2	2	yes	no	yes	no	no	2	yes
3	12215000	7500	4	2	2	yes	no	yes	no	yes	3	yes
4	11410000	7420	4	1	2	yes	yes	yes	no	yes	2	no

GroupBy()

In [23]:
```
group_data=data.groupby("stories")
```

In [24]:
```
group_data.get_group(4)[:3]
```

Out[24]:

	price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	prefarea
1	12250000	8960	4	4	4	yes	no	no	no	yes	3	no
6	10150000	8580	4	3	4	yes	no	no	no	yes	2	yes
9	9800000	5750	3	2	4	yes	yes	no	no	yes	1	yes

In [25]:
```
group_data.get_group(4).min()
```

Out[25]:
```
price                 4550000
area                     4500
bedrooms                    2
bathrooms                   1
stories                     4
mainroad                  yes
guestroom                  no
basement                   no
hotwaterheating            no
airconditioning            no
parking                     0
prefarea                   no
furnishingstatus    furnished
dtype: object
```

Data Transformation

In [26]:
```
#data['mainroad'] = data['mainroad'].replace({'yes': 1, 'no': 0})
#data['guestroom'] = data['guestroom'].replace({'yes': 1, 'no': 0})
#data['basement'] = data['basement'].replace({'yes': 1, 'no': 0})
#data['hotwaterheating'] = data['hotwaterheating'].replace({'yes': 1, 'no': 0})
#data['airconditioning'] = data['airconditioning'].replace({'yes': 1, 'no': 0})
#data['prefarea'] = data['prefarea'].replace({'yes': 1, 'no': 0})
```

In [27]:
```
data
```

Out[27]:

	price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	prefare
0	13300000	7420	4	2	3	yes	no	no	no	yes	2	y
1	12250000	8960	4	4	4	yes	no	no	no	yes	3	r
2	12250000	9960	3	2	2	yes	no	yes	no	no	2	y
3	12215000	7500	4	2	2	yes	no	yes	no	yes	3	y
4	11410000	7420	4	1	2	yes	yes	yes	no	yes	2	r
...	...	...	...	...	...	...	...	...	...	...	...	
540	1820000	3000	2	1	1	yes	no	yes	no	no	2	r
541	1767150	2400	3	1	1	no	no	no	no	no	0	r
542	1750000	3620	2	1	1	yes	no	no	no	no	0	r
543	1750000	2910	3	1	1	no	no	no	no	no	0	r
544	1750000	3850	3	1	2	yes	no	no	no	no	0	r

545 rows × 13 columns

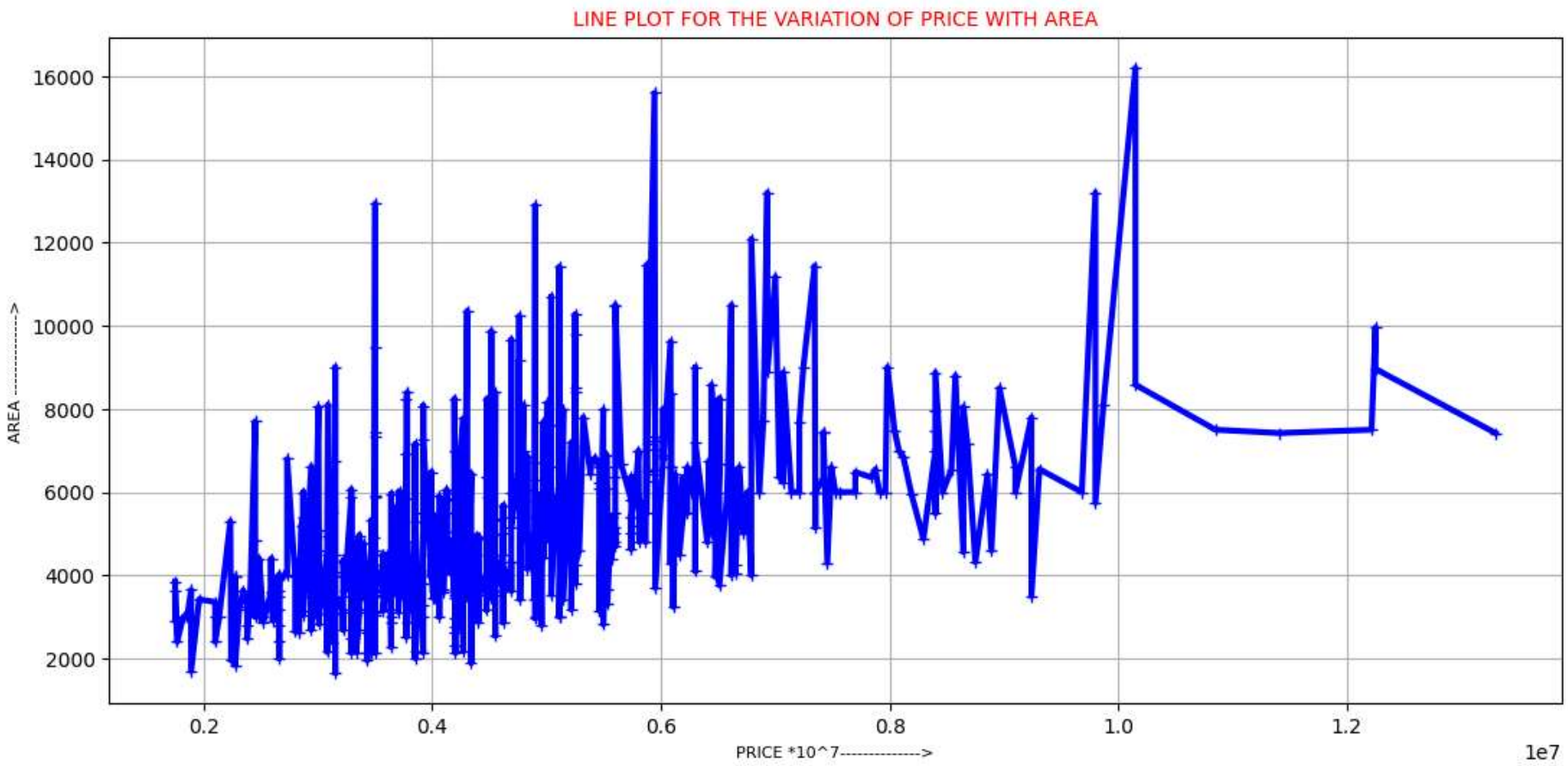
In [28]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 545 entries, 0 to 544
Data columns (total 13 columns):
 #   Column            Non-Null Count  Dtype 
---  ------            --------------  ----- 
 0   price             545 non-null    int64 
 1   area              545 non-null    int64 
 2   bedrooms          545 non-null    int64 
 3   bathrooms         545 non-null    int64 
 4   stories           545 non-null    int64 
 5   mainroad          545 non-null    object
 6   guestroom         545 non-null    object
 7   basement          545 non-null    object
 8   hotwaterheating   545 non-null    object
 9   airconditioning   545 non-null    object
 10  parking           545 non-null    int64 
 11  prefarea          545 non-null    object
 12  furnishingstatus  545 non-null    object
dtypes: int64(6), object(7)
memory usage: 55.5+ KB
```

Basic Plots

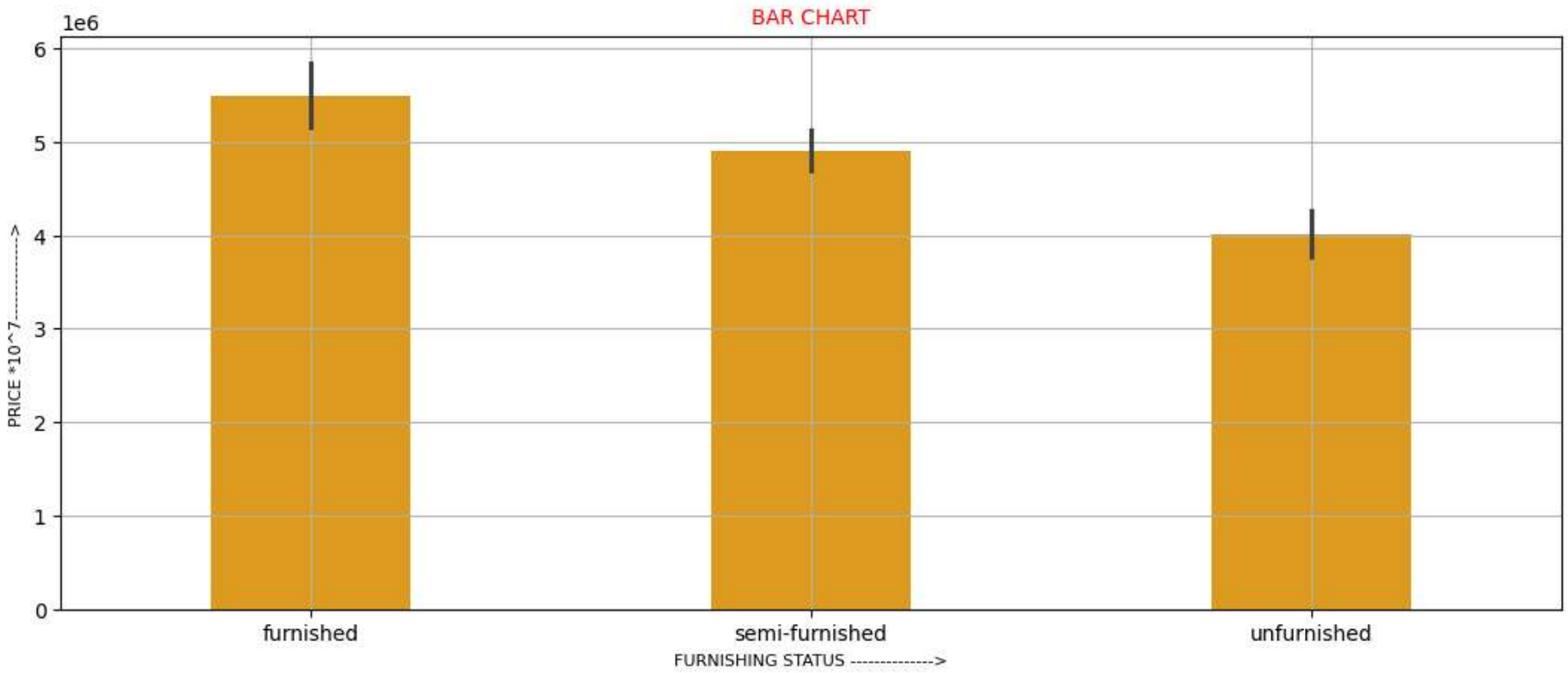
a)Line Plot

In [29]:
```
plt.figure(figsize=(13,6))
plt.plot(data["price"],data['area'],marker='+',ls='-',lw=3,color='b')
plt.title("LINE PLOT FOR THE VARIATION OF PRICE WITH AREA",color='r',fontsize=10)
plt.xlabel("PRICE *10^7-------------->",fontsize=8)
plt.ylabel("AREA -------------->",fontsize=8)
plt.grid()
plt.show()
```



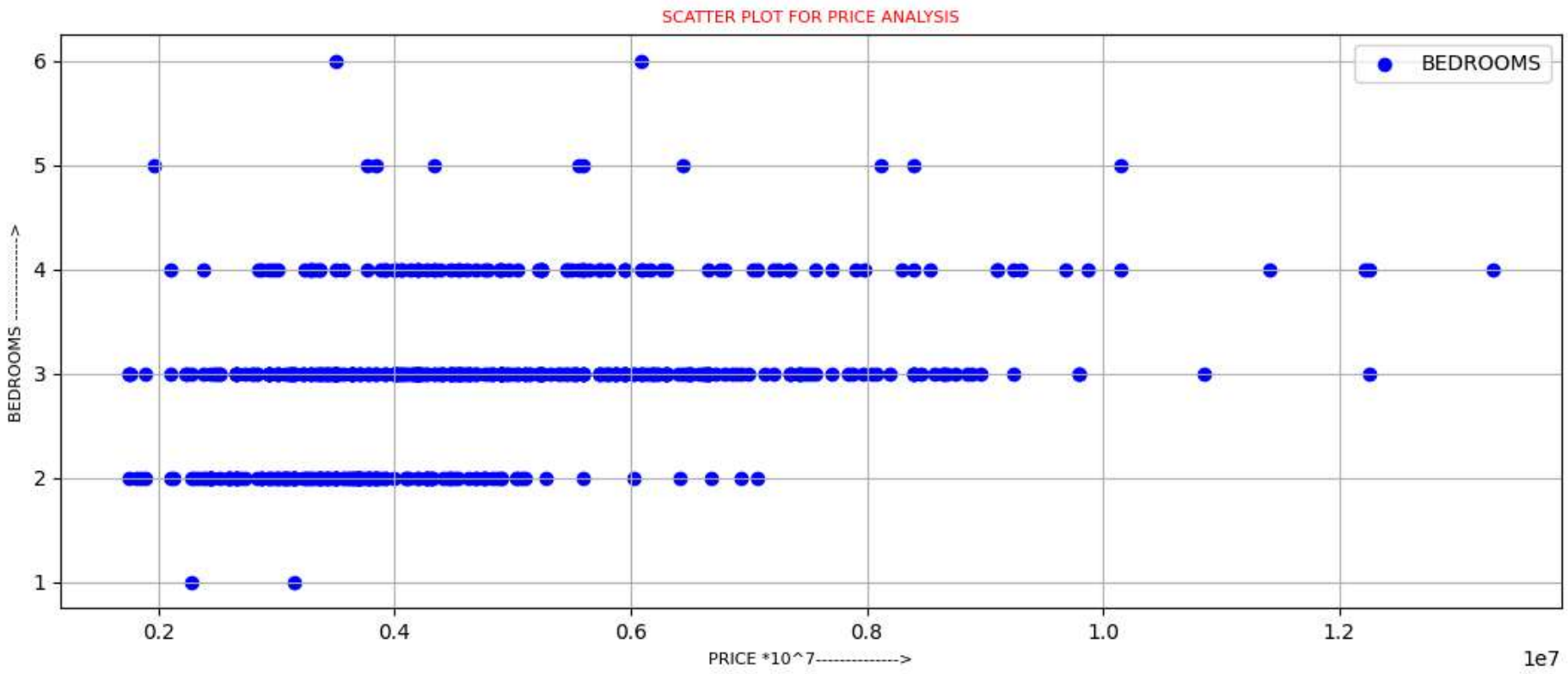
b)Bar Plot

In [30]:
```
plt.figure(figsize=(13,5))
sns.barplot(x='furnishingstatus', y='price', data=data,color="orange",width=0.4)
plt.title("BAR CHART",color='red',fontsize=10)
plt.xlabel("FURNISHING STATUS ---------->",fontsize=8)
plt.ylabel("PRICE *10^7---------->",fontsize=8)
plt.grid()
plt.show()
```



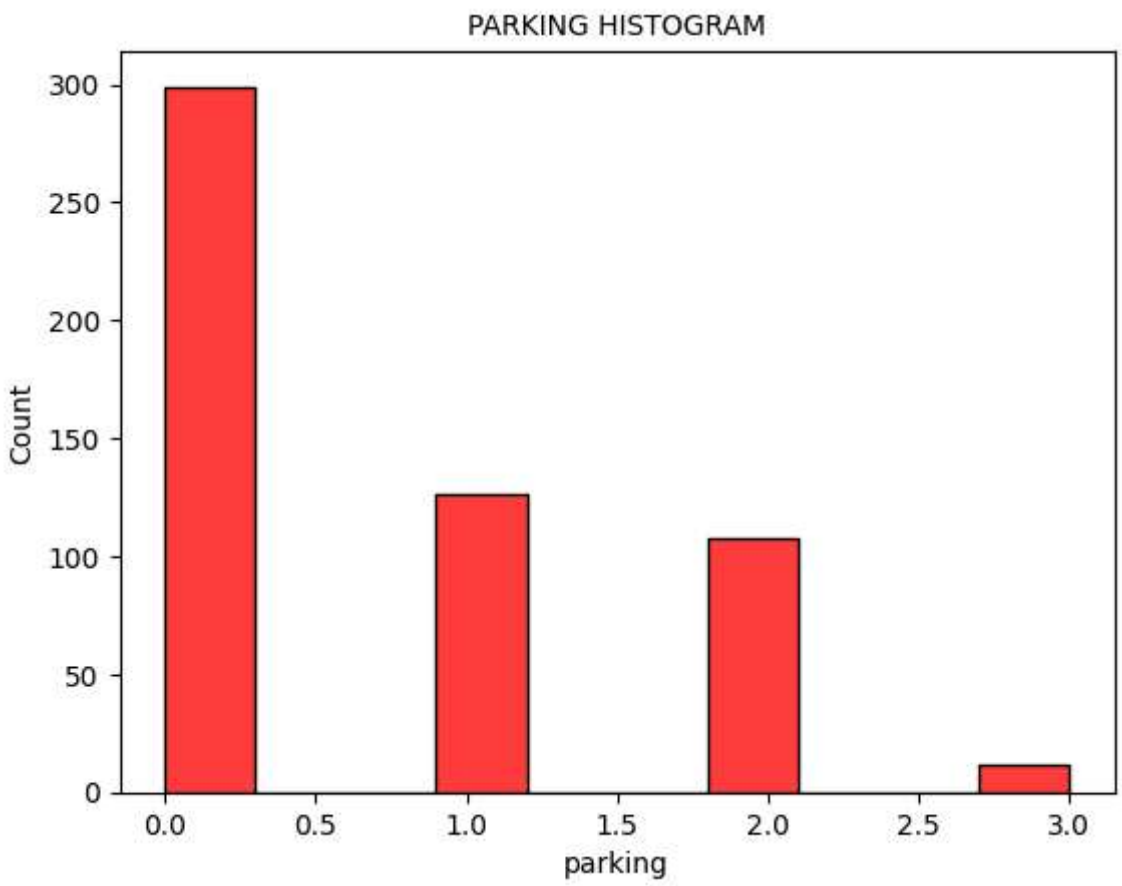
c)Scatter Plot

In [31]:
```
plt.figure(figsize=(13,5))
x=data['price']
y1=data['bedrooms']
plt.scatter(x,y1,color='b',marker='o',label='BEDROOMS')
plt.title("SCATTER PLOT FOR PRICE ANALYSIS",color="r",fontsize=8)
plt.xlabel("PRICE *10^7---------->",fontsize=8)
plt.ylabel("BEDROOMS ---------->",fontsize=8)
plt.legend()
plt.grid()
plt.show()
```



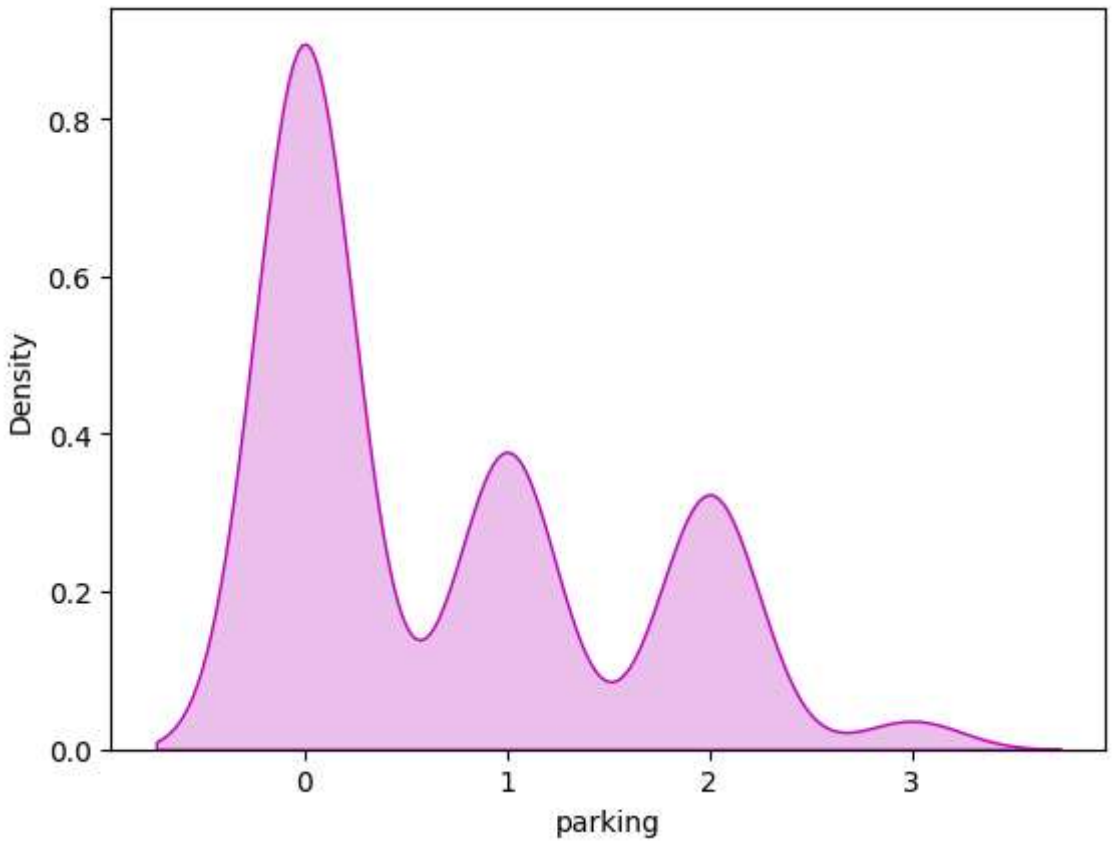
d)Histogram

In [32]:
```
sns.histplot(data["parking"],bins=10,color='r')
plt.title("PARKING HISTOGRAM",fontsize=10)
plt.show()
```



e)KDE [Kernel Density Estimate] Plot

In [46]:
```
sns.kdeplot(data["parking"],fill=True,color="m")
plt.show()
```



f)Distribution Plot

In [39]:
```
d=data.select_dtypes(exclude='object')
d
```

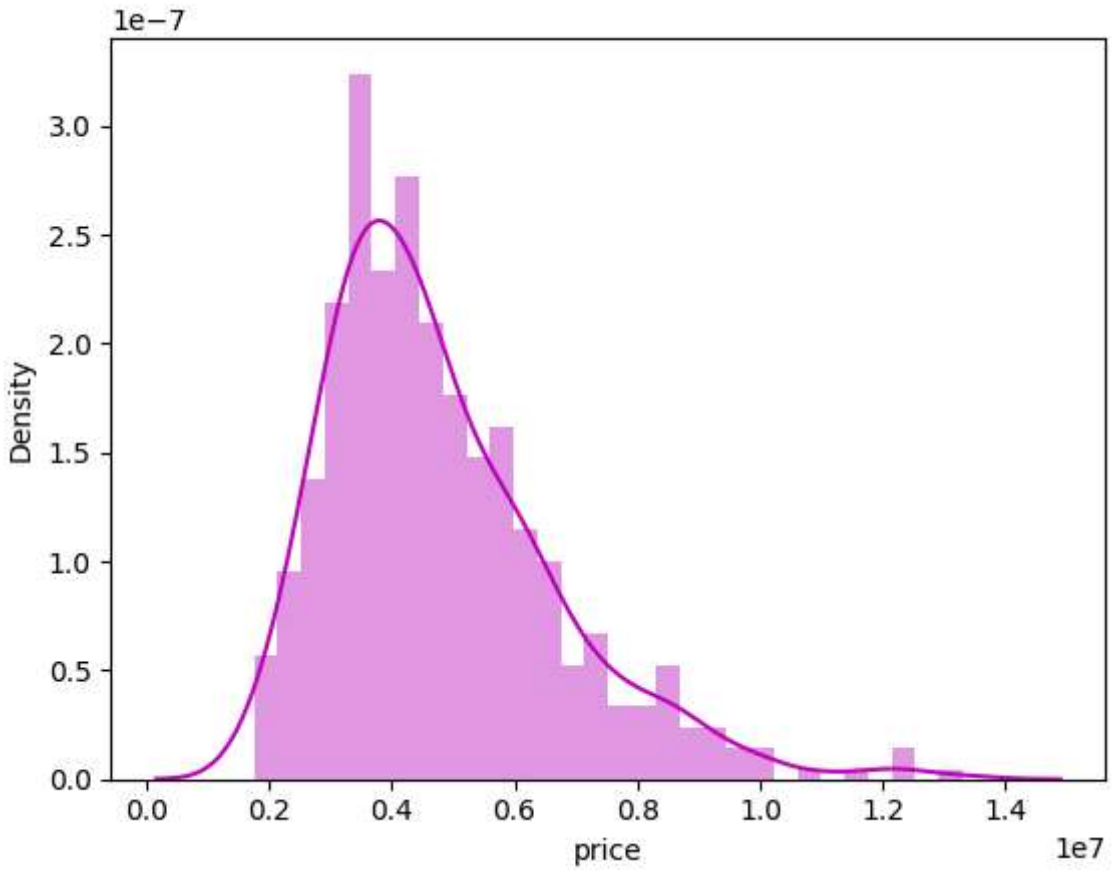
Out[39]:

	price	area	bedrooms	bathrooms	stories	parking
0	13300000	7420	4	2	3	2
1	12250000	8960	4	4	4	3
2	12250000	9960	3	2	2	2
3	12215000	7500	4	2	2	3
4	11410000	7420	4	1	2	2
...	...	...	...	...	...	...
540	1820000	3000	2	1	1	2
541	1767150	2400	3	1	1	0
542	1750000	3620	2	1	1	0
543	1750000	2910	3	1	1	0
544	1750000	3850	3	1	2	0

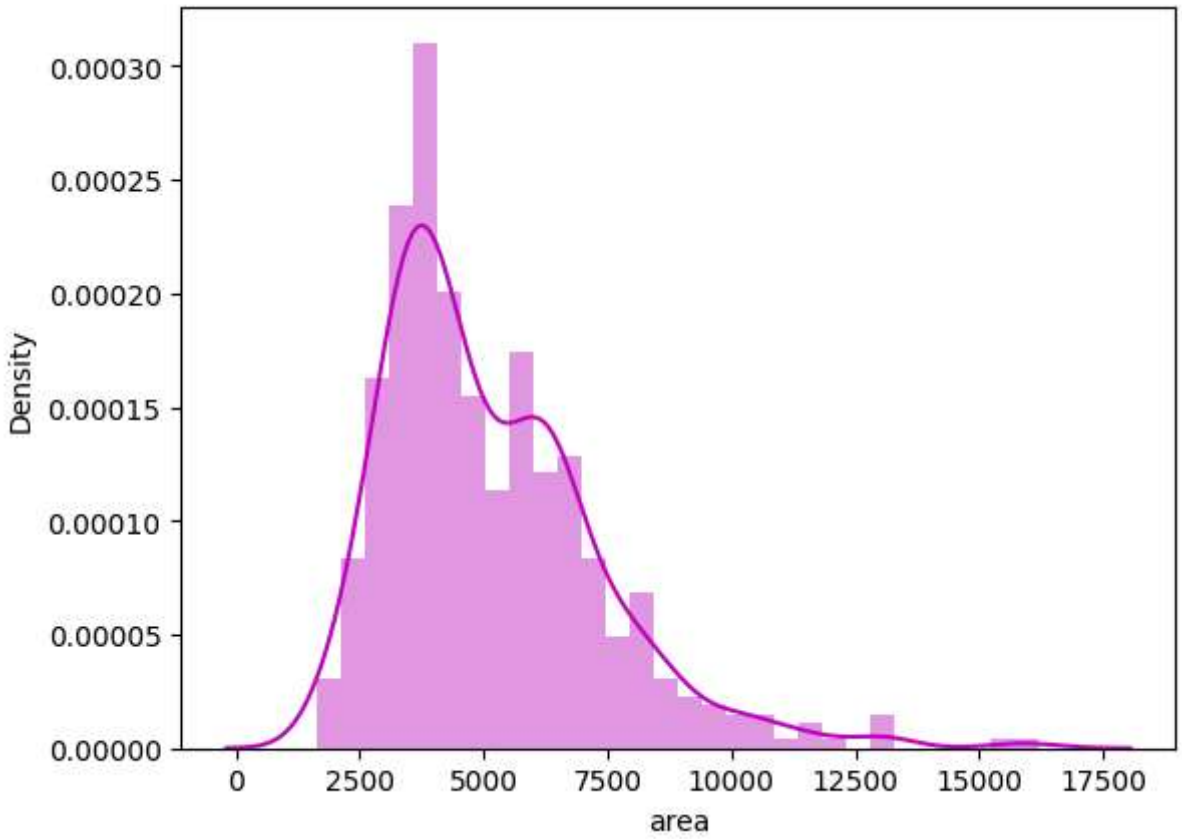
545 rows × 6 columns

In [40]:
```
for i in d.columns:
    print(i)
    sns.distplot(d[i],color='m',bins=30)
    plt.show()
```

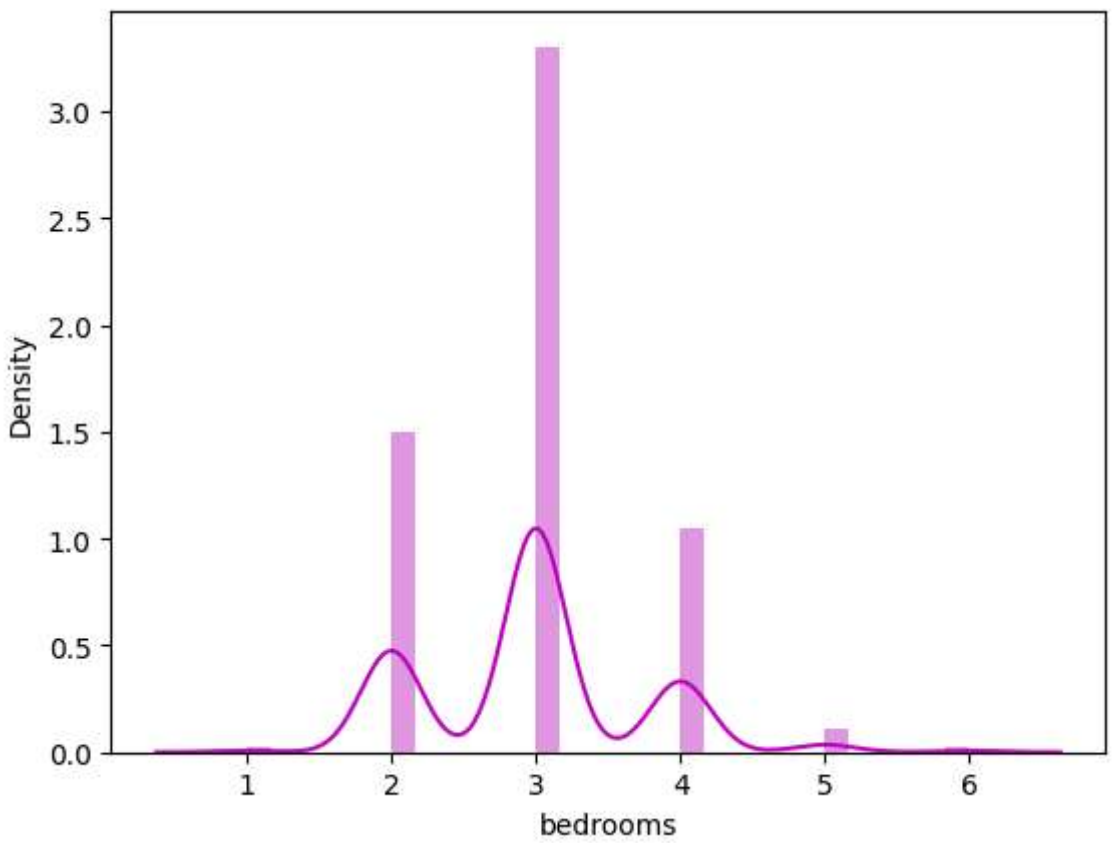
```
price
```



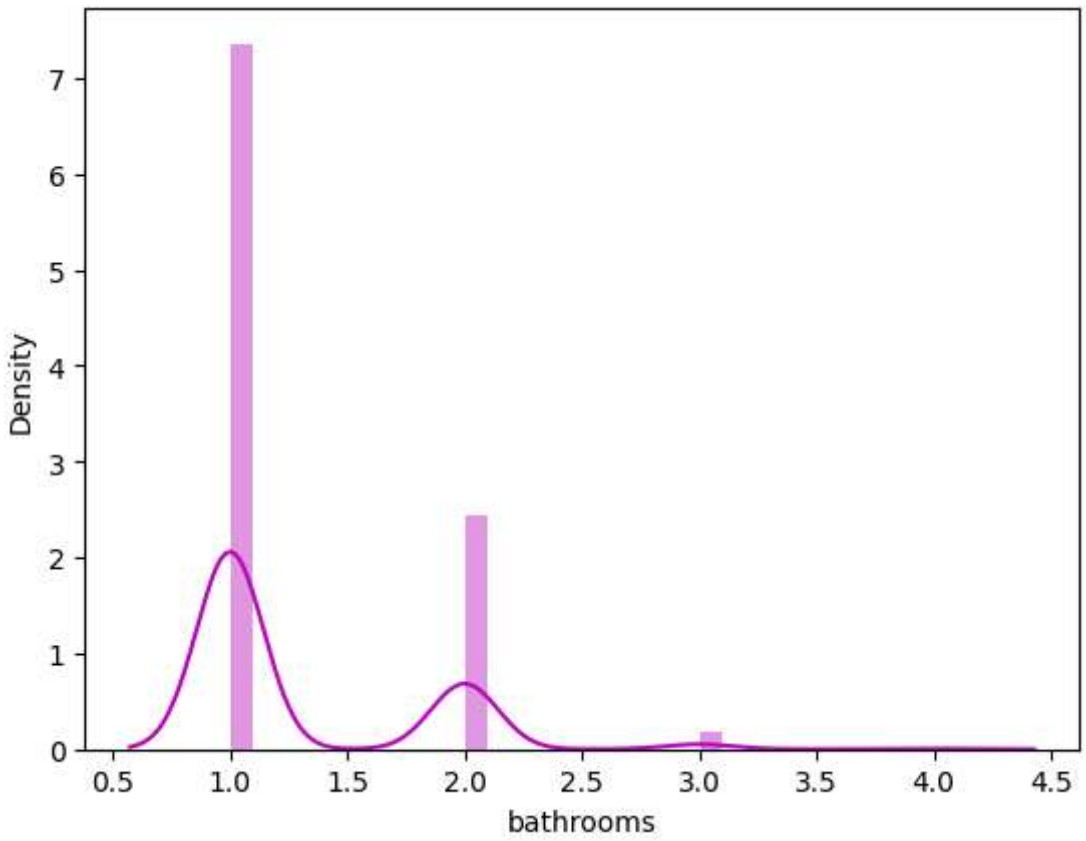

```
area
```



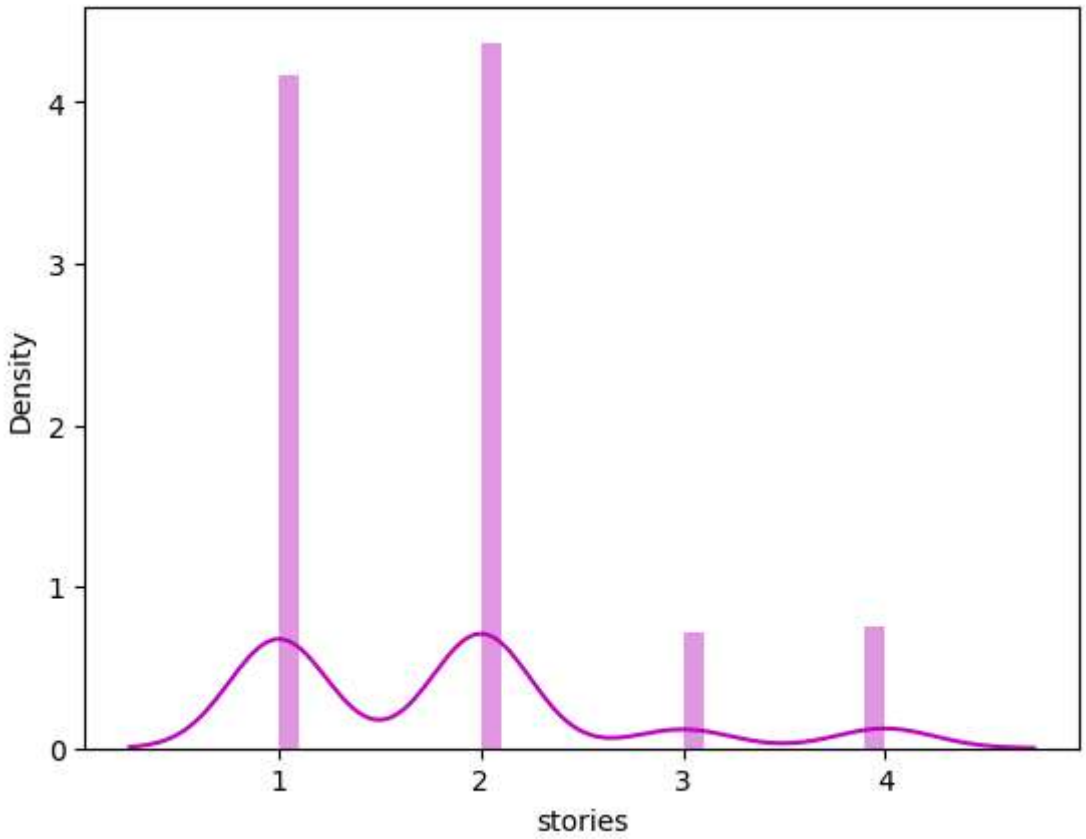

```
bedrooms
```



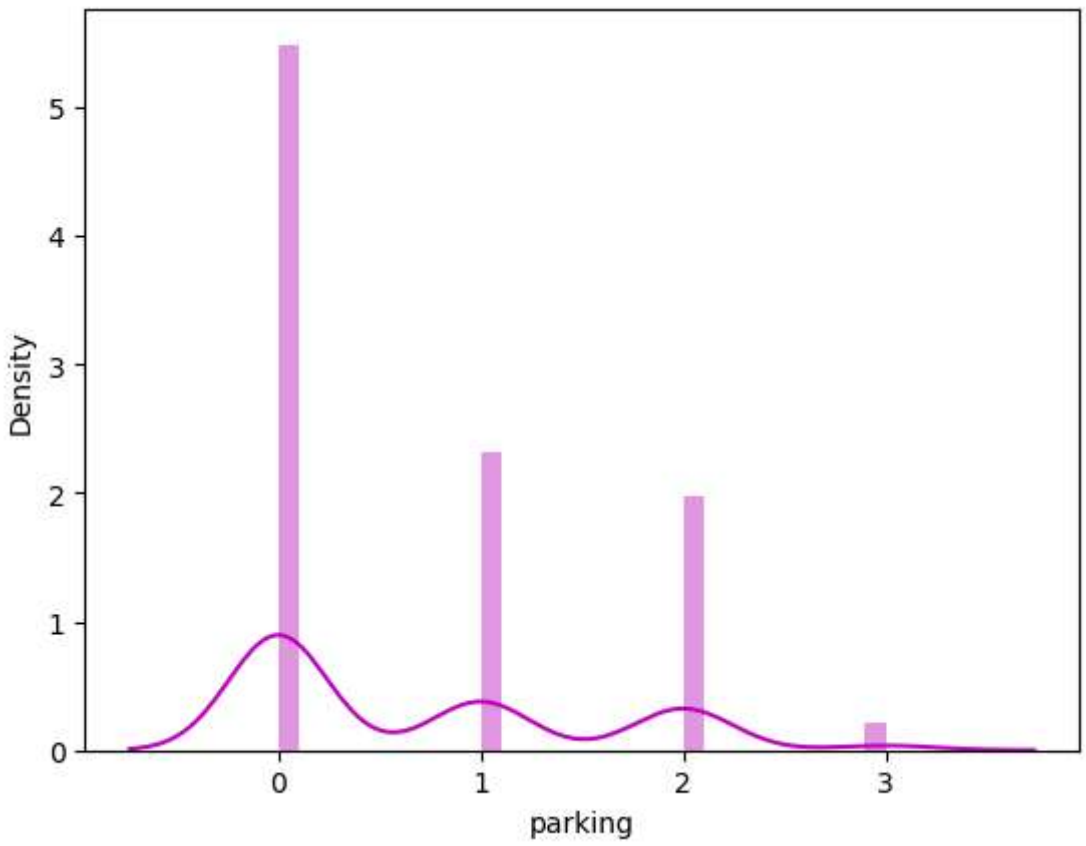

```
bathrooms
```




```
stories
```




```
parking
```



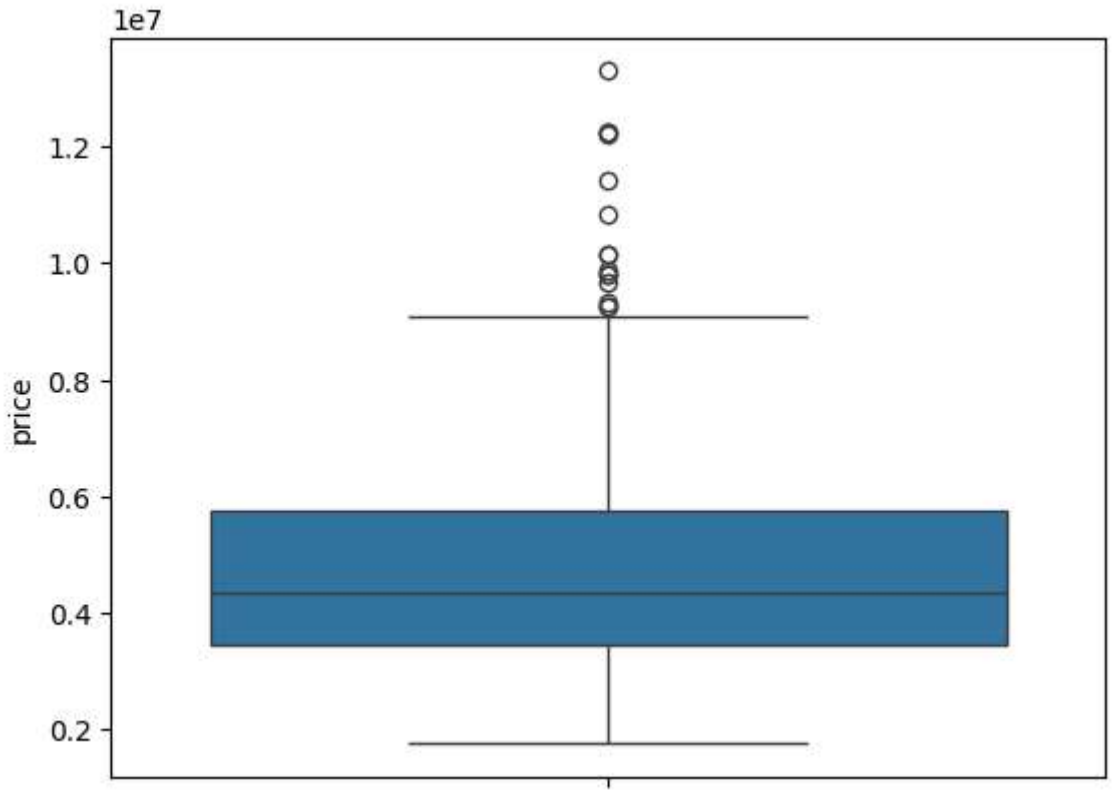
Outlier Detection

a)Box Plot

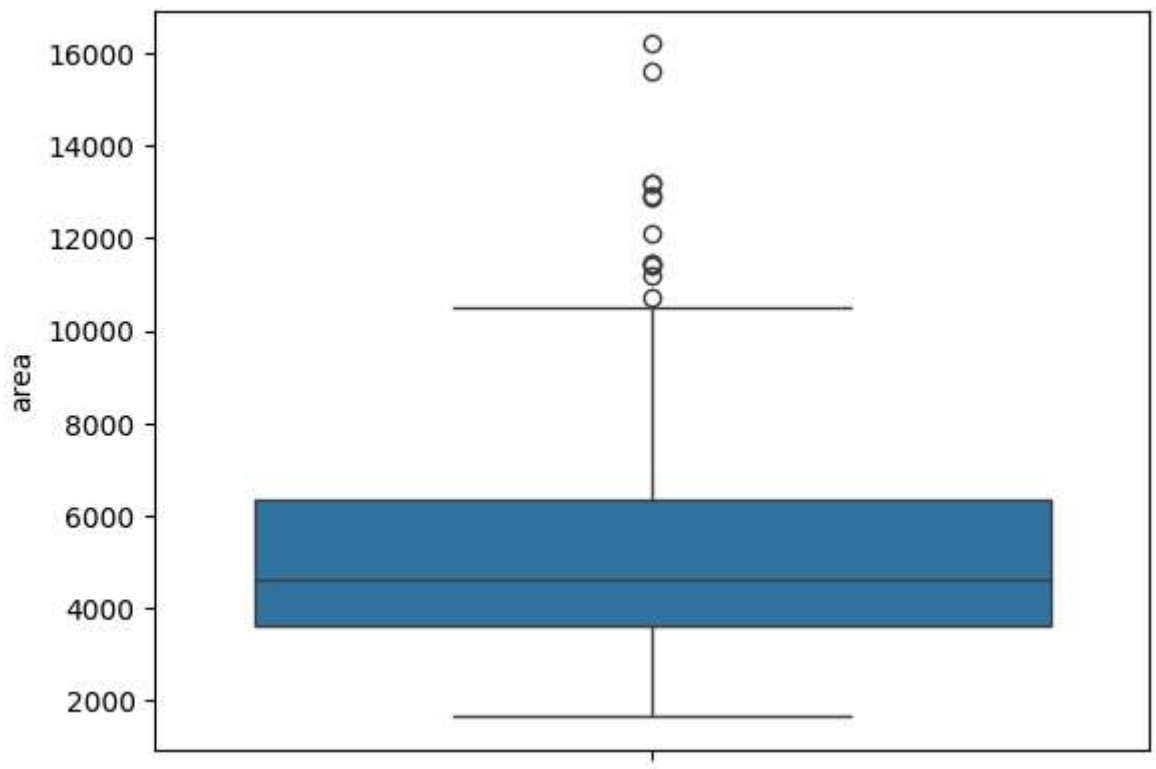
In [41]:
```
for i in d.columns:
    print(i)
```

```
    sns.boxplot(d[i])
    plt.show()
```

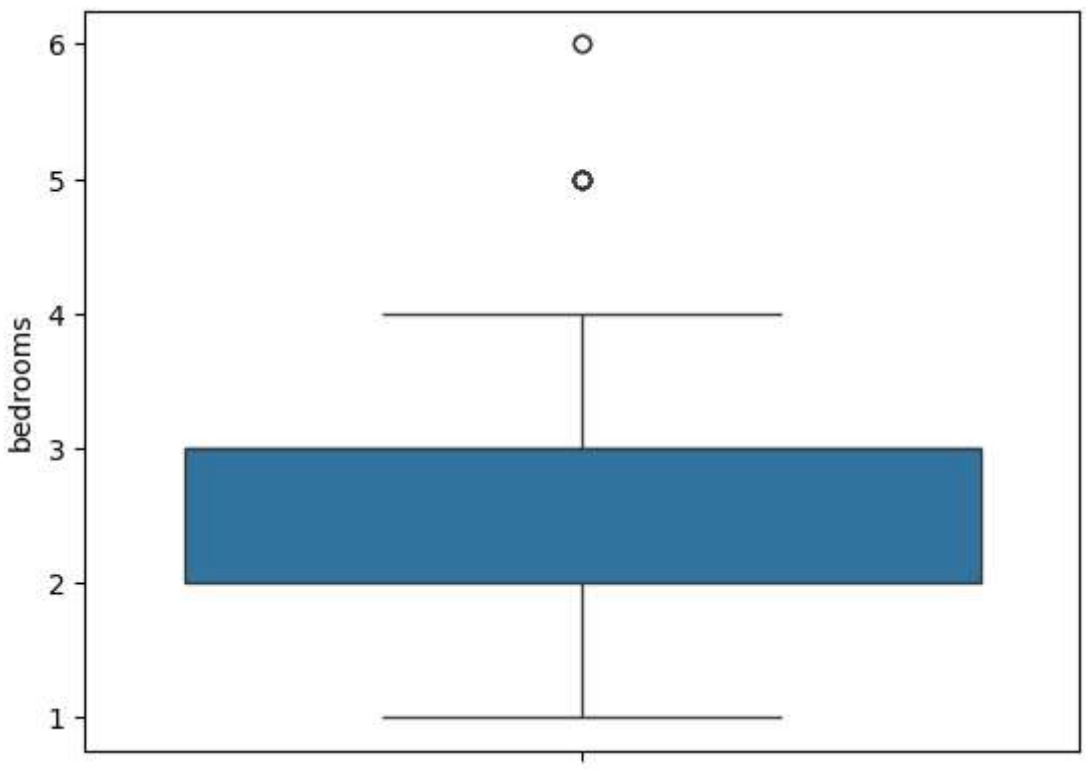
price



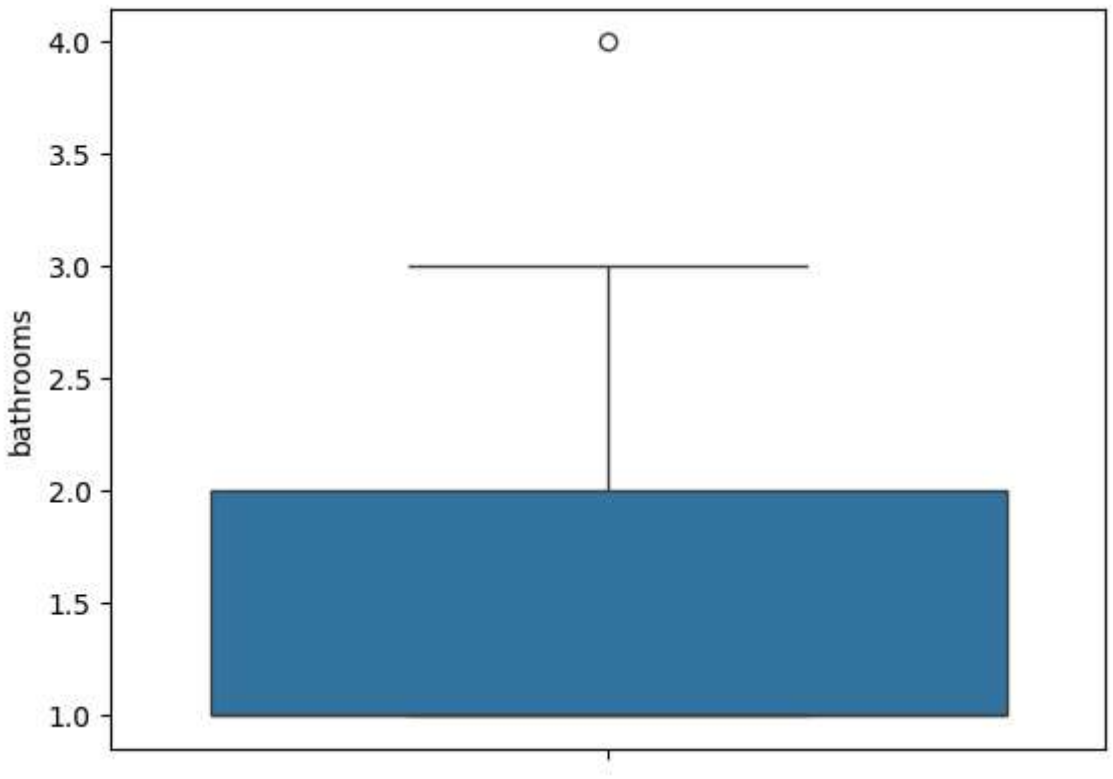
area



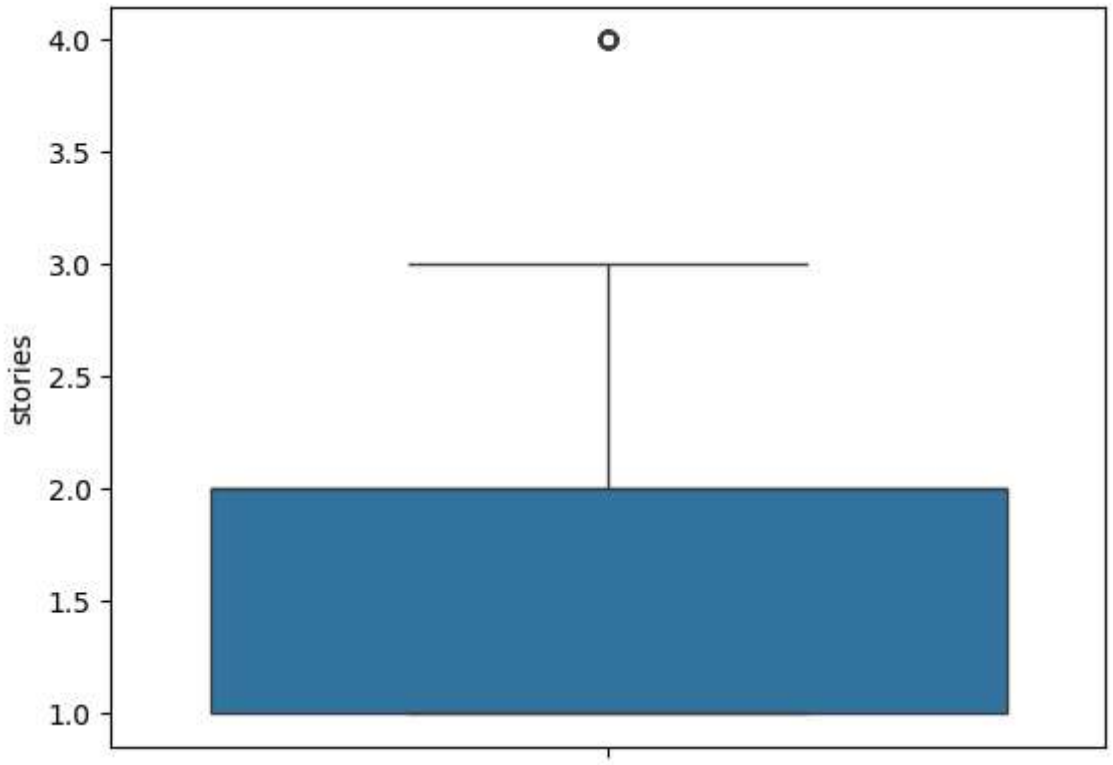
bedrooms



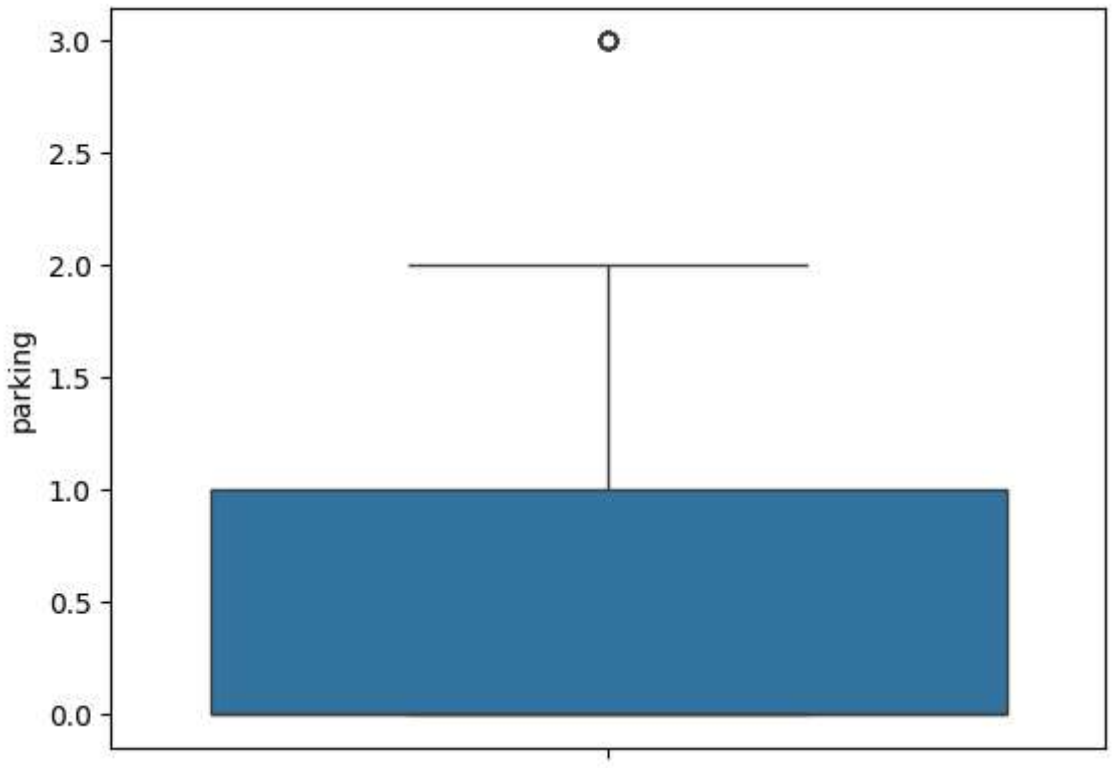
bathrooms



stories



parking



b)IQR (Interquartile Range)

In [42]:
```
Q1=d.quantile(0.25)
Q3=d.quantile(0.75)
IQR=Q3-Q1
print(f"IQR: \n {IQR}")
```

```
IQR:
 price        2310000.0
area            2760.0
bedrooms           1.0
bathrooms          1.0
stories            1.0
parking            1.0
dtype: float64
```

In [43]:
```
#Define Upper and Lower bound for Outliers
lower_bound=Q1-1.5*IQR
upper_bound=Q3+1.5*IQR

print(f"Lower bound for outliers: \n \n{lower_bound}\n \n")
print(f"Upper bound for outliers: \n \n {upper_bound}")
```

```
Lower bound for outliers:

price       -35000.0
area          -540.0
bedrooms         0.5
bathrooms       -0.5
stories         -0.5
parking         -1.5
dtype: float64


Upper bound for outliers:

 price        9205000.0
area           10500.0
bedrooms           4.5
bathrooms          3.5
stories            3.5
parking            2.5
dtype: float64
```

In [52]:
```
d=d[~((d<lower_bound)|(d>upper_bound)).any(axis=1)]
d
```

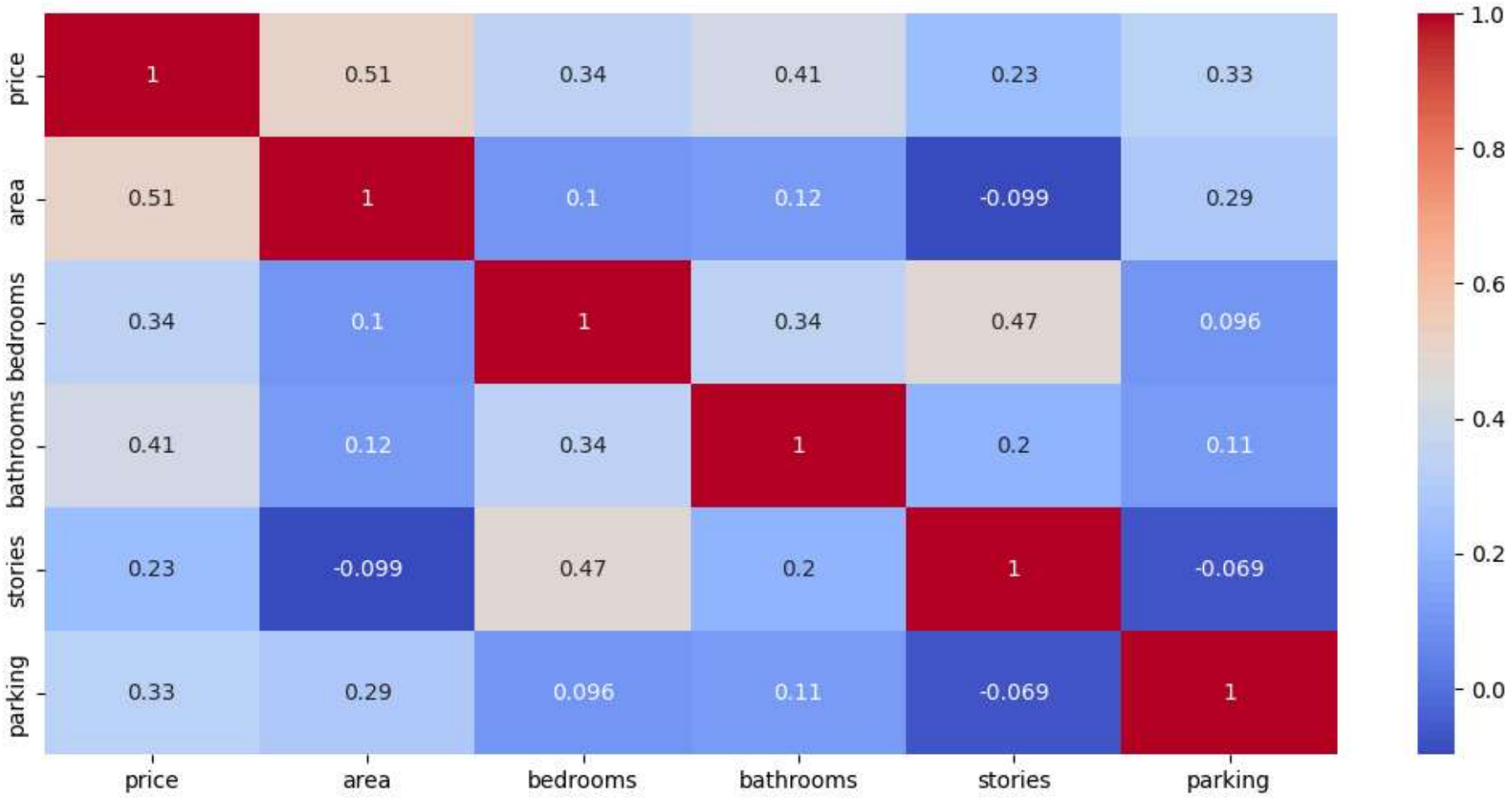
Out[52]:

	price	area	bedrooms	bathrooms	stories	parking
15	9100000	6000	4	1	2	2
16	9100000	6600	4	2	2	1
18	8890000	4600	3	2	2	2
19	8855000	6420	3	2	2	1
20	8750000	4320	3	1	2	2
...	...	...	...	...	...	...
540	1820000	3000	2	1	1	2
541	1767150	2400	3	1	1	0
542	1750000	3620	2	1	1	0
543	1750000	2910	3	1	1	0
544	1750000	3850	3	1	2	0

463 rows × 6 columns

Correlation & Heatmap

In [45]:
```
plt.figure(figsize=(13,6))
sns.heatmap(d.corr(),annot=True,cmap='coolwarm',)
plt.show()
```



In [54]:
```
d.to_csv("cleaned_housing_data.csv", index=False)
```

In [ ]: