NM DATA ANALYTICS ASSIGNMENT 3 - House Price dataset of India

DONE BY Jacinth Susanna S

Importing the necessary libraries for EDA and data preprocessing

```
In [2]: import pandas as pd
```

import pandas as pd import numpy as np import matplotlib. pyplot as PIt import seaborn as sns import folium from scipy import stats

---

Converting csv file into dataframe

```
df=pd.read_csv('C:/Users/Reshma/Downloads/House Price India.csv')
```

```
In          df=df.drop([ 'Date' ] , axis-I)
 Out[5] :
```

```
                  number   number  number condition grade number of living    lot     waterfront      Built Renovatio
          id   of     of     of    of the of the ...bedrooms bathrooms  area  area   present house house     Year    Yee
               floors         views
------------------------------------------------------------------------------------------------------------------------
   o 6762810145            5          2.50    3650    9050         2.0                   4          5         10...1921

  1  6762810635        4        2.50     2920     4000    1.5      5         8...1909

  2  6762810998        5        2.75     2910     9480    1.5      3         8...1939
```

```
    3  6762812605     4    2.50   3310 42998   2.0    3     9...2001

    4  6762812919     3    2.00   2710   4500   1.5    4     8...1929


14615  6762830250     2    1.50   1556 20000   1.0    4     7...1957

14616  6762830339     3    2.00   1680   7000   1.5    4     7...1968

14617  6762830618     2    1.00   1070   6120   1.0    3     6...1962

14618  6762830709     4    1.00   1030   6621   1.0    4     6...1955

14619  6762831463     3    1.00   900    4770   1.0    3     6...1969 200

14620  rows x 22 columns
```

```
[6]:df.head()
Out6]:
```

```
                  number   number      number condition grade number of living    lot     waterfront    Built Renovation
                                  F
              id   of of      of      of the of the ...bathrooms      area     area    present Year    Year bedrooms        floors  views
                    house house

 o 6762810145          5           2.50    3650    9050        2.0                          4          5          10 ... 1921

 1  6762810635    4        2.50    2920    4000    1.5      0       5       8...1909

 2  6762810998    5        2.75    2910    9480    1.5      3       8...1939
```

```
3  6762812605     4      2.50    3310 42998    2.0     0       3       9...2001 o 1:

4  6762812919     3      2.00    2710    4500    1.5     4       8 ... 1929

5  rows x 22 columns
```

```
[7]:df.tail()
```

```
Out [7] :
                          number    number  number condition grade number of living      lot       waterfront       Built Renovatio
                     id   of      of     of      of the  of the ...bedrooms bathrooms    area     area       present house house     Year      Yee
                          floors          views

14615  6762830250        2       1.5      1556 20000     1.0      4         71957
                                                                                                                        ...
14616  6762830339        3       2.0      1680     7000    1.5      4         7...1968

14617  6762830618        2       1.0      1070     6120    1.0      3         6...1962

14618  6762830709        4       1.0      1030     6621    1.0      4         6...1955

14619  6762831463        3       1.0      900      4770    1.0      3         6...1969 200

5 rows x 22 columns
```

Checking for null and duplicated values

```
In [8]:  df.isna() .sum()

Out [8]: id                                              0

          number of bedrooms                             0

         number of bathrooms            basement)    0
         living area lot area                        0
         number of floors                            0
         waterfront present                          0
         number of views                             0
         condition of the house                      0
         grade of the house                          0
         Area of the house(excluding                 0
         Area of the basement Built                  0
         Year                                        0
         Renovation Year                             0
         Postal Code                                 0
         L attitude                                  0
         Longitude living                            0
         area renov lot area                         0
         renov                                       0
         Number of schools nearby                    0
         Distance from the airport                   0
         Price dtype: int64                          0
                                                     0
```

```
[9]:  df.duplicated() . sum()

Out[9 0
] :

In
[10] :  df.info()
```

```
<class 'pandas. core. frame. DataFrame' >
Rangelndex: 14620 entries, 0 to 14619
Data columns (total 22 columns) :
 #   Column                                      Non-Null Count Dtype
     ------                                      -------------- -----
 e   id                                          14620non-null  int64
 1   number of bedrooms                          14620non-null  int64
 2   number of bathrooms                         14620non-null  float64
 3   living area                                 14620non-null  int64
 4   lot area                                    14620non-null  int64
 5   number of floors                            14620non-null  float64
 6   waterfront present                          14620non-null  int64
 7   number of views                             14620non-null  int64
 8   condition of the house                      14620non-null  int64
 9   grade of the house                          14620non-null  int64
 10  Area of the house(excluding    basement)    14620non-null  int64
 11  Area of the basement                        14620non-null  int64
 12  Built Year                                  14620non-null  int64
 13  Renovation Year                             14620non-null  int64
 14  Postal Code                                 14620non-null  int64
 15  L attitude                                  14620non-null  float64
 16  Longitude                                   14620non-null  float64
 17  living area renov                           14620non-null  int64
 18  lot area renov                              14620non-null  int64
 19  Number of schools nearby                    14620non-null  int64
 20  Distance from the airport                   14620non-null  int64
 21  Price                                       14620non-null  int64
dtypes:    float64(4),    int64(18)
memory usage: 2.5 MB
```

```
In[11] :  df.describe()
Out[ll] :
```

	id	number of bedrooms	number of bathrooms	living area	lot area	number of floors	waterfront present	number of views	condi the
count	1.462000e+04	14620.000000	14620.000000	14620.000000	1.462000e+04	14620.000000	14620.000000	14620.000000	14620.
mean	6.762821e+09	3.379343	2.129583	2098.262996	1.509328e+04	1.502360	0.007661	0.233105	3.
std	6.237575e+03	0.938719	0.769934	928.275721	3.791962e+04	0.540239	0.087193	0.766259	o.
min	6.762810e+09	1.000000	0.500000	370.000000	5.200000e+02	1.000000	0.000000	0.000000	1.
25%	6.762815e+09	3.000000	1.750000	1440.000000	5.010750e+03	1.000000	0.000000	0.000000	3.
50%	6.762821e+09	3.000000	2.250000	1930.000000	7.620000e+03	1.500000	0.000000	0.000000	3.
75%	6.762826e+09	4.000000	2.500000	2570.000000	1.080000e+04	2.000000	0.000000	0.000000	4.
max	6.762832e+09	33.000000	8.000000	13540.000000	1.074218e+06	3.500000	1.000000	4.000000	5.

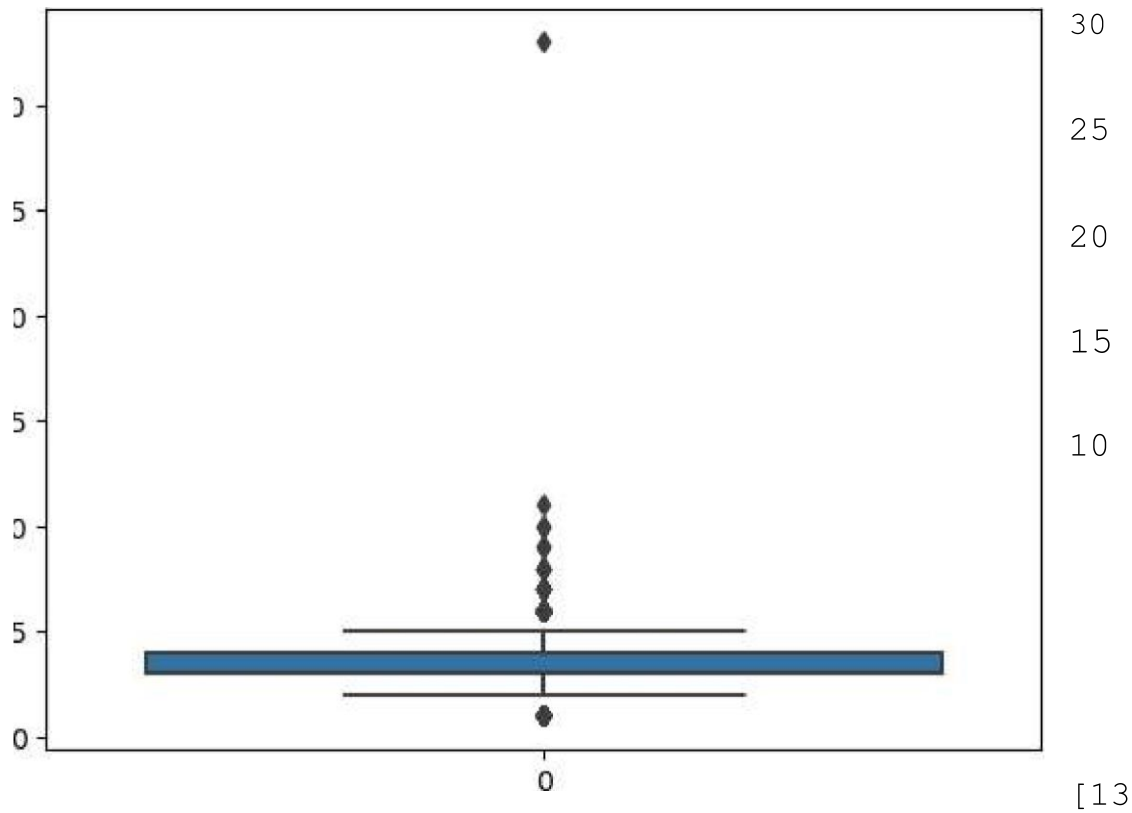
8 rows x 22 columns

UNIVARIATE ANALYSIS

Checking for outliers

```
In [12] : sns.boxplot(df[ ' number of bedrooms ' ] )
```

```
Out [12] : <AxesSubp10t : >
```



In [13] :z=np.abs(stats.zscore(df'number of bedrooms.

In[14] : threshold-3

```
print(np.where(z>3),len(np.where(z>3)[0]))
```

```
(array([   76,  243,  268,  275,  624,  785,1512,1519,1553,
        1706,  2814,  3109, 3114,     3532, 3600, 4207,  4486,
                                3322,
        4658,  4680,   6591, 6596,     6982, 6998, 7003,  7454,
                                6730,
        8559,  8650,  9282, 9629,     9955,10168,10177,10676,
                                9810,
       10748,10916,10944,11247,   11547 11877,12273,13048,
                           11441,   ,
        13444,13825,14220, 14481]),
                          ) 49
```

```
In [15] : print(np.where(z<-3))
```

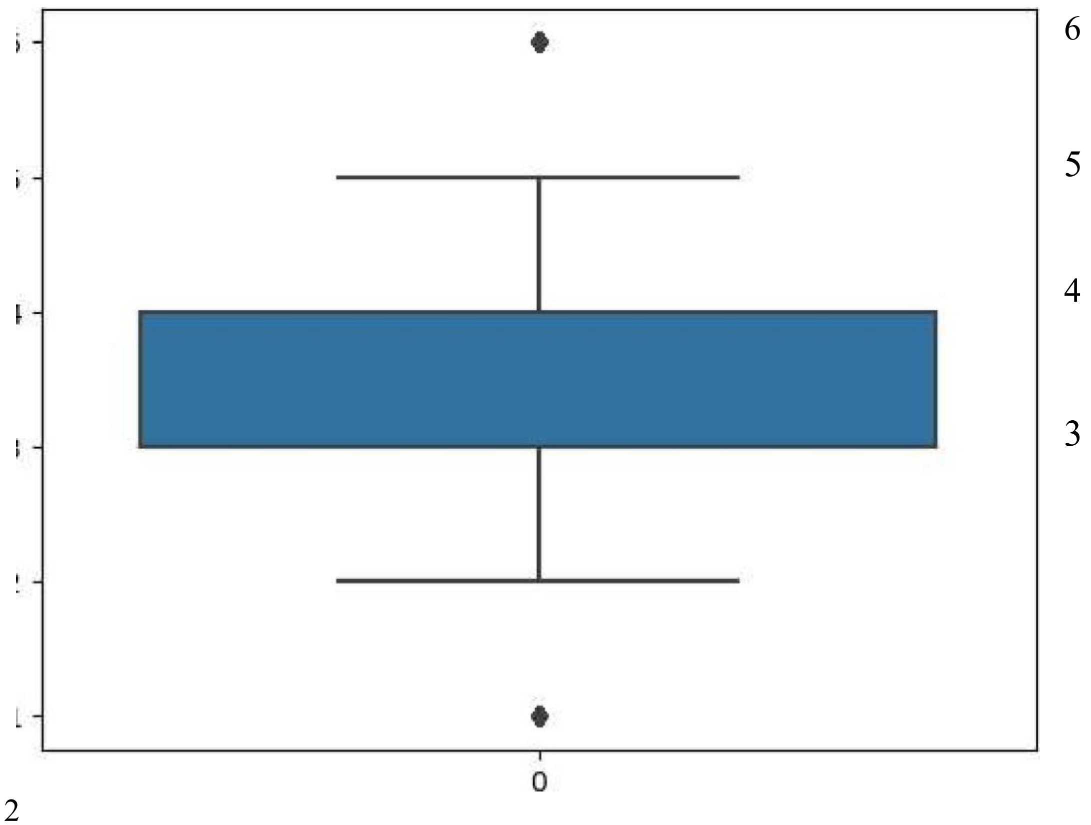
```
(array([], dtype=int64), )
```

There are 138 outliers in number of bedrooms as proved from the boxplot and the fact that there are observations whose z-score is beyond 3

```
In [16] :df1=df[(z
```

```
In [17] : sns.boxplot(dfl[ 'number of bedrooms ' ] )
```

```
Out[17] : <AxesSubp10t : >
```



In [18]: dfl

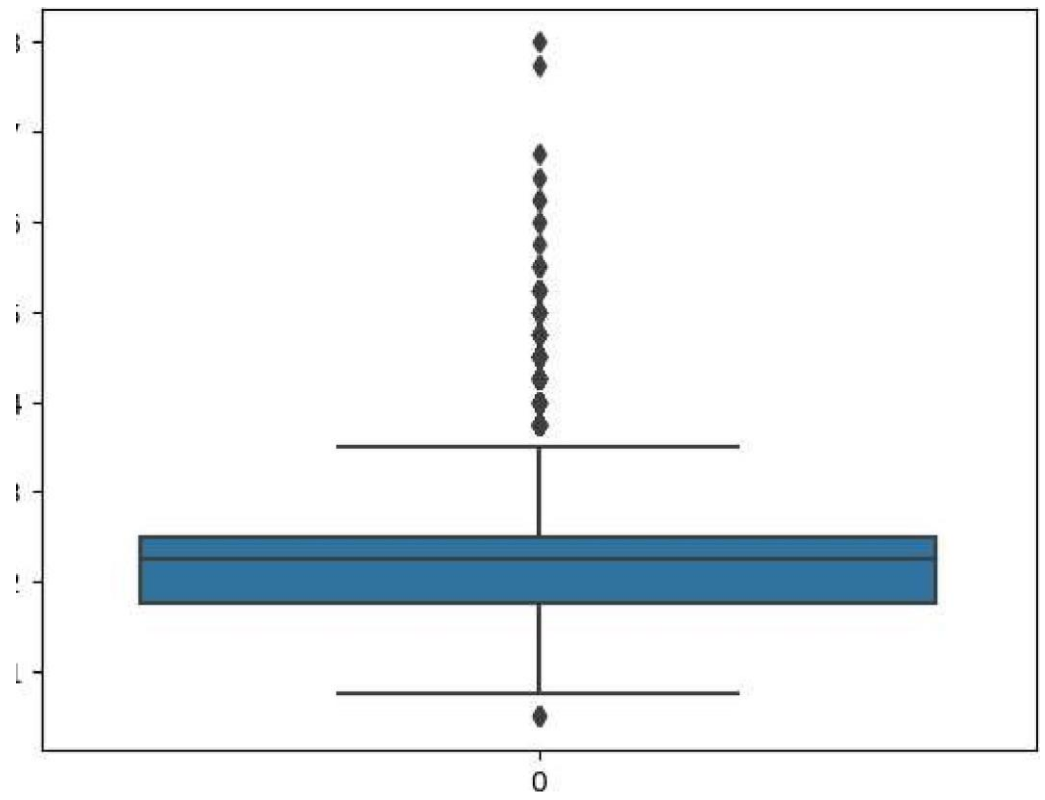
Out[18] :

```
             number    number  number condition grade number of living      lot        waterfront        Built Renovatio
     id  of of of of the of the ...bedrooms bathrooms area area floors present views house house Year Yee
```

```
o 6762810145       5       2.50  3650  9050     2.0                  4         5       10…1921

1 6762810635    4      2.50  2920  4000  1.5   5      8…1909

2 6762810998    5      2.75  2910  9480  1.5   3      8…1939

3 6762812605    4      2.50  3310  42998 2.0   3      9…2001

4 6762812919    3      2.00  2710  4500  1.5   4      8…1929


14615 6762830250    2      1.50  1556  20000 1.0   4      7…1957

14616 6762830339    3      2.00  1680  7000  1.5   4      7…1968

14617 6762830618    2      1.00  1070  6120  1.0   3      6…1962

14618 6762830709    4      1.00  1030  6621  1.0   4      6…1955

14619 6762831463    3      1.00  900   4770  1.0   3      6…1969     200
```

14571 rows x 22 columns

```
In [ 19] : sns.boxplot(dfl[ 'number of bathrooms'])

Out[19] : <AxesSubp10t : >
```



8

7

6

5

4

3

: <AxesSubp10t : >

2

1

```
In [20] : z=np.abs(stats.zscore(df1['number of bathrooms' ]
))
```

```
[21]: len(np.where(z>3)
[0] )
Out[21] : 124
```

```
In [22]
:  print(np.where(z<-
3))
```

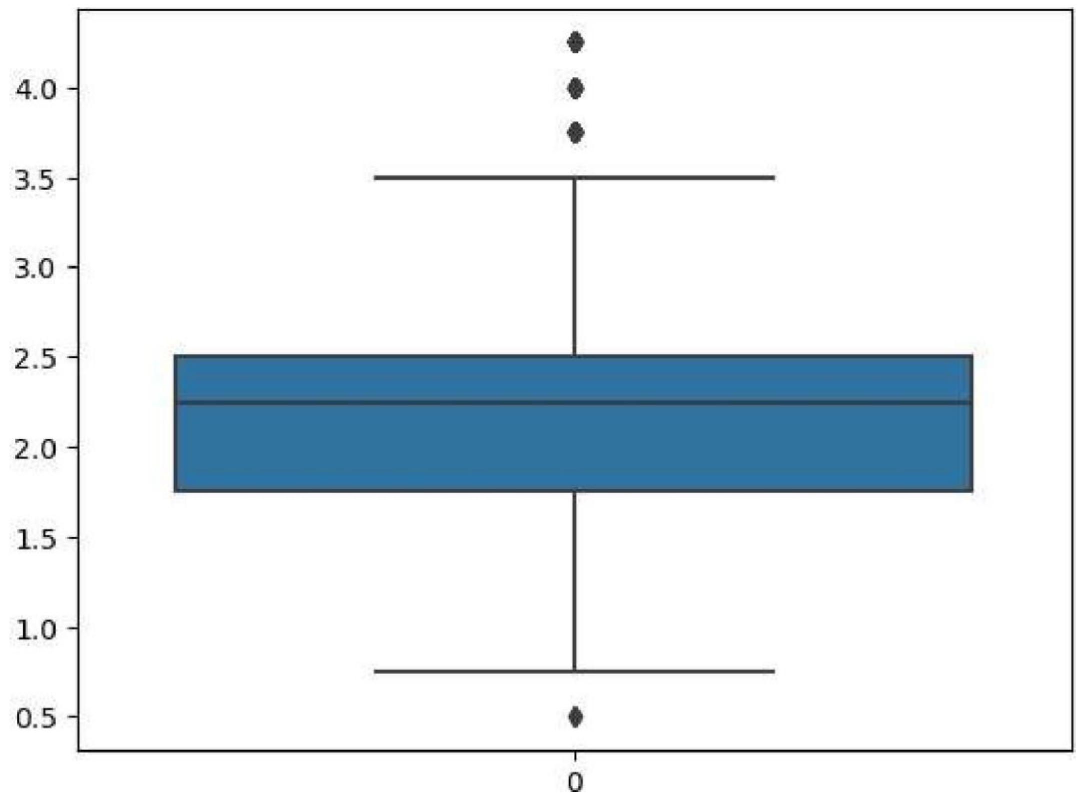
```
(array([], dtype=int64), )
```

```
df1=df1[(z< 3)]
```

```
I n [ 24 ] : sns.boxplot(dfl[ 'number of bathrooms' ] )
Out[24]
```

```
sns.boxplot(dfl[ ' living area ] )
```

```
: <AxesSubp10t : >
```



```
In[25] : dfl

Out[25] :
                          number    number  number condition grade number of living     lot      waterfront     Built Renovatio
                    id  of     of     of    of the of the ...bedrooms bathrooms  area    area     present house house   Year     Yee
                        floors           views

   o 6762810145           5        2.50   3650   9050      2.0                      4         5         10...1921

   1  6762810635    4       2.50    2920    4000   1.5     5       8...1909
```

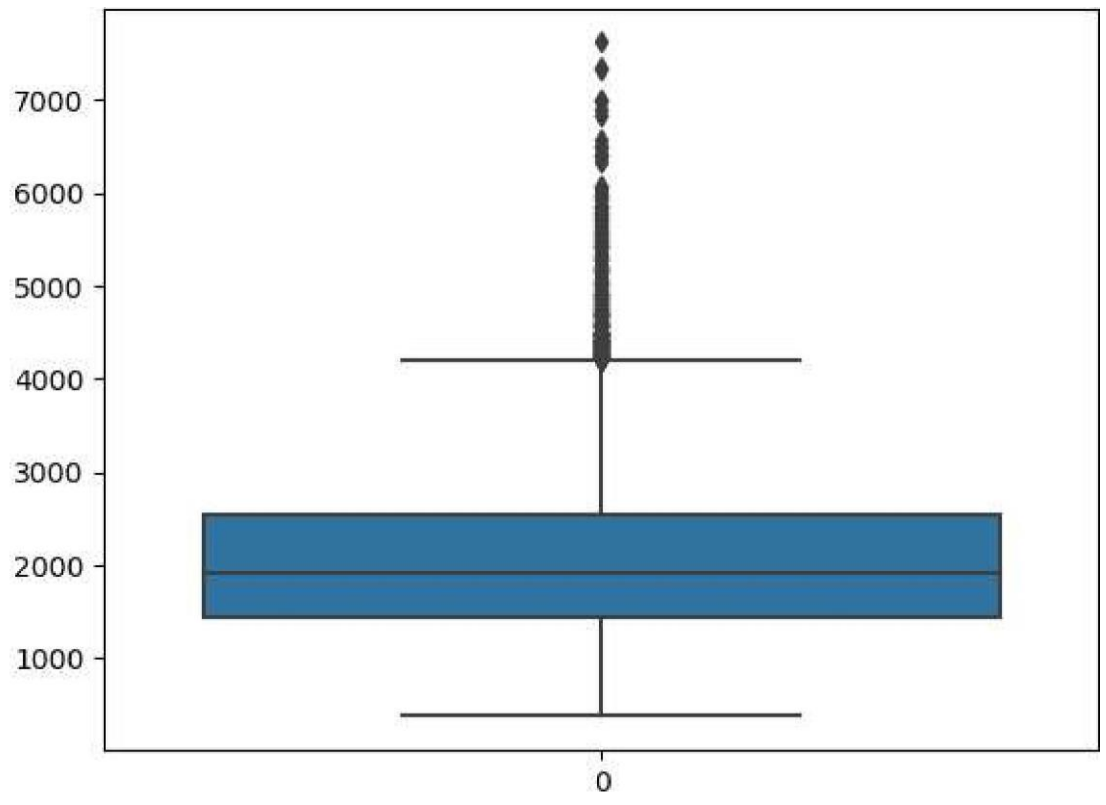
```
    2  6762810998   5   2.75   2910   9480   1.5   3   8...1939
    3  6762812605   4   2.50   3310 42998   2.0   3   9...2001
    4  6762812919   3   2.00   2710   4500   1.5   4   8...1929

14615  6762830250   2   1.50   1556 20000   1.0   4   7...1957
14616  6762830339   3   2.00   1680   7000   1.5   4   7...1968
14617  6762830618   2   1.00   1070   6120   1.0   3   6...1962
14618  6762830709   4   1.00   1030   6621   1.0   4   6...1955
14619  6762831463   3   1.00   900    4770   1.0   3   6...1969 200

14447 rows x 22 columns
```

There are 124 outliers in number of bathrooms as proved from the boxplot and the fact that there are observations whose z-score is beyond 3

```
[26]: sns.boxplot(df1['living area'])
```

Out [26]

```
sns.boxplot(dfl[ ' living area ] )

: <AxesSubp10t : >
```



```
In [27] :z=np.abs(stats.zscore(df1[' living area' ] ) )
```

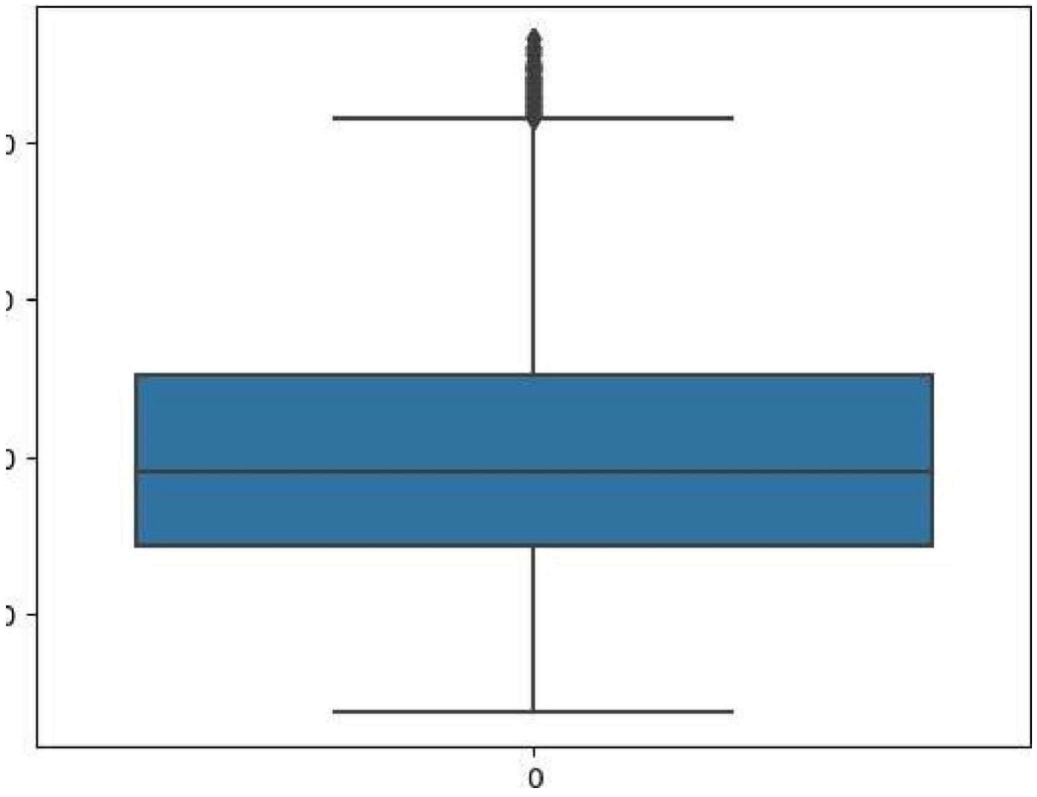
```
In [28] : len(np.where(z>3) [0] )

Out[28] : 136

In [29] : len(np.where(z<-3) [e])
```

```
sns.boxplot(dfl[ ' living area ] )

: <AxesSubp10t : >
```

Out[29] : 0

```
[30]: df1=df1[(z<3)]
```

In [31] :



Out[31]

4000

```
sns.boxplot(dfl[ ' living area ] )
```

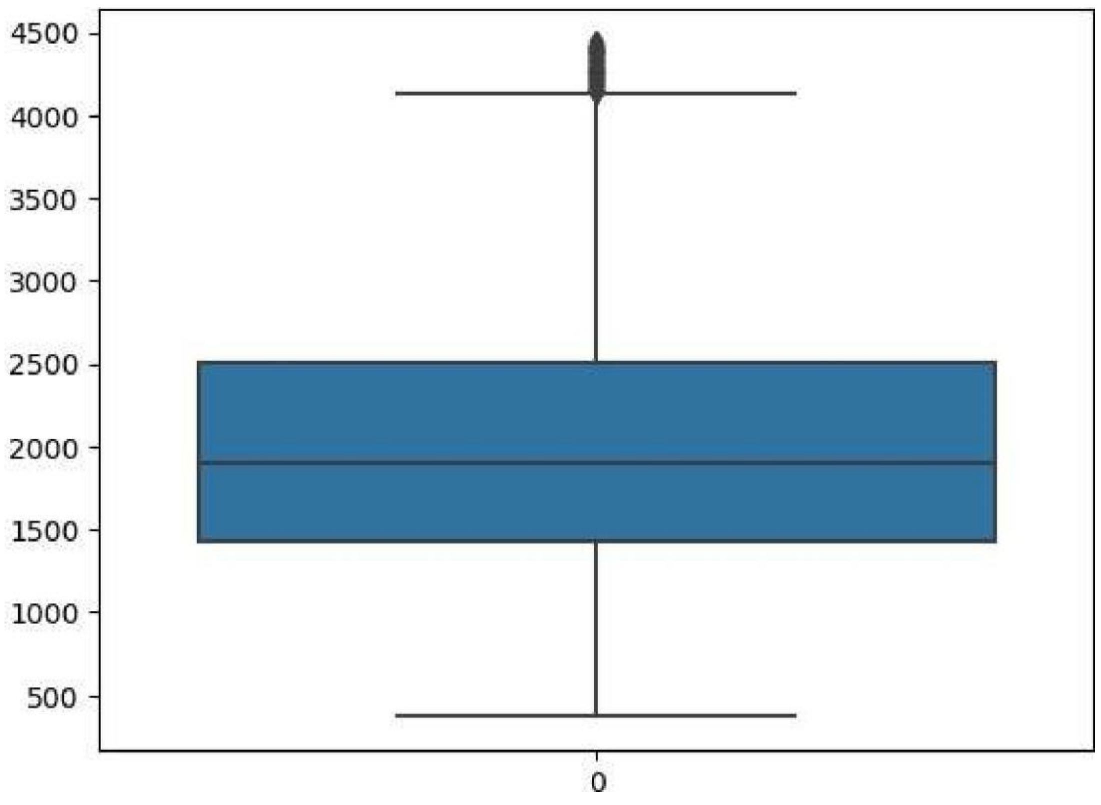
```
: <AxesSubp10t : >
```

3000

2000

1000

```
In [32]: z=np.abs(stats.zscore(df1[' living area' ]) )

In [33]: len(np.where(z>3) [0] )

Out[33] : 67

In [34]: df1=df1[(z<3)]

In [35]: '

Out[35]
```



```
Iη [ 36 ] : df1
```

```
sns.boxplot(dfl[ ' living area ] )
```

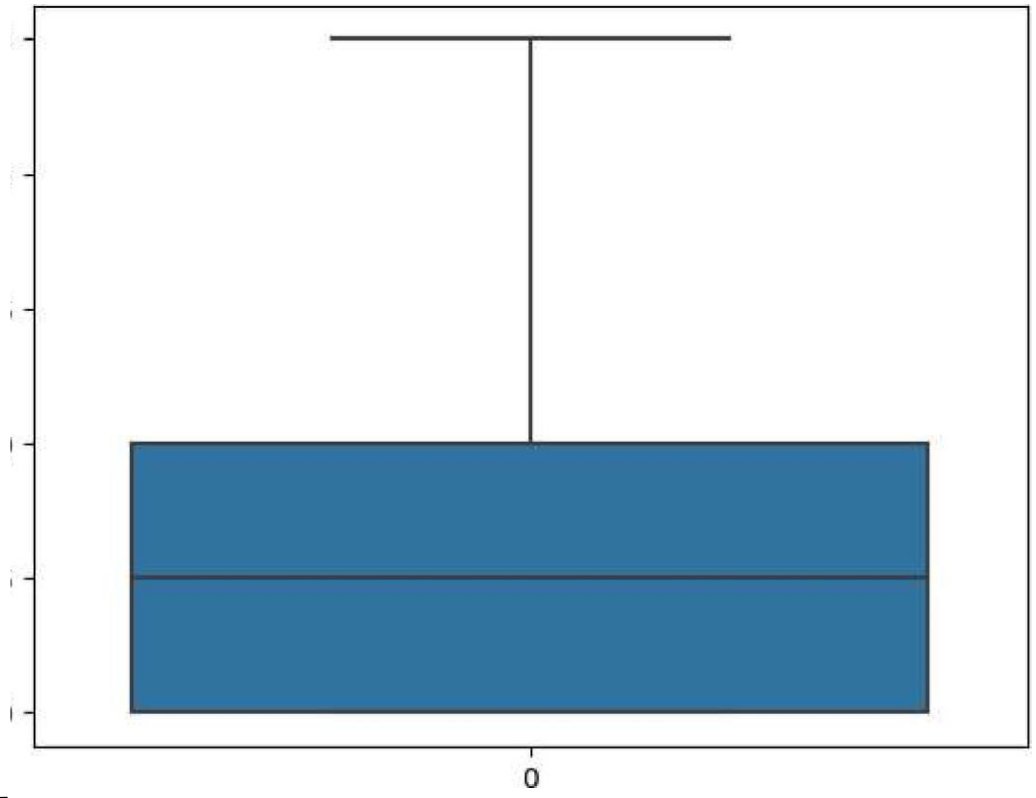
```
: <AxesSubp10t : >
```

```
Out[36] :
                        number    number  number condition grade number of living     lot    waterfront      Built Renovatio
                   id   of    of    of      of the of the ...bedrooms bathrooms   area     area   present house house     Year     Yee
                        floors          views

         o 6762810145              5          2.50     3650      9050          2.0                        4           5          10...1921

         1  6762810635          4         2.50      2920      4000     1.5        5          8...1909

         2  6762810998          5         2.75      2910      9480     1.5        3          8...1939

         3  6762812605          4         2.50      3310 42998       2.0        3          9...2001

         4  6762812919          3         2.00      2710      4500     1.5        4          8...1929


     14615  6762830250          2         1.50      1556 20000       1.0        4          7...1957

     14616  6762830339          3         2.00      1680      7000     1.5        4          7...1968

     14617  6762830618          2         1.00      1070      6120     1.0        3          6...1962

     14618  6762830709          4         1.00      1030      6621     1.0        4          6...1955

     14619  6762831463          3         1.00      900       4770     1.0        3          6...1969 200

    14244 rows x 22 columns


  : <AxesSubp10t : >
```

There are 205 outliers in living as proved from the boxplot and the fact that there are observations whose z-score is beyond 3

In [37] : sns.boxplot(dfl['number of floors'])

Out[37]



3.5

3.0

2.5

2.0

1.5

1.0

In [38]:
```
z=np.abs(stats.zscore(df1['number of floors' ] ) )
```

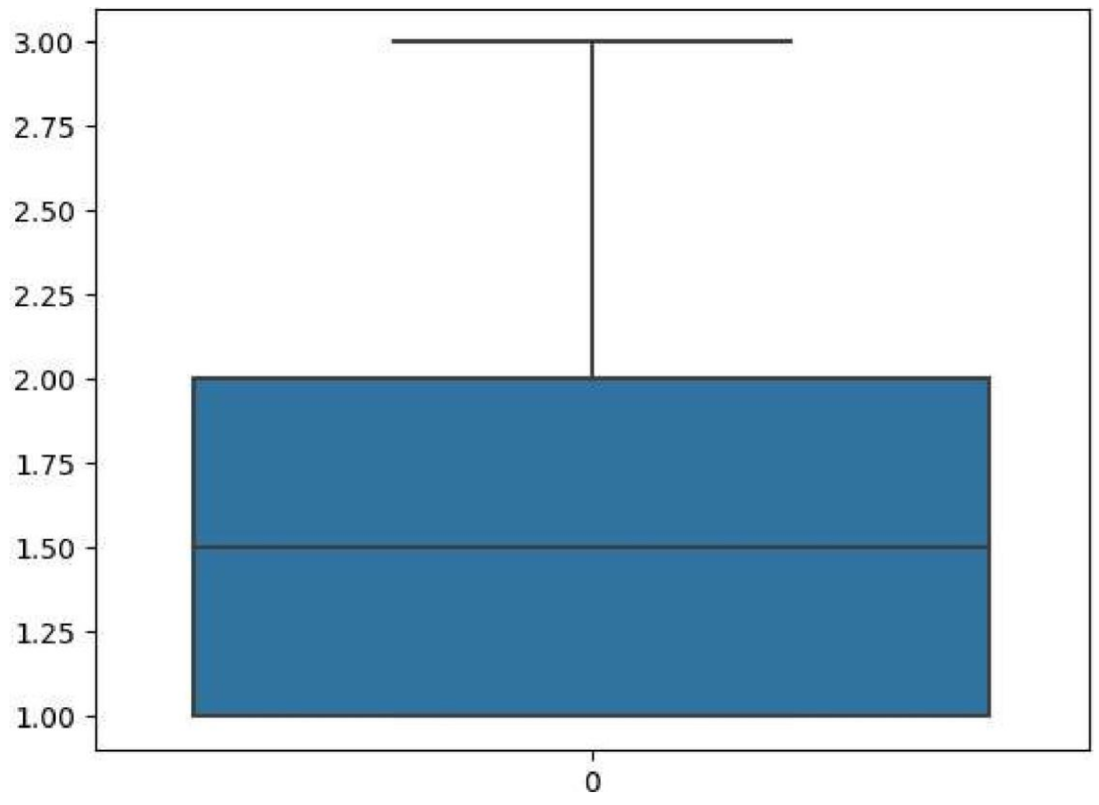
In [39]:
```
len(np.where(z>3) [0] )
```

Out[39] :
```
3
```

In [40]:
```
df1=df1[(z<3)]
```

[41]:
```
sns.boxplot(dfl[ 'number of floors' ] )
```

Out[41] :
```
<AxesSubp10t : >
```

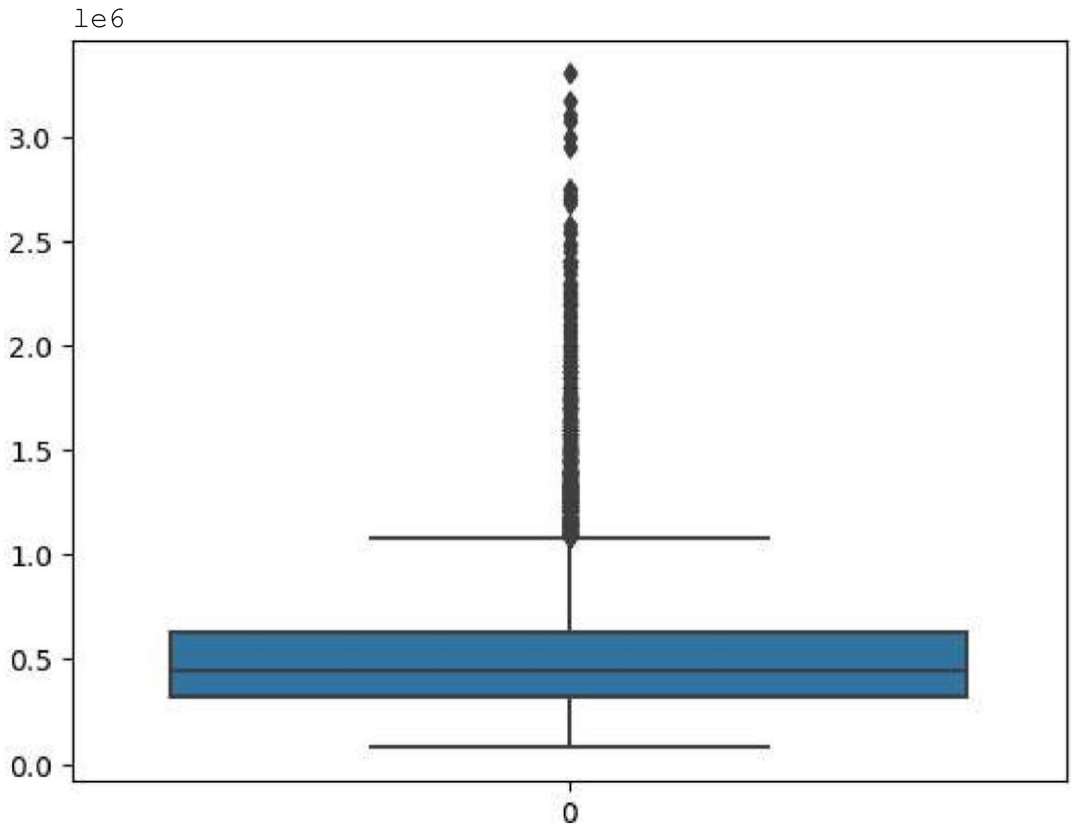


There are 3 outliers in number of floors

```
I n [ 42 :
sns.boxplot(df1['Price'])
```

sns .

Out[42] : <AxesSubp10t : >



```
df1=df1[(z<3)]
```

In [43]:

```
z=np.abs(stats.zscore(df1 ['Price' ] ) )
len(np.where(z>3)[0])
```

In [44]:

Out[44] :

```
259
```

In [45]:

In [46]:

```
dfl
```

Out [46] :

```
                   number   number  number condition grade number of living     lot       waterfront       Built Renovatio
              id  of of of of the of the ...bedrooms bathrooms area area floors present views house house Year Yee

   2  6762810998    5     2.75  2910  9480  1.5   3     8...1939

   3  6762812605    4     2.50  3310  42998 2.0   3     9...2001

   4  6762812919    3     2.00  2710  4500  1.5   4     8...1929

   5  6762813105    3     2.50  2600  4750  1.0   4     9...1951

   6  6762813157    5     3.25  3660  11995 2.0   2     3     10...2006


14615 6762830250    2     1.50  1556  20000 1.0   4     7...1957

14616 6762830339    3     2.00  1680  7000  1.5   4     7...1968

14617 6762830618    2     1.00  1070  6120  1.0   3     6...1962

14618 6762830709    4     1.00  1030  6621  1.0   4     6...1955

14619 6762831463    3     1.00  900   4770  1.0   3     6...1969      200
```

13982 rows x 22 columns

In [47] :

```
df1=df1.drop(['Renovation Year'],axis=1)
```

In [48] : dfl

```
                   number   number  number condition grade      Area of number of living     lot       waterfront      Built
```

```
Out [46] :
                 id  of    of      of      of the of the...the bathrooms    area    area    present Year bedrooms floors  views  house
                     house basement

    2  6762810998    5     2.75  2910   9480  1.5    3      8...o 1939

    3  6762812605    4     2.50  3310  42998  2.0    3      9...o  2001

    4  6762812919    3     2.00  2710   4500  1.5    4      8...830  1929

    5  6762813105    3     2.50  2600   4750  1.0    4      9...900  1951

    6  6762813157    5     3.25  3660  11995  2.0    2      3      10...o 2006


14615 6762830250    2     1.50  1556  20000  1.0    4      7...o 1957

14616 6762830339    3     2.00  1680   7000  1.5    4      7...o 1968

14617 6762830618    2     1.00  1070   6120  1.0    3      6...o 1962

14618 6762830709    4     1.00  1030   6621  1.0    4      6...o  1955

14619 6762831463    3     1.00  900    4770  1.0    3      6...o 1969

13982 rows x 21 columns
```

Bl - VARIATE ANALYSIS

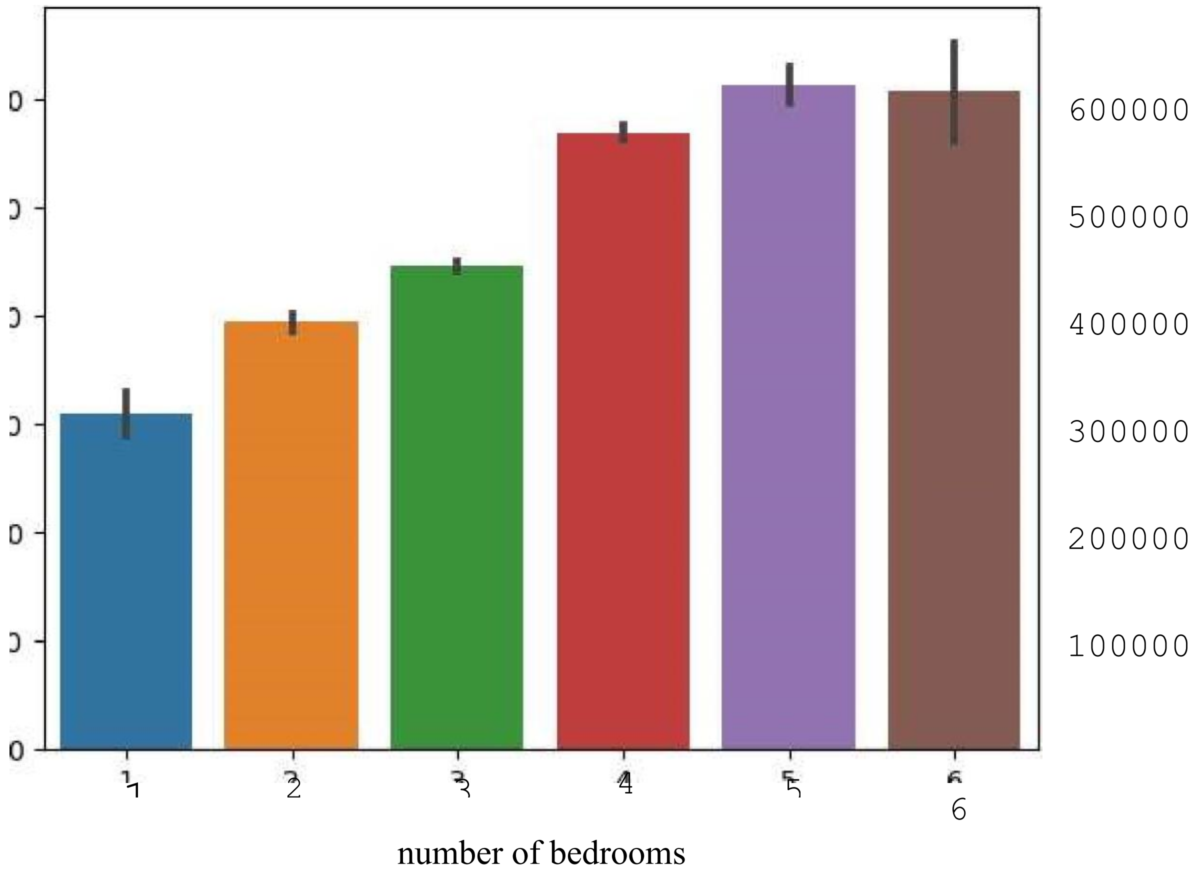
Out [46] :

The column Renovation year have been removed. This is because most of the Renovation Year are O and proves to be of no use to the model

In [49] :

```
sns.barplot(data=df1,x='number of bedrooms',y='Price')
```

```
<AxesSubp10t:x1abe1='number of bedrooms '      ylabel= ' Price' >
```

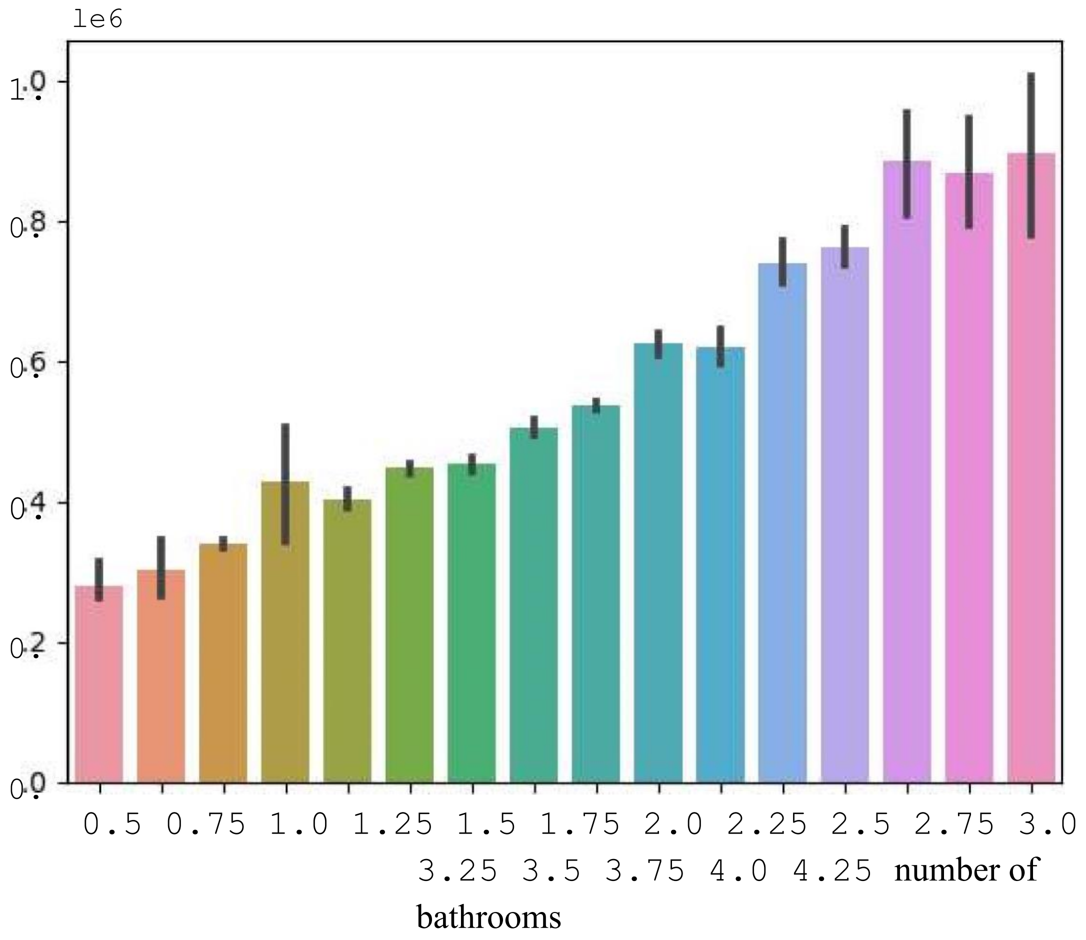


Out [46] :

Clear indication of Price increasing with number of bedrooms

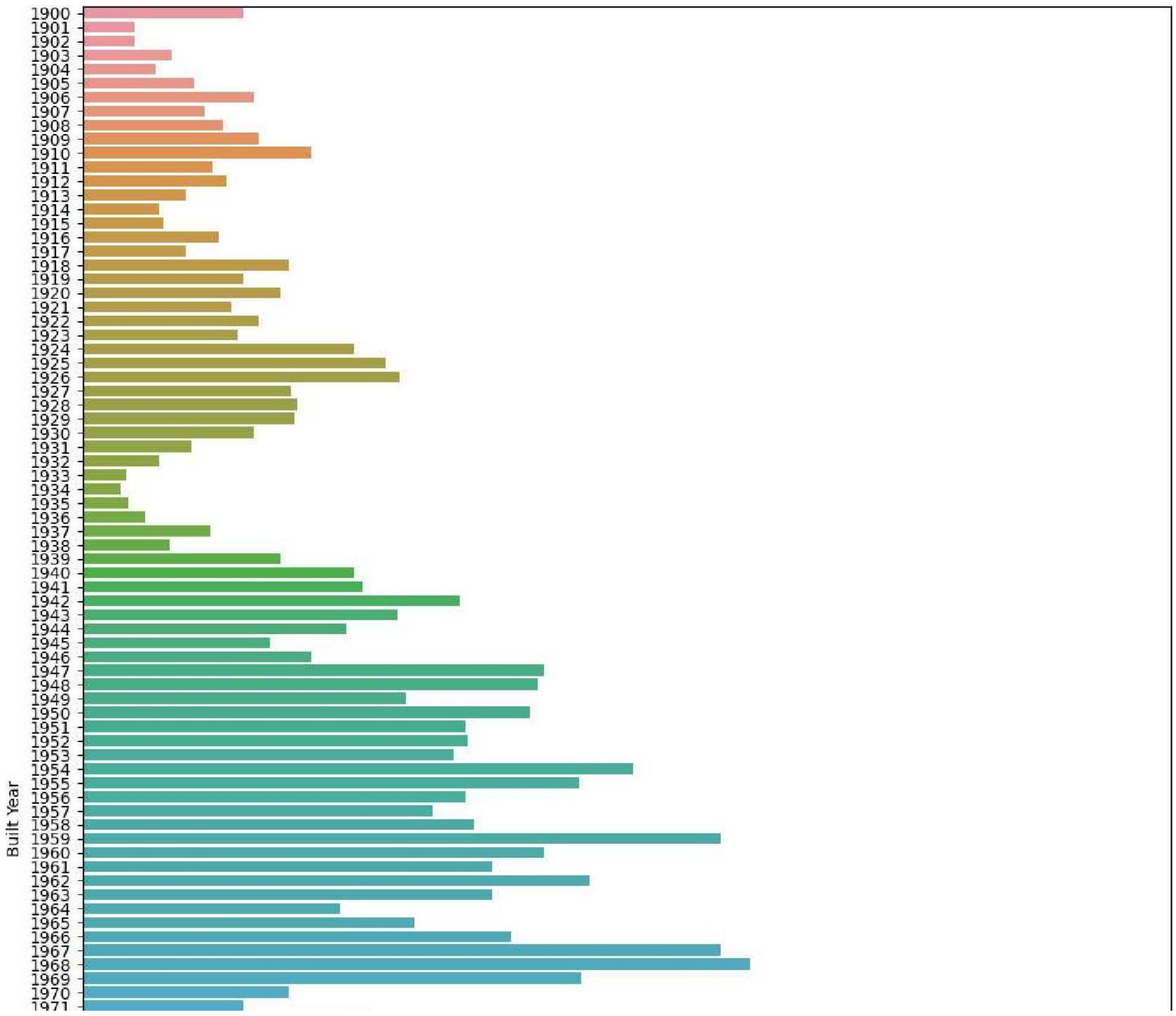
```
[50]: sns.barplot(data=df1,x='number of bathrooms',y='Price')
```

```
Out[50] :<AxesSubplot:xlabel='number of bathrooms' ,ylabel='Price'>
```

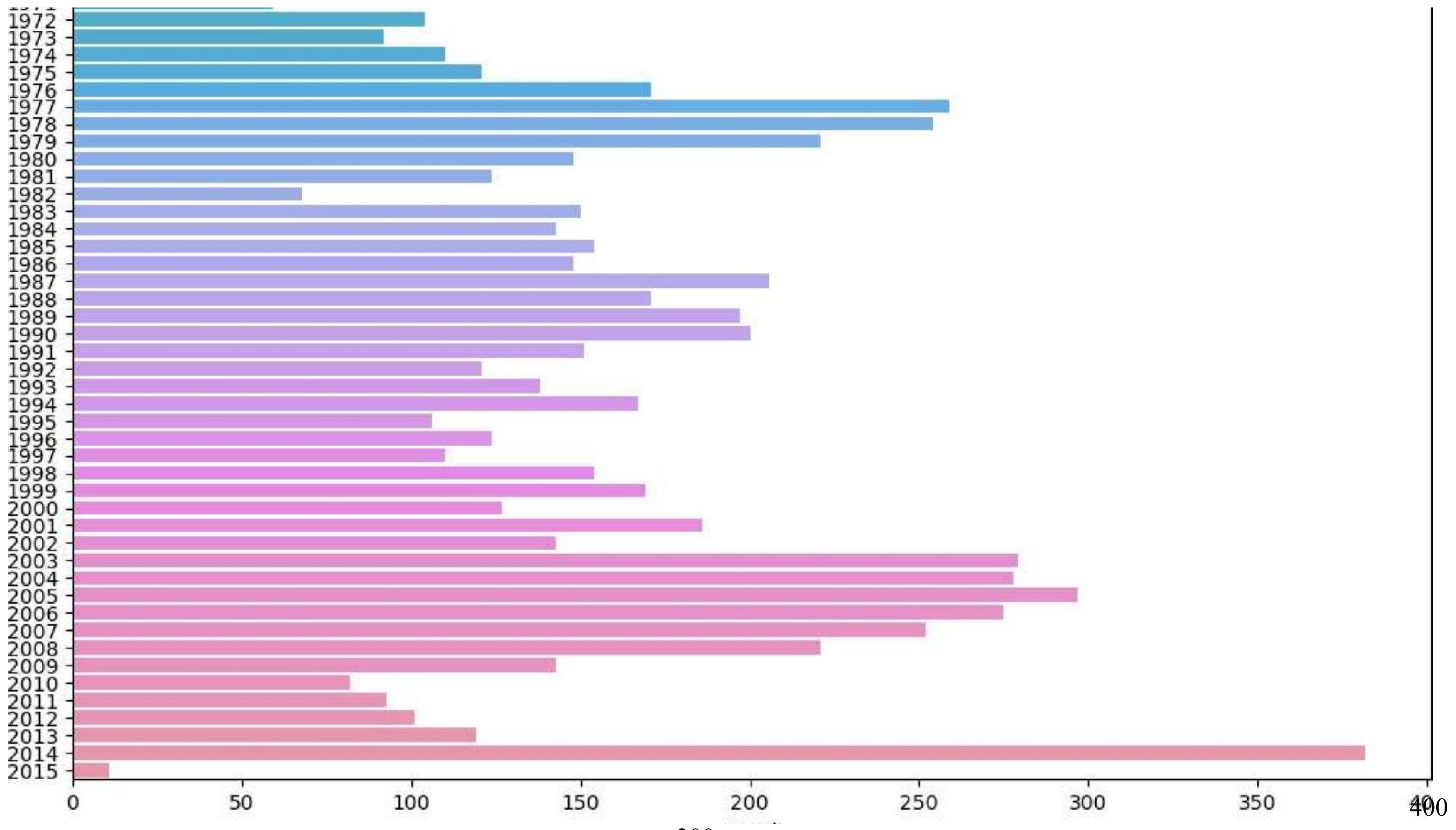


Clear indication of Price increasing with number of bathrooms

```
In [51]  plt.figure(figsize=(12,18  :   18))
         sns.countplot(data=df1,y=   ' Built Year' )
         PI t . show()
```



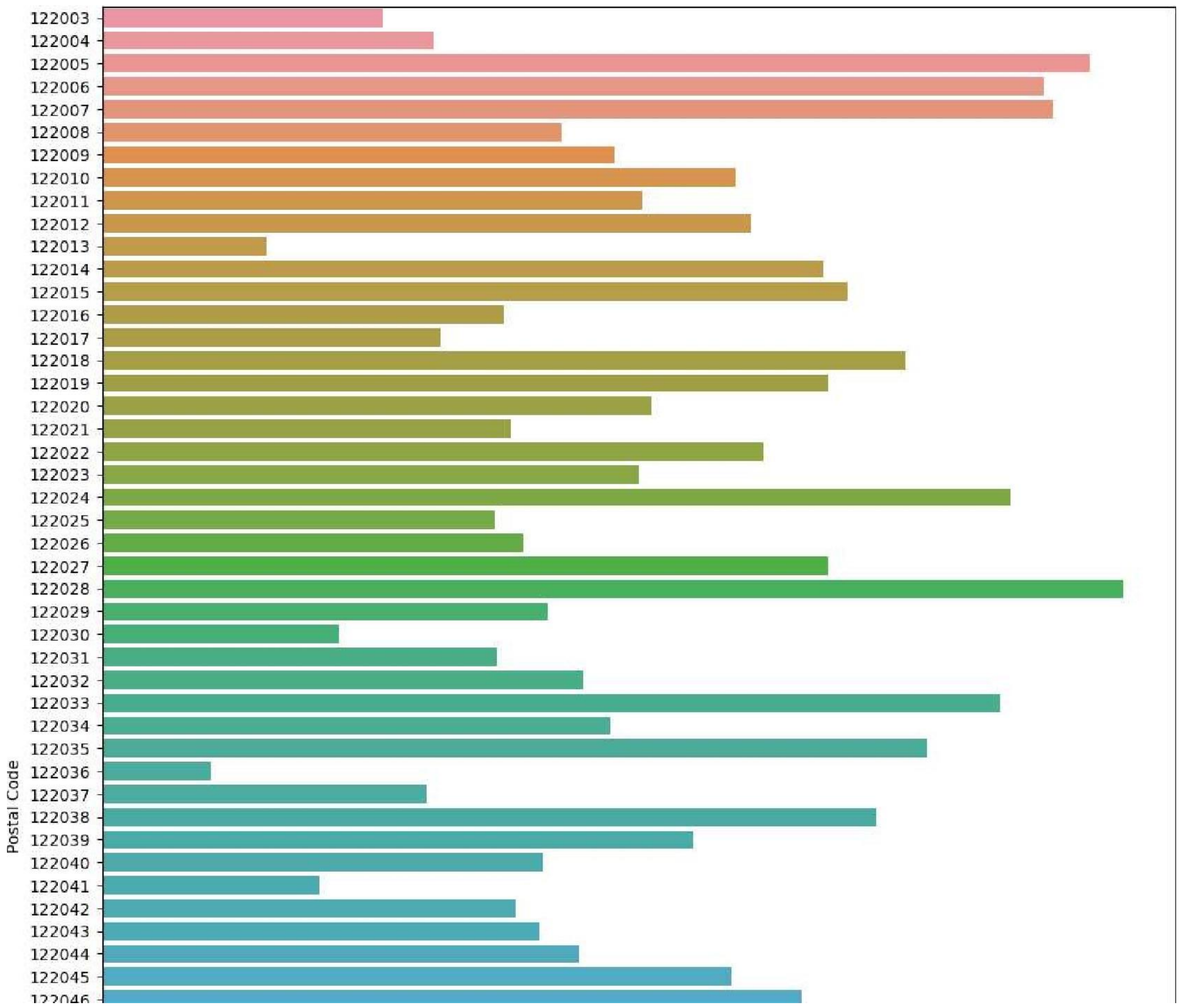
Built Year
1900
1901
1902
1903
1904
1905
1906
1907
1908
1909
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971

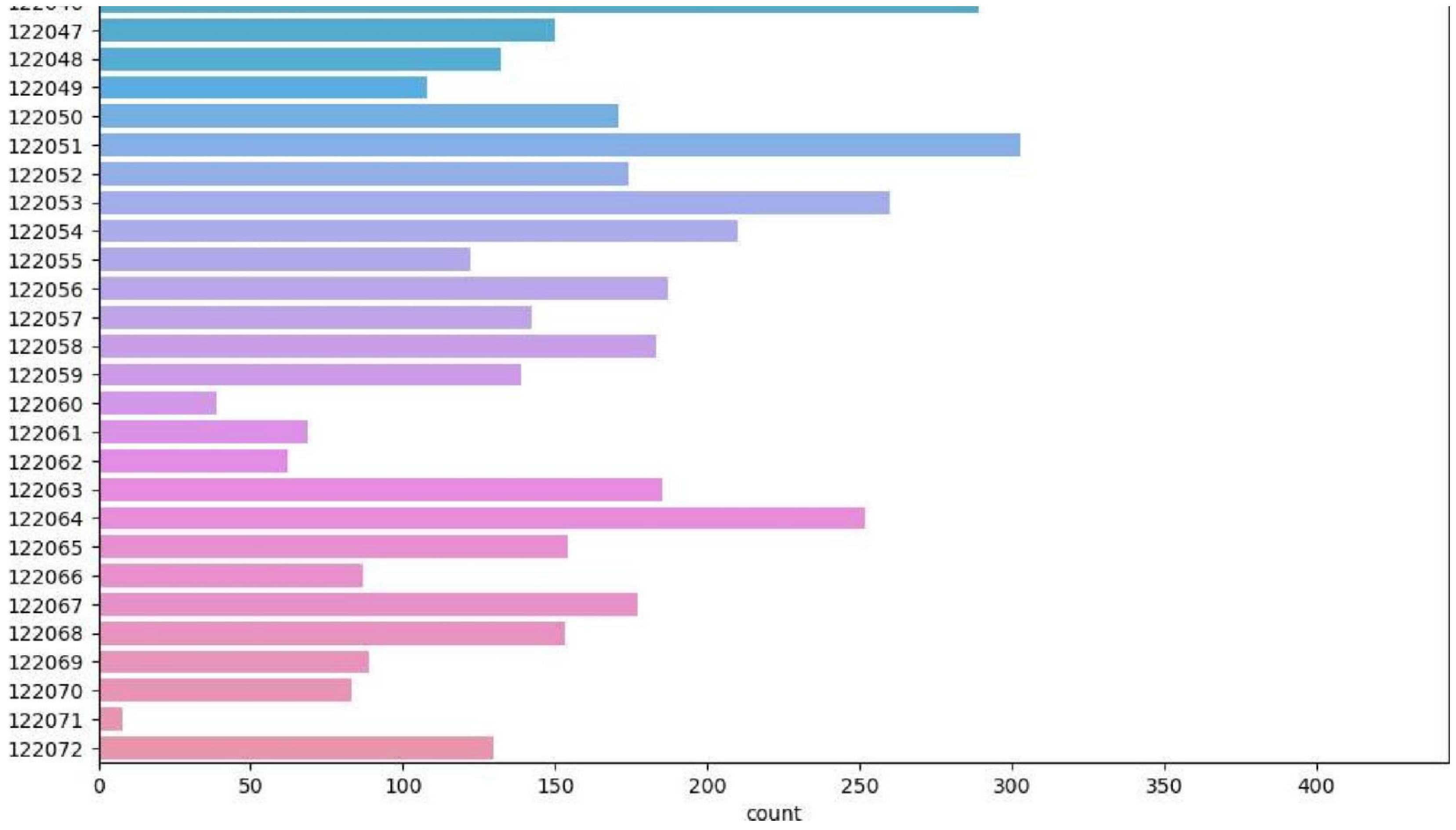


200 count

Most of the houses were listed for sale in 2017

```
ln [52] : plt.figure(figsize=(12,18) ) sns.countplot
         (data=dfl,y='Posta1 Code' ) Pl t . show()
```


Postal Code
122003
122004
122005
122006
122007
122008
122009
122010
122011
122012
122013
122014
122015
122016
122017
122018
122019
122020
122021
122022
122023
122024
122025
122026
122027
122028
122029
122030
122031
122032
122033
122034
122035
122036
122037
122038
122039
122040
122041
122042
122043
122044
122045
122046



Most of the houses listed for sale are from the Pincode 122028

```
In [53] : df1[d     .Bu1.l t Year     -2014] [ ' L attitude' ] .
                                     mean()
```

Out[54] :

Out [53]

```
:          52.77583376963351
In [54] :
```

```
df1[df1['Built Year']==2014]['Longitude'].mean()
```

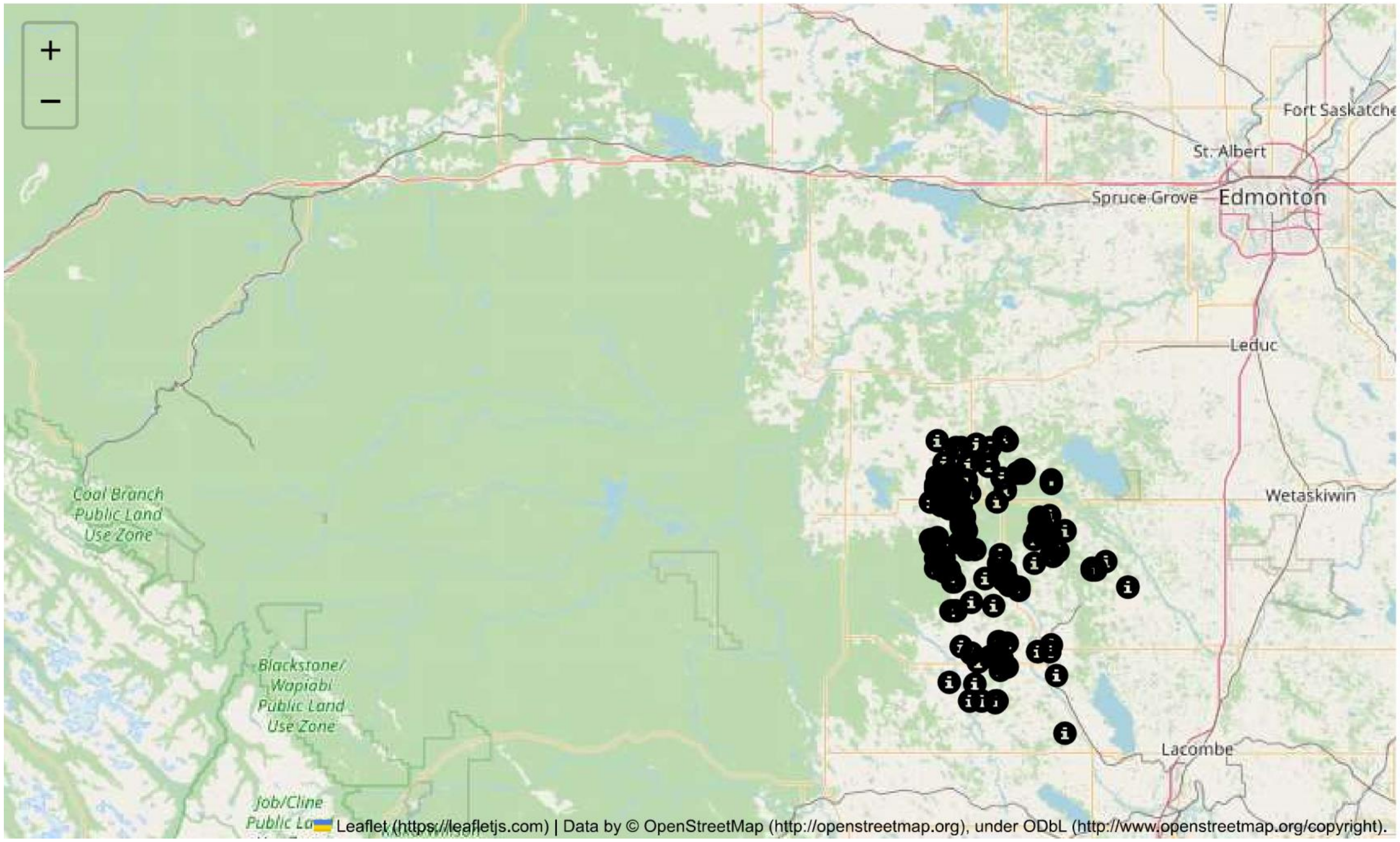
```
           -114.38898952879582
```

```
[55] :m = folium. Map(location    [52.77, -114.4], tiles = 'OpenStreetMap' , zoom_start=8)
```

Out[54] :

Out[55] :

```
for index, location_info in df1[(df1['Built Year']==2014) & (df1['Distance from the airport']<=70)].iterrows():
    folium.Marker([location_info["Lattitude"], location_info["Longitude"]], popup=location_info["Price"],icon=folium.
m
```


Fort Saskatche
St. Albert
Spruce Grove
Edmonton
Leduc
Wetaskiwin
Lacombe
Coal Branch Public Land Use Zone
Blackstone/ Wapiabi Public Land Use Zone
Job/Cline Public La
Leaflet (https://leafletjs.com) | Data by © OpenStreetMap (http://openstreetmap.org), under ODbL (http://www.openstreetmap.org/copyright).

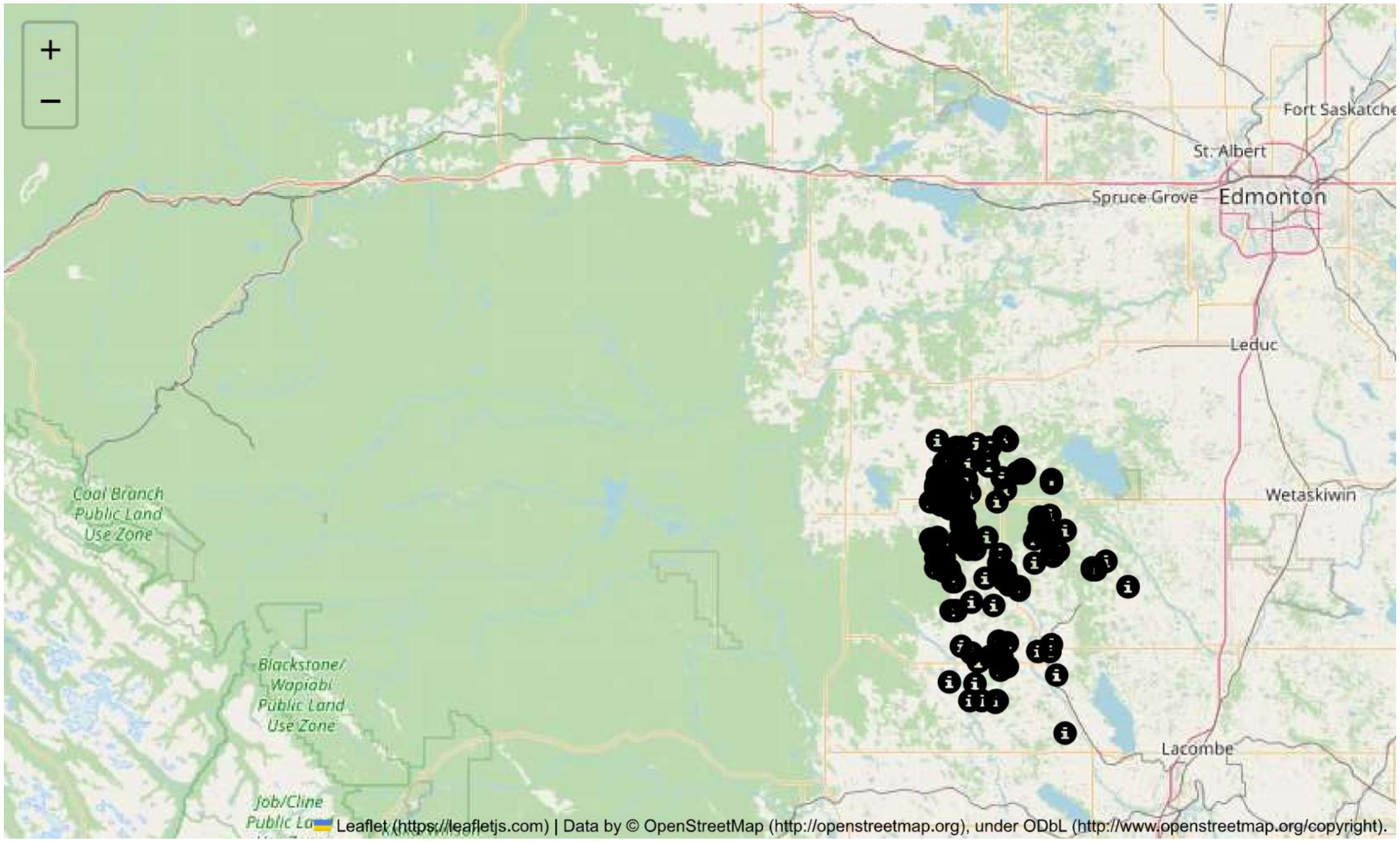
In [56] :

```
df1[df1['Built Year']>=2014]['Lattitude'].mean()
```

```
52 .77850305343512
```

```
Out[54] :
In [57] : df1[df1     ['Built Year' >=2014]['Longitude'].mean()
          -114.39186768447837
Out[57] :
        : m =folium. Map (location = [52.77, -114.4], tiles = 'OpenStreetMap' ,
              zoom_start=8)

          for index, location _info in df1[(df1[ 'Bui1t Year' ]>=2014) & (dfl[ 'Distance from the airport'
          folium.Marker([10cation_info["Lattitude"], location_info["Longitude"] ], m
```

Out[54]:


+
−
Fort Saskatche
St. Albert
Spruce Grove
Edmonton
Leduc
Wetaskiwin
Lacombe
Coal Branch Public Land Use Zone
Blackstone/ Wapiabi Public Land Use Zone
Job/Cline Public La
Leaflet (https://leafletjs.com) | Data by © OpenStreetMap (http://openstreetmap.org), under ODbL (http://www.openstreetmap.org/copyright).

The houses listed for sale in this dataset are located in Alberta, Canada

```
df1=df1.drop(['id'],axis=1)
```

Out[54] :

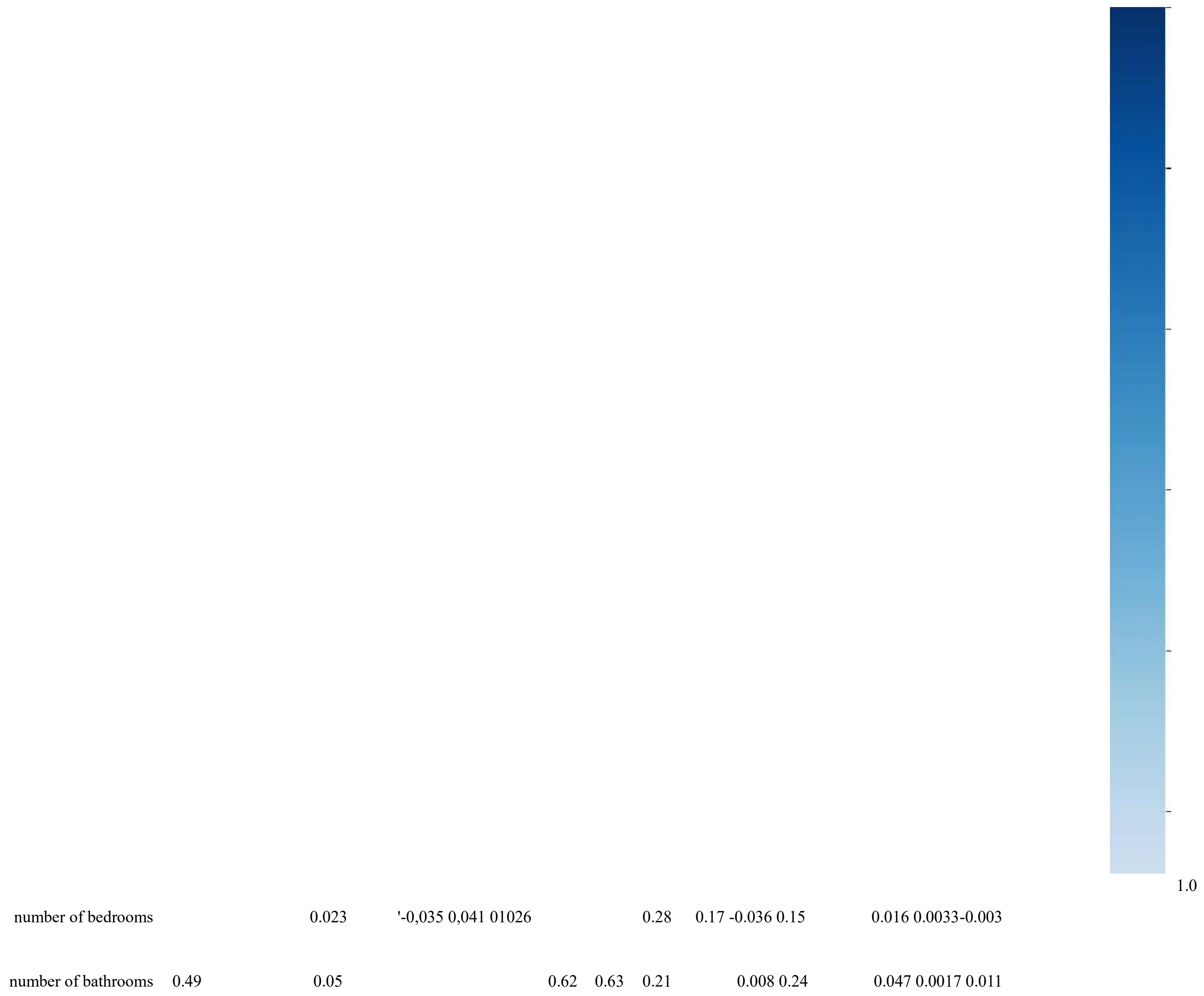
In [60] :

```
df1=df1.drop([' Postal Code' ],axis=l)
```

MULTI - VARIATE ANALYSIS

Columns ID and Postal Code have been dropped from df as an increase or decrease in Postal Code shall not directly impact the Price of the property

```
In [61] : plt.figure(figsize=(15,15)) sns . heatmap(dfl . corr() ,
          linewidths=0.5, annot=True, cmap= ' Blues ' ) PIt . show()
```


1.0
number of bedrooms 0.023 '-0,035 0,041 01026 0.28 0.17 -0.036 0.15 0.016 0.0033-0.003
number of bathrooms 0.49 0.05 0.62 0.63 0.21 0.008 0.24 0.047 0.0017 0.011

liVing area 0.6 0.71 0.15 0.72 0.85 .36 0.34 0.16 0.00060.0055

0.8

o. 05 0.15 -0.014 0.031 0.075 -0.0047 0.087 0.16 -0.00240.042 -0.097 0.21 0.14 0.00890.0055 0.078

number of floors 0.16 -0,014 -0,011 40.023 0.28 -0.3 0,041 0.13 0.27 -0.023 -0,007 0,017 0.2

waterfront present•-O.035 -0.004 0.011 0.03i -0.011 01019-0.00460.0038 0.02? -0.039 -0.047 -0.0" 0.02 0.038 -0.01 -0.0086 0.090.6

number of views - 0.041 0-1 0.18 0.075 -0.023 0.046 0.16 0,067 0.22 -0.072-0.027 -O.OB9 0.21 0.067 0.0027-0.0058 0.2

condition of the house - 0.02& -0.13 -0.071-0.0047 -0.23 0,019 0,046 -0.17 -0.19 0.2 -0.38 -0.0051 -0.12

0.4 grade of the house 0.34 0.62 0.72 0.004& o.lí -0.17 0.72 0.07 0.1 o. 093 -0.00140.0078

Area of the house(excluding basement) 0116 0,0038 0,067 -0.19 -0.18 -0,031 0.17 -0.00370.0067

Area of the basement .28 0.21 .0024 -0.3 0,027 0.22 0.2 0.07 -0.18 -0.17 0.1L -0.17 '0.11 -0.011 0.0077-0.0016, 0.2

0.2

Built year 0.17 0.042 *0.039 -0.38 0.47 0.46 0.06+0.00038000410.047

Lattitude -90.036 0.008 0028 -0,097 0.041 -0,047 0.1 -0.031 0.11 -0.15 -0.13 0.028 -0.1 O.OL6 0.0078

Longitude 0.15 0.24 0.28 0.21 0.13 0069 -0.089 -0.12 0.22 0.39 0.41 0.25 -0.00911000420.04

0.0

livi 0.39 0.53 0.74 0.68 0.72 0,028 0,17 -0.007-0.001

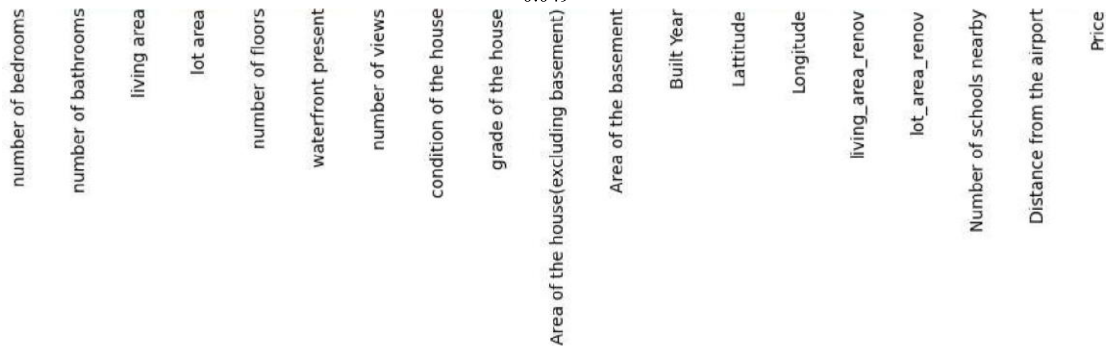
IOt area renov -0.016 0.047 0.16 -0.023 0,038 0,067-0.000670.093 0.17 -0,011 0.063 -0.1 0.25 0.17 -0.023 -0.012 0.065

Number ot schools nearbY -0.00330.00170.00058).0089-0.007 -0.01 0.023 -000100026

Distance from the airport -0.0033 0.011 0.00550.0055 0.017 0.0051

Price 0.07B 0.27 0.091 00.28 0.053 0.065 0.00260.0051 5' 0.2S o.

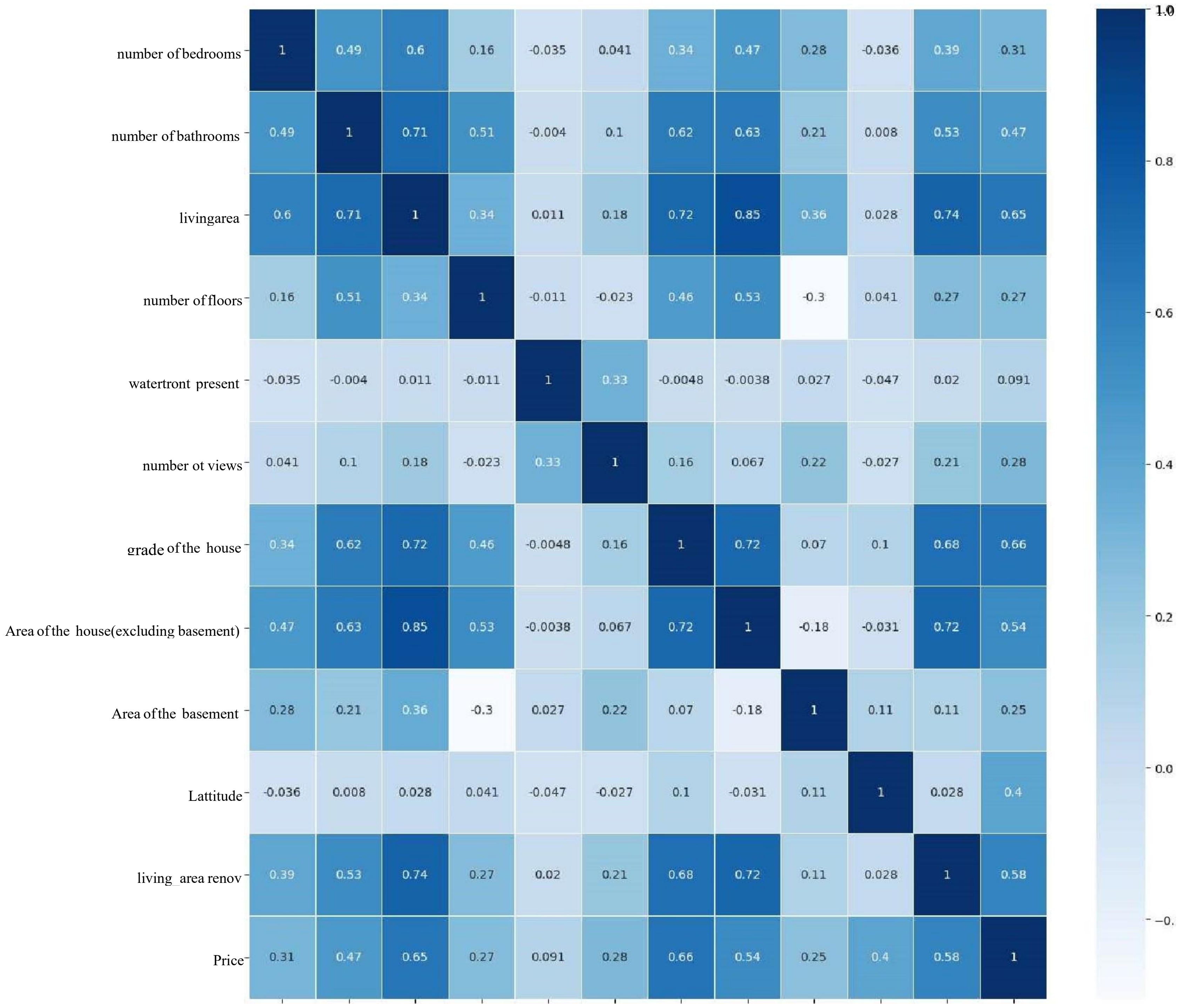
047 0.049



Columns like 'lot area','condition of the house','Built Year','lot_area_renov','Number of schools nearby','Distance from the airport','Longitude' contribute minimal to Price which is the Target variable. Hence it is removed before training

```
In [62] : df1=df1.drop([ 'lot area' , ' condition of the house' , ' Built Year' , 'lot area renov' , 'Number of schools nearby' , 'Distance
```

```
In [63] : plt.figure(figsize=(15,15) ) sns .heatmap(dfl . corr() ,
          linewidths=0.5, annot=True, cmap= ' Blues ' ) PIt . show()
```


number of bedrooms 1 0.49 0.6 0.16 -0.035 0.041 0.34 0.47 0.28 -0.036 0.39 0.31
number of bathrooms 0.49 1 0.71 0.51 -0.004 0.1 0.62 0.63 0.21 0.008 0.53 0.47
livingarea 0.6 0.71 1 0.34 0.011 0.18 0.72 0.85 0.36 0.028 0.74 0.65
number of floors 0.16 0.51 0.34 1 -0.011 -0.023 0.46 0.53 -0.3 0.041 0.27 0.27
watertront present -0.035 -0.004 0.011 -0.011 1 0.33 -0.0048 -0.0038 0.027 -0.047 0.02 0.091
number ot views 0.041 0.1 0.18 -0.023 0.33 1 0.16 0.067 0.22 -0.027 0.21 0.28
grade of the house 0.34 0.62 0.72 0.46 -0.0048 0.16 1 0.72 0.07 0.1 0.68 0.66
Area of the house(excluding basement) 0.47 0.63 0.85 0.53 -0.0038 0.067 0.72 1 -0.18 -0.031 0.72 0.54
Area of the basement 0.28 0.21 0.36 -0.3 0.027 0.22 0.07 -0.18 1 0.11 0.11 0.25
Lattitude -0.036 0.008 0.028 0.041 -0.047 -0.027 0.1 -0.031 0.11 1 0.028 0.4
living area renov 0.39 0.53 0.74 0.27 0.02 0.21 0.68 0.72 0.11 0.028 1 0.58
Price 0.31 0.47 0.65 0.27 0.091 0.28 0.66 0.54 0.25 0.4 0.58 1
1.0
0.8
0.6
0.4
0.2
0.0
−0.

Training of Model, Splitting of Dataset into Train and Test Set

```
In [64] : from   sklearn   .   model_selection
           import train_test_split

In [65] : X=df1.drop( [ ' Price' ],axis =1)

In [66] : X. shape

Out[66]: (13982, 11)

In [67] : y_df1[ ' Price ' ]

In [68] : y. shape

Out[68]: (13982, )

In [69] : X_train, X_test,   train_test_split     (X,      y,
           y_train,           test_size=0.2, random_state=11)
```

Out[71] : (2797, 11)

72]:

```
from sklearn.pipeline import make_pipeline from sklearn.preprocessing import
StandardSca1er from sklearn.linear_model import ElasticNet, Lasso,
LinearRegression, RidgeCV from catboost import CatBoostRegressor from
sklearn.ensemble import RandomForestRegressor, GradientBoostingRegressor f rom
xgboost import XGBRegressor from sklearn.tree import DecisionTreeRegressor from
sklearn.ensemble import StackingRegressor from sklearn.svm import SVR
```

In [73] :

```
pipelines _   {.en' :make_pipe1ine(StandardSca1er(),
    ElasticNet()),
    ' lasso' :make_pipe1ine(StandardSca1er(), Lasso())'
    'Rcv ' :make_pipe1ine(StandardSca1er(), RidgeCV()),
    'CatB' : make_ pipeline(StandardSca1er(), CatBoostRegressor(eva1_metr1c• ='RMSE ' ,verbose-
    1000) ) ,
    ' Ir ' :make_pipe1ine(StandardSca1er(), LinearRegression()),
    ' rf' :make_pipe1ine(StandardSca1er(), RandomForestRegressor()),
    'gb'  :make_pipe1ine(StandardSca1er(),  GradientBoostingRegressor()),  '
    dtc :make_pipeline (StandardSca1er()  ,  DecisionTreeRegressor()), ' xg'
    :make_pipe1ine(StandardSca1er() ,XGBRegressor())
```

In [74] :

```
fit_models = {}
```

In [70] : X_train . shape

Out[70] : (11185, 11)

In [71] : X_test . shape

```
for algo, pipeline in pipelines. items() :
    model        pipeline.fit(X_train, y_train)
    fit_models[algo] - model
```

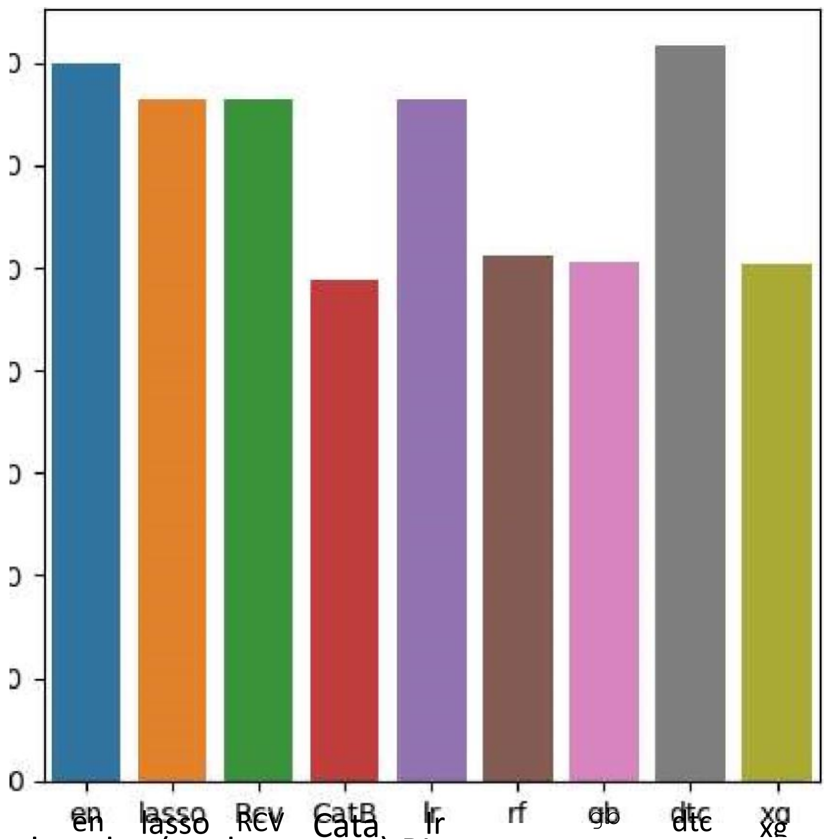
```
/opt/conda/1ib/python3.7/site-packages/sk1earn/1inear_mode1/_coordinate_descent.py:648: ConvergenceWarning: Objective did not converge. You might want to increase the number of iterations, check the scale of the features or consider inc reasing regularisation. Duality gap: 4.781e+12, tolerance: 5.929e+1e coef 11_ reg, 12_ reg, X, y, max_iter, tol, rng, random, positive Learning rate set to 0.05996 e: learn: 221490.1496581 total: 61.4ms remaining: 1m Is
999:     learn: 77595.2298921     total: 2.85s     remaining: eus
```

```
[75]: from sklearn . metrics import mean_absolute_error, mean_ squared _error

 for algo, model in fit_models.items() :
     Yhat model . predict (X_test) al . append (algo) maes . append (mean_squared_error (y_test , yhat) * *0.5) print(algo, 'MEAN ABSOLUTE ERROR' , mean_absolute_error(y_test, yhat) ) print(algo, 'ROOT MEAN SQUARED ERROR' ,mean_squared_error(y_test,yhat)**0.5)
```

```
en MEAN ABSOLUTE ERROR 104444.32355671145 en
ROOT MEAN SQUARED ERROR 140011.53917862213
lasso MEAN ABSOLUTE ERROR 97479.23118789196
lasso ROOT MEAN SQUARED ERROR
132916.1566456281 Rcv MEAN ABSOLUTE ERROR
97481.91673717603
Rcv ROOT MEAN SQUARED ERROR 132918.333682342
CatB MEAN ABSOLUTE ERROR 66637.30790160663
CatB ROOT MEAN SQUARED ERROR
97508.34029611414 Ir MEAN ABSOLUTE ERROR
97574.48622571728 Ir ROOT MEAN SQUARED ERROR
132952.7515959945 rf MEAN ABSOLUTE ERROR
69217.89879907611 rf ROOT MEAN SQUARED ERROR
102292.3632979867 gb MEAN ABSOLUTE ERROR
69874.84067217445 gb ROOT MEAN SQUARED ERROR
101056.41447857216 dtc MEAN ABSOLUTE ERROR
96944.72285782386 dtc ROOT MEAN SQUARED ERROR
143316.21683052482 xg MEAN ABSOLUTE ERROR
69035.05210660976 xg ROOT MEAN SQUARED ERROR
100694.41040458805
```

```
In [76] : plt.figure(figsize=(5, 5)) plt.xlabel(
           'ML Algorithms. . . ') plt.ylabel(
```

'Root Mean Squared Errors. ')



en lasso RCV Cata lr dtc xg

ax=sns . barplot (x=al, y=maes) Pl t .
show()

140000

120000

2 100000

LLI

a 80000

a 60000
Root Me
40000

200001

ML Algorithmsv..

[ ]:

```
CatB = CatBoostRegressor(verbose=1000,eval_metric= ' RMSE
'      )      rf      =      RandomForestRegressor()      gb      =
GradientBoostingRegressor() xg = XGBRegressor()
1r=LinearRegression()

stregr - StackingRegressor(estimators=[( 'catb' ,CatB), ( 'xg' , xg),('gb',gb)],
                                   final_estimator=lr)

pipeline - make_pipeline(
     StandardSca1er(),
     stregr

pipeline. fit (X_train, y_train)
```

```
# Generate predictions on the test set y_pred
pipeline. predict (X_test)

# Evaluate the model print( " Root Mean Squared Error: %.4f" %
mean_squared_error(y_test,y_pred)**0.5)
```

```
Learning rate   set to 0.05996
e :      learn :  221490. 1496581    total : 4.18ms    remaining:  4.18s
999:     learn :  77595.2298921      total : 2.81s     remaining:  eus
Learning rate   set to 0.057883
e:       learn:   222091.4863333     total : 3. 52ms   remaining:  3. 51s
999 :    learn :  76337  .  1933964  total : 2.52s     remaining:  eus
Learning rate   set to 0.057883
e :      learn :  222546. 8538661    total : 2 .94ms   remaining:  2. 94s
999 :    learn :  75466.   5961681   total : 2. 51s    remaining:  eus
Learning rate   set to 0.057883
e :      learn :  223455 . 5230951   total : 3.2ms     remaining:  3.2s
999:     learn :  75656.   3661258   total : 2.52s     remaining:  eus
Learning rate   set to 0.057883
e:       learn :  221606.9467960     total : 3.71ms    remaining:  3.7s
999:     learn :  75195    .9699196  total : 2.46s     remaining:  eus
Learning rate   set to 0.057883
e:       learn :  219316.0911020     total : 2.47ms    remaining:  2.47s
```

```
[ ]:mean_ squared _error (y_test , y_pred)          .5
```

```
[ ]:al . append( stacked model' ) maes . append (mean_squared_error
    (y_test, y_pred) * *0.5)
```

```
[ ]:for i in range(10) :
        print("The RMSE of" , al [ i ] , ' is ' ,maes[i] )
```

```
[ ]:plt.figure(figsize=(9,5))
    plt.xlabel( 'ML Algorithms . . .
    ')
    plt.ylabel( ' Root Mean Squared Errors . ' ) ax=sns
    . barplot (x=al, y=maes) PI t . show()
```

ALL DONE BY RESHMA J AS NAAN MUDALVAN IBM SMARTINTERNZ ASSIGNMENT 3