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

In [2]:
```
house_details=pd.read_csv("House_Price.csv")
```

In [3]:
```
house_details.head(10)
```

Out[3]:

	bedrooms	bathrooms	sqft_living	sqft_lot	floors	price
0	3	1	1180	5650	1	221900
1	3	2	2570	7242	2	538000
2	2	1	770	10000	1	180000
3	4	3	1960	5000	1	604000
4	3	2	1680	8080	1	510000
5	4	5	5420	101930	1	1225000
6	3	2	1715	6819	2	257500
7	3	2	1060	9711	1	291850
8	3	1	1780	7470	1	229500
9	3	3	1890	6560	2	323000

In [4]:
```
house_details.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 21613 entries, 0 to 21612
Data columns (total 6 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   bedrooms     21613 non-null  int64
 1   bathrooms    21613 non-null  int64
 2   sqft_living  21613 non-null  int64
 3   sqft_lot     21613 non-null  int64
 4   floors       21613 non-null  int64
 5   price        21613 non-null  int64
dtypes: int64(6)
memory usage: 1013.2 KB
```

In [5]:
```
house_details.describe()
```

Out[5]:

	bedrooms	bathrooms	sqft_living	sqft_lot	floors	price
count	21613.000000	21613.000000	21613.000000	2.161300e+04	21613.000000	2.161300e+04
mean	3.370842	2.312543	2079.899736	1.510697e+04	1.542405	5.400881e+05
std	0.930062	0.865405	918.440897	4.142051e+04	0.567504	3.671272e+05
min	0.000000	0.000000	290.000000	5.200000e+02	1.000000	7.500000e+04
25%	3.000000	2.000000	1427.000000	5.040000e+03	1.000000	3.219500e+05
50%	3.000000	2.000000	1910.000000	7.618000e+03	2.000000	4.500000e+05
75%	4.000000	3.000000	2550.000000	1.068800e+04	2.000000	6.450000e+05
max	33.000000	8.000000	13540.000000	1.651359e+06	4.000000	7.700000e+06

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

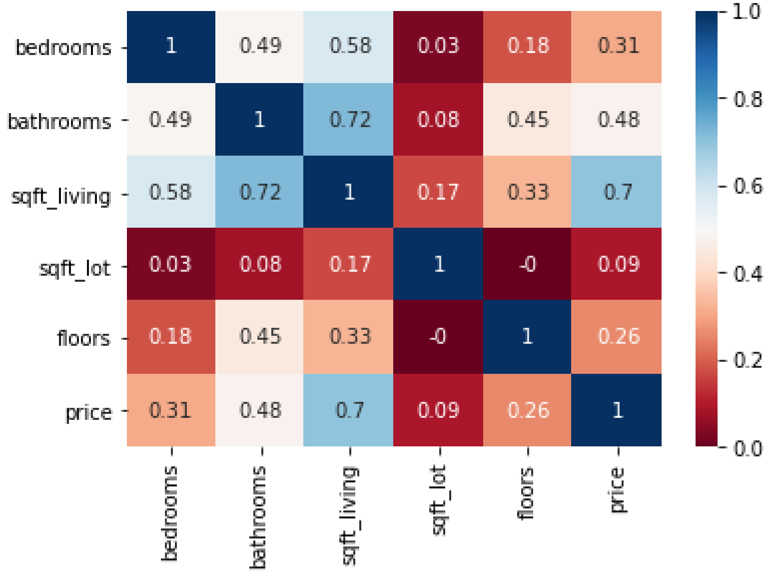
Out[6]:
```
bedrooms       0
bathrooms      0
sqft_living    0
sqft_lot       0
floors         0
price          0
dtype: int64
```

In [7]:
```
house_info=house_details.corr().round(2)
house_info
```

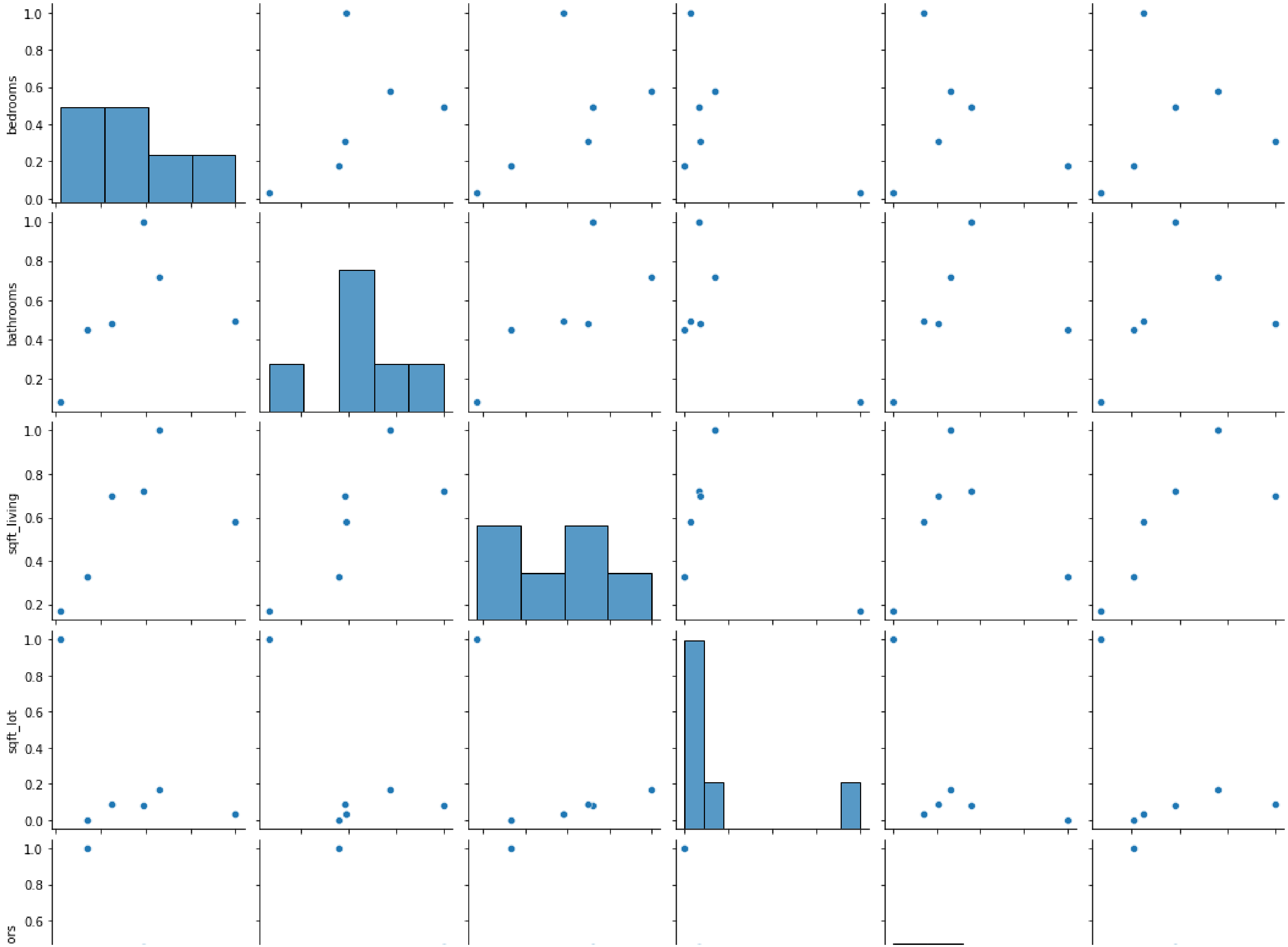
Out[7]:

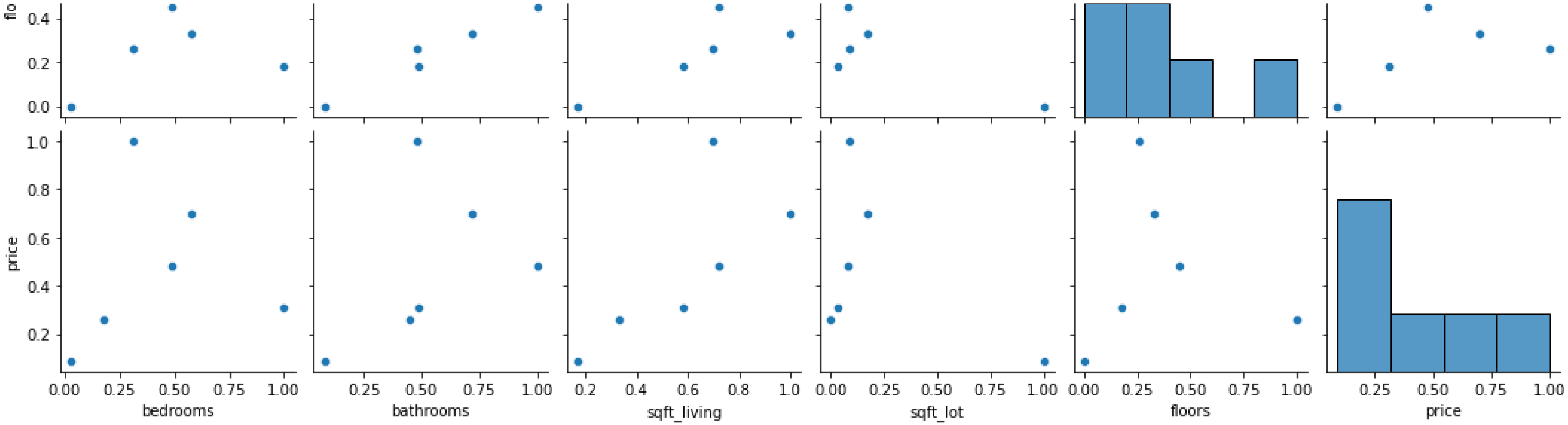
	bedrooms	bathrooms	sqft_living	sqft_lot	floors	price
bedrooms	1.00	0.49	0.58	0.03	0.18	0.31
bathrooms	0.49	1.00	0.72	0.08	0.45	0.48
sqft_living	0.58	0.72	1.00	0.17	0.33	0.70
sqft_lot	0.03	0.08	0.17	1.00	-0.00	0.09
floors	0.18	0.45	0.33	-0.00	1.00	0.26
price	0.31	0.48	0.70	0.09	0.26	1.00

In [8]:
```
sns.heatmap(house_info,annot=True,cmap='RdBu');
```

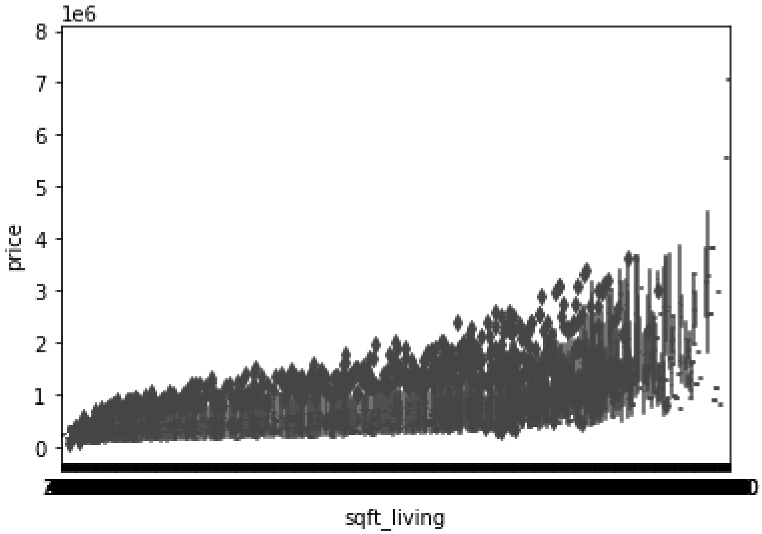


In [9]:
```
sns.pairplot(house_info); #By seeing this pairplot we can say,sqft_living has high correlation with price(dependent vari
```

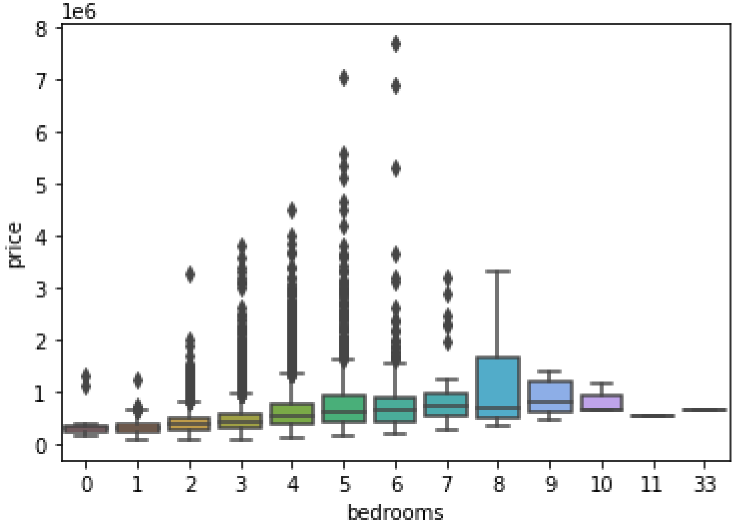




In [10]:
```
sns.boxplot(x="sqft_living",y="price",data=house_details);
```

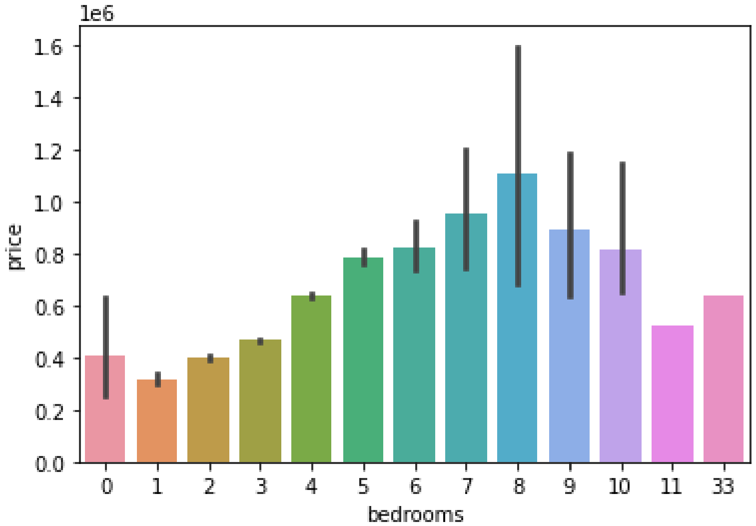


In [11]:
```
sns.boxplot(x="bedrooms",y="price",data=house_details);
```



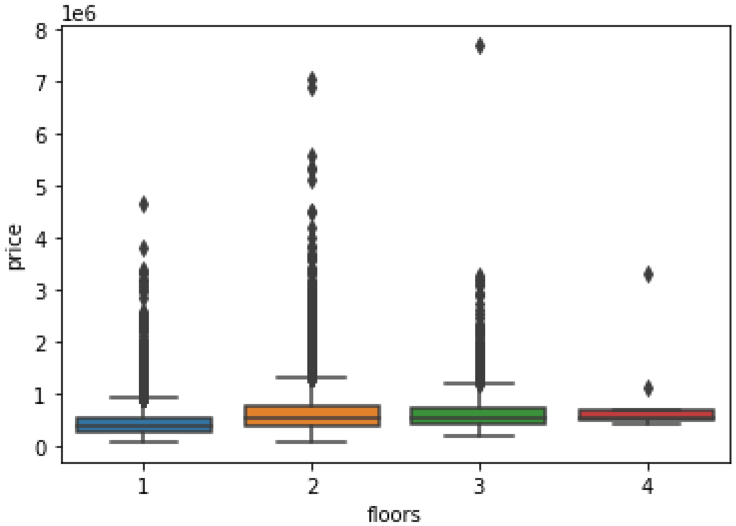
from boxplot it seems price deflections(outliers) are high where houses have 4,5 and 6 bedrooms.

In [12]:
```
sns.barplot(x="bedrooms",y="price",data=house_details);
```



from barplot we conclude house with 8 bedrooms have high price

In [13]:
```
sns.boxplot(x="floors",y="price",data=house_details);
```



price deflection are high in houses having 2 floors

In [14]:
```
ss=pd.DataFrame(house_details)
ss
```

Out[14]:

	bedrooms	bathrooms	sqft_living	sqft_lot	floors	price
0	3	1	1180	5650	1	221900
1	3	2	2570	7242	2	538000
2	2	1	770	10000	1	180000
3	4	3	1960	5000	1	604000
4	3	2	1680	8080	1	510000
...	...	...	...	...	...	...
21608	3	3	1530	1131	3	360000
21609	4	3	2310	5813	2	400000
21610	2	1	1020	1350	2	402101
21611	3	3	1600	2388	2	400000
21612	2	1	1020	1076	2	325000

21613 rows × 6 columns

just found the max price

In [15]:
```
column = ss["price"]
max_value = column.max()
print(max_value)
```

```
7700000
```

In [16]:
```
ss[ss['price']==ss['price'].max()]
```

Out[16]:

	bedrooms	bathrooms	sqft_living	sqft_lot	floors	price
7252	6	8	12050	27600	3	7700000

seperating dependent and independent variables

In [17]:
```
y_dep=house_details.price
y_dep
```

Out[17]:
```
0        221900
1        538000
2        180000
3        604000
4        510000
          ...
21608    360000
21609    400000
21610    402101
21611    400000
21612    325000
Name: price, Length: 21613, dtype: int64
```

In [18]:
```
x_indep=house_details.drop("price",axis=1) #DROPING THE DEPENDENT VARIABLE
x_indep
```

Out[18]:

	bedrooms	bathrooms	sqft_living	sqft_lot	floors
0	3	1	1180	5650	1
1	3	2	2570	7242	2
2	2	1	770	10000	1
3	4	3	1960	5000	1
4	3	2	1680	8080	1
...	...	...	...	...	...
21608	3	3	1530	1131	3
21609	4	3	2310	5813	2
21610	2	1	1020	1350	2
21611	3	3	1600	2388	2
21612	2	1	1020	1076	2

21613 rows × 5 columns

CHECKING p-value

In [19]:
```
import statsmodels.api as sm
```

In [20]:
```
model=sm.OLS(y_dep,x_indep)
```

In [21]:
```
my_fit=model.fit()
```

In [22]:
```
my_fit.summary()
```

Out[22]:

OLS Regression Results

Dep. Variable:	price	**R-squared (uncentered):**	0.845
Model:	OLS	**Adj. R-squared (uncentered):**	0.845
Method:	Least Squares	**F-statistic:**	2.352e+04
Date:	Fri, 20 Aug 2021	**Prob (F-statistic):**	0.00
Time:	19:19:14	**Log-Likelihood:**	-2.9992e+05
No. Observations:	21613	**AIC:**	5.999e+05
Df Residuals:	21608	**BIC:**	5.999e+05
Df Model:	5		
Covariance Type:	nonrobust		

	coef	**std err**	**t**	**P>|t|**	**[0.025**	**0.975]**
bedrooms	-4.195e+04	1798.147	-23.329	0.000	-4.55e+04	-3.84e+04
bathrooms	-2.337e+04	3106.713	-7.524	0.000	-2.95e+04	-1.73e+04
sqft_living	324.7097	2.975	109.141	0.000	318.878	330.541
sqft_lot	-0.3486	0.043	-8.103	0.000	-0.433	-0.264
floors	4.002e+04	3138.743	12.750	0.000	3.39e+04	4.62e+04

Omnibus:	13945.067	**Durbin-Watson:**	1.984
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	457933.849
Skew:	2.609	**Prob(JB):**	0.00
Kurtosis:	24.938	**Cond. No.**	9.37e+04

Notes:
[1] R^2 is computed without centering (uncentered) since the model does not contain a constant.
[2] Standard Errors assume that the covariance matrix of the errors is correctly specified.

[3] The condition number is large, 9.37e+04. This might indicate that there are strong multicollinearity or other numerical problems.

From summary we conclude,R-square value is 0.8 so correlation is high and none of the independent variables have p>0.05 so all the independent variables have high correlation with dependent variable.

PREDICTION

In [63]:
```
my_fit.predict(x_indep).round()
```

Out[63]:
```
0        271987.0
1        739423.0
2        179288.0
3        436790.0
4        410120.0
           ...
21608    420501.0
21609    590174.0
21610    303501.0
21611    402773.0
21612    303596.0
Length: 21613, dtype: float64
```

here python predicted the price of each houses

In [24]:
```
my_fit.predict(x_indep).round().head(10)
```

Out[24]:
```
0     271987.0
1     739423.0
2     179288.0
3     436790.0
4     410120.0
5    1479743.0
6     461944.0
7     208232.0
8     466178.0
9     495484.0
dtype: float64
```

MACHINE LEARNING

#Machine learning is performed to check whether the predicted values are correct or not.

In [25]:
```
import sklearn
from sklearn import model_selection
from sklearn.model_selection import train_test_split
```

splitting 100% data into 80% of data for fitting and 20% for prediction

In [26]:
```
x_train,x_test,y_train,y_test=train_test_split(x_indep,y_dep,train_size=0.8,random_state=1)
```

In [27]:
```
my_data=sm.OLS(y_train,x_train)
```

In [28]:
```
my_fit1=my_data.fit()
```

just checking the R-sq and p values of 80% of data

In [29]:
```
my_fit1.summary()
```

Out[29]:

OLS Regression Results

Dep. Variable:	price	**R-squared (uncentered):**	0.850
Model:	OLS	**Adj. R-squared (uncentered):**	0.850
Method:	Least Squares	**F-statistic:**	1.963e+04
Date:	Fri, 20 Aug 2021	**Prob (F-statistic):**	0.00
Time:	19:19:15	**Log-Likelihood:**	-2.3938e+05
No. Observations:	17290	**AIC:**	4.788e+05
Df Residuals:	17285	**BIC:**	4.788e+05
Df Model:	5		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
bedrooms	-3.773e+04	1942.300	-19.427	0.000	-4.15e+04	-3.39e+04
bathrooms	-2.63e+04	3383.120	-7.773	0.000	-3.29e+04	-1.97e+04
sqft_living	317.3245	3.278	96.810	0.000	310.900	323.749
sqft_lot	-0.3065	0.045	-6.808	0.000	-0.395	-0.218
floors	4.419e+04	3404.985	12.979	0.000	3.75e+04	5.09e+04

Omnibus:	9379.778	**Durbin-Watson:**	2.002
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	165630.922
Skew:	2.220	**Prob(JB):**	0.00
Kurtosis:	17.498	**Cond. No.**	9.72e+04

Notes:
[1] R^2 is computed without centering (uncentered) since the model does not contain a constant.
[2] Standard Errors assume that the covariance matrix of the errors is correctly specified.

[3] The condition number is large, 9.72e+04. This might indicate that there are strong multicollinearity or other numerical problems.

In [30]:
```
x_train
```

Out[30]:

	bedrooms	bathrooms	sqft_living	sqft_lot	floors
7291	3	2	2190	7021	1
14835	3	3	2370	6840	2
15880	2	1	1230	3800	1
8812	4	2	2510	9963	1
17220	3	1	1160	7491	1
...	...	...	...	...	...
10955	3	3	1920	3867	2
17289	4	5	3420	7440	3
5192	3	2	1970	54450	1
12172	3	2	1980	8775	1
235	5	4	3760	28040	2

17290 rows × 5 columns

In [31]:
```
y_train
```

Out[31]:
```
7291      353000
14835     300523
15880     435000
8812      800000
17220     417500
          ...
10955     571000
17289    1350000
5192      650000
12172     437000
235      1025000
Name: price, Length: 17290, dtype: int64
```

IMPORTING LINEAR REGRESSION

In [32]:
```
from sklearn import linear_model
from sklearn.linear_model import LinearRegression
```

In [33]:
```
data=LinearRegression()
```

In [34]:
```
data.fit(x_train,y_train)
```

Out[34]:
```
LinearRegression()
```

predicting price with 20% of the independent variables(x_test)

In [35]:
```
y_pred=data.predict(x_test)
y_pred
```

Out[35]:
```
array([ 731166.67967974,  409898.60570831,  669252.27860429, ...,
        478178.67569015, 1472510.04262538,  363850.457691  ])
```

In [36]:
```
comp=pd.DataFrame({"actual_price":y_test,"machine_pred_price":y_pred}) #giving column names
comp
```

Out[36]:

	actual_price	machine_pred_price
15544	459000	7.311667e+05
17454	445000	4.098986e+05
21548	1057000	6.692523e+05
3427	732350	5.637444e+05
8809	235000	4.046212e+05
...	...	...
13597	965000	9.325628e+05
9648	359950	5.967553e+05
18627	260000	4.781787e+05
9553	1795000	1.472510e+06
14200	418000	3.638505e+05

4323 rows × 2 columns

Finding residual(error) by taking difference from machine calculated value to actual calculated value.

In [37]:
```
res=y_pred-y_test
res.round()
```

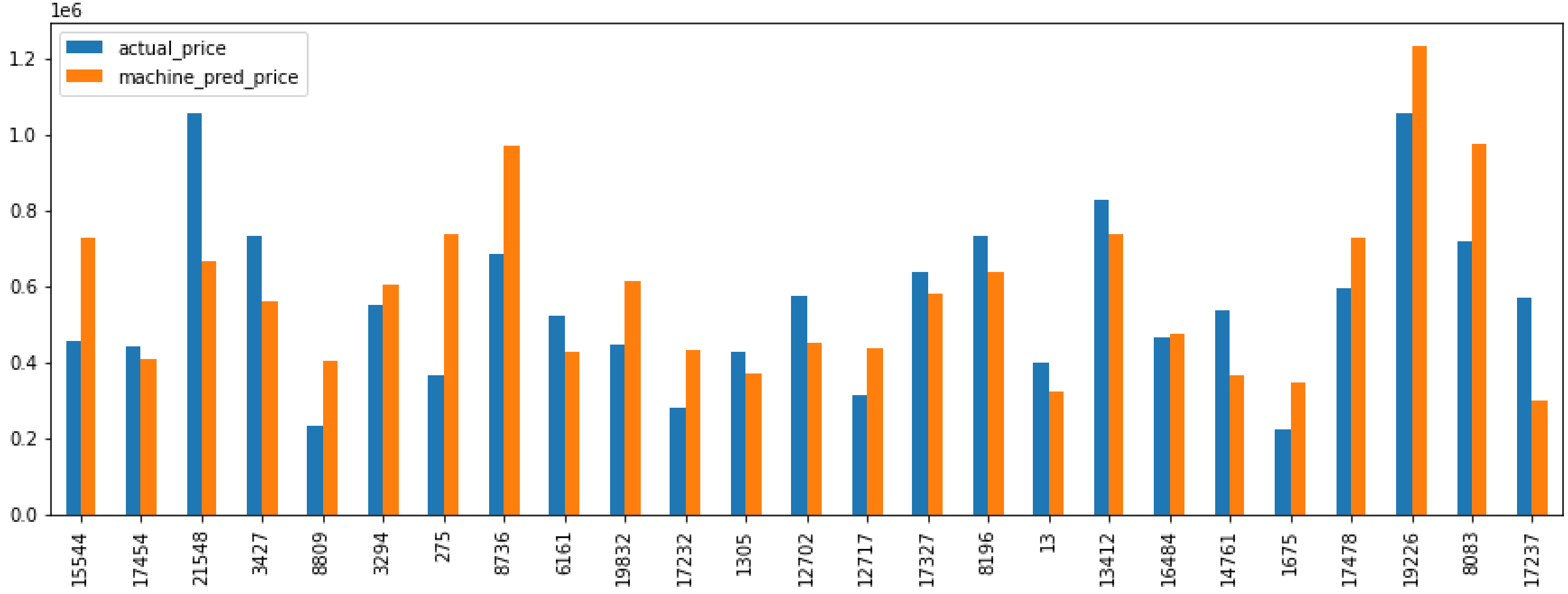
Out[37]:
```
15544    272167.0
17454    -35101.0
21548   -387748.0
3427    -168606.0
8809     169621.0
           ...
13597    -32437.0
9648     236805.0
18627    218179.0
9553    -322490.0
14200    -54150.0
Name: price, Length: 4323, dtype: float64
```

here are the errors or differences from machine calc and actual calc

GRAPHS

In [38]:
```
com_lmt=comp.head(25)
```

In [39]:
```
com_lmt.plot(kind="bar",figsize=(15,5));
```

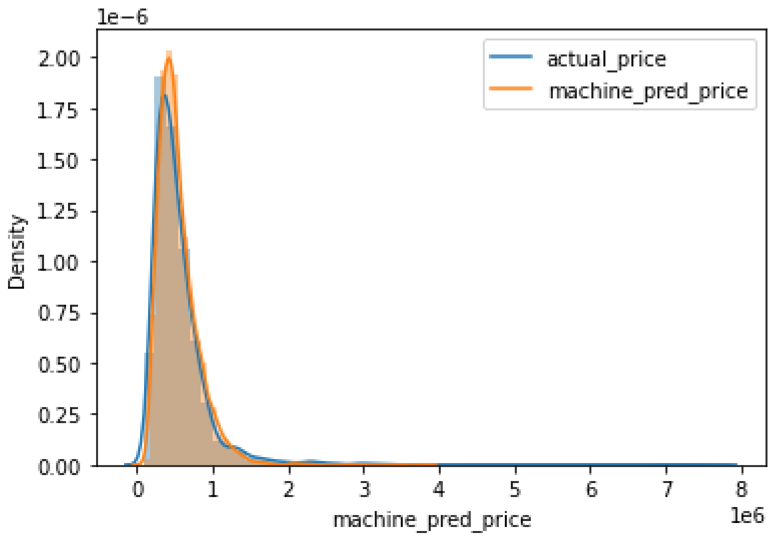


There is only minimum difference b/w actual and predicted values

In [40]:
```
sns.distplot(comp["actual_price"])
sns.distplot(comp["machine_pred_price"])
plt.legend(["actual_price","machine_pred_price"])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated fun
ction and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function
with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated fun
ction and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function
with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

Out[40]: <matplotlib.legend.Legend at 0x115deb0f8b0>

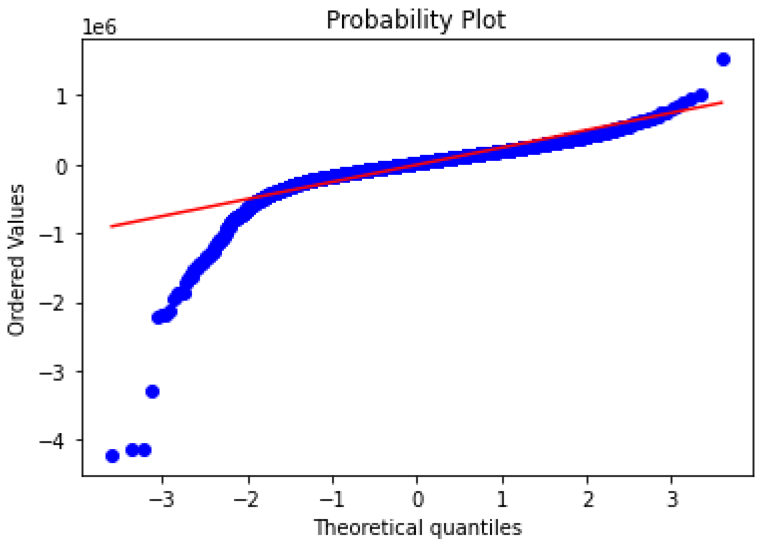


from this graph we can see that both the bell curves are nearer to each other,there is only less variation b/w both values

ASSUMPTIONS IN LINEAR REGRESSION

In [41]:
```
# NORMALITY CHECK
import scipy.stats as sps
sps.probplot(res,dist="norm",plot=plt)
```

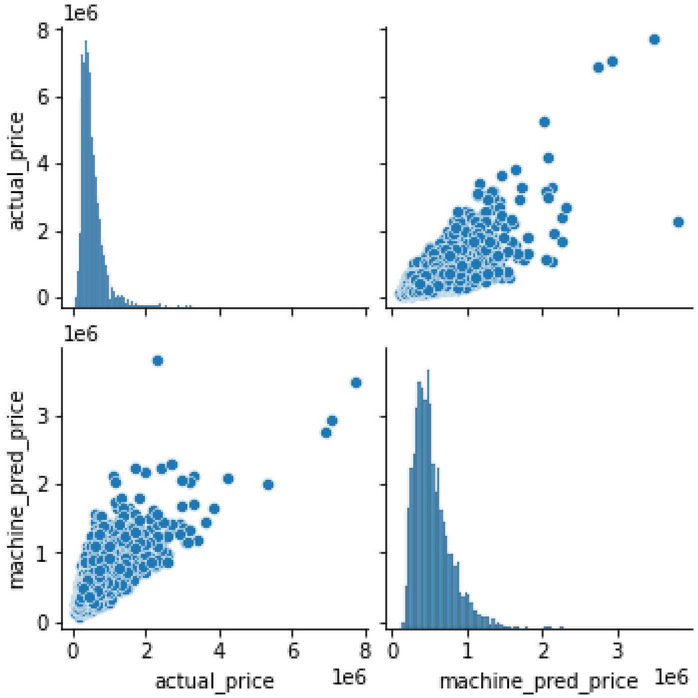
Out[41]:
```
((array([-3.59801667, -3.36038867, -3.22930113, ...,  3.22930113,
          3.36038867,  3.59801667]),
  array([-4221931.46193083, -4132071.6104107 , -4123216.48079273, ...,
           965453.51862481,  1002997.08966016,  1530206.98421065])),
 (249171.33518121368, -3865.5587791720936, 0.8659735742459718))
```



Finally i conclude most of the errors are equal to 1 and near by 1 so the predicted values can be taken into account.The predicted dependent variables values are good

In [42]:
```
sns.pairplot(comp)
```

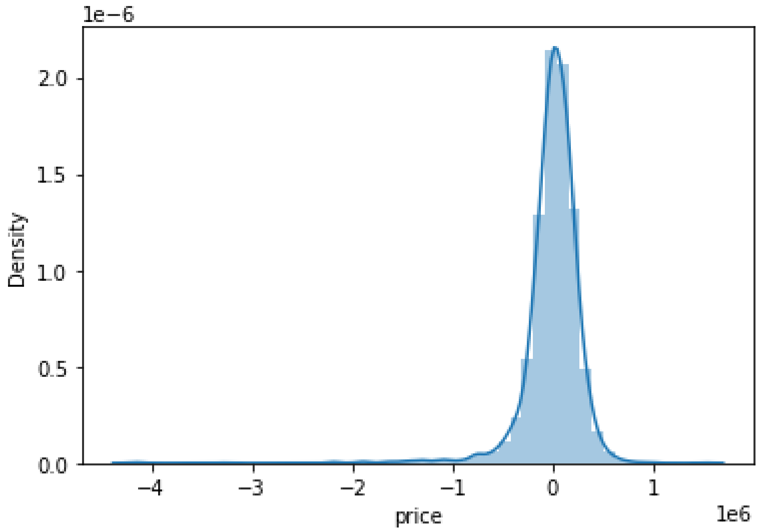
Out[42]: <seaborn.axisgrid.PairGrid at 0x115e4199220>



In [43]:
```
sns.distplot(res)
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated fun
ction and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function
with similar flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

Out[43]: <AxesSubplot:xlabel='price', ylabel='Density'>



In [44]:
```
from sklearn.metrics import mean_squared_error
mean_squared_error(y_test,y_pred)
```

Out[44]: 82680872234.52504

In [45]:
```
mse = np.mean((y_test - y_pred)**2)
mse
```

Out[45]: 82680872234.525

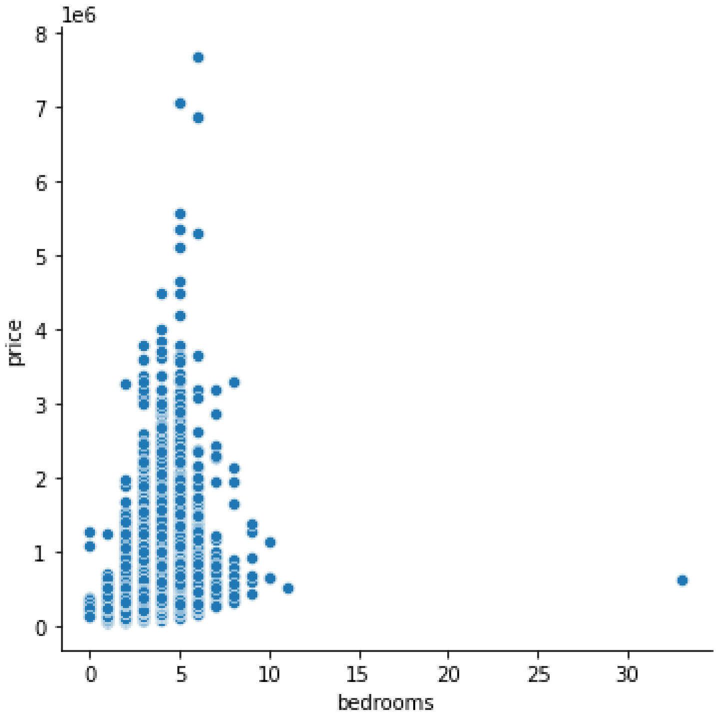
In [46]:
```
rmse= mean_squared_error(y_test,[0 for _ in y_test], squared=False)
rmse
```

Out[46]: 688412.0089742545

Below are just for practice

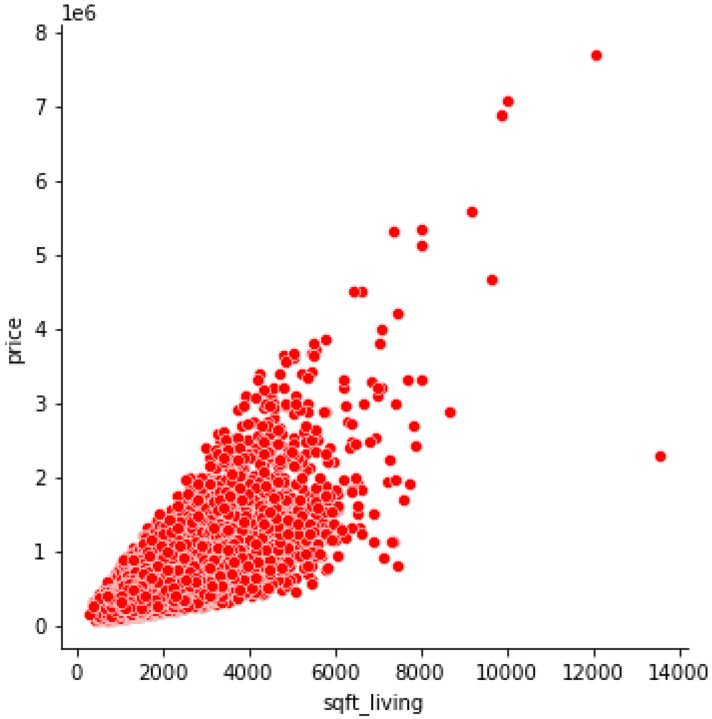
In [47]:
```
sns.relplot(x="bedrooms",y="price",data=house_details)
```

Out[47]: <seaborn.axisgrid.FacetGrid at 0x115ded2a3a0>



In [48]:
```
sns.relplot(x="sqft_living",y="price",color="red",data=house_details)
```

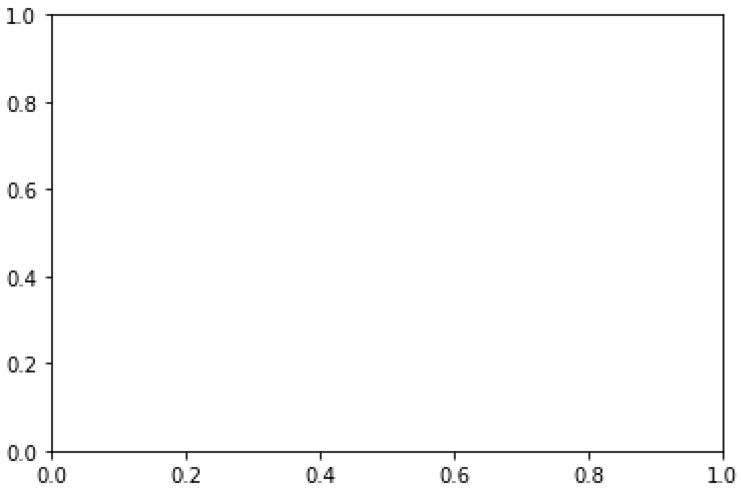
Out[48]: <seaborn.axisgrid.FacetGrid at 0x115de82f2b0>



In [49]:
```
sns.barplot(x="bedrooms",y="price",kind="violin",data=house_details);
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
<ipython-input-49-bd7413dc1e5e> in <module>
----> 1 sns.barplot(x="bedrooms",y="price",kind="violin",data=house_details);

C:\ProgramData\Anaconda3\lib\site-packages\seaborn\_decorators.py in inner_f(*args, **kwargs)
     44             )
     45         kwargs.update({k: arg for k, arg in zip(sig.parameters, args)})
---> 46         return f(**kwargs)
     47     return inner_f
     48 

C:\ProgramData\Anaconda3\lib\site-packages\seaborn\categorical.py in barplot(x, y, hue, data, order, hue_order, estimator, ci, n_boot, units, seed, orient, color, palette, saturation, errcolor, errwidth, capsize, dodge, ax, **kwargs)
   3185         ax = plt.gca()
   3186 
-> 3187     plotter.plot(ax, kwargs)
   3188     return ax
   3189 

C:\ProgramData\Anaconda3\lib\site-packages\seaborn\categorical.py in plot(self, ax, bar_kws)
   1637     def plot(self, ax, bar_kws):
   1638         """Make the plot."""
-> 1639         self.draw_bars(ax, bar_kws)
   1640         self.annotate_axes(ax)
   1641         if self.orient == "h":

C:\ProgramData\Anaconda3\lib\site-packages\seaborn\categorical.py in draw_bars(self, ax, kws)
   1602 
   1603             # Draw the bars
-> 1604             barfunc(barpos, self.statistic, self.width,
   1605                     color=self.colors, align="center", **kws)
   1606 

C:\ProgramData\Anaconda3\lib\site-packages\matplotlib\__init__.py in inner(ax, data, *args, **kwargs)
   1445     def inner(ax, *args, data=None, **kwargs):
   1446         if data is None:
-> 1447             return func(ax, *map(sanitize_sequence, args), **kwargs)
   1448 
```

```
   1449         bound = new_sig.bind(ax, *args, **kwargs)

C:\ProgramData\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py in bar(self, x, height, width, bottom, align, **kwa
rgs)
   2486                 label='_nolegend_',
   2487                 )
-> 2488             r.update(kwargs)
   2489             r.get_path()._interpolation_steps = 100
   2490             if orientation == 'vertical':

C:\ProgramData\Anaconda3\lib\site-packages\matplotlib\artist.py in update(self, props)
    994                     func = getattr(self, f"set_{k}", None)
    995                     if not callable(func):
--> 996                         raise AttributeError(f"{type(self).__name__!r} object "
    997                                              f"has no property {k!r}")
    998                     ret.append(func(v))

AttributeError: 'Rectangle' object has no property 'kind'
```



In [ ]:
```
plt.scatter(x="sqft_living",y="price",color="red",data=house_details);
```

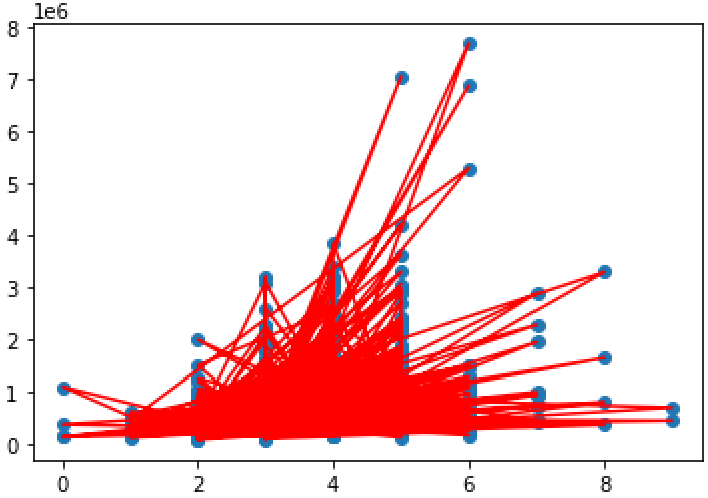
In [ ]:
```
plt.xlabel("actual_price")
plt.ylabel("machine_pred_price")
plt.scatter(comp.actual_price,comp.machine_pred_price)
```

In [ ]:
```
y_pred.intercept_
```

In [ ]:
```
sns.distplot(house_details)
```

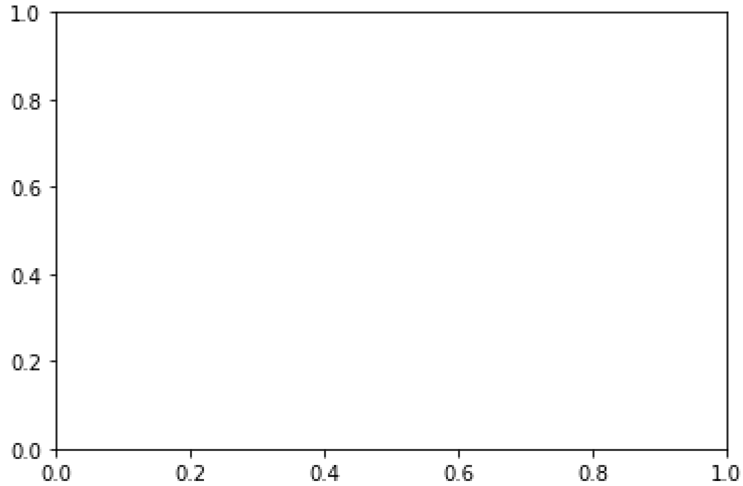
In [68]:
```
k=x_test.bedrooms
```

In [69]:
```
plt.scatter(k,y_test)
plt.plot(k,y_test, color='red')
plt.show()
```



In [53]:
```
plt.plot(x="bedrooms" , y="sqft_living", color='red')
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
<ipython-input-53-6d57da7c7a70> in <module>
----> 1 plt.plot(x="bedrooms" , y="sqft_living", color='red')

C:\ProgramData\Anaconda3\lib\site-packages\matplotlib\pyplot.py in plot(scalex, scaley, data, *args, **kwargs)
   2838 @_copy_docstring_and_deprecators(Axes.plot)
   2839 def plot(*args, scalex=True, scaley=True, data=None, **kwargs):
-> 2840     return gca().plot(
   2841         *args, scalex=scalex, scaley=scaley,
   2842         **({"data": data} if data is not None else {}), **kwargs)

C:\ProgramData\Anaconda3\lib\site-packages\matplotlib\axes\_axes.py in plot(self, scalex, scaley, data, *args, **kwarg
s)
   1741         """
   1742         kwargs = cbook.normalize_kwargs(kwargs, mlines.Line2D)
-> 1743         lines = [*self._get_lines(*args, data=data, **kwargs)]
   1744         for line in lines:
   1745             self.add_line(line)

C:\ProgramData\Anaconda3\lib\site-packages\matplotlib\axes\_base.py in __call__(self, data, *args, **kwargs)
    212         for pos_only in "xy":
    213             if pos_only in kwargs:
--> 214                 raise TypeError("{} got an unexpected keyword argument {!r}"
    215                                 .format(self.command, pos_only))
    216 

TypeError: plot got an unexpected keyword argument 'x'
```



In [ ]: