In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
from scipy.stats import mode
```

In [2]:
```
import os
#data1=os.chdir("C:/Users/SUBHAM/Desktop/Python NA/part3/Python Part 3/Class 16")
os.listdir()
```

Out[2]:
```
['.ipynb_checkpoints', 'housing.ipynb', 'housing.xlsx']
```

1. Load the data :

In [3]:
```
df = pd.read_excel('housing.xlsx')
```

In [4]:
```
df.head()
```

Out[4]:

	longitude	latitude	housing_median_age	total_rooms	total_bedrooms	population	households	median_income	ocean_proximity	median_hou
0	-122.23	37.88	41	880	129.0	322	126	8.3252	NEAR BAY	
1	-122.22	37.86	21	7099	1106.0	2401	1138	8.3014	NEAR BAY	
2	-122.24	37.85	52	1467	190.0	496	177	7.2574	NEAR BAY	
3	-122.25	37.85	52	1274	235.0	558	219	5.6431	NEAR BAY	
4	-122.25	37.85	52	1627	280.0	565	259	3.8462	NEAR BAY	

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

Out[5]:

	longitude	latitude	housing_median_age	total_rooms	total_bedrooms	population	households	median_income	median_h
count	20640.000000	20640.000000	20640.000000	20640.000000	20433.000000	20640.000000	20640.000000	20640.000000	20
mean	-119.569704	35.631861	28.639486	2635.763081	537.870553	1425.476744	499.539680	3.870671	206
std	2.003532	2.135952	12.585558	2181.615252	421.385070	1132.462122	382.329753	1.899822	115
min	-124.350000	32.540000	1.000000	2.000000	1.000000	3.000000	1.000000	0.499900	14
25%	-121.800000	33.930000	18.000000	1447.750000	296.000000	787.000000	280.000000	2.563400	119
50%	-118.490000	34.260000	29.000000	2127.000000	435.000000	1166.000000	409.000000	3.534800	179
75%	-118.010000	37.710000	37.000000	3148.000000	647.000000	1725.000000	605.000000	4.743250	264
max	-114.310000	41.950000	52.000000	39320.000000	6445.000000	35682.000000	6082.000000	15.000100	500

In [49]:
```
X = df.drop(['median_house_value'],axis=1)
Y = df['median_house_value']
```

In [50]:
```
print(X.shape)
print(Y.shape)
```

```
(20640, 9)
(20640,)
```

2. Handle missing values :

In [51]:
```
X.isnull().sum()/X.count()
```

Out[51]:
```
longitude             0.000000
latitude              0.000000
housing_median_age    0.000000
total_rooms           0.000000
total_bedrooms        0.010131
population            0.000000
```

```
households            0.000000
median_income         0.000000
ocean_proximity       0.000000
dtype: float64
```

In [52]:
```
X['total_bedrooms'].mode()
```

Out[52]:
```
0    280.0
dtype: float64
```

In [53]:
```
X['total_bedrooms'] = X['total_bedrooms'].fillna(mode(X['total_bedrooms']).mode[0])
```

3. Encode categorical data :

In [54]:
```
X.dtypes
```

Out[54]:
```
longitude             float64
latitude              float64
housing_median_age      int64
total_rooms             int64
total_bedrooms        float64
population              int64
households              int64
median_income         float64
ocean_proximity        object
dtype: object
```

In [55]:
```
X['ocean_proximity'].unique()
```

Out[55]:
```
array(['NEAR BAY', '<1H OCEAN', 'INLAND', 'NEAR OCEAN', 'ISLAND'],
      dtype=object)
```

In [56]:
```
X['ocean_proximity'].value_counts()
```

Out[56]:
```
<1H OCEAN     9136
INLAND        6551
NEAR OCEAN    2658
NEAR BAY      2290
ISLAND           5
Name: ocean_proximity, dtype: int64
```

In [57]:
```
categorical_data = {'NEAR BAY':1, '<1H OCEAN':2, 'INLAND':3, 'NEAR OCEAN':4, 'ISLAND':5}
```

In [58]:
```
categorical_data
```

Out[58]:
```
{'NEAR BAY': 1, '<1H OCEAN': 2, 'INLAND': 3, 'NEAR OCEAN': 4, 'ISLAND': 5}
```

In [59]:
```
X['ocean_proximity']=X['ocean_proximity'].map(categorical_data)
```

In [ ]:
```

```

In [60]:
```
X.corr()
```

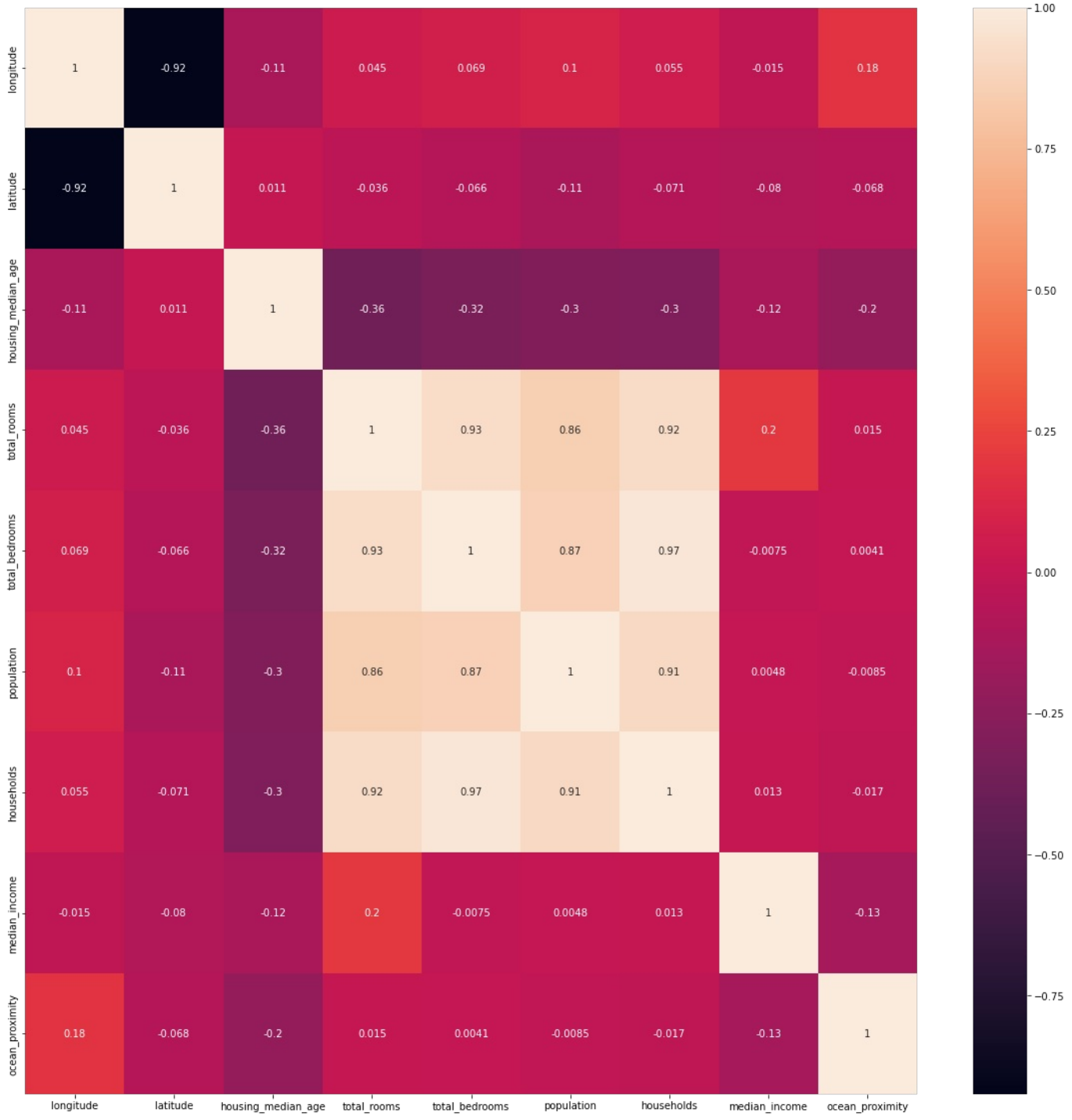
Out[60]:

	longitude	latitude	housing_median_age	total_rooms	total_bedrooms	population	households	median_income	ocean_p
longitude	1.000000	-0.924664	-0.108197	0.044568	0.068831	0.099773	0.055310	-0.015176	
latitude	-0.924664	1.000000	0.011173	-0.036100	-0.066147	-0.108785	-0.071035	-0.079809	-(
housing_median_age	-0.108197	0.011173	1.000000	-0.361262	-0.318710	-0.296244	-0.302916	-0.119034	-(

total_rooms	0.044568	-0.036100	-0.361262	1.000000	0.925723	0.857126	0.918484	0.198050
total_bedrooms	0.068831	-0.066147	-0.318710	0.925723	1.000000	0.871989	0.972731	-0.007511
population	0.099773	-0.108785	-0.296244	0.857126	0.871989	1.000000	0.907222	0.004834
households	0.055310	-0.071035	-0.302916	0.918484	0.972731	0.907222	1.000000	0.013033
median_income	-0.015176	-0.079809	-0.119034	0.198050	-0.007511	0.004834	0.013033	1.000000
ocean_proximity	0.180381	-0.067586	-0.204882	0.014818	0.004094	-0.008511	-0.016911	-0.129135

In [61]:
```
import seaborn as sns
corr=X.corr()
top_features=corr.index
plt.figure(figsize=(20,20))
sns.heatmap(X[top_features].corr(),annot=True)
```

Out[61]: <AxesSubplot:>

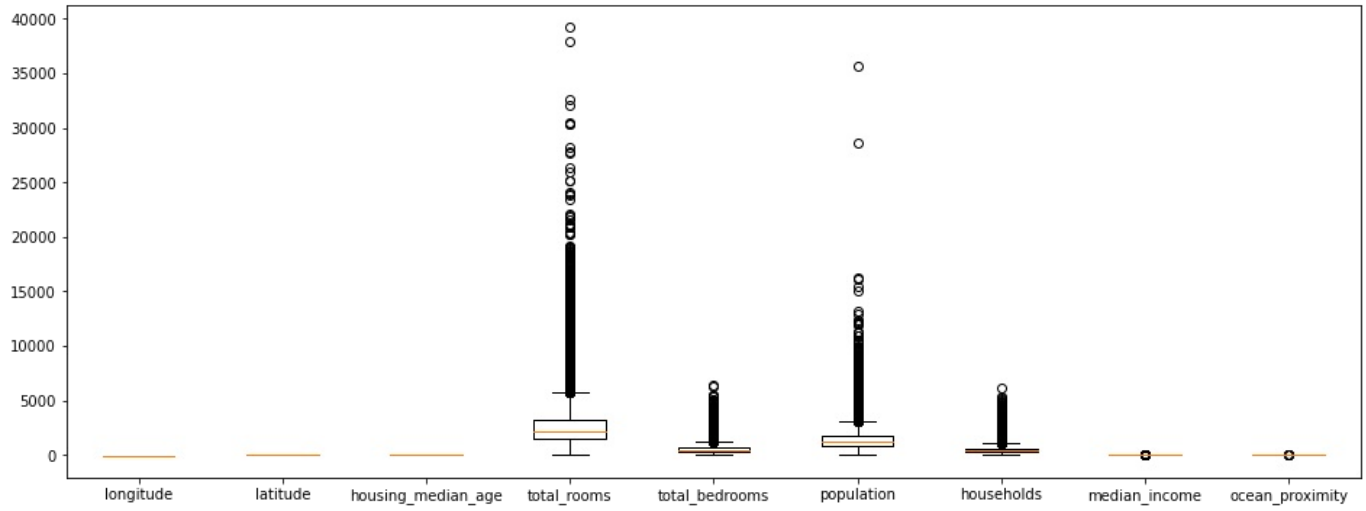


In [62]:
```
#categorical_data=df['ocean_proximity'].value_counts().to_dict()
```

In [63]:
```
X.columns
```

Out[63]:
```
Index(['longitude', 'latitude', 'housing_median_age', 'total_rooms',
       'total_bedrooms', 'population', 'households', 'median_income',
       'ocean_proximity'],
      dtype='object')
```

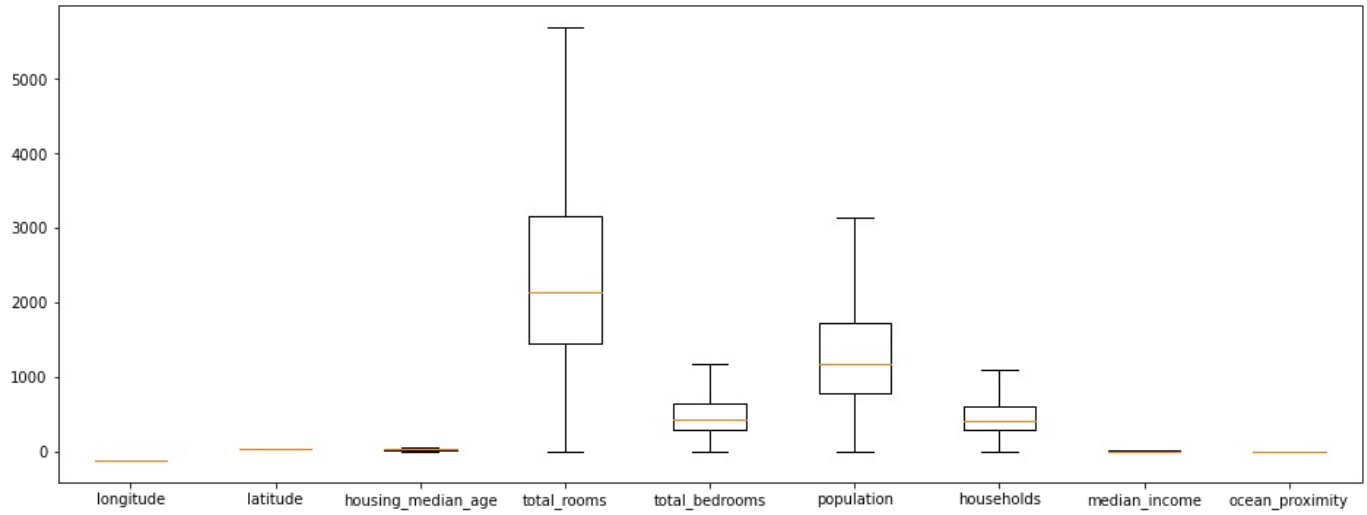
In [64]:
```
plt.figure(figsize=(16,6))
plt.boxplot(X)
plt.xticks((1,2,3,4,5,6,7,8,9),['longitude', 'latitude', 'housing_median_age', 'total_rooms',
       'total_bedrooms', 'population', 'households','median_income','ocean_proximity'])
plt.show()
```



In [65]:
```
columns = ['total_rooms','total_rooms','total_bedrooms', 'population', 'households','median_income','ocean_proxim
```

In [66]:
```
for col in columns:
    Q3 = X[col].quantile(0.75)
    Q1 = X[col].quantile(0.25)
    IQR = Q3 - Q1
    UB = Q3 + 1.5 * IQR
    LB = Q1 - 1.5 * IQR
    X[col]  =  X[col].apply(lambda x: LB if x < LB else x)
    X[col]  = X[col].apply(lambda x: UB if x > UB else x)
```

In [68]:
```
plt.figure(figsize=(16,6))
plt.boxplot(X)
plt.xticks((1,2,3,4,5,6,7,8,9),['longitude', 'latitude', 'housing_median_age', 'total_rooms',
       'total_bedrooms', 'population', 'households','median_income',
       'ocean_proximity'])
plt.show()
```



4. Split the dataset :

In [69]:
```
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=14)
```

In [70]:
```
print('X Train :',x_train.shape)
print('X Test : ',x_test.shape)
print('Y Train : ',y_train.shape)
print('Y test : ',y_test.shape)
```

```
X Train : (16512, 9)
X Test :  (4128, 9)
Y Train :  (16512,)
Y test :  (4128,)
```

5. Standardize data :

In [71]:
```
from sklearn.preprocessing import StandardScaler
```

In [72]:
```
scaler = StandardScaler()
```

In [73]:
```
scaler.fit(x_train)
x_train=scaler.fit_transform(x_train)
```

In [74]:
```
scaler.fit(x_test)
x_test = scaler.fit_transform(x_test)
```

In [ ]:
```

```

6. Perform Linear Regression :

In [75]:
```
from sklearn.linear_model import LinearRegression
model = LinearRegression()
```

In [76]:
```
x_train.dtype
```

Out[76]:
```
dtype('float64')
```

In [77]:
```
model.fit(x_train,y_train)
```

Out[77]:
```
LinearRegression()
```

In [78]:
```
print(model.intercept_)
print(model.coef_)
```

```
207308.80414244178
[-76783.19938087 -83421.69914429  16044.68517787 -25761.18811851
  44429.58854309 -52542.86570188  37930.90619831  79691.47901211
  -1565.85227306]
```

In [79]:
```
pred_train = model.predict(x_train)
pred_test = model.predict(x_test)
```

In [80]:
```
from sklearn.metrics import mean_squared_error
from math import sqrt
```

In [81]:
```
print(sqrt(mean_squared_error(y_train, pred_train)))
```

```
68277.9599224311
```

In [82]:
```
print(sqrt(mean_squared_error(y_test, pred_test)))
```

```
66497.57558296944
```

In [83]:
```
pd.DataFrame({'Actual': y_test, 'Predicted': model.predict(x_test)}).head(10)
```

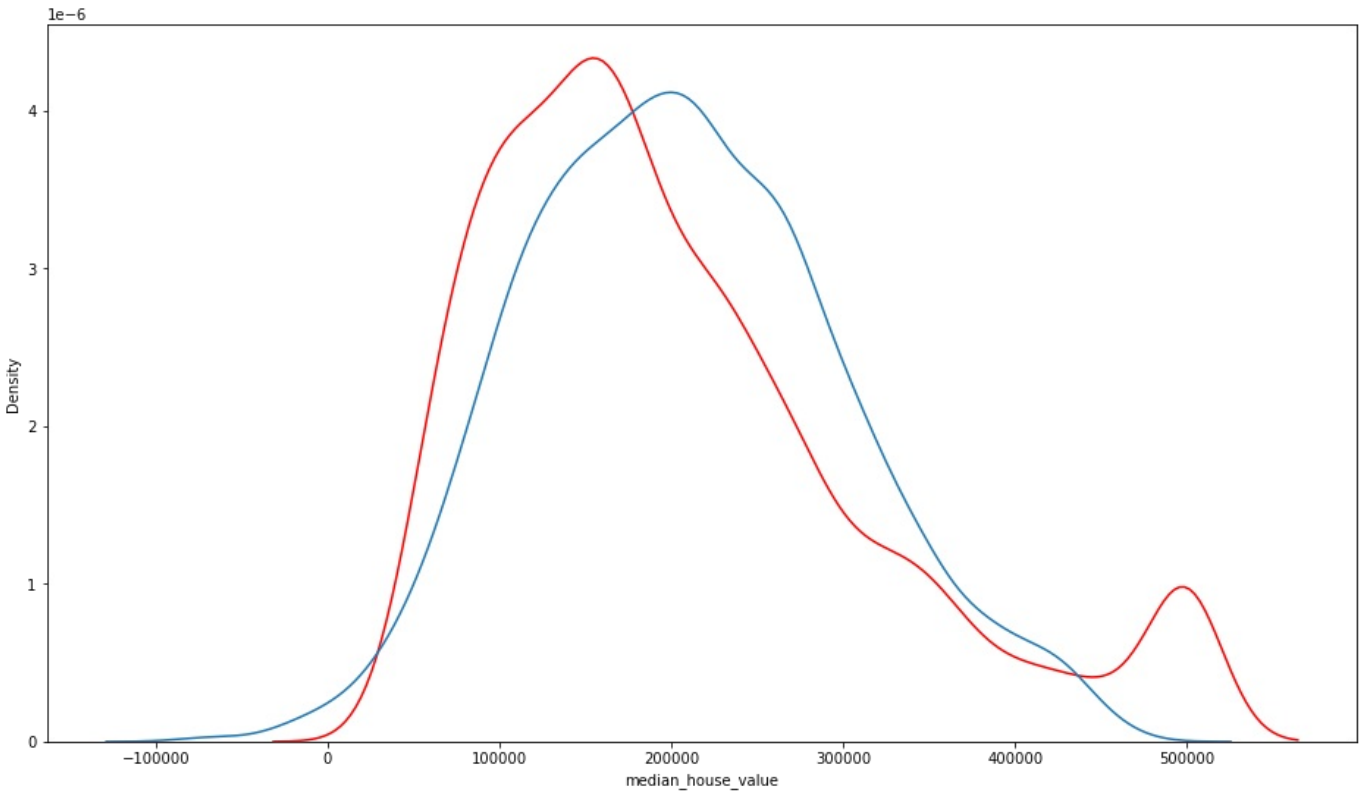
Out[83]:

	Actual	Predicted
15409	162500	195082.290321
17622	238000	299368.227859
13107	91200	107186.510430
12668	109800	95729.848036
18591	350000	279429.074197
7493	97400	148810.198266
8471	180500	249784.100199
5601	165500	232766.084266
17825	257400	145378.570209
10766	455000	224157.455962

In [84]:
```
import seaborn as sns
plt.figure(figsize=(16,9))
sns.distplot(y_test,hist = False,color='r')
sns.distplot(model.predict(x_test),hist = False)
```

```
C:\Users\SUBHAM\anaconda3\envs\new_base\lib\site-packages\seaborn\distributions.py:2619: FutureWarning: `distplot
` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot
` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plot
s).
  warnings.warn(msg, FutureWarning)
C:\Users\SUBHAM\anaconda3\envs\new_base\lib\site-packages\seaborn\distributions.py:2619: FutureWarning: `distplot
` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot
` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plot
s).
  warnings.warn(msg, FutureWarning)
```

Out[84]:
```
<AxesSubplot:xlabel='median_house_value', ylabel='Density'>
```



In [85]:
```
from sklearn import metrics
metrics.r2_score(y_test,pred_test)
```

Out[85]:
```
0.6576127956856676
```

7. Bonus exercise: Perform Linear Regression with one independent variable :

In [86]:
```
x_bonus = X.drop(['median_income'],axis=1)
y_bonus = X.median_income
```

In [87]:
```
xtrain,xtest,ytrain,ytest = train_test_split(x_bonus,y_bonus,test_size=.2,random_state=14)
```

In [88]:
```
scaler.fit(xtrain)
scaler.fit(xtest)
xtrain = scaler.fit_transform(xtrain)
xtest = scaler.fit_transform(xtest)
```

In [89]:
```
model.fit(xtrain,ytrain)
```

Out[89]:
```
LinearRegression()
```

In [90]:
```
pred_bo_train = model.predict(xtrain)
pred_bo_test = model.predict(xtest)
```

In [91]:
```
print(sqrt(mean_squared_error(ytrain, pred_bo_train)))
```

```
1.1271193580457823
```

In [92]:
```
print(sqrt(mean_squared_error(ytest, pred_bo_test)))
```

```
1.1686377236294792
```

In [93]:
```
pd.DataFrame({'Actual': ytest, 'Predicted': model.predict(xtest)}).head(10)
```

Out[93]:

	Actual	Predicted
15409	4.1316	4.637184
17622	4.9236	4.279059
13107	3.3281	3.115844
12668	2.7262	3.447507
18591	4.7188	4.163442
7493	2.4464	3.468943
8471	4.2083	3.844784
5601	4.0000	3.674487
17825	5.3400	10.073512
10766	3.2125	4.033937

In [94]:
```
from sklearn import metrics
metrics.r2_score(ytest,pred_bo_test)
```

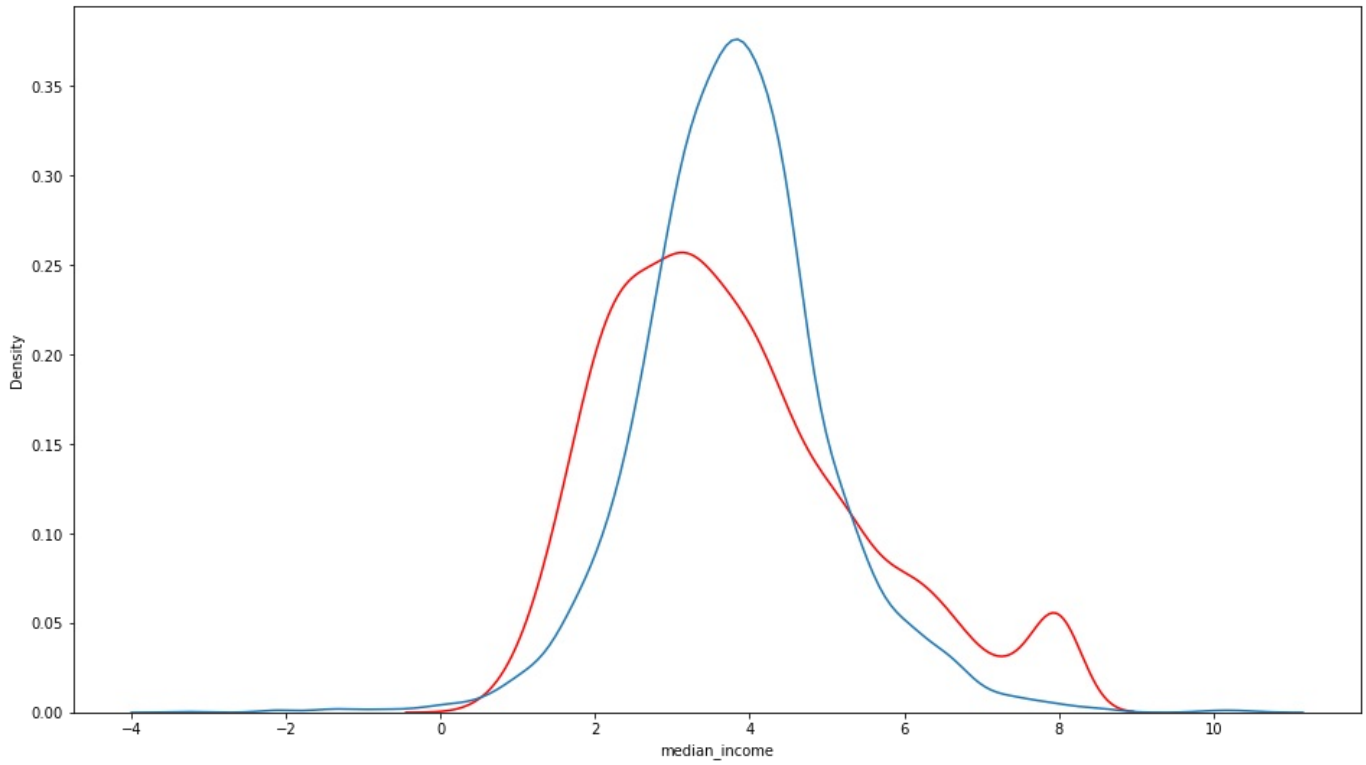
Out[94]:
```
0.5096475809291172
```

In [95]:
```
import seaborn as sns
```

```
plt.figure(figsize=(16,9))
sns.distplot(ytest,hist = False,color='r')
sns.distplot(model.predict(xtest),hist = False)
```

```
C:\Users\SUBHAM\anaconda3\envs\new_base\lib\site-packages\seaborn\distributions.py:2619: FutureWarning: `distplot
` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot
` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plot
s).
  warnings.warn(msg, FutureWarning)
C:\Users\SUBHAM\anaconda3\envs\new_base\lib\site-packages\seaborn\distributions.py:2619: FutureWarning: `distplot
` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot
` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plot
s).
  warnings.warn(msg, FutureWarning)
```

Out[95]: <AxesSubplot:xlabel='median_income', ylabel='Density'>



In [ ]: