```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

```
df = pd.read_csv("/content/USA_Housing.csv")
df.head()
```

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Ad
0	79545.458574	5.682861	7.009188	4.09	23086.800503	1.059034e+06	208 Michael Fer 674\nLaurabu
1	79248.642455	6.002900	6.730821	3.09	40173.072174	1.505891e+06	188 Johnson Suite 079\ Kathleen
2	61287.067179	5.865890	8.512727	5.13	36882.159400	1.058988e+06	9127 Eliz Stravenue\nDanie WI 06
3	63345.240046	7.188236	5.586729	3.26	34310.242831	1.260617e+06	USS Barnett\nFl
4	59982.197226	5.040555	7.839388	4.23	26354.109472	6.309435e+05	USNS Raymond\ AE

Next steps: View recommended plots

```
df.info(verbose=True)
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5000 entries, 0 to 4999
Data columns (total 7 columns):
 #   Column                        Non-Null Count  Dtype  
---  ------                        --------------  -----  
 0   Avg. Area Income              5000 non-null   float64
 1   Avg. Area House Age           5000 non-null   float64
 2   Avg. Area Number of Rooms     5000 non-null   float64
 3   Avg. Area Number of Bedrooms  5000 non-null   float64
 4   Area Population               5000 non-null   float64
 5   Price                         5000 non-null   float64
 6   Address                       5000 non-null   object 
```

```
dtypes: float64(6), object(1)
memory usage: 273.6+ KB
```

```
df.describe(percentiles=[0.1,0.25,0.5,0.75,0.9])
```

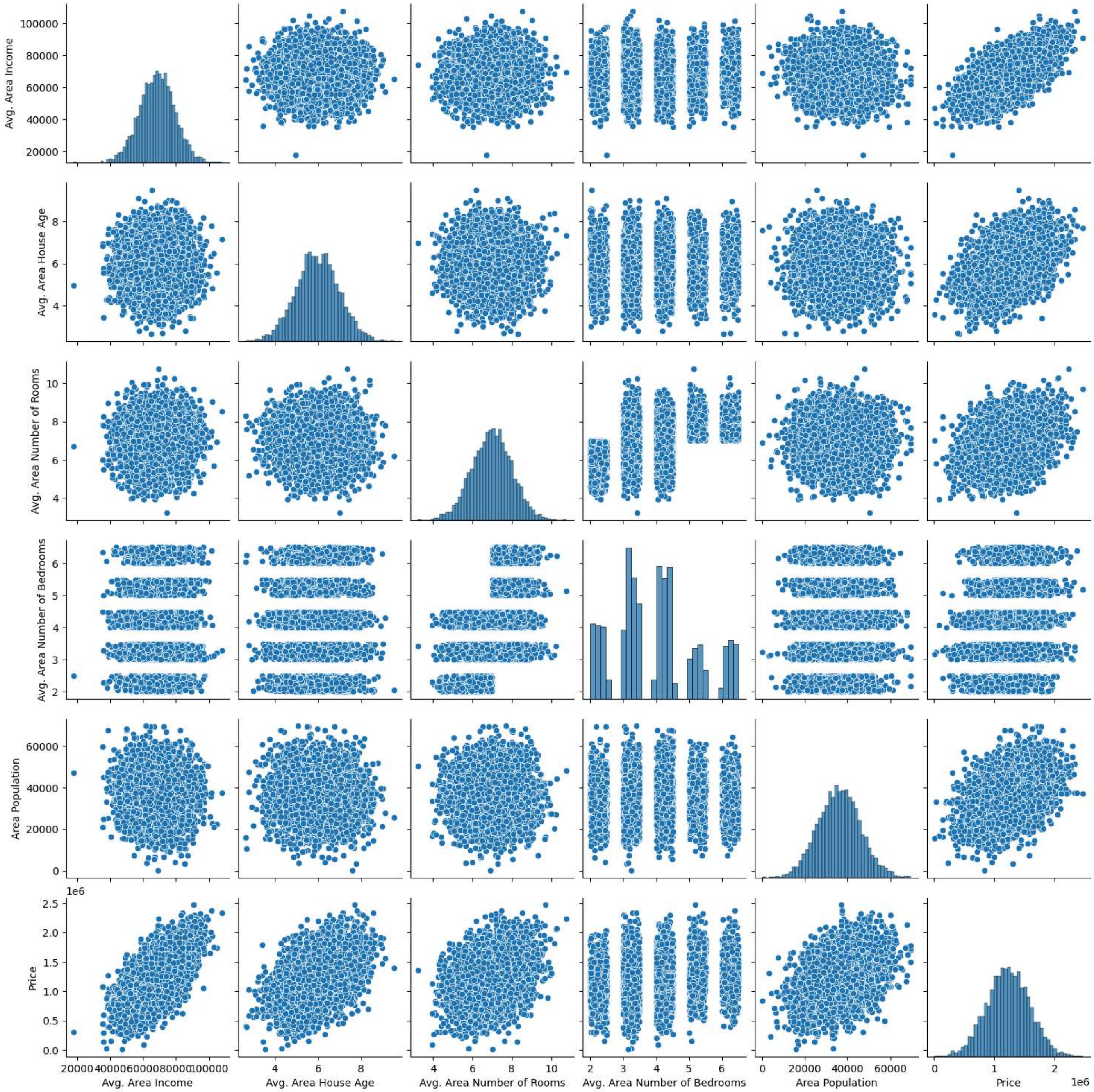
	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price
count	5000.000000	5000.000000	5000.000000	5000.000000	5000.000000	5.000000e+03
mean	68583.108984	5.977222	6.987792	3.981330	36163.516039	1.232073e+06
std	10657.991214	0.991456	1.005833	1.234137	9925.650114	3.531176e+05
min	17796.631190	2.644304	3.236194	2.000000	172.610686	1.593866e+04
10%	55047.633980	4.697755	5.681951	2.310000	23502.845262	7.720318e+05
25%	61480.562388	5.322283	6.299250	3.140000	29403.928702	9.975771e+05
50%	68804.286404	5.970429	7.002902	4.050000	36199.406689	1.232669e+06
75%	75783.338666	6.650808	7.665871	4.490000	42861.290769	1.471210e+06
90%	82081.188283	7.243978	8.274222	6.100000	48813.618633	1.684621e+06
max	107701.748378	9.519088	10.759588	6.500000	69621.713378	2.469066e+06

```
df.columns
```

```
Index(['Avg. Area Income', 'Avg. Area House Age', 'Avg. Area Number of Rooms',
       'Avg. Area Number of Bedrooms', 'Area Population', 'Price', 'Address'],
      dtype='object')
```

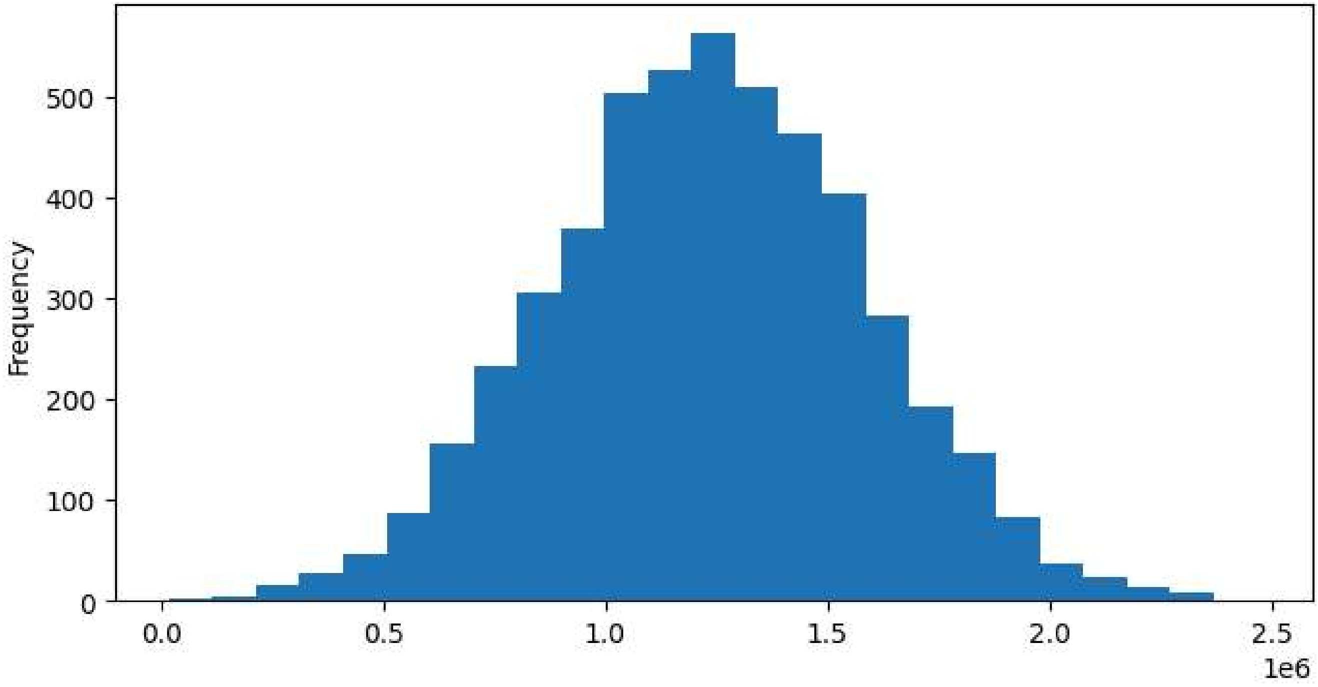
```
sns.pairplot(df)
```

```
<seaborn.axisgrid.PairGrid at 0x7d5716c02680>
```



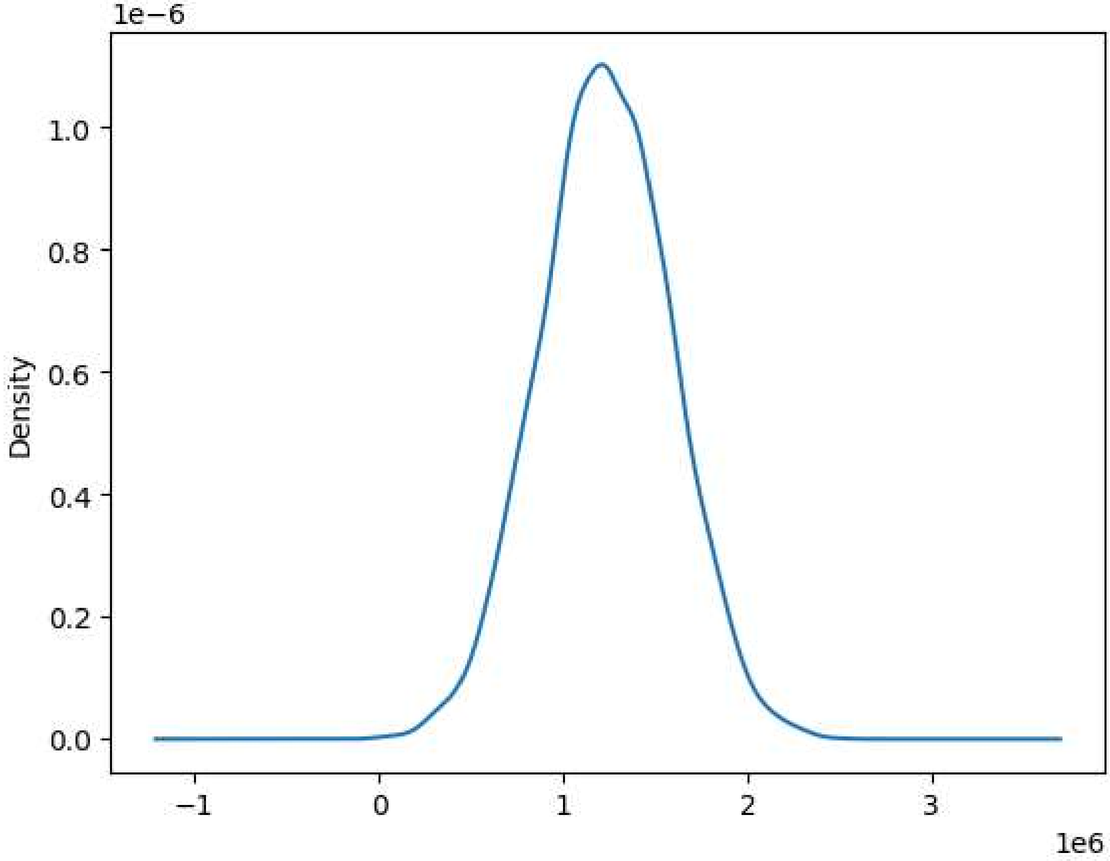
```
df['Price'].plot.hist(bins=25,figsize=(8,4))
```

```
<Axes: ylabel='Frequency'>
```



```
df['Price'].plot.density()
```

```
<Axes: ylabel='Density'>
```



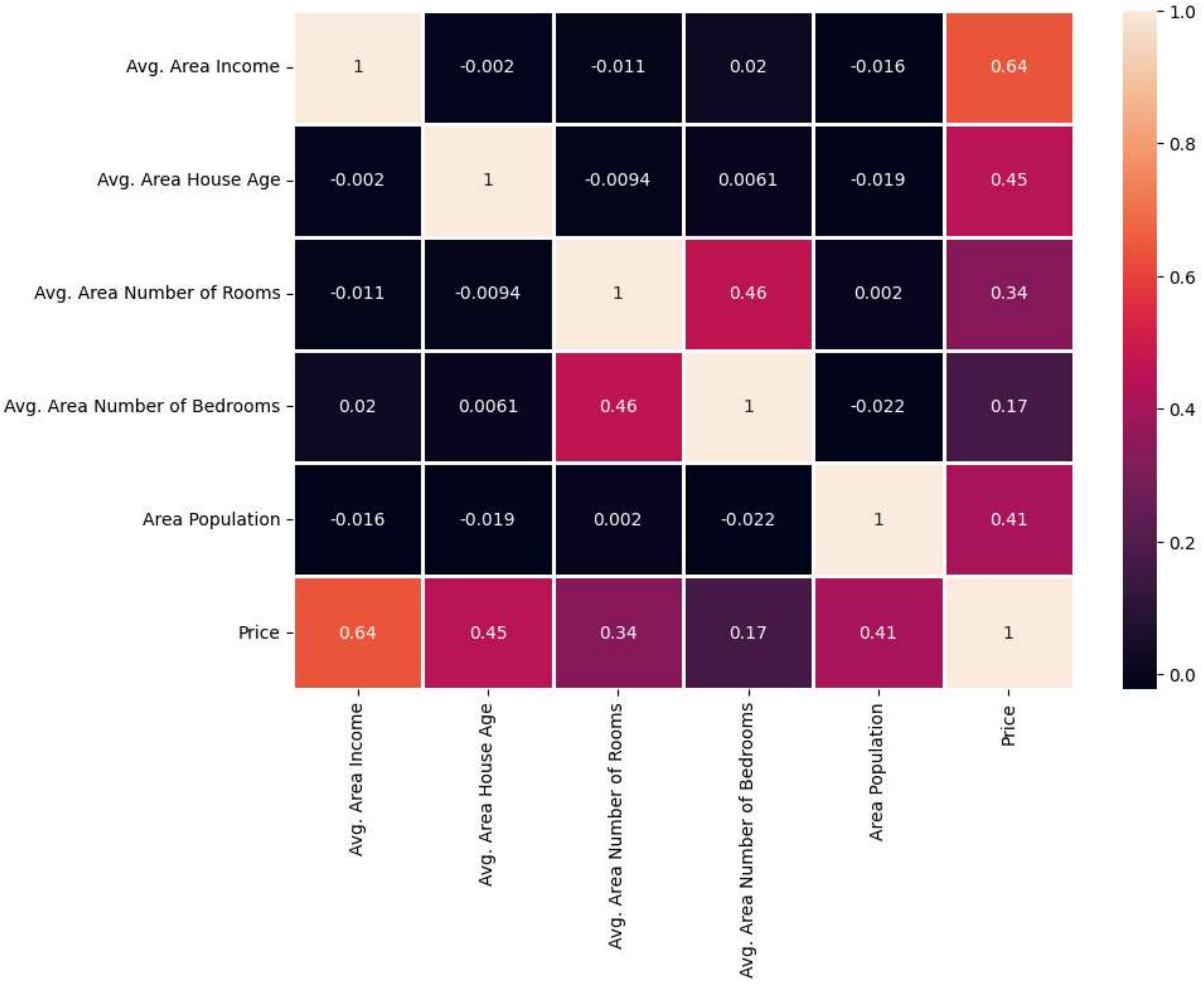
```
df.corr()
```

```
<ipython-input-9-2f6f6606aa2c>:1: FutureWarning: The default value of numeric_only in D
  df.corr()
```

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price
Avg. Area Income	1.000000	-0.002007	-0.011032	0.019788	-0.016234	0.639734
Avg. Area House Age	-0.002007	1.000000	-0.009428	0.006149	-0.018743	0.452543
Avg. Area Number of Rooms	-0.011032	-0.009428	1.000000	0.462695	0.002040	0.335664
Avg. Area Number of Bedrooms	0.019788	0.006149	0.462695	1.000000	-0.022168	0.171071
Area Population	-0.016234	-0.018743	0.002040	-0.022168	1.000000	0.408556
Price	0.639734	0.452543	0.335664	0.171071	0.408556	1.000000

```
plt.figure(figsize=(10,7))
sns.heatmap(df.corr(),annot=True,linewidths=2)
```

```
<ipython-input-10-73d88c5a3f1a>:2: FutureWarning: The default value of numeric_only in
  sns.heatmap(df.corr(),annot=True,linewidths=2)
<Axes: >
```



```
l_column = list(df.columns) # Making a list out of column names
len_feature = len(l_column) # Length of column vector list
l_column
```

```
['Avg. Area Income',
 'Avg. Area House Age',
 'Avg. Area Number of Rooms',
 'Avg. Area Number of Bedrooms',
 'Area Population',
 'Price',
 'Address']
```

```
X = df[l_column[0:len_feature-2]]
y = df[l_column[len_feature-2]]
```

```
print("Feature set size:",X.shape)
print("Variable set size:",y.shape)
```

```
Feature set size: (5000, 5)
Variable set size: (5000,)
```

```
X.head()
```

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population
0	79545.458574	5.682861	7.009188	4.09	23086.800503
1	79248.642455	6.002900	6.730821	3.09	40173.072174
2	61287.067179	5.865890	8.512727	5.13	36882.159400
3	63345.240046	7.188236	5.586729	3.26	34310.242831
4	59982.197226	5.040555	7.839388	4.23	26354.109472

Next steps: View recommended plots

```
y.head()
```

```
0    1.059034e+06
1    1.505891e+06
2    1.058988e+06
3    1.260617e+06
4    6.309435e+05
Name: Price, dtype: float64
```

```
from sklearn.model_selection import train_test_split
```

```
X_train, X_test, y_train, y_test = train_test_split(X, y,test_size=0.3, random_state=123)
```

```
print("Training feature set size:",X_train.shape)
print("Test feature set size:",X_test.shape)
print("Training variable set size:",y_train.shape)
print("Test variable set size:",y_test.shape)
```

```
Training feature set size: (3500, 5)
Test feature set size: (1500, 5)
Training variable set size: (3500,)
Test variable set size: (1500,)
```

```
from sklearn.linear_model import LinearRegression
from sklearn import metrics
```

```
lm = LinearRegression()
```

```
lm.fit(X_train,y_train)
```

```
▾ LinearRegression
LinearRegression()
```

```
print("The intercept term of the linear model:", lm.intercept_)
```

```
The intercept term of the linear model: -2631028.9017454907
```

```
print("The coefficients of the linear model:", lm.coef_)
```

```
The coefficients of the linear model: [2.15976020e+01 1.65201105e+05 1.19061464e+05 3.2
 1.52281212e+01]
```

```
#idict = {'Coefficients':lm.intercept_}
#idf = pd.DataFrame(data=idict,index=['Intercept'])
cdf = pd.DataFrame(data=lm.coef_, index=X_train.columns, columns=["Coefficients"])
#cdf=pd.concat([idf,cdf], axis=0)
cdf
```

	Coefficients
Avg. Area Income	21.597602
Avg. Area House Age	165201.104954
Avg. Area Number of Rooms	119061.463868
Avg. Area Number of Bedrooms	3212.585606
Area Population	15.228121

Next steps: View recommended plots

```
n=X_train.shape[0]
k=X_train.shape[1]
dfN = n-k
train_pred=lm.predict(X_train)
train_error = np.square(train_pred - y_train)
sum_error=np.sum(train_error)
se=[0,0,0,0,0]
for i in range(k):
  r = (sum_error/dfN)
  r = r/np.sum(np.square(X_train[
      list(X_train.columns)[i]]-X_train[list(X_train.columns)[i]].mean()))
    se[i]=np.sqrt(r)
  cdf['Standard Error']=se
  cdf['t-statistic']=cdf['Coefficients']/cdf['Standard Error']
  cdf
```

	Coefficients	Standard Error	t-statistic
Avg. Area Income	21.597602	0.160361	134.681505
Avg. Area House Age	165201.104954	1722.412068	95.912649
Avg. Area Number of Rooms	119061.463868	1696.546476	70.178722
Avg. Area Number of Bedrooms	3212.585606	1376.451759	2.333962
Area Population	15.228121	0.169882	89.639472

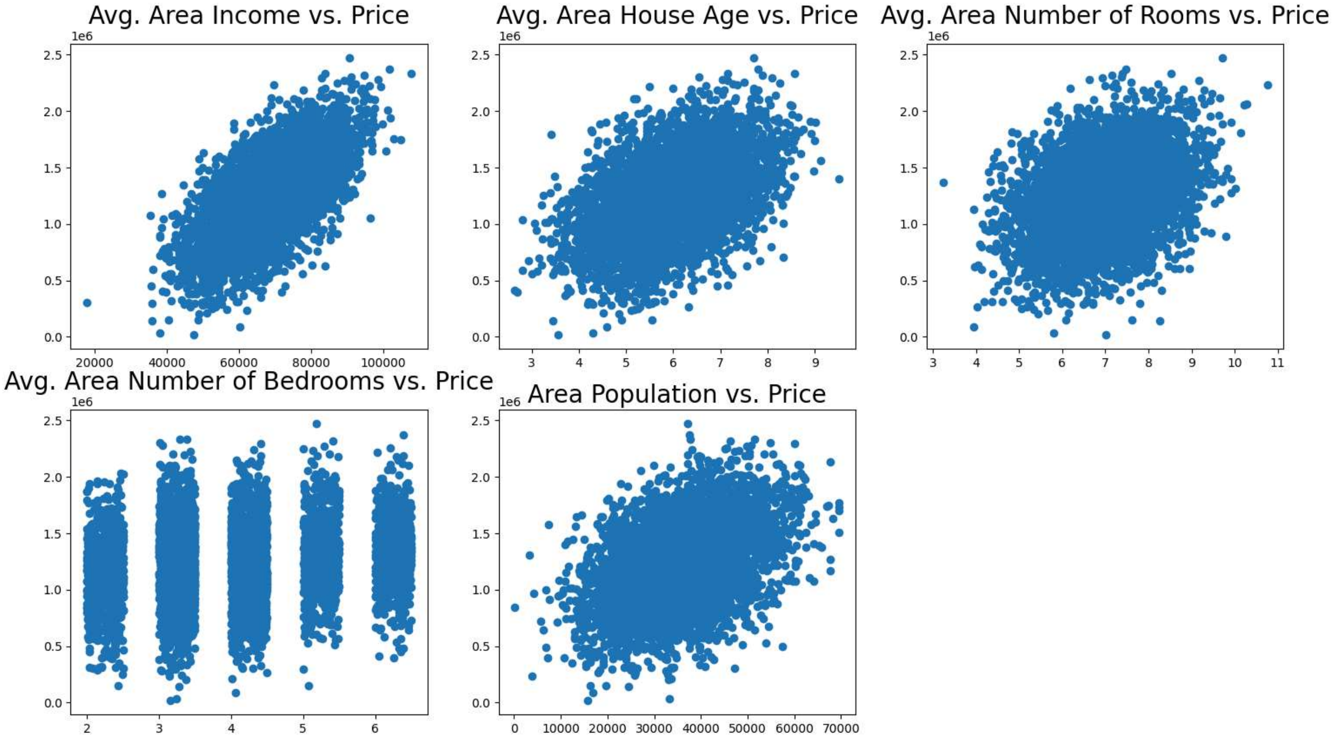
Next steps: View recommended plots

```
print("Therefore, features arranged in the order of importance for predicting the house pri
l=list(cdf.sort_values('t-statistic',ascending=False).index)
print(' > \n'.join(l))
```

```
Therefore, features arranged in the order of importance for predicting the house price
Avg. Area Income >
Avg. Area House Age >
Area Population >
Avg. Area Number of Rooms >
Avg. Area Number of Bedrooms
```

```
l=list(cdf.index)
from matplotlib import gridspec
fig = plt.figure(figsize=(18, 10))
gs = gridspec.GridSpec(2,3)
#f, ax = plt.subplots(nrows=1,ncols=len(l), sharey=True)
ax0 = plt.subplot(gs[0])
ax0.scatter(df[l[0]],df['Price'])
ax0.set_title(l[0]+" vs. Price", fontdict={'fontsize':20})
ax1 = plt.subplot(gs[1])
ax1.scatter(df[l[1]],df['Price'])
ax1.set_title(l[1]+" vs. Price",fontdict={'fontsize':20})
ax2 = plt.subplot(gs[2])
ax2.scatter(df[l[2]],df['Price'])
ax2.set_title(l[2]+" vs. Price",fontdict={'fontsize':20})
ax3 = plt.subplot(gs[3])
ax3.scatter(df[l[3]],df['Price'])
ax3.set_title(l[3]+" vs. Price",fontdict={'fontsize':20})
ax4 = plt.subplot(gs[4])
ax4.scatter(df[l[4]],df['Price'])
ax4.set_title(l[4]+" vs. Price",fontdict={'fontsize':20})
```

```
Text(0.5, 1.0, 'Area Population vs. Price')
```



```
print("R-squared value of this fit:",round(metrics.r2_score(y_train,train_pred),3))
```

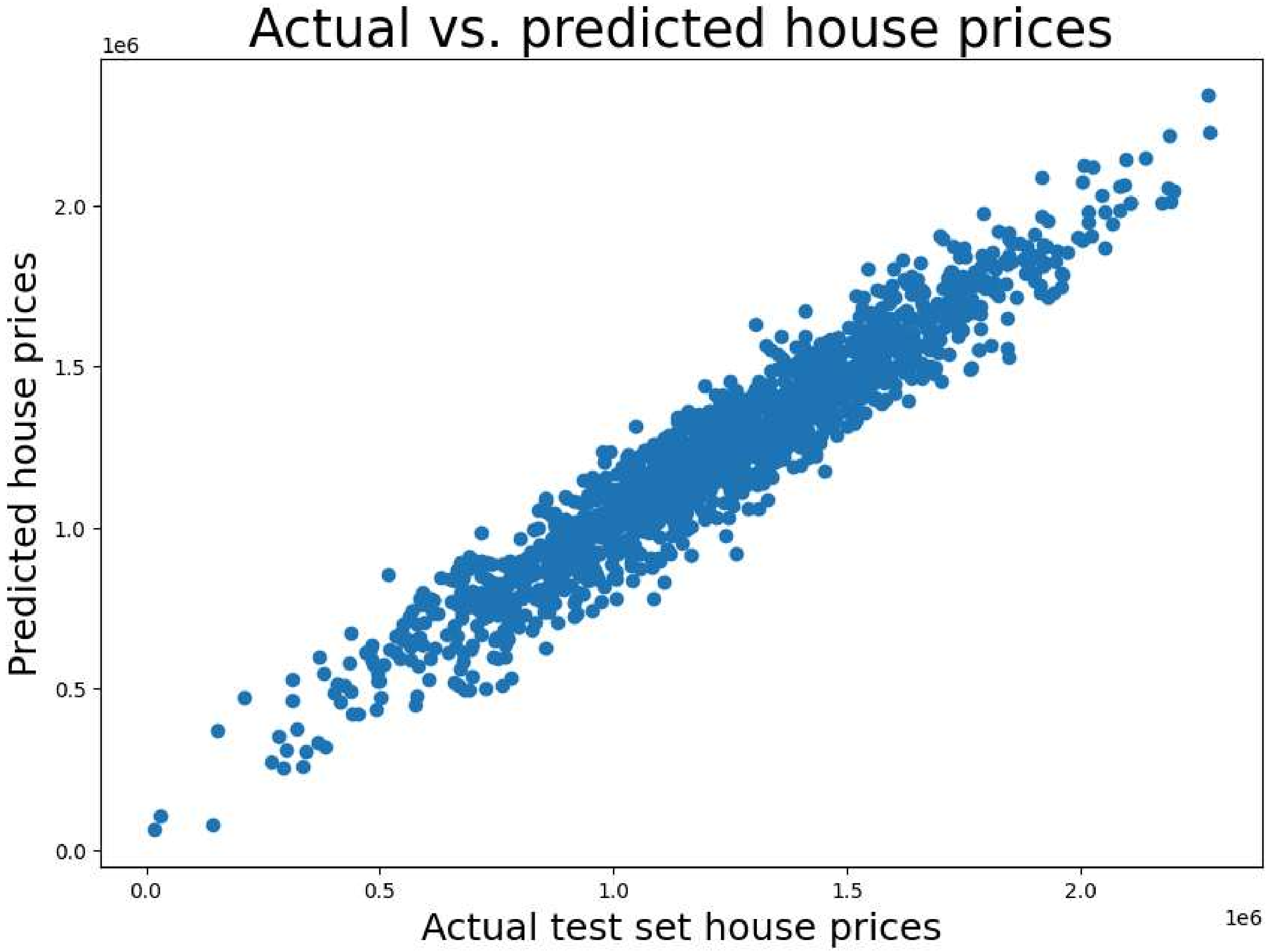
```
    R-squared value of this fit: 0.917
```

```
predictions = lm.predict(X_test)
print ("Type of the predicted object:", type(predictions))
print ("Size of the predicted object:", predictions.shape)
```

```
    Type of the predicted object: <class 'numpy.ndarray'>
    Size of the predicted object: (1500,)
```

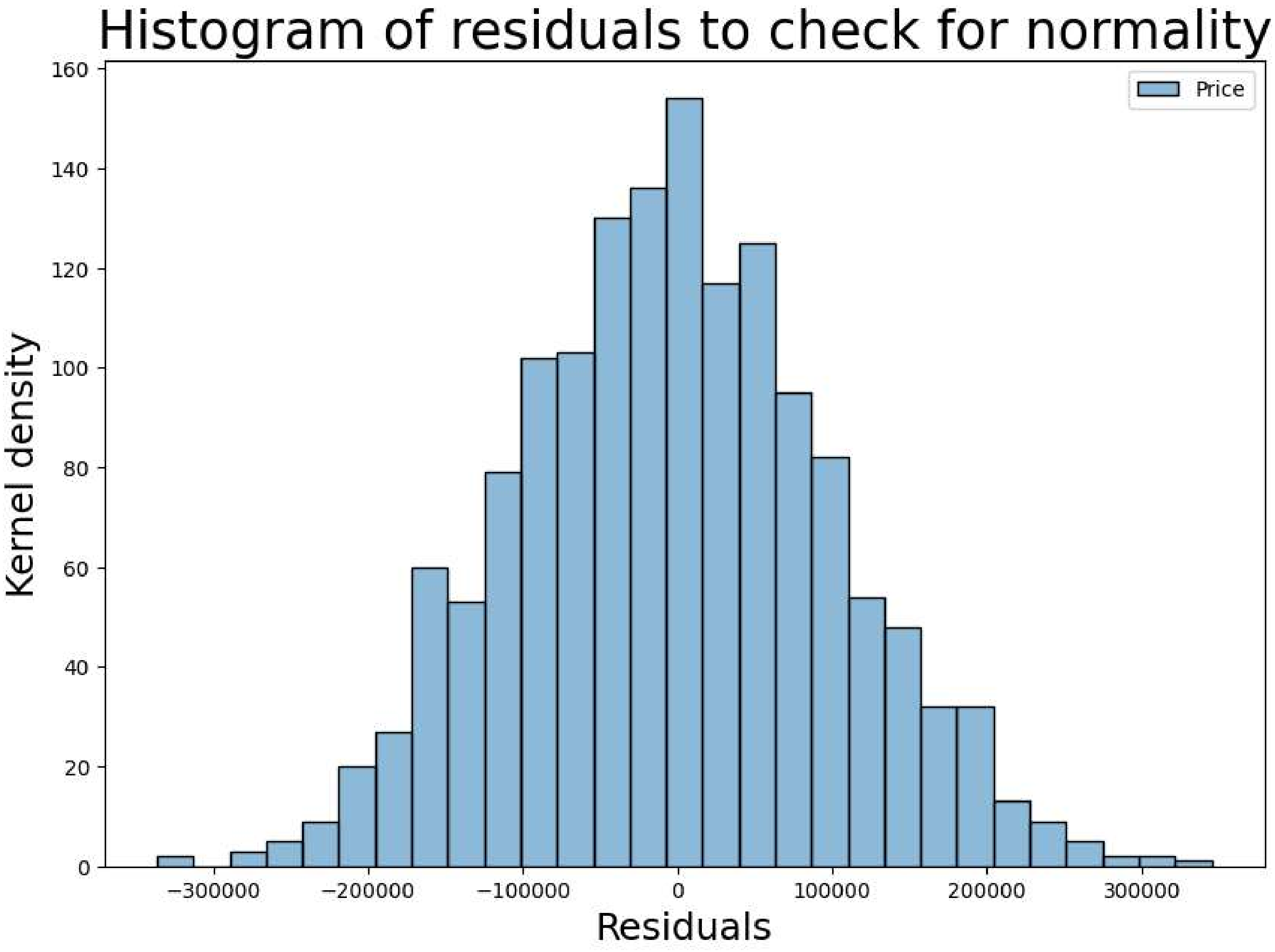
```
plt.figure(figsize=(10,7))
plt.title("Actual vs. predicted house prices",fontsize=25)
plt.xlabel("Actual test set house prices",fontsize=18)
plt.ylabel("Predicted house prices", fontsize=18)
plt.scatter(x=y_test,y=predictions)
```

```
<matplotlib.collections.PathCollection at 0x7d570dd26f50>
```



```
plt.figure(figsize=(10,7))
plt.title("Histogram of residuals to check for normality",fontsize=25)
plt.xlabel("Residuals",fontsize=18)
plt.ylabel("Kernel density", fontsize=18)
sns.histplot([y_test-predictions])
```

```
<Axes: title={'center': 'Histogram of residuals to check for normality'},
xlabel='Residuals', ylabel='Kernel density'>
```



```
plt.figure(figsize=(10,7))
plt.title("Residuals vs. predicted values plot (Homoscedasticity)\n",fontsize=25)
plt.xlabel("Predicted house prices",fontsize=18)
plt.ylabel("Residuals", fontsize=18)
plt.scatter(x=predictions,y=y_test-predictions)
```

```
<matplotlib.collections.PathCollection at 0x7d570dac1840>
```

Residuals vs. predicted values plot (Homoscedasticity)