MultipleLinearRegression

December 5, 2023

0.1 House Price Prediction

0.1.1 Import

[1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error
from sklearn.model_selection import train_test_split
```

[2]:

```
df = pd.read_csv('housing_price_dataset.csv')
df.head(5)
```

[2]:

```
   SquareFeet  Bedrooms  Bathrooms Neighborhood  YearBuilt          Price
0        2126         4          1        Rural       1969  215355.283618
1        2459         3          2        Rural       1980  195014.221626
2        1860         2          1       Suburb       1970  306891.012076
3        2294         2          1        Urban       1996  206786.787153
4        2130         5          2       Suburb       2001  272436.239065
```

0.1.2 Data Cleaning

[3]:

```
df.shape
```

[3]:

```
(50000, 6)
```

[4]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 50000 entries, 0 to 49999
Data columns (total 6 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   SquareFeet    50000 non-null  int64
 1   Bedrooms      50000 non-null  int64
 2   Bathrooms     50000 non-null  int64
 3   Neighborhood  50000 non-null  object
 4   YearBuilt     50000 non-null  int64
 5   Price         50000 non-null  float64
dtypes: float64(1), int64(4), object(1)
memory usage: 2.3+ MB
```

[5]:

```
df.describe()
```

[5]:

```
         SquareFeet      Bedrooms     Bathrooms     YearBuilt          Price
count  50000.000000  50000.000000  50000.000000  50000.000000   50000.000000
mean    2006.374680      3.498700      1.995420   1985.404420  224827.325151
std      575.513241      1.116326      0.815851     20.719377   76141.842966
min     1000.000000      2.000000      1.000000   1950.000000  -36588.165397
25%     1513.000000      3.000000      1.000000   1967.000000  169955.860225
50%     2007.000000      3.000000      2.000000   1985.000000  225052.141166
75%     2506.000000      4.000000      3.000000   2003.000000  279373.630052
max     2999.000000      5.000000      3.000000   2021.000000  492195.259972
```

[6]:

```
df.dropna()
```

[6]:

```
       SquareFeet  Bedrooms  Bathrooms Neighborhood  YearBuilt          Price
0            2126         4          1        Rural       1969  215355.283618
1            2459         3          2        Rural       1980  195014.221626
2            1860         2          1       Suburb       1970  306891.012076
3            2294         2          1        Urban       1996  206786.787153
4            2130         5          2       Suburb       2001  272436.239065
…               …         …          …          …          …              …
49995        1282         5          3        Rural       1975  100080.865895
49996        2854         2          2       Suburb       1988  374507.656727
49997        2979         5          3       Suburb       1962  384110.555590
49998        2596         5          2        Rural       1984  380512.685957
49999        1572         5          3        Rural       2011  221618.583218

[50000 rows x 6 columns]
```

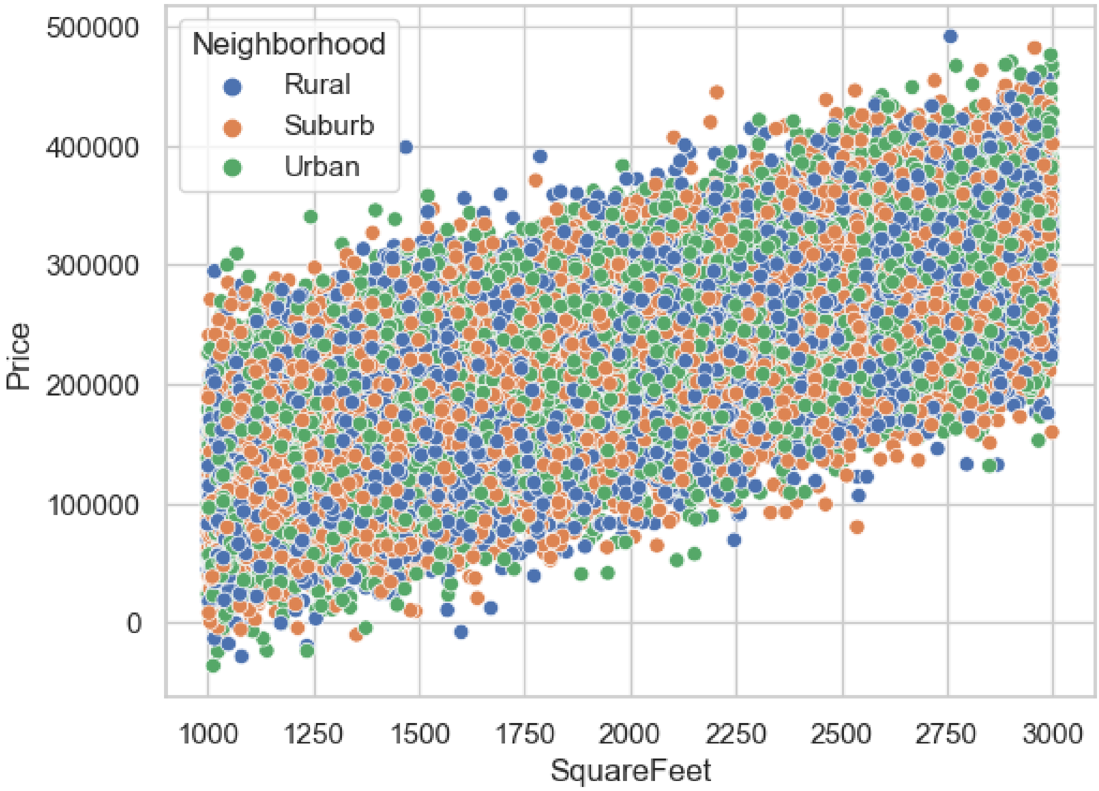
0.1.3 Visualization

[7]:

```
sns.set(style = 'whitegrid')
sns.scatterplot(x = 'SquareFeet', y = 'Price', data = df, hue = 'Neighborhood')
```

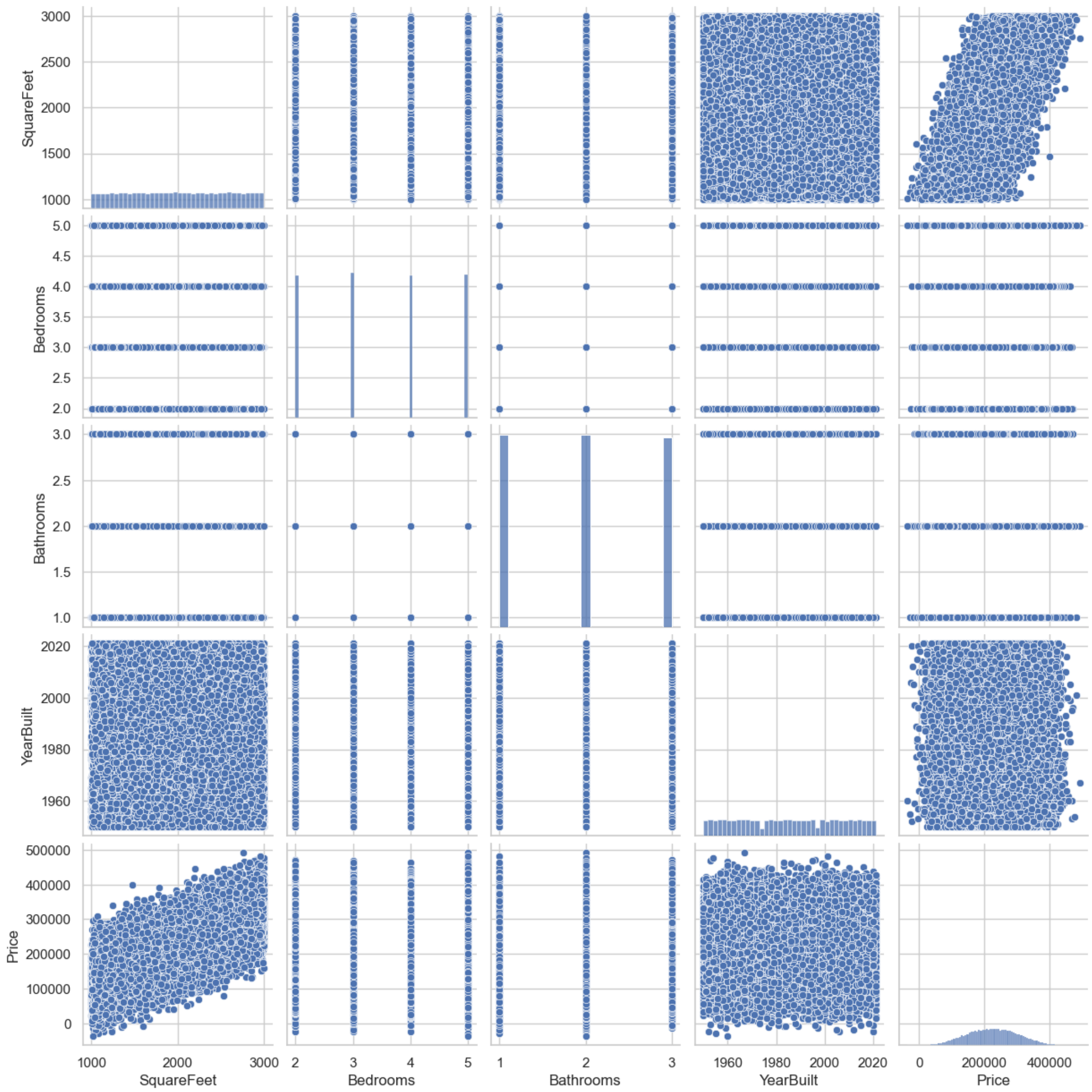
[7]:

```
<Axes: xlabel='SquareFeet', ylabel='Price'>
```



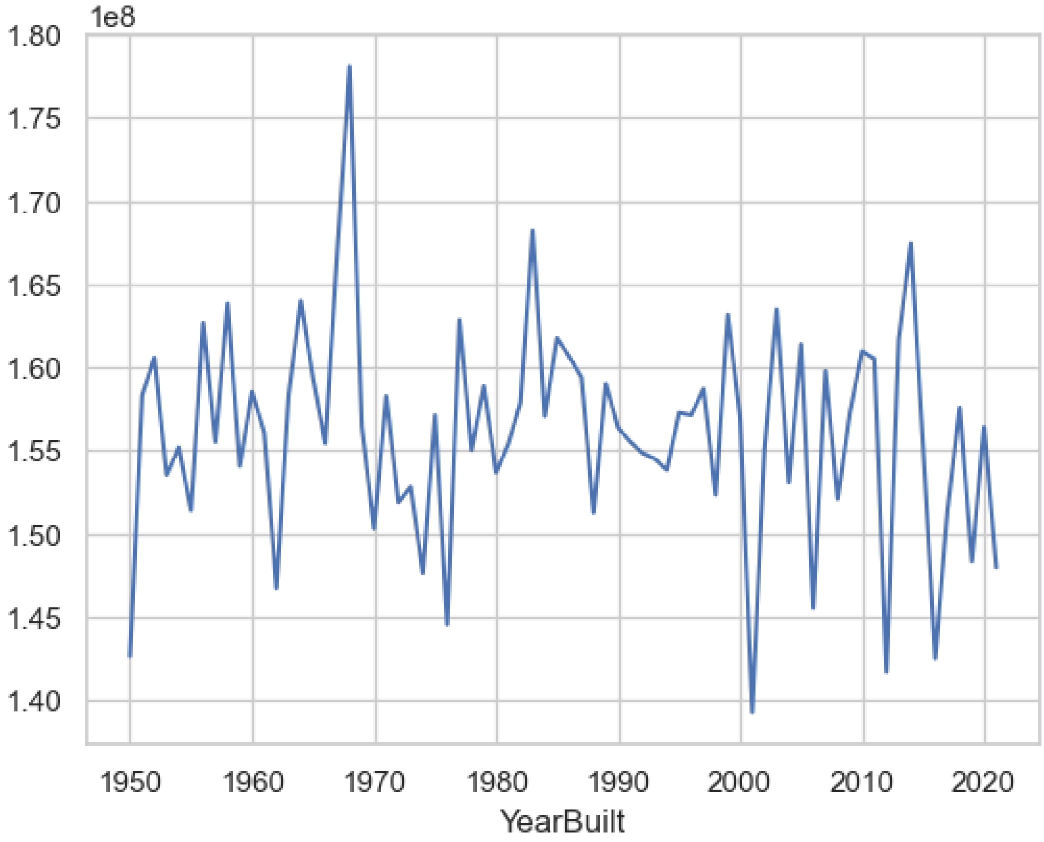
```
[8]: sns.pairplot(df)
```

```
[8]: <seaborn.axisgrid.PairGrid at 0x219db262150>
```



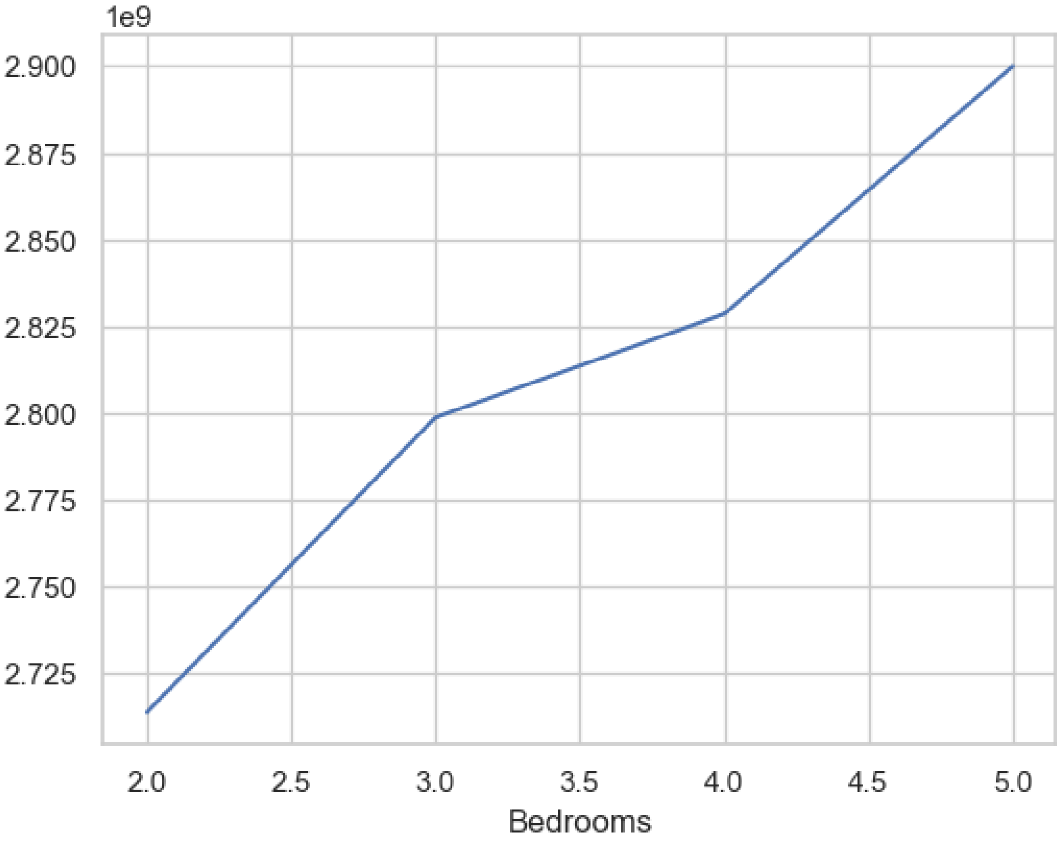
```
[9]: df.groupby('YearBuilt')['Price'].sum().plot(kind = 'line')
```

```
[9]: <Axes: xlabel='YearBuilt'>
```



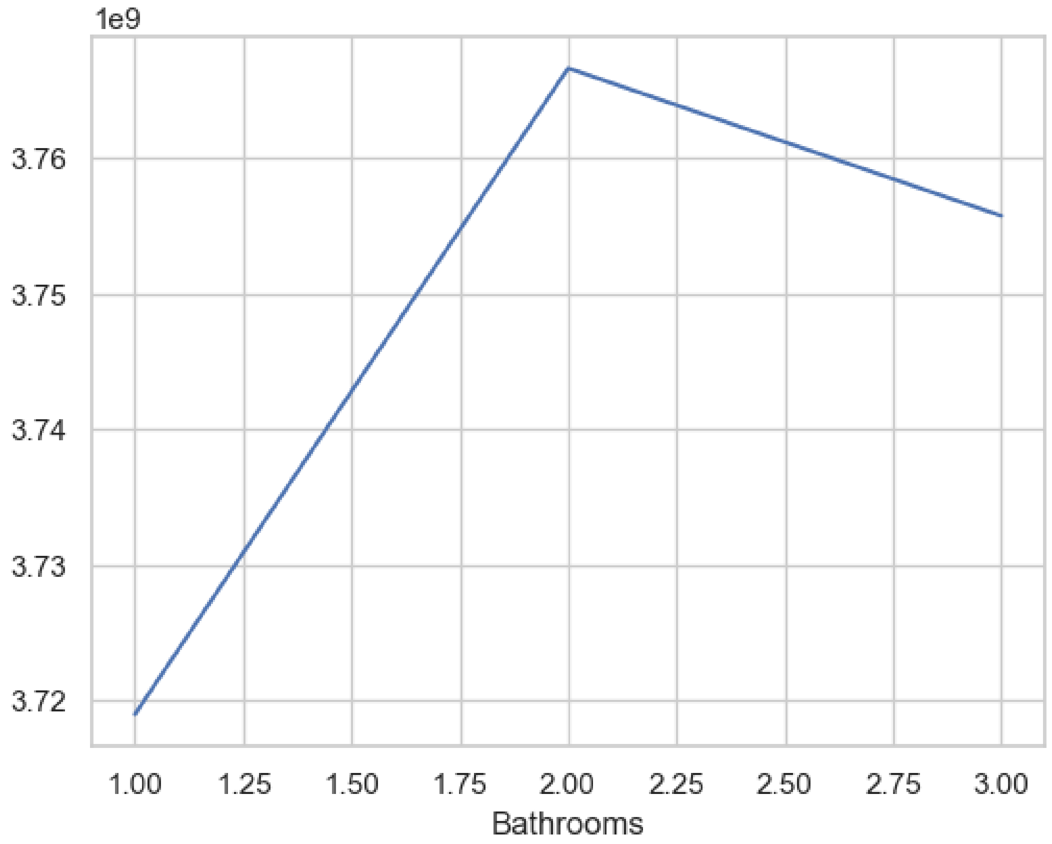
```
[10]: df.groupby('Bedrooms')['Price'].sum().plot(kind = 'line')
```

```
[10]: <Axes: xlabel='Bedrooms'>
```



```
[11]: df.groupby('Bathrooms')['Price'].sum().plot(kind = 'line')
```

```
[11]: <Axes: xlabel='Bathrooms'>
```



One-hot Encoding

[12]:
```
# Since the Neighbourhoods are of type object, convert that to numeric type..
df = pd.get_dummies(df,columns=['Neighborhood'],drop_first=True, dtype=int)
df.head()
```

[12]:
```
   SquareFeet  Bedrooms  Bathrooms  YearBuilt          Price  \
0        2126         4          1       1969  215355.283618
1        2459         3          2       1980  195014.221626
2        1860         2          1       1970  306891.012076
3        2294         2          1       1996  206786.787153
4        2130         5          2       2001  272436.239065

   Neighborhood_Suburb  Neighborhood_Urban
0                    0                   0
1                    0                   0
2                    1                   0
3                    0                   1
4                    1                   0
```

[13]:

```
Y = df['Price']
X = df.drop('Price',axis=1)
```

[14]:

```
X.columns
```

[14]:

```
Index(['SquareFeet', 'Bedrooms', 'Bathrooms', 'YearBuilt',
       'Neighborhood_Suburb', 'Neighborhood_Urban'],
      dtype='object')
```

Scaling

[15]:

```
ss = StandardScaler()
X[['SquareFeet', 'Bedrooms', 'Bathrooms','YearBuilt']] = ss.
 ↪fit_transform(X[['SquareFeet', 'Bedrooms', 'Bathrooms','YearBuilt']])
X.head()
```

[15]:

```
   SquareFeet  Bedrooms  Bathrooms  YearBuilt  Neighborhood_Suburb  \
0    0.207861  0.449067  -1.220113  -0.791751                    0
1    0.786480 -0.446738   0.005614  -0.260842                    0
2   -0.254340 -1.342543  -1.220113  -0.743486                    1
3    0.499777 -1.342543  -1.220113   0.511390                    0
4    0.214811  1.344872   0.005614   0.752713                    1

   Neighborhood_Urban
0                   0
1                   0
2                   0
3                   1
4                   0
```

0.1.4 Model Training

[16]:

```
X_train, X_test, Y_train, Y_test = train_test_split(X,Y)
```

[17]:

```
X_train.shape,X_test.shape
```

[17]:

```
((37500, 6), (12500, 6))
```

[18]:

```
lr = LinearRegression()
lr.fit(X_train,Y_train)
```

[18]:

```
LinearRegression()
```

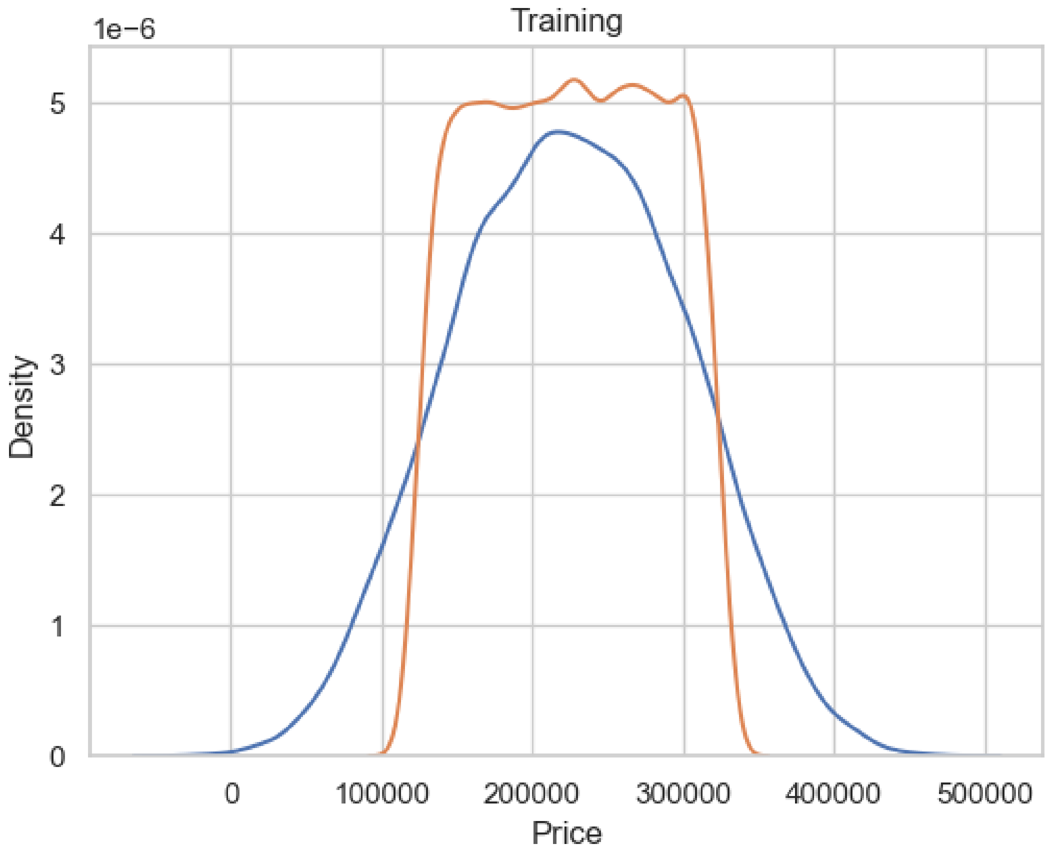
[24]:

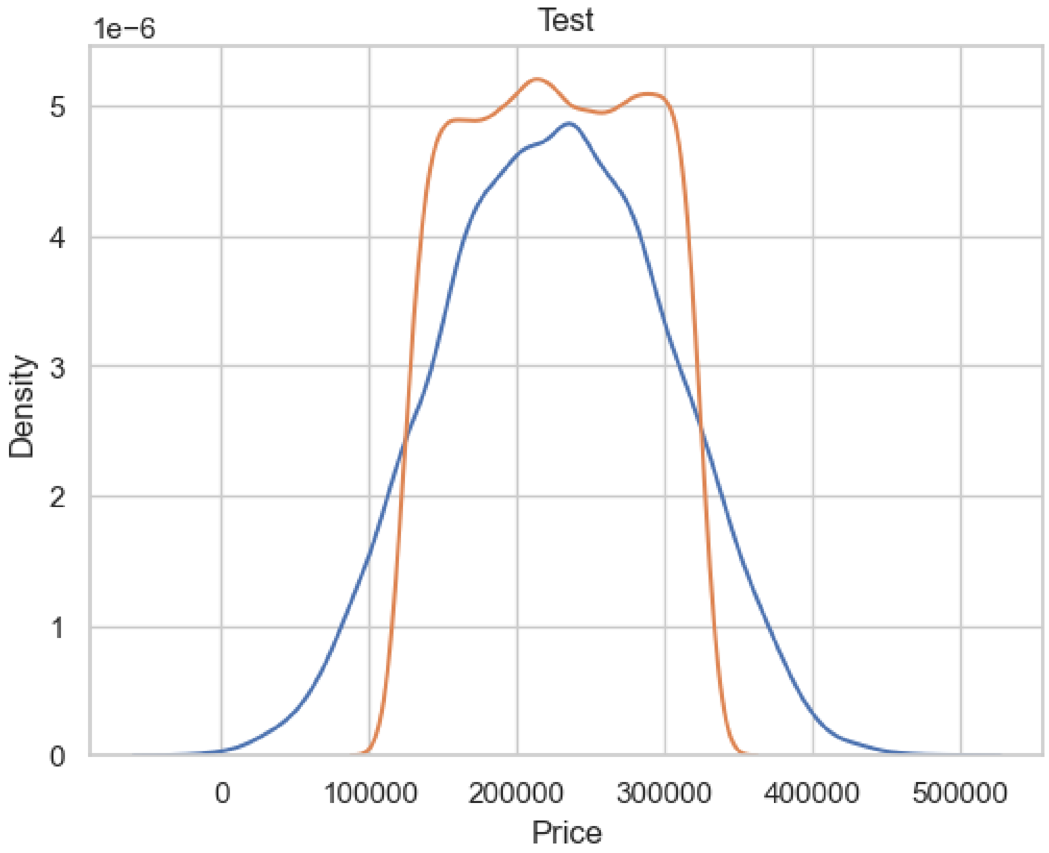
```
Y_pred_train = lr.predict(X_train)
Y_pred_test = lr.predict(X_test)
print(f'Training RMSE: {np.sqrt(mean_squared_error(Y_pred_train,Y_train))}')
print(f'Test RMSE: {np.sqrt(mean_squared_error(Y_pred_train,Y_train))}')
```

```
Training RMSE: 49871.25195609414
Test RMSE: 49871.25195609414
```

- Prediction Analysis

[22]:
```
sns.kdeplot(Y_train)
sns.kdeplot(Y_pred_train)
plt.title('Training')
plt.show()
sns.kdeplot(Y_test)
sns.kdeplot(Y_pred_test)
plt.title('Test')
plt.show()
```




Test
1e−6
5
4
3
2
1
0
Density
0
100000
200000
300000
400000
500000
Price