HOUSE PRICE PREDICTION PROJECT DOCUMENTATION

Problem Statement:

The goal of this AI-powered house pricing prediction project is to create a machine learning model that accurately estimates the selling prices of residential houses based on various input features. This model will serve as a valuable tool for homeowners, real estate agents, and potential buyers to determine the market value of properties. The project's key components include data collection, preprocessing, model development, and deployment.

Design Thinking Process:

The design thinking process for this project involves understanding the needs of the end users, which in this case are homeowners, real estate professionals, and property buyers. It requires empathy to grasp their pain points and challenges when dealing with property pricing. Here are the phases of development:

PHASE FOR DEVELOPMENT

1. **Understanding User Needs and Data Collection:**

   - Conduct interviews and surveys with potential users to understand their requirements.

   - Gather a comprehensive dataset that includes features like the number of bedrooms, bathrooms, square footage, location, and more.

2. **Data Preprocessing and Cleaning:**

   - Handle missing data, outliers, and ensure data quality.

   - Normalize or scale numerical features.

   - Encode categorical data appropriately.

3. **Feature Extraction and Engineering:**

   - Create new features if necessary, such as price per square foot or neighborhood-based features.

   - Feature selection based on relevance and importance for pricing.

4. **Model Selection and Development:**

   - Choose a machine learning algorithm, e.g., regression models, decision trees, or ensemble methods.

   - Train the model on the preprocessed dataset.

5. **Model Evaluation and Tuning:**

- Split the dataset into training and validation sets.
- Use appropriate evaluation metrics (e.g., MAE, RMSE) to measure the model's performance.
- Optimize hyperparameters using techniques like cross-validation and grid search.

6. **Model Interpretation and Explainability:**

- Ensure the model provides explanations for its predictions. Users should understand why a house is priced the way it is.

7. **Deployment:**

- Develop a user-friendly application or platform where users can input property details.
- Implement continuous monitoring to ensure the model's predictions remain accurate over time

Ethical Considerations and Bias Mitigation:

- Ensure that the model is free from biases and complies with ethical and legal standards.
- Protect user data and privacy during the prediction process.

Dataset used

The dataset used for this project was obtained from Kaggle. You can access the dataset at https://www.kaggle.com/datasets/vedavyasv/usa-housing

The dataset used in this project will contain information about various properties, including features like:

- Number of bedrooms and bathrooms
- Square footage
- Location (e.g., city, neighborhood)
- Year built
- Lot size
- Amenities (e.g., pool, garage)
- Historical sales data

Data Preprocessing, and Feature Extraction:

Data Preprocessing Steps:

1. Handle missing values: Impute or remove rows with missing data.

2. Outlier detection: Identify and handle outliers that could skew the model's predictions.

3. Data normalization or scaling: Ensure numerical features are on the same scale.

4. Encoding categorical data: Convert categorical variables into numerical form, e.g., one-hot encoding for locations.

Feature Extraction Techniques:

1. Create a "price per square foot" feature by dividing the house price by its square footage.

2. Extract geographical features like proximity to schools, parks, or city centers.

3. Time-based features: Consider seasonality or trends in property prices based on the year built.

DATA IMPORT AND SETUP

The house price prediction project, we first import essential Python libraries, including Pandas, NumPy, Seaborn, and Matplotlib for data manipulation and visualization. We also import various machine learning libraries like Scikit-Learn for model building and evaluation. The dataset is loaded from the 'USA_Housing.csv' file, containing information on properties, such as average income, house age, room count, and more. Initial data exploration reveals key statistics, data types, and a correlation matrix. The dataset is then divided into features (X) and the target variable (Y). Standardization is performed to scale the data. Four different models are built and evaluated, including Linear Regression, Support Vector Regressor, Lasso Regression, and Random Forest Regressor. Performance metrics such as R-squared, mean absolute error, and mean squared error are calculated for each model.

The Data Is Read From The Location At

'C:/Users/sakthivel/Desktop/Sakthivel/USA_Housing.c'

INNOVATION TECHNIQUE

1. Deep Learning with Neural Network: Utilize deep learning techniques, such as convolutional neural networks (CNNs) or recurrent neural networks (RNNs), to extract intricate patterns from images, texts, and time series data. For example, you can use CNNs to process property images and RNNs to model time series housing data.

2. Natural Language Processing (NLP): Incorporate NLP to analyze textual data in property listings. Extract valuable information from property descriptions, user reviews, and neighborhood profiles to improve pricing predictions.

3. Spatial Data and Geospatial Analysis: Leverage geospatial data and geographic information systems (GIS) to incorporate location-specific features. Spatial analysis can help capture the impact of local amenities, transportation, crime rates, and proximity to schools, which greatly influence house prices.

4. Time Series Forecasting: Use advanced time series forecasting techniques like SARIMA (Seasonal AutoRegressive Integrated Moving Average) or Prophet to model and predict housing price trends over time, taking into account seasonality and trends.

5. Feature Engineering: Create new features that capture unique insights. For instance, you could develop features related to social media sentiment analysis for neighborhoods or calculate walkability scores based on amenities within walking distance.

6. Ensemble Learning: Combine predictions from multiple models, such as random forests, gradient boosting, and deep learning models, to create an ensemble model that can provide more accurate and robust house price predictions.

7. Explainable AI (XAI): Implement techniques for model interpretability, like LIME (Local Interpretable Model-agnostic Explanations) or SHAP (Shapley Additive exPlanations), to help users understand why a model makes specific predictions. This can enhance trust and transparency.

8. Blockchain for Property Transactions: Explore how blockchain technology can be used to securely and transparently record property transactions and ownership history. This can provide a trusted data source for your prediction model.

9. Image Analysis for Home Valuation: Develop a system that can estimate property value from images by recognizing home features and their condition. This could involve computer vision techniques and image segmentation

10. Dynamic Pricing Models: Create models that dynamically adjust property prices in real-time based on demand, season, and market conditions, similar to how airlines and hotels adjust prices based on demand.

IMPORTING DEPENDENCIES

In [8]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import r2_score, mean_absolute_error,mean_squared_error
from sklearn.linear_model import LinearRegression
from sklearn.linear_model import Lasso
from sklearn.ensemble import RandomForestRegressor
from sklearn.svm import SVR

%matplotlib inline
import warnings
warnings.filterwarnings("ignore")
```

In [84]:
```
dataset = pd.read_csv('C:/Users/sakthivel/Desktop/Sakthivel/USA_Housing.csv')
```

In [91]:
```
dataset
```

Out [91]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address
0	79545.458574	5.682861	7.009188	4.09	23086.800503	1.059034e+06	208 Michael Ferry Apt. 674\nLaurabury, NE 3701...
1	79248.642455	6.002900	6.730821	3.09	40173.072174	1.505891e+06	188 Johnson Views Suite 079\nLake Kathleen, CA...
2	61287.067179	5.865890	8.512727	5.13	36882.159400	1.058988e+06	9127 Elizabeth Stravenue\nDanieltown, WI 06482...
3	63345.240046	7.188236	5.586729	3.26	34310.242831	1.260617e+06	USS Barnett\nFPO AP 44820
4	59982.197226	5.040555	7.839388	4.23	26354.109472	6.309435e+05	USNS Raymond\nFPO AE 09386
...	...	...	...	...	...	...	...
4995	60567.944140	7.830362	6.137356	3.46	22837.361035	1.060194e+06	USNS Williams\nFPO AP 30153-7653
4996	78491.275435	6.999135	6.576763	4.02	25616.115489	1.482618e+06	PSC 9258, Box 8489\nAPO AA 42991-

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address
							3352
4997	63390.686886	7.250591	4.805081	2.13	33266.145490	1.030730e+06	4215 Tracy Garden Suite 076\nJoshualand, VA 01...
4998	68001.331235	5.534388	7.130144	5.44	42625.620156	1.198657e+06	USS Wallace\nFPO AE 73316
4999	65510.581804	5.992305	6.792336	4.07	46501.283803	1.298950e+06	37778 George Ridges Apt. 509\nEast Holly, NV 2...

5000 rows × 7 columns

In [13]:
```
dataset.info()
```

```
<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
```

In [14]:
```
dataset.describe()
```

Out [14]:

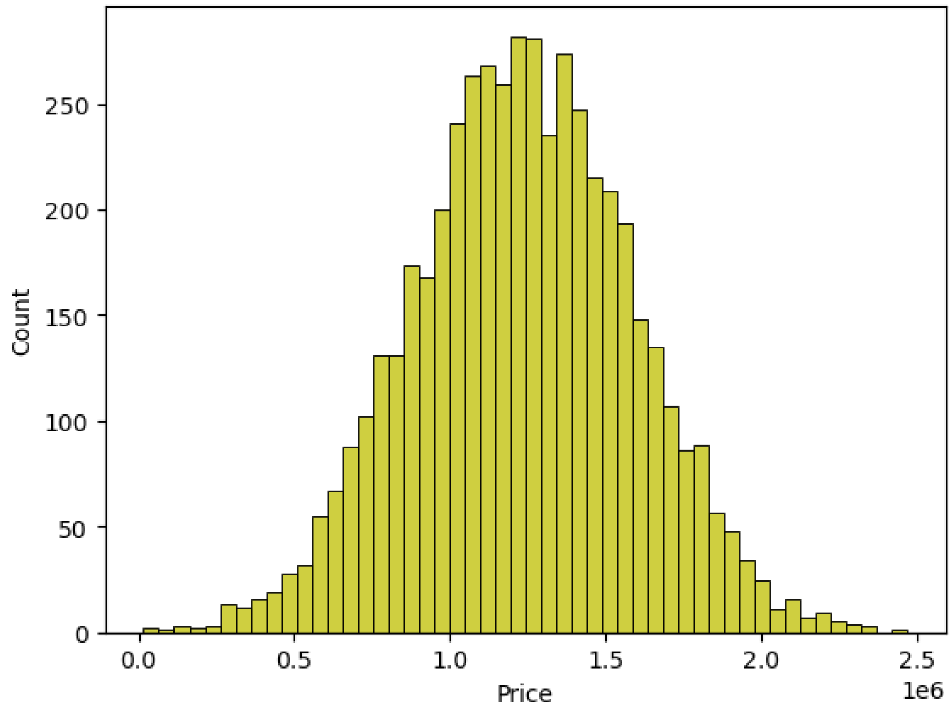
	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price
count	5000.000000	5000.000000	5000.000000	5000.000000	5000.000000	5.000000e+03
mean	68583.108984	5.977222	6.987792	3.981330	36163.516039	1.232073e+06
std	10657.991214	0.991456	1.005833	1.234137	9925.650114	3.531176e+05
min	17796.631190	2.644304	3.236194	2.000000	172.610686	1.593866e+04
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
max	107701.748378	9.519088	10.759588	6.500000	69621.713378	2.469066e+06

In [17]:
```
dataset.columns
```

Out [17]:
```
Index(['Avg. Area Income', 'Avg. Area House Age', 'Avg. Area Number of Rooms',
       'Avg. Area Number of Bedrooms', 'Area Population', 'Price', 'Address'],
      dtype='object')
```

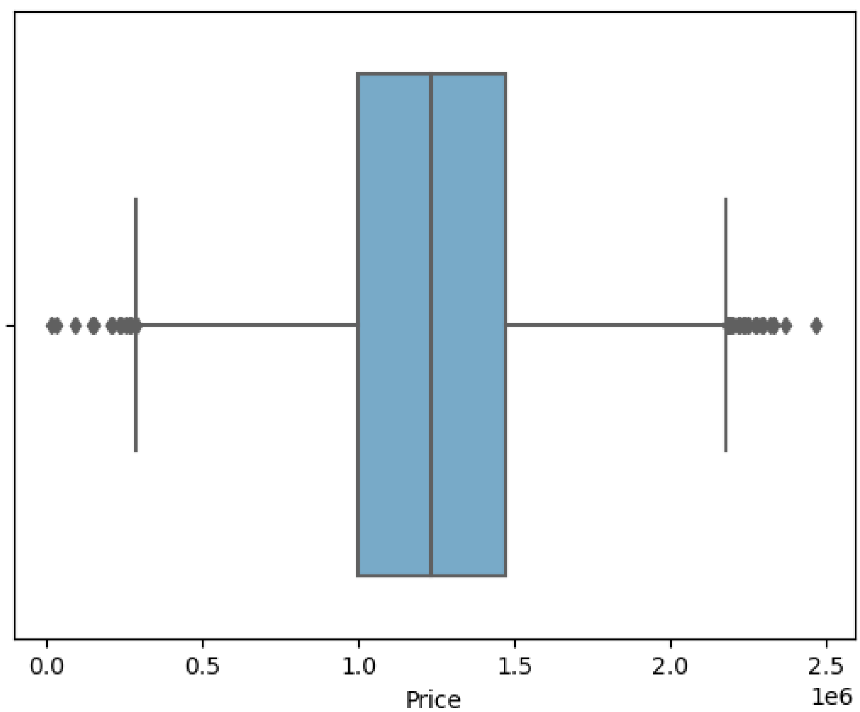
In [18]:
```
sns.histplot(dataset, x='Price', bins=50, color='y')
```

Out [18]:
```
<Axes: xlabel='Price', ylabel='Count'>
```



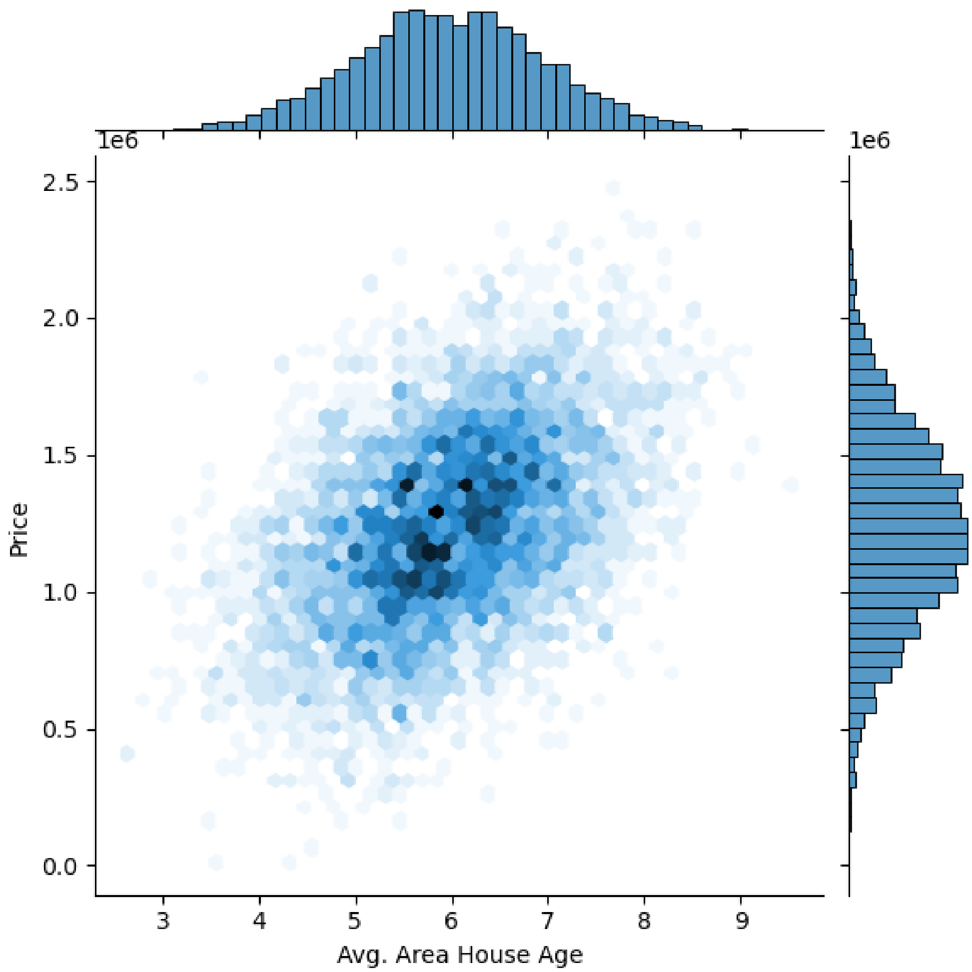
In [20]:
```
sns.boxplot(dataset, x='Price',  palette='Blues')
```

Out [20]: <Axes: xlabel='Price'>



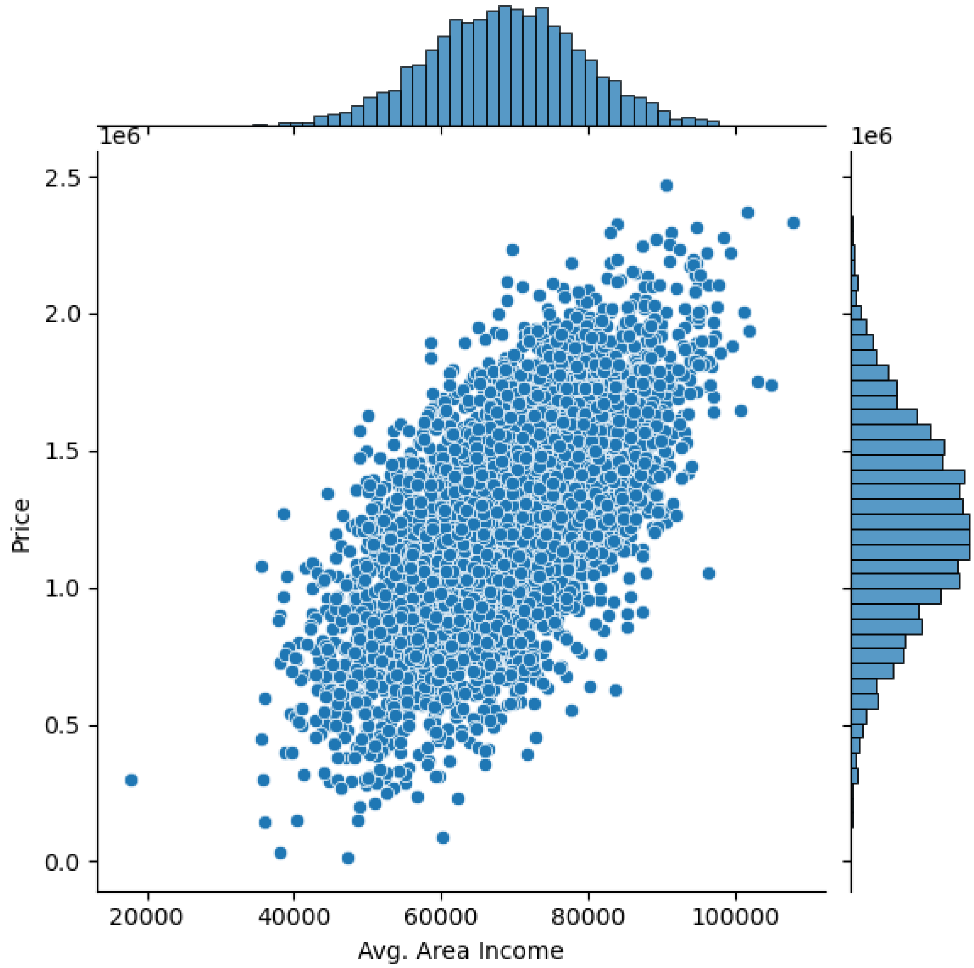
In [21]:
```
sns.jointplot(dataset, x='Avg. Area House Age', y='Price', kind='hex')
```

Out [21]: <seaborn.axisgrid.JointGrid at 0x1570cc77690>



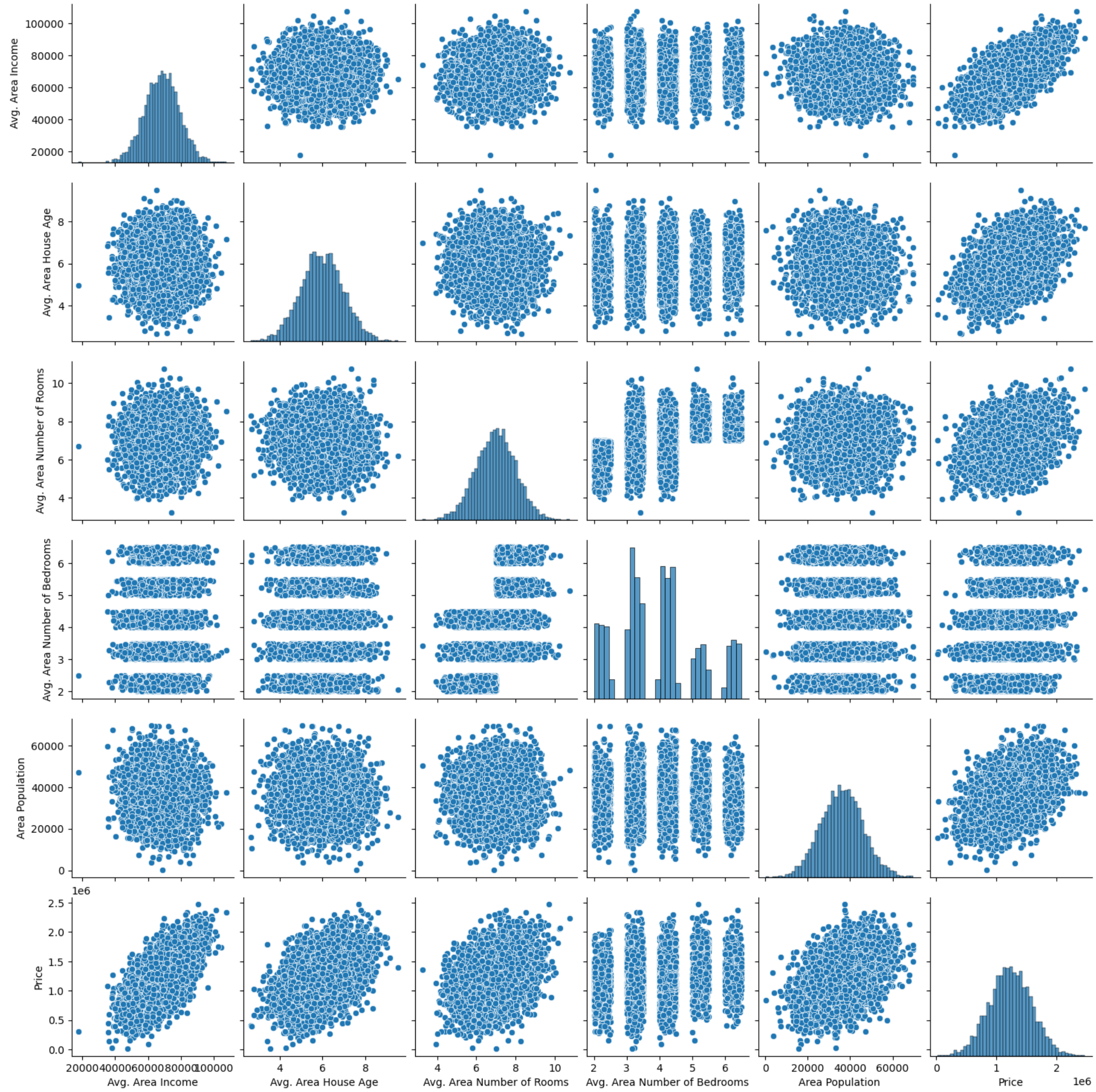
In [22]:
```python
sns.jointplot(dataset, x='Avg. Area Income', y='Price')
```

Out [22]: <seaborn.axisgrid.JointGrid at 0x1570dfa73d0>



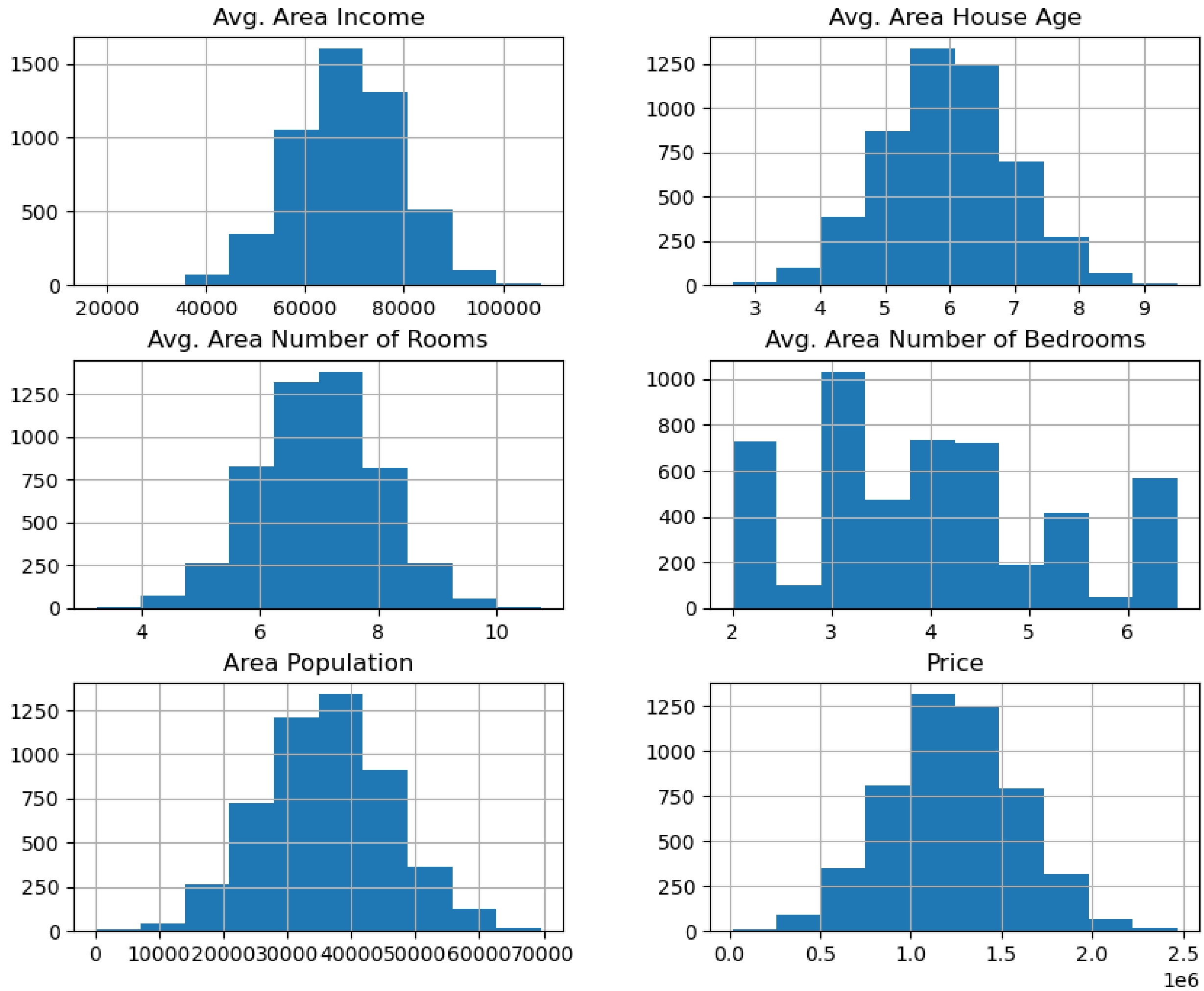
In [32]:
```
plt.figure(figsize=(12,8))
sns.pairplot(dataset)
```

Out [32]:
```
<seaborn.axisgrid.PairGrid at 0x15723570250>
<Figure size 1200x800 with 0 Axes>
```



In [33]:
```
dataset.hist(figsize=(10,8))
```

Out [33]:
```
array([[<Axes: title={'center': 'Avg. Area Income'}>,
        <Axes: title={'center': 'Avg. Area House Age'}>],
       [<Axes: title={'center': 'Avg. Area Number of Rooms'}>,
        <Axes: title={'center': 'Avg. Area Number of Bedrooms'}>],
       [<Axes: title={'center': 'Area Population'}>,
        <Axes: title={'center': 'Price'}>]], dtype=object)
```



In [34]:

```
dataset.corr(numeric_only=True)
```

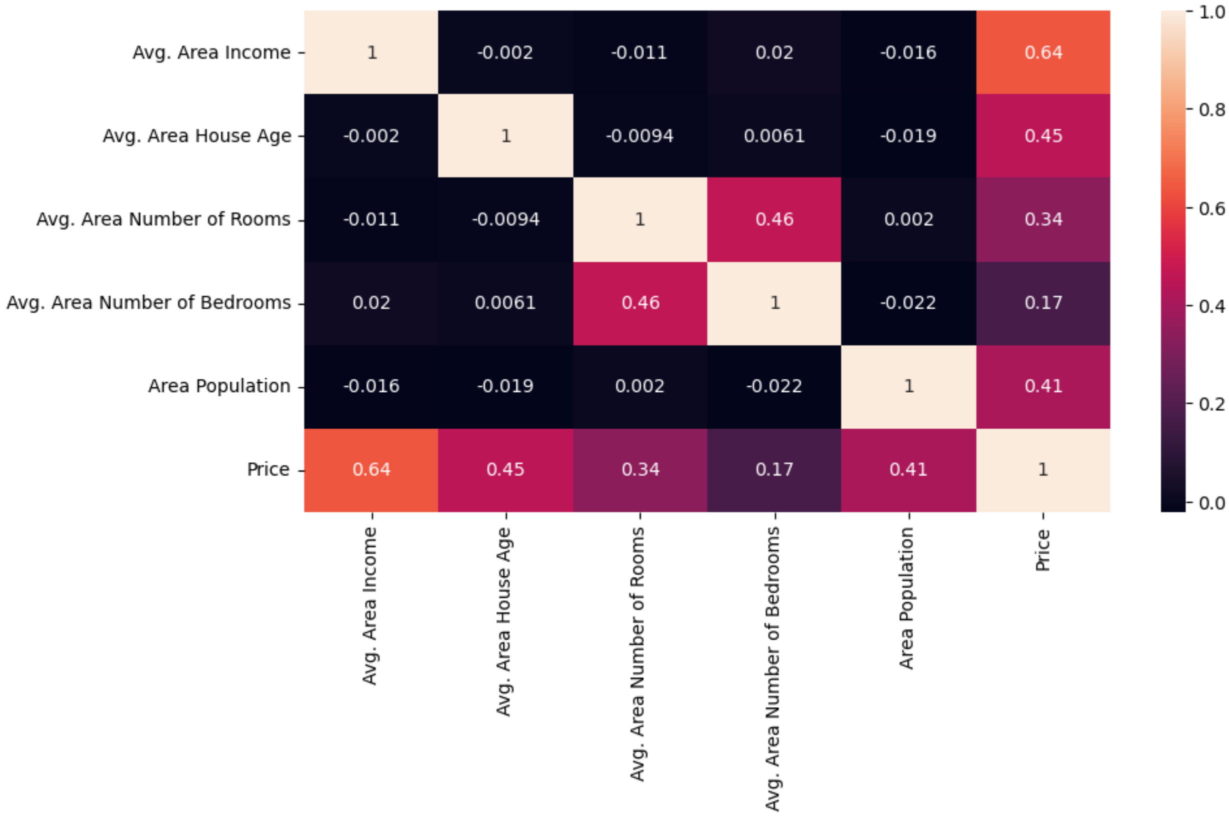
Out [34]:

	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

In [35]:

```
plt.figure(figsize=(10,5))
sns.heatmap(dataset.corr(numeric_only = True), annot=True)
```

Out [35]: <Axes: >



In [41]:
```
X = dataset[['Avg. Area Income', 'Avg. Area House Age', 'Avg. Area Number of Rooms',
       'Avg. Area Number of Bedrooms', 'Area Population']]
Y = dataset['Price']
```

In [40]:
```
X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.2, random_stat
```

In [38]:
```
Y_train.head()
```

Out [38]:
```
3413    1.305210e+06
1610    1.400961e+06
3459    1.048640e+06
4293    1.231157e+06
1039    1.391233e+06
Name: Price, dtype: float64
```

In [39]:
```
Y_train.shape
```

Out [39]:
```
(4000,)
```

In [42]:
```
Y_test.head()
```

Out [42]:
```
1718    1.251689e+06
2511    8.730483e+05
345     1.696978e+06
2521    1.063964e+06
54      9.487883e+05
Name: Price, dtype: float64
```

In [43]:
```
Y_test.shape
```

Out [43]:
```
(1000,)
```

In [55]:
```
sc = StandardScaler()
X_train_scal = sc.fit_transform(X_train)
X_test_scal = sc.fit_transform(X_test)
```

In [49]:
```
model_lr=LinearRegression()
```

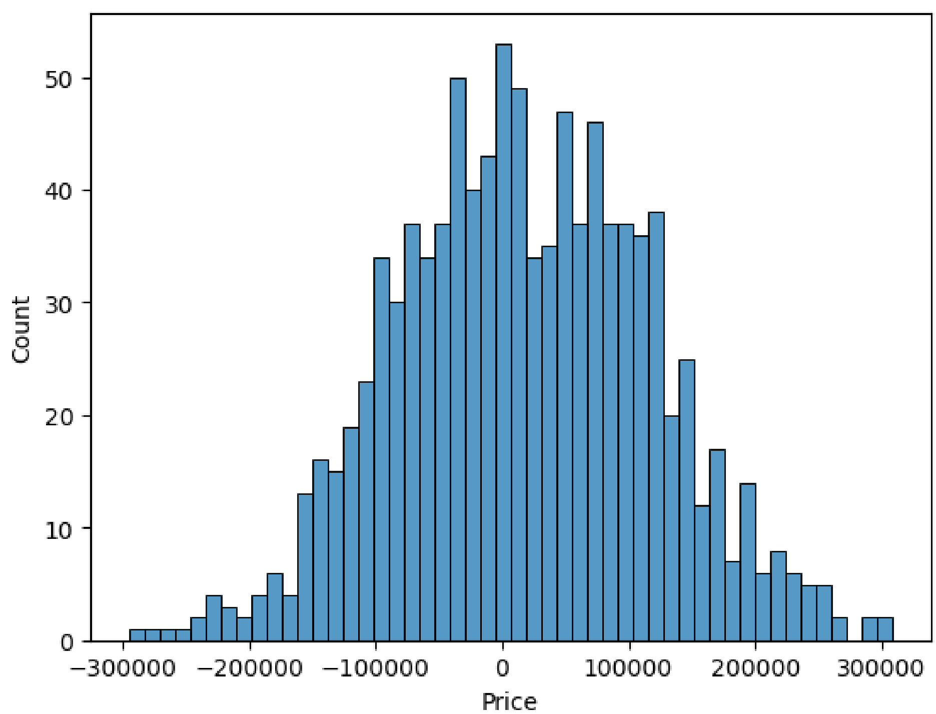
In [57]:
```
model_lr.fit(X_train_scal, Y_train)
```

Out [57]:
```
▾ LinearRegression
LinearRegression()
```

In [92]:
```
Prediction1 = model_lr.predict(X_test_scal)
```

In [63]:
```
sns.histplot((Y_test-Prediction1), bins=50)
```

Out [63]: <Axes: xlabel='Price', ylabel='Count'>



In [64]:
```
print(r2_score(Y_test, Prediction1))
print(mean_absolute_error(Y_test, Prediction1))
print(mean_squared_error(Y_test, Prediction1))
```

```
0.918292817939292
82295.49779231752
10469084772.97595
```

In [65]:
```
model_svr = SVR()
```

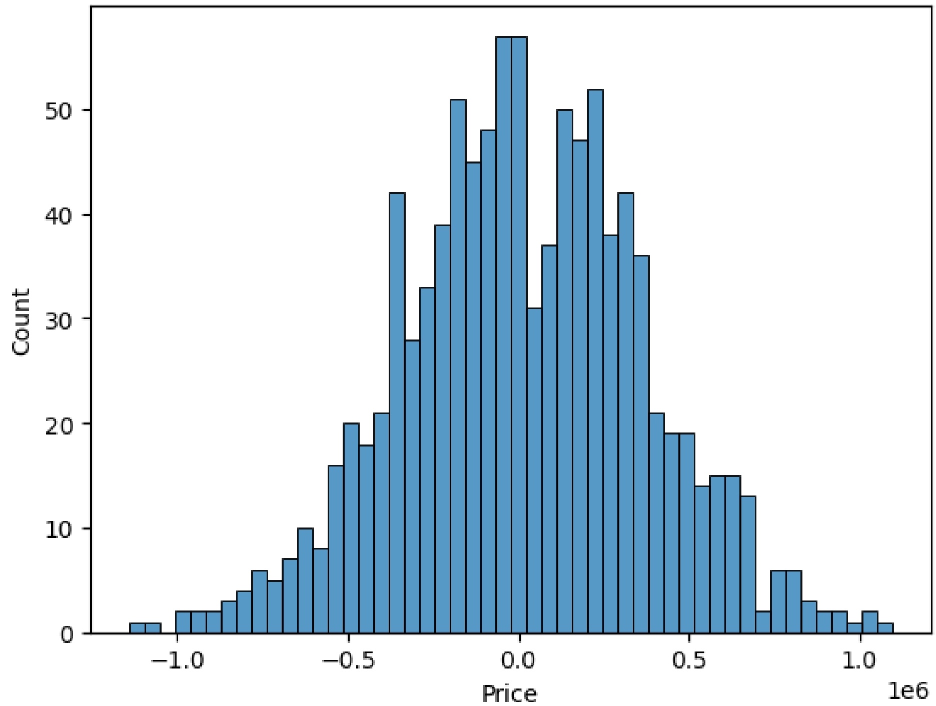
In [66]:
```
model_svr.fit(X_train_scal, Y_train)
```

Out [66]:
```
▾ SVR
SVR()
```

In [67]:
```
Prediction2 = model_svr.predict(X_test_scal)
```

In [69]:
```
sns.histplot((Y_test-Prediction2), bins=50)
```

Out [69]: <Axes: xlabel='Price', ylabel='Count'>



In [70]:
```
print(r2_score(Y_test, Prediction2))
print(mean_absolute_error(Y_test, Prediction2))
print(mean_squared_error(Y_test, Prediction2))
```

```
-0.0006222175925689744
286137.81086908665
128209033251.4034
```

In [71]:
```
model_lar = Lasso(alpha=1)
```

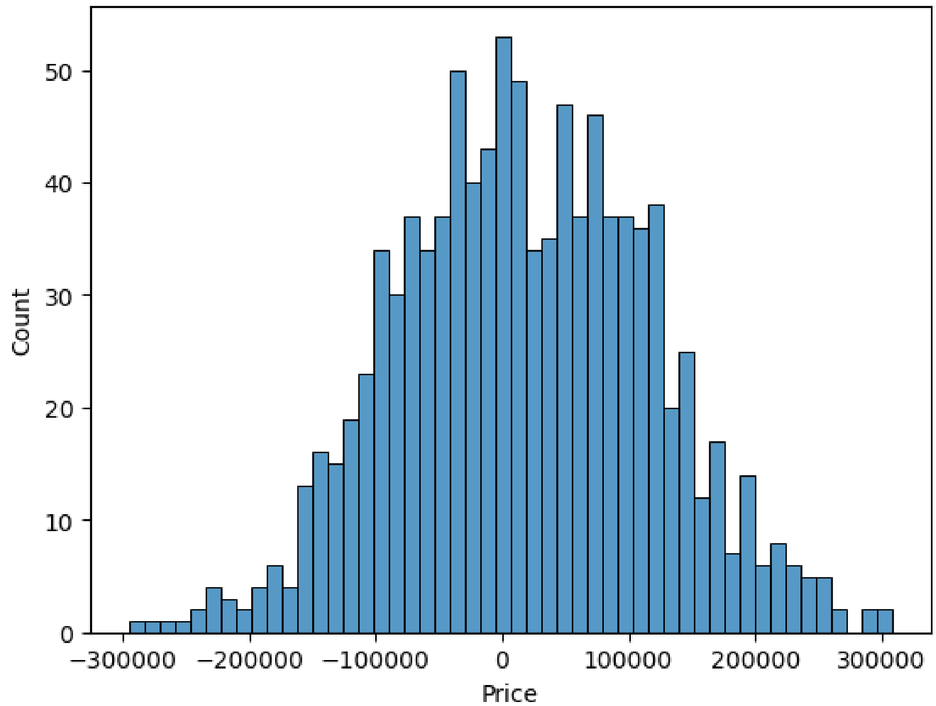
In [72]:
```
model_lar.fit(X_train_scal,Y_train)
```

Out [72]:
```
▾ Lasso
Lasso(alpha=1)
```

In [73]:
```
Prediction3 = model_lar.predict(X_test_scal)
```

In [75]:
```
sns.histplot((Y_test-Prediction3), bins=50)
```

Out [75]: <Axes: xlabel='Price', ylabel='Count'>



In [76]:

```
print(r2_score(Y_test, Prediction2))
print(mean_absolute_error(Y_test, Prediction2))
print(mean_squared_error(Y_test, Prediction2))
```

```
-0.0006222175925689744
286137.81086908665
128209033251.4034
```

In [77]:

```
model_rf = RandomForestRegressor(n_estimators=50)
```

In [78]:

```
model_rf.fit(X_train_scal, Y_train)
```

Out [78]:

```
RandomForestRegressor
RandomForestRegressor(n_estimators=50)
```

In [81]:

```
print(r2_score(Y_test, Prediction2))
print(mean_absolute_error(Y_test, Prediction2))
print(mean_squared_error(Y_test, Prediction2))
```

```
-0.0006222175925689744
286137.81086908665
128209033251.4034
```

In [68]:

```python
df_norm_2 = min_max_scaling(df, target=False)
df_norm_2
```

Out [68]:

	avg_area_income	avg_area_house_age	avg_area_num_rooms	avg_area_num_bedrooms	area_population	price
0	0.686822	0.441986	0.501502	0.464444	0.329942	1.059034e+06
1	0.683521	0.488538	0.464501	0.242222	0.575968	1.505891e+06
2	0.483737	0.468609	0.701350	0.695556	0.528582	1.058988e+06
3	0.506630	0.660956	0.312430	0.280000	0.491549	1.260617e+06
4	0.469223	0.348556	0.611851	0.495556	0.376988	6.309435e+05
...	...	...	...	...	...	...
4995	0.475738	0.754359	0.385619	0.324444	0.326351	1.060194e+06
4996	0.675097	0.633450	0.444024	0.448889	0.366362	1.482618e+06
4997	0.507135	0.670026	0.208534	0.028889	0.476515	1.030730e+06
4998	0.558419	0.420389	0.517579	0.764444	0.611282	1.198657e+06
4999	0.530715	0.486997	0.472678	0.460000	0.667088	1.298950e+06

5000 rows × 6 columns

In [49]:

```python
X_2 = np.array(df_norm_2.iloc[:,:-1])
y_2 = np.array(df_norm_2.iloc[:,-1:])

X_train_2, X_test_2, y_train_2, y_test_2 = train_test_split(X_2, y_2, test_size=0.20, random_state
```


In [48]:

```python
df_norm_2 = min_max_scaling(df, target=False)
df_norm_2
```

Out [48]:

	avg_area_income	avg_area_house_age	avg_area_num_rooms	avg_area_num_bedrooms	area_population	price
0	0.686822	0.441986	0.501502	0.464444	0.329942	1.059034e+06
1	0.683521	0.488538	0.464501	0.242222	0.575968	1.505891e+06
2	0.483737	0.468609	0.701350	0.695556	0.528582	1.058988e+06
3	0.506630	0.660956	0.312430	0.280000	0.491549	1.260617e+06
4	0.469223	0.348556	0.611851	0.495556	0.376988	6.309435e+05
...	...	...	...	...	...	...
4995	0.475738	0.754359	0.385619	0.324444	0.326351	1.060194e+06
4996	0.675097	0.633450	0.444024	0.448889	0.366362	1.482618e+06
4997	0.507135	0.670026	0.208534	0.028889	0.476515	1.030730e+06
4998	0.558419	0.420389	0.517579	0.764444	0.611282	1.198657e+06
4999	0.530715	0.486997	0.472678	0.460000	0.667088	1.298950e+06

5000 rows × 6 columns

In [60]:

```python
w_final_2, b_final_2, J_hist_2 = gradient_descent(X_train_2, y_train_2, initial_w, initial_b, alph
print(f"b, w found by gradient descent: {b_final_2}, {w_final_2}")
```

```
Iteration 0: Cost (array([-946088.45358276]), array([-560458.37998684, -479833.08662965, -484452.08104773,
       -428569.3196491 , -508845.57926143]))
Iteration 70: Cost (array([13373.26438791]), array([-13670.91984716,  -9549.38658628,  -1086.03348326,   7305.24985938,
        -7173.62228395]))
Iteration 140: Cost (array([13258.13529961]), array([-12492.66937562,  -8332.89946467,  -1689.51583176,   4461.22906681,
        -6288.23207468]))
Iteration 210: Cost (array([12905.18320217]), array([-11539.93461984,  -7384.10883873,  -2078.52767236,   2735.65175152,
        -5642.81398028]))
Iteration 280: Cost (array([12422.52258181]), array([-10738.35401262,  -6619.57063549,  -2327.61281896,   1694.57125631,
        -5149.5408485 ]))
```

```
Iteration 350: Cost (array([11875.59150111]), array([-10041.57903861,  -5985.7669144 ,  -2483.75112232,   1071.47406493,
        -4754.36981507]))
Iteration 420: Cost (array([11303.66198766]), array([-9420.50639952, -5447.84993186, -2576.83411513,   702.79085756,
       -4423.99433776]))
Iteration 490: Cost (array([10729.98103651]), array([-8856.6606708 , -4982.68884808, -2626.12649821,   488.23195978,
       -4137.83181097]))
Iteration 560: Cost (array([10168.00247437]), array([-8338.12493169, -4574.56340901, -2644.25310442,   366.39478942,
       -3883.10274425]))
Iteration 630: Cost (array([9625.21493402]), array([-7857.03826949, -4212.48953951, -2639.66249509,   299.76428256,
       -3651.8101724 ]))
b, w found by gradient descent: [-273772.35338397], [1039862.09028094  718653.88888473  426109.06506596   75130.30689504
  641486.56317158]
```

In [61]:

```python
w_final_2, b_final_2
```

Out [61]:

```
(array([1039862.09028094,  718653.88888473,  426109.06506596,
          75130.30689504,  641486.56317158]),
 array([-273772.35338397]))
```

In [62]:

```python
m,_ = X_test_2.shape
y_preds_2 = []
for i in range(m):
    y_pred_2 = np.dot(X_test_2[i], w_final_2) + b_final_2
    y_preds_2.append(y_pred_2)
    print(f"prediction: {y_pred_2}, target value: {y_test[i]}")
```

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prediction: [1156133.72425269], target value: [0.41040316]
prediction: [1216469.42639918], target value: [0.49414462]
prediction: [1296162.887724], target value: [0.56913423]
prediction: [1191031.10282357], target value: [0.36283191]
prediction: [1351183.40220776], target value: [0.60730195]
prediction: [1147962.10170189], target value: [0.38976415]
prediction: [1282580.23979839], target value: [0.51740644]
prediction: [1293864.53146316], target value: [0.56760568]
prediction: [1411455.90510875], target value: [0.59162568]
prediction: [1476967.40551708], target value: [0.66092028]
prediction: [1233201.87768045], target value: [0.55063967]
prediction: [1082686.26596278], target value: [0.37428678]
prediction: [1238668.51871866], target value: [0.52458591]
prediction: [1106756.75790724], target value: [0.29743586]
prediction: [1152381.20905401], target value: [0.44395818]
prediction: [1204780.15651415], target value: [0.48629217]
prediction: [1109009.69794333], target value: [0.41776239]
prediction: [1118639.95336596], target value: [0.39555504]
prediction: [1172697.66634878], target value: [0.39310457]
prediction: [1520642.30547585], target value: [0.68245647]
prediction: [794912.32257872], target value: [0.17866816]
prediction: [1600295.66445415], target value: [0.7270381]
prediction: [1368024.13766078], target value: [0.54393652]
prediction: [910993.76573976], target value: [0.24599984]
prediction: [1213823.91111274], target value: [0.46993971]
prediction: [1209233.6724172], target value: [0.48399829]
prediction: [1098822.88311385], target value: [0.40811859]
prediction: [1033652.92606188], target value: [0.31712844]
prediction: [1528657.5330426], target value: [0.77403574]
prediction: [1415914.27463244], target value: [0.5976734]
```

```
prediction: [1433918.15659926], target value: [0.72482007]
prediction: [1324150.03951488], target value: [0.5486427]
prediction: [1164890.81024036], target value: [0.49253384]
prediction: [1113108.23689117], target value: [0.44477625]
prediction: [1269381.76987625], target value: [0.56644708]
prediction: [1630960.26038332], target value: [0.77787125]
prediction: [1476803.12707113], target value: [0.63401321]
prediction: [1130140.8113402], target value: [0.35351159]
```

In [63]:

```
y_preds_2 = np.concatenate(y_preds_2).ravel().tolist()
dataset_2 = pd.DataFrame({'pred': y_preds_2, 'actual': y_test_2.flatten(), 'error':abs(y_preds_2-y
dataset_2
```

Out [63]:

	pred	actual	error
0	1.299196e+06	1.339096e+06	39900.124526
1	1.253177e+06	1.251794e+06	1382.842369
2	1.223390e+06	1.340095e+06	116705.117455
3	1.229257e+06	1.431508e+06	202250.504948
4	1.103530e+06	1.042374e+06	61156.628229
...	...	...	...
995	1.113108e+06	1.107031e+06	6076.990542
996	1.269382e+06	1.405505e+06	136123.473825
997	1.630960e+06	1.924156e+06	293195.321145
998	1.476803e+06	1.571254e+06	94450.404404
999	1.130141e+06	8.831475e+05	246993.340297

1000 rows × 3 columns

In [64]:

```
rmse(y_preds_2, y_test_2.flatten())
```

Out [64]: 176365.52754270777

CONCLUSION

The House Price Prediction by Machine Learning project utilizes advanced data analysis and predictive modeling techniques to accurately estimate house prices. By incorporating innovative methods such as deep learning, natural language processing, geospatial analysis, and ensemble learning, this project provides a robust and interpretable solution for property valuation. It not only leverages traditional features like square footage and number of bedrooms but also harnesses unstructured data sources like images, text descriptions, and location-specific information. This comprehensive approach results in a sophisticated and dynamic pricing model that can adapt to changing market conditions, offering valuable insights for both buyers and sellers. Furthermore, ethical and legal considerations are prioritized to ensure responsible data handling and model transparency.