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20MID0172

Importing libraries

In [3]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
from sklearn.preprocessing import OrdinalEncoder
from sklearn.preprocessing import StandardScaler
from tldextract import extract
import ssl
import socket
from bs4 import BeautifulSoup
import urllib.request
import whois
import datetime
from googlesearch import search
```

Load the dataset into the tool

In [4]:
```
import pandas as pd
# reading data from csv file
```

In [5]:

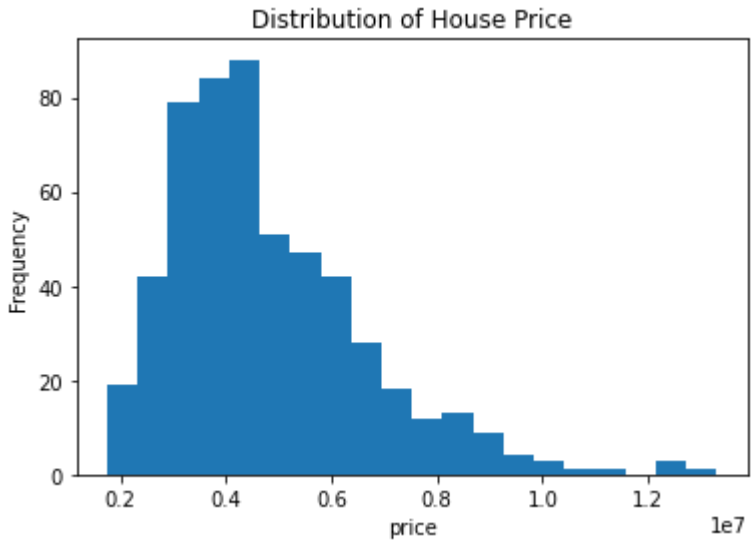
	price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	furnish
0	13300000	7420	4	2	3	yes	no	no	no	yes	2	
1	12250000	8960	4	4	4	yes	no	no	no	yes	3	
2	12250000	9960	3	2	2	yes	no	yes	no	no	2	sem
3	12215000	7500	4	2	2	yes	no	yes	no	yes	3	
4	11410000	7420	4	1	2	yes	yes	yes	no	yes	2	
...	...	...	...	...	...	...	...	...	...	...	...	
540	1820000	3000	2	1	1	yes	no	yes	no	no	2	u
541	1767150	2400	3	1	1	no	no	no	no	no	0	sem
542	1750000	3620	2	1	1	yes	no	no	no	no	0	u
543	1750000	2910	3	1	1	no	no	no	no	no	0	
544	1750000	3850	3	1	2	yes	no	no	no	no	0	u

545 rows × 12 columns

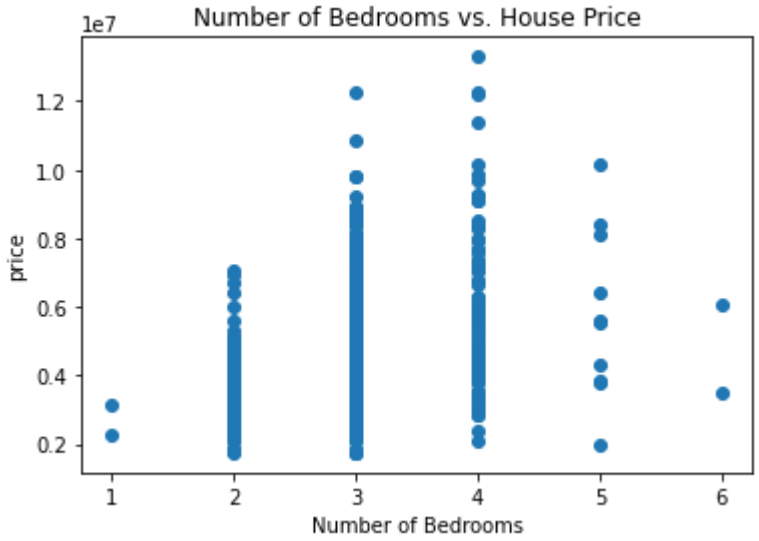
Perform Below Visualizations.

@ Univariate Analysis @ Bi-Variate Analysis @ Multi-Variate Analysis

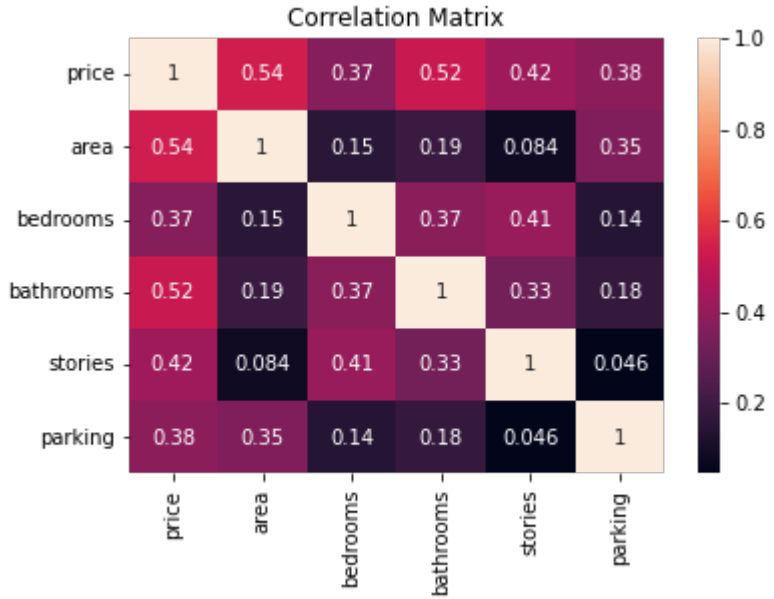
In [6]:
```
# Univariate Analysis - House Price
plt.hist(dataset1['price'], bins=20)
plt.xlabel('price')
plt.ylabel('Frequency')
plt.title('Distribution of House Price')
```



In [7]:
```
# Bi-Variate Analysis - Number of Bedrooms vs. House Price
plt.scatter(dataset1['bedrooms'], dataset1['price'])
plt.xlabel('Number of Bedrooms')
plt.ylabel('price')
plt.title('Number of Bedrooms vs. House Price')
```



In [8]:
```
# Multi-Variate Analysis - Correlation Matrix
correlation_matrix = dataset1.corr()
sns.heatmap(correlation_matrix, annot=True)
plt.title('Correlation Matrix')
plt.show()
```



Perform descriptive statistics on the dataset.

In [9]:
```
# Descriptive statistics
descriptive_stats = dataset1.describe()
print(descriptive_stats)
```

```
              price          area    bedrooms   bathrooms     stories  \
count  5.450000e+02    545.000000  545.000000  545.000000  545.000000
mean   4.766729e+06   5150.541284    2.965138    1.286239    1.805505
std    1.870440e+06   2170.141023    0.738064    0.502470    0.867492
min    1.750000e+06   1650.000000    1.000000    1.000000    1.000000
25%    3.430000e+06   3600.000000    2.000000    1.000000    1.000000
50%    4.340000e+06   4600.000000    3.000000    1.000000    2.000000
75%    5.740000e+06   6360.000000    3.000000    2.000000    2.000000
max    1.330000e+07  16200.000000    6.000000    4.000000    4.000000

          parking
count  545.000000
mean     0.693578
std      0.861586
min      0.000000
25%      0.000000
50%      0.000000
75%      1.000000
max      3.000000
```

Check for Missing values and deal with them.

In [10]:
```
# Select only valid columns
valid_columns = dataset1.select_dtypes(include=[np.number]).columns

# Fill missing values with mean of valid columns
dataset1[valid_columns] = dataset1[valid_columns].fillna(dataset1[valid_columns].mean())
```

In [11]:
```
# Check for missing values in the dataset
missing_values = dataset1.isnull().sum()
```

```
price             0
area              0
bedrooms          0
bathrooms         0
stories           0
mainroad          0
guestroom         0
basement          0
hotwaterheating   0
airconditioning   0
parking           0
furnishingstatus  0
dtype: int64
```

Find the outliers and replace them outliers

In [12]:
```
# Find outliers and replace them with median
Q1 = dataset1['price'].quantile(0.25)
Q3 = dataset1['price'].quantile(0.75)
IQR = Q3 - Q1
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR
dataset1['price'] = np.where((dataset1['price'] < lower_bound) | (dataset1['price'] > upper_bound), dataset1[
```

In [13]:

```
3430000.0
```

In [14]:

```
5740000.0
```

In [15]:

```
2310000.0
```

In [16]:

```
display(lower_bound)
```

```
-35000.0

9205000.0
```

In [17]:

```
0      4340000.0
1      4340000.0
2      4340000.0
3      4340000.0
4      4340000.0
         ...
540    1820000.0
541    1767150.0
542    1750000.0
543    1750000.0
544    1750000.0
Name: price, Length: 545, dtype: float64
```

Check for Categorical columns and perform encoding.

In [18]:

```
print(dataset1.columns)
```

```
Index(['price', 'area', 'bedrooms', 'bathrooms', 'stories', 'mainroad',
       'guestroom', 'basement', 'hotwaterheating', 'airconditioning',
       'parking', 'furnishingstatus'],
      dtype='object')
```

In [19]:
```
categorical_cols = ['furnishingstatus', 'basement']

# Perform label encoding
encoder = OrdinalEncoder()
dataset1[categorical_cols] = encoder.fit_transform(dataset1[categorical_cols])
```

In [20]:

	furnishingstatus	basement
0	0.0	0.0
1	0.0	0.0
2	1.0	1.0
3	0.0	1.0
4	0.0	1.0
...	...	...
540	2.0	1.0
541	1.0	0.0
542	2.0	0.0
543	0.0	0.0
544	2.0	0.0

545 rows × 2 columns

Split the data into dependent and independent variables.

In [21]:
```
# Split the data into X (features) and y (target variable)
X = dataset1.drop('price', axis=1)
y = dataset1['price']
```

Scale the independent variables

In [22]:
```
print(X.dtypes)
```

```
area                int64
bedrooms            int64
bathrooms           int64
stories             int64
mainroad           object
guestroom          object
basement          float64
hotwaterheating    object
airconditioning    object
parking             int64
furnishingstatus  float64
dtype: object
```

In [23]:
```
X_encoded = pd.get_dummies(X, drop_first=True)
```

In [24]:

	price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	furnis
0	4340000.0	7420	4	2	3	yes	no	0.0	no	yes	2	
1	4340000.0	8960	4	4	4	yes	no	0.0	no	yes	3	
2	4340000.0	9960	3	2	2	yes	no	1.0	no	no	2	
3	4340000.0	7500	4	2	2	yes	no	1.0	no	yes	3	
4	4340000.0	7420	4	1	2	yes	yes	1.0	no	yes	2	
...	...	...	...	...	...	...	...	...	...	...	...	...
540	1820000.0	3000	2	1	1	yes	no	1.0	no	no	2	
541	1767150.0	2400	3	1	1	no	no	0.0	no	no	0	
542	1750000.0	3620	2	1	1	yes	no	0.0	no	no	0	
543	1750000.0	2910	3	1	1	no	no	0.0	no	no	0	
544	1750000.0	3850	3	1	2	yes	no	0.0	no	no	0	

545 rows × 12 columns

In [25]:
```
categorical_cols = ['furnishingstatus', 'mainroad']

# Perform label encoding
encoder = OrdinalEncoder()
dataset1[categorical_cols] = encoder.fit_transform(dataset1[categorical_cols])
```

In [26]:
```
categorical_cols = ['furnishingstatus', 'guestroom']

# Perform label encoding
encoder = OrdinalEncoder()
dataset1[categorical_cols] = encoder.fit_transform(dataset1[categorical_cols])
```

In [27]:
```
categorical_cols = ['furnishingstatus', 'hotwaterheating']

# Perform label encoding
encoder = OrdinalEncoder()
dataset1[categorical_cols] = encoder.fit_transform(dataset1[categorical_cols])
```

In [28]:
```
categorical_cols = ['furnishingstatus', 'airconditioning']

# Perform label encoding
encoder = OrdinalEncoder()
dataset1[categorical_cols] = encoder.fit_transform(dataset1[categorical_cols])
```

In [29]:

	price	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	furnis
0	4340000.0	7420	4	2	3	1.0	0.0	0.0	0.0	1.0	2	
1	4340000.0	8960	4	4	4	1.0	0.0	0.0	0.0	1.0	3	
2	4340000.0	9960	3	2	2	1.0	0.0	1.0	0.0	0.0	2	
3	4340000.0	7500	4	2	2	1.0	0.0	1.0	0.0	1.0	3	
4	4340000.0	7420	4	1	2	1.0	1.0	1.0	0.0	1.0	2	
...	...	...	...	...	...	...	...	...	...	...	...	...
540	1820000.0	3000	2	1	1	1.0	0.0	1.0	0.0	0.0	2	
541	1767150.0	2400	3	1	1	0.0	0.0	0.0	0.0	0.0	0	
542	1750000.0	3620	2	1	1	1.0	0.0	0.0	0.0	0.0	0	
543	1750000.0	2910	3	1	1	0.0	0.0	0.0	0.0	0.0	0	
544	1750000.0	3850	3	1	2	1.0	0.0	0.0	0.0	0.0	0	

545 rows × 12 columns

In [30]:
```
# Split the data into dependent and independent variables
X = dataset1.drop('price', axis=1)  # Independent variables (features)
```

In [31]:
```
display(X)
```

	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	furnishingstatus
0	7420	4	2	3	1.0	0.0	0.0	0.0	1.0	2	0.0
1	8960	4	4	4	1.0	0.0	0.0	0.0	1.0	3	0.0
2	9960	3	2	2	1.0	0.0	1.0	0.0	0.0	2	1.0
3	7500	4	2	2	1.0	0.0	1.0	0.0	1.0	3	0.0
4	7420	4	1	2	1.0	1.0	1.0	0.0	1.0	2	0.0
...	...	...	...	...	...	...	...	...	...	...	...
540	3000	2	1	1	1.0	0.0	1.0	0.0	0.0	2	2.0
541	2400	3	1	1	0.0	0.0	0.0	0.0	0.0	0	1.0
542	3620	2	1	1	1.0	0.0	0.0	0.0	0.0	0	2.0
543	2910	3	1	1	0.0	0.0	0.0	0.0	0.0	0	0.0
544	3850	3	1	2	1.0	0.0	0.0	0.0	0.0	0	2.0

545 rows × 11 columns

```
0      4340000.0
1      4340000.0
2      4340000.0
3      4340000.0
4      4340000.0
         ...
540    1820000.0
541    1767150.0
542    1750000.0
543    1750000.0
544    1750000.0
Name: price, Length: 545, dtype: float64
```

In [32]:
```
# Minmax Scaling (Scaling values between 0 and 1)
name = X.columns
name
from sklearn.preprocessing import MinMaxScaler
scale = MinMaxScaler()
X_scaled = scale.fit_transform(X)
X_scaled
X = pd.DataFrame(X_scaled,columns=name)
```

Out[32]:

	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	furnishings
0	0.396564	0.6	0.333333	0.666667	1.0	0.0	0.0	0.0	1.0	0.666667	
1	0.502405	0.6	1.000000	1.000000	1.0	0.0	0.0	0.0	1.0	1.000000	
2	0.571134	0.4	0.333333	0.333333	1.0	0.0	1.0	0.0	0.0	0.666667	
3	0.402062	0.6	0.333333	0.333333	1.0	0.0	1.0	0.0	1.0	1.000000	
4	0.396564	0.6	0.000000	0.333333	1.0	1.0	1.0	0.0	1.0	0.666667	
...	...	...	...	...	...	...	...	...	...	...	
540	0.092784	0.2	0.000000	0.000000	1.0	0.0	1.0	0.0	0.0	0.666667	
541	0.051546	0.4	0.000000	0.000000	0.0	0.0	0.0	0.0	0.0	0.000000	
542	0.135395	0.2	0.000000	0.000000	1.0	0.0	0.0	0.0	0.0	0.000000	
543	0.086598	0.4	0.000000	0.000000	0.0	0.0	0.0	0.0	0.0	0.000000	
544	0.151203	0.4	0.000000	0.333333	1.0	0.0	0.0	0.0	0.0	0.000000	

545 rows × 11 columns

In [33]:
```
from sklearn.preprocessing import StandardScaler

# Scale the independent variables
scaler = StandardScaler()
X_scaled = scaler.fit_transform(X)
```

Split the data into training and testing

In [34]:
```
from sklearn.model_selection import train_test_split
```

In [35]:

Out[35]:

	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	furnishingstat
542	0.135395	0.2	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	
496	0.161512	0.2	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	
484	0.095533	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
507	0.134021	0.2	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	
252	0.564261	0.4	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	

In [36]:

Out[36]:

	area	bedrooms	bathrooms	stories	mainroad	guestroom	basement	hotwaterheating	airconditioning	parking	furnishings
239	0.161512	0.4	0.0	0.333333	1.0	0.0	0.0	0.0	0.0	0.333333	
113	0.547766	0.4	0.0	0.000000	1.0	0.0	1.0	0.0	0.0	0.666667	
325	0.124399	0.6	0.0	0.333333	1.0	0.0	0.0	0.0	1.0	0.000000	
66	0.793814	0.2	0.0	0.000000	1.0	0.0	1.0	1.0	0.0	0.333333	
479	0.138144	0.6	0.0	0.333333	0.0	0.0	0.0	0.0	0.0	0.000000	

In [37]:
```
y_test
```

Out[37]:
```
239    4585000.0
113    6083000.0
325    4007500.0
66     6930000.0
479    2940000.0
         ...
76     6650000.0
132    5810000.0
311    4123000.0
464    3080000.0
155    5530000.0
Name: price, Length: 109, dtype: float64
```

In [38]:

```
Out[38]: 542    1750000.0
         496    2695000.0
         484    2870000.0
         507    2590000.0
         252    4515000.0
                  ...
         70     6790000.0
         277    4305000.0
         9      4340000.0
         359    3710000.0
         192    5040000.0
         Name: price, Length: 436, dtype: float64
```

Build the Model

Train the Model

In [39]:

```
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression

# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X_scaled, y, test_size=0.2, random_state=42)

# Train the regression model
model = LinearRegression()
model.fit(X_train, y_train)
```

Out[39]:

```
LinearRegression()
```

In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

Test the Model

In [40]:
```
# Test the model
y_pred = model.predict(X_test)
```

In [41]:

```
array([4762820.38139376, 6238793.29440677, 3291921.32627299,
       4685677.04447131, 3451971.55553113, 3694756.41459477,
       5392435.48905113, 5622691.6218176 , 2976131.89129328,
       2693763.08944725, 7882542.21676693, 3103913.61011644,
       3263542.77968098, 3597702.85881814, 4108771.95236896,
       4589288.18309793, 3350227.37232082, 4873437.72971142,
       4645694.93839739, 3700013.039294  , 5490012.92294426,
       5453236.24569591, 3044573.74368226, 4585956.09718913,
       5119258.11839377, 6404672.9527739 , 3798814.73111835,
       5197584.02323963, 7353451.75526719, 3724374.88002879,
       5572814.76918884, 3573742.84830762, 6501780.04257737,
       4321886.3722662 , 3783611.9999477 , 5339690.24873999,
       5073527.33363741, 4655105.50597372, 3224341.94966872,
       4293374.45511416, 4414014.69253638, 3740667.66791876,
       6222136.48979367, 4130484.61067289, 3856170.58254184,
       4355669.42557111, 6451805.37921262, 4066929.16982781,
       3960906.20746056, 3703960.20416716, 6883953.91946355,
       3054933.49387899, 4379970.36902361, 4589246.85487955,
       4050832.21716695, 2737487.20155664, 6746395.2693755 ,
       3278343.52916918, 4298301.29657872, 3076013.46238949,
       4499184.6143045 , 3319113.22017442, 4928139.61285975,
       4521125.67727923, 4185621.45509501, 4602224.30242505,
       6535387.99736357, 3906808.19643509, 5940946.81920434,
       5675913.5361094 , 3971522.04407167, 4751847.37124387,
       4511142.70535179, 6754551.10798619, 3689189.03098935,
       5017931.90955659, 3991355.50538087, 4153334.03629454,
       4722258.06611788, 3603284.2546168 , 6511389.62540193,
       4085050.03132957, 5526030.7589582 , 5153993.67174309,
       3132596.48880453, 6219308.12117022, 2878572.98855276,
       3808389.61738087, 6732092.28652554, 7133633.12451642,
       3370431.00756401, 6019719.09399876, 3751434.95762312,
       3858759.25935838, 6393090.20794218, 4958802.78038213,
       5501995.54507821, 6244225.91763567, 4552337.34922935,
       4941826.02392766, 3910153.582892  , 6018207.5534072 ,
       4046015.27576366, 5318826.96320574, 4999121.55853871,
       4213803.85849454, 6608063.04066019, 5998276.10647177,
       5283865.01655397])
```

Measure the performance using Metrics.

In [42]:
```
from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_score

# Calculate evaluation metrics
mae = mean_absolute_error(y_test, y_pred)
mse = mean_squared_error(y_test, y_pred)
rmse = np.sqrt(mse)
r2 = r2_score(y_test, y_pred)

print("Mean Absolute Error (MAE):", mae)
print("Mean Squared Error (MSE):", mse)
print("Root Mean Squared Error (RMSE):", rmse)
print("R-squared (R2):", r2)
```

```
Mean Absolute Error (MAE): 983227.0624552093
Mean Squared Error (MSE): 1632793740796.799
Root Mean Squared Error (RMSE): 1277808.1784042546
R-squared (R2): 0.45115335372870646
```

In [ ]: