Real Estate House Price Prediction

Linear Regression

In [ ]:
```
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error, r2_score
import matplotlib.pyplot as plt
import seaborn as sns
```

In [2]:
```
df = pd.read_csv('./Data/Real estate.csv')
```

In [3]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 414 entries, 0 to 413
Data columns (total 8 columns):
 #   Column                                  Non-Null Count  Dtype  
---  ------                                  --------------  -----  
 0   No                                      414 non-null    int64  
 1   X1 transaction date                     414 non-null    float64
 2   X2 house age                            414 non-null    float64
 3   X3 distance to the nearest MRT station  414 non-null    float64
 4   X4 number of convenience stores         414 non-null    int64  
 5   X5 latitude                             414 non-null    float64
 6   X6 longitude                            414 non-null    float64
 7   Y house price of unit area              414 non-null    float64
dtypes: float64(6), int64(2)
memory usage: 26.0 KB
```

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

Out[4]:

	No	X1 transaction date	X2 house age	X3 distance to the nearest MRT station	X4 number of convenience stores	X5 latitude	lon
count	414.000000	414.000000	414.000000	414.000000	414.000000	414.000000	414.
mean	207.500000	2013.148971	17.712560	1083.885689	4.094203	24.969030	121.
std	119.655756	0.281967	11.392485	1262.109595	2.945562	0.012410	0.
min	1.000000	2012.667000	0.000000	23.382840	0.000000	24.932070	121.
25%	104.250000	2012.917000	9.025000	289.324800	1.000000	24.963000	121.
50%	207.500000	2013.167000	16.100000	492.231300	4.000000	24.971100	121.
75%	310.750000	2013.417000	28.150000	1454.279000	6.000000	24.977455	121.
max	414.000000	2013.583000	43.800000	6488.021000	10.000000	25.014590	121.

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

Out[5]:

	No	X1 transaction date	X2 house age	X3 distance to the nearest MRT station	X4 number of convenience stores	X5 latitude	X6 longitude	Y house price of unit area
0	1	2012.917	32.0	84.87882	10	24.98298	121.54024	37.9
1	2	2012.917	19.5	306.59470	9	24.98034	121.53951	42.2
2	3	2013.583	13.3	561.98450	5	24.98746	121.54391	47.3
3	4	2013.500	13.3	561.98450	5	24.98746	121.54391	54.8
4	5	2012.833	5.0	390.56840	5	24.97937	121.54245	43.1

In [6]:
```
df= df.drop('No', axis=1)
```

In [7]:
```
df.columns
```

Out[7]:
```
Index(['X1 transaction date', 'X2 house age',
       'X3 distance to the nearest MRT station',
       'X4 number of convenience stores', 'X5 latitude', 'X6 longitude',
       'Y house price of unit area'],
      dtype='object')
```

In [8]:
```
df.columns = ['transaction date','house age','distance to the nearest MRT statio
```

In [9]:
```
df.head()
```

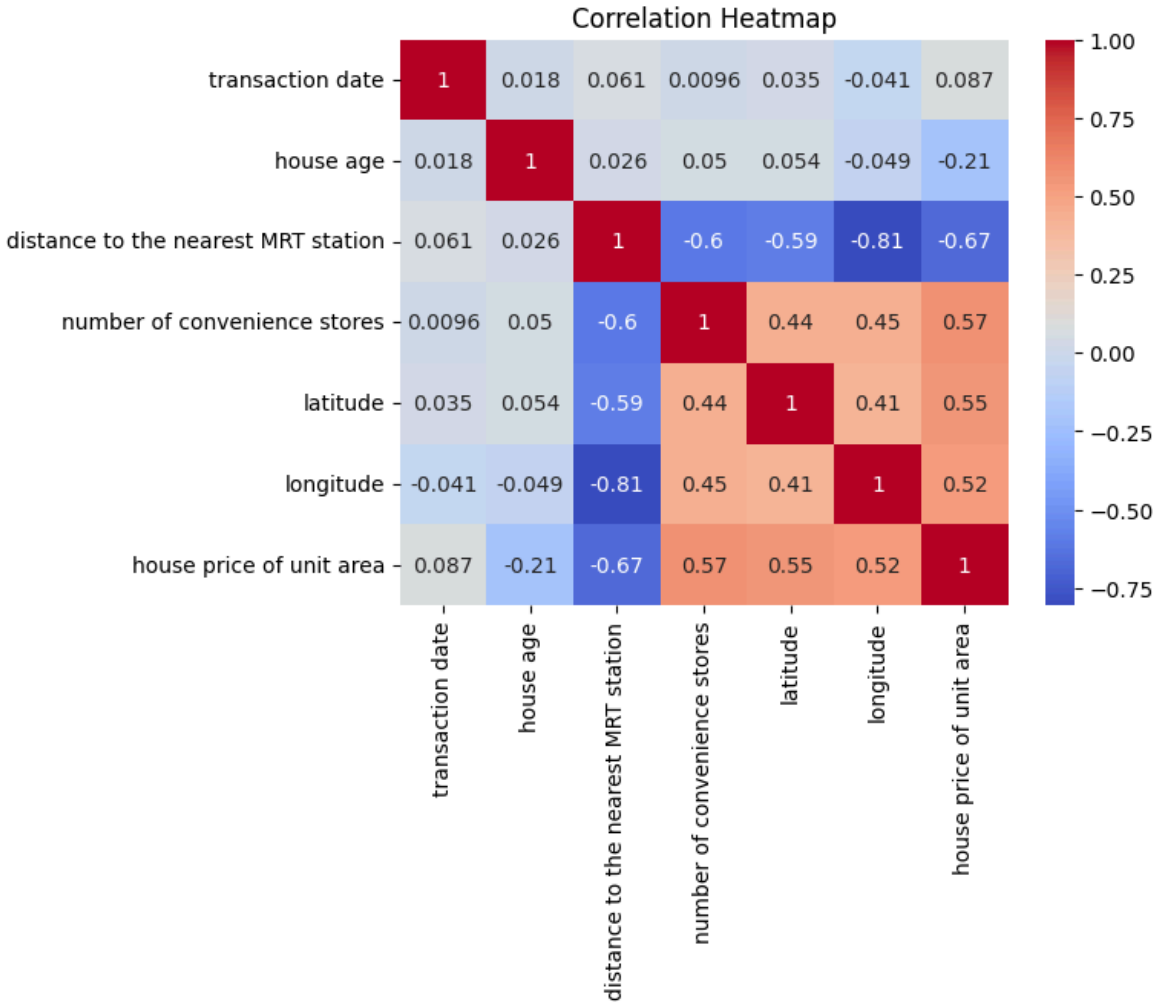
Out[9]:

	transaction date	house age	distance to the nearest MRT station	number of convenience stores	latitude	longitude	house price of unit area
0	2012.917	32.0	84.87882	10	24.98298	121.54024	37.9
1	2012.917	19.5	306.59470	9	24.98034	121.53951	42.2
2	2013.583	13.3	561.98450	5	24.98746	121.54391	47.3
3	2013.500	13.3	561.98450	5	24.98746	121.54391	54.8
4	2012.833	5.0	390.56840	5	24.97937	121.54245	43.1

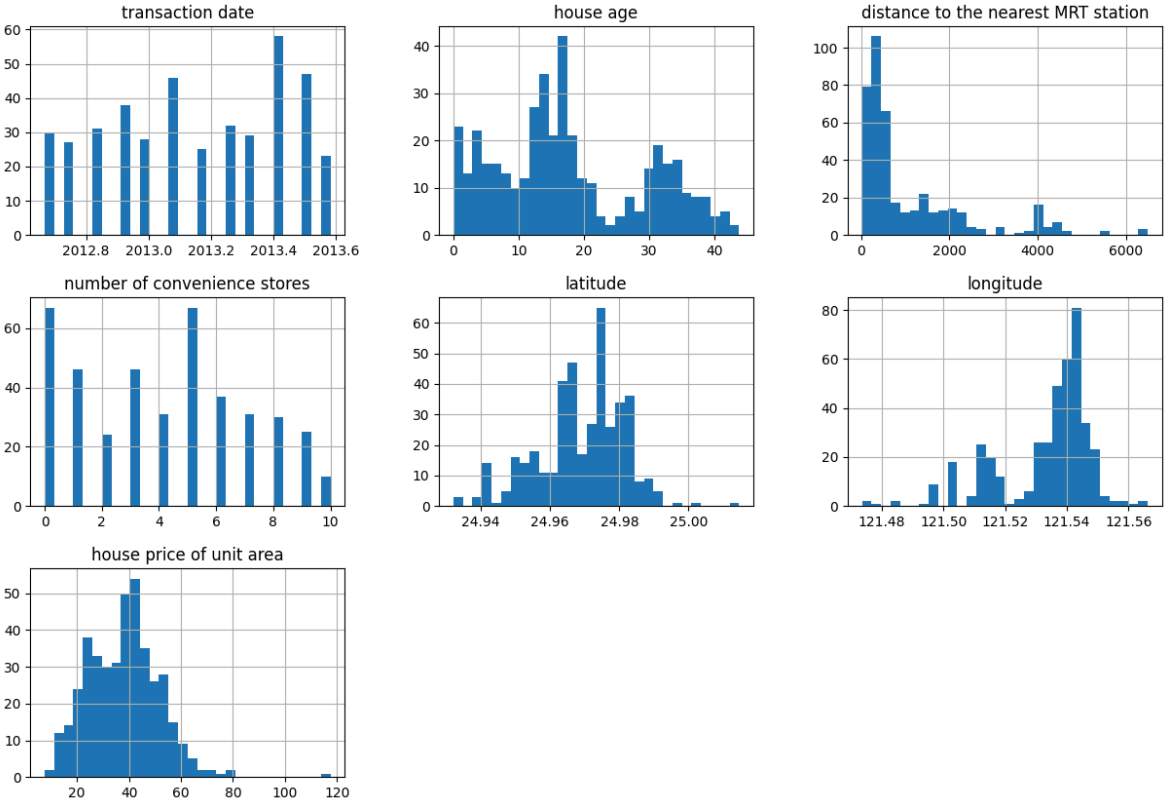
In [10]:
```
df.isna().sum()
```

Out[10]:
```
transaction date                        0
house age                               0
distance to the nearest MRT station     0
number of convenience stores            0
latitude                                0
longitude                               0
house price of unit area                0
dtype: int64
```

In [11]:
```
correlation_matrix = df.corr()
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm')
plt.title('Correlation Heatmap')
plt.show()
```

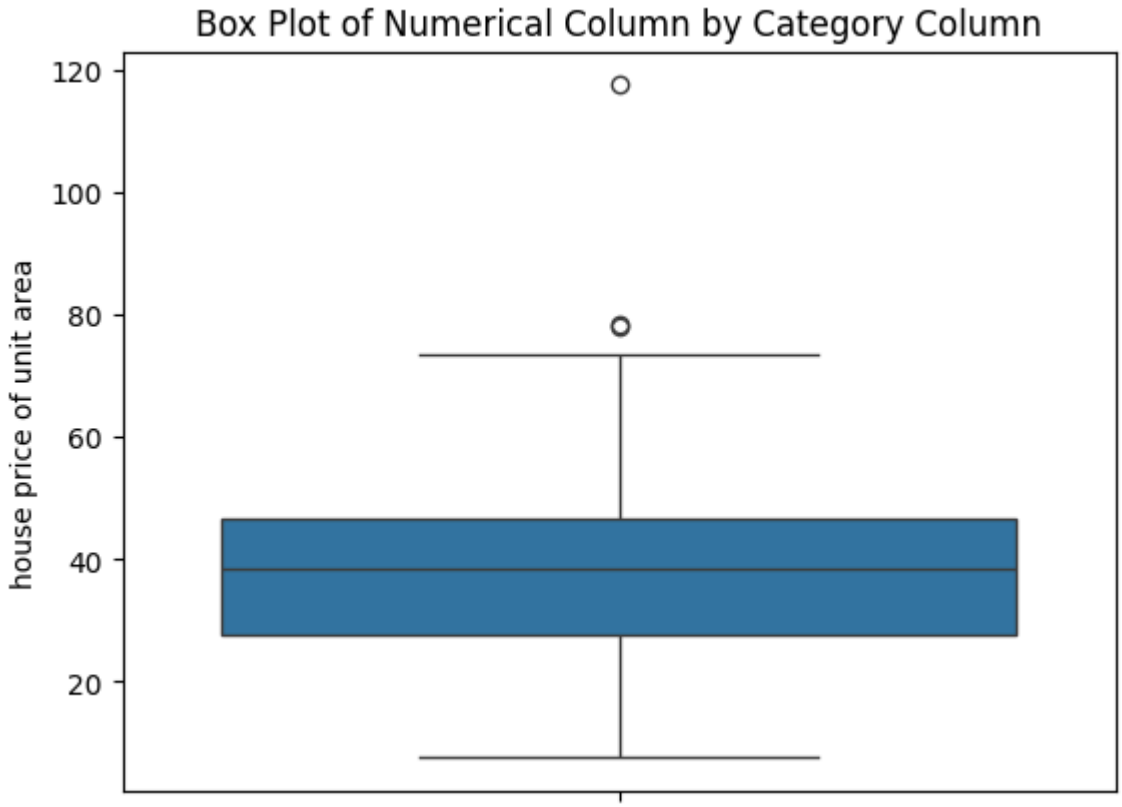


In [12]:
```
df.hist(bins=30,figsize=(15, 10))
plt.figure(figsize=(10,15))
plt.show()
```



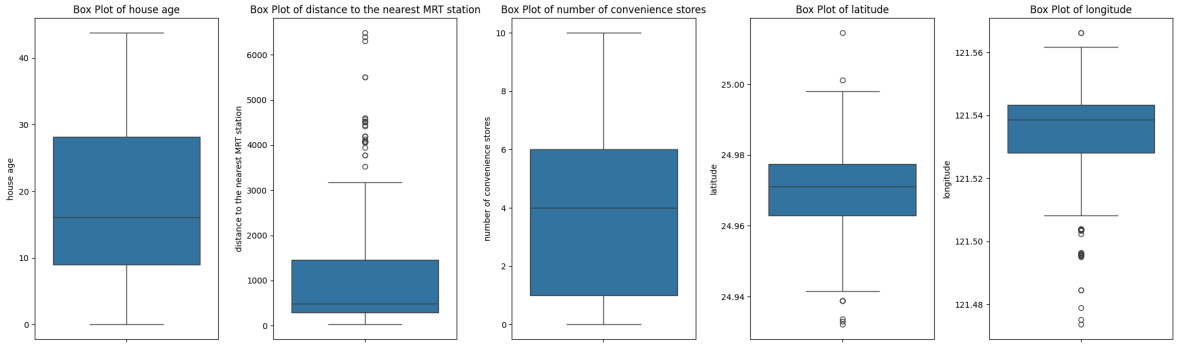
<Figure size 1000x1500 with 0 Axes>

In [13]:
```
sns.boxplot( y='house price of unit area', data=df)
plt.title('Box Plot of Numerical Column by Category Column')
plt.show()
```

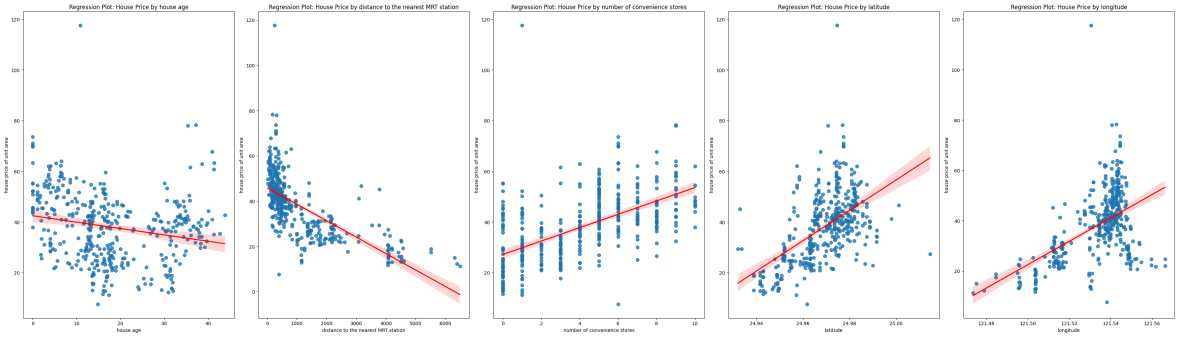


In [14]:
```
numerical_columns = ['house age', 'distance to the nearest MRT station',
                     'number of convenience stores', 'latitude', 'longitude']

fig, axes = plt.subplots(1, 5, figsize=(20, 6))
for i, column in enumerate(numerical_columns):
```

```
    sns.boxplot(y=column, data=df, ax=axes[i])
    axes[i].set_title(f'Box Plot of {column}')

plt.tight_layout()
plt.show()
```



In [15]:
```
numerical_columns = ['house age', 'distance to the nearest MRT station',
                     'number of convenience stores', 'latitude', 'longitude']
fig, axes = plt.subplots(1, 5, figsize=(35, 10))
for i, column in enumerate(numerical_columns):
    sns.regplot(x=column, y='house price of unit area', data=df,
                scatter_kws={'s': 50}, line_kws={'color': 'red'}, ax=axes[i])
    axes[i].set_title(f'Regression Plot: House Price by {column}')
plt.tight_layout()
plt.show()
```



In [16]:
```
df = df.drop('transaction date', axis=1)
```

In [17]:
```
X = df.drop('house price of unit area', axis=1)
y = df['house price of unit area']
```

In [18]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_
```

In [19]:
```
# Instantiate the model
model = LinearRegression()

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

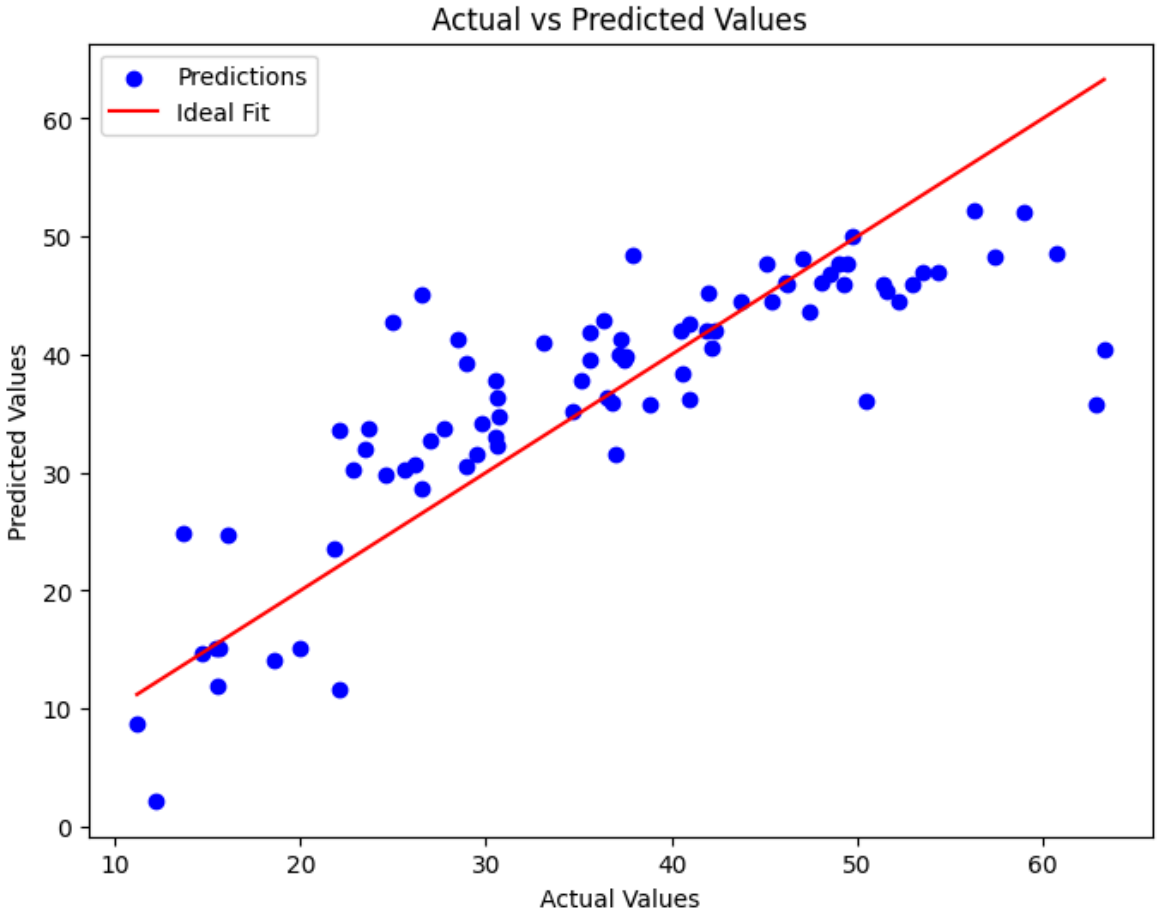
Out[19]:
```
LinearRegression()
```

In [20]:
```
# Predict on test data
y_pred = model.predict(X_test)
```

```
# Calculate evaluation metrics
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

print(f'Mean Squared Error: {mse}')
print(f'R-squared: {r2}')
```

```
Mean Squared Error: 54.58094520086278
R-squared: 0.6746481382828138
```

In [21]:
```
plt.figure(figsize=(8, 6))
plt.scatter(y_test, y_pred, color='blue', label='Predictions')
plt.plot([min(y_test), max(y_test)], [min(y_test), max(y_test)], color='red', la
plt.xlabel('Actual Values')
plt.ylabel('Predicted Values')
plt.title('Actual vs Predicted Values')
plt.legend()
plt.show()
```



Summary

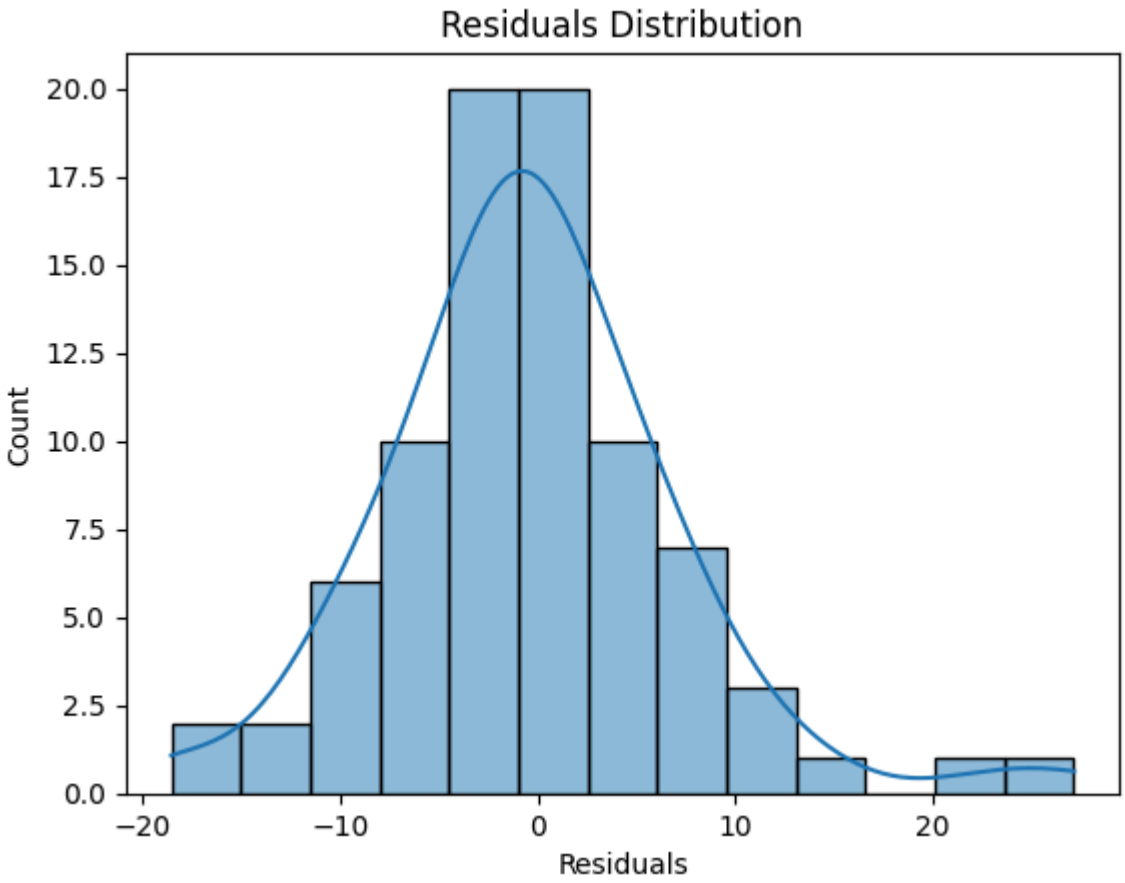
MSE = 54.58 indicates the average squared error between predicted and actual values.

R^2 = 0.675 suggests that your model explains 67.5% of the variance in the target variable, which is a decent fit but still leaves room for improvement.

In [22]:
```
# Intercept and Coefficients
print("Intercept:", model.intercept_)
print("Coefficients:", model.coef_)
```

```
Intercept: -2946.658859024451
Coefficients: [-2.70593236e-01 -4.55249601e-03  1.10512079e+00  2.36092831e+02
 -2.39036942e+01]
```

In [23]:
```
# Residuals plot
residuals = y_test - y_pred
sns.histplot(residuals, kde=True)
plt.title('Residuals Distribution')
plt.xlabel('Residuals')
plt.show()
```

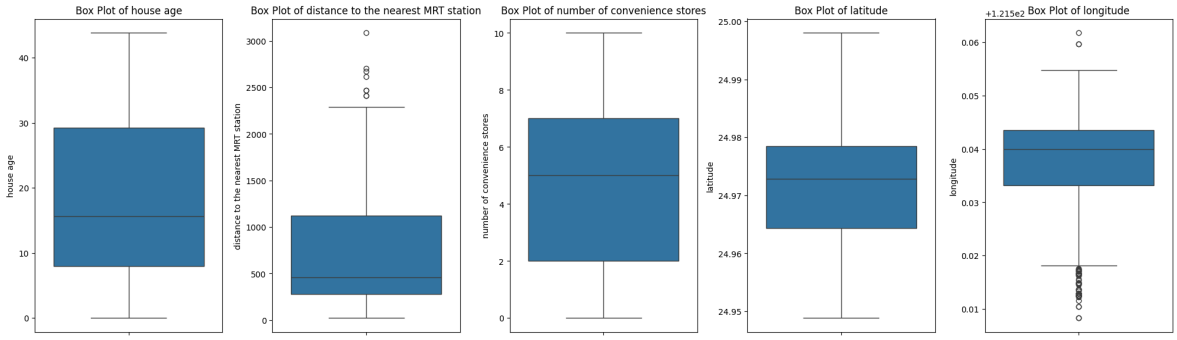


Improving Model Performance

In [24]:
```
numerical_columns = ['house age', 'distance to the nearest MRT station',
                     'number of convenience stores', 'latitude', 'longitude']

# Calculate Q1 (25th percentile) and Q3 (75th percentile) for each column
Q1 = df[numerical_columns].quantile(0.25)
Q3 = df[numerical_columns].quantile(0.75)
IQR = Q3 - Q1

# Define the range for normal data
df1 = df[~((df[numerical_columns] < (Q1 - 1.5 * IQR)) | (df[numerical_columns] >
```

In [25]:
```
fig, axes = plt.subplots(1, 5, figsize=(20, 6))
for i, column in enumerate(numerical_columns):
    sns.boxplot(y=column, data=df1, ax=axes[i])
    axes[i].set_title(f'Box Plot of {column}')
```

```
plt.tight_layout()
plt.show()
```



In [26]:
```
df1.columns
```

Out[26]:
```
Index(['house age', 'distance to the nearest MRT station',
       'number of convenience stores', 'latitude', 'longitude',
       'house price of unit area'],
      dtype='object')
```

In [27]:
```
X1 = df.drop('house price of unit area', axis=1)
y1 = df['house price of unit area']
```

In [28]:
```
X_train, X_test, y_train, y_test = train_test_split(X1, y1, test_size=0.2, randc
```

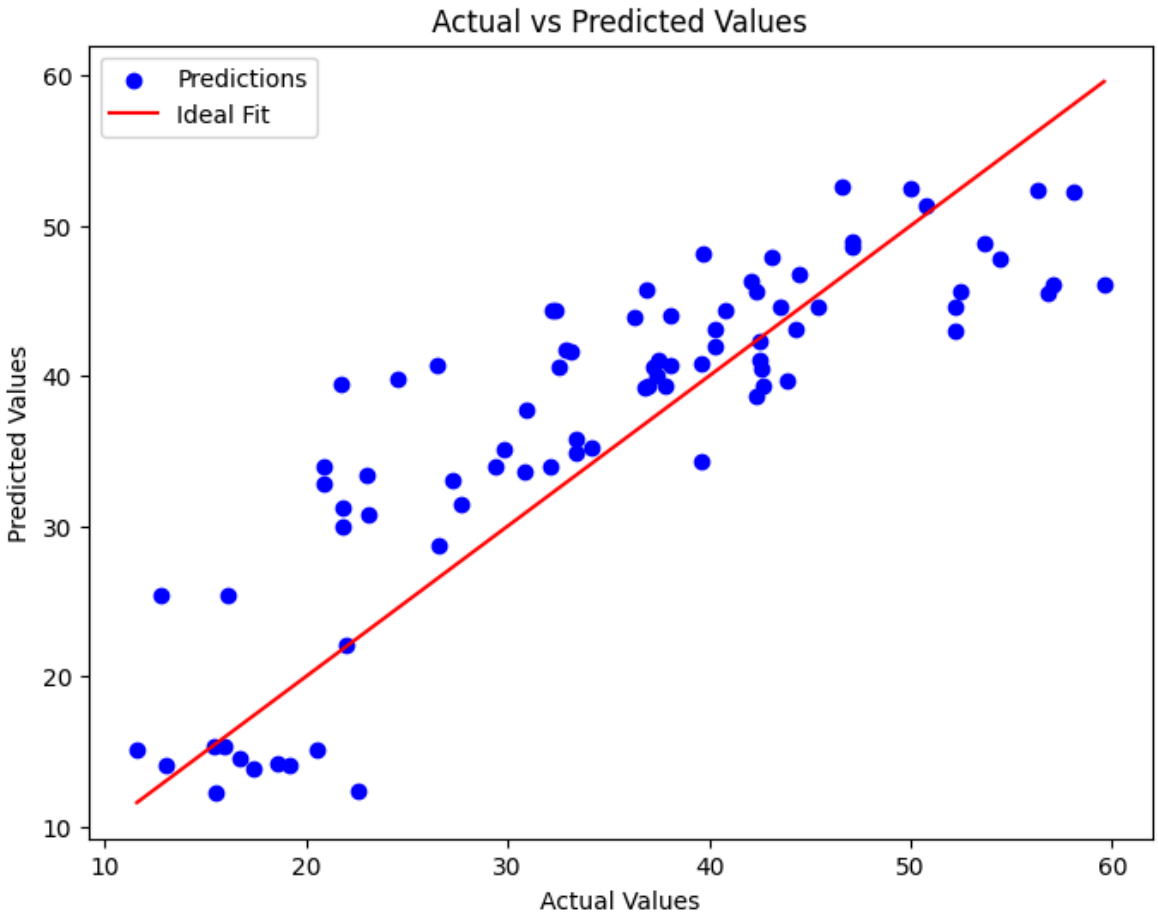
In [29]:
```
# Instantiate the model
model1 = LinearRegression()

# Train the model
model1.fit(X_train, y_train)
```

Out[29]:
```
LinearRegression
LinearRegression()
```

In [30]:
```
y_pred = model1.predict(X_test)
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

print(f'Mean Squared Error: {mse}')
print(f'R-squared: {r2}')
```

```
Mean Squared Error: 45.424791224614694
R-squared: 0.7007314553053445
```

In [31]:
```
plt.figure(figsize=(8, 6))
plt.scatter(y_test, y_pred, color='blue', label='Predictions')
plt.plot([min(y_test), max(y_test)], [min(y_test), max(y_test)], color='red', la
plt.xlabel('Actual Values')
plt.ylabel('Predicted Values')
plt.title('Actual vs Predicted Values')
plt.legend()
plt.show()
```


Actual vs Predicted Values
Predictions
Ideal Fit
Predicted Values
Actual Values
10
20
30
40
50
60