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# Import necessary libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split

# Load the dataset
df = pd.read_csv("boston_housing.csv")

# Display basic information
print("Dataset shape:", df.shape)
print("First 5 rows:\n", df.head())
print("\nSummary statistics:\n", df.describe())

# Assign features (independent variables) to df_x by removing the target column 'price'
df_x = df.drop("price", axis=1)
print("\nFeature variables (df_x):\n", df_x.head())

# Assign target variable (dependent variable) to df_y
df_y = df["price"]
print("\nTarget variable (df_y):\n", df_y.head())

# Initialize the Linear Regression model
reg = LinearRegression()

# Split the data: 67% training and 33% testing
x_train, x_test, y_train, y_test = train_test_split(df_x, df_y, test_size=0.33, random_state=42)
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# Train the model using training data
reg.fit(x_train, y_train)

# Print the coefficients for each feature
print("\nModel Coefficients:\n", reg.coef_)

# Predict the prices using test data
y_pred = reg.predict(x_test)
print("\nPredicted Prices (first 5):\n", y_pred[:5])

# Compare first predicted vs actual price
print("\nPredicted vs Actual (first sample):")
print("Predicted:", y_pred[0])
print("Actual:", y_test.iloc[0])

# Calculate and print Mean Squared Error (MSE)
mse = np.mean((y_pred - y_test) ** 2)
print("\nMean Squared Error (MSE):", mse)
```