CHRIST
(DEEMED TO BE UNIVERSITY)
DELHI-NCR, INDIA

AI ML(MCA 475)

Lab Assignment-05

BY

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SUBMITTED TO

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Multiple Regression on Tips Dataset

Libraries Used

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import r2_score,mean_squared_error
from scipy import stats
```

```
df=pd.read_csv("C:/Users/samdc/OneDrive/Desktop/AI ML/tips - tips.csv")
```

Exploratory Dataset Analysis

```
df.head()
```

	total_bill	tip	sex	smoker	day	time	size
0	16.99	1.01	Female	No	Sun	Dinner	2
1	10.34	1.66	Male	No	Sun	Dinner	3
2	21.01	3.50	Male	No	Sun	Dinner	3
3	23.68	3.31	Male	No	Sun	Dinner	2
4	24.59	3.61	Female	No	Sun	Dinner	4

```
df.sample(7)
```

	total_bill	tip	sex	smoker	day	time	size
30	9.55	1.45	Male	No	Sat	Dinner	2
164	17.51	3.00	Female	Yes	Sun	Dinner	2
100	11.35	2.50	Female	Yes	Fri	Dinner	2
224	13.42	1.58	Male	Yes	Fri	Lunch	2
41	17.46	2.54	Male	No	Sun	Dinner	2
42	13.94	3.06	Male	No	Sun	Dinner	2
115	17.31	3.50	Female	No	Sun	Dinner	2

```
df.describe()
```

	total_bill	tip	size
count	244.000000	244.000000	244.000000
mean	19.785943	2.998279	2.569672
std	8.902412	1.383638	0.951100
min	3.070000	1.000000	1.000000
25%	13.347500	2.000000	2.000000
50%	17.795000	2.900000	2.000000
75%	24.127500	3.562500	3.000000
max	50.810000	10.000000	6.000000

```
df.dtypes
```

```
total_bill    float64
tip           float64
sex            object
smoker         object
day            object
time           object
size            int64
dtype: object
```

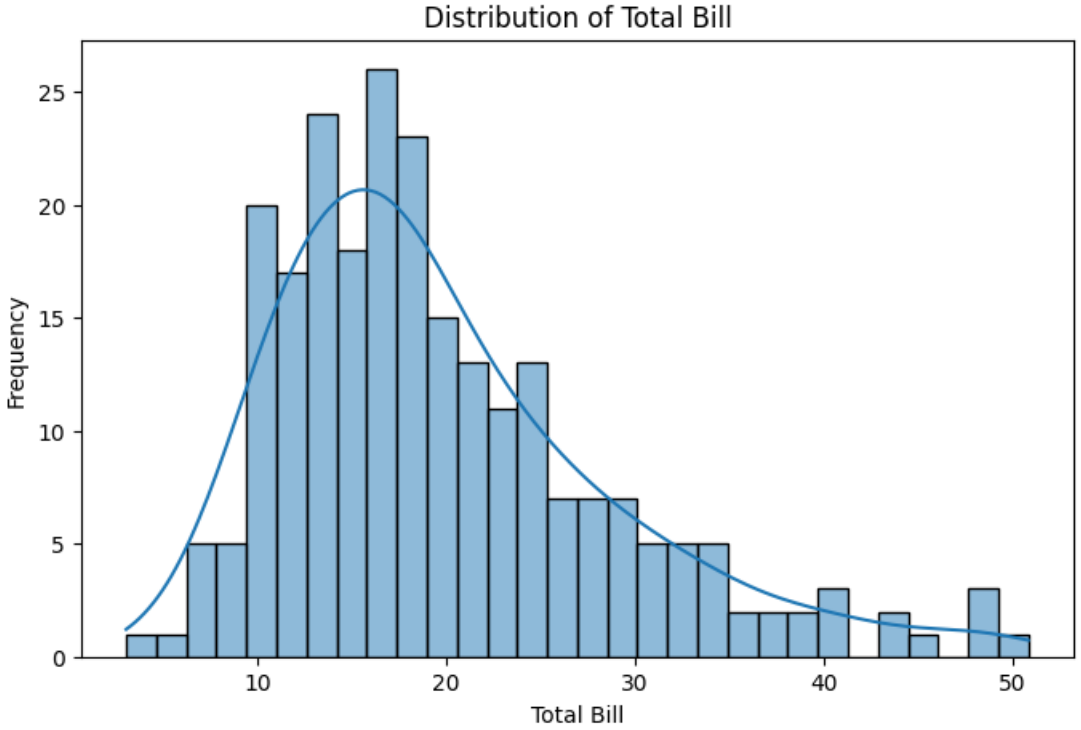
```
df.isnull().sum()
```

```
total_bill    0
tip           0
sex           0
smoker        0
day           0
time          0
size          0
dtype: int64
```

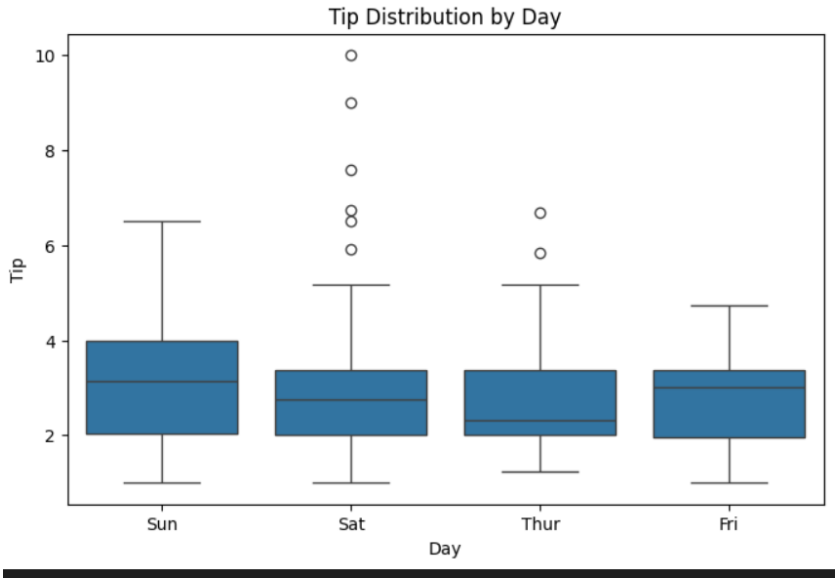
Visualization

```
plt.figure(figsize=(8, 5))
sns.histplot(df['total_bill'], bins=30, kde=True)
plt.title('Distribution of Total Bill')
```

```
plt.xlabel('Total Bill')
plt.ylabel('Frequency')
plt.show()
```

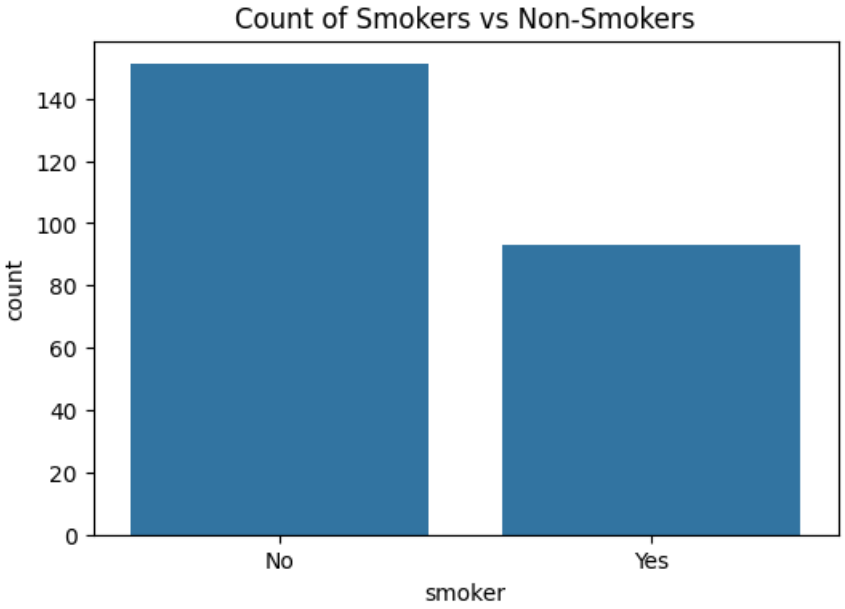



```
plt.figure(figsize=(8, 5))
sns.boxplot(x='day', y='tip', data=df)
plt.title('Tip Distribution by Day')
plt.xlabel('Day')
plt.ylabel('Tip')
plt.show()
```

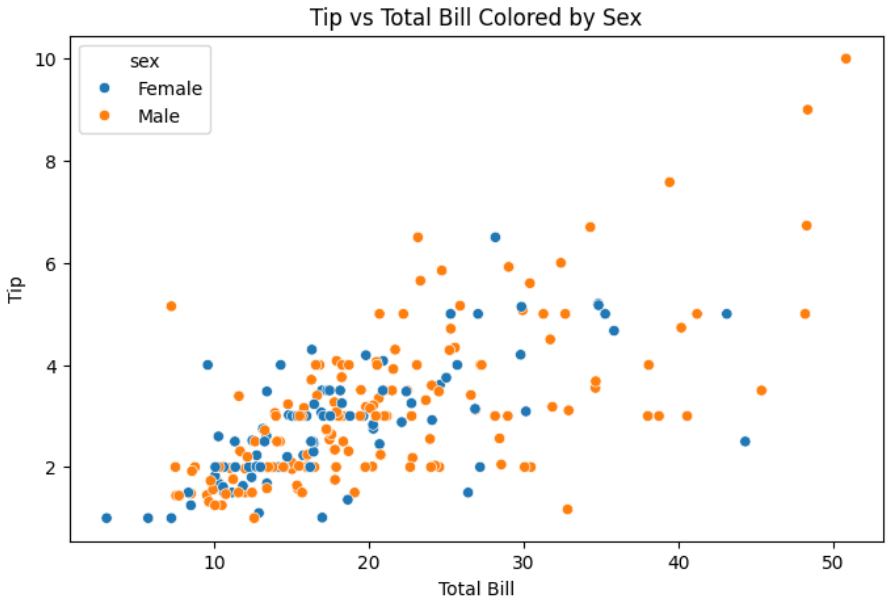



```
plt.figure(figsize=(6, 4))
sns.countplot(x='smoker', data=df)
```

```
plt.title('Count of Smokers vs Non-Smokers')
plt.show()
```

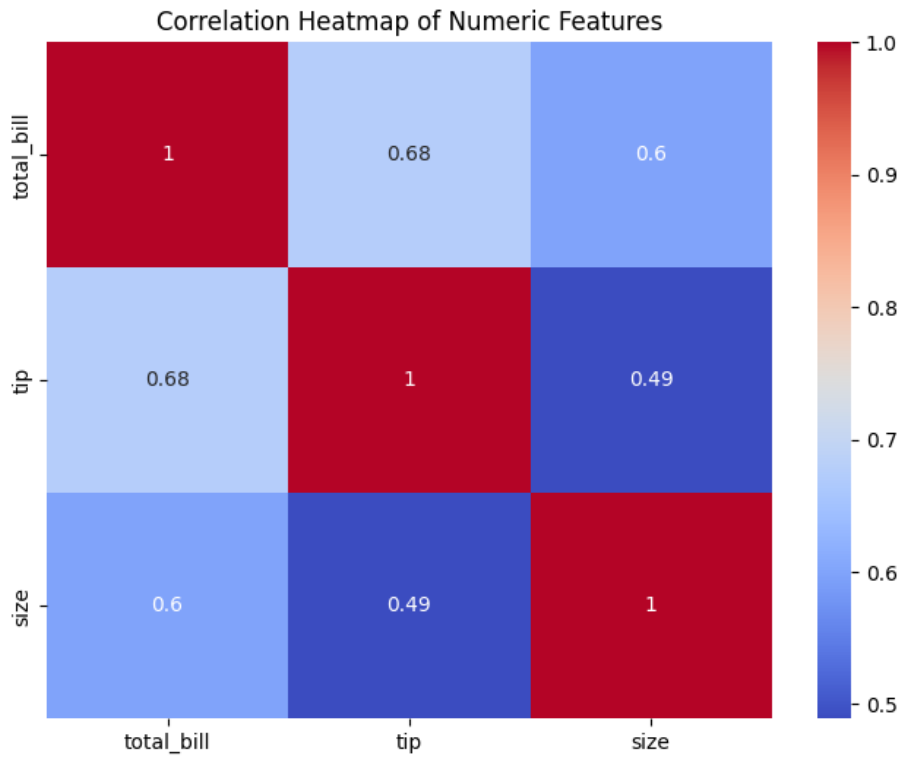



```
plt.figure(figsize=(8, 5))
sns.scatterplot(x='total_bill', y='tip', hue='sex', data=df)
plt.title('Tip vs Total Bill Colored by Sex')
plt.xlabel('Total Bill')
plt.ylabel('Tip')
plt.show()
```




```
numeric_df = df.select_dtypes(include=['float64', 'int64']) # Select only numeric columns
plt.figure(figsize=(8, 6))
sns.heatmap(numeric_df.corr(), annot=True, cmap='coolwarm')
```

```
plt.title('Correlation Heatmap of Numeric Features')
plt.show()
```



Outlier detection (IQR and Z-score) for numerical columns

```
num_cols=df.select_dtypes(include=[np.number]).columns
```

```
Q1=df[num_cols].quantile(0.25)
Q3=df[num_cols].quantile(0.75)
```

```
print("Quartile 1 :\n",Q1)
print("Quartile 3 :\n",Q3)
```

```
Quartile 1 :
 total_bill    13.3475
tip            2.0000
size           2.0000
Name: 0.25, dtype: float64
Quartile 3 :
 total_bill    24.1275
tip            3.5625
size           3.0000
Name: 0.75, dtype: float64
```

```
IQR=Q3-Q1
```

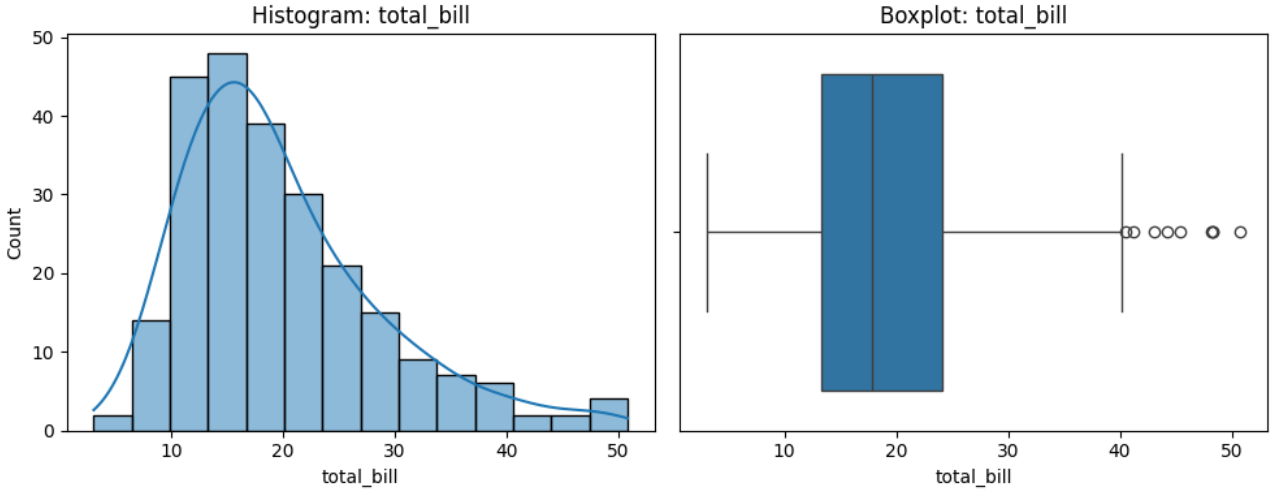
```
iqr_outlier_mask = (df[num_cols] < (Q1 - 1.5 * IQR)) | (df[num_cols] > (Q3 + 1.5 * IQR))
iqr_outlier=((df[num_cols]<Q1-(1.5*IQR)) | (df[num_cols]>Q3 +(1.5*IQR))).sum()
```

```
z = np.abs(stats.zscore(df[num_cols]))
zscore_outlier_mask = z > 3
outlier_zscore = (z > 3).sum(axis=0)
```

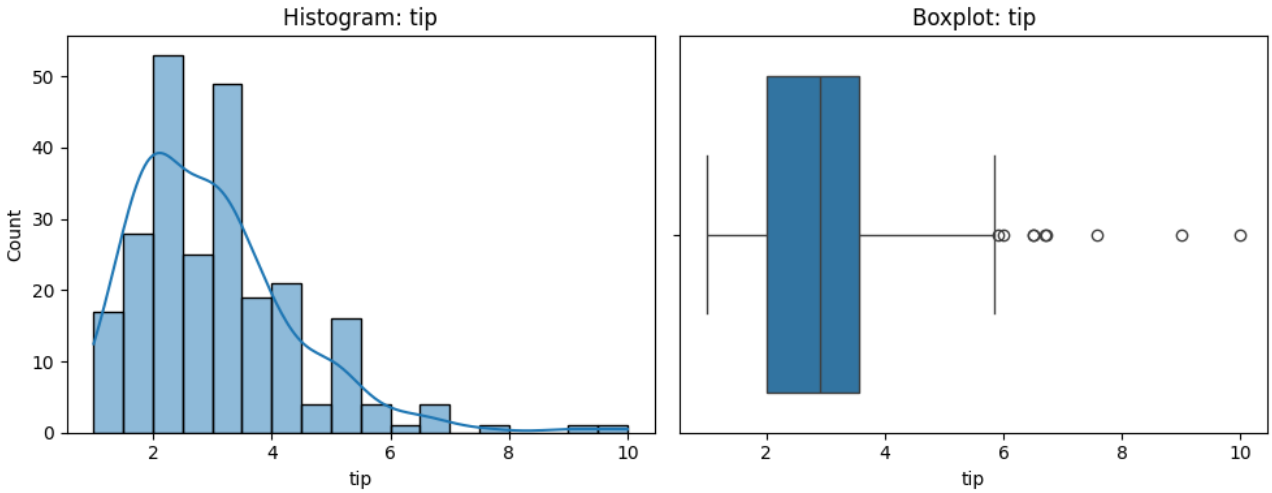
```
print("IQR outliers:\n", iqr_outlier)
print("Z-score outliers:\n", outlier_zscore)
```

```
IQR outliers:
 total_bill    9
tip            9
size           9
dtype: int64
Z-score outliers:
 total_bill    4
tip            3
size           4
dtype: int64
```

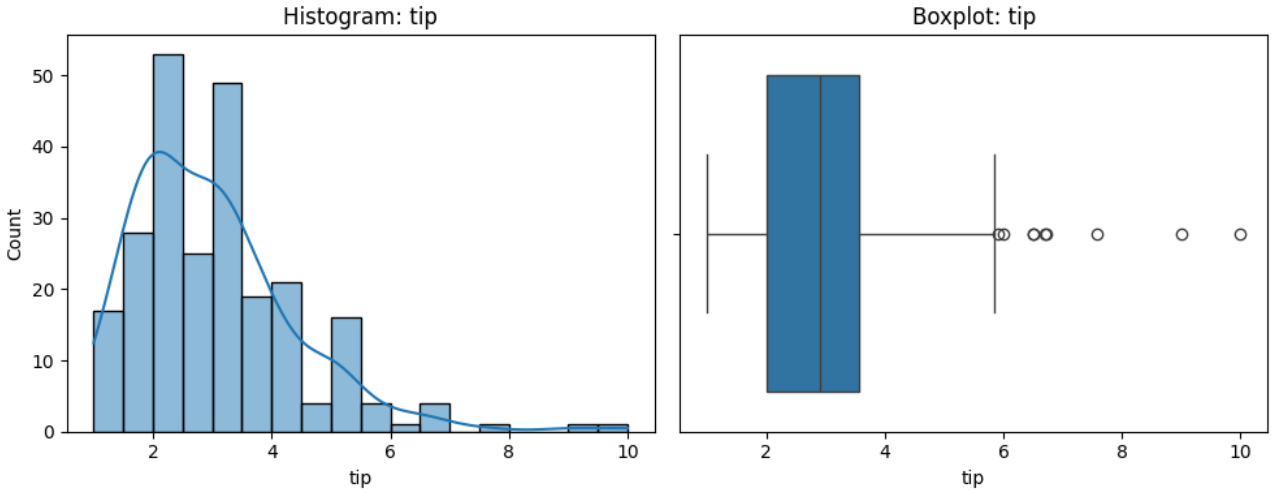
```
for col in num_cols:
    plt.figure(figsize=(10,4))
    plt.subplot(1,2,1)
    sns.histplot(df[col], kde=True)
    plt.title(f'Histogram: {col}')
    plt.subplot(1,2,2)
    sns.boxplot(x=df[col])
    plt.title(f'Boxplot: {col}')
    plt.tight_layout()
    plt.show()
```


Histogram: total_bill
Count
total_bill
0
10
20
30
40
50

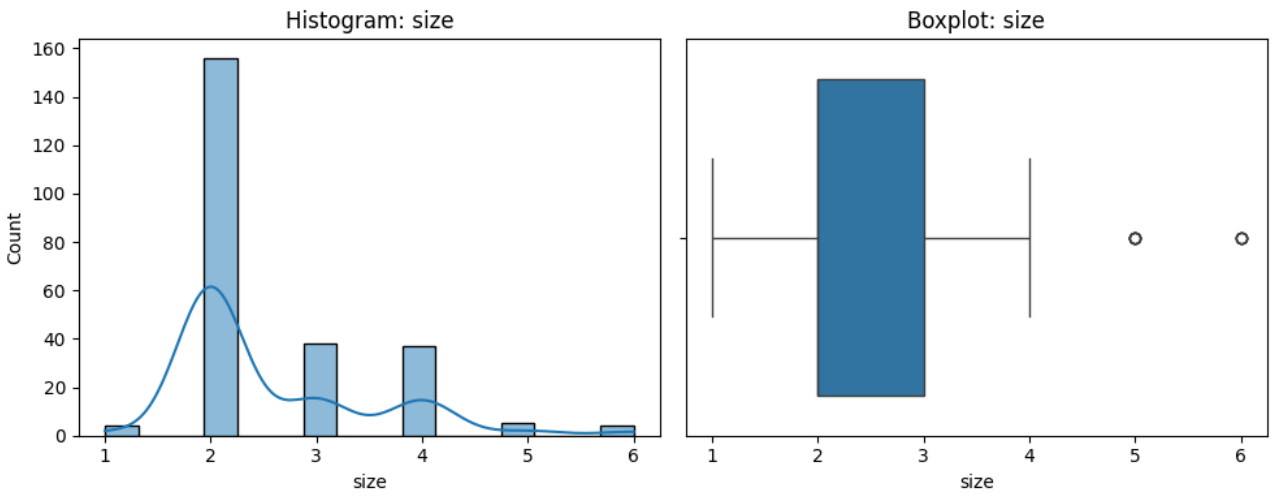
Boxplot: total_bill
total_bill
10
20
30
40
50


Histogram: tip
Count
tip
0
10
20
30
40
50
2
4
6
8
10

Boxplot: tip
tip
2
4
6
8
10


Histogram: tip
Count
tip
0
10
20
30
40
50
2
4
6
8
10

Boxplot: tip
tip
2
4
6
8
10




```
# Combine masks: rows with outliers by either method
combined_outlier_mask = iqr_outlier_mask.any(axis=1) | zscore_outlier_mask.any(axis=1)
```

```
# Create cleaned dataset by removing outlier rows
df_cleaned = df[~combined_outlier_mask].copy()

# Check shapes before and after
print("Original shape:", df.shape)
print("Cleaned shape:", df_cleaned.shape)
```

```
Original shape: (244, 7)
Cleaned shape: (223, 7)
```

Multilinear regression

```
X = pd.get_dummies(df_cleaned.drop('tip', axis=1), drop_first=True)
y = df_cleaned['tip']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

model = LinearRegression()
model.fit(X_train, y_train)

y_pred = model.predict(X_test)

print("Mean Squared Error:", mse)
```

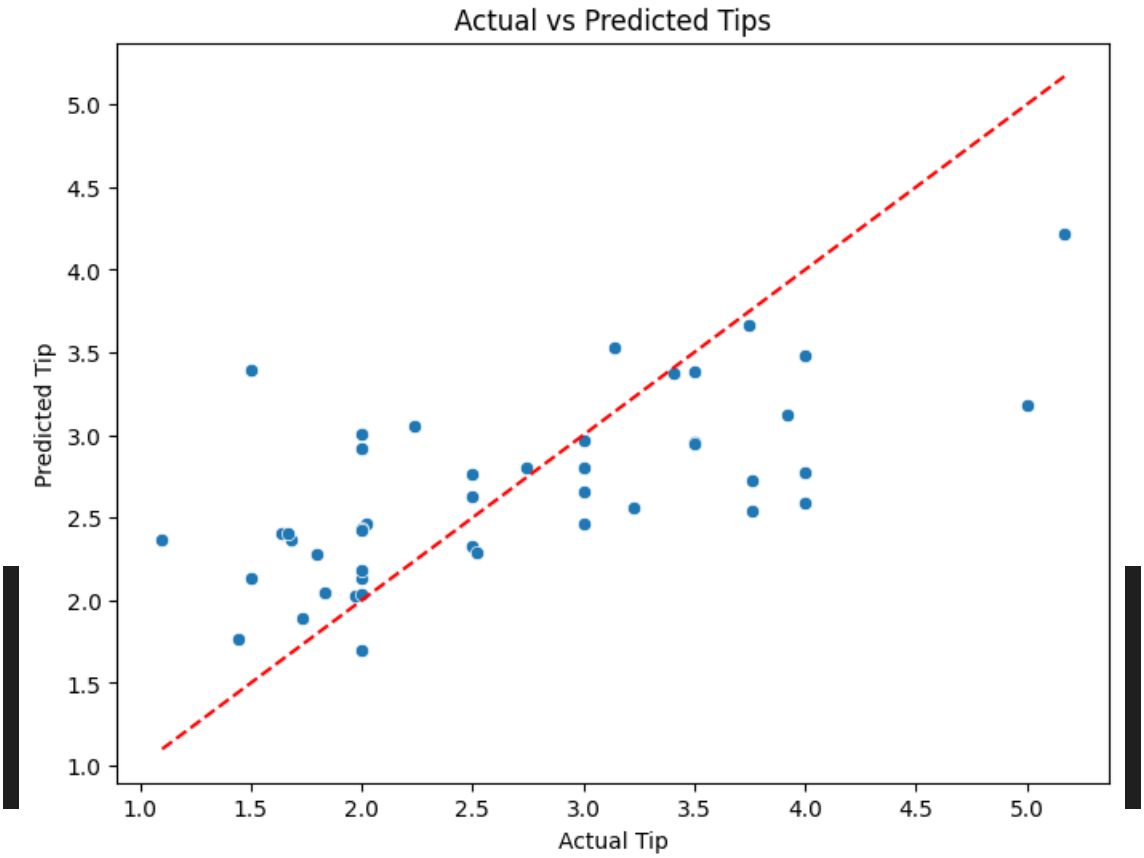
```
print("R-squared:", r2)
```

```
Mean Squared Error: 0.5302606901799164
R-squared: 0.4395689103225353
```

```
print("Coefficients:", model.coef_)
print("Intercept:", model.intercept_)
```

```
Coefficients: [ 0.08291921  0.03864524 -0.17358266  0.10149536 -0.08821967  0.22174651
 -0.06041716  0.02335491]
Intercept: 1.2112989953182727
```

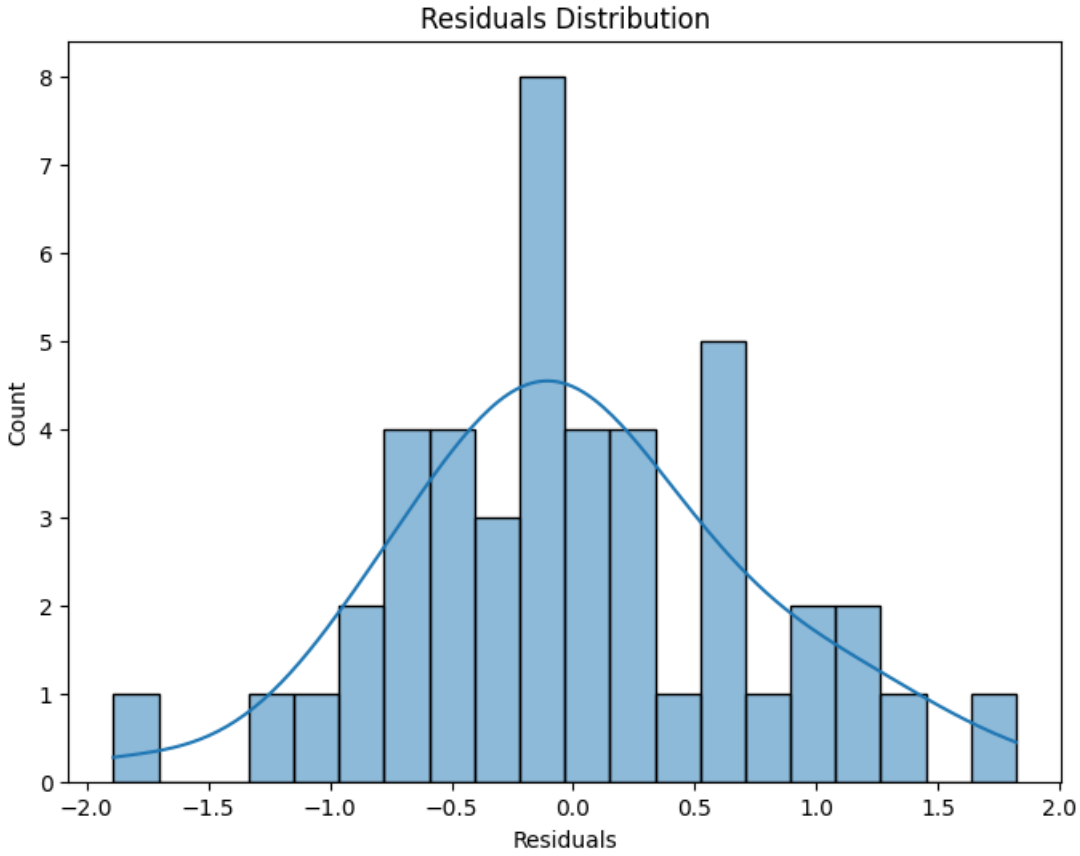
```
# Scatter plot: Actual vs Predicted
plt.figure(figsize=(8, 6))
sns.scatterplot(x=y_test, y=y_pred)
plt.xlabel('Actual Tip')
plt.ylabel('Predicted Tip')
plt.title('Actual vs Predicted Tips')
plt.plot([y_test.min(), y_test.max()], [y_test.min(), y_test.max()], 'r--')  # Perfect fit line
plt.show()
```



Histogram: Residuals

```
residuals = y_test - y_pred
```

```
plt.figure(figsize=(8, 6))
sns.histplot(residuals, kde=True, bins=20)
plt.title('Residuals Distribution')
plt.xlabel('Residuals')
plt.show()
```




```
plt.plot(y_test.values, label='Actual', color='red', linewidth=2)
plt.scatter(range(len(y_pred)), y_pred, label='Predicted', color='blue')
plt.title('Actual vs Predicted')
plt.xlabel('Sample Index')
plt.ylabel('Target Value')
plt.show()
```