```python
# PRACTICAL 6: Regression metrics and residual analysis
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```python
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```

```python
import numpy as np
from sklearn.metrics import mean_squared_error, r2_score, mean_absolute_error
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
```

```python
# Create sample data
np.random.seed(42)
X = np.random.rand(100, 1) * 10
y = 5 + 1.5 * X.flatten() + np.random.randn(100) * 2
```

```python
# Train-test split
X_train, X_test, y_train, y_test = train_test_split(
    X, y, test_size=0.3, random_state=42
)
```

```python
# Train model
model = LinearRegression()
model.fit(X_train, y_train)
y_pred = model.predict(X_test)
```

```python
# Metrics
print("--- Regression Model Evaluation Metrics ---")
mse = mean_squared_error(y_test, y_pred)
rmse = np.sqrt(mse)
mae = mean_absolute_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)
```
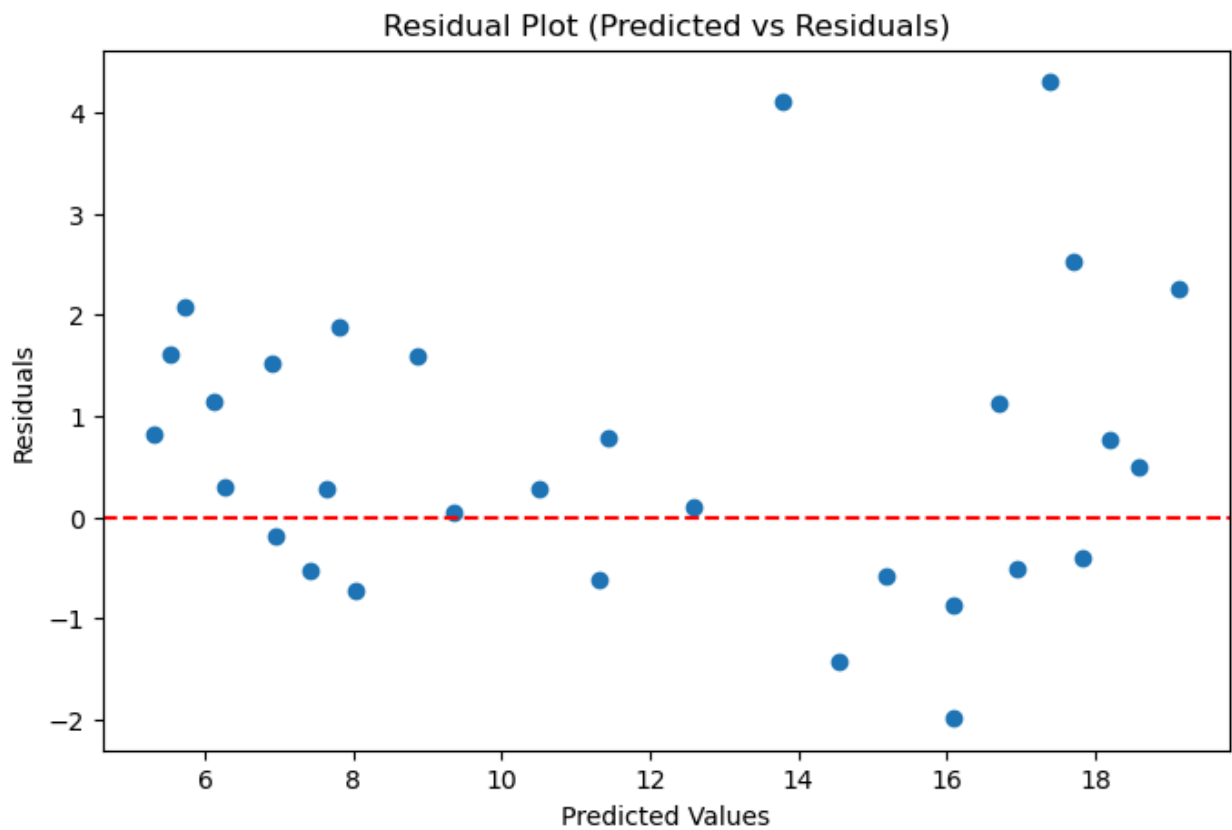
```
--- Regression Model Evaluation Metrics ---
```

```python
print(f"Mean Squared Error (MSE): {mse:.4f}")
print(f"Root Mean Squared Error (RMSE): {rmse:.4f}")
print(f"Mean Absolute Error (MAE): {mae:.4f}")
print(f"R-squared (R2 Score): {r2:.4f}")
```

```
Mean Squared Error (MSE): 2.5238
Root Mean Squared Error (RMSE): 1.5886
Mean Absolute Error (MAE): 1.1947
R-squared (R2 Score): 0.8963
```
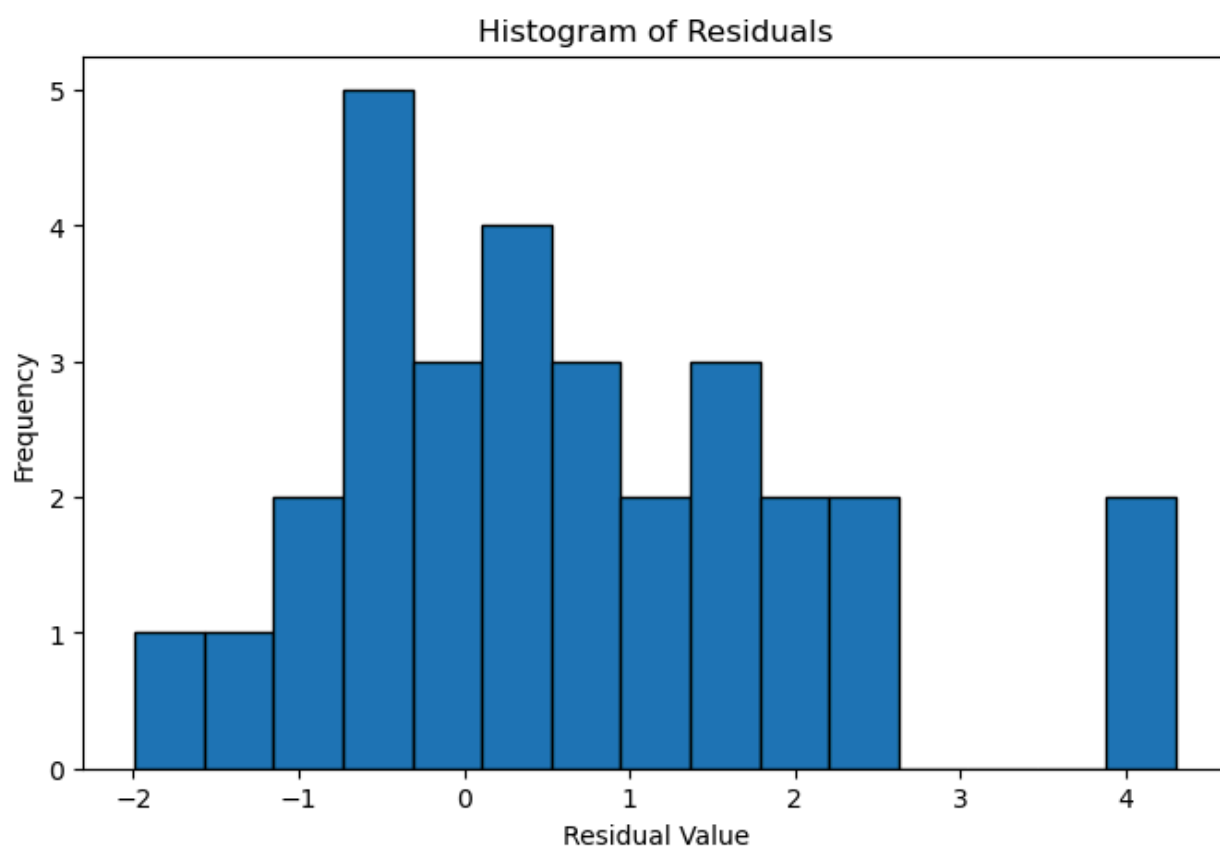
```python
# Residuals
residuals = y_test - y_pred
```

```python
# Residual plot
plt.figure(figsize=(8, 5))
plt.scatter(y_pred, residuals)
```

```
plt.axhline(0, color='red', linestyle='--')
plt.title("Residual Plot (Predicted vs Residuals)")
plt.xlabel("Predicted Values")
plt.ylabel("Residuals")
plt.show()
```


Residual Plot (Predicted vs Residuals)

```
# Histogram of residuals
plt.figure(figsize=(8, 5))
plt.hist(residuals, bins=15, edgecolor='black')
plt.title("Histogram of Residuals")
plt.xlabel("Residual Value")
plt.ylabel("Frequency")
plt.show()
```

Histogram of Residuals

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