Linear Regression Implementation

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Change Log:

SL No.	Change Category	Description	Duration (mins)	Difficulty (1-10)
1	Dataset Update	Replaced previous dataset with Penguins dataset.	10	3
2	Feature Engineering	Selected numerical (`bill_length_mm` , `bill_depth_mm` , `flipper_length_mm`) and categorical (`species` , `island` , `sex`) features.	15	5
3	Preprocessing Pipeline	Standardized numerical features with `StandardScaler` .	10	5
4	Preprocessing Pipeline	Encoded categorical features with `OneHotEncoder` .	10	5
5	Preprocessing Pipeline	Combined all preprocessing steps using `ColumnTransformer` .	15	6
6	Model Update	Removed Ridge Regression and used plain Linear Regression.	5	3
7	Model Evaluation	Computed RMSE and R^2 scores for performance evaluation.	10	5
8	Visualization	Added residual plot to display model errors.	10	4
9	Model Saving	Serialized trained model using `joblib.dump()` .	5	3
10	Initial Enhancements	Improved data handling and missing value removal.	10	4
11	Train-Test Split	Ensured proper 80/20 train-test split.	5	3
12	Structured Pipeline	Used structured pipeline for model training.	15	6
13	Evaluation Metrics	Added better model evaluation metrics.	10	5

In [1]:

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.preprocessing import StandardScaler, OneHotEncoder
from sklearn.pipeline import Pipeline
from sklearn.compose import ColumnTransformer
from sklearn.linear_model import Ridge, LinearRegression
from sklearn.metrics import mean_squared_error, r2_score
import joblib
```

In [2]:

```
# Load Penguins dataset
penguins = sns.load_dataset("penguins").dropna()
```

In [3]:

```
# Define features and target
X = penguins.drop(columns=['body_mass_g'])
y = penguins['body_mass_g']
```

In [4]:

```
# Identify numerical and categorical features
num_features = ['bill_length_mm', 'bill_depth_mm', 'flipper_length_mm']
cat_features = ['species', 'island', 'sex']
```

In [5]:

```
# Preprocessing pipeline
num_transformer = StandardScaler()
cat_transformer = OneHotEncoder(handle_unknown='ignore')
preprocessor = ColumnTransformer([
    ('num', num_transformer, num_features),
    ('cat', cat_transformer, cat_features)
])
```

In [6]:

```
model = Pipeline([
    ('preprocessor', preprocessor),
    ('regressor', LinearRegression())
])
```

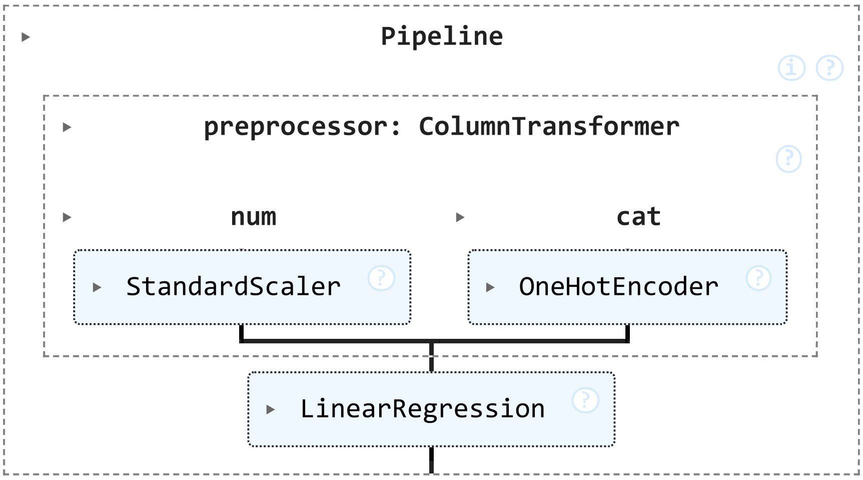
In [7]:

```
# Hyperparameter tuning - removed Ridge regularization

# Split data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_

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

Out[7]:



In [8]:

```
# Predictions
y_pred = model.predict(X_test)
```

In [9]:

```
# Model evaluation
rmse = np.sqrt(mean_squared_error(y_test, y_pred))
r2 = r2_score(y_test, y_pred)
print(f'RMSE: {rmse:.2f}')
print(f'R² Score: {r2:.2f}')
```

```
RMSE: 255.75
R² Score: 0.90
```

In [10]:

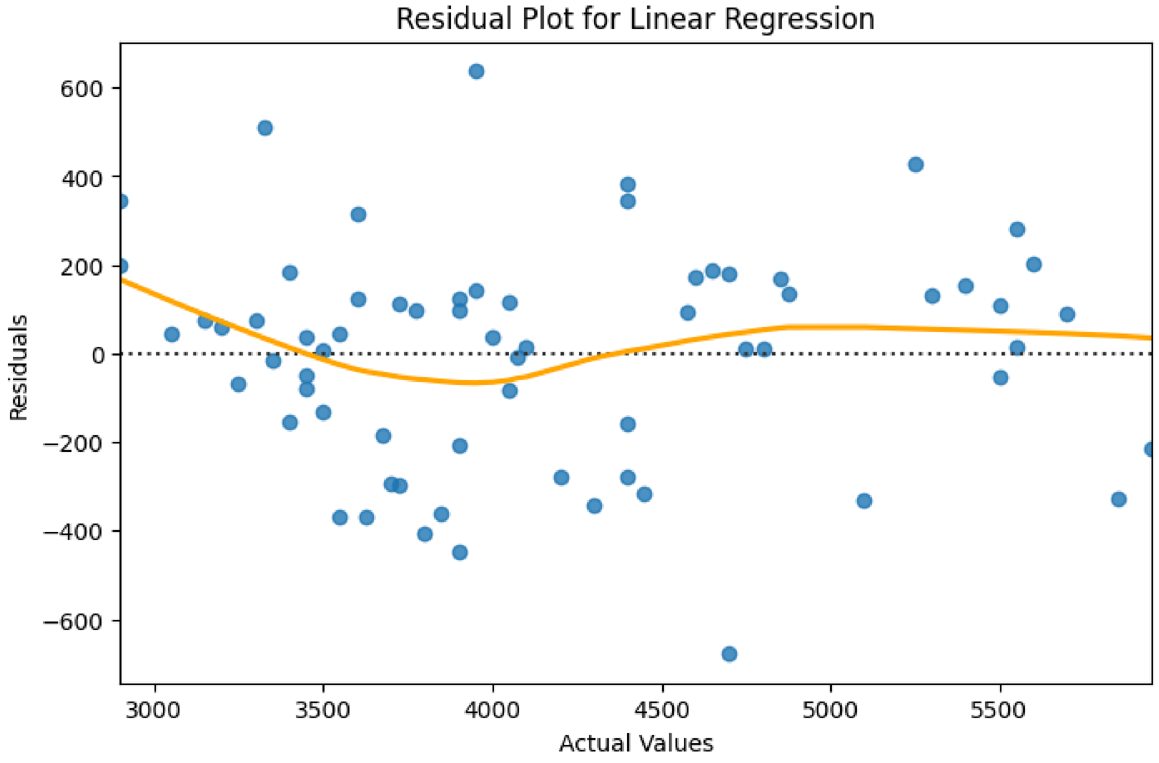
```
# Save model
joblib.dump(model, 'linear_regression_penguins.pkl')
```

Out[10]:

```
['linear_regression_penguins.pkl']
```

In [13]:

```
# Residual plot
plt.figure(figsize=(8, 5))
sns.residplot(x=y_test, y=y_pred, lowess=True, line_kws={'color': 'orange'})
plt.xlabel("Actual Values")
plt.ylabel("Residuals")
plt.title("Residual Plot for Linear Regression")
plt.show()
```


Residual Plot for Linear Regression
Residuals
Actual Values