AIM: To apply a simple linear regression on fish quality dataset

```
import pandas as pd
import numpy as np
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
```

```
df = pd.read_csv('/content/Fish[1].csv')
display(df.head())
```

	Species	Weight	Length1	Length2	Length3	Height	Width
0	Bream	242.0	23.2	25.4	30.0	11.5200	4.0200
1	Bream	290.0	24.0	26.3	31.2	12.4800	4.3056
2	Bream	340.0	23.9	26.5	31.1	12.3778	4.6961
3	Bream	363.0	26.3	29.0	33.5	12.7300	4.4555
4	Bream	430.0	26.5	29.0	34.0	12.4440	5.1340

```
print("Missing values before cleaning:")
print(df.isnull().sum())
```

```
Missing values before cleaning:
Species    0
Weight     0
Length1    0
Length2    0
Length3    0
Height     0
Width      0
dtype: int64
```

```
df.dropna(inplace=True)
```

```
X = df[['Length1']]
y = df['Weight']
```

```
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)
print(f"Intercept: {model.intercept_:.2f}")
print(f"Coefficient (Length1): {model.coef_[0]:.2f}")
```

```
Intercept: -464.13
Coefficient (Length1): 32.44
```

```
X_len2 = df[['Length2']]
y_len2 = df['Weight']
```

```
X_train_len2, X_test_len2, y_train_len2, y_test_len2 = train_test_split(X_len2, y_len2, test_size=0.2, random_state=42)
```

```
model_len2 = LinearRegression()
model_len2.fit(X_train_len2, y_train_len2)
print(f"Intercept (Length2 model): {model_len2.intercept_:.2f}")
print(f"Coefficient (Length2): {model_len2.coef_[0]:.2f}")
```

```
Intercept (Length2 model): -477.31
Coefficient (Length2): 30.43
```

```
y_pred_len2 = model_len2.predict(X_test_len2)

mae_len2 = mean_absolute_error(y_test_len2, y_pred_len2)
```

```
mse_len2 = mean_squared_error(y_test_len2, y_pred_len2)
rmse_len2 = np.sqrt(mse_len2)
r2_len2 = r2_score(y_test_len2, y_pred_len2)

print(f"\nEvaluation Metrics for Length2 Model:")
print(f"Mean Absolute Error (MAE): {mae_len2:.2f}")
print(f"Mean Squared Error (MSE): {mse_len2:.2f}")
print(f"Root Mean Squared Error (RMSE): {rmse_len2:.2f}")
print(f"R-squared (R2): {r2_len2:.2f}")
```

```
Evaluation Metrics for Length2 Model:
Mean Absolute Error (MAE): 128.85
Mean Squared Error (MSE): 25604.52
Root Mean Squared Error (RMSE): 160.01
R-squared (R2): 0.82
```

```
X_len3 = df[['Length3']]
y_len3 = df['Weight']
```

```
X_train_len3, X_test_len3, y_train_len3, y_test_len3 = train_test_split(X_len3, y_len3, test_size=0.2, random_state=42)
```

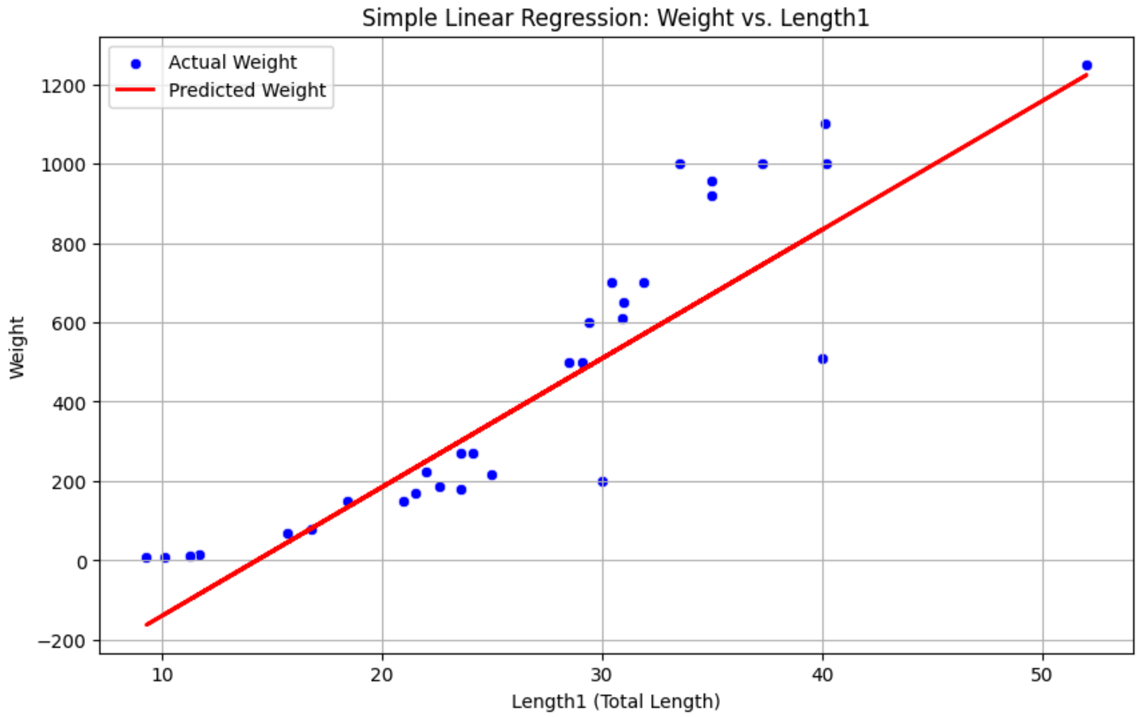
```
model_len3 = LinearRegression()
model_len3.fit(X_train_len3, y_train_len3)
print(f"Intercept (Length3 model): {model_len3.intercept_:.2f}")
print(f"Coefficient (Length3): {model_len3.coef_[0]:.2f}")
```

```
Intercept (Length3 model): -495.48
Coefficient (Length3): 28.32
```

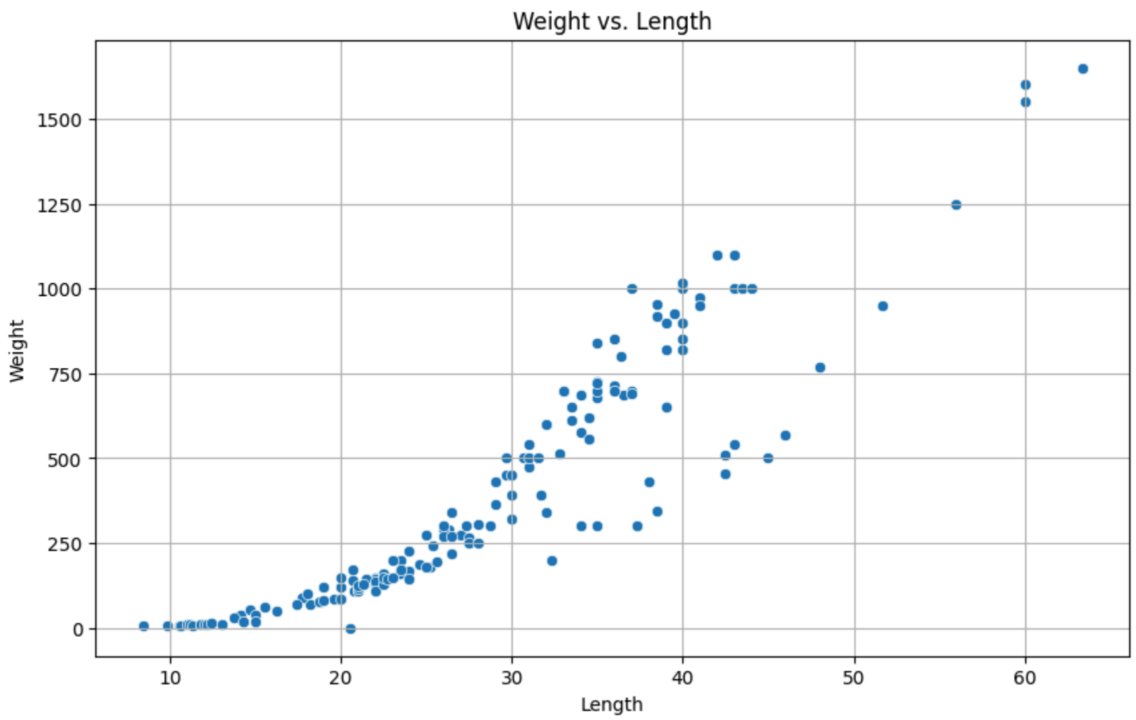
```
y_pred_len3 = model_len3.predict(X_test_len3)

mae_len3 = mean_absolute_error(y_test_len3, y_pred_len3)
mse_len3 = mean_squared_error(y_test_len3, y_pred_len3)
rmse_len3 = np.sqrt(mse_len3)
r2_len3 = r2_score(y_test_len3, y_pred_len3)

print(f"\nEvaluation Metrics for Length3 Model:")
print(f"Mean Absolute Error (MAE): {mae_len3:.2f}")
print(f"Mean Squared Error (MSE): {mse_len3:.2f}")
print(f"Root Mean Squared Error (RMSE): {rmse_len3:.2f}")
print(f"R-squared (R2): {r2_len3:.2f}")
```

```
Evaluation Metrics for Length3 Model:
Mean Absolute Error (MAE): 114.93
Mean Squared Error (MSE): 21835.27
Root Mean Squared Error (RMSE): 147.77
R-squared (R2): 0.85
```

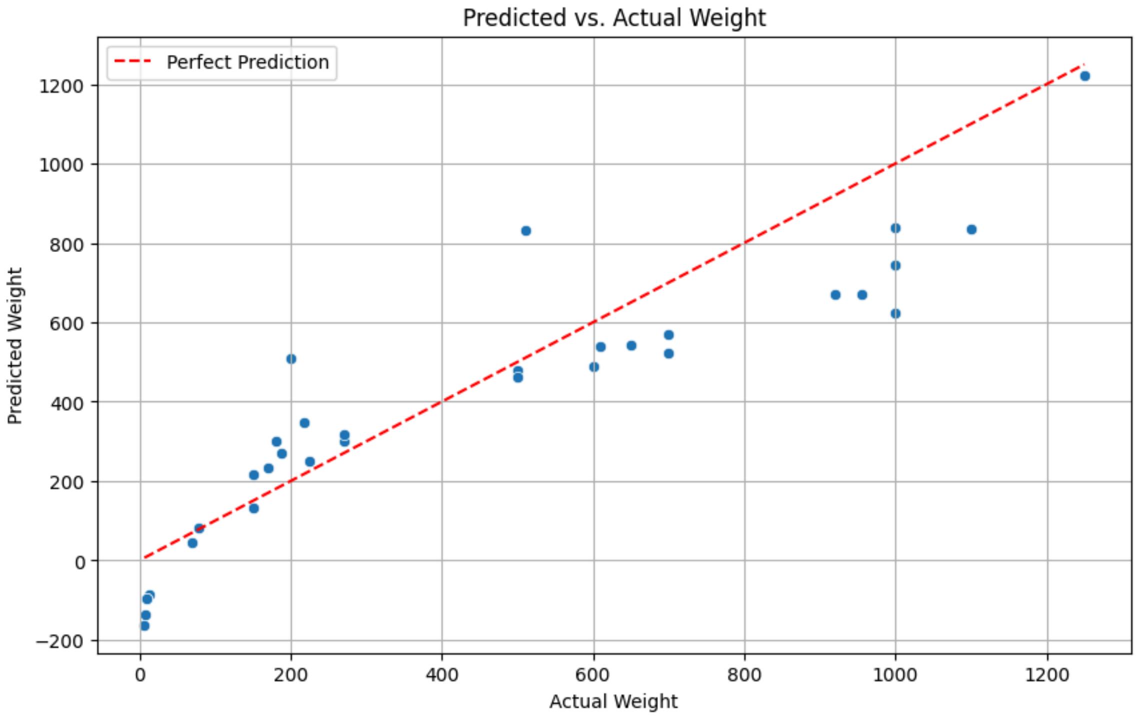
```
plt.figure(figsize=(10, 6))
sns.scatterplot(x=X_test['Length1'], y=y_test, color='blue', label='Actual Weight')
plt.plot(X_test, y_pred, color='red', linewidth=2, label='Predicted Weight')
plt.title('Simple Linear Regression: Weight vs. Length1')
plt.xlabel('Length1 (Total Length)')
plt.ylabel('Weight')
plt.legend()
plt.grid(True)
plt.show()
```



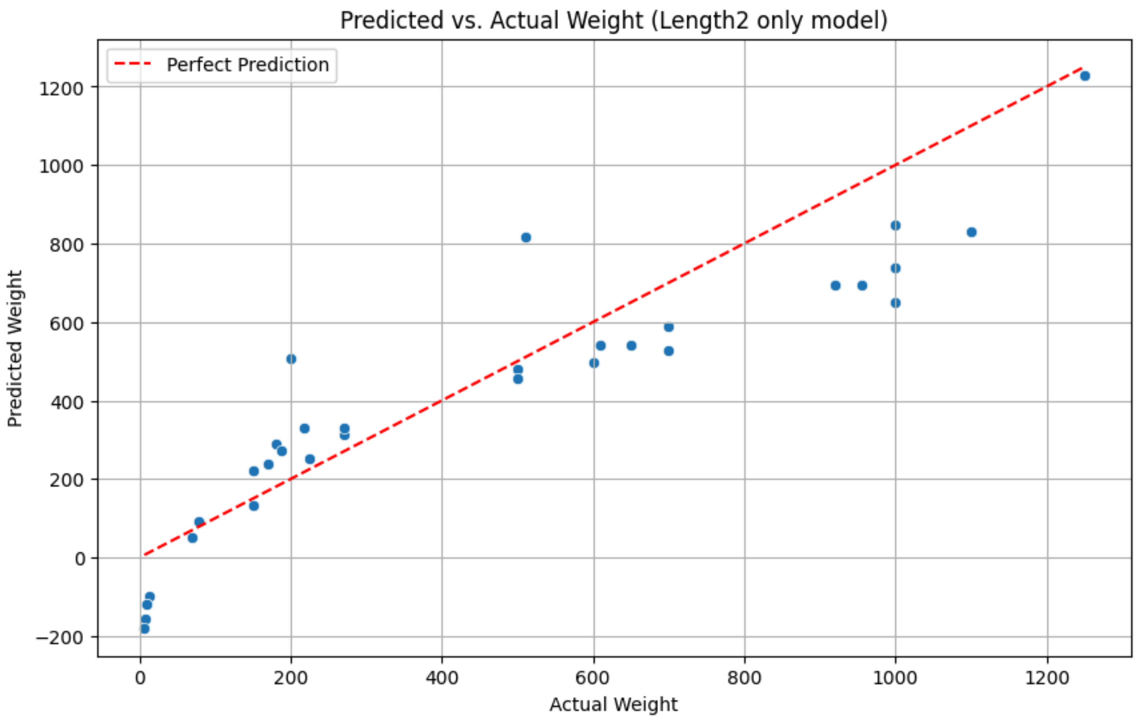

```python
plt.figure(figsize=(10, 6))
sns.scatterplot(x='Length2', y='Weight', data=df)
plt.title('Weight vs. Length')
plt.xlabel('Length')
plt.ylabel('Weight')
plt.grid(True)
plt.show()
```



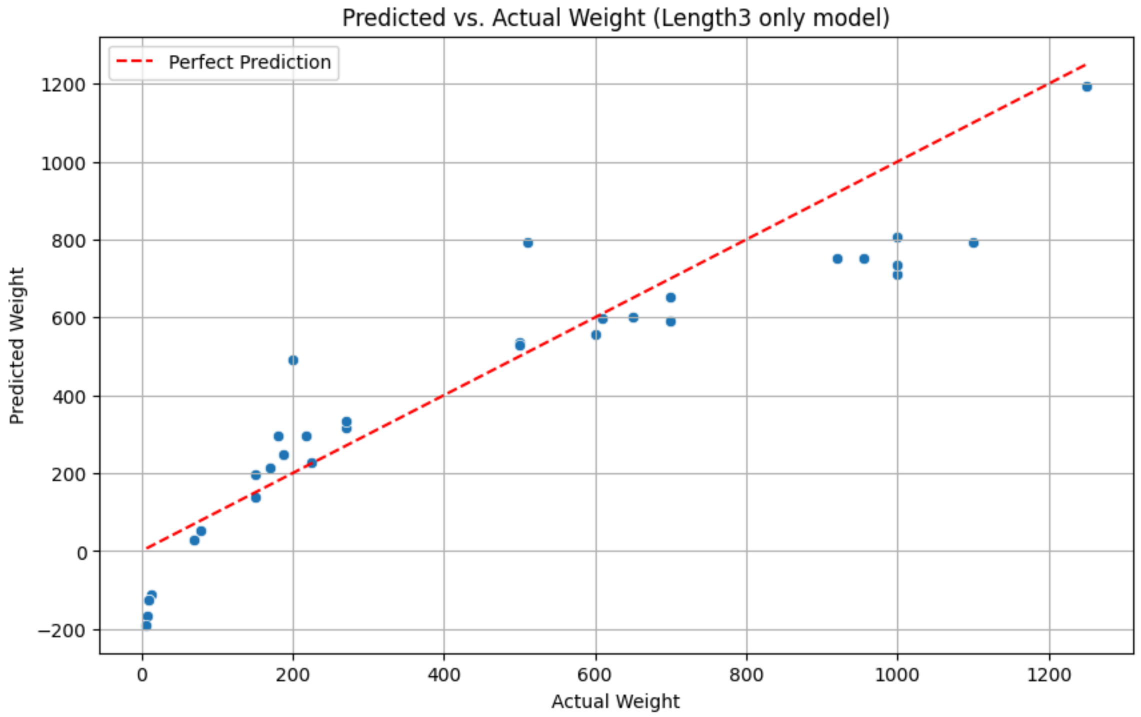

```python
plt.figure(figsize=(10, 6))
sns.scatterplot(x=y_test, y=y_pred)
plt.plot([y_test.min(), y_test.max()], [y_test.min(), y_test.max()], 'r--', label='Perfect Prediction')
plt.title('Predicted vs. Actual Weight')
plt.xlabel('Actual Weight')
plt.ylabel('Predicted Weight')
plt.legend()
plt.grid(True)
plt.show()
```



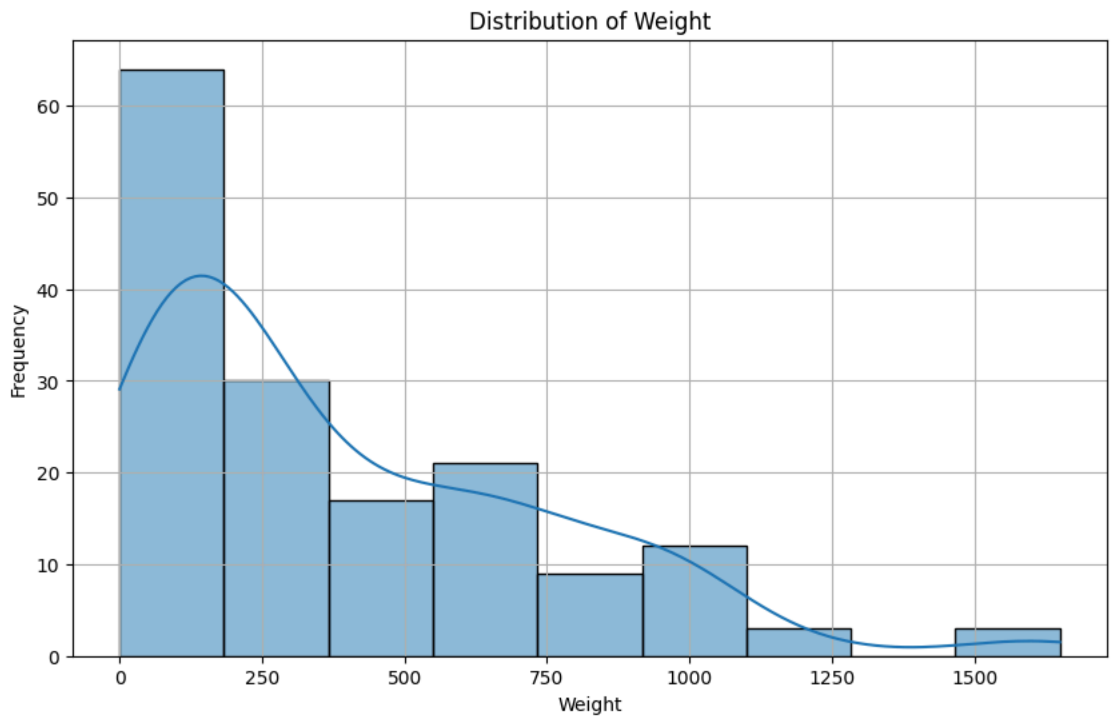

```
plt.figure(figsize=(10, 6))
sns.scatterplot(x=y_test_len2, y=y_pred_len2)
plt.plot([y_test_len2.min(), y_test_len2.max()], [y_test_len2.min(), y_test_len2.max()], 'r--', label='Perfect Prediction'
plt.title('Predicted vs. Actual Weight (Length2 only model)')
plt.xlabel('Actual Weight')
plt.ylabel('Predicted Weight')
plt.legend()
plt.grid(True)
plt.show()
```



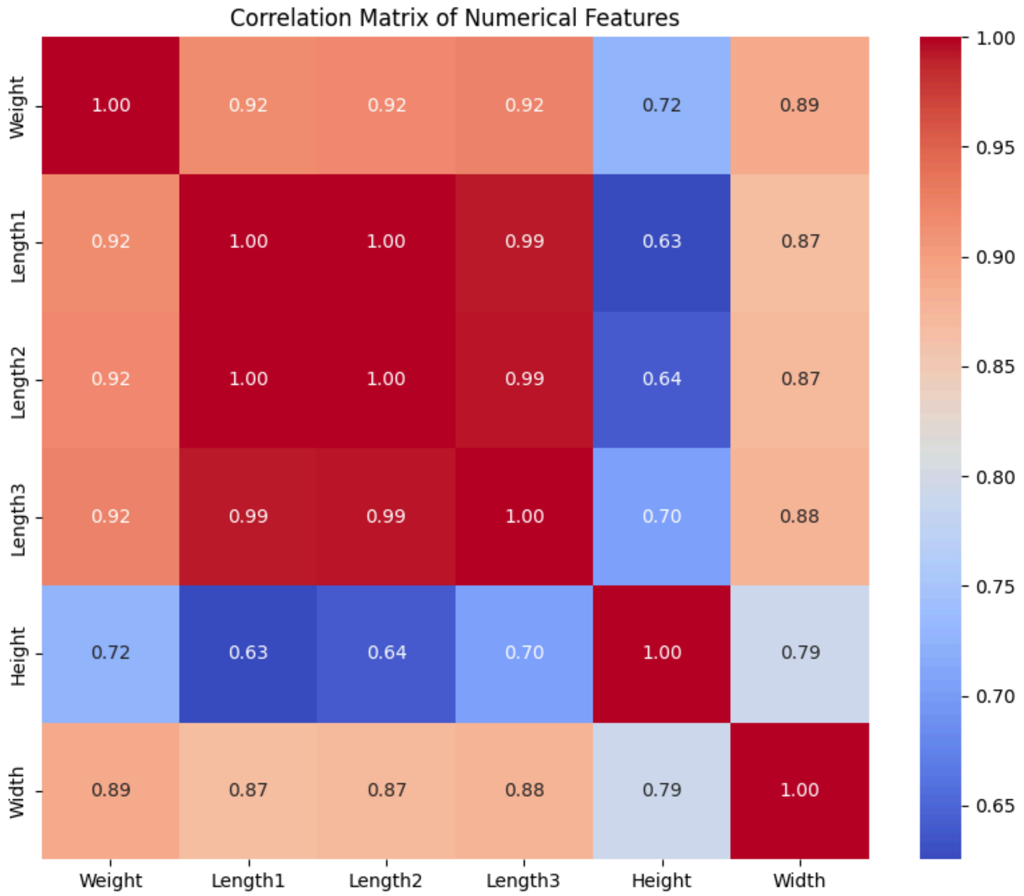

```
plt.figure(figsize=(10, 6))
sns.scatterplot(x=y_test_len3, y=y_pred_len3)
plt.plot([y_test_len3.min(), y_test_len3.max()], [y_test_len3.min(), y_test_len3.max()], 'r--', label='Perfect Prediction'
plt.title('Predicted vs. Actual Weight (Length3 only model)')
plt.xlabel('Actual Weight')
plt.ylabel('Predicted Weight')
plt.legend()
plt.grid(True)
plt.show()
```




```
plt.figure(figsize=(10, 6))
sns.histplot(df['Weight'], kde=True)
plt.title('Distribution of Weight')
plt.xlabel('Weight')
plt.ylabel('Frequency')
plt.grid(True)
plt.show()
```




```
plt.figure(figsize=(10, 8))
sns.heatmap(df.select_dtypes(include=['float64', 'int64']).corr(), annot=True, cmap='coolwarm', fmt=".2f")
plt.title('Correlation Matrix of Numerical Features')
plt.show()
```




```
comparison_data = {
    'Metric': ['MAE', 'MSE', 'RMSE', 'R2'],
    'Model (Length1 Only)': [mae, mse, rmse, r2],
    'Model (Length2 Only)': [mae_len2, mse_len2, rmse_len2, r2_len2],
    'Model (Length3 Only)': [mae_len3, mse_len3, rmse_len3, r2_len3],
}

comparison_df_all = pd.DataFrame(comparison_data)
display(comparison_df_all.round(2))
```

	Metric	Model (Length1 Only)	Model (Length2 Only)	Model (Length3 Only)
0	MAE	129.37	128.85	114.93
1	MSE	26796.68	25604.52	21835.27
2	RMSE	163.70	160.01	147.77
3	R2	0.81	0.82	0.85

Insights/Observations

1. Data is clean with no missing values.
2. Strong Relationship between length and weight
3. Correlation heatmap showed a very strong positive correlation betweenn weight and all length.
4. The correlation heatmap clearly showed a very strong positive correlation between 'Weight' and all 'Length' variables ('Length1', 'Length2', 'Length3'). This is a fundamental observation: as fish length increases, their weight tends to increase proportionally. The lengths themselves ('Length1', 'Length2', 'Length3') are also highly correlated with each other, as expected.
5. All length features are strong predictors of fish weight, as evidenced by the high R-squared values (around 0.81 to 0.85) in our linear regression models.
6. When comparing models using single length features, the model built with 'Length3 Only' consistently demonstrated the best performance across all metrics: It achieved the highest R-squared (0.85), meaning it explains 85% of the variance in 'Weight'. It had the lowest MAE (114.93), MSE (21835.27), and RMSE (147.77), indicating the most accurate predictions with the smallest average error.

7. The 'Predicted vs. Actual Weight' plots for all models showed points generally clustering along the ideal y=x line, confirming that