Experiment 3

Aim: Perform Data Modeling.

Problem Statement:

a. Partition the data set, for example 75% of the records are included in the training data set and 25% are included in the test data set.

b. Use a bar graph and other relevant graph to confirm your proportions.

c. Identify the total number of records in the training data set.

d. Validate partition by performing a two-sample Z-test.

Steps:

1) Partition the data set, for example 75% of the records are included in the training data set and 25% are included in the test data set.

Code:

```
from sklearn.model_selection import train_test_split

# Partition data into training and testing sets (75% training, 25% testing)

train_data, test_data = train_test_split(df, test_size=0.25, random_state=42)

# Check the size of each dataset

print(f"Training set size: {len(train_data)}")

print(f"Test set size: {len(test_data)}")
```

This function imports the train_test_split function from sklearn.model_selection library. This makes 2 dataframes, a train_df and test_df. Here, based on the test_size parameter, it would divide the dataset into that percent of values and insert it in the test_df dataframe. The remaining values are put in the train_df dataframe. Defining the random_state parameter helps the splitting to be consistent. The value of the parameter does not matter, only the condition being it should be consistent.

2) Use a bar graph and other relevant graphs to confirm your proportions.

   Graphs help validate the correct division of data. Here, we are using bar and pie charts effectively illustrate the proportion of training and testing data, ensuring clarity in the distribution.

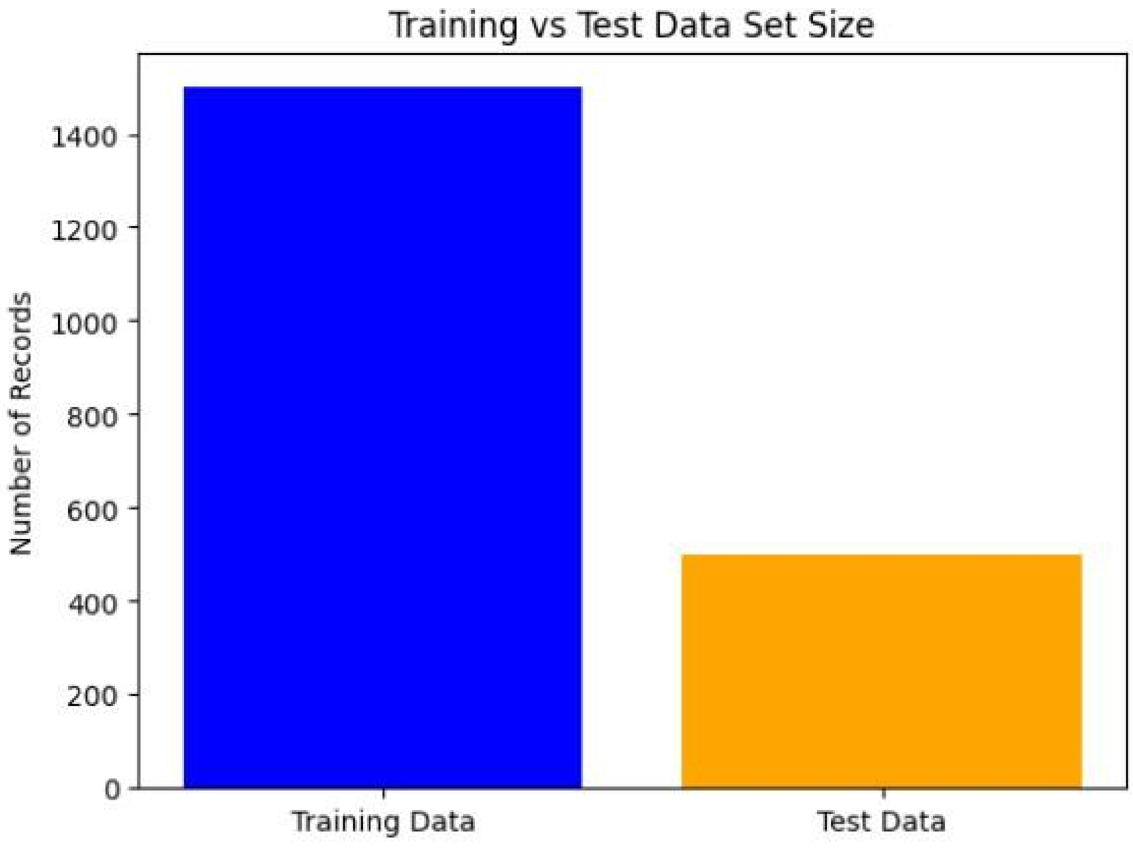
Bar Graph: **Code:**

```
import matplotlib.pyplot as plt

# Plot the distribution
sizes = [len(train_data), len(test_data)]
labels = ['Training Data', 'Test Data']

plt.bar(labels, sizes, color=['blue', 'orange'])
plt.title('Training vs Test Data Set Size')
plt.ylabel('Number of Records')
plt.show()
```

Output:



<u>Pie chart:</u>

Code:

plt.figure(figsize=(6,6)) plt.pie(sizes, labels=labels, autopct='%1.1f%%', colors=['#ff9999','#66b3ff']) plt.title("Proportion of Training and Testing Data") plt.show()

Output:

2) Identify the total number of records in the training data set.

Code:

```
print(f"Total records: {len(df)}")
print(f"Training records: {len(train_df)}")
print(f"Testing records: {len(test_df)}")
```

Output:

```
Total records: 1999
Training records: 1499
Testing records: 500
```

3) Validate partition by performing a two-sample Z-test.

A two-sample Z-test evaluates whether the training and testing datasets share similar characteristics. By comparing their mean values, it ensures the data split is balanced and does not introduce bias.

Code:

```
train_values = train_data["Total Spent"]
test_values = test_data["Total Spent"]

mean_train = np.mean(train_values)
mean_test = np.mean(test_values) std_train =
np.std(train_values, ddof=1) std_test =
np.std(test_values, ddof=1)

n_train = len(train_values)
n_test = len(test_values)

z_score = (mean_train - mean_test) / np.sqrt((std_train**2 / n_train) + (std_test**2 / n_test))
p_value = 2 * (1 - norm.cdf(abs(z_score)))

print(f"Z-score: {z_score:.4f}") print(f"P-
value: {p_value:.4f}")

alpha = 0.05 if
p_value < alpha:
    print("Reject the null hypothesis: The means are significantly different.")
else:
    print("Fail to reject the null hypothesis: No significant difference in means.")
```

Output:

```
Z-score: -0.2026
P-value: 0.8395
Fail to reject the null hypothesis: No significant difference in means.
```

Since the **Z-score is -0.2026** and the **P-value is 0.8395**, which is much greater than the typical significance level (e.g., **0.05 or 0.01**), we **fail to reject the null hypothesis**.

Above, we performed the Z-score test manually without using any libraries. To check if we get the same results by using a library, we performed the test with an imported library

```
from statsmodels.stats.weightstats import ztest

z_stat, p_value = ztest(train_data["Total Spent"], test_data["Total Spent"])

print(f"Z-test result for total_spent: Z-stat = {z_stat}, P-value = {p_value}")
```

```
Z-test result for total_spent: Z-stat = -0.20397977377150175, P-value = 0.8383693048042808
```

Conclusion: The Z-test results confirm that the training and testing datasets do not differ significantly, ensuring a balanced partition. To maintain accuracy and reproducibility, it is important to consistently split the dataset into 75% training and 25% testing using a fixed random_state. Additionally, verifying column names, data types, and handling missing values properly helps avoid potential issues in future tests. Checking means, standard deviations, and sample sizes before computing the Z-score ensures the correctness of statistical comparisons