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Data Preprocessing and Feature Engineering Capstone Project

Assume you are a Chancellor Of Private University and you are having less results in Btech DataScience.You are hiring a DataAnalyst who can work on the raw data of students and give you useful insights.The DataAnalyst has now start the process with Data Collection, Data Cleaning, Data Encoding & Data Visualization Such that the insights given by him are useful for your university.

DATA COLLECTION

The dataset utilized in this analysis is a mock dataset specifically created for the purpose of illustrating the essential procedures involved in data analysis. It serves as a practical tool to showcase the various steps and methodologies that should be employed when working with an authentic dataset to extract the desired insights. While the data within this mock dataset is synthetic, the analysis techniques applied herein mirror those employed in real-world scenarios, enabling users to acquire a comprehensive understanding of the data analysis process. By utilizing this simulated dataset, users can familiarize themselves with the methodologies and gain the necessary proficiency to effectively tackle data analysis tasks using genuine datasets.

[1]:
```
import pandas as pd
```

[6]:
```
# Load the dataset
df = pd.read_excel('DPFE Capstone Project Dataset.xlsx')
df.head(10)
```

[6]:

	Student ID	Name	Age	Gender	Attendance (%)	Midterm Score	\
0	1	Rajesh	20.0	Male	95.0	85	
1	2	Priya	21.0	Female	92.0	78	

```
2           3     Arjun  19.0    Male           88.0            80
3           4     Aarav  20.0    Male           90.0            85
4           5    Sameer  20.0    Male           94.0            75
5           6    Ishika  21.0  Female           92.0            80
6           7    Advait  19.0    Male            NaN            78
7           8  Nivedita  20.0  Female           90.0            90
8           9     Akash  22.0    Male           85.0            75
9          10    Ishita  21.0  Female           92.0            88

   Project Score  Final Exam Score  Overall Score Scholarship Study Material  \
0           90.0              88.0          89.50         Yes             Yes
1           85.0              90.0          84.75          No             Yes
2           82.0              85.0          83.75         Yes              No
3            NaN              88.0          89.50         Yes             Yes
4           80.0              82.0          80.25          No              No
5           85.0               NaN          84.75          No             Yes
6           82.0              85.0          83.75         Yes              No
7           92.0              95.0          92.25         Yes             Yes
8           78.0              80.0          77.00          No              No
9           85.0              88.0          87.25          No             Yes

  Programming Language
0               Python
1                    R
2               Python
3               Python
4                    R
5                    R
6               Python
7               Python
8               Python
9                    R
```

DATA CLEANING

[8]:
```
# Check for missing values
df.isnull().sum()
```

[8]:
```
Student ID             0
Name                   0
Age                    2
Gender                 1
Attendance (%)         1
Midterm Score          0
Project Score          1
Final Exam Score       1
```

```
Overall Score           1
Scholarship             1
Study Material          1
Programming Language    1
dtype: int64
```

[9]:
```
# Replace missing values with appropriate strategies

df['Project Score'].fillna(df['Project Score'].mean(), inplace=True)
df['Final Exam Score'].fillna(df['Final Exam Score'].mean(), inplace=True)
df['Attendance (%)'].fillna(df['Attendance (%)'].median(), inplace=True)
df['Overall Score'].fillna(df['Overall Score'].mean(), inplace=True)
df['Age'].fillna(df['Age'].mode()[0], inplace=True)
df['Study Material'].fillna(df['Study Material'].mode()[0], inplace=True)
df['Scholarship'].fillna(df['Scholarship'].mode()[0], inplace=True)
df['Gender'].fillna(df['Gender'].mode()[0], inplace=True)
df['Programming Language'].fillna(df['Programming Language'].mode()[0],␣
↪inplace=True)
```

[10]:
```
# Check for missing values
df.isnull().sum()
```

[10]:
```
Student ID              0
Name                    0
Age                     0
Gender                  0
Attendance (%)          0
Midterm Score           0
Project Score           0
Final Exam Score        0
Overall Score           0
Scholarship             0
Study Material          0
Programming Language    0
dtype: int64
```

[13]:
```
#Checking for duplicates
df.duplicated().sum()
```

[13]:
```
0
```

[14]:
```
import numpy as np

# Identify and handle outliers using z-score
```

```
z_scores = np.abs((df[['Midterm Score', 'Project Score', 'Final Exam Score',␣
 ↪'Overall Score']] - df[['Midterm Score', 'Project Score', 'Final Exam␣
 ↪Score', 'Overall Score']].mean()) / df[['Midterm Score', 'Project Score',␣
 ↪'Final Exam Score', 'Overall Score']].std())
z_scores
```

[14]:

	Midterm Score	Project Score	Final Exam Score	Overall Score
0	0.502431	0.998983	0.323062	0.931244
1	0.803289	0.081477	0.797925	0.112578
2	0.430226	0.729754	0.389232	0.332330
3	0.502431	0.000000	0.323062	0.931244
4	1.362883	1.161938	1.101526	1.101461
..	…	…	…	…
57	1.435088	1.431167	1.985082	1.535561
58	1.362883	1.594122	1.576389	1.815655
59	1.062026	0.081477	0.323062	0.436802
60	0.502431	0.998983	0.323062	0.931244
61	0.803289	0.081477	0.797925	0.112578

[62 rows x 4 columns]

[15]:
```
# Removing values with more than 3 z-score
df = df[(z_scores < 3).all(axis=1)]
```

[16]:
```
# Saving the cleaned dataset
df.to_csv('cleaned_dataset.csv', index=False)
```

DATA ENCODING

[69]:
```
# Importing the cleaned dataset
df = pd.read_csv('cleaned_dataset.csv')
df.head(10)
```

[69]:

	Student ID	Name	Age	Gender	Attendance (%)	Midterm Score	\
0	1	Rajesh	20.0	Male	95.0	85	
1	2	Priya	21.0	Female	92.0	78	
2	3	Arjun	19.0	Male	88.0	80	
3	4	Aarav	20.0	Male	90.0	85	
4	5	Sameer	20.0	Male	94.0	75	
5	6	Ishika	21.0	Female	92.0	80	
6	7	Advait	19.0	Male	91.0	78	
7	8	Nivedita	20.0	Female	90.0	90	
8	9	Akash	22.0	Male	85.0	75	
9	10	Ishita	21.0	Female	92.0	88	

Project Score	Final Exam Score	Overall Score	Scholarship	Study Material	\

```
0      90.000000          88.000000          89.50         Yes              Yes
1      85.000000          90.000000          84.75          No              Yes
2      82.000000          85.000000          83.75         Yes               No
3      85.377049          88.000000          89.50         Yes              Yes
4      80.000000          82.000000          80.25          No               No
5      85.000000          86.639344          84.75          No              Yes
6      82.000000          85.000000          83.75         Yes               No
7      92.000000          95.000000          92.25         Yes              Yes
8      78.000000          80.000000          77.00          No               No
9      85.000000          88.000000          87.25          No              Yes

  Programming Language
0               Python
1                    R
2               Python
3               Python
4                    R
5                    R
6               Python
7               Python
8               Python
9                    R
```

[70]:
```
# Mapping dictionary
mapping = { 'Python' : 0 , 'R' : 1, 'No': 0, 'Yes': 1}

# Encoding 'Scholarship' and 'Study Material'
df['Scholarship'] = df['Scholarship'].replace(mapping)
df['Programming Language'] = df['Programming Language'].replace(mapping)
df.head(3)
```

[70]:
```
   Student ID    Name   Age  Gender  Attendance (%)  Midterm Score  \
0           1  Rajesh  20.0    Male            95.0             85
1           2   Priya  21.0  Female            92.0             78
2           3   Arjun  19.0    Male            88.0             80

   Project Score  Final Exam Score  Overall Score  Scholarship Study Material  \
0           90.0              88.0          89.50            1             Yes
1           85.0              90.0          84.75            0             Yes
2           82.0              85.0          83.75            1              No

   Programming Language
0                     0
1                     1
2                     0
```

[71]:
```
from sklearn.preprocessing import LabelEncoder

label_encoder = LabelEncoder()

# Encode 'Gender'
df['Gender'] = label_encoder.fit_transform(df['Gender'])
df.head()
```

[71]:

	Student ID	Name	Age	Gender	Attendance (%)	Midterm Score	Project Score	Final Exam Score	Overall Score	Scholarship	Study Material	Programming Language
0	1	Rajesh	20.0	1	95.0	85	90.000000	88.0	89.50	1	Yes	0
1	2	Priya	21.0	0	92.0	78	85.000000	90.0	84.75	0	Yes	1
2	3	Arjun	19.0	1	88.0	80	82.000000	85.0	83.75	1	No	0
3	4	Aarav	20.0	1	90.0	85	85.377049	88.0	89.50	1	Yes	0
4	5	Sameer	20.0	1	94.0	75	80.000000	82.0	80.25	0	No	1

[72]:
```
# Encode 'Programming Language'

df = pd.get_dummies(df, columns=['Study Material'])
df.head()
```

[72]:

	Student ID	Name	Age	Gender	Attendance (%)	Midterm Score	Project Score	Final Exam Score	Overall Score	Scholarship	Programming Language
0	1	Rajesh	20.0	1	95.0	85	90.000000	88.0	89.50	1	0
1	2	Priya	21.0	0	92.0	78	85.000000	90.0	84.75	0	1
2	3	Arjun	19.0	1	88.0	80	82.000000	85.0	83.75	1	0
3	4	Aarav	20.0	1	90.0	85	85.377049	88.0	89.50	1	0
4	5	Sameer	20.0	1	94.0	75	80.000000	82.0	80.25	0	1

```
   Programming Language  Study Material_No  Study Material_Yes
0                     0                  0                   1
1                     1                  0                   1
2                     0                  1                   0
3                     0                  0                   1
4                     1                  1                   0
```

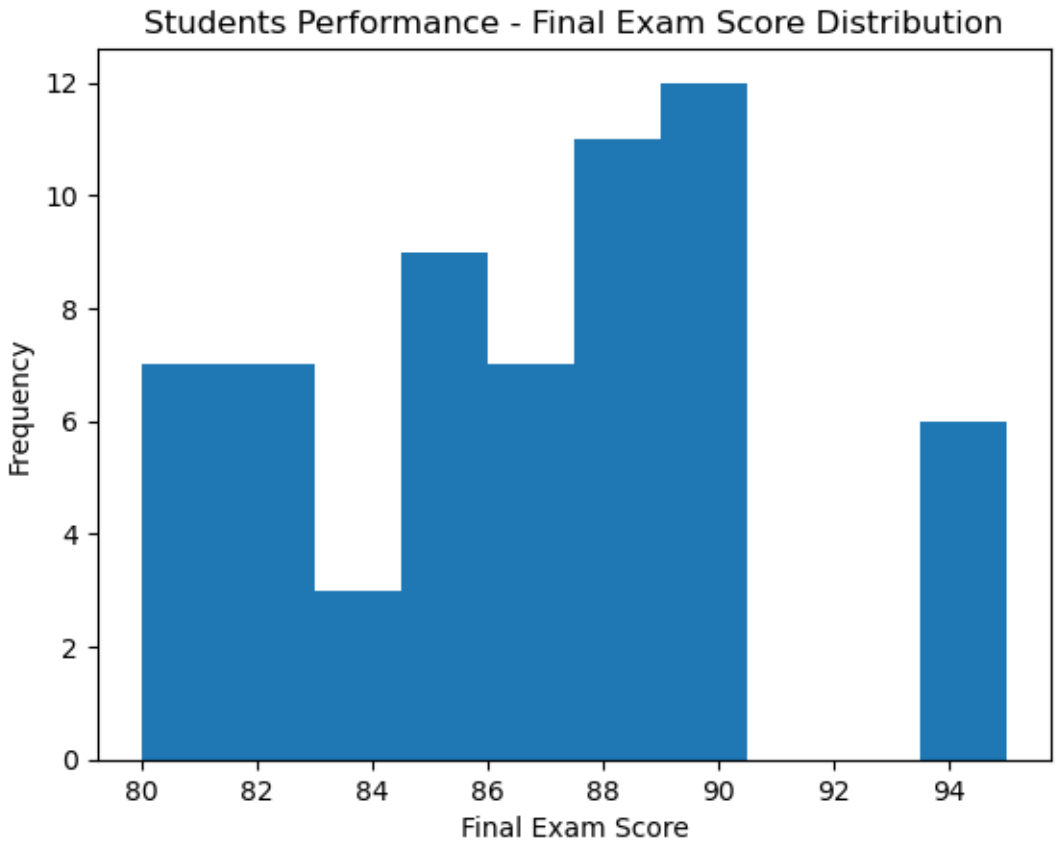
[73]:
```
# Saving the encoded dataset
df.to_csv('encoded_dataset.csv',index=False)
```

DATA VISUALIZATION

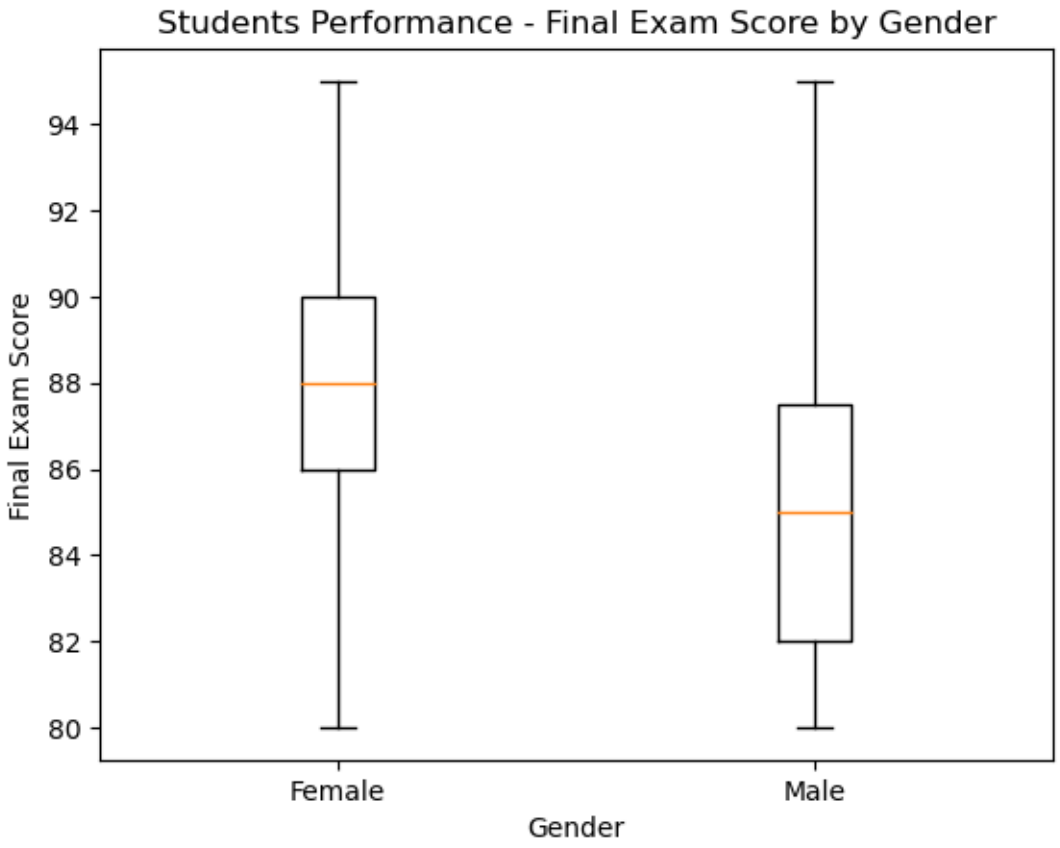
[74]:
```
import matplotlib.pyplot as plt

# Importing Cleaned and Encoded dataset
df = pd.read_csv('encoded_dataset.csv')
df.head()
```

[74]:
```
   Student ID    Name   Age  Gender  Attendance (%)  Midterm Score  \
0           1  Rajesh  20.0       1            95.0             85
1           2   Priya  21.0       0            92.0             78
2           3   Arjun  19.0       1            88.0             80
3           4   Aarav  20.0       1            90.0             85
4           5  Sameer  20.0       1            94.0             75

   Project Score  Final Exam Score  Overall Score  Scholarship  \
0      90.000000              88.0          89.50            1
1      85.000000              90.0          84.75            0
2      82.000000              85.0          83.75            1
3      85.377049              88.0          89.50            1
4      80.000000              82.0          80.25            0

   Programming Language  Study Material_No  Study Material_Yes
0                     0                  0                   1
1                     1                  0                   1
2                     0                  1                   0
3                     0                  0                   1
4                     1                  1                   0
```

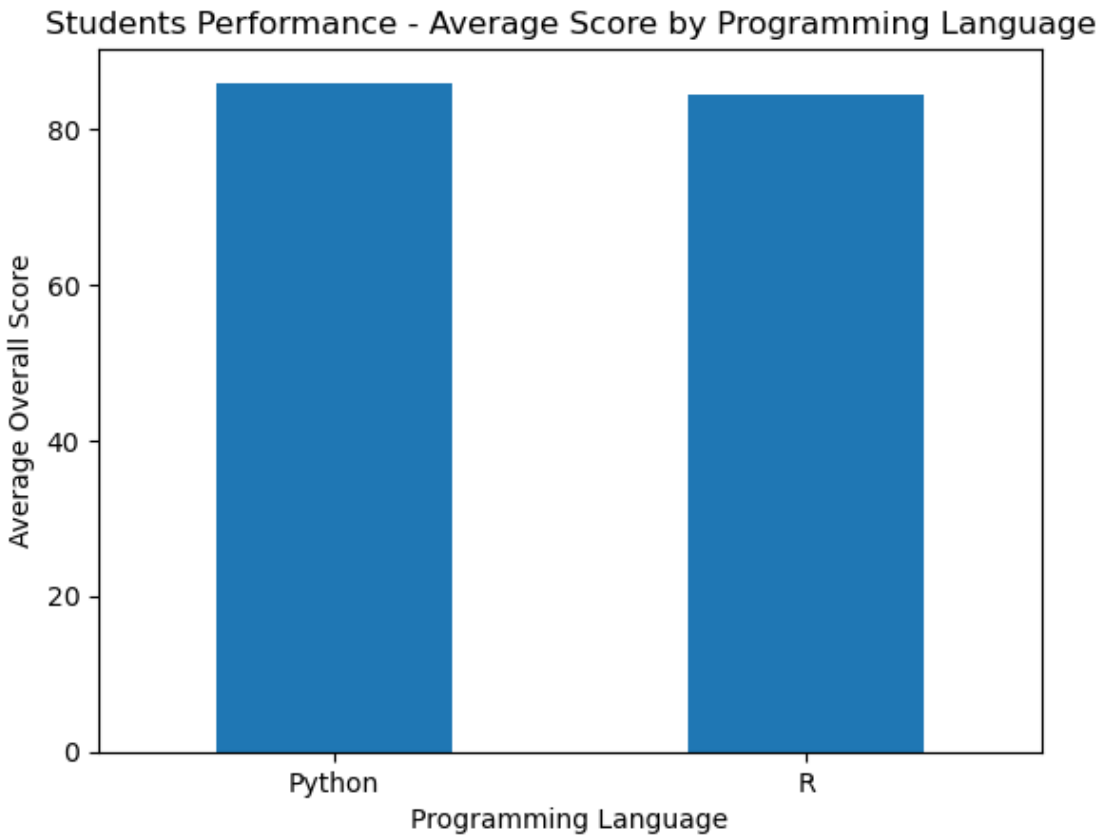
[75]:
```
# Histogram of Final Exam Score
plt.hist(df['Final Exam Score'], bins=10)
plt.xlabel('Final Exam Score')
plt.ylabel('Frequency')
plt.title('Students Performance - Final Exam Score Distribution')
plt.show()
```



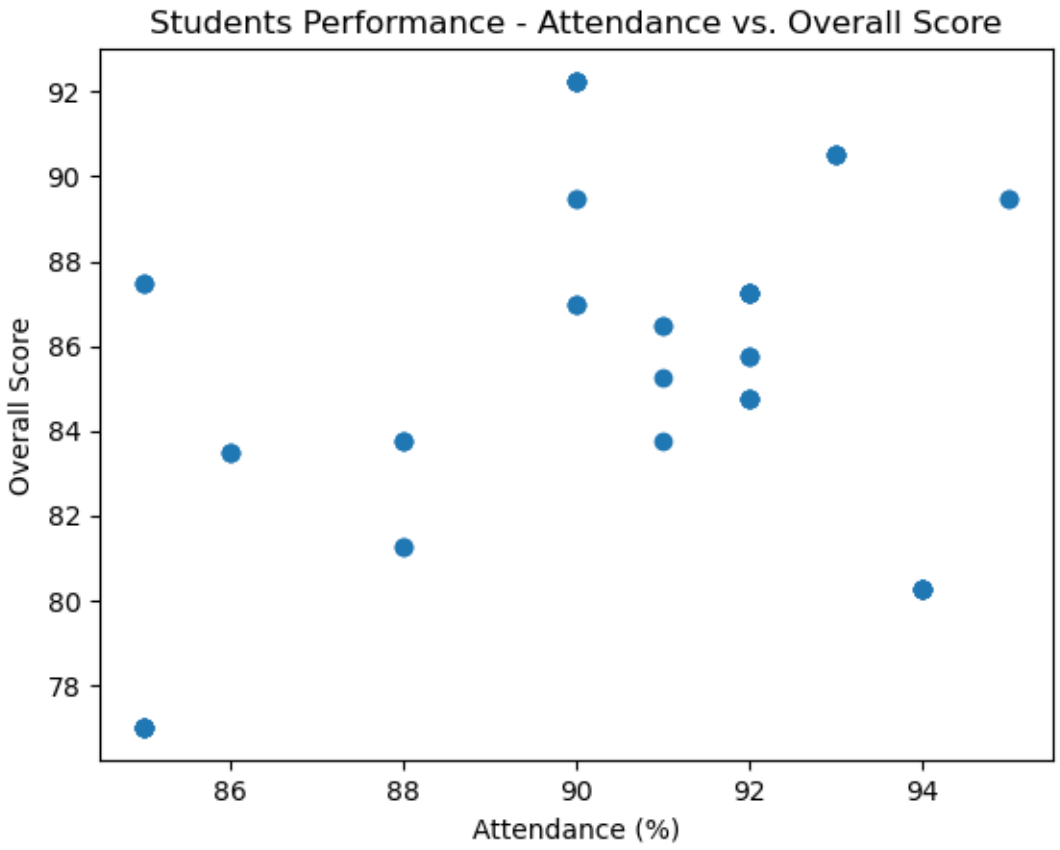
[86]:
```
# Box plot of Final Exam Score by Gender
plt.boxplot([df[df['Gender'] == 0]['Final Exam Score'], df[df['Gender'] ==␣
 ↪1]['Final Exam Score']])
plt.xticks([1, 2], ['Female', 'Male'])
plt.xlabel('Gender')
plt.ylabel('Final Exam Score')
plt.title('Students Performance - Final Exam Score by Gender')
plt.show()
```



[83]:
```
# Bar plot of Average Score by Programming Language
average_scores = df.groupby('Programming Language')['Overall Score'].mean()
average_scores.plot(kind='bar')
plt.xticks([0, 1], ['Python', 'R'], rotation=0)
plt.xlabel('Programming Language')
plt.ylabel('Average Overall Score')
plt.title('Students Performance - Average Score by Programming Language')
plt.show()
```



[84]:
```
# Scatter plot of Overall Score vs. Attendance (%)
plt.scatter(df['Attendance (%)'], df['Overall Score'])
plt.xlabel('Attendance (%)')
plt.ylabel('Overall Score')
plt.title('Students Performance - Attendance vs. Overall Score')
plt.show()
```



1.0.1 - INSIGHTS -

- The analysis of the final score distribution reveals that the majority of students' scores fall within the range of 80 to 90. However, to achieve a satisfactory level of performance, there is a need to push the scores towards the 90s. This indicates a potential area of improvement and suggests implementing strategies to enhance student performance and raise the overall score distribution to meet the desired satisfactory threshold.
- The analysis of the final exam scores by gender indicates that females tend to have higher performance compared to males. This insight suggests that more attention and support should be directed towards male students to bridge the performance gap and help them achieve comparable levels of success. Implementing targeted interventions and tailored support systems can potentially enhance the performance of male students and ensure equitable outcomes across genders.
- The analysis based on programming languages reveals that there is no significant difference in performance between R and Python users, although Python users have a slight edge. This insight suggests that both R and Python are equally effective languages for students in terms of achieving academic success. However, the slight advantage observed for Python

may indicate its popularity and versatility in the field of data science, encouraging students to consider it as a preferred language for their studies.

- The analysis of attendance and final exam scores demonstrates a generally positive correlation, indicating that higher attendance is associated with better performance on the final exams. However, there are a few outliers where students with high attendance did not achieve expected scores. These outliers may be influenced by other factors, such as individual learning styles or external circumstances, highlighting the need for a holistic approach to student support and identifying potential areas for targeted interventions.
