In [1]:

```
import pandas as pd
import numpy as np

np.random.seed(10)
rows = 150
```

In [3]:

```
data = {
    "Student_ID": range(1, rows + 1),
    "Age": np.random.randint(16, 30, rows),
    "Gender": np.random.choice(["Male", "Female", "Other"], rows),
    "Study_Hours": np.random.normal(6, 2, rows),
    "Attendance": np.random.randint(40, 110, rows),
    "Internal_Marks": np.random.randint(10, 50, rows),
    "Final_Marks": np.random.randint(25, 100, rows),
    "Backlogs": np.random.randint(0, 5, rows),
    "CGPA": np.round(np.random.normal(7.2, 1.5, rows), 2)
}
```

In [5]:

```
df = pd.DataFrame(data)
```

In [7]:

```
df.loc[np.random.choice(df.index, 12), "Study_Hours"] = np.nan
df.loc[np.random.choice(df.index, 10), "CGPA"] = np.nan
df.loc[np.random.choice(df.index, 8), "Age"] = np.nan
df.loc[np.random.choice(df.index, 6), "Gender"] = np.nan
```

In [9]:

```
df.loc[5, "Attendance"] = 150
df.loc[8, "Attendance"] = -20

df.loc[12, "Final_Marks"] = 200
df.loc[20, "Final_Marks"] = 250
df.loc[25, "Final_Marks"] = -10

df.loc[30, "CGPA"] = 12
df.loc[35, "CGPA"] = -3

df.loc[40, "Study_Hours"] = 20
df.loc[45, "Study_Hours"] = 0

df.loc[50, "Backlogs"] = -2
df.loc[55, "Backlogs"] = 10
```

In [27]:

```
df.to_csv("academic_performance.csv", index=False)
```

In [13]:

```
print("Dataset created with missing values, inconsistencies & outliers!")
```

```
Dataset created with missing values, inconsistencies & outliers!
```

In [29]:

```
df = pd.read_csv("academic_performance.csv")
df.head()
```

Out[29]:

	Student_ID	Age	Gender	Study_Hours	Attendance	Internal_Marks	Final_Marks	B
0	1	25.0	Other	4.194497	94	28	87	
1	2	29.0	Other	2.577449	48	14	29	
2	3	20.0	NaN	7.665052	50	21	34	
3	4	16.0	Male	7.658504	97	42	55	
4	5	17.0	Other	2.961550	44	22	75	

In [17]:

```
df.isnull().sum()
```

Out[17]:
```
Student_ID        0
Age               8
Gender            5
Study_Hours      10
Attendance        0
Internal_Marks    0
Final_Marks       0
Backlogs          0
CGPA              9
dtype: int64
```

In [23]:
```
df.describe()
```

Out[23]:

	Student_ID	Age	Study_Hours	Attendance	Internal_Marks	Final_Marks
count	150.000000	142.000000	140.000000	150.000000	150.000000	150.000000
mean	75.500000	22.471831	5.843993	74.346667	29.693333	61.753333
std	43.445368	4.347811	2.419555	22.336050	12.651205	28.571102
min	1.000000	16.000000	0.000000	-20.000000	10.000000	-10.000000
25%	38.250000	18.000000	4.153575	57.250000	19.000000	43.250000
50%	75.500000	23.000000	5.868341	75.000000	29.000000	60.000000
75%	112.750000	26.000000	7.438421	94.000000	41.750000	77.000000
max	150.000000	29.000000	20.000000	150.000000	49.000000	250.000000

In [25]:
```
df[df["Attendance"] > 100]
df[df["CGPA"] > 10]
df[df["Final_Marks"] < 0]
```

Out[25]:

	Student_ID	Age	Gender	Study_Hours	Attendance	Internal_Marks	Final_Marks
25	26	24.0	Female	2.747605	91	48	-10

In [39]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from scipy import stats
```

In [41]:
```
df = pd.read_csv("academic_performance.csv")
df.head()
```

Out[41]:

	Student_ID	Age	Gender	Study_Hours	Attendance	Internal_Marks	Final_Marks	B
0	1	25.0	Other	4.194497	94	28	87	
1	2	29.0	Other	2.577449	48	14	29	
2	3	20.0	NaN	7.665052	50	21	34	
3	4	16.0	Male	7.658504	97	42	55	
4	5	17.0	Other	2.961550	44	22	75	

In [43]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 9 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   Student_ID      150 non-null    int64  
 1   Age             142 non-null    float64
 2   Gender          145 non-null    object 
 3   Study_Hours     140 non-null    float64
 4   Attendance      150 non-null    int64  
 5   Internal_Marks  150 non-null    int64  
 6   Final_Marks     150 non-null    int64  
 7   Backlogs        150 non-null    int64  
 8   CGPA            141 non-null    float64
dtypes: float64(3), int64(5), object(1)
memory usage: 10.7+ KB
```

In [45]:

```
df.isnull().sum()
```

Out[45]:

```
Student_ID         0
Age                8
Gender             5
Study_Hours       10
Attendance         0
Internal_Marks     0
Final_Marks        0
Backlogs           0
CGPA               9
dtype: int64
```

In [100…

```
df["Study_Hours"] = df["Study_Hours"].fillna(df["Study_Hours"].median())
df["CGPA"] = df["CGPA"].fillna(df["CGPA"].mean())
df["Age"] = df["Age"].fillna(df["Age"].median())
```

In [102…

```
if not df["Gender"].mode().empty:
    df["Gender"] = df["Gender"].fillna(df["Gender"].mode()[0])
else:
    df["Gender"] = df["Gender"].fillna("Unknown")
```

In [104…

```
df.isnull().sum()
```

Out[104…

```
Student_ID        0
Age               0
Gender            0
Study_Hours       0
Attendance        0
Internal_Marks    0
Final_Marks       0
Backlogs          0
CGPA              0
dtype: int64
```

In [106…

```
df.describe()
```

Out[106…

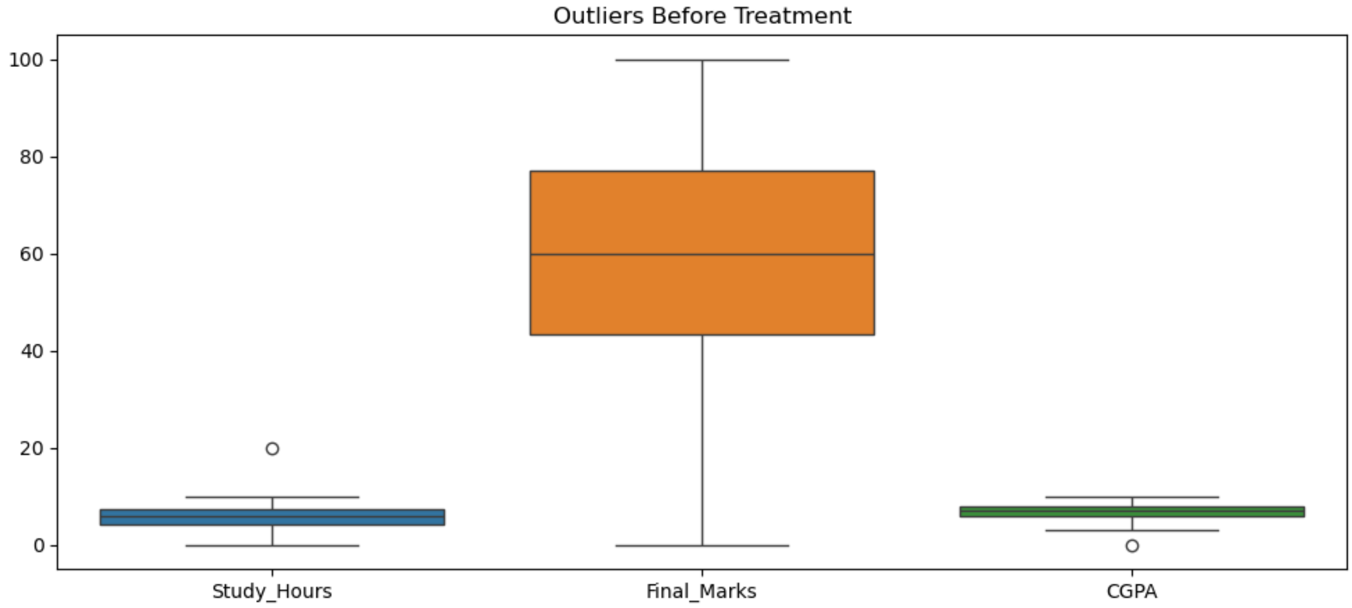
	Student_ID	Age	Study_Hours	Attendance	Internal_Marks	Final_Marks
count	150.000000	150.000000	150.000000	150.000000	150.000000	150.000000
mean	75.500000	22.500000	5.845617	74.346667	29.693333	61.753333
std	43.445368	4.231156	2.336960	22.336050	12.651205	28.571102
min	1.000000	16.000000	0.000000	-20.000000	10.000000	-10.000000
25%	38.250000	18.250000	4.215299	57.250000	19.000000	43.250000
50%	75.500000	23.000000	5.868341	75.000000	29.000000	60.000000
75%	112.750000	26.000000	7.239838	94.000000	41.750000	77.000000
max	150.000000	29.000000	20.000000	150.000000	49.000000	250.000000

In [108…

```
df.loc[df["Attendance"] > 100, "Attendance"] = 100
df.loc[df["Attendance"] < 0, "Attendance"] = 0

df.loc[df["CGPA"] > 10, "CGPA"] = 10
df.loc[df["CGPA"] < 0, "CGPA"] = 0

df.loc[df["Final_Marks"] > 100, "Final_Marks"] = 100
df.loc[df["Final_Marks"] < 0, "Final_Marks"] = 0

df.loc[df["Backlogs"] < 0, "Backlogs"] = 0
```

In [110…

```
plt.figure(figsize=(12,5))
sns.boxplot(data=df[["Study_Hours", "Final_Marks", "CGPA"]])
plt.title("Outliers Before Treatment")
plt.show()
```

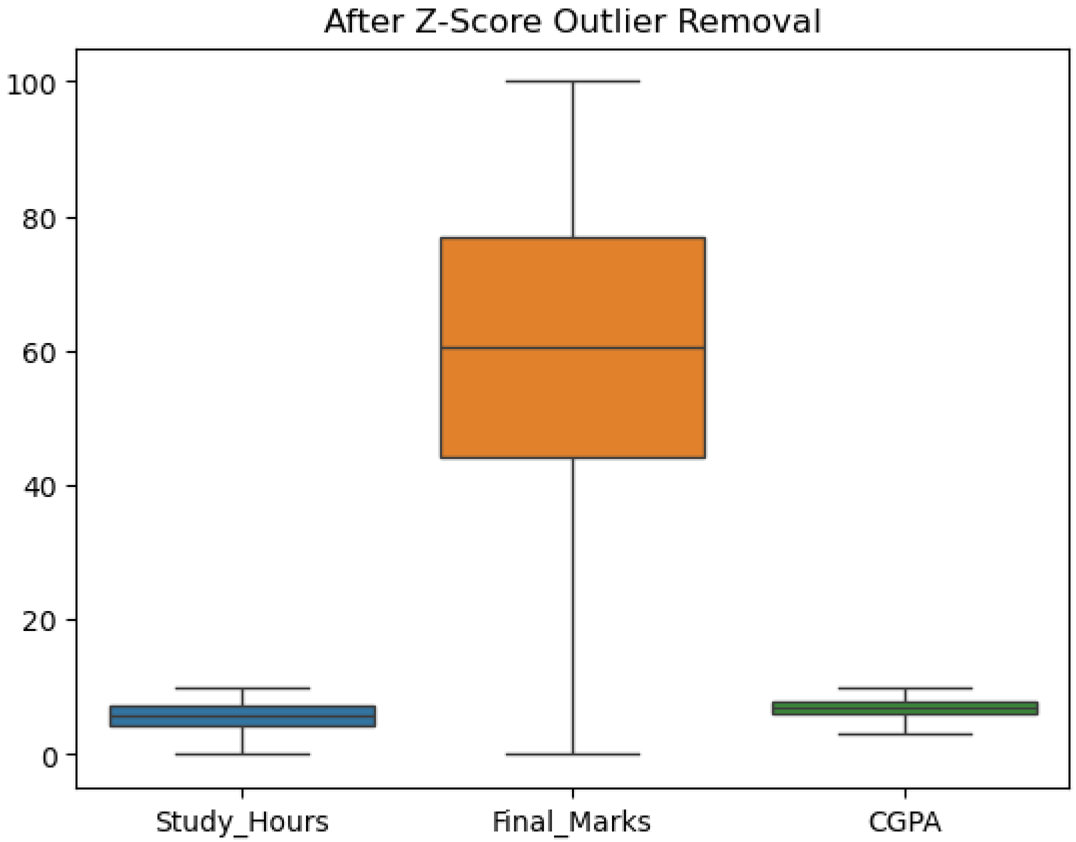


In [112…

```
z_scores = np.abs(stats.zscore(df.select_dtypes(include=np.number)))
df_z = df[(z_scores < 3).all(axis=1)]
```

In [114…

```
sns.boxplot(data=df_z[["Study_Hours", "Final_Marks", "CGPA"]])
plt.title("After Z-Score Outlier Removal")
plt.show()
```

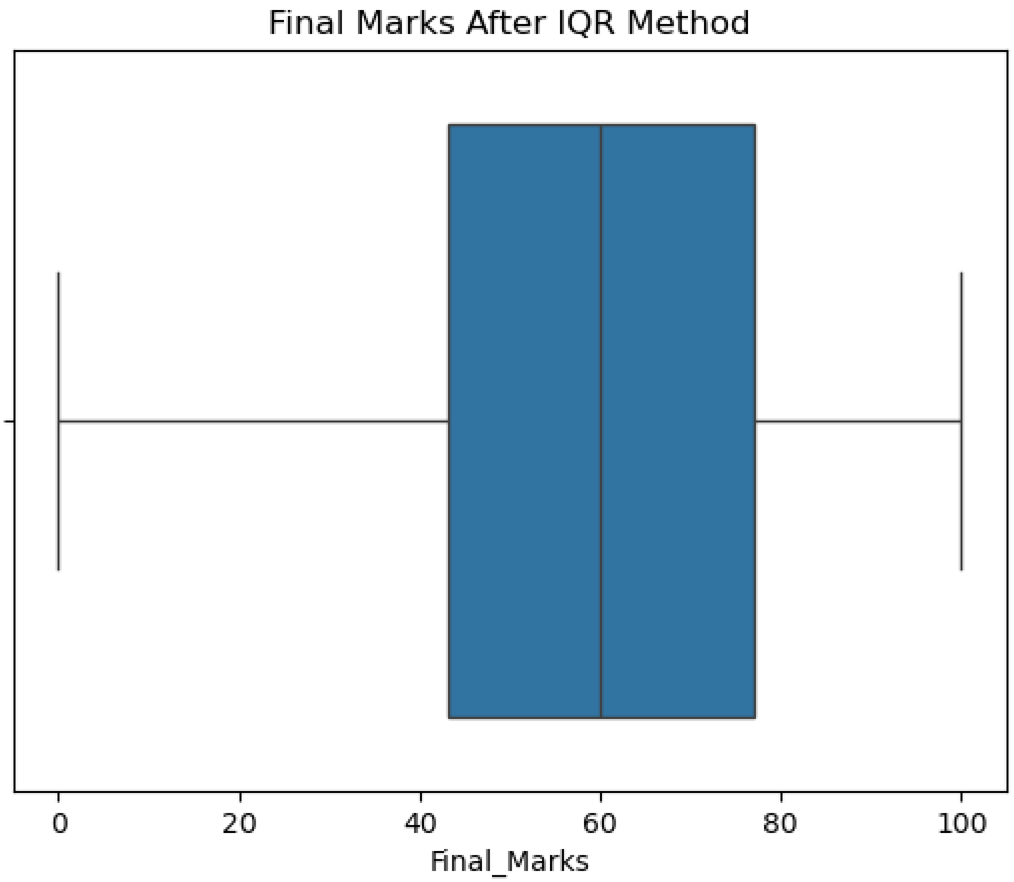


In [116…

```
Q1 = df["Final_Marks"].quantile(0.25)
Q3 = df["Final_Marks"].quantile(0.75)
IQR = Q3 - Q1

lower = Q1 - 1.5 * IQR
upper = Q3 + 1.5 * IQR

df_iqr = df[(df["Final_Marks"] >= lower) & (df["Final_Marks"] <= upper)]
```

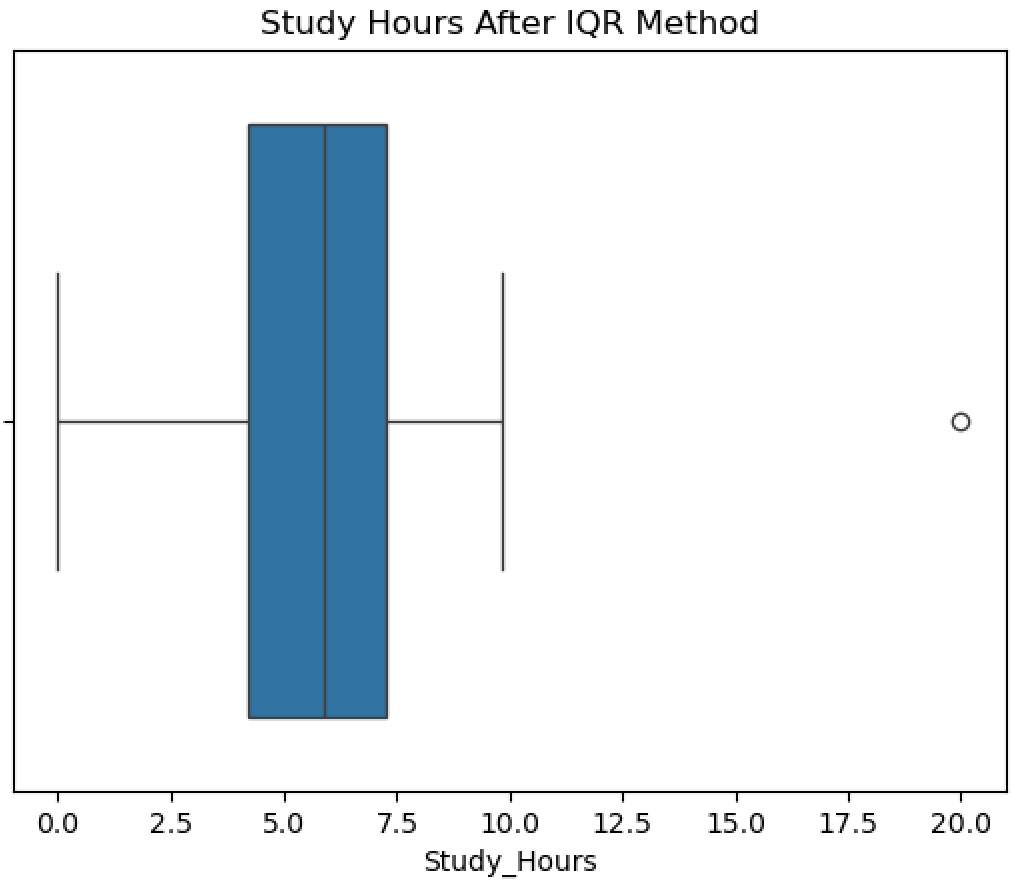
In [118…

```
sns.boxplot(x=df_iqr["Final_Marks"])
plt.title("Final Marks After IQR Method")
plt.show()
```



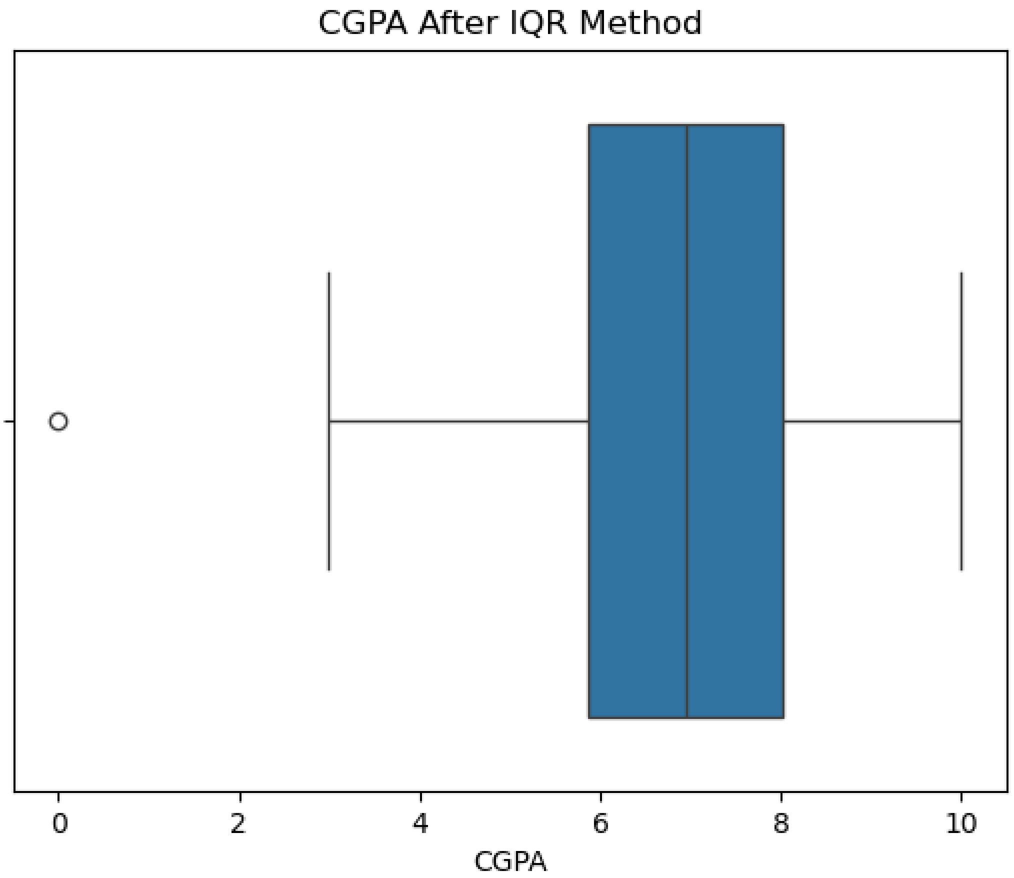
In [122…

```
sns.boxplot(x=df_iqr["Study_Hours"])
plt.title("Study Hours After IQR Method")
plt.show()
```



In [124…

```
sns.boxplot(x=df_iqr["CGPA"])
plt.title("CGPA After IQR Method")
plt.show()
```

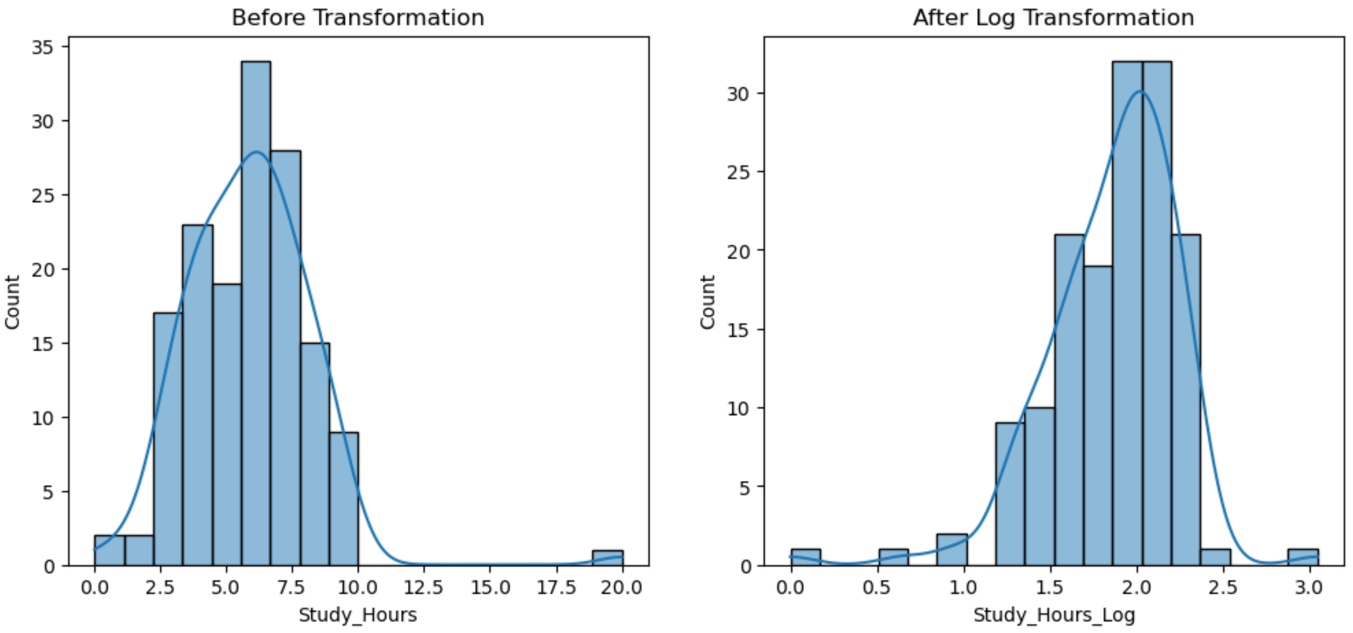


```
In [126…  df["Study_Hours"].skew()
```

```
Out[126…  1.3168478698792767
```

```
In [128…  df["Study_Hours_Log"] = np.log1p(df["Study_Hours"])
```

```
In [130…  plt.figure(figsize=(12,5))

          plt.subplot(1,2,1)
          sns.histplot(df["Study_Hours"], kde=True)
          plt.title("Before Transformation")

          plt.subplot(1,2,2)
          sns.histplot(df["Study_Hours_Log"], kde=True)
          plt.title("After Log Transformation")

          plt.show()
```



In [132…

```
df.head()
```

Out[132…

	Student_ID	Age	Gender	Study_Hours	Attendance	Internal_Marks	Final_Marks	B
0	1	25.0	Other	4.194497	94	28	87	
1	2	29.0	Other	2.577449	48	14	29	
2	3	20.0	Female	7.665052	50	21	34	
3	4	16.0	Male	7.658504	97	42	55	
4	5	17.0	Other	2.961550	44	22	75	

In [134…

```
df.to_csv("academic_performance_cleaned.csv", index=False)
```

In [ ]:

```
```