Import Important Libraries

```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
```

Load Dataset

```
df = pd.read_csv("student_scores.csv")
```

Let's Analyze Dataset

`Analyze attributes`

```
df.head(3)
```

```
   Unnamed: 0  Gender EthnicGroup         ParentEduc LunchType
TestPrep  \
0           0  female         NaN  bachelor's degree  standard
none
1           1  female     group C       some college  standard
NaN
2           2  female     group B    master's degree  standard
none

  ParentMaritalStatus PracticeSport IsFirstChild  NrSiblings
TransportMeans  \
0             married     regularly          yes         3.0
school_bus
1             married     sometimes          yes         0.0
NaN
2              single     sometimes          yes         4.0
school_bus

  WklyStudyHours  MathScore  ReadingScore  WritingScore
0            < 5         71            71            74
1         5 - 10         69            90            88
2            < 5         87            93            91
```

```
df.tail()
```

```
       Unnamed: 0  Gender EthnicGroup          ParentEduc
LunchType  \
30636         816  female     group D         high school
standard
30637         890    male     group E         high school
```

```
standard
30638         911  female         NaN         high school
free/reduced
30639         934  female     group D  associate's degree
standard
30640         960    male     group B        some college
standard

        TestPrep ParentMaritalStatus PracticeSport IsFirstChild
NrSiblings  \
30636       none              single     sometimes           no
2.0
30637       none              single     regularly           no
1.0
30638  completed             married     sometimes           no
1.0
30639  completed             married     regularly           no
3.0
30640       none             married         never           no
1.0

      TransportMeans WklyStudyHours  MathScore  ReadingScore
WritingScore
30636     school_bus         5 - 10         59            61
65
30637        private         5 - 10         58            53
51
30638        private         5 - 10         61            70
67
30639     school_bus         5 - 10         82            90
93
30640     school_bus         5 - 10         64            60
58
```

Check how many rows and columns are present in dataset

```
df.shape

(30641, 15)
```

Get info of dataset

```
df.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 30641 entries, 0 to 30640
Data columns (total 15 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
```

```
 0   Unnamed: 0           30641 non-null  int64
 1   Gender               30641 non-null  object
 2   EthnicGroup          28801 non-null  object
 3   ParentEduc           28796 non-null  object
 4   LunchType            30641 non-null  object
 5   TestPrep             28811 non-null  object
 6   ParentMaritalStatus  29451 non-null  object
 7   PracticeSport        30010 non-null  object
 8   IsFirstChild         29737 non-null  object
 9   NrSiblings           29069 non-null  float64
 10  TransportMeans       27507 non-null  object
 11  WklyStudyHours       29686 non-null  object
 12  MathScore            30641 non-null  int64
 13  ReadingScore         30641 non-null  int64
 14  WritingScore         30641 non-null  int64
dtypes: float64(1), int64(4), object(10)
memory usage: 3.5+ MB
```

Analyze columns one by one

```
df['Gender'].unique()
```

```
array(['female', 'male'], dtype=object)
```

```
df['EthnicGroup'].unique()
```

```
array([nan, 'group C', 'group B', 'group A', 'group D', 'group E'],
      dtype=object)
```

We see that their are some missing values present in EthnicGroup column

```
df['ParentEduc'].unique()
```

```
array(["bachelor's degree", 'some college', "master's degree",
       "associate's degree", 'high school', 'some high school', nan],
      dtype=object)
```

```
df['TransportMeans'].unique()
```

```
array(['school_bus', nan, 'private'], dtype=object)
```

```
df['WklyStudyHours'].unique()
```

```
array(['< 5', '5 - 10', '> 10', nan], dtype=object)
```

Describe data

```
df.describe()
```

```
         Unnamed: 0    NrSiblings     MathScore  ReadingScore  
WritingScore
count  30641.000000  29069.000000  30641.000000  30641.000000  
30641.000000
mean     499.556607      2.145894     66.558402     69.377533  
68.418622
std      288.747894      1.458242     15.361616     14.758952  
15.443525
min        0.000000      0.000000      0.000000     10.000000  
4.000000
25%      249.000000      1.000000     56.000000     59.000000  
58.000000
50%      500.000000      2.000000     67.000000     70.000000  
69.000000
75%      750.000000      3.000000     78.000000     80.000000  
79.000000
max      999.000000      7.000000    100.000000    100.000000  
100.000000
```

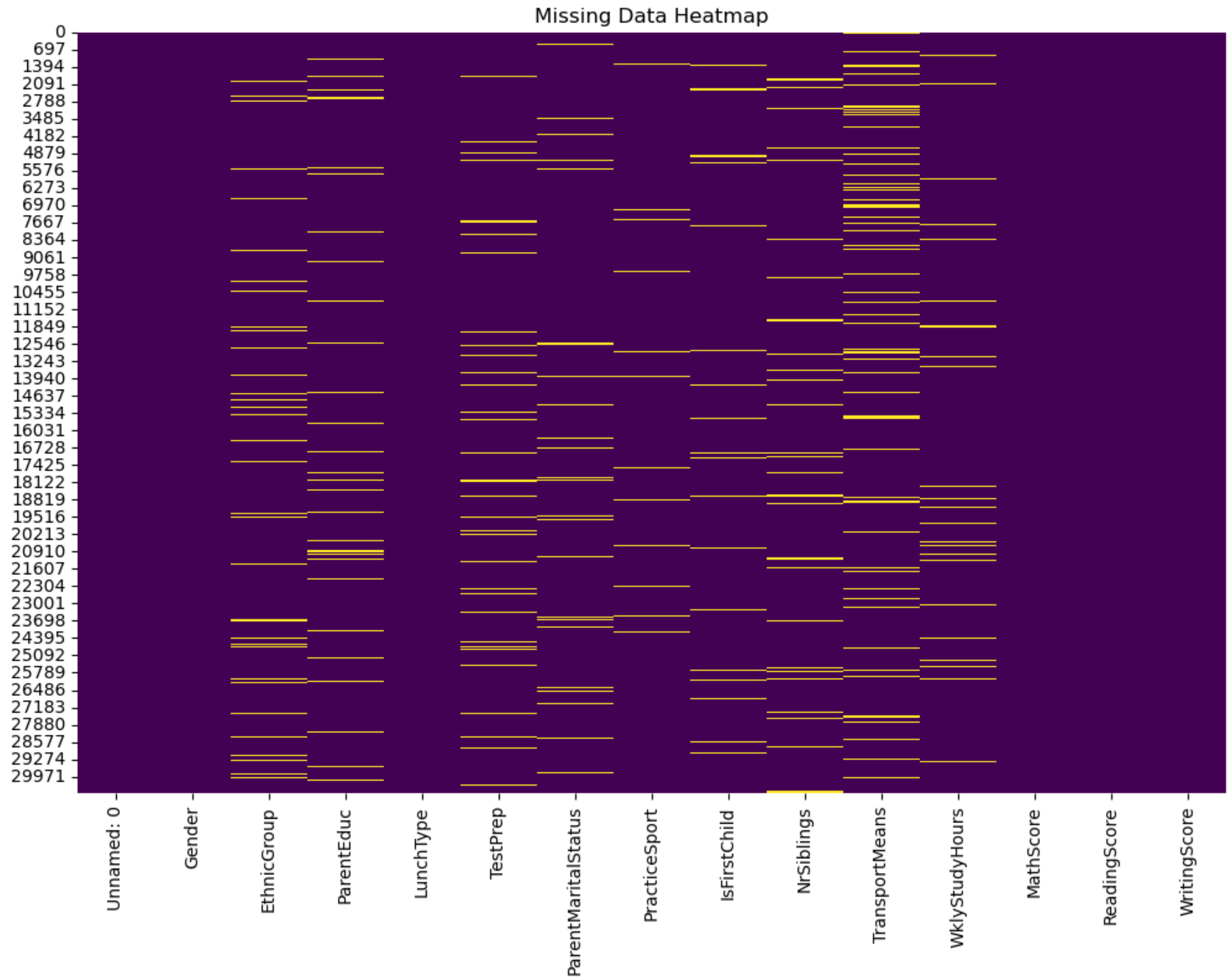
```
df.isna().sum() ## Check how many values are null
```

```
Unnamed: 0                0
Gender                    0
EthnicGroup            1840
ParentEduc             1845
LunchType                 0
TestPrep               1830
ParentMaritalStatus    1190
PracticeSport           631
IsFirstChild            904
NrSiblings             1572
TransportMeans         3134
WklyStudyHours          955
MathScore                 0
ReadingScore              0
WritingScore              0
dtype: int64
```

Heatmap of missing values

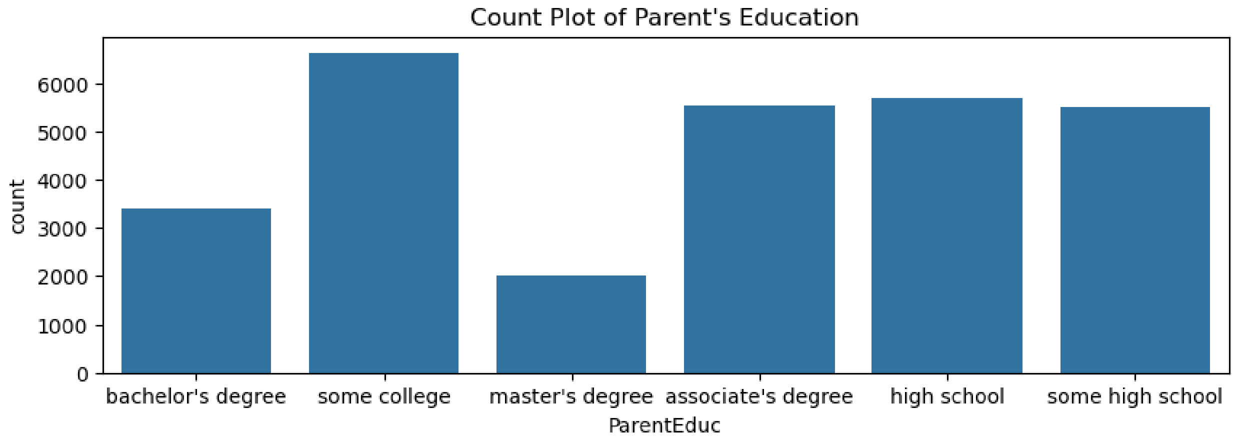
```
plt.figure(figsize=(12, 8))
sns.heatmap(df.isnull(), cbar=False, cmap='viridis')
```

```
plt.title('Missing Data Heatmap')
plt.show()
```



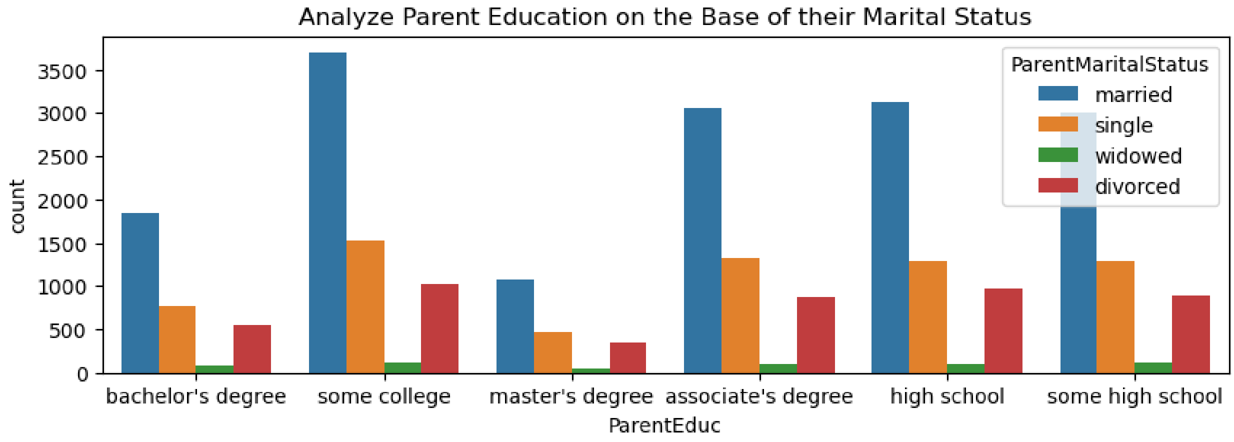
Let's fill and drop values

```
plt.figure(figsize=(10,3))
sns.countplot(x=df['ParentEduc'])
plt.title("Count Plot of Parent's Education")
plt.show()
```



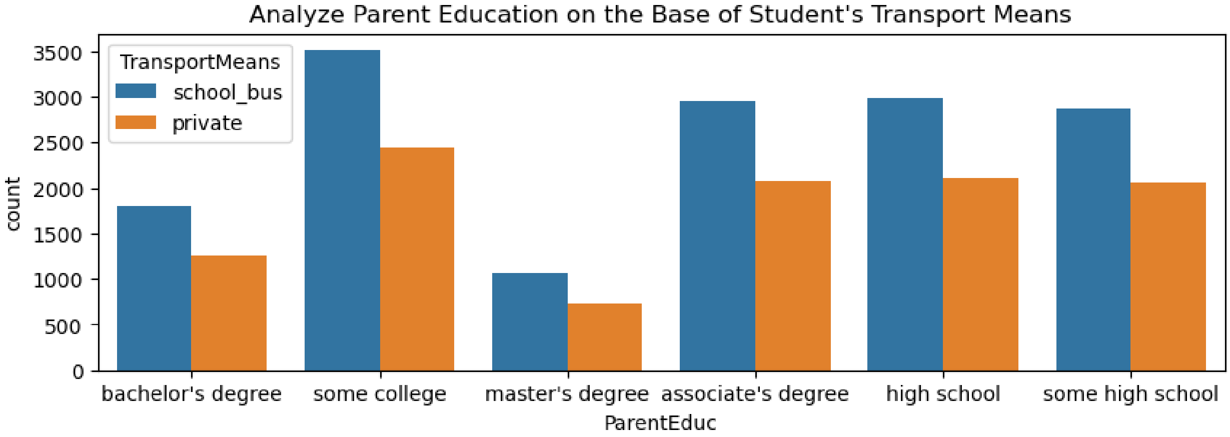
```
df['ParentEduc'].value_counts()

ParentEduc
some college          6633
high school           5687
associate's degree    5550
some high school      5517
bachelor's degree     3386
master's degree       2023
Name: count, dtype: int64
```

```
## Let's check degree on the basis of Parent Marital Status
plt.figure(figsize=(10,3))
sns.countplot(x=df['ParentEduc'], hue=df['ParentMaritalStatus'])
plt.title("Analyze Parent Education on the Base of their Marital
Status")
plt.show()
```



```
## Analyze education on the base of transport means
plt.figure(figsize=(10,3))
sns.countplot(x=df['ParentEduc'], hue=df['TransportMeans'])
```

```
plt.title("Analyze Parent Education on the Base of Student's Transport
Means")
plt.show()
```



As,.I don't found any specific trend in Parent Educ with other, so the better option is dropna values from it

```
df.dropna(subset=['ParentEduc'], inplace=True)

df.isna().sum()
```

```
Unnamed: 0                0
Gender                    0
EthnicGroup            1726
ParentEduc                0
LunchType                 0
TestPrep               1722
ParentMaritalStatus    1116
PracticeSport           581
IsFirstChild            844
NrSiblings             1477
TransportMeans         2933
WklyStudyHours          893
MathScore                 0
ReadingScore              0
WritingScore              0
dtype: int64
```

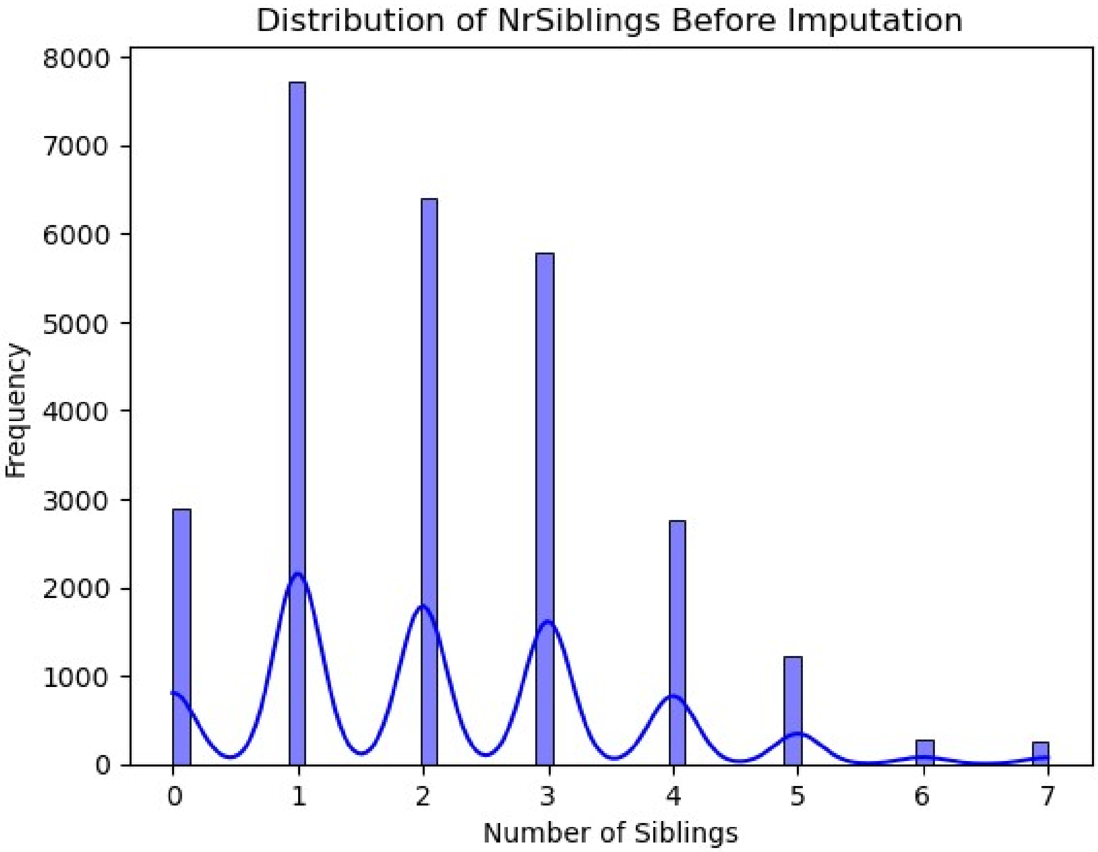
Let's first drop UnNamed Column from our dataset b/c it makes no sense

```
df.head(1)
```

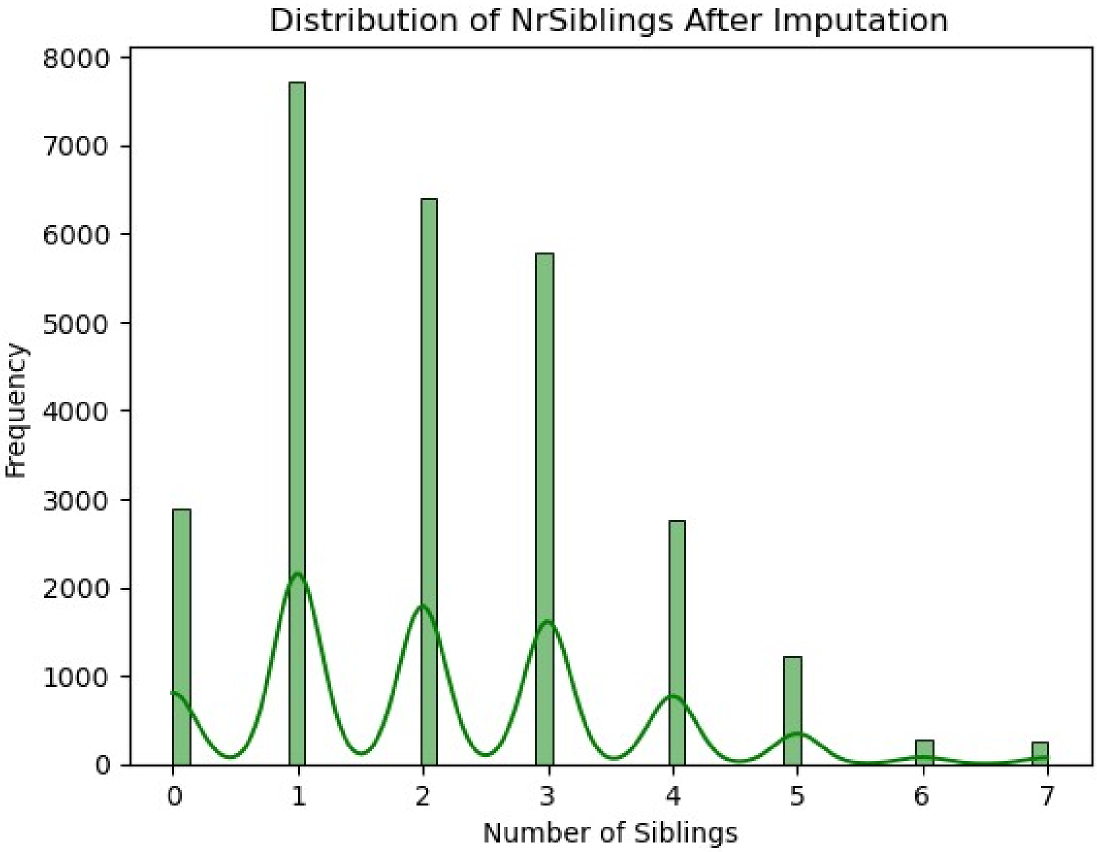
```
   Unnamed: 0  Gender EthnicGroup          ParentEduc LunchType
TestPrep  \
0           0  female         NaN  bachelor's degree  standard
none

  ParentMaritalStatus PracticeSport IsFirstChild  NrSiblings
TransportMeans  \
0             married     regularly          yes         3.0
school_bus

  WklyStudyHours  MathScore  ReadingScore  WritingScore
0            < 5         71            71            74

df.drop('Unnamed: 0', axis=1, inplace=True)
 # Axis = 1 specifies that i want to drop column, not row

df.head(1)

   Gender EthnicGroup          ParentEduc LunchType TestPrep  \
0  female         NaN  bachelor's degree  standard     none

  ParentMaritalStatus PracticeSport IsFirstChild  NrSiblings
TransportMeans  \
0             married     regularly          yes         3.0
school_bus

  WklyStudyHours  MathScore  ReadingScore  WritingScore
0            < 5         71            71            74
```

Analyze no. of siblings

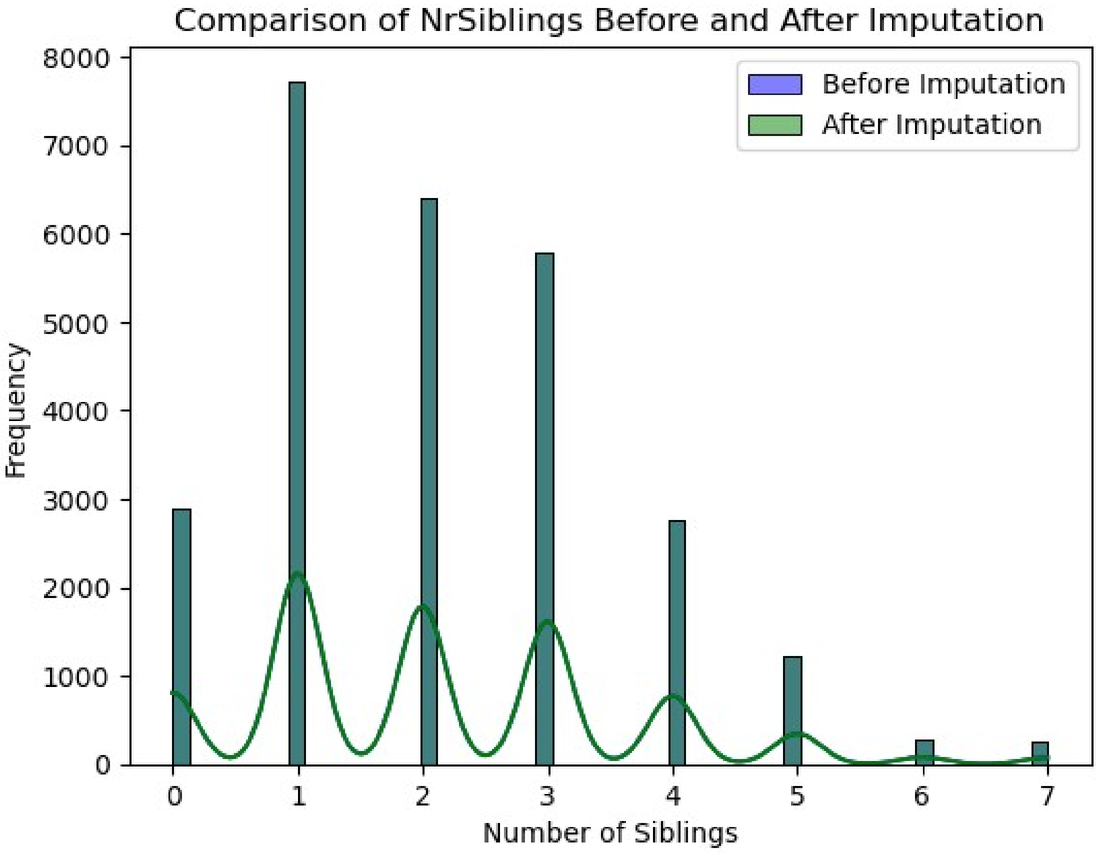
```
df['NrSiblings'].unique()

array([ 3.,  0.,  4.,  1., nan,  2.,  5.,  7.,  6.])

sns.histplot(df['NrSiblings'], kde=True, color='blue')
plt.title('Distribution of NrSiblings Before Imputation')
plt.xlabel('Number of Siblings')
plt.ylabel('Frequency')
plt.show()
```



```
## Fill Missing value with mean
df_filled = df.copy()  # Create a copy to compare before and after
df_filled['NrSiblings'].fillna(df['NrSiblings'].mode())

0        3.0
1        0.0
2        4.0
3        1.0
4        0.0
        ... 
30636    2.0
30637    1.0
30638    1.0
30639    3.0
30640    1.0
Name: NrSiblings, Length: 28796, dtype: float64

sns.histplot(df_filled['NrSiblings'], kde=True, color='green')
plt.title('Distribution of NrSiblings After Imputation')
plt.xlabel('Number of Siblings')
plt.ylabel('Frequency')
plt.show()
```



```
sns.histplot(df['NrSiblings'], kde=True, color='blue', label='Before
Imputation')
sns.histplot(df_filled['NrSiblings'], kde=True, color='green',
label='After Imputation', alpha=0.5)
plt.title('Comparison of NrSiblings Before and After Imputation')
plt.xlabel('Number of Siblings')
plt.ylabel('Frequency')
plt.legend()
plt.show()
```



As we see that it does not affect our data, if we fill no of sibbling with mode, so we fill it in our original dataset

```
df.isna().sum()

Gender                     0
EthnicGroup             1726
ParentEduc                 0
LunchType                  0
TestPrep                1722
ParentMaritalStatus     1116
PracticeSport            581
IsFirstChild             844
NrSiblings              1477
TransportMeans          2933
WklyStudyHours           893
MathScore                  0
ReadingScore               0
WritingScore               0
dtype: int64

# Compute the mode of 'NrSiblings' (mode returns a Series, take the
first value)
```

```python
mode_value = df['NrSiblings'].mode()[0]

# Fill missing values with the mode
df['NrSiblings'] = df['NrSiblings'].fillna(mode_value)

df.isna().sum()
```

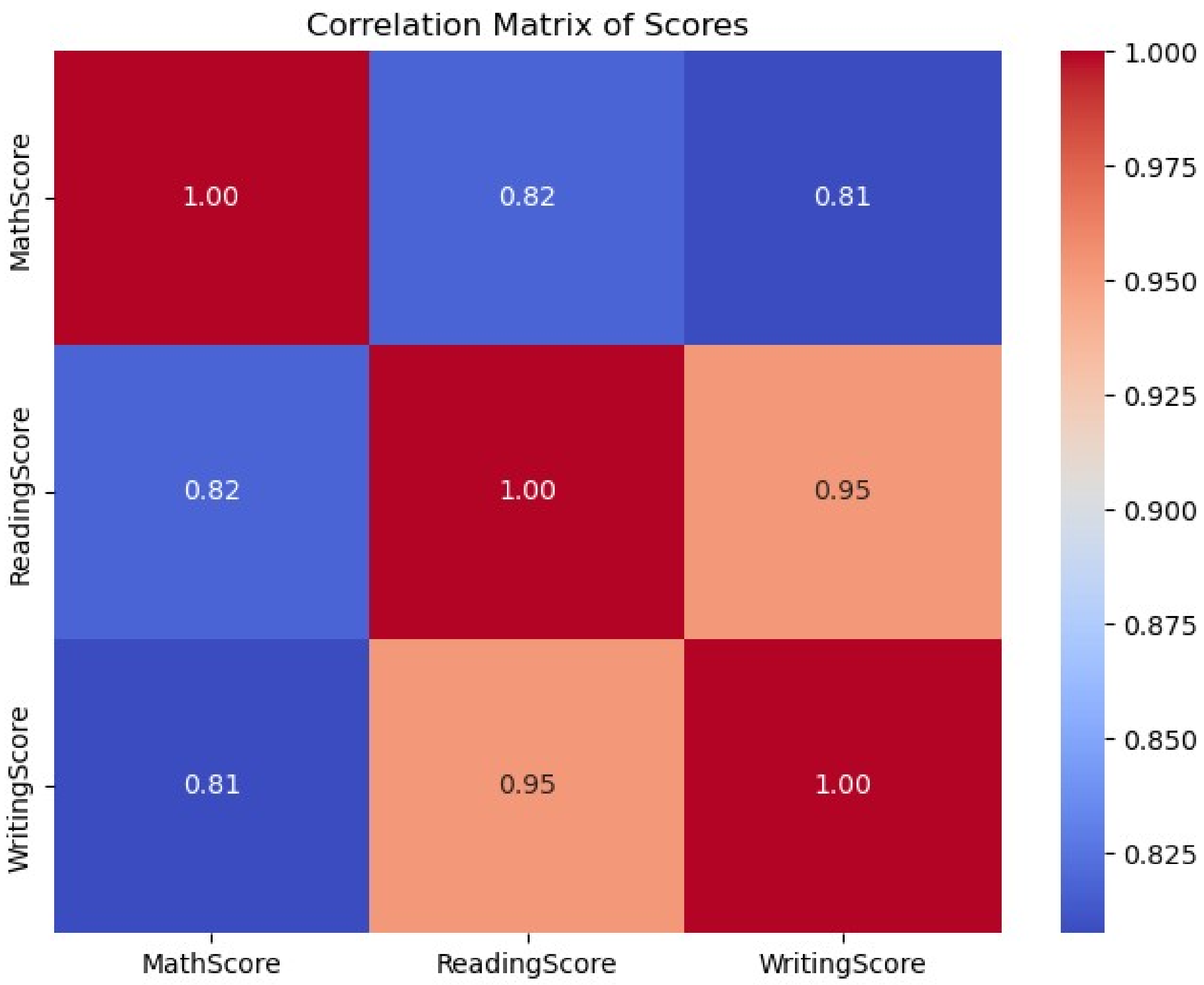
```
Gender                    0
EthnicGroup            1726
ParentEduc                0
LunchType                 0
TestPrep               1722
ParentMaritalStatus    1116
PracticeSport           581
IsFirstChild            844
NrSiblings                0
TransportMeans         2933
WklyStudyHours          893
MathScore                 0
ReadingScore              0
WritingScore              0
dtype: int64
```

```python
df['NrSiblings'].unique()
```

```
array([3., 0., 4., 1., 2., 5., 7., 6.])
```

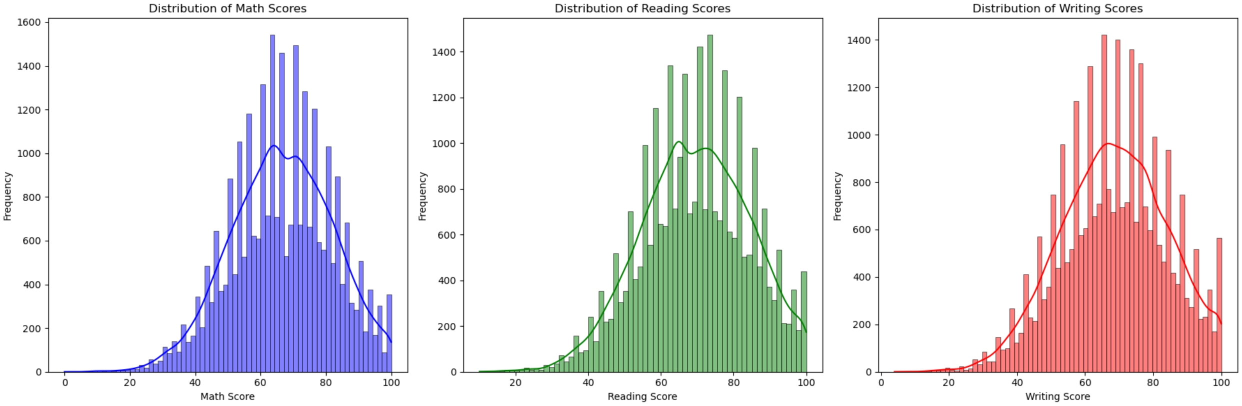
Compute the correlation matrix

```python
corr = df[['MathScore', 'ReadingScore', 'WritingScore']].corr()

# Create a heatmap of the correlation matrix
plt.figure(figsize=(8, 6))
sns.heatmap(corr, annot=True, cmap='coolwarm', fmt='.2f')
plt.title('Correlation Matrix of Scores')
plt.show()
```



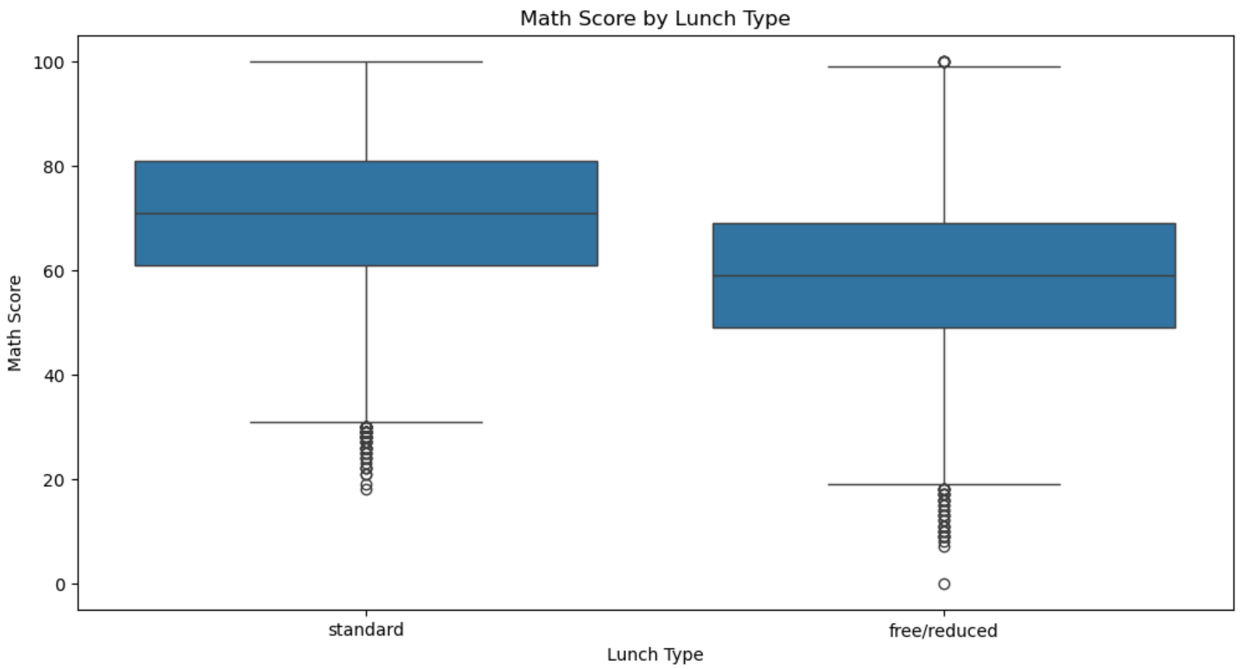
Distribution of Score

```
plt.figure(figsize=(18, 6))

# Histogram for MathScore
plt.subplot(1, 3, 1)
sns.histplot(df['MathScore'], kde=True, color='blue')
plt.title('Distribution of Math Scores')
plt.xlabel('Math Score')
plt.ylabel('Frequency')

# Histogram for ReadingScore
plt.subplot(1, 3, 2)
sns.histplot(df['ReadingScore'], kde=True, color='green')
plt.title('Distribution of Reading Scores')
plt.xlabel('Reading Score')
plt.ylabel('Frequency')

# Histogram for WritingScore
plt.subplot(1, 3, 3)
sns.histplot(df['WritingScore'], kde=True, color='red')
plt.title('Distribution of Writing Scores')
plt.xlabel('Writing Score')
plt.ylabel('Frequency')

plt.tight_layout()
plt.show()
```



Box plot for lunch type

```
# Box plot for MathScore by LunchType
plt.figure(figsize=(12, 6))
sns.boxplot(x='LunchType', y='MathScore', data=df)
plt.title('Math Score by Lunch Type')
plt.xlabel('Lunch Type')
plt.ylabel('Math Score')
plt.show()
```

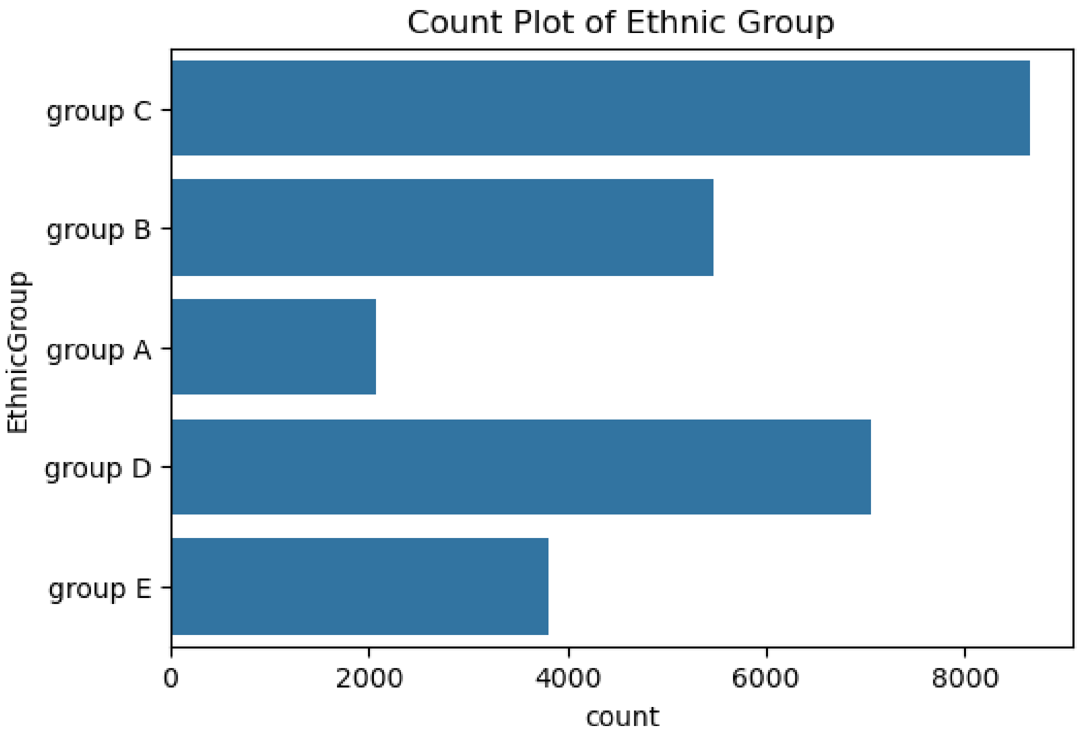


Analyze Ethnic Group

```
df['EthnicGroup'].unique()
```

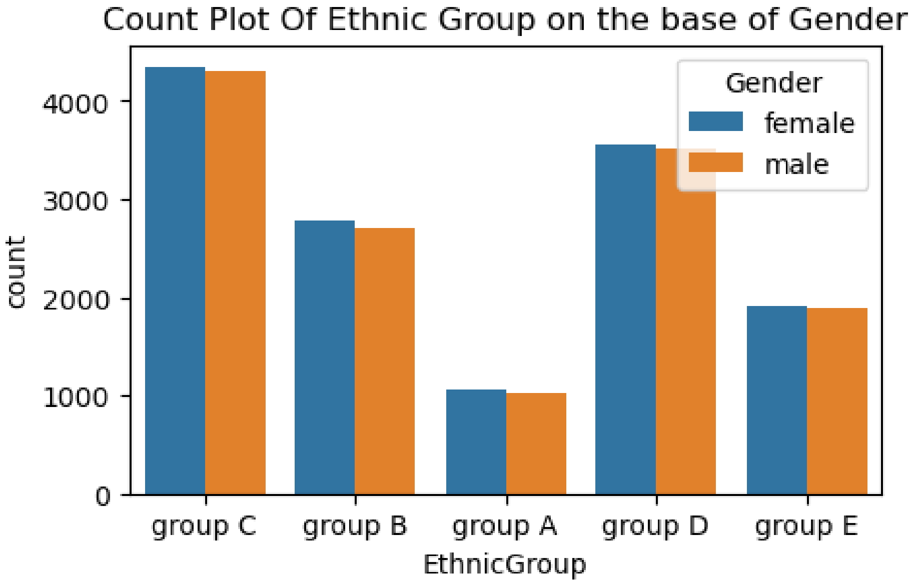
```
array([nan, 'group C', 'group B', 'group A', 'group D', 'group E'],
      dtype=object)
```

```
plt.figure(figsize=(6,4))
plt.title("Count Plot of Ethnic Group")
sns.countplot(df['EthnicGroup'])
plt.show()
```



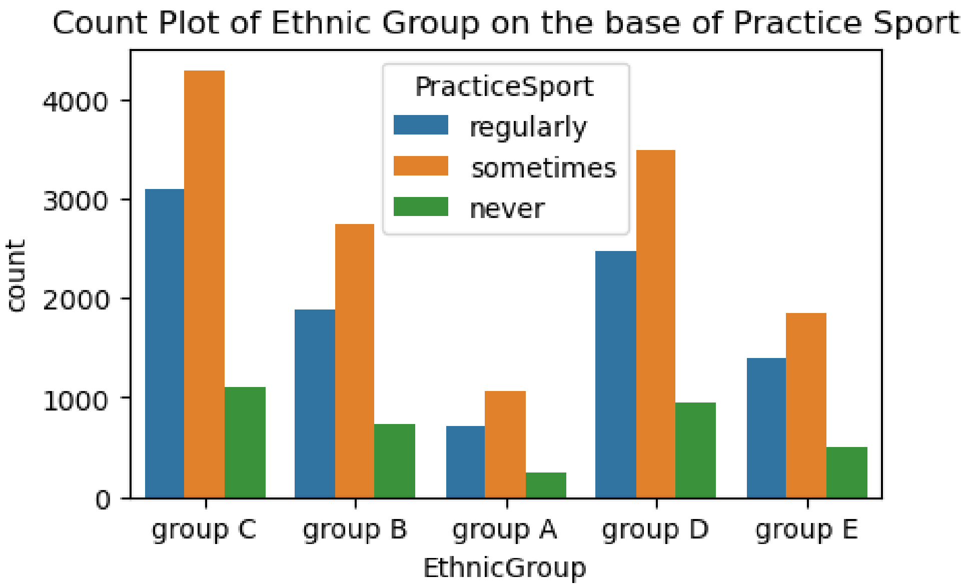
Analyze Ethnic Group on the base of gender

```
plt.figure(figsize=(5,3))
sns.countplot(x=df['EthnicGroup'], hue=df['Gender'])
plt.title("Count Plot Of Ethnic Group on the base of Gender")
plt.show()
```



Let's Analyze it with practice sport

```
plt.figure(figsize=(5,3))
sns.countplot(x=df['EthnicGroup'], hue=df['PracticeSport'])
plt.title("Count Plot of Ethnic Group on the base of Practice Sport")
plt.show()
```



It follow no trend, lets dropna

```
df.dropna(subset=['EthnicGroup'], inplace=True)
```

```
df.isna().sum()
```

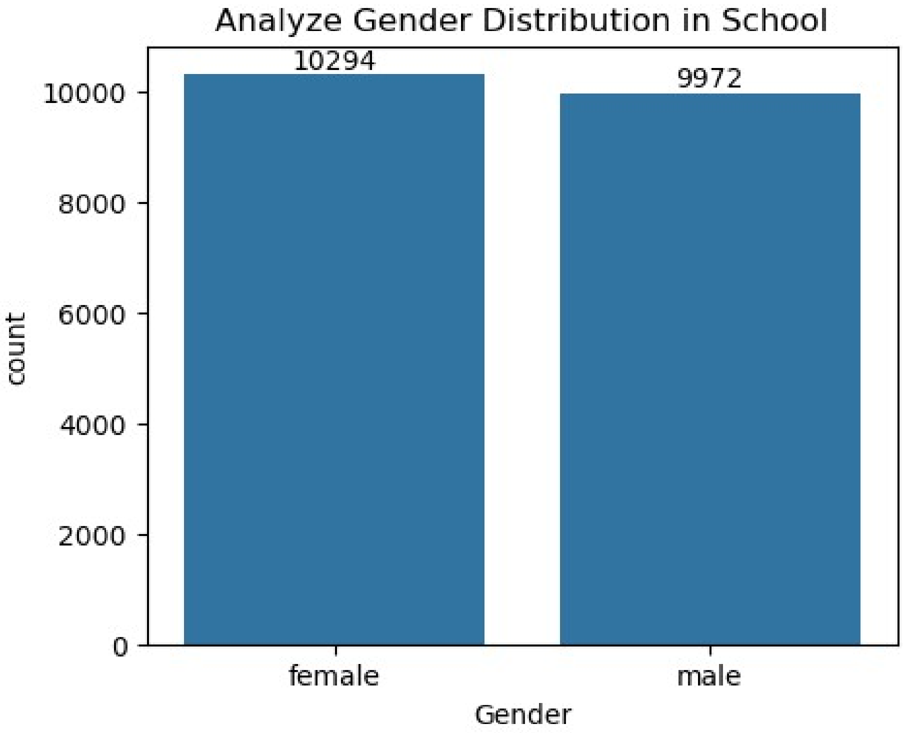
```
Gender                  0
EthnicGroup             0
ParentEduc              0
LunchType               0
TestPrep             1611
ParentMaritalStatus  1038
PracticeSport         535
IsFirstChild          796
NrSiblings              0
TransportMeans       2763
WklyStudyHours        829
MathScore               0
ReadingScore            0
WritingScore            0
dtype: int64
```

Lets drop all null values

```
df.dropna(inplace=True)

df.info()

<class 'pandas.core.frame.DataFrame'>
Index: 20266 entries, 2 to 30640
Data columns (total 14 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   Gender              20266 non-null  object
 1   EthnicGroup         20266 non-null  object
 2   ParentEduc          20266 non-null  object
 3   LunchType           20266 non-null  object
 4   TestPrep            20266 non-null  object
 5   ParentMaritalStatus  20266 non-null  object
 6   PracticeSport       20266 non-null  object
 7   IsFirstChild        20266 non-null  object
 8   NrSiblings          20266 non-null  float64
 9   TransportMeans      20266 non-null  object
 10  WklyStudyHours      20266 non-null  object
 11  MathScore           20266 non-null  int64
 12  ReadingScore        20266 non-null  int64
 13  WritingScore        20266 non-null  int64
dtypes: float64(1), int64(3), object(10)
memory usage: 2.3+ MB
```

Analyze Gender distribution

```
plt.figure(figsize=(5,4))
ax = sns.countplot(x=df['Gender'])
ax.bar_label(ax.containers[0])
plt.title("Analyze Gender Distribution in School")
plt.show()
```



```
df['Gender'].value_counts()

Gender
female    10294
male       9972
Name: count, dtype: int64
```

Analysis

From the above chart, we analyze that no of female in a school is greater than no. on male students

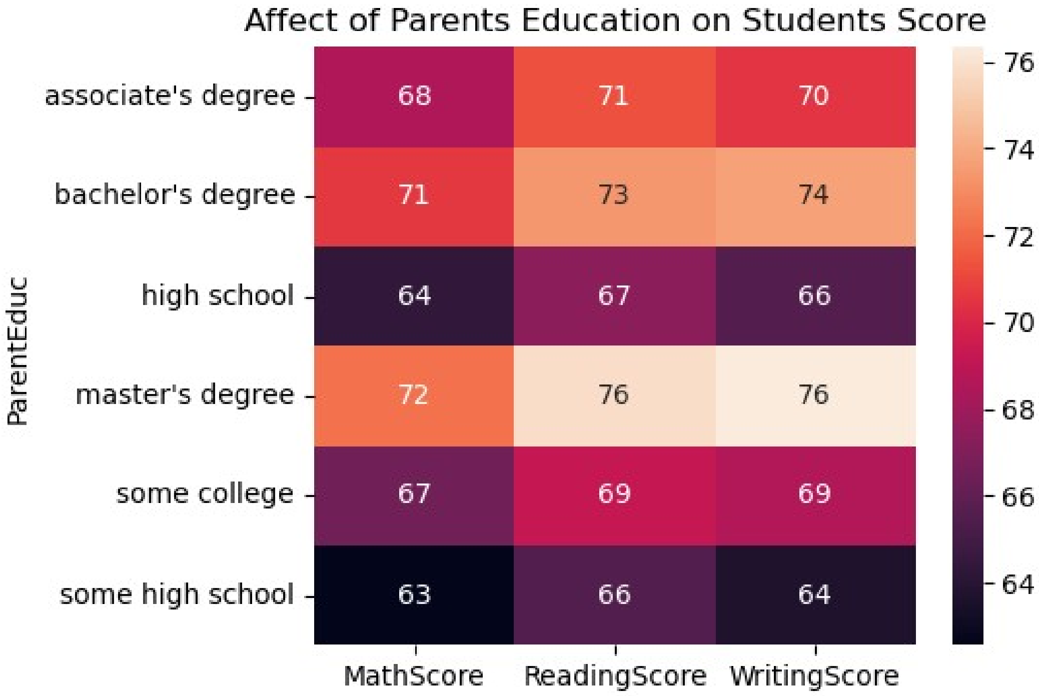
Parent Education Impact on scores of Student

```
## We find the aggregate/estimate of parent education on student score
gb =
df.groupby('ParentEduc').agg({'MathScore':'mean','ReadingScore':'mean'
,'WritingScore':'mean'})
gb

                    MathScore  ReadingScore  WritingScore
ParentEduc
associate's degree  68.483472     71.302296     70.496089
```

```
bachelor's degree   70.600165      73.383726     73.703428
high school         64.364892      67.354847     65.541688
master's degree     72.223796      75.825779     76.331445
some college        66.530300      69.230537     68.586802
some high school    62.558556      65.503246     63.645547
```

We use heatmap for this type of data analysis

```
plt.figure(figsize=(5,4))
sns.heatmap(gb, annot=True)
plt.title("Affect of Parents Education on Students Score")
plt.show()
```



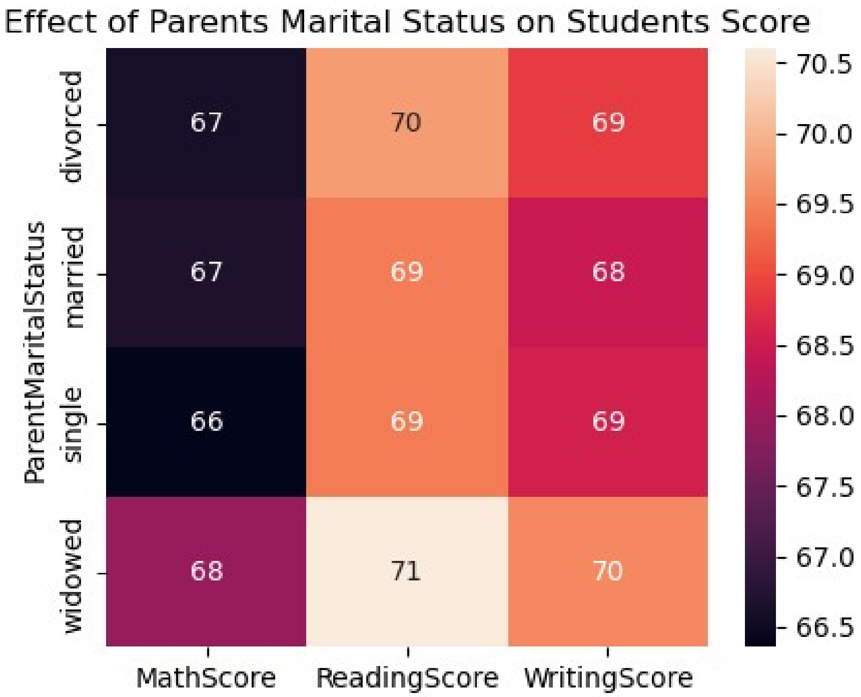
Parents education impacts alot on their children scores

Parent Marital Status Impact on scores of Student

```
## We find the aggregate/estimate of parent education on student score
gb =
df.groupby('ParentMaritalStatus').agg({'MathScore':'mean','ReadingScor
e':'mean','WritingScore':'mean'})
gb

                     MathScore  ReadingScore  WritingScore
ParentMaritalStatus
```

```
divorced                  66.619941      69.742522      68.872434
married                   66.675799      69.447144      68.455070
single                    66.357481      69.428689      68.569665
widowed                   67.966667      70.594872      69.543590
```

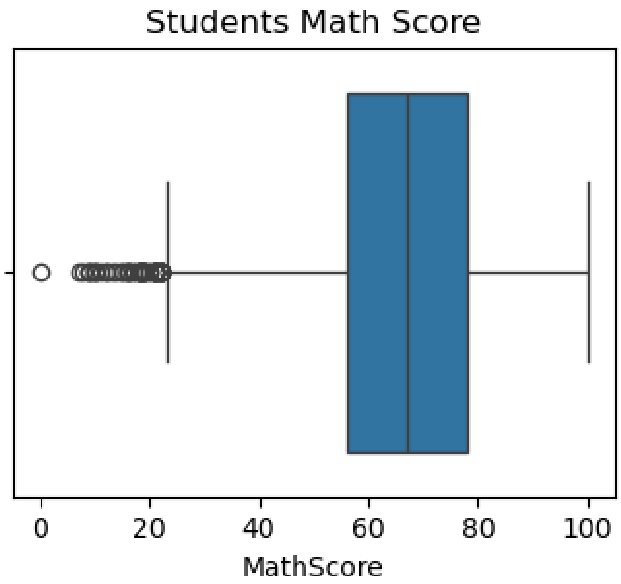
```
plt.figure(figsize=(5,4))
sns.heatmap(gb, annot=True)
plt.title("Effect of Parents Marital Status on Students Score")
plt.show()
```



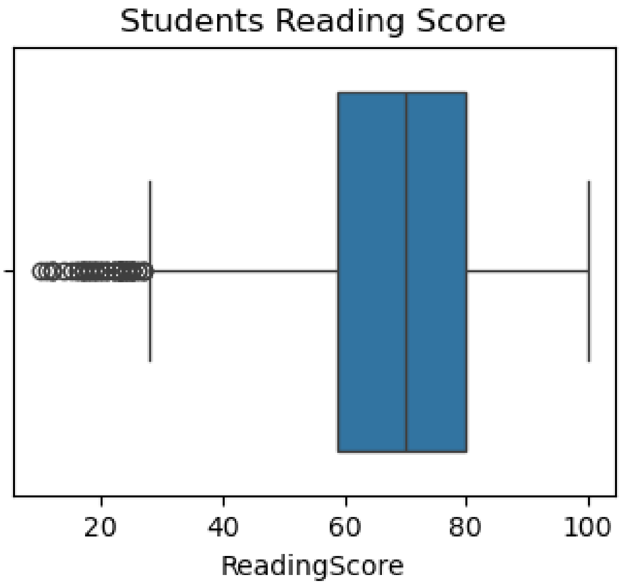
From the above chart we have concluded that there is no/negliable impact on students score due to their parents merital status

Lets detect outlier in scores

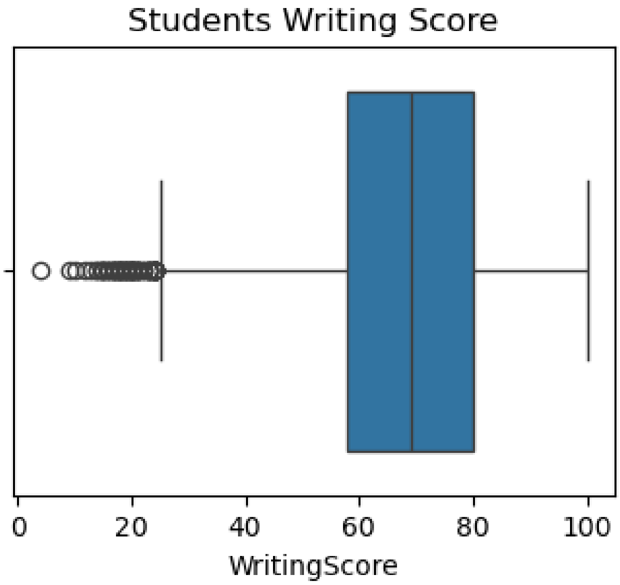
```
plt.figure(figsize=(4,3))
sns.boxplot(x=df['MathScore'])
plt.title("Students Math Score")
plt.show()
```



```
plt.figure(figsize=(4,3))
sns.boxplot(x=df['ReadingScore'])
plt.title("Students Reading Score")
plt.show()
```

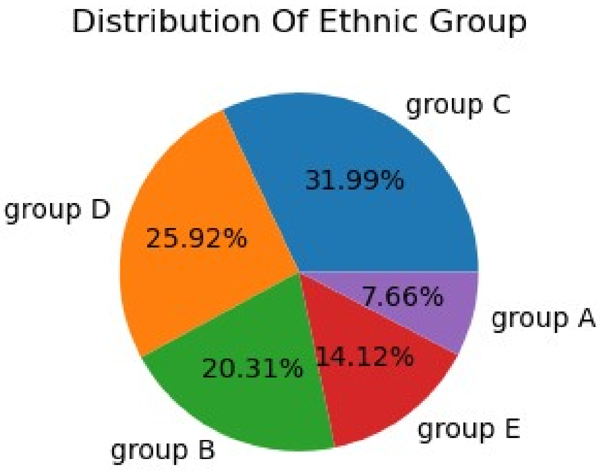


```
plt.figure(figsize=(4,3))
sns.boxplot(x=df['WritingScore'])
plt.title("Students Writing Score")
plt.show()
```



Ethnics Group Distribution

```
values_count = df['EthnicGroup'].value_counts()

plt.figure(figsize=(5,3))
plt.title("Distribution Of Ethnic Group")
plt.pie(values_count, labels=values_count.keys(),autopct='%.2f%%')
plt.show()
```



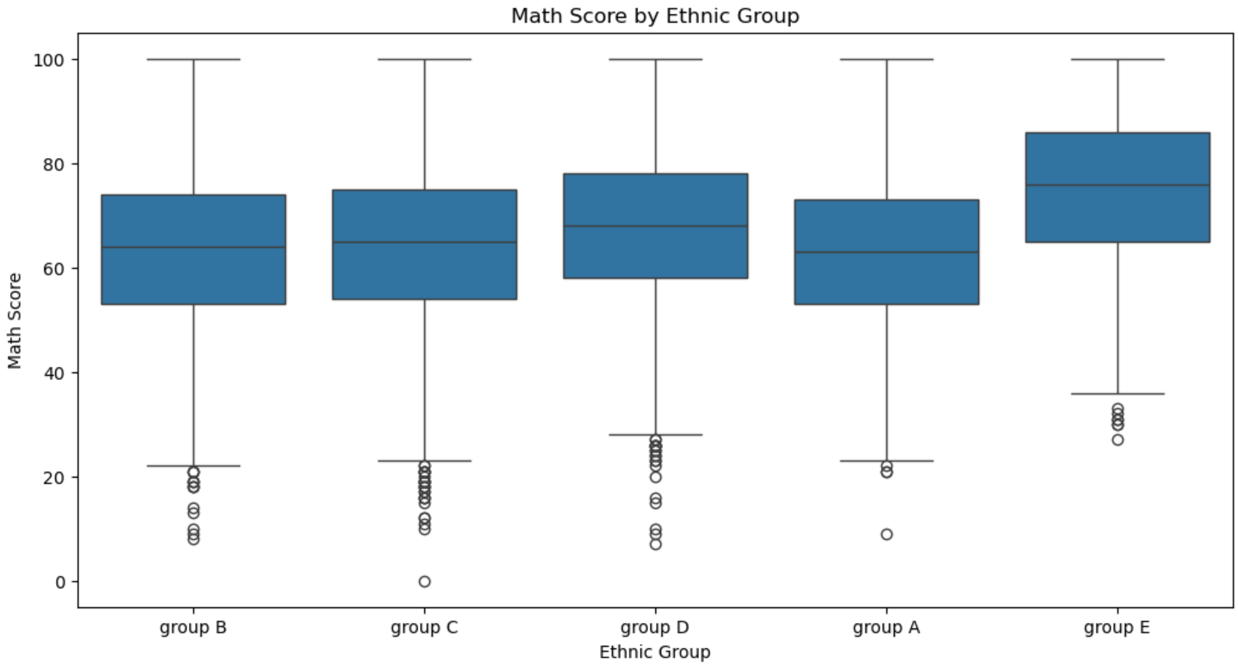
```
values_count
```

```
EthnicGroup
group C    6484
group D    5252
group B    4116
group E    2862
group A    1552
Name: count, dtype: int64
```

```
values_count.keys()
```

```
Index(['group C', 'group D', 'group B', 'group E', 'group A'],
dtype='object', name='EthnicGroup')
```

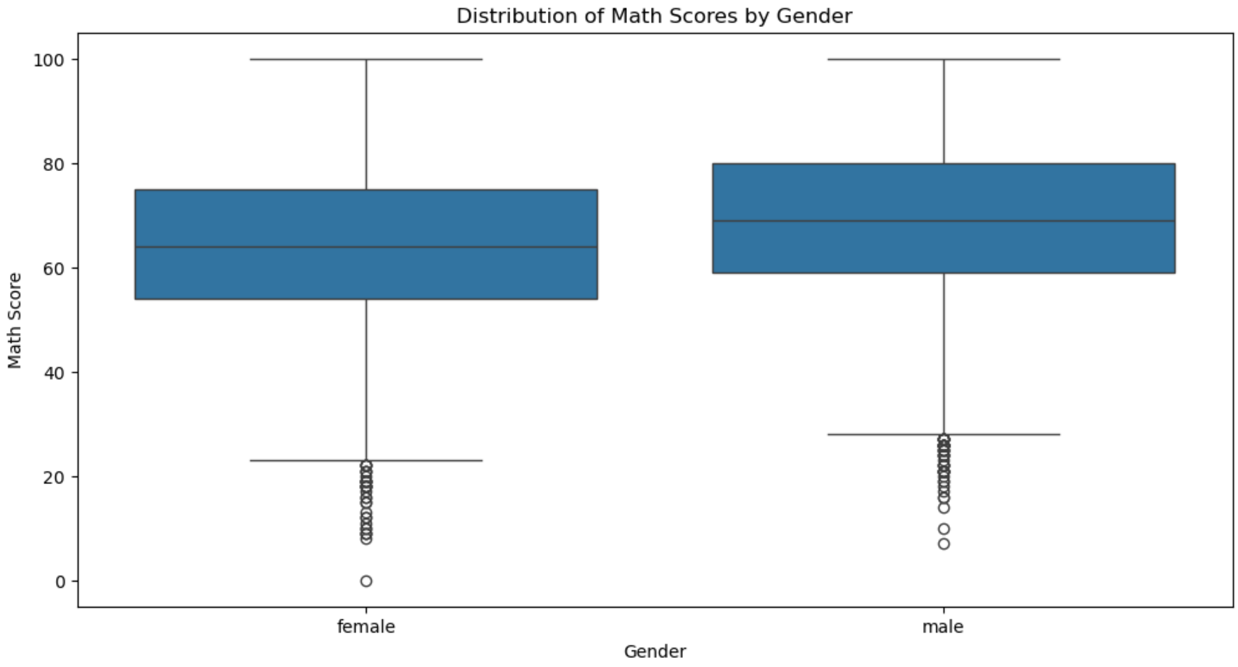
```
# Box plot for MathScore by EthnicGroup
plt.figure(figsize=(12, 6))
sns.boxplot(x='EthnicGroup', y='MathScore', data=df)
plt.title('Math Score by Ethnic Group')
plt.xlabel('Ethnic Group')
plt.ylabel('Math Score')
plt.show()
```



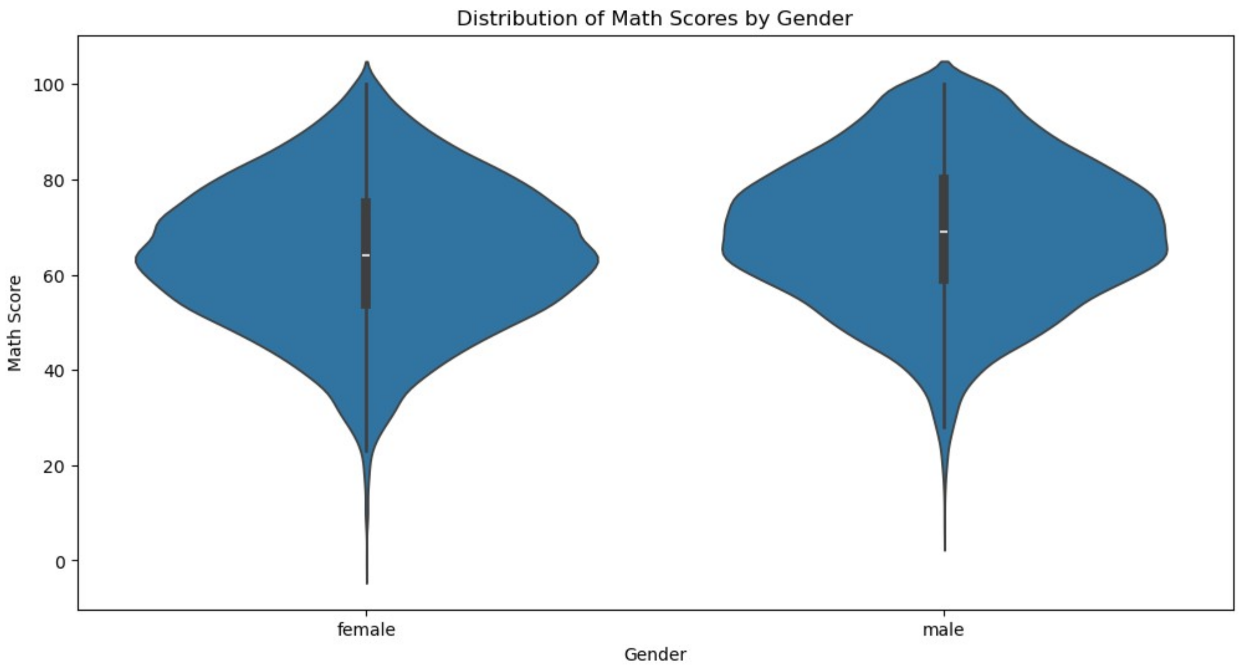
Effect of Gender on Score

Math Score

```
plt.figure(figsize=(12, 6))

# Box plot for MathScore by Gender
sns.boxplot(x='Gender', y='MathScore', data=df)
plt.title('Distribution of Math Scores by Gender')
plt.xlabel('Gender')
plt.ylabel('Math Score')
plt.show()
```



```
plt.figure(figsize=(12, 6))

# Violin plot for MathScore by Gender
sns.violinplot(x='Gender', y='MathScore', data=df)
plt.title('Distribution of Math Scores by Gender')
plt.xlabel('Gender')
plt.ylabel('Math Score')
plt.show()
```

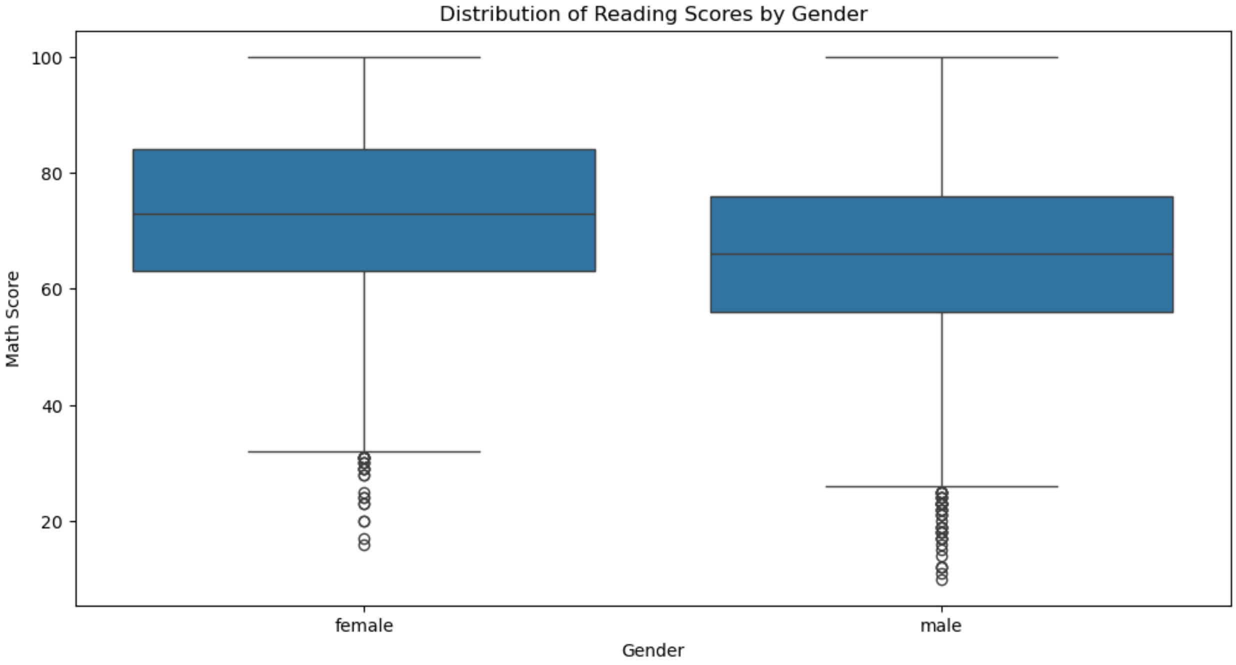


```
# Summary statistics for MathScore by Gender
summary = df.groupby('Gender')['MathScore'].agg(['mean', 'median',
'std', 'count'])
print(summary)
```

```
             mean  median        std  count
Gender
female  64.234991    64.0  15.142134  10294
male    69.071701    69.0  15.230742   9972
```

Reading Score

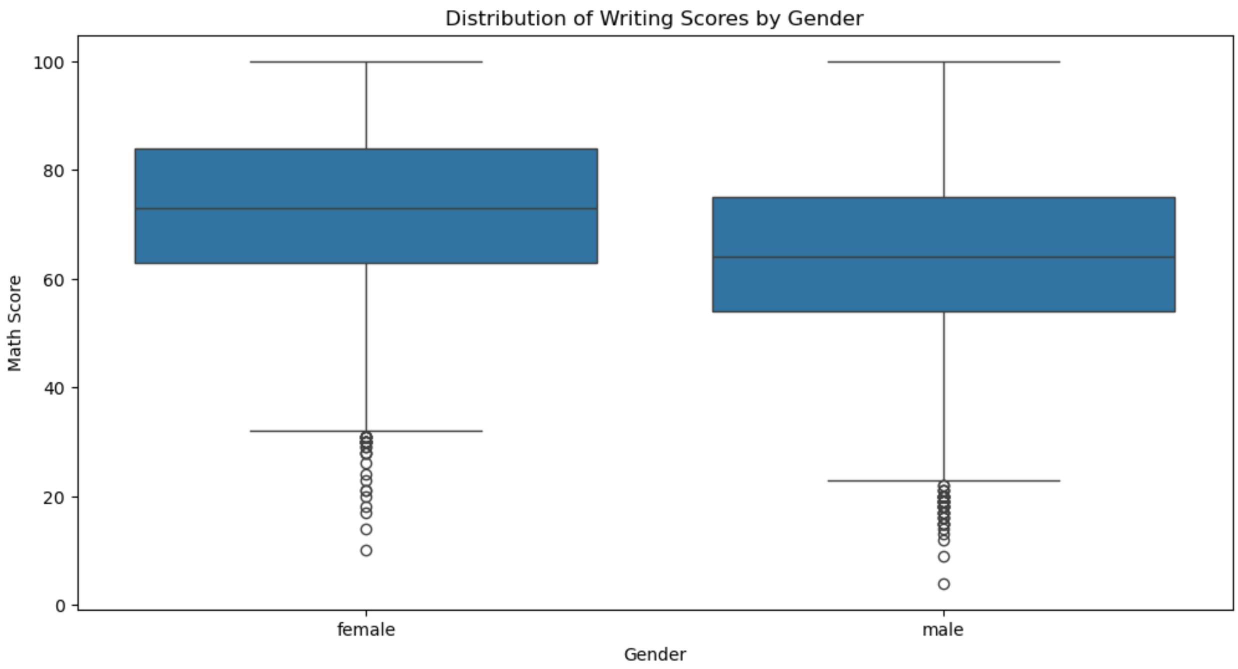
```
plt.figure(figsize=(12, 6))

# Box plot for Reading by Gender
sns.boxplot(x='Gender', y='ReadingScore', data=df)
plt.title('Distribution of Reading Scores by Gender')
plt.xlabel('Gender')
plt.ylabel('Math Score')
plt.show()
```



```
# Summary statistics for Reading by Gender
summary = df.groupby('Gender')['ReadingScore'].agg(['mean', 'median',
'std', 'count'])
print(summary)

             mean  median        std  count
Gender
female  73.052943    73.0  14.153673  10294
male    65.861813    66.0  14.550282   9972
```

Writing Score

```
plt.figure(figsize=(12, 6))

# Box plot for Writing by Gender
sns.boxplot(x='Gender', y='WritingScore', data=df)
plt.title('Distribution of Writing Scores by Gender')
plt.xlabel('Gender')
plt.ylabel('Math Score')
plt.show()
```



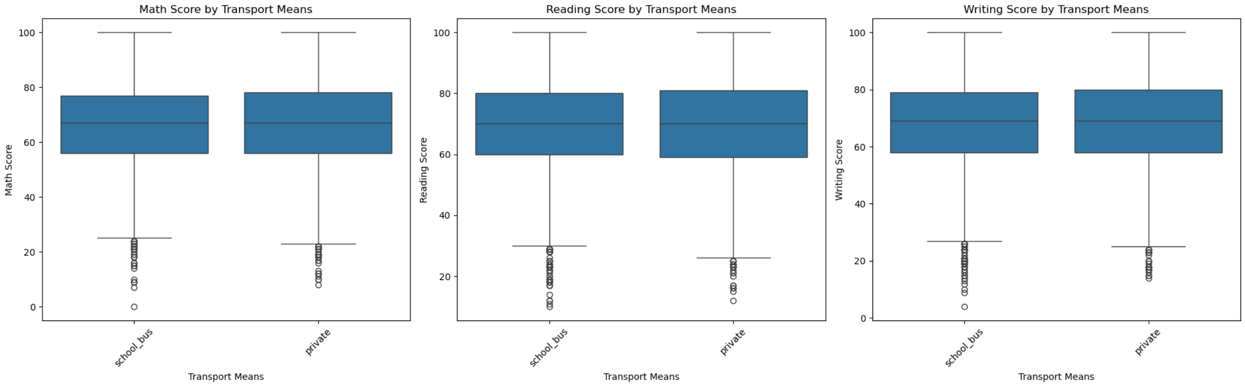
```
# Summary statistics for Writing by Gender
summary = df.groupby('Gender')['WritingScore'].agg(['mean', 'median',
'std', 'count'])
print(summary)
```

```
             mean  median        std  count
Gender
female  73.046338    73.0  14.572488  10294
male    63.956679    64.0  15.041557   9972
```

Effect of Weekly Study Hours on Student Score

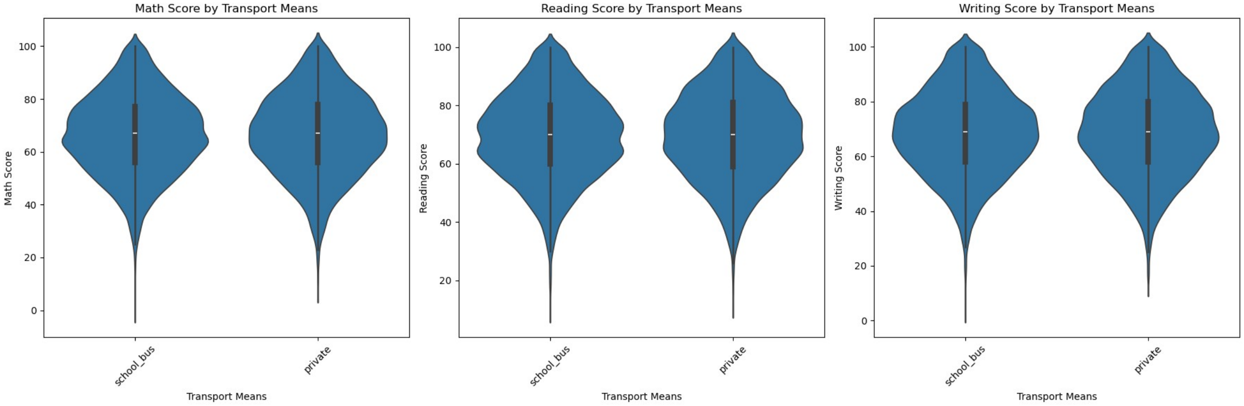
```
# Set the size of the plots
plt.figure(figsize=(19, 6))

# Plot MathScore by TransportMeans
plt.subplot(1, 3, 1)
sns.boxplot(x='TransportMeans', y='MathScore', data=df)
plt.title('Math Score by Transport Means')
plt.xlabel('Transport Means')
plt.ylabel('Math Score')
plt.xticks(rotation=45)

# Plot ReadingScore by TransportMeans
```

```
plt.subplot(1, 3, 2)
sns.boxplot(x='TransportMeans', y='ReadingScore', data=df)
plt.title('Reading Score by Transport Means')
plt.xlabel('Transport Means')
plt.ylabel('Reading Score')
plt.xticks(rotation=45)

# Plot WritingScore by TransportMeans
plt.subplot(1, 3, 3)
sns.boxplot(x='TransportMeans', y='WritingScore', data=df)
plt.title('Writing Score by Transport Means')
plt.xlabel('Transport Means')
plt.ylabel('Writing Score')
plt.xticks(rotation=45)

plt.tight_layout()
plt.show()
```



```
plt.figure(figsize=(18, 6))

# Plot MathScore by TransportMeans
plt.subplot(1, 3, 1)
sns.violinplot(x='TransportMeans', y='MathScore', data=df)
plt.title('Math Score by Transport Means')
plt.xlabel('Transport Means')
plt.ylabel('Math Score')
plt.xticks(rotation=45)

# Plot ReadingScore by TransportMeans
plt.subplot(1, 3, 2)
sns.violinplot(x='TransportMeans', y='ReadingScore', data=df)
plt.title('Reading Score by Transport Means')
plt.xlabel('Transport Means')
plt.ylabel('Reading Score')
plt.xticks(rotation=45)
```

```
# Plot WritingScore by TransportMeans
plt.subplot(1, 3, 3)
sns.violinplot(x='TransportMeans', y='WritingScore', data=df)
plt.title('Writing Score by Transport Means')
plt.xlabel('Transport Means')
plt.ylabel('Writing Score')
plt.xticks(rotation=45)

plt.tight_layout()
plt.show()
```



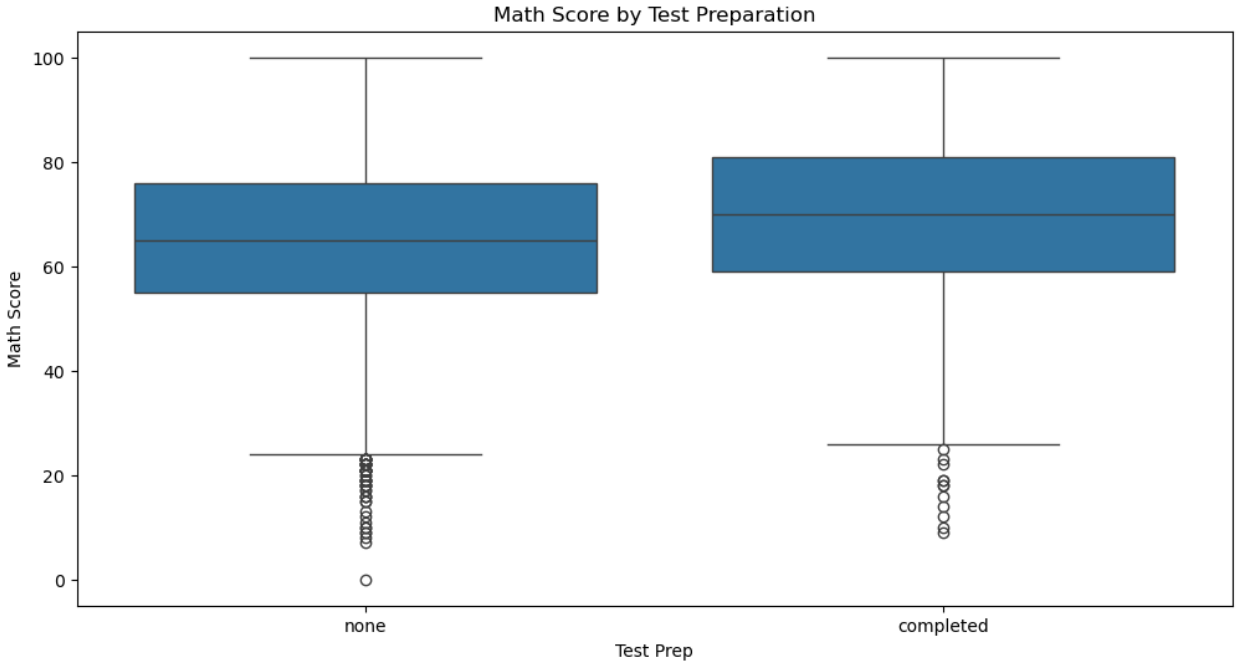
```
# Summary statistics for MathScore by TransportMeans
summary_math = df.groupby('TransportMeans')['MathScore'].agg(['mean',
'median', 'std', 'count'])
print("Math Score Summary by Transport Means:\n", summary_math)

# Summary statistics for ReadingScore by TransportMeans
summary_reading = df.groupby('TransportMeans')
['ReadingScore'].agg(['mean', 'median', 'std', 'count'])
print("Reading Score Summary by Transport Means:\n", summary_reading)

# Summary statistics for WritingScore by TransportMeans
summary_writing = df.groupby('TransportMeans')
['WritingScore'].agg(['mean', 'median', 'std', 'count'])
print("Writing Score Summary by Transport Means:\n", summary_writing)
```

```
Math Score Summary by Transport Means:
                     mean  median        std  count
TransportMeans
private        66.570783    67.0  15.608412   8406
school_bus     66.646206    67.0  15.210997  11860
Reading Score Summary by Transport Means:
                     mean  median        std  count
TransportMeans
```

```
private         69.564478    70.0  14.951528   8406
school_bus      69.479089    70.0  14.680749  11860
Writing Score Summary by Transport Means:
                      mean  median        std  count
TransportMeans
private         68.629550    69.0  15.671928   8406
school_bus      68.534148    69.0  15.354334  11860
```

Effect of Test Preperation

```
# Box plot for MathScore by TestPrep
plt.figure(figsize=(12, 6))
sns.boxplot(x='TestPrep', y='MathScore', data=df)
plt.title('Math Score by Test Preparation')
plt.xlabel('Test Prep')
plt.ylabel('Math Score')
plt.show()
```


Math Score by Test Preparation
Math Score
none
completed
Test Prep