Module 01: Basic Statistics

Contents

Data Overview & Summary

Data & Library Import

In [54]:

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

import warnings
warnings.filterwarnings("ignore", category=FutureWarning)
```

In [2]:

```
data = pd.read_csv('StudentsPerformance.csv')
```

Head & Tail, shape

In [3]:

```
data.head()
```

Out[3]:

	gender	race/ethnicity	parental level of education	lunch	test preparation course	math score	reading score	writing score
0	female	group B	bachelor's degree	standard	none	72	72	74
1	female	group C	some college	standard	completed	69	90	88
2	female	group B	master's degree	standard	none	90	95	93
3	male	group A	associate's degree	free/reduced	none	47	57	44
4	male	group C	some college	standard	none	76	78	75

In [22]:

```
data.tail()
```

Out[22]:

	gender	race/ethnicity	parental level of education	lunch	test preparation course	math score	reading score	writi sco
995	female	group E	master's degree	standard	completed	88	99	
996	male	group C	high school	free/reduced	none	62	55	
997	female	group C	high school	free/reduced	completed	59	71	
998	female	group D	some college	standard	completed	68	78	
999	female	group D	some college	free/reduced	none	77	86	

In [4]:

```
data.shape
```

Out[4]:

```
(1000, 8)
```

Columns & Info

In [5]:

```
data.columns
```

Out[5]:

```
Index(['gender', 'race/ethnicity', 'parental level of education', 'lunch',
       'test preparation course', 'math score', 'reading score',
       'writing score'],
      dtype='object')
```

In [6]:

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 8 columns):
 #   Column                       Non-Null Count  Dtype 
---  ------                       --------------  ----- 
 0   gender                       1000 non-null   object
 1   race/ethnicity               1000 non-null   object
 2   parental level of education  1000 non-null   object
 3   lunch                        1000 non-null   object
 4   test preparation course      1000 non-null   object
 5   math score                   1000 non-null   int64 
 6   reading score                1000 non-null   int64 
 7   writing score                1000 non-null   int64 
dtypes: int64(3), object(5)
memory usage: 62.6+ KB
```

Missing Values

In [7]:

```
data.isnull().sum()
```

Out[7]:

```
gender                         0
race/ethnicity                 0
parental level of education    0
lunch                          0
test preparation course        0
math score                     0
reading score                  0
writing score                  0
dtype: int64
```

Numerical Summary

In [8]:

```
data.describe()
```

Out[8]:

	math score	reading score	writing score
count	1000.00000	1000.000000	1000.000000
mean	66.08900	69.169000	68.054000
std	15.16308	14.600192	15.195657
min	0.00000	17.000000	10.000000
25%	57.00000	59.000000	57.750000
50%	66.00000	70.000000	69.000000
75%	77.00000	79.000000	79.000000
max	100.00000	100.000000	100.000000

Central Tendency, Dispersion & Outliers

Measures of Central Tendency

In [9]:
```
data['math score'].mean()
```

Out[9]:
```
np.float64(66.089)
```

In [10]:
```
data['reading score'].median()
```

Out[10]:
```
np.float64(70.0)
```

In [15]:
```
data['writing score'].mode()
```

Out[15]:
```
0    74
Name: writing score, dtype: int64
```

Measures of Dispersion

In [11]:
```
data['writing score'].std()
```

Out[11]:
```
np.float64(15.19565701086965)
```

In [16]:
```
data['reading score'].var()
```

Out[16]:
```
np.float64(213.16560460460462)
```

In [29]:
```
range_val = data['math score'].max() - data['math score'].min()
print("Range:", range_val)
```

```
Range: 100
```

In [13]:
```
data['reading score'].max()
```

Out[13]:
```
np.int64(100)
```

In [28]:
```
data['reading score'].min()
```

Out[28]:
```
np.int64(17)
```

In [74]:
```
data['math score'].quantile(0.25)
```

Out[74]:
```
np.float64(57.0)
```

In [75]:
```
data['reading score'].quantile(0.50)
```

Out[75]:
```
np.float64(70.0)
```

In [26]:
```
data['writing score'].quantile(0.75)
```

Out[26]:
```
np.float64(79.0)
```

Covariance & Correlation

In [37]:

```
corr = data.corr(numeric_only=True)
corr
```

Out[37]:

	math score	reading score	writing score
math score	1.000000	0.817580	0.802642
reading score	0.817580	1.000000	0.954598
writing score	0.802642	0.954598	1.000000

In [44]:

```
data.cov(numeric_only=True)
```

Out[44]:

	math score	reading score	writing score
math score	229.918998	180.998958	184.939133
reading score	180.998958	213.165605	211.786661
writing score	184.939133	211.786661	230.907992

Categorical Counts

In [20]:

```
data['gender'].value_counts()
```

Out[20]:

```
gender
female    518
male      482
Name: count, dtype: int64
```

In [21]:

```
data['race/ethnicity'].value_counts()
```

Out[21]:

```
race/ethnicity
group C    319
group D    262
group B    190
group E    140
group A     89
Name: count, dtype: int64
```

Outlier Detection (IQR Method)

In [ ]:

```
num_col = ['math score', 'reading score', 'writing score']

Q1 = data[num_col].quantile(0.25)
Q3 = data[num_col].quantile(0.75)
IQR = Q3 - Q1

lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR

for col in num_col:
    outlier_count = ((data[col] < lower_bound[col]) | (data[col] > upper_bound[c
    print(f"{col} outliers = {outlier_count}")
```

```
math score outliers = 8
reading score outliers = 6
writing score outliers = 5
```

Distribution Shape

```
In [33]: data['math score'].skew()
```

```
Out[33]: np.float64(-0.27893514909431694)
```

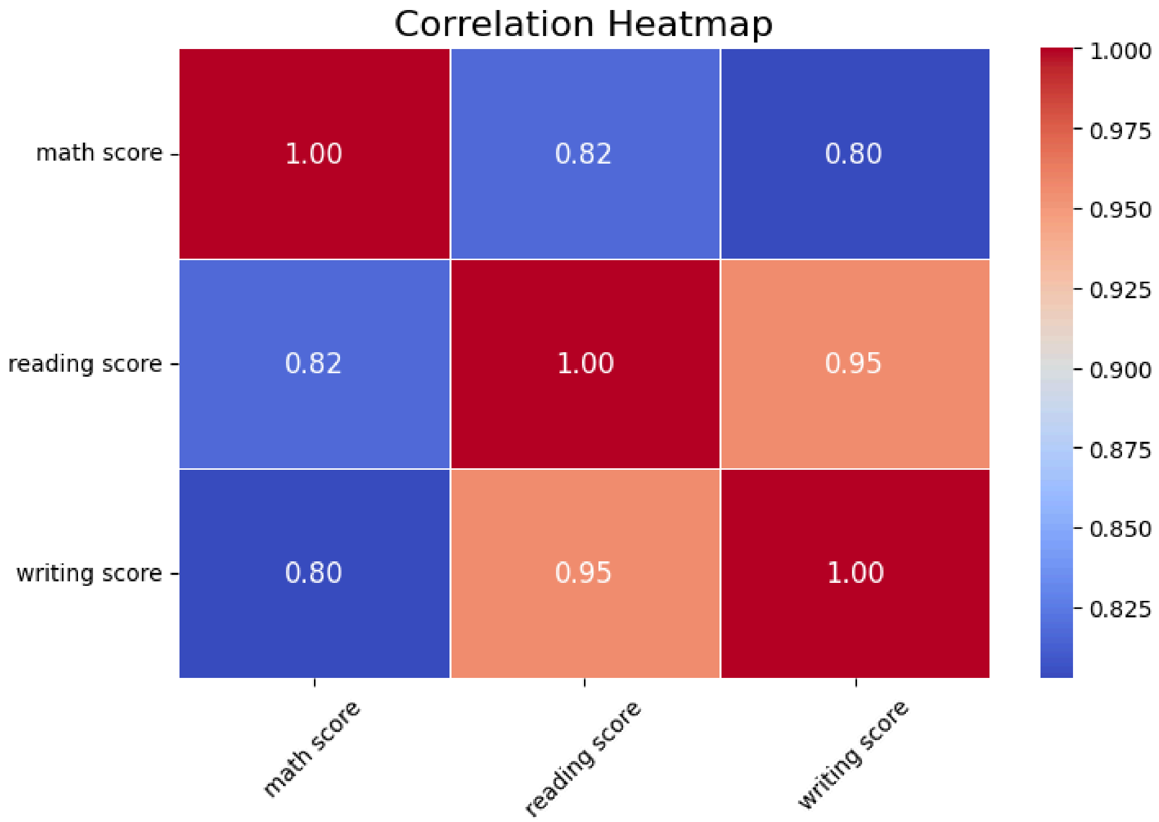
```
In [36]: data['reading score'].kurtosis()
```

```
Out[36]: np.float64(-0.0682654585647704)
```

Distribution Analysis & Basic Visualizations

Correlation Heatmap

```
In [ ]: plt.figure(figsize=(8,5))
        sns.heatmap(corr,
                    annot=True,
                    fmt=".2f",
                    cmap="coolwarm",
                    linewidths=0.5,
                    annot_kws={"size":12})
        plt.title("Correlation Heatmap", fontsize=16)
        plt.xticks(rotation=45)
        plt.yticks(rotation=0)
        plt.show()
```



Categorical Columns Visualization

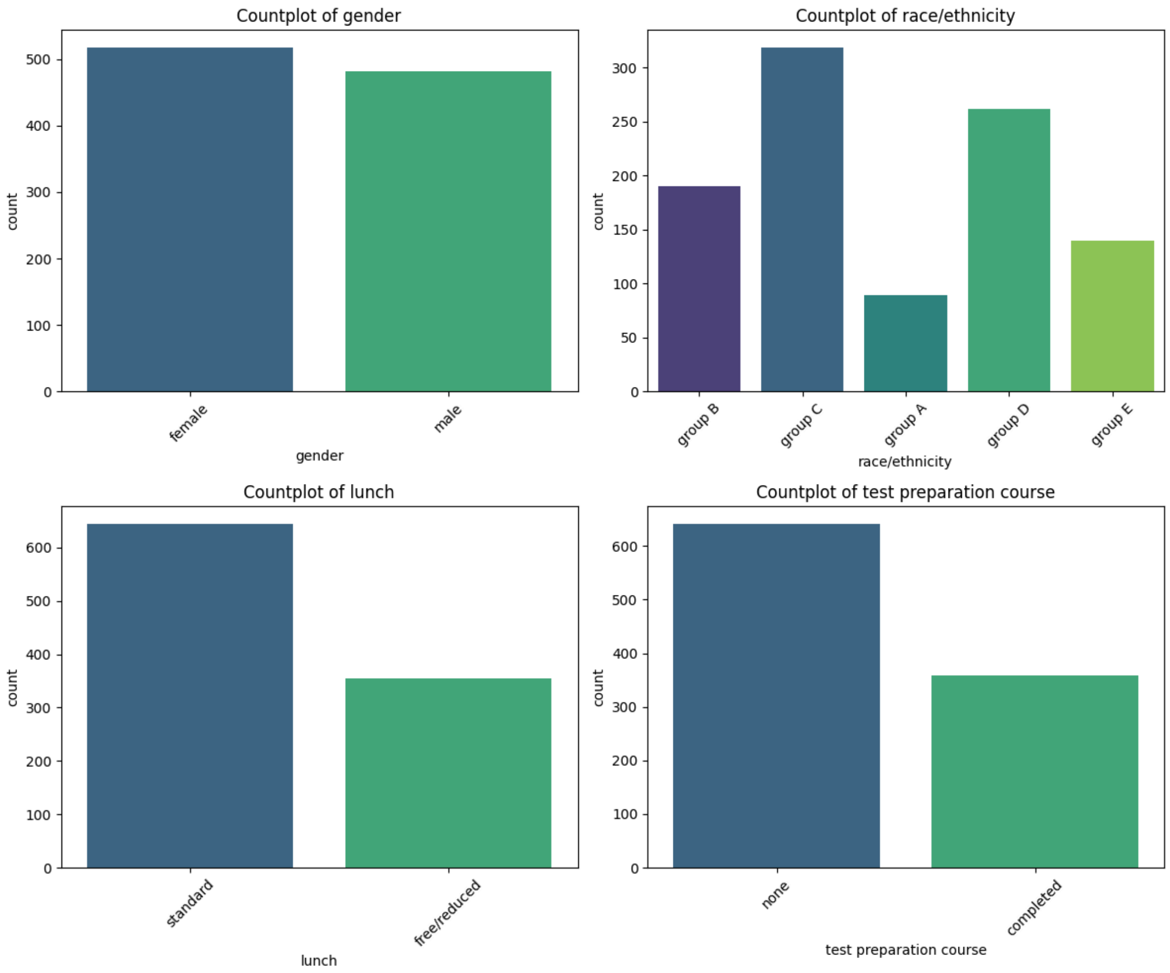
In [65]:

```
important_cat = ['gender', 'race/ethnicity', 'lunch', 'test preparation course']

fig, axes = plt.subplots(2, 2, figsize=(12,10))
axes = axes.flatten()

for i, col in enumerate(important_cat):
    sns.countplot(x=col, data=data, palette="viridis", ax=axes[i])
    axes[i].set_title(f"Countplot of {col}", fontsize=12)
    axes[i].tick_params(axis='x', rotation=45)

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



Numerical Columns Visualization

Histogram + KDE

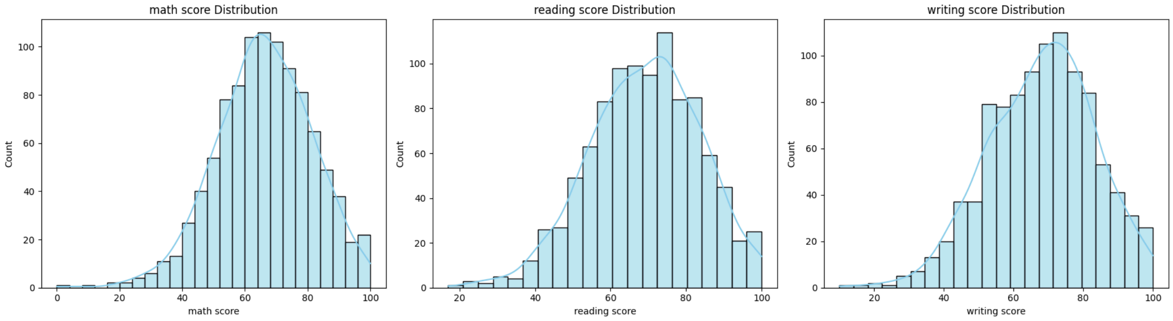
In [62]:

```
fig, axes = plt.subplots(1, 3, figsize=(18,5))

for i, col in enumerate(num_col):

    sns.histplot(data[col], kde=True, ax=axes[i], color='skyblue')
    axes[i].set_title(f"{col} Distribution", fontsize=12)
    axes[i].set_xlabel(col)
    axes[i].set_ylabel("Count")

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



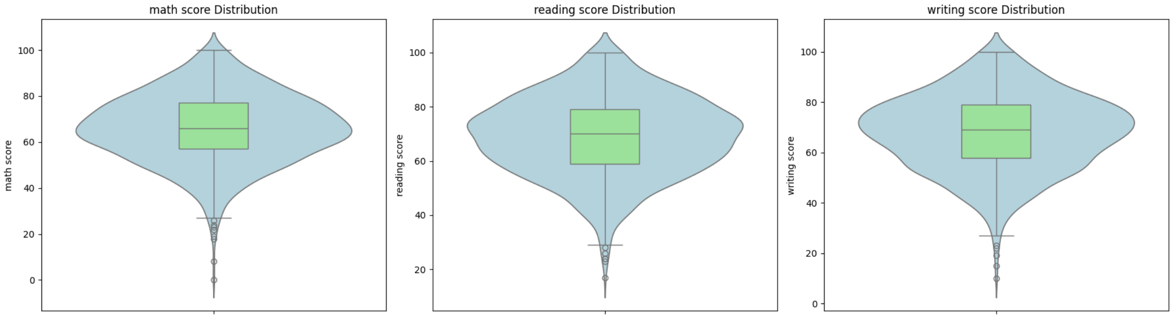
Violin + Boxplots

In [64]:

```
fig, axes = plt.subplots(1, 3, figsize=(18,5))

for i, col in enumerate(num_col):
    sns.violinplot(y=data[col], ax=axes[i], inner=None, color="lightblue")
    sns.boxplot(y=data[col], ax=axes[i], width=0.2, color="lightgreen")
    axes[i].set_title(f"{col} Distribution", fontsize=12)
    axes[i].set_ylabel(col)

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

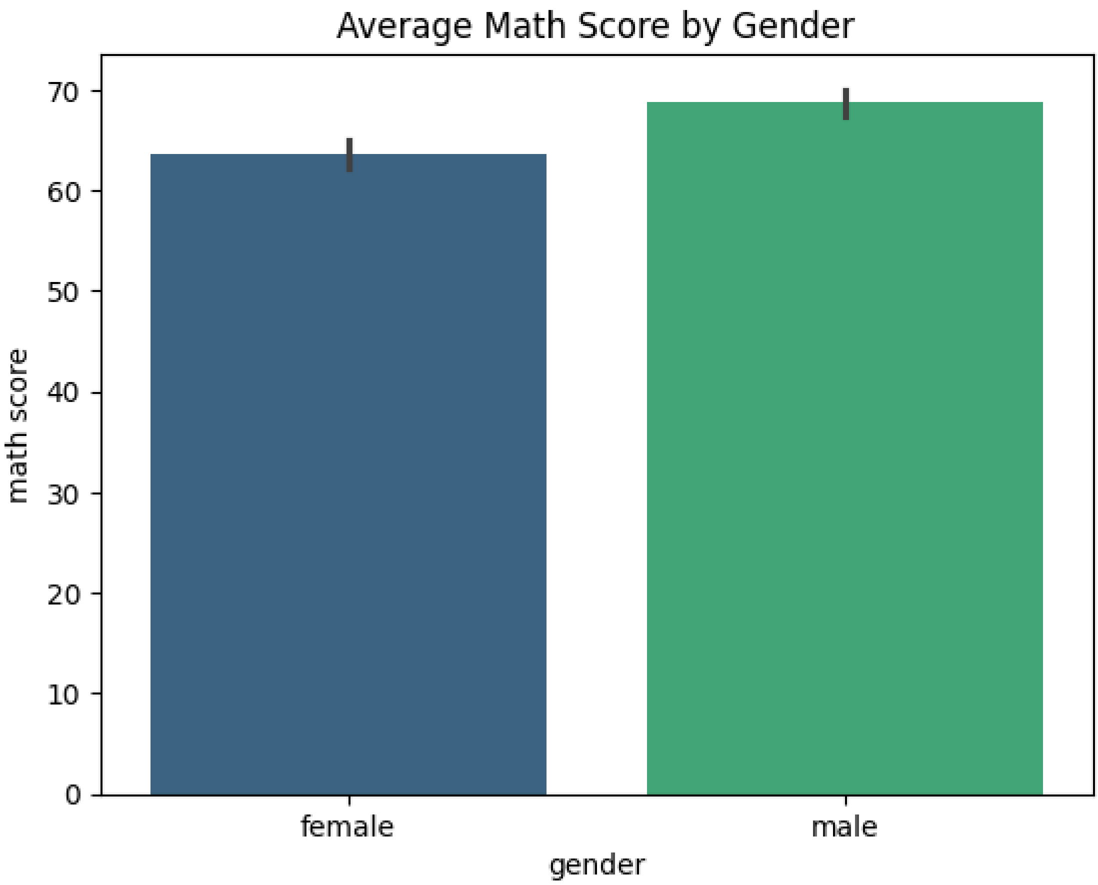


Grouped Visualizations

Average Math Score by Gender

In [68]:

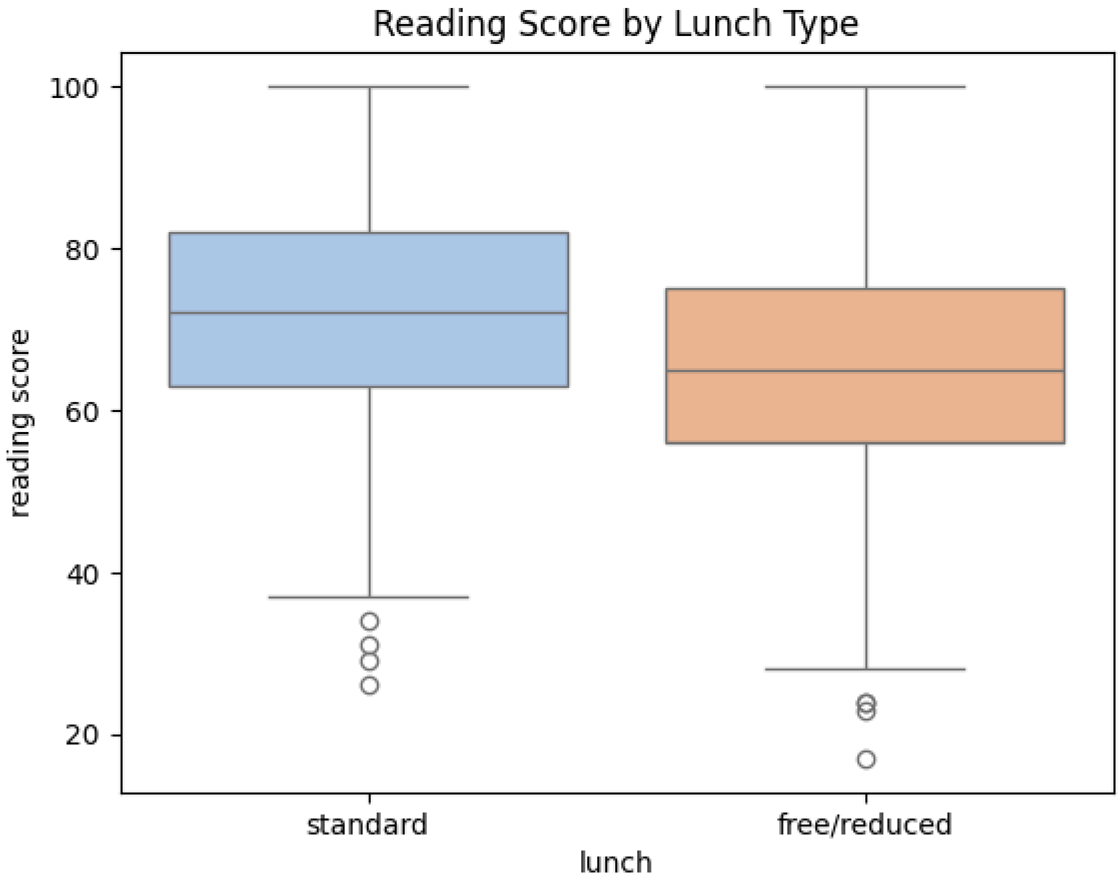
```
sns.barplot(x='gender', y='math score', data=data, palette='viridis')
plt.title("Average Math Score by Gender")
plt.show()
```



Reading Score by Lunch Type

In [70]:

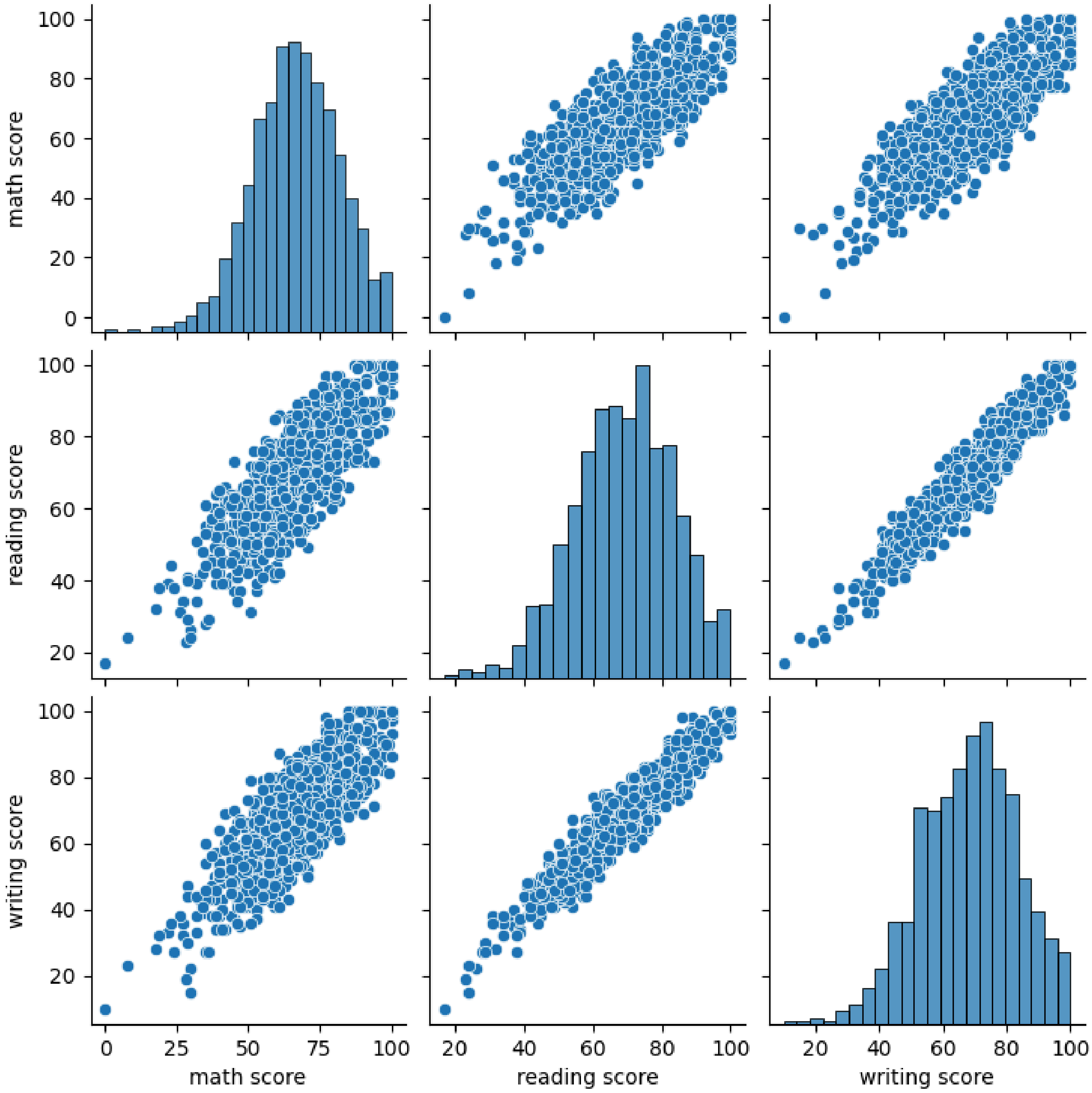
```
sns.boxplot(x='lunch', y='reading score', data=data, palette='pastel')
plt.title("Reading Score by Lunch Type")
plt.show()
```



Pairwise Relationships

In [72]:

```
sns.pairplot(data)
plt.show()
```


math score
reading score
writing score
0
20
40
60
80
100
0
25
50
75
100
20
40
60
80
100
20
40
60
80
100
math score
reading score
writing score