Module 01: Basic Statistics

Contents

Data Overview & Summary

Library Import & Data Loading

In [61]:

```
library(tidyverse)
library(ggplot2)
library(ggpubr)
library(corrplot)
library(GGally)
library(moments)
```

In [62]:

```
file_path <- "/kaggle/input/students-performance-in-exams/StudentsPerformance.cs
data <- read.csv(file_path)
```

Head & Tail, Shape

In [10]:

```
head(data)
```

A data.frame: 6 × 8

	gender	race.ethnicity	parental.level.of.education	lunch	test.preparation.course
	<chr>	<chr>	<chr>	<chr>	<chr>
1	female	group B	bachelor's degree	standard	none
2	female	group C	some college	standard	completed
3	female	group B	master's degree	standard	none
4	male	group A	associate's degree	free/reduced	none
5	male	group C	some college	standard	none
6	female	group B	associate's degree	standard	none

In [12]:

```
tail(data)
```

A data.frame: 6 × 8

	gender	race.ethnicity	parental.level.of.education	lunch	test.preparation.cou
	<chr>	<chr>	<chr>	<chr>	<ch
995	male	group A	high school	standard	nc
996	female	group E	master's degree	standard	complet
997	male	group C	high school	free/reduced	nc
998	female	group C	high school	free/reduced	complet
999	female	group D	some college	standard	complet
1000	female	group D	some college	free/reduced	nc

In [13]:

```
dim(data)
```

1000 · 8

Columns & Info

In [14]:

```
colnames(data)
```

'gender' · 'race.ethnicity' · 'parental.level.of.education' · 'lunch' · 'test.preparation.course' · 'math.score' · 'reading.score' · 'writing.score'

In [15]:

```
str(data)
```

```
'data.frame':	1000 obs. of  8 variables:
 $ gender                     : chr  "female" "female" "female" "male" ...
 $ race.ethnicity             : chr  "group B" "group C" "group B" "group A" ...
 $ parental.level.of.education: chr  "bachelor's degree" "some college" "master's
degree" "associate's degree" ...
 $ lunch                      : chr  "standard" "standard" "standard" "free/reduc
ed" ...
 $ test.preparation.course    : chr  "none" "completed" "none" "none" ...
 $ math.score                 : int  72 69 90 47 76 71 88 40 64 38 ...
 $ reading.score              : int  72 90 95 57 78 83 95 43 64 60 ...
 $ writing.score              : int  74 88 93 44 75 78 92 39 67 50 ...
```

In [59]:

```r
summary(data)
```

```
    gender          race.ethnicity     parental.level.of.education
 Length:1000        Length:1000        Length:1000                
 Class :character   Class :character   Class :character           
 Mode  :character   Mode  :character   Mode  :character           
                                                                  
                                                                  
                                                                  
    lunch           test.preparation.course   math.score     reading.score   
 Length:1000        Length:1000             Min.   :  0.00   Min.   : 17.00  
 Class :character   Class :character        1st Qu.: 57.00   1st Qu.: 59.00  
 Mode  :character   Mode  :character        Median : 66.00   Median : 70.00  
                                            Mean   : 66.09   Mean   : 69.17  
                                            3rd Qu.: 77.00   3rd Qu.: 79.00  
                                            Max.   :100.00   Max.   :100.00  
 writing.score   
 Min.   : 10.00  
 1st Qu.: 57.75  
 Median : 69.00  
 Mean   : 68.05  
 3rd Qu.: 79.00  
 Max.   :100.00  
```

Missing Values

In [16]:

```r
colSums(is.na(data))
```

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

Class & Type Check

In [63]:

```r
class(data$math.score)
class(data$reading.score)
class(data$writing.score)
```

'integer'

'integer'

'integer'

Central Tendency, Dispersion & Outliers

Measures of Dispersion

In [65]:

```r
mean(data$math.score)
median(data$reading.score)
Mode <- function(x) {
  ux <- unique(x)
  ux[which.max(tabulate(match(x, ux)))]
}
Mode(data$writing.score)
```

```
66.089
70
74
```

Measures of Dispersion

In [64]:

```r
sd(data$writing.score)
var(data$reading.score)
range_val <- max(data$math.score) - min(data$math.score)
range_val
quantile(data$math.score, 0.25)
quantile(data$reading.score, 0.50)
quantile(data$writing.score, 0.75)
```

```
15.1956570108697
213.165604604605
100
```

25%: 57

50%: 70

75%: 79

Covariance & Correlation

In [66]:

```r
numeric_cols <- data %>% select(`math.score`, `reading.score`, `writing.score`)
cor(numeric_cols)
cov(numeric_cols)
```

A matrix: 3 × 3 of type dbl

	math.score	reading.score	writing.score
math.score	1.0000000	0.8175797	0.8026420
reading.score	0.8175797	1.0000000	0.9545981
writing.score	0.8026420	0.9545981	1.0000000

A matrix: 3 × 3 of type dbl

	math.score	reading.score	writing.score
math.score	229.9190	180.9990	184.9391
reading.score	180.9990	213.1656	211.7867
writing.score	184.9391	211.7867	230.9080

Categorical Counts

In [67]:

```
table(data$gender)
```

```
female   male
   518    482
```

In [69]:

```
table(data$`race.ethnicity`)
```

```
group A group B group C group D group E
     89     190     319     262     140
```

In [70]:

```
table(data$'parental.level.of.education')
```

```
associate's degree  bachelor's degree        high school    master's degree
               222                118                196                 59
      some college   some high school
               226                179
```

In [71]:

```
table(data$'lunch')
```

```
free/reduced     standard
         355          645
```

In [72]:

```
table(data$'test.preparation.course')
```

```
completed      none
      358       642
```

Outlier Detection (IQR Method)

In [37]:

```
Q1 <- apply(numeric_cols, 2, quantile, 0.25)
Q3 <- apply(numeric_cols, 2, quantile, 0.75)
IQR <- Q3 - Q1

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

for(col in colnames(numeric_cols)) {
  outlier_count <- sum(numeric_cols[[col]] < lower_bound[col] | numeric_cols[[cc
  cat(col, "outliers =", outlier_count, "\n")
}
```

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

Distribution Shape

In [39]:

```
skewness(data$`math.score`)
kurtosis(data$`reading.score`)
```

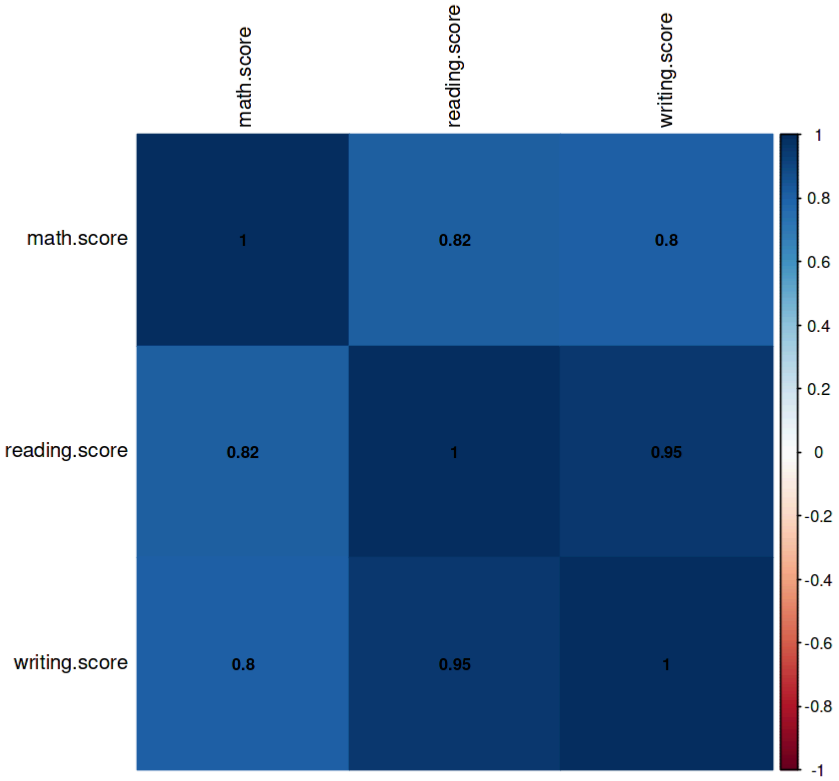
-0.278516571914075

2.92608138521669

Distribution Analysis & Basic Visualizations

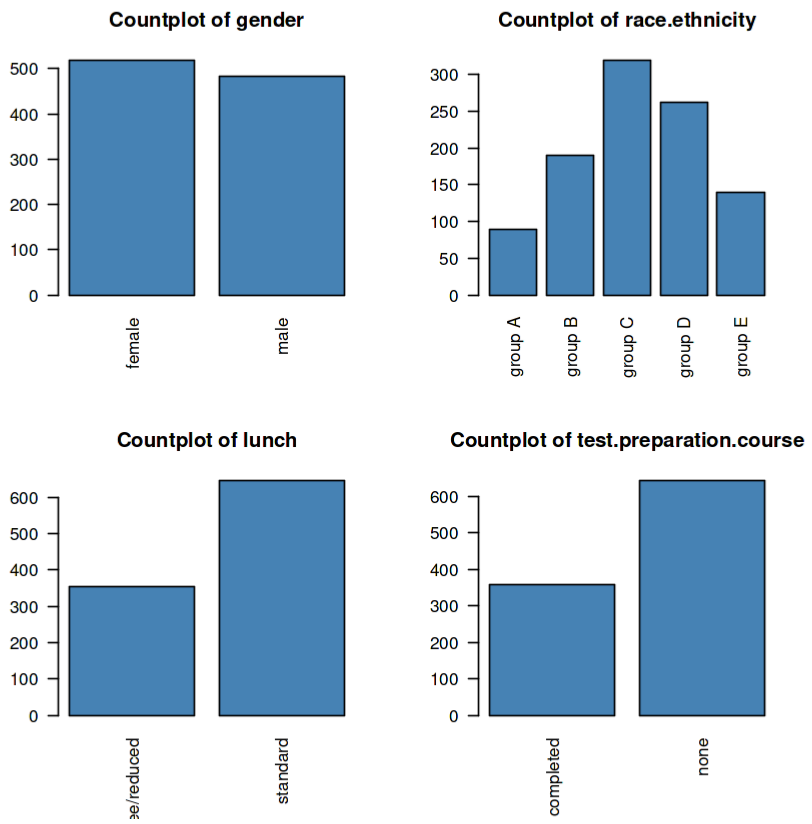
Correlation Heatmap

In [40]:
```
corr_mat <- cor(numeric_cols)
corrplot(corr_mat, method="color", addCoef.col="black", tl.col="black", number.c
```



Categorical Columns Visualization

In [42]:
```
important_cat <- c("gender", "race.ethnicity", "lunch", "test.preparation.course
par(mfrow=c(2,2))
for(col in important_cat){
  counts <- table(data[[col]])
  barplot(counts, main=paste("Countplot of", col), col="steelblue", las=2)
}
```

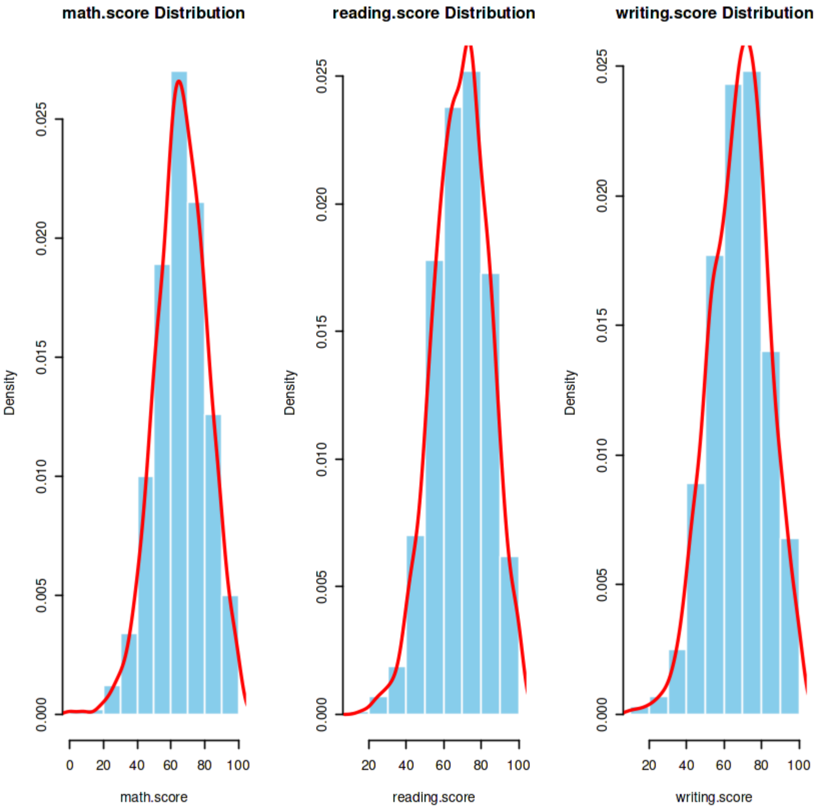


Numerical Columns Visualization

Histogram + Density

In [47]:

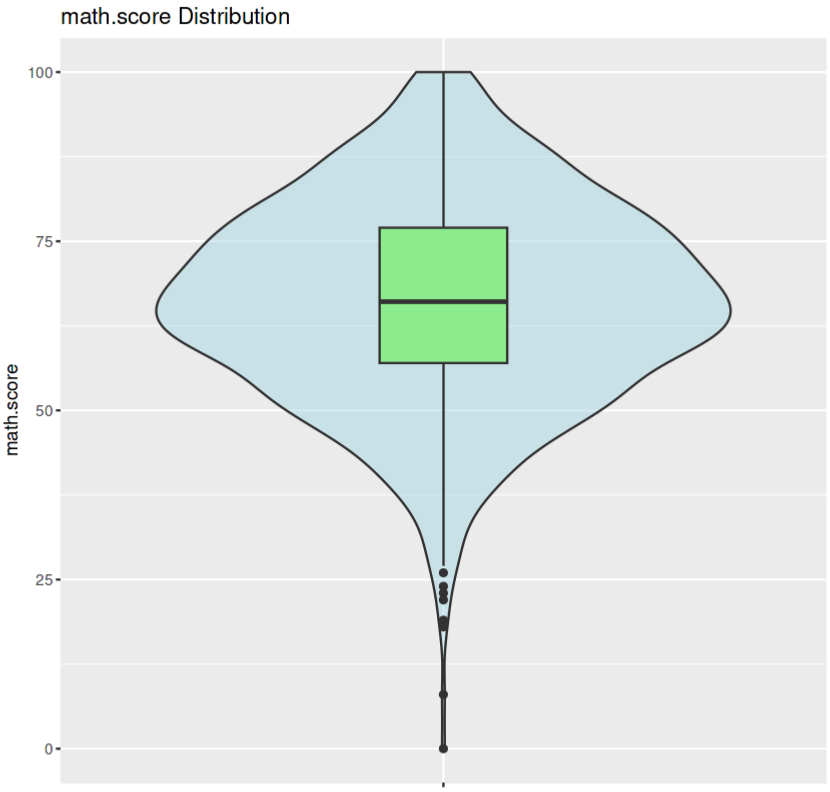
```
 par(mfrow=c(1,3))
for(col in colnames(numeric_cols)){
  hist(numeric_cols[[col]],
       main=paste(col, "Distribution"),
       xlab=col,
       col="skyblue",
       border="white",
       probability = TRUE)

  lines(density(numeric_cols[[col]], na.rm=TRUE), col="red", lwd=2)
}
```

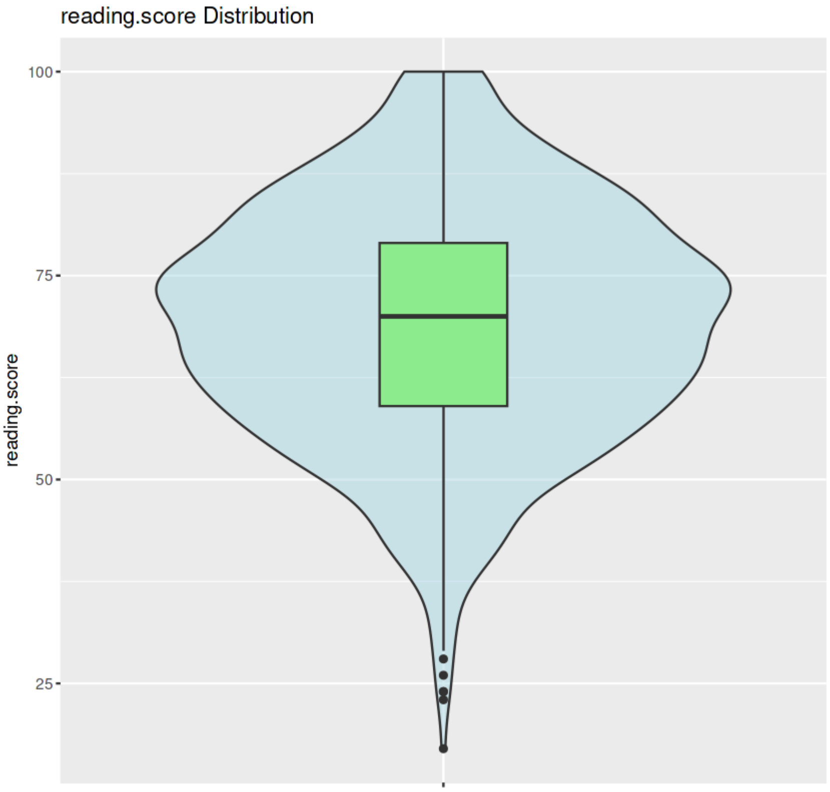


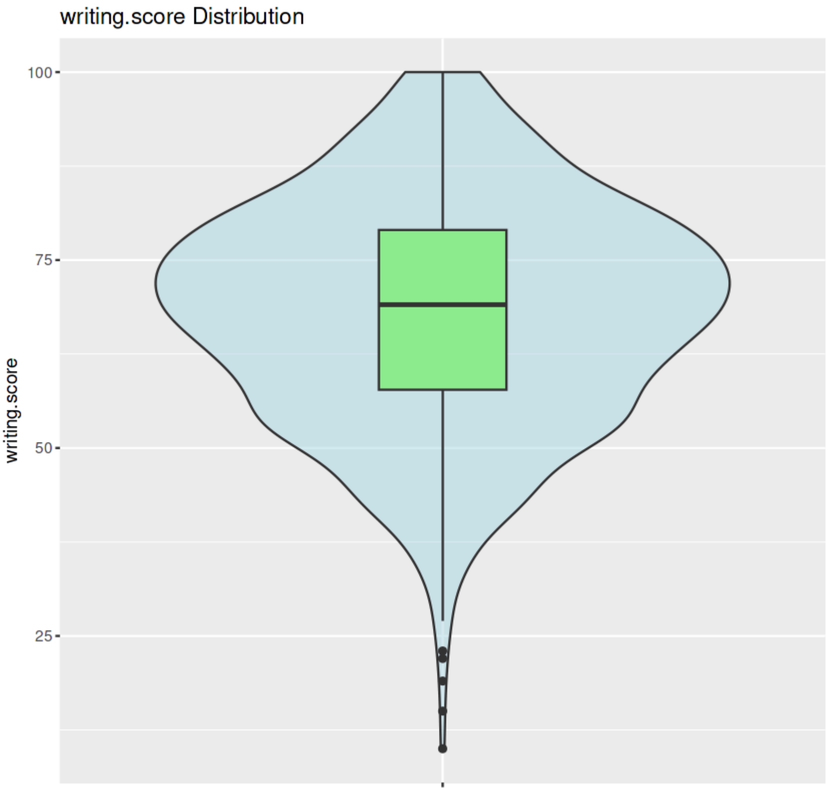
Violin + Boxplots

In [58]:

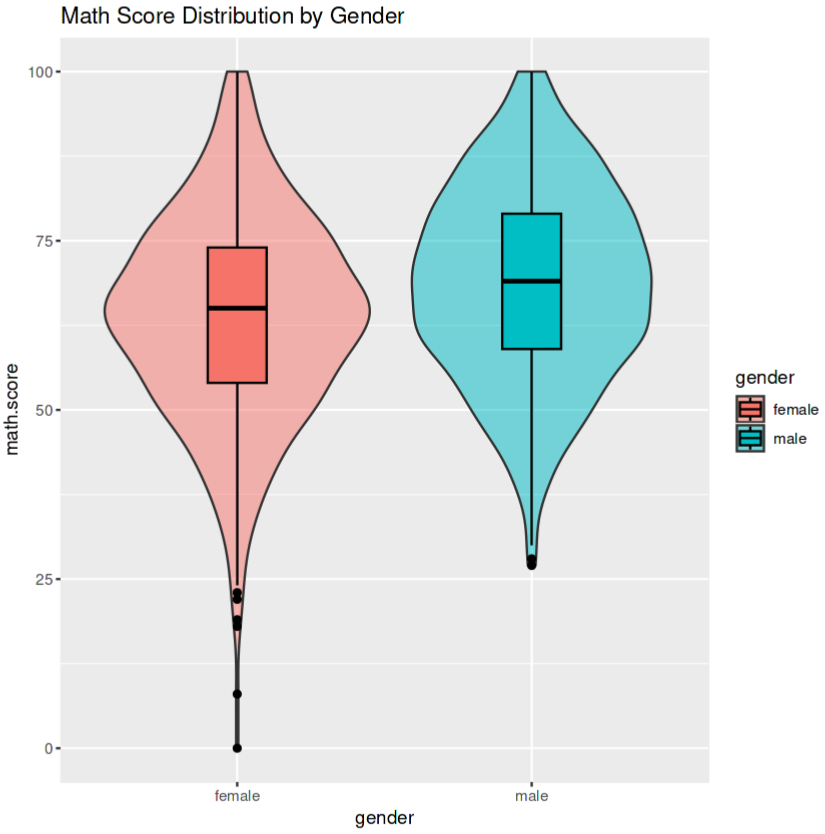
```
for(col in numeric_cols) {
  p <- ggplot(data, aes(x = "", y = .data[[col]])) +
    geom_violin(fill = "lightblue", alpha = 0.5) +
    geom_boxplot(width = 0.2, fill = "lightgreen") +
    ggtitle(paste(col, "Distribution")) +
    ylab(col) +
    xlab("")

  print(p)
}
```


math.score Distribution
math.score
100
75
50
25
0


reading.score Distribution
reading.score
100
75
50
25



```
In [55]: ggplot(data, aes(x = gender, y = math.score, fill = gender)) +
           geom_violin(alpha = 0.5) +
           geom_boxplot(width = 0.2, color="black") +
           ggtitle("Math Score Distribution by Gender")
```

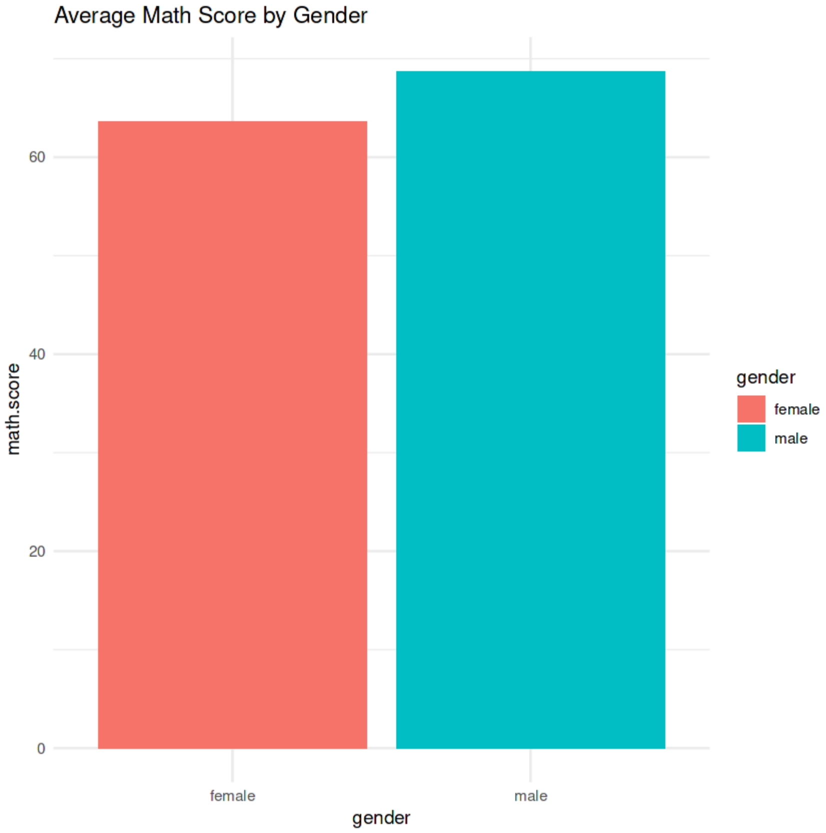


Grouped Visualizations

Average Math Score by Gender

In [50]:

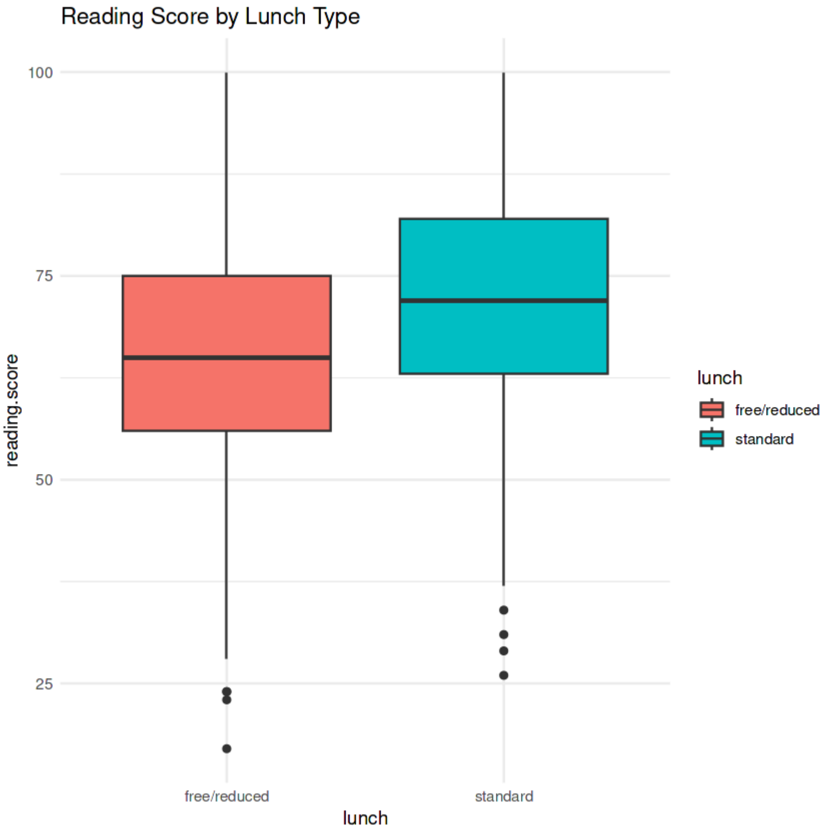
```
ggplot(data, aes(x=gender, y=`math.score`, fill=gender)) +
  stat_summary(fun="mean", geom="bar") +
  ggtitle("Average Math Score by Gender") +
  theme_minimal()
```



Reading Score by Lunch Type

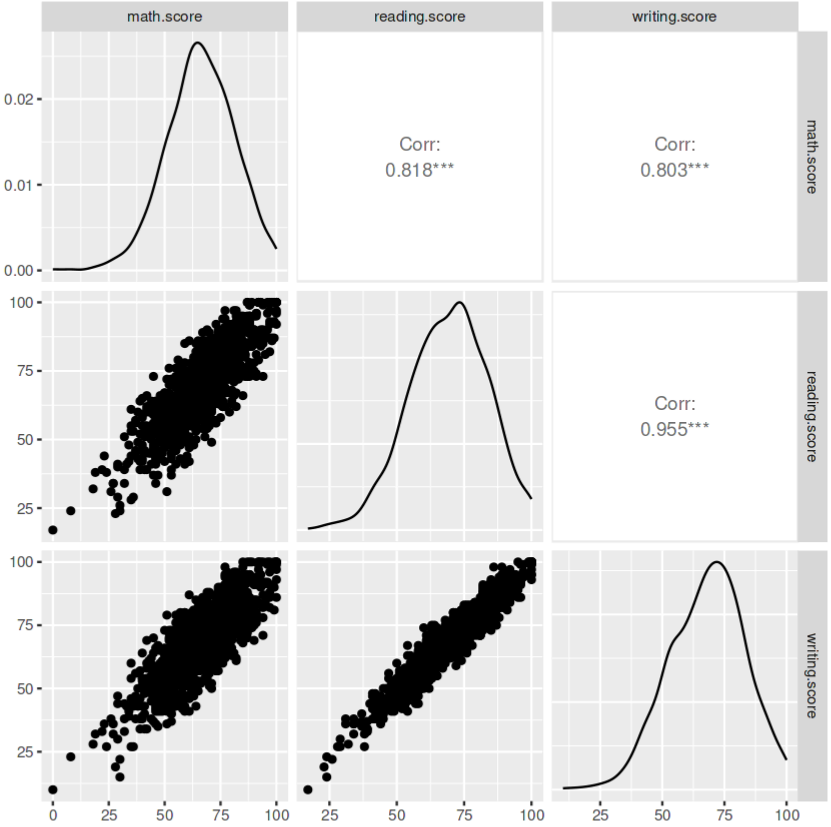
In [51]:

```
ggplot(data, aes(x=lunch, y=`reading.score`, fill=lunch)) +
  geom_boxplot() +
  ggtitle("Reading Score by Lunch Type") +
  theme_minimal()
```



Pairwise Relationships

In [60]:
```
GGally::ggpairs(data %>% select(`math.score`, `reading.score`, `writing.score`))
```


math.score
reading.score
writing.score
Corr:
0.818***
Corr:
0.803***
Corr:
0.955***
math.score
reading.score
writing.score