PSC205A Assignment 03: MANOVA

```
data <- haven::read_sav("manova_tf.sav")
```

1. Exploratory data analysis

The measures of academic performance are all roughly normally distributed. The data shows a strong correlation between Reading and Math scores and a medium correlation between Math and IQ scores.

Outliers in reading and math scores do not appear to exist. However, one subject with an IQ score is much higher than the rest of the sample.

```
psych::describe(data[,-1])
```

```
        vars  n   mean     sd median trimmed   mad min max range  skew kurtosis
WRAT_R     1 18  89.11 13.63   89.5   89.00 14.83  65 115    50  0.03    -1.01
WRAT_A     2 18  87.22 13.75   88.5   87.50 14.08  62 108    46 -0.18    -1.28
IQ         3 18 102.56  5.89  100.5  102.25  2.22  95 115    20  0.90    -0.26
DISABL     4 18   2.00  0.84    2.0    2.00  1.48   1   3     2  0.00    -1.66
TREAT      5 18   1.50  0.51    1.5    1.50  0.74   1   2     1  0.00    -2.11
         se
WRAT_R 3.21
WRAT_A 3.24
IQ     1.39
DISABL 0.20
TREAT  0.12
```
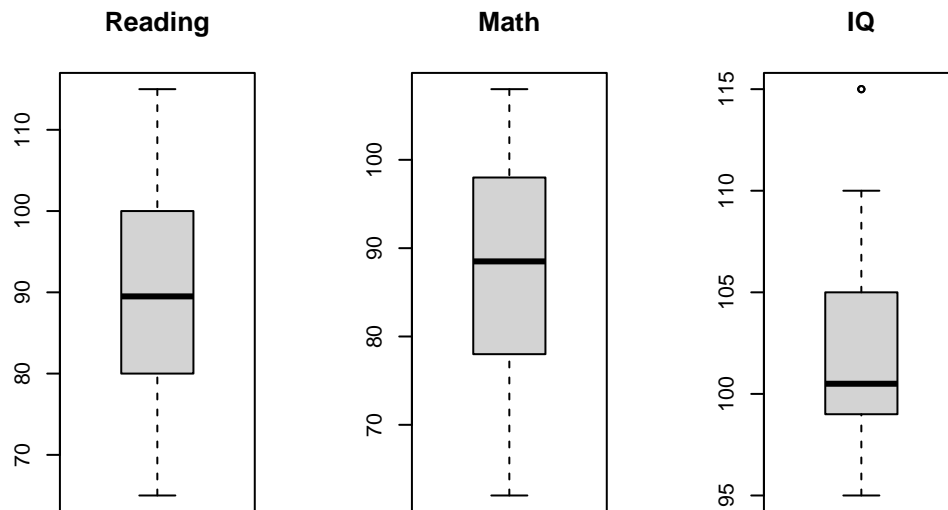
```
GGally::ggpairs(data[,2:4])
```
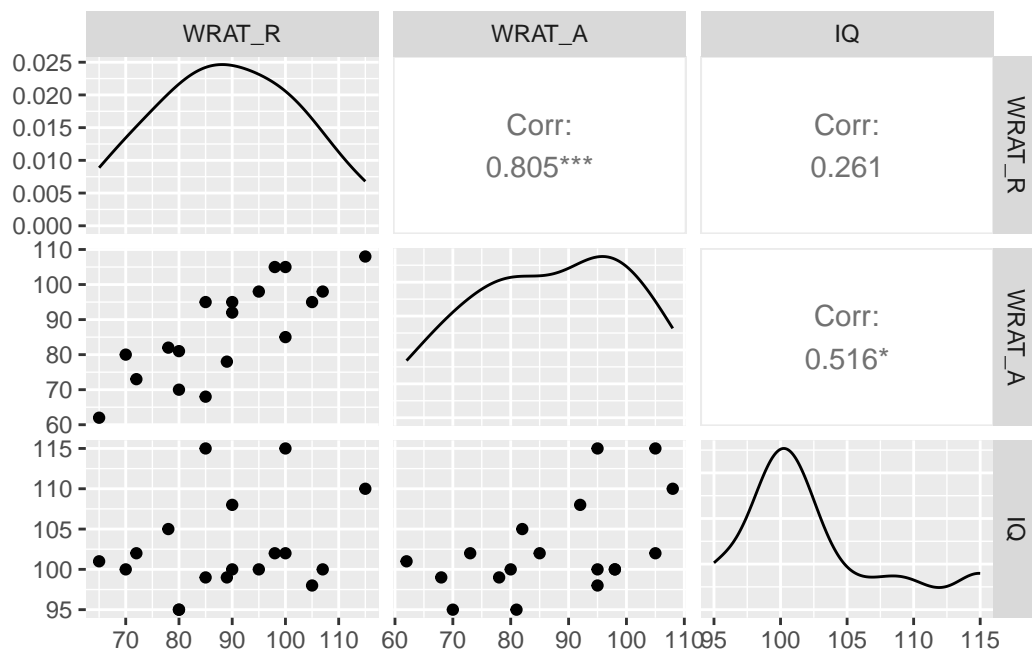
```
par(mfrow=c(1,3))
boxplot(data$WRAT_R, main = "Reading")
boxplot(data$WRAT_A, main = "Math")
boxplot(data$IQ, main = "IQ")
```

2. MANOVA

```r
ach <- cbind(data$WRAT_R, data$WRAT_A, data$IQ)
disabl <- factor(data$DISABL, labels = c("mild", "moderate", "severe"))
treat <- factor(data$TREAT, labels = c("treatment", "control"))
```

```r
fit <- manova(ach ~ disabl + treat + disabl * treat )
smv <- summary(fit, test = "Wilks") # Multivariate test
smv
```

```
             Df   Wilks approx F num Df den Df    Pr(>F)
disabl        2 0.21796   3.8065      6     20    0.0108 *
treat         1 0.10139  29.5444      3     10 2.775e-05 ***
disabl:treat  2 0.90381   0.1729      6     20    0.9811
Residuals    12
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The MANOVA analysis showed a significant main effect of Disability (Wilks' $\Lambda = 0.22$, $F(6, 20) = 3.80$, $p = .011$) and Treatment ($F(3, 10) = 29.54$, $p < .001$) on Academic Achievement.

However, the interaction between the two predictors was not statistically significant ($F(6, 20)$ = 0.17, $p = .98$).

3. Univariate tests

```
saov <- summary.aov(fit, test = "Wilks")
```

- **Reading**:

There is a significant main effect of disability ($F(2, 12) = 5.74$, $p = .018$), and a significant main effect of treatment ($F(1, 12) = 46.12$, $p < .001$). There is no significant interaction effect between disability and treatment ($F(2, 12) = 0.023$, $p = .977$).

- **Math**:

There is a significant main effect of disability ($F(2, 12) = 12.53$, $p = .001$), and a significant main effect of treatment ($F(1, 12) = 33.25$, $p < .001$). There is no significant interaction effect between disability and treatment ($F(2, 12) = 0.587$, $p = .571$).

- **IQ**

None of the main effects of disability ($F(2, 12) = 0.991$, $p = .399$) or treatment ($F(1, 12) = 0.049$, $p = .828$)were statistically significant, and neither the interaction between the two ($F(2, 12) = 0.233$, $p = .795z‘$).

4. Explaiend variance

$$\eta^2 = 1 - \Lambda$$

- **Disability**: η^2_D = 1 - 0.22 = 0.78
- **Treatment**: η^2_T = 1 - 0.10 = 0.90
- **Interaction**: η^2_{DT} = 1 - 0.90 = 0.10

5. Summary

A multivariate analysis of variance (MANOVA) was conducted to investigate the effects of Disability, Treatment, and their interaction on Academic achievement, formed as a composite of Reading scores, Math scores, and IQ. The MANOVA revealed a significant effect of Disability on the set of dependent variables, Wilks' $\Lambda = 0.22$, $F(6, 20) = 3.80$, $p = .011$. This indicates that the means of Academic achievement differ across the levels of Disability. Similarly, Treatment significantly affected the set of dependent variables, Wilks' $\Lambda = 0.10$, $F(3, 10) = 29.54$, $p < .001$. However, there was no significant interaction effect between Disability and Treatment, Wilks' $\Lambda = 0.90$, $F(6, 20) = 0.17$, $p = .98$. This suggests that the effect of Disability on Academic achievement is consistent across levels of Treatment.

6 SSCP matrices

```
library(HoRM)
```

```
Registered S3 method overwritten by 'quantmod':
  method            from
  as.zoo.data.frame zoo
```

```
SSCP.fn(fit)
```

```
$SSCPR
           [,1]       [,2]      [,3]
[1,] 2613.7778 2534.5556 269.8889
[2,] 2534.5556 2673.7778 387.1111
[3,]  269.8889  387.1111 101.7778
```

```
$SSCPE
       [,1]       [,2]      [,3]
[1,]   544   31.0000  87.0000
[2,]    31  539.3333 323.6667
[3,]    87  323.6667 488.6667
```

```
$SSCPTO
           [,1]       [,2]      [,3]
[1,] 3157.7778 2565.5556 356.8889
[2,] 2565.5556 3213.1111 710.7778
[3,]  356.8889  710.7778 590.4444
```