# Statistical Method --- HW4

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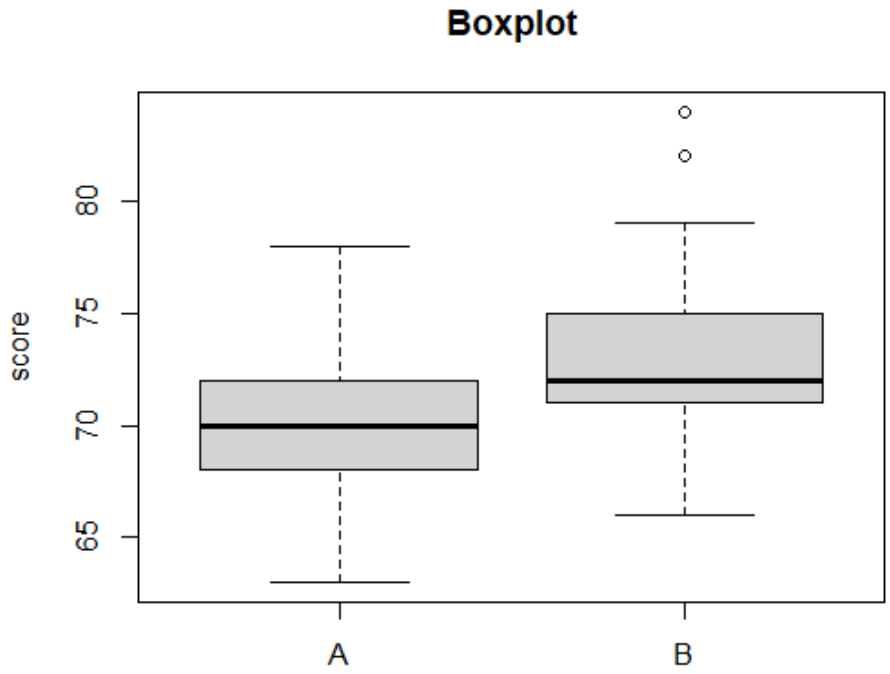
1. **We collect the scores of the MATH exam from two classes, Class A and Class B. There are 25 students in Class A and 21 students in Class B. The teacher wants to know if the students performed equally on the exam. The dataset is shown in the sheet Question 1.**

首先，從題目中可以觀察到我們想了解兩班的數學成績有沒有顯著差異，因此我們先畫出兩班數學成績的箱型圖，做粗略的觀察和比較。




接著，為了做兩獨立樣本 T 檢定，我們分別對兩班的數學成績做常態性假設檢定，檢定結果如下：

```
> shapiro.test(dat1$`Class A`)

        Shapiro-Wilk normality test

data:  dat1$`Class A`
W = 0.97926, p-value = 0.87
```

```
> shapiro.test(dat1$`Class B`)

        Shapiro-Wilk normality test

data:  dat1$`Class B`
W = 0.94411, p-value = 0.2625
```

檢定結果顯示 p-value 大於 0.05，代表不拒絕虛無假設，因此我們可以假設這兩筆資料來自常態分配。

最後，由於資料來自常態分配，因此我們可以進行 Welch's T test，虛無假設為兩樣本並無顯著差異，對立假設為兩樣本有顯著差異。

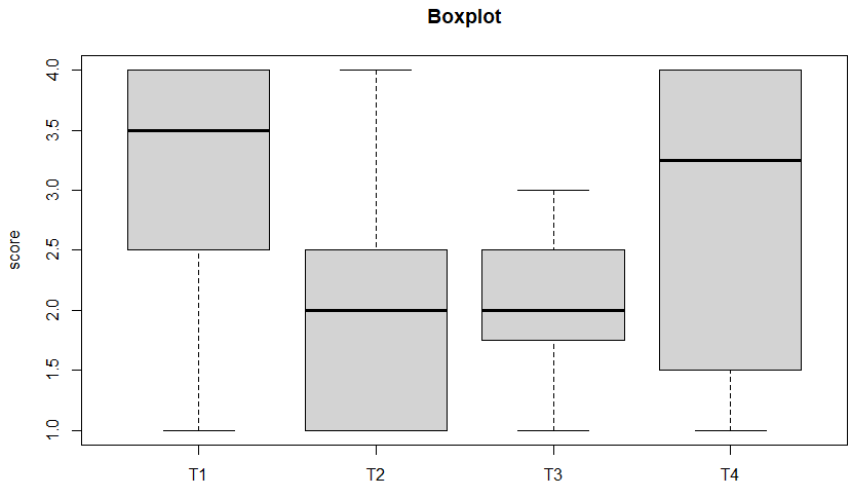
```
> t.test(dat1$`Class A`, dat1$`Class B`, alternative = "two.sided")

        Welch Two Sample t-test

data:  dat1$`Class A` and dat1$`Class B`
t = -2.7216, df = 32.574, p-value = 0.01035
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -6.1327273 -0.8844155
sample estimates:
mean of x mean of y
 69.92000  73.42857
```

檢定結果顯示 p-value 小於 0.05，代表拒絕虛無假設，因此我們有足夠的證據說明兩樣本有顯著差異，也就是說，兩班的數學成績表現並不相同。

2. **Twelve farmers are selected randomly in an experiment with a plant nursery. Each farmer is asked to select four fair and identical areas in the yard and to plant four different types of grasses. One type in each area of the yard. After the grasses grow, the farmer will give the score of each grass. The experiment is conducted to know if the four types of grasses are popular equally. The dataset is shown in the sheet Question 2.**

首先，從題目中可以觀察到我們想了解四個區塊中的植物表現是否一致，應使用 One-way ANOVA RBD，但由於資料筆數過少，因此應使用無母數版本 Friedman test。

我們先畫出箱型圖，簡單觀察四個區塊中植物的分數，從圖形來看，發現四個區塊的植物分數有可能不太一致。




由於 Friedman test 也是需要同質變異數假設，因此我們也先對此四個區塊的變異數做 levene test，檢定結果如下：

```
> leveneTest(`Scores` ~ factor(`Type of grass`) , data = dat2)
Levene's Test for Homogeneity of Variance (center = median)
      Df F value Pr(>F)
group  3  1.3013  0.286
      44
```

結果顯示 p-value 大於 0.05，代表不拒絕虛無假設，因此我們可以假設四個區塊的變異數是相等的。

最後，進行 Friedman test，檢定結果如下：

```
> friedman.test(y=dat2$Scores, groups=dat2$`Type of grass`, blocks=dat2$Judge)

        Friedman rank sum test

data:  dat2$Scores, dat2$`Type of grass` and dat2$Judge
Friedman chi-squared = 8.0973, df = 3, p-value = 0.04404
```

結果顯示 p-value 小於 0.05，代表拒絕虛無假設，因此我們有足夠的證據說明四個區塊中植物的分數並不一致。

**3. 50 people were surveyed regarding their opinion about candidates for Mayor. 15 people were in Candidate A and 35 people were in Candidate B. After they listened to a debate by the two candidates and the survey done by the 50 people was repeated. Then, 17 voted in Candidate A and 33 in Candidate B. Did the debate affect people's opinions? The dataset is shown in the sheet Question 3.**

從題目來看，我們想知道在一場爭論前後，候選人的支持比例是否有顯著差異，因此我們可以使用 McNemar test 來檢定這件事。

```
> mcnemar.test(df)

        McNemar's Chi-squared test with continuity correction

data:  df
McNemar's chi-squared = 0.125, df = 1, p-value = 0.7237
```

檢定結果顯示，p-value 大於 0.05，代表不拒絕虛無假設，因此我們可以說明在這場爭論前後，候選人的支持比例並無顯著差異。