Multivariate Analysis of Variance (MANOVA) - 19BCE1460

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
require("datasets")
penguinsdata <- read.csv("S:/WIN SEM 21-22/Data Visualization/Lab/penguins_lter.csv")
penguinsdata <- na.omit(penguinsdata)
str(penguinsdata)
```

```
## 'data.frame':    330 obs. of  17 variables:
##  $ studyName        : chr  "PAL0708" "PAL0708" "PAL0708" "PAL0708" ...
##  $ Sample.Number    : int  2 3 5 6 7 8 10 11 15 17 ...
##  $ Species          : chr  "Adelie Penguin (Pygoscelis adeliae)" "Adelie Penguin (Pygoscelis adeliae)
##  $ Region           : chr  "Anvers" "Anvers" "Anvers" "Anvers" ...
##  $ Island           : chr  "Torgersen" "Torgersen" "Torgersen" "Torgersen" ...
##  $ Stage            : chr  "Adult, 1 Egg Stage" "Adult, 1 Egg Stage" "Adult, 1 Egg Stage" "Adult, 1 E
##  $ Individual.ID    : chr  "N1A2" "N2A1" "N3A1" "N3A2" ...
##  $ Clutch.Completion: chr  "Yes" "Yes" "Yes" "Yes" ...
##  $ Date.Egg         : chr  "11-11-2007" "11/16/07" "11/16/07" "11/16/07" ...
##  $ CulmenLengthmm   : num  39.5 40.3 36.7 39.3 38.9 39.2 42 37.8 34.6 38.7 ...
##  $ CulmenDepthmm    : num  17.4 18 19.3 20.6 17.8 19.6 20.2 17.1 21.1 19 ...
##  $ FlipperLengthmm  : int  186 195 193 190 181 195 190 186 198 195 ...
##  $ BodyMassg        : int  3800 3250 3450 3650 3625 4675 4250 3300 4400 3450 ...
##  $ Sex              : chr  "FEMALE" "FEMALE" "FEMALE" "MALE" ...
##  $ Delta.15.N..o.oo.: num  8.95 8.37 8.77 8.66 9.19 ...
##  $ Delta.13.C..o.oo.: num  -24.7 -25.3 -25.3 -25.3 -25.2 ...
##  $ Comments         : chr  "" "" "" "" ...
##  - attr(*, "na.action")= 'omit' Named int [1:14] 1 4 9 12 13 14 16 40 42 47 ...
##   ..- attr(*, "names")= chr [1:14] "1" "4" "9" "12" ...
```

```
set.seed(1234)
dplyr::sample_n(penguinsdata, 10)
```

```
##    studyName Sample.Number                                Species Region    Island
```

```
## 1    PAL0809            77   Gentoo penguin (Pygoscelis papua) Anvers    Biscoe
## 2    PAL0910           112 Adelie Penguin (Pygoscelis adeliae) Anvers    Biscoe
## 3    PAL0910           122 Adelie Penguin (Pygoscelis adeliae) Anvers Torgersen
## 4    PAL0910           144 Adelie Penguin (Pygoscelis adeliae) Anvers     Dream
## 5    PAL0910           109 Adelie Penguin (Pygoscelis adeliae) Anvers    Biscoe
## 6    PAL0910           114 Adelie Penguin (Pygoscelis adeliae) Anvers    Biscoe
## 7    PAL0708             6   Gentoo penguin (Pygoscelis papua) Anvers    Biscoe
## 8    PAL0910           101 Adelie Penguin (Pygoscelis adeliae) Anvers    Biscoe
## 9    PAL0809            90 Adelie Penguin (Pygoscelis adeliae) Anvers     Dream
## 10   PAL0809            63   Gentoo penguin (Pygoscelis papua) Anvers    Biscoe
##                  Stage Individual.ID Clutch.Completion   Date.Egg CulmenLengthmm
## 1  Adult, 1 Egg Stage         N58A1               Yes 11-06-2008           47.5
## 2  Adult, 1 Egg Stage         N58A2               Yes 11-12-2009           45.6
## 3  Adult, 1 Egg Stage         N66A2                No   11/17/09           37.7
## 4  Adult, 1 Egg Stage         N81A2               Yes   11/16/09           40.7
## 5  Adult, 1 Egg Stage         N55A1               Yes   11/20/09           38.1
## 6  Adult, 1 Egg Stage         N60A2               Yes   11/15/09           42.2
## 7  Adult, 1 Egg Stage         N33A2               Yes   11/18/07           46.5
## 8  Adult, 1 Egg Stage         N47A1               Yes 11-09-2009           35.0
## 9  Adult, 1 Egg Stage         N44A2               Yes 11-08-2008           38.9
## 10 Adult, 1 Egg Stage         N19A1               Yes   11/13/08           45.7
##    CulmenDepthmm FlipperLengthmm BodyMassg    Sex Delta.15.N..o.oo.
## 1           14.2             209      4600 FEMALE           8.39299
## 2           20.3             191      4600   MALE           8.65466
## 3           19.8             198      3500   MALE           9.11066
## 4           17.0             190      3725   MALE           9.05674
## 5           17.0             181      3175 FEMALE           9.79532
## 6           19.5             197      4275   MALE           8.80186
## 7           13.5             210      4550 FEMALE           7.99530
## 8           17.9             192      3725 FEMALE           8.84451
## 9           18.8             190      3600 FEMALE           8.36936
## 10          13.9             214      4400 FEMALE           8.62870
##    Delta.13.C..o.oo.                            Comments
## 1          -26.78733
## 2          -26.32909
## 3          -26.42563 Nest never observed with full clutch.
## 4          -25.79529
## 5          -25.27385
## 6          -26.41218
## 7          -25.32829
## 8          -26.28055
## 9          -26.11199
## 10         -26.60484
```

```
cul <- penguinsdata$CulmenLengthmm
fli <- penguinsdata$FlipperLengthmm
# MANOVA test
res.man <- manova(cbind(CulmenLengthmm, FlipperLengthmm) ~ Island, data = penguinsdata)
summary(res.man)
```

```
##            Df  Pillai approx F num Df den Df    Pr(>F)
## Island      2 0.54556   61.328      4    654 < 2.2e-16 ***
## Residuals 327
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
summary.aov(res.man)
```

```
##  Response CulmenLengthmm :
##              Df Sum Sq Mean Sq F value   Pr(>F)
## Island        2 1347.4  673.72  26.185 2.83e-11 ***
## Residuals   327 8413.5   25.73
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##  Response FlipperLengthmm :
##              Df Sum Sq Mean Sq F value    Pr(>F)
## Island        2  23176 11587.9  92.504 < 2.2e-16 ***
## Residuals   327  40963   125.3
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```