```
Handout #1

#
# R input
#
Xmatrix <- c(1, 264, 38.5,
             1, 200, 35.5,
             1, 225, 36.5,
             1, 268, 38,
             1, 215, 36,
             1, 241, 36,
             1, 232, 36.5,
             1, 256, 36.5,
             1, 229, 35.5,
             1, 288, 38.5,
             1, 253, 37,
             1, 288, 38,
             1, 230, 37,
             2, 283, 37,
             2, 312, 39,
             2, 291, 38,
             2, 259, 37.5,
             2, 216, 36,
             2, 201, 36,
             2, 267, 38,
             2, 326, 38.5,
             2, 241, 37,
             2, 291, 40,
             2, 269, 37.5,
             2, 282, 39,
             2, 257, 38.5)

X <- matrix(data = Xmatrix, ncol = 3, byrow = TRUE)

Group <- X[,1]
LeafArea <- X[,2]
Height <- X[,3]

# Produce Univariate Analyses - anova

boxplot(LeafArea ~ Group, ylab = 'LeafArea (cm^2)')
aov.L <- aov(LeafArea ~ Group)
summary(aov.L)

boxplot(Height ~ Group, ylab = 'Height (cm)')
aov.H <- aov(Height ~ Group)
summary(aov.H)

# Produce Wilks' Lambda and F - manova

plot(LeafArea, Height, pch = Group)
CellDat <- data.frame(Group = X[,1], LeafArea = X[,2], Height = X[,3])
fit <- manova(cbind(LeafArea,Height) ~ factor(Group), data = CellDat)
summary(fit, test="Wilks")
```

```
# R output
> summary(aov.L)
            Df Sum Sq Mean Sq F value Pr(>F)
Group        1   3601    3601   3.653  0.068 .
Residuals   24  23658     986
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
>
> summary(aov.H)
            Df Sum Sq Mean Sq F value Pr(>F)
Group        1   6.01   6.010   4.765 0.0391 *
Residuals   24  30.27   1.261
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
>
> summary(fit, test="Wilks")
              Df    Wilks approx F num Df den Df Pr(>F)
factor(Group)  1 0.83228   2.3175      2     23 0.1211
Residuals     24
```