The University of Sydney
STAT2012 Statistical Tests

Semester 2	Computer Practice Week 7	2015

Useful R commands

- Kruskal Wallis test: To test $H_0: \mu_1 = \mu_2 = \cdots = \mu_g$ against H_1: at least one equality does not hold, the R codes are

```
xv=as.matrix(x)
xv=as.vector(xv)
factor=factor(rep(letters[1:g],c(ni,...,ni)))
kruskal.test(xv,factor)
```

  where `ni` is the number of rows, `g` is the number of columns and `x` is a matrix of `ni` rows and `g` columns.

Important points

- You will perform ANOVA test, the Bonferroni test for multiple comparisons and the nonparametric Kruskal-Wallis test to compare the means of $g > 2$ populations.
- Only some of the R codes are provided. For others, please refer to lecture note.

Practice Problems

Open the data set `itch` containing ten (`ni=10`) measurements from seven (`g=7`) treatments.

```
itch=read.csv("http://www.maths.usyd.edu.au/u/UG/IM/STAT2012/r/itch.csv")
attach(itch)
itch
```

1. Test if the means of measurements from the seven treatments are equal using the *ANOVA test*. Use $\alpha = 0.1$.
   (a) State the null and alternative hypotheses.
   (b) Perform the test and report the test statistic and p-value. Draw your conclusion about H_0 based on the p-value.

   (Hint: Since this data have a *matrix* format, you need to create vectors of outcomes `itchv` and factor labels `factor`.)

   (c) Draw the boxplot for each treatment and the normal qq plot for the residuals of the ANOVA model and comment the normality and equality-of-variance assumptions. Identify any pairs of treatments that differ greatly in the median from the boxplots. This gives you insight of the possible pairs of treatments with significant differences in means.

2. Perform multiple comparisons using the *Bonferroni* method to identify any pairs of means that are significantly different. Use $\alpha = 0.1$.

   (a) Check the matrix of differences in means for all pairs of treatments.

   (b) Evaluate the test statistics for all pairs of treatments using some suitable R codes.

   (c) Evaluate p-values, output the significant level α^* for each pair of test and compute the logical comparison of p-values with α^*. Identify pair(s) which give significant test result at α^*. At an overall $\alpha = 0.1$ significant level, does the result using Bonferroni test agree with ANOVA test?

3. Repeat the test in Question 1 using the *Kruskal Wallis* (KW) test.

   (a) Perform the test and draw your conclusion about H_0 based on the p-value. Does the result of KW agree with ANOVA and Bonferroni tests?

   (b) Check the p-value of the test using some suitable R codes.