**Lab 7 self assessment – Corrected answers**

The data in teaching.csv are reconstructed from a study on the effectiveness of teaching methods. This study compared 5 different teaching methods:

traditional lecture + discussion (LD)

programmed text (Prog)

programmed text + lecture (ProgL)

computer aided (Comp)

computer aided + lecture (CompL)

The names in () are the treatment names used in the data file. Treatments were randomly assigned to individuals, with 9 individuals in each treatment group. The details of the treatments are not important. The response is the score on a test assessing retention of information 6 weeks after the instruction.

1) Test the null hypothesis of no difference among the treatments, i.e., all 5 treatments have the same mean. Report numerator and denominator degrees of freedom for the F statistic.

2) Report the p-value for the test in question 1.

3) Write a one-sentence conclusion from the p-value in question 2.

4) The characteristics of the 5 treatments suggest three a-priori contrasts:

a) The difference between traditional lecture + discussion and the novel methods

Compares LD to the average of Prog, ProgL, Comp and CompL

b) The difference between programmed text and computer aided instruction

Compares the average of Prog and ProgL to the average of Comp and CompL

c) The difference between treatments with lectures and those without.

Compares the average of LD, ProgL and CompL to the average of Prog and Comp

5) What is the order of treatment names in the software you are using?

Your answer is an ordered list of names

6) For each of the three contrasts, write down the coefficients of the linear contrast that estimates each quantity. Write down the coefficients in the appropriate order for your software

7) Estimate the value of each contrast (R or SAS, only do-able by hand using JMP)

8) Test the null hypotheses (one for each contrast) of no difference for each contrast. Report the p-value for each contrast.

9) You should find that at least some contrasts lead to a different conclusion than does the overall F test. Briefly explain how this can happen.

**Answers:**

1) F statistic = 1.944, numerator\_df = 4, denominator\_df =40

2) p-value = 0.122

3) Fail to reject H0: T here is no significant difference among the treatment groups,

OR: No evidence of a difference among the treatment means.

5) Comp CompL LD Prog ProgL

6) Coefficients for LD = [-0.25, -0.25, 1, -0.25, -0.25]

Coefficients for Prog = [-0.5, -0.5, 0, 0.5, 0.5]

Coefficients for Lectures = [-0.5, 1/3, 1/3, -0.5, 1/3]

(For Lectures, SAS is a little bit different, should be: -3 2 2 -3 2 /divisor = 6)

7) 1.14, -3.15, -1.09

8) 0.46, 0.028, 0.39

9) Contrasts focus on specific differences between groups, so they may detect differences that the overall F test, which tests for any differences among groups, might not detect. This can happen when some treatment groups are very different from others, even if there is no overall difference. Contrasts allow you to make more specific and targeted comparisons.