

Stat 322 (F17) - Assignment #2

(Due Wed. Nov. 1 at 4:00 pm in appropriate STAT 322 slot in assignment box #15 outside the Math Tutorial Centre (MC 4066/4067). Electronic submissions or in-class submissions will not be accepted.

- 1) An education researcher wishes to examine how external clues influence student performance on an exam. Two different exams, one with simple questions and one with difficult questions, were each printed on three different coloured paper; red, green and blue. 18 undergraduate students were randomly assigned to the six different exam combinations. The results (grade on exam out of 100) are presented in the table below, and are found in the *A2Q1.txt* dataset on LEARN. The data may be imported into R using the *read.table* function:

```
>name=read.table("A1Q2.txt",header=TRUE)
```

You will first need to copy the file to the current working directory, which can be found with the *>getwd()* command.

Question type

Colour	Simple	Difficult
Red	72, 84, 88	46, 54, 61
Green	91, 88, 88	43, 51, 38
Blue	85, 80, 84	66, 60, 60

- Provide the model associated with this factorial design.
 - Create an interaction plot in R and briefly comment on what you see.
 - Create an ANOVA table in R that includes both main effects terms and interaction terms.
The command *>anova(lm(response~A+B+A*B))* will generate the appropriate ANOVA table.
 - Does the effect of exam colour on grade depend on question type?
 - The colour red has been associated with an increase in blood pressure and anxiety. **For the simple question type**, is there a difference the effect of the red colour and the average effect of the other colours on exam performance? Answer this question by creating a 95% confidence interval for the appropriate contrast.
 - Calculate the contribution to the SS(Colour) of the red exam grades.
 - Calculate the contribution to the SS(Res) of the green/difficult treatment combination grades.
- 2) The following is the ANOVA table generated for a modified version of the dentist study in exercise 5 page 48 of the course notes (data from dentists 11 and 12 have been omitted from the analysis leaving $n = 60$ observations). Please read the introduction in the course notes to familiarize yourself with the study.

```
> dentist_aov=anova(lm(pain~brand+desensization+dentist+
  brand*desensization))
```

```
> dentist_aov
```

Analysis of Variance Table

Response: pain

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
brand	2	2.172	1.0862	*****	*****
desensization	1	2.091	2.0907	*****	*****
dentist	9	58.073	6.4526	*****	*****
brand:desensization	2	4.090	2.0452	*****	*****
Residuals	*	*****	*****		

- a) What is the role of the dentist variate in this experimental design?
- b) R yields the following output for the sample standard deviation of the response:
- ```
> sd(pain)
[1] 1.393528
```
- Use this value to calculate  $SS(Res)$  and  $MS(Res)$  (recall that the sample standard deviation is a function of  $SS(Tot)$ , not  $SS(Res)$ )
- c) Complete the ANOVA table, including F values and p-values (using the  $pf$  function in R), and summarize your conclusions regarding all main effects and interaction effect.