

## Statistics 516 - Spring 2003 - Practice Exam 2 Answers

Part I:

- 1) The errors must be normally distributed, have mean zero, and equal variances at each treatment level, and must be independent.
- 2) The probability of observing a test statistic as extreme as the one observed, or more extreme, if the null hypothesis is true.

Part II:

1)  $X_{red} = 1$  if the observation is in the red group, 0 if in the blue or green groups

$X_{blue} = 1$  if the observation is in the blue group, 0 if in the red or green groups

2)  $0.2483 \pm 2.042(0.6235) = 0.2483 \pm 1.2732$  (the t had 30df)

3) We need to cancel out the error and interaction term, so  $2527.3379/330.6544=7.6434$

4)  $(2527.3379-330.6544)/28=78.452$

5) Factorial because all combinations occur, replications because there are two at each combination of levels, and balanced because there are the same number (2) at each combination of levels.

6)

Factor A	Factor C				Factor A Means
	1	2	3	4	
1	$x_{111}=26.4$	$x_{121}=38.3$	40.5	19.8	33.1
	$x_{112}=32.6$	31.7	46.9	28.7	
2	34.0	27.7	40.3	32.9	34.4
	20.7	37.2	44.7	37.6	
3	43.8	54.4	49.0	43.8	47.7
	49.4	50.6	44.3	$x_{342}=46.6$	
Factor C Means	$\bar{x}_{\bullet 1 \bullet}=34.5$	40.0	44.3	34.9	$\bar{x}_{\bullet \bullet \bullet}=38.4$

7)  $y_{ijk} = \mu_{\text{baseline}} + \alpha_i + \gamma_j + (\alpha\gamma)_{ij} + \varepsilon_{ijk}$  for  $i=1, \dots, 3$ ,  $j=1, \dots, 4$ , and  $k=1, \dots, 2$

where the  $y_{ijk}$  are the observations,  $\mu_{\text{baseline}}$  is the baseline

$\alpha_1, \alpha_2$  are the main effects for the levels of factor A

$\gamma_1, \gamma_2, \dots, \gamma_4$  are the main effects for the levels of factor C

$(\alpha\gamma)_{11}, (\alpha\gamma)_{12}, \dots, (\alpha\gamma)_{21}, \dots, (\alpha\gamma)_{24}$  are the interactions for the combinations of A and C

and the  $\varepsilon_{ijk}$  are the errors

8)  $SS = 1767.3413 - 1049.97 - 329.11 = 388.2613$      $df = 11 - 2 - 6 = 3$

9)

A3	2	46.6000	A	(none are significantly different!)
A1	2	29.5000	A	
A2	2	27.3500	A	

10a) Type III test for Factor C

b) Type III test for Interaction

c) Contrast 1 0 0 -1 on Factor C

d) ANOVA table

11) From residual vs. predicted plot the means of the errors appear to be zero (and must be for a two-way ANOVA with interaction!), but the variances appear somewhat troubling. The p-value of 0.3945 in the Brown and Forsythe test is not significant, so you could probably go either way (remember, it is fail to reject, not a green light!) The q-q plot looks linear so the errors appear to be at least approximately normal. As the rats were randomly assigned independence of the errors should hold.

12) The Regular-Obese Group had zeros for the main effect and interaction estimates.

13) With a p-value of 0.6451 we fail to find significant evidence of an effect on kidney weight due to choice of diet.

With a p-value of  $< 0.0001$  we do find significant evidence of an effect on kidney weight due to the size of the rat.

With a p-value of 0.4324 we do not find significant evidence of an interaction between the diet and rat size as far as kidney weight is concerned. (Keep in mind we are not saying that Vitamin B has no effect, just that we don't have enough evidence from this experiment to conclude that it does!)