

STAT502 Homework #2

due Monday, 7/10

1. The following ANOVA table is partially summarized from a study involving four treatment groups. Find the missing values.

Source	SS	DF	MS	F	p -value
Between treatments	64.42	-----	-----	8.98	-----
Within treatments	-----	-----	2.39		
Total	-----	20			

2. The tensile strength of Portland cement is being studied. Four different mixing techniques can be used economically. The following data have been collected:

Technique	Tensile strength			
1	3129	3000	2865	2890
2	3200	3300	2975	3150
3	2800	2900	2985	3050
4	2600	2700	2600	2765

Test the hypothesis that mixing techniques affect the strength of the cement. Use the one-way ANOVA model, assuming that the assumptions are met. Report the ANOVA table, including the p -value, and your conclusion with $\alpha = .05$.

3. (*adapted from KNNL 17.9*) The data in “CH16PR08.txt” are from an experiment investigating the effect of paper color on response rates for a questionnaire (1=blue, 2=green, 3=orange). The ANOVA model for this situation is

$$Y_{ij} = \mu_i + \epsilon_{ij}$$

where μ_i is the population mean for the i th color, and ϵ_{ij} are iid $N(0, \sigma^2)$.

- (a) Find the estimates for μ_1 , μ_2 , and μ_3 . Also, find the estimate for σ^2 .
 - (b) Find the corresponding standard errors for the estimates above.
 - (c) Is there a difference between the green and orange group means? Answer with the appropriate hypothesis test. Use $\alpha = .05$.
 - (d) Is there a difference between the orange group mean and the average of the blue and green group means? State the appropriate contrast for this test, and carry out the test with $\alpha = .05$.
4. The bioactivity of four different drugs for treating a particular illness was compared in a study. The treatment averages are as follows: $\bar{y}_1. = 66.10$, $\bar{y}_2. = 65.75$, $\bar{y}_3. = 62.63$, $\bar{y}_4. = 63.85$. The sample size within each group was $n = 7$. A partial ANOVA table is provided below:

Source	SS	df	MS	F
Drug	56.10			
Error	62.12			
Total				

- (a) From the ANOVA table, find the value of the F test statistic. Is this significant evidence that the population mean bioactivity levels are different among the four drugs.

- (b) We wish to make all pairwise comparisons between the four treatments. How many possible pairwise comparisons are there?
- (c) Without adjustment for multiplicity, what would the critical value be for an individual pairwise comparison? Use $\alpha = .05$.
- (d) If the desired FWER is 0.05, what would Tukey's critical value be in this situation? Also, find Bonferroni's and Scheffé's critical values.
- (e) Using each of the three approaches in (d) above, which pairs of means are significantly different? *Hint: Since the sample sizes are equal, you don't have to compute the test statistic every time. Using the Tukey critical value as an example,*
- (f) Comment on any differences in the results in parts (c), (d) and (e). Which is the most appropriate procedure in this case?