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Introduction to Statistical Methods  
Homework 9

Name: \_\_\_\_\_

1. A researcher investigates the number of viral infections people contract as a function of the amount of stress they experienced in a 6 month period, and obtains the following data:

Amount of stress			
Negligible	Minimal	Moderate	Severe
2	4	6	5
1	3	5	7
4	2	7	8
1	3	5	4

You are going to analyze this data using a one-way ANOVA.

- (a) What are  $H_0$  and  $H_a$ ?
- (b) Complete the ANOVA summary table, and compute  $F_{\text{obt}}$ .
- (c) With  $\alpha=0.05$ , what is  $F_{\text{crit}}$ ? Report the results of your ANOVA.

2. Using the data in Problem 1, perform the appropriate post-hoc comparisons. What do you conclude from this study?

3. Here are the data from a study on the effect of age on creativity scores:

Age 4	Age 6	Age 8	Age 10
3	9	9	7
5	11	12	7
7	14	9	6
4	10	8	4
3	10	9	5

- (a) Complete the ANOVA summary table, and compute  $F_{\text{obt}}$ .
- (b) With  $\alpha=0.05$ , what are the results of your ANOVA?

4. Using the data in Problem 3, perform the appropriate post-hoc comparisons. What are your conclusions from this study? Graph the results.

5. In a study in which  $k=3$ ,  $n_i = 21$  for all  $i$ ,  $m_1 = 45.3$ ,  $m_2 = 16.9$ ,  $m_3 = 8.2$ , you compute the following sums of squares:

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Source	Sum of squares	df	MS	F
Between	147.32			
Within	862.99			
Total	1010.31			

- (a) Complete the ANOVA summary table.
- (b) With  $\alpha=0.05$ , what do you conclude from the ANOVA?
- (c) Perform the appropriate post-hoc comparisons.
- (d) What proportion of the variance is accounted for by the effect of the independent variable?

6. A researcher investigated the effect of the volume of the background noise on participants' accuracy rates while performing a boring task. He tested 3 groups of randomly selected students, and obtained the following means and sums of squares:

	Low volume	Moderate volume	High volume
Mean	61.5	65.5	48.25
$n_i$	4	5	7

Source	Sum of squares	df	MS	F
Between	652.16			
Within	612.75			
Total	1264.92			

- (a) Complete the ANOVA.
- (b) At  $\alpha=0.05$ , what is  $F_{crit}$ ? Report the results of the ANOVA.
- (c) Perform the appropriate post-hoc tests.
- (d) What do you conclude from this study?

7. An experimenter studies whether audio-visual synchrony has an effect on recall of spoken materials. Subjects are shown a film of a person repeating a list of 50 common words. One group of subjects sees a normal film, in which the audio and video are synchronized. A second group, labeled "fast sound," sees a film in which the voice and lips are out of synchrony, with the sound preceding the video. The third group, labeled "slow sound," sees a film in which one can hear the sound slightly after seeing the corresponding lip movements. After the film, each subject recalled as many of the 50 words as they could, and the researcher measured the number of recalled words. The data is shown in the following table:

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Fast sound	Normal sound	Slow sound
23	27	23
22	28	24
18	33	21
15	19	25
29	25	19
30	29	24
23	36	22
16	30	17
19	26	20
17	21	23

Complete the analysis of variance. Show the summary table, and state the results of the ANOVA.

8. A researcher studies the effect of a lesion introduced into a particular structure in a rat's brain on the rat's ability to perform a discrimination task. The structure is bilaterally symmetric. Group I had a lesion on the right side, group II on left side, group III on both sides, and group IV had no lesion (a control group). The following is the performance data for the rats in the 4 groups:

Group			
I	II	III	IV
20	24	20	27
18	22	22	35
26	25	30	18
19	25	27	24
26	20	22	28
24	21	24	32
26	34	28	16
	18	21	18
	32	23	25
	23	25	
	22	18	
		30	
		32	

Complete the analysis of variance. Show the summary table, and state the results of the analysis.

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9. In a study of the effects of reward on learning, there were 4 groups. Each child was given a puzzle which could be solved only if a sequence of steps were taken in order. In Group I, the child was rewarded for every correct move until the puzzle was solved. In Group II (frequent reward), 75% of a child's correct moves were rewarded, on a random schedule. In Group III, the child was rewarded infrequently, for 25% of their correct moves. In Group IV, no moves were rewarded. The experimenter wants to test the following hypotheses:

- (i) Constant reward will produce faster learning than the average of the other conditions
- (ii) Frequent reward will produce faster learning than the average of infrequent or no reward
- (iii) Infrequent reward will produce faster learning than no reward

(a) Find weights corresponding to each of these three hypotheses, and show that the 3 are independent

(b) Test each of the experimenter's hypotheses, using a per-comparison  $\alpha=0.017$ , and planned comparisons (you can use online statistical tables like those at <http://math.uc.edu/~brycw/classes/148/tables.htm> to get  $t_{crit}$  for  $\alpha=0.017$ ). The data is shown below:

Group			
Constant reward	Frequent	Infrequent	Never
12	9	15	17
13	10	16	18
11	9	17	12
12	13	16	17
12	14	16	19

(c) If all three of the planned comparisons is tested for significance with  $\alpha=0.017$ , what is the experiment-wise probability of a Type I error? If each were tested using  $\alpha=0.05$ , what is the experiment-wise probability of a Type I error?

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10. Consider a set of seven groups, each containing 10 subjects. Planned comparisons are to be made with the following weights:

Groups						
I	II	III	IV	V	VI	VII
4	4	4	-3	-3	-3	-3
1	1	-2	0	0	0	0
0	0	0	1	1	-1	-1

- (a) Show that the comparisons are orthogonal (i.e. independent)
- (b) Find the weights for three additional comparisons, such that the full set of 6 comparisons is orthogonal.
- (c) For the new comparisons you have suggested, what is the interpretation of the comparison in terms of comparing the means of the different conditions?