1 In a study of memory processes, animals were tested in an avoidance-learning task. In the

2 learning trials before the test trial, they were presented with a fear-producing stimulus as

3 soon as they stepped across a line in the test chamber. This was followed by an electrical

4 stimulation through electrodes implanted in their cortex, possibly compromising their mem-

5 ory. On the test trial after the learning trials, the time for the animals to step across the

6 line was recorded as the DV. There were two factors in this experiment. The first factor was

7 the time lag between the fear-producing stimulus and the electrical stimulation (50, 100 or

8 150 ms) in the learning trials. The second factor was the brain area implemented with the

9 electrodes. This factor had three levels: neutral site not relevant to memory, Area A and

10 Area B. If the stimulated brain area was involved in memory, stimulation would interfere

11 with memory consolidation and the animal would have trouble remembering their experience

12 in the learning trials, resulting in shorter time in the test trial (smaller value of DV). The

13 sample cell means are presented in the table below. $MS_{error} = 29.311$. Per cell sample size

14 is $n = 5$.

	Area N	Area A	Area B	Row Means
50 ms	28.6	16.8	24.4	23.27
100 ms	28	23.0	16.0	22.33
150 ms	28	26.8	26.4	27.07
Column Means	28.2	22.2	22.27	24.22

16 For notation, we treat Time lag as the first factor with $i = 50, 100, 150$ for 50, 100 and 150

17 ms conditions; Area of brain is the second factor, with $j = N, A, B$ for the brain areas.

18 1 Test the hypotheses $\mathbf{H}_0$: $(\bar{\mu}_{\cdot A} + \bar{\mu}_{\cdot B})/2 \geq \bar{\mu}_{\cdot N}$ vs. $\mathbf{H}_1$: $(\bar{\mu}_{\cdot A} + \bar{\mu}_{\cdot B})/2 < \bar{\mu}_{\cdot N}$ at $\alpha = 0.05$.

19 Draw conclusions in terms of the problem.

20 2 Suppose for **each** time lag you would like to test the difference between Area N and Area

21 A and the difference between Area N and Area B, both in one-sided tests. Which direction

22 should be specified in the alternative hypotheses of these tests in order to determine the

23 effective brain area at each time lag? Obtain t statistics, unadjusted one-sided p-values and

24 use Hochberg method to draw conclusion. There should be a total of six tests. You don't

need to write the hypotheses.

3 Write a contrast that describes how much the difference between Areas A and B changes from time lag 100ms to time lag 50ms. Obtain an unadjusted 95% CI for this contrast.

4 If you wish to protect the family of all interaction contrasts, what is the CV?

5 How many interaction contrasts are interactions of two pairwise comparisons? To obtain simultaneous CIs for this family of contrasts, what is the CV using Bonferroni method?

6 For the test in Problem 1 to achieve a power of 0.8 in detecting $d = 0.5$, what is the minimum per cell sample size? Attach screen shot of WebPower. Note if your effect size is specified as a positive number, the type of analysis should be "greater than".