Psych 310: Assignment 2 (Part B) Multiple Comparisons in One-factor Between Subjects ANOVA

Study: 176 healthy boys ages 8 – 10 with a diagnosis of ADHD participated in a study examining the effects of three ADHD medications on heart functioning. Boys were randomly assigned to one of four conditions: DRUG A, DRUG B, DRUG C, and NO medication. The dependent variable in this problem is each boy's average resting heart rate.

Assume that in each of the five scenarios below you wish to maintain a familywise Type I error rate of .05. Each scenario is self-contained. Use SPSS for your data analyses and annotate the output as requested in each question below. ATTACH YOUR OUTPUT TO THIS DOCUMENT. Be sure to use the multiple-comparison decision chart to help you choose the best procedure.

1. **Scenario One:** These two hypotheses were stated before data collection:

Hypothesis 1: Boys taking DRUG C have a higher heart rate than boys taking DRUG A. Write the **null hypothesis** for this comparison:

$H_0: \mu_A - \mu_C = 0$

Hypothesis 2: Boys taking NO ADHD medication will have a lower heart rate than boys taking an ADHD medication. Write the **null hypothesis** for this comparison:

$H_0: \frac{\mu_A + \mu_B + \mu_C}{3} - \mu_N = 0$

a. Is it useful to carry out the overall (omnibus) ANOVA F test before you examine any planned comparisons. YES (NO) Why or why not?

It is not necessary to have a significant overall F test before carrying out these tests.

b. Are these two comparisons orthogonal (independent)? Demonstrate how you arrive at an answer to this question.

c. Which multiple comparison procedure is optimal for testing these two hypotheses?

The Bonferroni adjusted test

d. Show the computation of t_{obs} for Ψ1. (Assume HOV.)

e. Find the t_{crit} that you will use to test this comparison:

f. What is the correct p-value for this comparison?

g. What statistical decision will you make for Ψ1? On what do you base this decision?

h. Construct the 95% CI for Ψ1. (Assume HOV)

g. SPSS output for Scenario 1: Mark the obtained test statistic assuming HOV for each of these comparisons (use labels **Ψ1HOV** and **Ψ2HOV**). Do the same thing for the tests that do NOT assume HOV, but use the labels **Ψ1** and **Ψ2** for these tests.

2. **Scenario Two:** Now assume you planned to compare each group to each other group (separately), with no other comparisons planned.

a. How many of these comparisons are there? (Show your formula and result.)

b. Write the contrast coefficients for the comparison of NO DRUG v. DRUG C (Ψ3.2) and for the comparison of DRUG A v. DRUG B (Ψ4)

c. Are comparisons 3 and 4 independent? Is the entire set independent? Support your answer.

d. Is the entire set of comparisons independent? Show how you know.

No

Note: your work on this question should lead you to conclude that this is not a SET of independent comparisons! Be sure you know why this matters.

e. If you are willing to assume HOV, which multiple comparison procedure is optimal for testing the comparisons in Scenario 2?

Tukey's Honestly Significant Difference

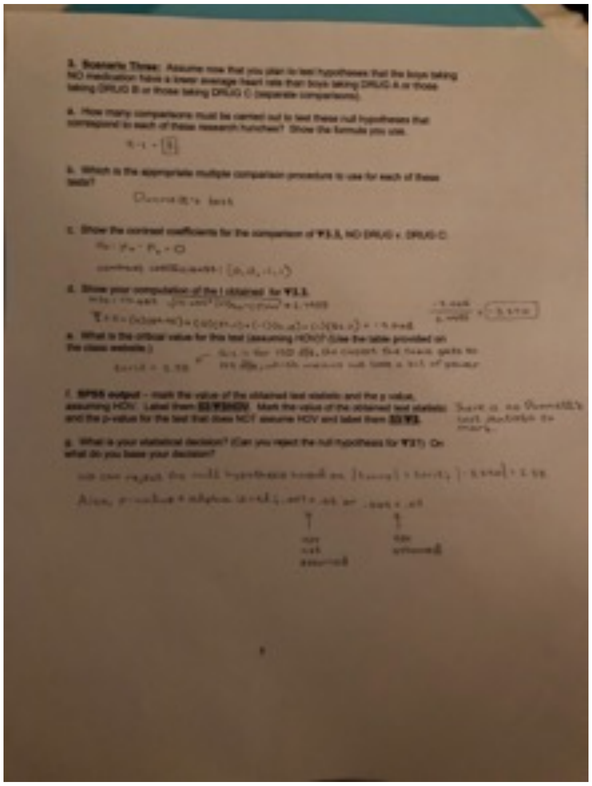
e. Which procedure is optimal if you do NOT want to assume HOV?

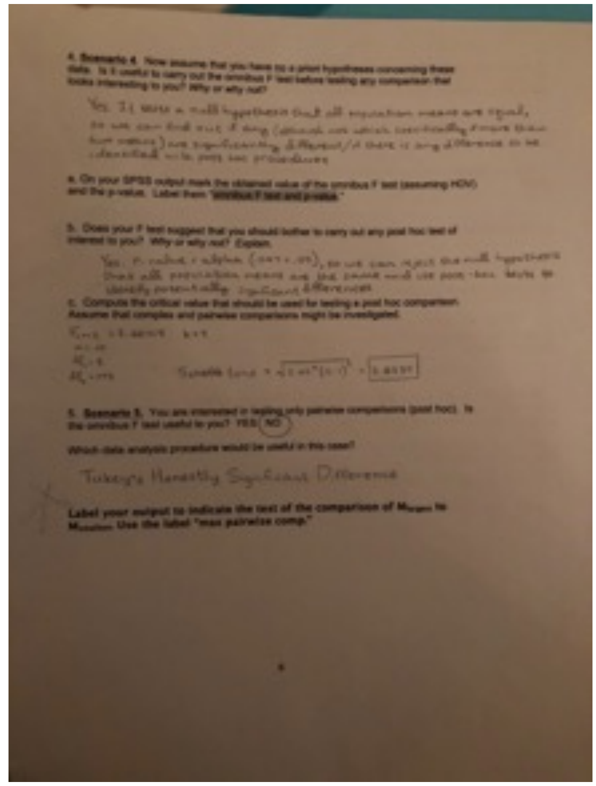
Games-Howell

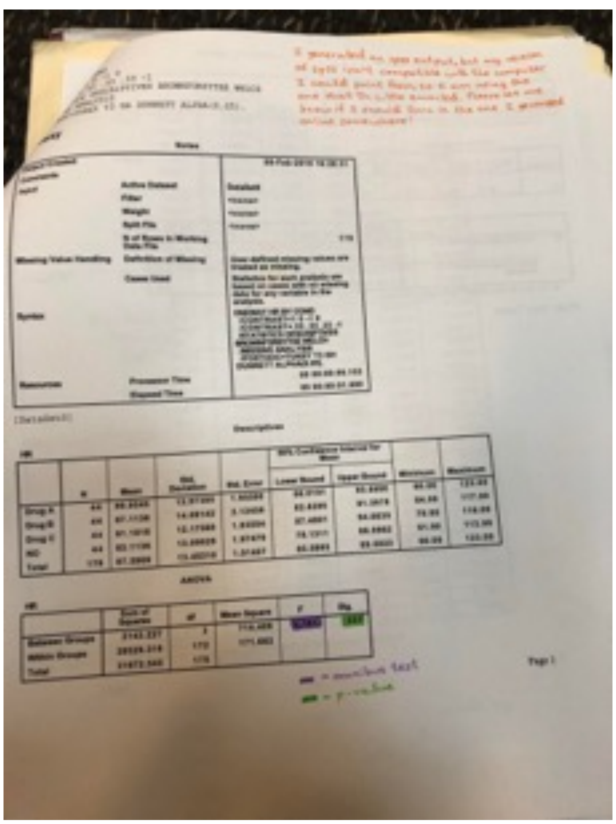
f. On your SPSS output mark the test of the null hypothesis ψ3 = 0. Label it **Ψ3.2HOV**. Mark the test you will use if you do NOT wish to assume HOV, and label it **Ψ3.2**.

g. Do NOT assume HOV. Can you reject the null hypothesis for Ψ3.2? On what do you base this decision?

h. State the correct p-value for Ψ3.2: ______ **This is the p-value you compare to the familywise alpha level.**


3. Scenario Three: Assume now that you plan to test hypotheses that the boys taking NO medication have a lower average heart rate than boys taking DRUG A or those taking DRUG B or those taking DRUG C (separate comparisons).
a. How many comparisons must be carried out to test these null hypotheses that correspond to each of these research hunches? Show the formula you use.
b. Which is the appropriate multiple comparison procedure to use for each of these tests?
Dunnett's test
c. Show the contrast coefficients for the comparison of ¶3.3, NO DRUG v. DRUG C
d. Show your computation of the t obtained for ¶3.3.
e. What is the critical value for this test (assuming HOV)? (Use the table provided on the class website.)
f. SPSS output – mark the value of the obtained test statistic and the p value, assuming HOV.
g. What is your statistical decision? (Can you reject the null hypothesis for ¶3?) On what do you base your decision?


4. Scenario 4. Now assume that you have no a priori hypotheses concerning these data. Is it useful to carry out the omnibus F test before testing any comparison that looks interesting to you? Why or why not?
a. On your SPSS output mark the obtained value of the omnibus F test (assuming HOV) and the p-value.
b. Does your F test suggest that you should bother to carry out any post hoc test of interest to you? Why or why not? Explain.
c. Compute the critical value that should be used for testing a post hoc comparison. Assume that complex and pairwise comparisons might be investigated.
5. Scenario 5. You are interested in testing only pairwise comparisons (post hoc). Is the omnibus F test useful to you? YES NO
Which data analysis procedure would be useful in this case?
Tukey's Honestly Significant Difference
Label your output to indicate the test of the comparison of
Use the label "max pairwise comp."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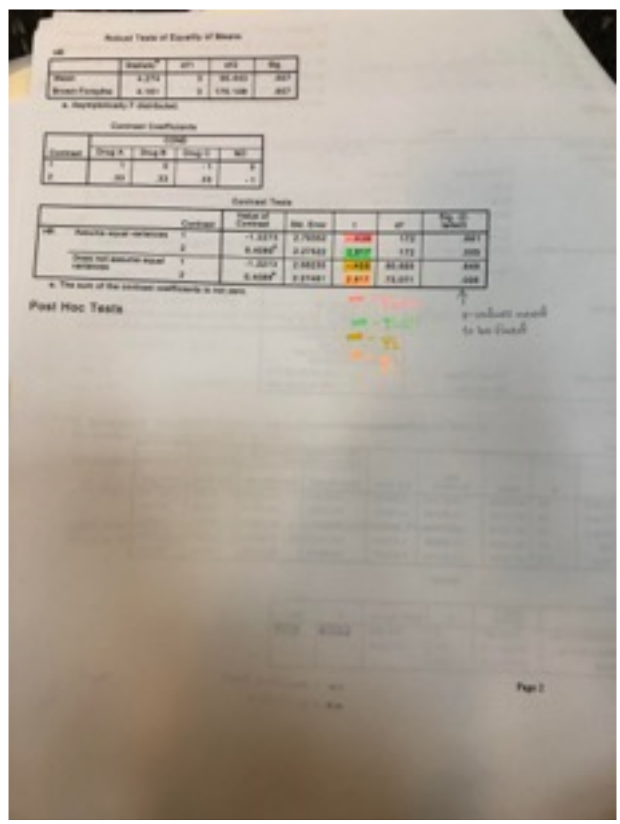
Robust Tests of Equality of Means
Contrast Coefficients
Contrast Tests
Post Hoc Tests
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	(I) COND	(J) COND	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
[illegible]	Drug A	Drug B	2.84091	2.79052	.745	[illegible]	[illegible]
		Drug C	-1.22727	2.79052	.972	[illegible]	[illegible]
		NO	7.84091*	2.79052	.029	[illegible]	[illegible]
	Drug B	Drug A	-2.84091	2.79052	.745	[illegible]	[illegible]
		Drug C	-4.06818	2.79052	.466	[illegible]	[illegible]
		NO	5.00000	2.79052	.282	[illegible]	[illegible]
	Drug C	Drug A	1.22727	2.79052	.972	[illegible]	[illegible]
		Drug B	4.06818	2.79052	.466	[illegible]	[illegible]
		NO	9.06818*	2.79052	[illegible]	[illegible]	[illegible]
	NO	Drug A	-7.84091*	2.79052	.029	[illegible]	[illegible]
		Drug B	-5.00000	2.79052	.282	[illegible]	[illegible]
		Drug C	-9.06818*	2.79052	[illegible]	[illegible]	[illegible]
Dunnett T3	Drug A	Drug B	2.84091	[illegible]	[illegible]	[illegible]	[illegible]
		Drug C	-1.22727	[illegible]	[illegible]	[illegible]	[illegible]
		NO	7.84091*	[illegible]	[illegible]	[illegible]	[illegible]
	Drug B	Drug A	-2.84091	[illegible]	[illegible]	[illegible]	[illegible]
		Drug C	-4.06818	[illegible]	[illegible]	[illegible]	[illegible]
		NO	5.00000	[illegible]	[illegible]	[illegible]	[illegible]
	Drug C	Drug A	1.22727	[illegible]	[illegible]	[illegible]	[illegible]
		Drug B	4.06818	[illegible]	[illegible]	[illegible]	[illegible]
		NO	9.06818*	[illegible]	[illegible]	[illegible]	[illegible]
	NO	Drug A	-7.84091*	[illegible]	[illegible]	[illegible]	[illegible]
		Drug B	-5.00000	[illegible]	[illegible]	[illegible]	[illegible]
		Drug C	-9.06818*	[illegible]	[illegible]	[illegible]	[illegible]
Games-Howell	Drug A	Drug B	2.84091	[illegible]	[illegible]	[illegible]	[illegible]
		Drug C	-1.22727	[illegible]	[illegible]	[illegible]	[illegible]
		NO	7.84091*	[illegible]	[illegible]	[illegible]	[illegible]
	Drug B	Drug A	-2.84091	[illegible]	[illegible]	[illegible]	[illegible]
		Drug C	-4.06818	[illegible]	[illegible]	[illegible]	[illegible]
		NO	5.00000	[illegible]	[illegible]	[illegible]	[illegible]
	Drug C	Drug A	1.22727	[illegible]	[illegible]	[illegible]	[illegible]
		Drug B	4.06818	[illegible]	[illegible]	[illegible]	[illegible]
		NO	9.06818*	[illegible]	[illegible]	[illegible]	[illegible]
	NO	Drug A	-7.84091*	[illegible]	[illegible]	[illegible]	[illegible]
		Drug B	-5.00000	[illegible]	[illegible]	[illegible]	[illegible]
		Drug C	-9.06818*	[illegible]	[illegible]	[illegible]	[illegible]
Dunnett t (2-sided)[a]	Drug A	NO	7.84091*	[illegible]	[illegible]	[illegible]	[illegible]
	Drug B	NO	5.00000	[illegible]	[illegible]	[illegible]	[illegible]
	Drug C	NO	9.06818*	[illegible]	[illegible]	[illegible]	[illegible]

*. The mean difference is significant at the 0.05 level.

a. Dunnett t-tests treat one group as a control, and compare all other groups against it.