**PSY/SOC-48: Statistics for the Behavioral Sciences (Fall, 2020)**

Homework #4: ANOVAs

Due: Friday, 11/20/20, by 11:59 p.m.

Conduct the appropriate analyses on Statcrunch using the datafile “Homework #4: ANOVA (Fall, 2020).”

* For this assignment, I would recommend using the Statcrunch guides found on Canvas.

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**One-Way ANOVA**

Instructions: Dr. Chronos evaluates the effect of different study strategies on test performance. Three different groups of people are used. Each group read a passage about dolphins. Group A created note cards on the material and reviewed them. Group B created note cards and tested themselves once on the passage before the “real” test. Group C created note cards on the passage and tested themselves twice on the passage before the “real” test. Thus, there were three different study strategies: (1) review, (2) take a practice test once, or (3) take a practice test twice. Higher scores indicate higher test performance.

1. What is the independent variable? How many levels of the independent variable are there and what are they? (1 point)

a) **IV: (0.5 point)**

b) **Levels of IV and name the treatment conditions: (0.5 point)**

2. What is the **dependent variable? (0.5 points)**

3. State the alternative hypothesis in words.

* *H0*(Null Hypothesis): μGroup A = μGroup B = μGroup C
* There is not a significant mean difference in test performance based on study strategy.

* ***H1*(Alternative Hypothesis): μGroup A ≠ μGroup B ≠ μGroup C (0.5 points)**

Conduct a one-way ANOVA to assess whether study strategy has an effect on test performance. Use the following variables: Group A, Group B, and Group C.

4. What are the results of the one-way ANOVA? Specifically, answer the questions below.

* Take a look at the one-way ANOVA source table. Report the values below **(2** **points)**.

***dfbetween* (columns) =** \_\_\_\_\_\_\_\_\_\_\_\_\_ ***dfwithin* (error):** \_\_\_\_\_\_\_\_\_\_\_\_\_\_

***F*-value**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ***p*-value**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* Assume an alpha criteria level of .05 to answer the questions below. Look at the *p*-value in the ANOVA source table and compare it to the alpha criterion level.
* Are the results significant - yes or no? **(0.5 points)** \_\_\_\_\_\_\_\_\_\_\_\_\_
* What should the researcher decide? Choose either Option A or Option B as described below **(0.5 points)** \_\_\_\_\_\_\_\_\_\_\_
* Option A: fail to reject the null hypothesis (i.e., support the null hypothesis)
* Option B: reject the null hypothesis (i.e., support the alternative hypothesis)

If the results of the *F*-test were significant, conduct a follow-up test to examine which means were different from each other. Report which mean group differences were significant from each other below. Fill in the means, standard deviations, and *p*-values each of the post-hoc tests below. Compare the means for interpretation if the post-hoc test was significant (e.g., which group mean was higher?). If the post-hoc test is not significant, you can just state that it wasn't significant without any further interpretation with the means.

5. **Group A vs. Group B (Pairwise Comparison #1)**

**a)** Group A: *M* = \_\_\_\_\_\_\_\_\_\_\_\_, *SD* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.5 points)**

Group B: *M* = \_\_\_\_\_\_\_\_\_\_\_\_, *SD* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.5 points)**

**b)** *p*-value of Pairwise Comparison #1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.25 points)**

Was Pairwise Comparison #1 significant - yes or no? \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.25 points)**

**c)** Interpret this finding using the *p*-value from the Tukey's test that you just stated. If the result of the post-hoc test was significant, compare the means to state which group had higher test performance.

6. **Group A vs. Group C (Pairwise Comparison #2)**

**a)** Group A: *M* = \_\_\_\_\_\_\_\_\_\_\_\_, *SD* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.5 points)**

Group C: *M* = \_\_\_\_\_\_\_\_\_\_\_\_, *SD* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.5 points)**

**b)** *p*-value of Pairwise Comparison #2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.25 points)**

Was Pairwise Comparison #2 significant - yes or no? \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.25 points)**

**c)** Interpret this finding using the *p*-value from the Tukey's test that you just stated. If

the result of the post-hoc test was significant, compare the means to state which

group had higher test performance.

7. **Group B vs. Group C (Pairwise Comparison #3)**

**a)** Group B: *M* = \_\_\_\_\_\_\_\_\_\_\_\_, *SD* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.5 points)**

Group C: *M* = \_\_\_\_\_\_\_\_\_\_\_\_, *SD* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.5 points)**

**b)** *p*-value of Pairwise Comparison #3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.25 points)**

Was Pairwise Comparison #3 significant - yes or no? \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.25 points)**

**c)** Interpret this finding using the *p*-value from the Tukey's test that you just stated. If

the result of the post-hoc test was significant, compare the means to state which

group had higher test performance. **(1 point)**

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**Repeated Measures ANOVA**

A recent study examined whether simply giving college students a pedometer increases walking (Jackson & Howton, 2008). A pedometer is a device that tracks how many steps a person takes per day. Students were given pedometers for a 12-week period and asked to record the average number of steps per day during weeks 1, 6, and 12. Higher numbers therefore represent more steps taken.

1. What is the independent variable? How many levels of the independent variable are there and what are they? (1 point)

a) **IV: (0.5 point)**

b) **Levels of IV and name the treatment conditions: (0.5 point)**

2. What is the **dependent variable? (0.5 points)**

3. State the null hypothesis in words.

* ***H0*(Null Hypothesis): μWeek 1 = μWeek 6 = μWeek 12 (0.5 points)**
* ***H1*(Alternative Hypothesis): μWeek 1 ≠ μWeek 6  ≠ μWeek 12**
* The number of steps taken significantly differs over time.

Conduct a Repeated Measures (RM) ANOVA using the following variables: Participant (RM), Time, and Steps.

4. What are the results of the RM ANOVA? Specifically, answer the questions below.

a) Take a look at the RM ANOVA source table. Report the values below **(2** **points)**.

***dfbetween* (time) =** \_\_\_\_\_\_\_\_\_\_\_\_\_ ***dferror*:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_

***F*-value**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ***p*-value**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) Assume an alpha criteria level of .05 to answer the questions below. Look at the *p*-

value in the ANOVA source table and compare it to the alpha criterion level.

* Are the results significant - yes or no? **(0.5 points)** \_\_\_\_\_\_\_\_\_\_\_\_\_
* What should the researcher decide? Choose either Option A or Option B as described below **(0.5 points)** \_\_\_\_\_\_\_\_\_\_\_
* Option A: fail to reject the null hypothesis (i.e., support the null hypothesis)
* Option B: reject the null hypothesis (i.e., support the alternative hypothesis)

If the results of the *F*-test were significant, conduct a follow-up test to examine which means were different from each other. Report which mean group differences were significant from each other below. Fill in the means, standard deviations, and *p*-values each of the post-hoc tests below. Compare the means for interpretation if the post-hoc test was significant (e.g., which group mean was higher?). If the post-hoc test is not significant, you can just state that it wasn't significant without any further interpretation with the means.

6. **Week 1 vs. Week 6 (Pairwise Comparison #1)**

**a)** Week 1: *M* = \_\_\_\_\_\_\_\_\_\_\_\_, *SD* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.5 points)**

Week 6: *M* = \_\_\_\_\_\_\_\_\_\_\_\_, *SD* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.5 points)**

**b)** *p*-value of Pairwise Comparison #1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.25 points)**

Was Pairwise Comparison #1 significant - yes or no? \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.25 points)**

**c)** Interpret this finding using the *p*-value from the Tukey's test that you just stated. If

the result of the post-hoc test was significant, compare the means to state which

group had higher test performance. **(1 point)**

7. **Week 1 vs. Week 12 (Pairwise Comparison #2)**

**a)** Week 1: *M* = \_\_\_\_\_\_\_\_\_\_\_\_, *SD* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.5 points)**

Week 12: *M* = \_\_\_\_\_\_\_\_\_\_\_\_, *SD* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.5 points)**

**b)** *p*-value of Pairwise Comparison #2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.25 points)**

Was Pairwise Comparison #2 significant - yes or no? \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.25 points)**

**c)** Interpret this finding using the *p*-value from the Tukey's test that you just stated. If

the result of the post-hoc test was significant, compare the means to state which

group had higher test performance. **(1 point)**

* **Week 6 vs. Week 12 (Pairwise Comparison #3)**

**a)** Group 6: *M* = \_\_\_\_\_\_\_\_\_\_\_\_, *SD* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.5 points)**

Group 12: *M* = \_\_\_\_\_\_\_\_\_\_\_\_, *SD* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.5 points)**

**b)** *p*-value of Pairwise Comparison #3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.25 points)**

Was Pairwise Comparison #3 significant - yes or no? \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(0.25 points)**

**c)** Interpret this finding using the *p*-value from the Tukey's test that you just stated. If

the result of the post-hoc test was significant, compare the means to state which

group had higher test performance. **(1 point)**

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**Factorial ANOVA**

You may have heard the phrase “calm down and stay focused” if you are overanxious about doing well on a task. A researcher tested this claim by measuring how task difficulty (easy vs. hard) and arousal level (low anxiety vs. high anxiety) affects performance on a memory task. Dr. Y gave an easy or hard memory task to two different groups of participants who either experienced low or high anxiety while completing the task. The number of correct responses on the memory task was then measured. Higher scores on the memory task indicate better performance.

Here is the basic design for the study:



1. What are the independent variable(s)? Note how many levels per independent variable and what name them. (1.5 points)

a) **IVs: (0.5 point)**

b) **Levels of IV and name the treatment conditions: (1 point)**

2. What is the **dependent variable**? **(0.5 points)**

3. What is the design notation for this study (R x C notation)? **(1 point)**

4. What kind of factorial design is used in this study - between-subjects factorial design, within-subjects factorial design, or mixed-subjects factorial design? **(1 point)**

Conduct a two-way factorial ANOVA in Statcrunch. Use the variables task difficulty, arousal, and memory.

5. **Main Effect #1: Task Difficulty**

a) Take a look at the factorial ANOVA source table. Report the values below **(2** **points)**.

***dftask difficulty* =** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ***dfwithin* (error):** \_\_\_\_\_\_\_\_\_\_\_\_\_\_

***F*-value**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ***p*-value**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) ***MEasy*** = \_\_\_\_\_\_\_\_\_\_\_\_ vs. ***MHard*** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(1 point)**

c) Is there a significant main effect of task difficulty - yes or no? **(1 point)** \_\_\_\_\_\_\_\_\_\_\_

d) Interpret the results for main effect #1 by comparing the means of the easy and

difficult groups, if significant. (For example, which group performed better?) Do this

even if the interaction is significant. If the main effect was not significant, you can just

state the null hypothesis below for your interpretation. **(1 point)**

6. **Main Effect #2: Anxiety Level**

a) Take a look at the factorial ANOVA source table. Report the values below **(2** **points)**.

***dfanxiety* =** \_\_\_\_\_\_\_\_\_\_\_\_\_ ***dfwithin* (error):** \_\_\_\_\_\_\_\_\_\_\_\_\_\_

***F*-value**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ***p*-value**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) ***Mhigh*** = \_\_\_\_\_\_\_\_\_\_\_\_ vs. ***Mlow*** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ **(1 point)**

c) Is there a significant main effect of anxiety level - yes or no? **(1 point)** \_\_\_\_\_\_\_\_\_\_\_

d) Interpret the results for main effect #2 by comparing the means of the easy and

difficult groups, if significant. (For example, which group performed better?) Do this

even if the interaction is significant. If the main effect was not significant, you can just

state the null hypothesis below for your interpretation. **(1 point)**

7. **Task Difficulty x Anxiety Level Interaction**

a) Take a look at the factorial ANOVA source table. Report the values below **(2** **points)**.

***dfinteraction* =** \_\_\_\_\_\_\_\_\_\_\_\_\_ ***dfwithin* (error):** \_\_\_\_\_\_\_\_\_\_\_\_\_\_

***F*-value**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ***p*-value**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b) Is there a significant interaction between task difficulty and anxiety level - yes or no?

**(1 point)** \_\_\_\_\_\_\_\_\_\_\_\_ For assistance, here is the graph of the simple effects:



**Additional Extra Credit Questions:**

1. Take a look at the graph below. Is there a significant interaction between a teacher’s expectations for their students and the age of the student on IQ scores? **(1 point)**



2. Take a look at the graph below. Is there a significant interaction between a teacher’s expectations for their students and the age of the student on IQ scores? **(1 point)**

