**Name:\_Marwin Carmo\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Provide your answers and the code used for each question in the text boxes below. The boxes are approximately sized to match the amount of space you will need for each answer, but you are welcome to expand or shrink the text boxes as needed. You may submit answers as text or screenshots. Note: The text has been set to blue inside the text boxes. This is intentional and will make it easier for the TA’s to see your answers.

1. We know that a standard normal distribution or a t-distribution can take values anywhere from negative infinity to positive infinity. What is the range of F-distribution? (Hint: think of the components of F = and what they are estimates of.) **(1 pt.)**

Answer:

MS are ratios of variances, and variances are always positive. Therefore, the range of the F distribution is from 0 to infinity.

2. If the true means of the j-groups are equal in the population, then what is the value of the ratio ? Justify your answer. **(1 pt.)**

Answer:

The ratio is one. That happens because the subjects vary within groups at the same level they vary between groups.

3. Suppose you got an *F*-statistic of 1.02, what decision can you **likely** make about failing to reject or rejecting the null hypothesis? Explain your reasoning. **(1 pt.)**

Answer:

With an F value of 1.02 we are more likely to fail to reject the null hypothesis, given that when there is no effect of groups, the expected F value is 1.

4. A school district wants to know about the effects of using positive, negative, or no reinforcement to help children learn math. To examine this, they randomly assigned each student to one of three possible learning programs: positive, in which the children received positive reinforcement for getting correct answers on their practice problems; negative, in which the children received negative reinforcement for their incorrect responses on practice problems; or control, in which students were neither positively or negatively reinforced for their responses on practice problems. At the end of the learning program, students took a final math exam and their scores were recorded.

Use the data set (Homework5Data.csv) from the study to answer the following questions. The outcome variable is labeled “score”, these values indicate the student’s score on the final math exam after the learning program. The predictor variable is “condition”, which indicates the student’s learning program (“Positive” = positive reinforcement; “Negative” = negative reinforcement; “Control” = neither positive or negative reinforcement).

4a. State the null hypothesis and alternative hypothesis (use μPos, μNeg, and μControl to denote the means for each condition) for a one-way ANOVA testing the effect of reinforcement. **(1 pt.)**

Answer:

H0: μPos = μNeg = μControl

H1: At least one of the group means is different

4b. Conduct a one-way ANOVA to determine whether assigned condition influenced math scores. Can you reject H0? City any relevant statistics here. **(2 pts.)**

Answer:

Yes, we can reject the null hypothesis that the assigned condition does not influence math scores. F(2, 57) = 9.2, *p* < .001.

Code/Syntax:

aov(formula = score ~ condition, data = dat) |> summary()

4c. If the reinforcement conditions (positive and negative) are significantly different from the control condition in the previous ANOVA, run a post-hoc comparison to test (choose either Bonferroni or Tukey’s). Did you find any groups to be significantly different? **(2 pts.)**

Answer:

The statistically significant differences were between the Control and Positive conditions and Positive and Negative conditions.

Code/Syntax:

pairwise.t.test(x = dat$score,

g = dat$condition,

p.adjust.method = "bonferroni")

4d. Write a paragraph reporting your results from the one-way ANOVA and the post-hoc as you would in a research paper, including all relevant detail from the tests. **(2 pts.)**

Answer:

We conducted a one-way ANOVA to determine whether the student’s learning program would affect math scores. The one-way ANOVA test showed a statistically significant difference between the groups (F(2, 57) = 9.2, *p* < .001). We conducted post-hoc tests with Bonferroni correction to identify the specific groups that differed. The results of the post-hoc test showed that the mean math scores of students in the Positive condition (M = 6.96, SD = 2.02) was significantly higher than the mean math scores of students in the Negative (M = 4.69, SD = 1.93) and Control conditions (M = 4.29, SD = 2.41 ), both *p*’s < .05. There was no significant difference between the mean math scores of students in the Negative and Control groups, *p* > .05.