Psych 315, Winter 2021, Homework 10 Answer Key

Due Friday, March 12th by midnight (PST).

Name _____ ID _____

Section [AA] (Natalie), [AB] (Natalie), [AC] (Ryan), [AD] (Ryan), [AE] (Kelly), [AE] (Kelly)

Problem 1 Does how much time you spend playing video games vary with what kind of computer you have?

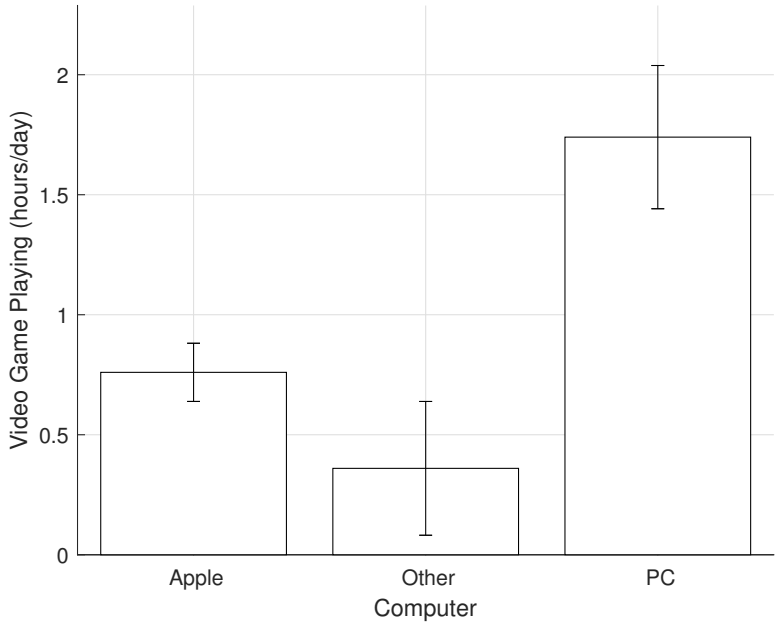
	Apple	Other	PC
n	95	11	46
mean	0.76	0.36	1.74
SS	131.168	8.5456	184.3696

The grand mean (mean of video game playing for all 152 students) is 1.0276 hours.

a) Make a bar graph of these means with the error bars representing the standard error of the mean:

(1) Calculate the standard deviation from SS: $s_x = \sqrt{\frac{SS}{n-1}}$

(2) Calculate the standard error of the mean from s_x: $s_{\bar{x}} = \frac{s_x}{\sqrt{n}}$



Apple: $s_x = \frac{131.168}{95-1} = 1.1813$, so $s_{\bar{x}} = \frac{1.1813}{\sqrt{95}} = 0.1212$. Bars range from 0.6 to 0.9

Other: $s_x = \frac{8.5456}{11-1} = 0.9244$, so $s_{\bar{x}} = \frac{0.9244}{\sqrt{11}} = 0.2787$. Bars range from 0.1 to 0.6

PC: $s_x = \frac{184.37}{46-1} = 2.0241$, so $s_{\bar{x}} = \frac{2.0241}{\sqrt{46}} = 0.2984$. Bars range from 1.4 to 2.0

You'll be filling in the following summary table in the remaining steps:

	SS	df	MS	F	F_{crit}	p-value
Between	35.0511	2	17.5256	8.0574	3.07	0.0005
Within	324.0832	149	2.1751			
Total	359.0239	151				

b) Calculate SS_{bet} by calculating the sums of squared deviations of each mean from the grand mean (1.0276), scaling each SS by its sample size.

$SS_{bet} = \sum n(\bar{X} - \bar{\bar{X}})^2$

Put the result in the table above.

$SS_{bet} = (95)(0.76 - 1.0276)^2 + (11)(0.36 - 1.0276)^2 + (46)(1.74 - 1.0276)^2 = 35.0511$

c) Calculate the degrees of freedom for SS_{bet}, which is the number of groups - 1. Calcualte MS_{bet} by dividing SS_{bet} by its degrees of freedom:

$$MS_{bet} = \frac{SS_{bet}}{df_{bet}}$$

Put the result in the table above

$$MS_{bet} = \frac{35.0511}{2} = 17.5255$$

d) Calculate SS_w by adding up the SS for each of the 3 groups. Put the value in the table above.

$SS_w = 131.168 + 8.5456 + 184.3696 = 324.0832$

e) Calculate the degrees of freedom df_w for SS_w, which is the total number of scores minus the number of groups ($n_{total} - k$). Calculate MS_w by dividing SS_w by df_w. Put the value in the table above.

df_w = 95 + 11 + 46 - 3 = 149

$MS_w = \frac{324.0832}{149} = 2.18$

f) Calculate the F statistic by dividing:

$$F = \frac{MS_{bet}}{MS_w}$$

Put the value in the table above.

$F = \frac{17.5256}{2.1751} = 8.06$

g) Find the critical value of F from Table E, using a value of alpha $\alpha = 0.05$. Use the F-calculator to find the p-value for this test. Place the values in the table above.

The critical value of F for 2 and 149 degrees of freedom and $\alpha = 0.05$ is 3.07

The p-value is 0.0005

h) State your conclusions using APA format

There is a significant difference in video game playing across the 3 computer types.
F(2,149) = 8.0574, p = 0.0005

Problem 2 Conduct the hypothesis test in problem 1 using R. From the survey, the amount of video game playing can be found in the field 'games_hours' and their choice of computer is in 'computer'. Don't worry about plotting the results or calculating the effect size.

Hint: Start with the example in the R script from the one factor ANOVA tutorial: OneFactorANOVA.R

```
# Homework 10, problem 3

# Clear the variables
rm(list = ls())
# load in the data.  Note the new option 'na.strings = ""'.  This converts missing
# responses in nominal data to 'NA's.
survey <-read.csv("http://www.courses.washington.edu/psy315/datasets/Psych315W21survey.csv",
                  na.strings = "")
# Use 'lm' to run the ANOVA. For this example, the ratio scale variable is 'games_hours' and the
# nominal scale variable is 'computer'.
out <- lm(games_hours ~ computer,data = survey,na.action = na.omit)
# Use 'anova' to print out the ANOVA results table:
anova.out <- anova(out)
anova.out
Analysis of Variance Table
Response: games_hours
           Df Sum Sq Mean Sq F value    Pr(>F)
computer    2  34.94 17.4705  8.0322 0.0004866 ***
Residuals 149 324.08  2.1751
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

# Useful fields in anovalout are 'Df', 'F value', and 'Pr(>F)' which is the p-value.
# We can use this output and 'sprintf' to present the results in APA format:
sprintf('F(%g,%g) = %0.2f, p = %0.4f',anova.out$Df[1],anova.out$Df[2],
        anova.out$`F value`,anova.out$`Pr(>F)`[1])
[1] "F(2,149) = 8.03, p = 0.0005" "F(2,149) = NA, p = 0.0005"
```