Psychology 315, Winter 2021, Exam 3 (v1 key)

Name ____ ID ____________________________

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The following problems are worth a total of 100 points. The exam is open book and open note, but not open Google or open to your neighbor's exam. For answers that require calculations, please show your work. Give all answers rounded to 4 decimal places. When using the stats tables, if your degrees of freedom falls between two values in the table, **use the lower degrees of freedom** to find your critical value.

Problem 1 (10 points) For the 147 students in this class, the correlation between the your age and your mother's age is 0.36. Test the hypothesis that this correlation is significantly different from zero in the following steps. Use an alpha value of $\alpha = 0.05$.

a) (5 points) What is the critical value of r?

df = 147 - 2 = 145, Using table G and df = 140, the critical value of r for a two-tailed test with $\alpha = 0.05$ is 0.165

b) (5 points) State the results of your hypothesis test in a complete sentence using APA format.

Our observed correlation of 0.36 falls inside the rejection region.
We reject H_0.
The correlation between your age and your mother's age is significantly different from zero, r(145) = 0.36, p < 0.05.

Problem 2 (40 points) Let's test the hypothesis that age differs with class rank. Using the students in our class as a sample, the age for the 74 Junior students has a mean of 21.24 and a standard deviation of 1.629. The age for 65 Senior students has a mean of 22.9 and a standard deviation of 3.4843. Test the hypothesis that the age varies with class rank. Use $\alpha = 0.01$.

a) (5 points) Calculate the pooled standard deviation (s_p).

Here are some mathematical facts, some of which are helpful:

$(74)(1.629)^2 + (65)(3.4843)^2 = 985.492$

$(74-1)(1.629)^2 + (65-1)(3.4843)^2 = 970.698$

$s_p = \sqrt{\frac{(74-1)1.629^2+(65-1)3.4843^2}{(74-1)+(65-1)}} = 2.6618$

b) (5 points) Calculate the pooled standard error of the mean ($s_{\bar{x}-\bar{y}}$)

Here are some mathematical facts, some of which are helpful:

$\sqrt{\frac{1}{74} + \frac{1}{65}} = 0.17$

$\sqrt{\frac{1}{71} + \frac{1}{62}} = 0.1738$

$s_{\bar{x}-\bar{y}} = 2.6618\sqrt{\frac{1}{74} + \frac{1}{65}} = 0.4525$

c) (5 points) Calculate the t-statistic

$t = \frac{\bar{x}-\bar{y}}{s_{\bar{x}-\bar{y}}} = \frac{21.24-22.9}{0.4525} = -3.67$

d) (5 points) Find the critical value of t.

For a two tailed test, $\alpha = 0.01$ and df = 74 + 65 - 2 = 137, $t_{crit} = \pm 2.612$ (using df = 130)

e) (10 points) State your decision in a complete sentence using APA format.

We reject H_0. The age for the Junior students (M = 21.24, SD = 1.629) is significantly different from the age for the Senior students (M = 22.9, SD = 3.4843), t(137) = -3.67, p < 0.01.

f) (5 points) What is the effect size? Is it small, medium or large?

$d = \frac{|\bar{x}-\bar{y}|}{sp} = \frac{|21.24-22.9|}{2.6618} = 0.62$

g) (5 points) Is the effect size small, medium or large?

This is a medium effect size.

h) (5 points) Use the appropriate power curve (provided at the end of this exam) to estimate the observed power of this test.

The observed power for two tailed test with an effect size of d = 0.62, n = $\frac{(74+65)}{2}$ = 70 and $\alpha = 0.01$ is 0.8500.

Problem 3: (10 points) Suppose you conduct a t-test and get a p-value exactly equal to $\alpha = 0.05$.

a) (5 points) Where is your observed value of t compared to the critical value of t?

The observed value of t t_{obs} will be equal to the critical value, t_{crit}

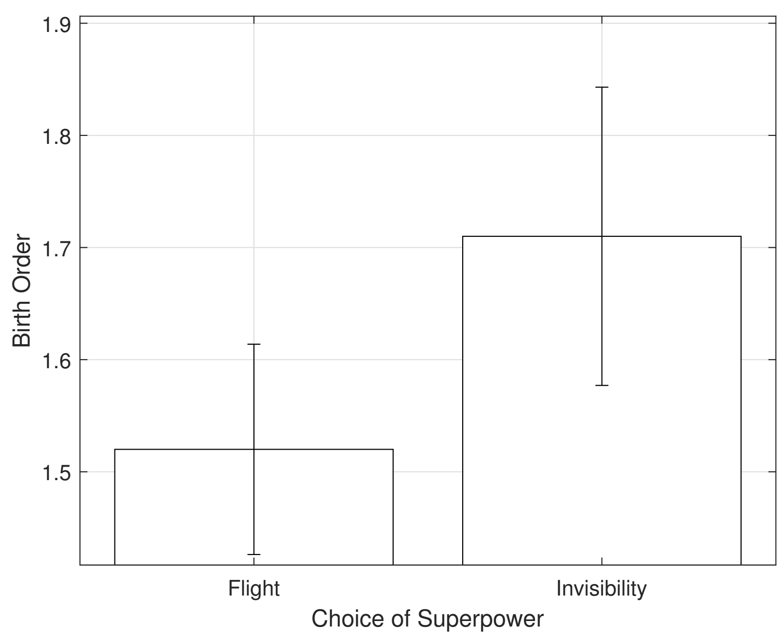
b) (5pts) What is the observed power of this test?

If $t_{obs} = t_{crit}$ then the true distribution is centered on t_{crit}, so exactly half the true distribution lies above t_{crit}. This means that the power is equal to 0.5

Problem 4 (10 points) Suppose you want to test the hypothesis that the order in which you were born compared to your siblings (birth order) varies with your choice of superpower. We have 71 Flights and 78 Invisibilitys in our class. The mean birth orders for these students is shown in the bar graph below, where the error bars represent the standard error of the mean. If you were to run a one-tailed t-test for two independent means with $\alpha = 0.05$, circle the most likely decision:

Reject H_0

Fail to reject H_0



Problem 5 (30 points)

Let's test the hypothesis that the correlation between UW GPA and high school GPA differs across students that use Apple computers and students that use PC computers. For the 93 students that use Apple computers in our class, the correlation between UW GPA and high school GPA is 0.31. For the 44 students that use PC computers, the correlation is -0.15. Using an alpha value of $\alpha = 0.05$ are these correlations significantly different from each other? State your p-value to four decimal places and state whether or not you reject the null hypothesis. **You don't need to give your answer as a sentence or use APA format for this question**.

Here are some mathematical facts, some of which are helpful:

Fisher's z for r = 0.31 is 0.3205

Fisher's z for r = -0.15 is -0.1511

$\sqrt{\frac{1}{90} + \frac{1}{41}} = 0.1884$

$\sqrt{\frac{1}{92} + \frac{1}{43}} = 0.1847$

a) (5 pts) Find the Fisher'z z score for the students that use Apple computers

z'(0.31) = 0.3205

b) (5 pts) Find the Fisher'z z score for the students that use PC computers

z'(0.31) = -0.1511

c) (5 pts) Calculate the denominator of the z-test

$\sigma_{z_1 - z_2} = \sqrt{\frac{1}{93-3} + \frac{1}{44-3}} = 0.1884$

d) (5 pts) Calculate the z-statistic for this test

$z = \frac{0.3205+0.1511}{0.1884} = 2.5032$

e) (5 pts) Find the p-value for this test

$Pr(z) > 2.50 = 0.00615$

For a two-tailed test, we mulitiply this probability by two: $p = (0.00615)(2) = 0.0123$

f) (5 pts)

We reject H_0.