PSYC 2317: Statistical Methods for Psychology

Note: for any problem involving hypothesis testing, you will need to justify your answer by explicitly defining your null hypothesis $\mathcal{H}_0$ and alternative hypothesis $\mathcal{H}_1$ and reporting an appropriate p-value, either exact or a range, depending on the test statistic that is being used.

1. A sample of $N = 5$ individuals is selected from a population with a mean of 70. A treatment is administered to the individuals in the sample and, after treatment, the sample has a mean of $\overline{X} = 74$ and $SS = 50$.

   (a) Compute a 95% confidence interval for μ, the population mean for the treatment group.

   (b) Compute an appropriate effect size (e.g., Cohen's d) for the treatment.

   (c) Perform a hypothesis test to decide whether the population mean of the treatment group is significantly larger than the mean of the general population.

2. A researcher would like to evaluate the effect of a new reading program for second-grade students. For the past 5 years, a standardized test given at the end of the second grade has produced a mean score of 45. A sample of $N = 25$ students is placed in the new program, and at the end of the school year, they obtain a mean test score of $\overline{x} = 51$ with $SS = 9600$.

   (a) Compute a 95% confidence interval for μ, the population mean score for students in the reading program.

   (b) Compute an appropriate effect size (e.g., Cohen's d) for the effect of the reading program.

   (c) Perform a hypothesis test to decide whether the population mean score for students in the new reading program is significantly different from the mean score for second graders in general.

3. A psychologist is examining the influence of an older sibling in the development of social skills. A sample of 24 three-year-old children is obtained. Half of these children had no siblings and the others had at least one older sibling who is within 5 years of the child's age. The psychologist records a social skills score for each child and obtained the following data.

No sibling	Older sibling
$N_1 = 12$	$N_2 = 12$
$\overline{X}_1 = 17$	$\overline{X}_2 = 24$
$SS_1 = 580$	$SS_2 = 608$

   (a) Compute a 95% confidence interval for $\mu_1 - \mu_2$, the population mean difference in social skills..

   (b) Compute an appropriate effect size (e.g., Cohen's d) for the effect of having an older sibling.

   (c) Perform a hypothesis test to decide whether the population mean social skills score for children with no siblings is significantly reduced compared to children with an older sibling.

4. The following data were obtained from giving two different treatments to two independent groups of participants.

Treatment 1	5	1	2	3	4
Treatment 2	6	10	14	12	18

(a) Compute a 95% confidence interval for $\mu_1 - \mu_2$, the population mean difference between the two treatments..

(b) Compute an appropriate effect size (e.g., Cohen's d) for the difference between the two treatments.

(c) Perform a hypothesis test to decide whether the population mean scores for Treatment 1 and Treatment 2 are significantly different.

5. Fifteen people are randomly assigned to one of three treatment groups, and measured on some dependent variable. The mean scores for the groups are as follows: $\overline{X}_1 = 1$, $\overline{X}_2 = 4$, and $\overline{X}_3 = 1$. An analysis of variance is performed in JASP, with output below:

ANOVA – score

Cases	Sum of Squares	df	Mean Square	F	p
treatment	30.000	2.000	15.000	7.500	0.008
Residual	24.000	12.000	2.000		

Note. Type III Sum of Squares

(a) Explicitly define the null hypothesis $\mathcal{H}_0$ and alternative hypothesis $\mathcal{H}_1$ for the analysis of variance.

(b) Correctly report the results of the ANOVA, being sure to include the F statistic, the appropriate degrees of freedom, and the p-value.

(c) Compute the effect size η^2 for the ANOVA. What does this number mean in the context of these data?

(d) Based on your answers above, what decision do we make regarding $\mathcal{H}_0$? What do we conclude?