PSYC 2317: Statistical Methods for Psychology

Tarleton State University | Exam 2 | Spring 2020

Instructions: please complete each problem below. You may submit your completed exam in Canvas using one of two file formats: either (1) wirite your solutions on paper and scan to a PDF, or (2) write your solutions in a Word/OpenOffice document. On either method, please show (or describe) as much work as possible. Report your final answers rounded to 2 decimal places. 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.

1. Recent results suggest that children with ADHD also tend to watch more TV than children who are not diagnosed with the disorder. To examine this relationship, a researcher obtains a random sample of $N = 36$ children, 8 to 12 years old, who have been diagnosed with ADHD. Each child is asked to keep a journal recording how much time each day is spent watching TV. The average daily time for the sample is $\overline{x} = 4.9$ hours. It is known that the average time for the general population (without ADHD) is 4.1 hours, with $\sigma = 1.8$.

   (a) Compute a 95% confidence interval for μ, the population mean for children with ADHD.

   (b) Perform a hypothesis test to decide whether children with ADHD spend significantly more time watching TV than the general population.

2. A researcher is testing the effectiveness of a new herbal supplement that claims to improve memory performance. A sample of $N = 25$ college students is obtained and each student takes the supplement daily for six weeks. At the end of the 6-week period, each student is given a standardized memory test and average score for the sample is $\overline{x} = 39$. For the general population of college students, the distribution of test scores is normal with a mean of 35 and $\sigma = 15$.

   (a) Compute a 95% confidence interval for μ, the population mean memory score for college students who have taken the supplement.

   (b) Perform a hypothesis test to decide whether students taking the supplement have significantly better memory scores than the general population.

3. Twenty-five women between the ages of 70 and 80 were randomly selected from the general population of women their age to take part in a special program to decrease reaction time (speed). After the course, the women had an average reaction time of 1.5 seconds. Assume that the mean reaction time for the general population of women of this age group is 1.8 with a standard deviation of 0.5 seconds.

   (a) Compute a 95% confidence interval for μ, the population mean reaction time for women who have taken part in the program.

   (b) Perform a hypothesis test to decide whether the course had a significant effect on reaction times.

4. 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 $SS = 50$. Perform a hypothesis test to decide whether the population mean of the treatment group is significantly larger than the mean of the general population.

5. The following data represent the results from a repeated-measures study comparing two treatment conditions. Each participant completes *both* treatments. Do the data indicate a significant difference between the two treatments?

Participant	Treatment 1	Treatment 2
#1	8	14
#2	6	11
#3	10	10
#4	9	11
#5	7	12
#6	10	16

6. 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 $SS = 9600$. 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.

7. 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) 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.

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

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

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

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Some useful formulas

1. z-statistic (use if σ is known):
   - $z = \dfrac{\overline{X} - \mu}{\sigma/\sqrt{N}}$
2. Estimating σ:
   - $\hat{\sigma} = \sqrt{\dfrac{SS}{df}}$ (if one sample)
   - $\hat{\sigma}_p = \sqrt{\dfrac{SS_1 + SS_2}{df_1 + df_2}}$ (if two independent samples)
3. t-statistic (use if σ is unknown):
   - $t = \dfrac{\overline{X} - \mu}{\hat{\sigma}/\sqrt{N}}$ (if one sample)
   - $t = \dfrac{(\overline{X}_1 - \overline{X}_2) - (\mu_1 - \mu_2)}{\hat{\sigma}_p\sqrt{\frac{1}{N_1} + \frac{1}{N_2}}}$ (if two independent samples)
4. 95% confidence interval for μ:
   - $\overline{X} \pm 1.96 \cdot \dfrac{\sigma}{\sqrt{N}}$ (if one sample, σ known)
5. Effect sizes:
   - $d = \dfrac{\overline{X} - \mu}{\hat{\sigma}}$ (if one sample)
   - $d = \dfrac{\overline{X}_1 - \overline{X}_2}{\hat{\sigma}_p}$ (if two independent samples)