PSYC 2317: Statistical Methods for Psychology

Tarleton State University | Exam 3 | Spring 2020

Instructions: This exam consists of two parts: a 20-question multiple choice portion (worth 20 points), and a short-answer portion (worth 80 points). For the multiple choice part, please write your answers (letters from the multiple-choice options) on a *single page*. There is no need to show any work for the multiple choice part. For the short answer part, please show (or describe) as much work as possible. Report all 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.

You may submit your completed exam in Canvas using one of two file formats: either (1) write your solutions on paper and scan to a PDF, or (2) write your solutions in a Word/OpenOffice document.

Part 1 – Multiple choice

1. ______ A set of test scores are normally distributed. Their mean is 34 and standard deviation is 5. These scores are converted to z scores. What would be the mean and median of this distribution of z scores?
   (a) 0
   (b) 1
   (c) 50
   (d) 100
2. ______ A set of data are put in numerical order, and a statistic is calculated that divides the data set into two equal parts. Which of the following statistics was computed?
   (a) mean
   (b) interquartile range
   (c) standard deviation
   (d) median
3. ______ Does the size of the standard deviation of a data set depend on where the center is?
   (a) Yes, the higher the mean, the higher the standard deviation
   (b) Yes, because you have to know the mean to calculate the standard deviation
   (c) No, the value of the standard deviation does not involve calculating the mean
   (d) No, because the standard deviation is only measuring how the values *differ* from the mean, on average.
4. ______ Suppose there is a population of test scores on a large, standardized exam for which the mean and standard deviation are unknown. Two different random samples of 50 data values are taken from the population. One sample has a larger standard deviation(SD) than the other. Each of the samples is used to construct a 95% confidence interval. How do you think these two confidence intervals would compare?
   (a) The two samples would produce identical values for the lower and upper bounds of the two confidence intervals.
   (b) The confidence interval based on the sample with the larger standard deviation would be wider.
   (c) The confidence interval based on the sample with the smaller standard deviation would be wider.
   (d) The two confidence intervals would have the same width because they are both 95% intervals.
5. ______ Which of the following will be most affected by the presence of outliers?
   (a) interquartile range
   (b) standard deviation
   (c) median
   (d) mode

6. ______ Which of the following values will *always* be within the upper and lower limits of a confidence interval?
   (a) the population mean
   (b) the sample mean
   (c) the sample size
   (d) the standard deviation of the sample

7. ______ Researchers ask a random sample of apartment dwellers in a large city their ideal air temperatures. They find the sample mean is 73 degrees. Using a two-tailed test, they reject $\mathcal{H}_0 : \mu = 68$ at the 5% significance level. Which of the following could be a 95% confidence interval for μ, the average ideal temperature for all apartment dwellers in the city?
   (a) (70, 76)
   (b) (69, 75)
   (c) (68, 76)
   (d) (66, 78)
   (e) (66, 70)
   (f) Not enough information is given to answer this question

8. ______ In a one-way ANOVA with 3 groups, a rejection of the null hypothesis implies that
   (a) the 3 population means are equal to each other
   (b) the 3 sample means are equal to each other
   (c) each population mean differs significantly from all other population means
   (d) some subset of population means differs from some other subset of population means

9. ______ A group of 30 introductory statistics students took a 25-item test. The mean and standard deviation were computed; the standard deviation was 0. You know that
   (a) about half of the scores were above the mean
   (b) the test was so hard that everyone missed all items
   (c) a calculation error must have been made in determining the standard deviation
   (d) everyone correctly answered the same number of items

10. ______ Here are the number of hours that eight statistics students studied for an exam: 3, 5, 11, 6, 4, 2, 5, 4. The median number of study hours is:
   (a) 4
   (b) 4.5
   (c) 5
   (d) 6
   (e) 11

11. ______ This list of test scores has a mean of 50. *Estimate* whether the standard deviation is closest to 0, 1, 2 or 10. (This problem requires NO arithmetic – instead, I'm looking at your *intuition* about standard deviation)

$$48, 51, 49, 52, 47, 52, 46, 52, 53, 51$$

(a) 0
(b) 1
(c) 2
(d) 10

12. ______ The average number of fruit candies in a large bag is estimated. The 95% confidence interval is (40, 48). Based on this information, you know that the best estimate of the population mean is

(a) 40
(b) 41
(c) 42
(d) 43
(e) 44
(f) 45

13. ______ After calculating the confidence interval in the previous problem, you discover an additional 10 bags of these candies. You add that data to the original set of counts and recalculate the confidence interval. Which of the following confidence intervals is most likely to result?

(a) (38, 50)
(b) (38, 48)
(c) (40, 50)
(d) (42, 46)
(e) (41, 46)
(f) The confidence interval will not change

14. ______ A standardized measure of achievement motivation is normally distributed, with a mean of 35 and a standard deviation of 14. Higher scores correspond to more achievement motivation. Seamus scored in the top 2% of test takers. Which of the following was closests to his actual achievement motivation score?

(a) 7
(b) 49
(c) 63
(d) 77

For Items 15 to 20, you are given a research situation. Decide which of the following statistical procedures would most likely be used to answer the research question posed:

a independent samples t-test
b analysis of variance
c single sample t-test
d paired samples t-test
e construct a confidence interval

15. ______ Do college grade point averages differ for male athletes in major sports (e.g., football), minor sports (e.g., swimming), and intramural sports?

16. ______ A college instructor wants to be 99% confident of the mean math anxiety score for freshman enrolled in college algebra.

17. ______ Do New Mexico high school seniors who attend a summer math camp score above the state mean on the math subtest of the state's standardized achievement test?

18. ______ Do scores on a test of science achievement differ for female and male 8th grade students?

19. ______ We sample the math self-esteem scores from a random sample of 25 females. What are the probable values of the population mean score for this group?

20. ______ A researcher wants to know if intelligence as measured by IQ scores differs between college students on academic probation and those not on probation.

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Part II - Short answer.

1. Data indicates that adolescent girls tend to experience a drop in self-esteem. To evaluate this result, a researcher obtains a sample of $N = 9$ adolescent girls, all 13 years old. A self-esteem measure is administered to each participant and the average score for the sample is $\overline{X} = 66$. It is known that the distribution of self-esteem scores for the population of pre-teen girls is normal with mean 75 and standard deviation 12.

   (a) Compute a 95% confidence interval for μ, the population mean self-esteem score for adolescent girls.

   (b) Compute an appropriate effect size.

   (c) Perform a hypothesis test to decide whether the mean self-esteem score for adolescent girls is significantly different from the mean self-esteem score for pre-teen girls.

2. To evaluate the effect of a treatment, a sample was obtained from a population with a mean of 6.2:

   Sample scores: $7, 1, 6, 3, 6, 7$.

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

   (b) Compute an appropriate effect size for the treatment.

   (c) Perform a hypothesis test to decide whether the population mean of the treatment group is significantly different from the mean of the general population

3. A sample of $N = 15$ individuals is selected from a population with a mean of 32. A treatment is administered to the individuals in the sample and, after treatment, the sample has a mean of $\overline{X} = 35$ and $SS = 154$.

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

   (b) Compute an appropriate effect size 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.

4. A researcher is investigating the effect of background noise on classroom performance for children aged 10 to 12. One class of $N = 15$ students who listens to calming music each day while working on arithmetic problems is chosen as the experimental group. Another class of $N = 15$ students serves as a control group with no music. Accuracy scores are measured for each child, and the average for students in the music condition is $\overline{X} = 86.4$ with $SS = 1550$. For the no-music condition, the average is $\overline{X} = 78.8$ with $SS = 1235$.

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

   (b) Compute an appropriate effect size for the effect of music on accuracy scores.

   (c) Perform a hypothesis test to decide whether the population mean accuracy is significantly increased for students who listen to calming music during study compared to those who do not listen to music.

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Some useful formulas

1. z-statistic (if σ 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 (if σ 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 (if σ known)
   - $\overline{x} \pm 1.96 \cdot \dfrac{\sigma}{\sqrt{N}}$
5. 95% confidence interval for μ (if σ unknown):
   - $\overline{X} \pm t^*_{df} \cdot \dfrac{\hat{\sigma}}{\sqrt{N}}$ (if one sample)
   - $(\overline{X}_1 - \overline{X}_2) \pm t^*_{df} \cdot \hat{\sigma}_p\sqrt{\dfrac{1}{N_1} + \dfrac{1}{N_2}}$ (if two independent samples)
6. 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)
   - $\eta^2 = \dfrac{SS_{\text{between}}}{SS_{\text{total}}}$