Chapter 10 Multiple Choice Practice

ANSWER KEY

Directions. *Identify the choice that best completes the statement or answers the question. Check your answers and note your performance when you are finished.*

1. Is the proportion of marshmallows in Mr. Miller's favorite breakfast cereal lower than it used to be? To determine this, you test the hypotheses H_0: $p_{old} = p_{new}$, H_a: $p_{old} > p_{new}$ at the $\alpha = 0.05$ level. You calculate a test statistic of 1.980. Which of the following is the appropriate P-value and conclusion for your test?
   - (A) *P*-value = 0.047; fail to reject H_0; we do not have convincing evidence that the proportion of marshmallows has been reduced.
   - (B) *P*-value = 0.047; accept H_a; there is convincing evidence that the proportion of marshmallows has been reduced.
   - (C) *P*-value = 0.024; fail to reject H_0; we do not have convincing evidence that the proportion of marshmallows has been reduced.
   - (D) *P*-value = 0.024; reject H_0; we have convincing evidence that the proportion of marshmallows has been reduced.
   - (E) *P*-value = 0.024; fail to reject H_0; we have convincing evidence that the proportion of marshmallows has not changed.

2. An SRS of 100 teachers showed that 64 owned smartphones. An SRS of 100 students showed that 80 owned smartphones. Let p_T be the proportion of all teachers who own smartphones, and let p_S be the proportion of all students who own smartphones. A 95% confidence interval for the difference $p_T - p_S$ is
   - (A) (0.264, 0.056)
   - (B) (0.098, 0.222)
   - (C) (-0.222, -0.098)
   - (D) (-0.264, -0.056)
   - (E) (-0.283, -0.038)

calculator: 2-prop Z Int
$x_1 = 64$
$n_1 = 100$
$x_2 = 80$
$n_2 = 100$

3. A school receives textbooks independently from two suppliers. An SRS of 400 textbooks from supplier 1 finds 20 that are defective. An SRS of 100 textbooks from supplier 2 finds 10 that are defective. Let p_1 and p_2 be the proportions of all textbooks from suppliers 1 and 2, respectively that are defective. Which of the following represents a 95% confidence interval for $p_1 - p_2$?
   - (A) $-0.05 \pm 1.96\sqrt{\frac{(0.05)(0.95)}{400} - \frac{(0.1)(0.9)}{100}}$
   - (B) $-0.05 \pm 1.96\sqrt{\frac{(0.05)(0.95)}{400} + \frac{(0.1)(0.9)}{100}}$
   - (C) $-0.05 \pm 1.64\sqrt{\frac{(0.05)(0.95)}{400} - \frac{(0.1)(0.9)}{100}}$
   - (D) $-0.05 \pm 1.64\sqrt{\frac{(0.05)(0.95)}{400} + \frac{(0.1)(0.9)}{100}}$
   - (E) $-0.05 \pm 1.64\sqrt{\frac{(0.06)(0.94)}{500}}$

$z = 1.98$

normalcdf(1.98, ∞)
p=.024

4. An agricultural researcher wishes to see if a new fertilizer helps increase the yield of tomato plants. One hundred tomato plants in individual containers are randomly assigned to two different groups. Plants in both groups are treated identically, except that the plants in group 2 are sprayed weekly with the fertilizer, while the plants in group 1 are not. After 4 weeks, 12 of the 50 plants in group 1 exhibited an increased yield, and 18 of the 50 plants in group 2 showed an increased yield. Let p_1 be the actual proportion of all tomato plants of this variety that would experience an increased yield under the fertilizer treatment, and let p_2 be the actual proportion of all tomato plants of this variety that would experience an increased yield under with no fertilizer treatment, assuming that the tomatoes are grown under conditions similar to those in the experiment. Is there evidence of an increase in the proportion of tomato plants with increased yield for those sprayed with fertilizer? To determine this, you test the hypotheses H_0: $p_1 = p_2$, H_a: $p_1 < p_2$. The *P*-value of your test is
   (A) greater than 0.10.
   (B) between 0.05 and 0.10.
   (C) between 0.01 and 0.05.
   (D) between 0.001 and 0.01.
   (E) below 0.001.

Calculator = 2-prop. Z test
$x_1 = 12$
$n_1 = 50$
$x_2 = 18$
$n_2 = 50$

5. An SRS of 45 male employees at a large company found that 36 felt that the company was supportive of female and minority employees. An independent SRS of 40 female employees found that 24 felt that the company was supportive of female and minority employees. Let p_1 represent the proportion of all male employees at the company and p_2 represent the proportion of all female employees members at the company who hold this opinion. We wish to test the hypotheses H_0: $p_1 - p_2 = 0$ vs. H_a: $p_1 - p_2 < 0$. Which of the following is the correct expression for the test statistic?
   (A) $$\frac{0.8-0.6}{\sqrt{\frac{(0.8)(0.2)}{45}+\frac{(0.6)(0.4)}{40}}}$$
   (B) $$\frac{0.8-0.6}{\sqrt{\frac{(0.706)(0.294)}{45}+\frac{(0.706)(0.294)}{40}}}$$
   (C) $$\frac{0.8-0.6}{\sqrt{\frac{(0.706)(0.294)}{45}-\frac{(0.706)(0.294)}{40}}}$$
   (D) $$\frac{0.8-0.6}{\frac{(0.8)(0.2)}{\sqrt{45}}+\frac{(0.6)(0.4)}{\sqrt{40}}}$$
   (E) $$\frac{0.8}{\frac{(0.8)(0.2)}{\sqrt{45}}}+\frac{0.6}{\frac{(0.6)(0.4)}{\sqrt{40}}}$$

6. Some researchers have conjectured that stem-pitting disease in peach tree seedlings might be controlled with weed and soil treatment. An experiment was conducted to compare peach tree seedling growth with soil and weeds treated with one of two herbicides. In a field containing 20 seedlings, 10 were randomly selected from throughout the field and assigned to receive Herbicide A. The remaining 10 seedlings were to receive Herbicide B. Soil and weeds for each seedling were treated with the appropriate herbicide, and at the end of the study period, the height (in centimeters) was recorded for each seedling. A box plot of each data set showed no indication of non-Normality. The following results were obtained:

	$\bar{x}$ (cm)	s_x (cm)
Herbicide A	94.5	10
Herbicide B	109.1	9

Suppose we wished to determine if there is a significant difference in mean height for the seedlings treated with the different herbicides. Based on our data, which of the following is the value of test statistic?

(A) 14.60
(B) 7.80
(C) 3.43
(D) 2.54
(E) 1.14

calculator: 2-samp T Test

t

$\bar{x}_1 = 94.5$ $\bar{x}_2 = 109.1$
$Sx_1 = 10$ $Sx_2 = 9$
$n_1 = 10$ $n_2 = 10$ don't pool

7. A researcher wished to test the effect of the addition of extra calcium on the "tastiness" of yogurt. Sixty-two adult volunteers were randomly divided into two groups of 31 subjects each. Group 1 tasted yogurt containing the extra calcium. Group 2 tasted yogurt from the same batch as group 1 but without the added calcium. Both groups rated the flavor on a scale of 1 to 10, with 1 being "very unpleasant" and 10 being "very pleasant." The mean rating for group 1 was 6.5 with a standard deviation of 1.5. The mean rating for group 2 was 7.0 with a standard deviation of 2.0. Let μ_1 and μ_2 represent the true mean ratings we would observe for the entire population represented by the volunteers if all of them tasted, respectively, the yogurt with and without the added calcium. Which of the following would lead us to believe that the *t*-procedures were not safe to use in this situation?

(A) The sample medians and means for the two groups were slightly different.
(B) The distributions of the data for the two groups were both slightly skewed right.
(C) The data are integers between 1 and 10 and so cannot be normal.
(D) The standard deviations from both samples were very different from each other.
(E) None of the above.

8. A researcher wishes to compare the effect of two stepping heights (low and high) on heart rate in a step-aerobics workout. The researcher constructs a 98% confidence interval for the difference in mean heart rate between those who did the high and those who did the low stepping heights. Which of the following is a correct interpretation of this interval?

(A) 98% of the time, the true difference in the mean heart rate of subjects in the high-step *vs*. low-step groups will be in this interval.
(B) We are 98% confident that this interval captures the true difference in mean heart rate of subjects like these who receive the high-step and low-step treatments.
(C) There is a 0.98 probability that the true difference in mean heart rate of subjects in the high-step *vs*. low-step groups in this interval.
(D) 98% of the intervals constructed in this way will contain the value 0.
(E) There is a 98% probability that we have not made a Type I error.

9. Using the setting from problem 8. The researcher decides to test the hypotheses H_0: $\mu_1 - \mu_2 = 0$ *vs.* H_a: $\mu_1 - \mu_2 < 0$ at the $\alpha = 0.05$ level and produces a *P*-value of 0.0475. Which of the following is a correct interpretation of this result?
   (A) The probability that there is a difference is 0.0475.
   (B) The probability that this test resulted in a Type II error is 0.0475.
   (C) If this test were repeated many times, we would make a Type I error 4.75% of the time.
   (D) If the null hypothesis is true, the probability of getting a difference in sample means as far or farther from 0 as the difference in our samples is 0.0475. definition of a p-value
   (E) If the null hypothesis is false, the probability of getting a difference in sample means as far or farther from 0 as the difference in our samples is 0.0475.

10. The researcher in question 8 randomly assigned 50 adult volunteers to two groups of 25 subjects each. Group 1 did a standard step-aerobics workout at the low height. The mean heart rate at the end of the workout for the subjects in group 1 was 90 beats per minute with a standard deviation of 9 beats per minute. Group 2 did the same workout but at the high step height. The mean heart rate at the end of the workout for the subjects in group 2 was 95.2 beats per minute with a standard deviation of 12.3 beats per minute. Assuming the conditions are met, which of the following could be the 98% confidence interval for the difference in mean heart rates based on these results?
    (A) (2.15, 8.25)
    (B) (-0.77, 11.17)
    (C) (-2.13, 12.54)
    (D) (-2.16, 12.56)
    (E) (-4.09, 14.49)

calculator: 2-sampTint

1. D
2. E
3. B
4. B
5. B
6. C
7. E
8. B
9. D
10. D

FRAPPY! Free Response AP® Problem, Yay!

The following problem is modeled after actual Advanced Placement Statistics free response questions. Your task is to generate a complete, concise response in 15 minutes. After you generate your response, view two example solutions and determine whether you feel they are "complete", "substantial", "developing" or "minimal". If they are not "complete", what would you suggest to the student who wrote them to increase their score? Finally, you will be provided with a rubric. Score your response and note what, if anything, you would do differently to increase your own score.

Researchers are interested in whether or not women who are part of a prenatal care program give birth to babies with a higher average birth weight than those who do not take part in the program. A random sample of hospital records indicates that the average birth weight for 75 babies born to mothers enrolled in a prenatal care program was 3100 g with standard deviation 420 g. A separate random sample of hospital records indicates that the average birth weight for 75 babies born to women who did not take part in a prenatal care program was 2750 g with standard deviation 425 g. Do these data provide convincing evidence that mothers who participate in a prenatal care program have babies with a higher average birth weight than those who don't?

$H_0: \mu_1 = \mu_2$ where μ_1 and μ_2 are the true average birth weights of babies born to women using the prenatal care program and ~~t~~ those who aren't, respectively.

$H_a: \mu_1 > \mu_2$

We will use a 2-sample t test with $\alpha = .05$

CONDITIONS

* It is stated as a random sample and we will assume this means SRS for both
* Both sample sizes (75) are ≥ 30 so the CLT ensures approx. Normality.
* There are more than 10(75) women taking part in the prenatal care program and not taking part in the program so independence is verified.

$t = 5.07$

$p = 0$

$df = 148$

Since $p < \alpha$ we reject H_0. We have convincing evidence that mothers who participate in a prenatal care program have babies with a higher average birth weight than those who don't.