9.3 & 9.4

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Assume that a simple random sample has been selected from a normally distributed population. Find the test statistic t.

1) Test the claim that for the population of female college students, the mean weight is given by \( \mu = 132 \) lb. Sample data are summarized as \( n = 20, \bar{x} = 137 \) lb, and \( s = 14.2 \) lb. Use a significance level of \( \alpha = 0.1 \).

Find the test statistic t.

- A) 1.57
- B) 20
- C) 14.2
- D) 1.729
- E) -1.57

2) Test the claim that for the adult population of one town, the mean annual salary is given by \( \mu = 30,000 \)$. Sample data are summarized as \( n = 17, \bar{x} = 22,298 \) , and \( s = 14,200 \)$. Use a significance level of \( \alpha = 0.05 \).

Find the test statistic t.

- A) -1.57
- B) 1.57
- C) 0.05
- D) 2.24
- E) -2.24

Provide an appropriate response.

3) A soft drink company claims the mean caffeine content of its HoP TopP soda is 40 milligrams per one 8-ounce bottle. To verify this claim, a random sample of 30 bottles is found to have a mean caffeine content of 39.2 milligrams with a standard deviation of 7.5 milligrams. Calculate the test statistic t for this for the population mean.

- A) 0.075
- B) -0.56
- C) -0.58
- D) 1.96
- E) None of the above

Assume that a simple random sample has been selected from a normally distributed population. State the final conclusion.

4) Test the claim that for the population of female college students, the mean weight is given by \( \mu = 132 \) lb. Sample data are summarized as \( n = 20, \bar{x} = 137 \) lb, and \( s = 14.2 \) lb. Use a significance level of \( \alpha = 0.1 \).

\( H_0: \mu = 132 \quad H_A: \mu \neq 132 \)

State your conclusion about \( H_0 \).

- A) Reject \( H_0 \)
- B) Do not reject \( H_A \)
- C) Reject \( H_A \)
- D) Do not reject \( H_0 \)
- E) Cannot draw a conclusion with information given.

5) Test the claim that for the adult population of one town, the mean annual salary is given by \( \mu = 30,000 \)$. Sample data are summarized as \( n = 17, \bar{x} = 22,298 \) , and \( s = 14,200 \)$. Use a significance level of \( \alpha = 0.05 \).

\( H_0: \mu = 30,000 \quad H_A: \mu \neq 30,000 \)

State your conclusion about \( H_0 \).

- A) Reject \( H_A \)
- B) Do not reject \( H_A \)
- C) Do not reject \( H_0 \)
- D) Cannot draw a conclusion for information given.
- E) Reject \( H_0 \)
Select the most appropriate answer.

6) The test statistic for testing \( H_0: \mu = 100 \) against \( H_A: \mu \neq 100 \) was \( t = 3.3 \), with \( P \)-value 0.001. Then, 6) ______

A) this must be wrong, because a large \( t \) test statistic must have a large \( P \)-value.
B) there is strong evidence that \( \mu > 100 \).
C) there is not strong evidence that \( \mu = 100 \).
D) there is not strong evidence that \( \mu < 100 \).
E) there is not enough information here to draw a conclusion.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

7) Recent findings have suggested that neonatal sex differences exist in behavioral and physiological reactions to stress. One study (M. Davis and E. Emory, *Child Development*, Vol. 66, 1995, pp. 14-27) evaluated changes in the heart rate for a sample of infants placed in a stressful situation. For the 15 female infants, the following is a printout for the data on the change in heart rate.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of Cases</th>
<th>Mean</th>
<th>SD</th>
<th>SE of Mean</th>
<th>t-value</th>
<th>df</th>
<th>2-Tail Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHANGE</td>
<td>15</td>
<td>10.70</td>
<td>17.70</td>
<td>4.570</td>
<td>2.341</td>
<td>14</td>
<td>0.0346</td>
</tr>
</tbody>
</table>

a. State the hypotheses.
b. State the test statistic.
c. State the \( P \)-value.
d. Interpret the \( P \)-value in context.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Classify the significance test as two-tailed, left-tailed, or right-tailed.

8) In the past, the mean running time for a certain type of flashlight battery has been 9.3 hours. The manufacturer has introduced a change in the production method and wants to perform a significance test to determine whether the mean running time has changed as a result. 8) ______

A) Middle-tailed
B) Right-tailed
C) Left-tailed
D) Two-tailed
E) Neither

9) At one school, the average amount of time that ninth-graders spend watching television each week is 21.6 hours. The principal introduces a campaign to encourage the students to watch less television. One year later, the principal wants to perform a significance test to determine whether the average amount of time spent watching television per week has decreased from the previous mean of 21.6 hours. 9) ______

A) Right-tailed
B) Middle-tailed
C) Two-tailed
D) Left-tailed
E) Neither
more information is necessary to determine what type of test should be used.

10) A health insurer has determined that the "reasonable and customary" fee for a certain medical procedure is $1500. They suspect that the average fee charged by one particular clinic for this procedure is higher than $1500. The insurer wants to perform a significance test to determine whether their suspicion is correct.
   A) Left-tailed
   B) Middle-tailed
   C) Right-tailed
   D) Two-tailed
   E) Neither

11) In 1990, the average duration of long-distance telephone calls originating in one town was 15.3 minutes. A long-distance telephone company wants to perform a significance test to determine whether the average duration of long-distance phone calls has changed from the 1990 mean of 15.3 minutes.
   A) Two-tailed
   B) Left-tailed
   C) Middle-tailed
   D) Right-tailed
   E) Neither

Select the most appropriate answer.

12) If an agronomist wishes to determine whether there is evidence that the average number of bales of cotton produced in a certain county equals 500, cotton produced in a certain county exceeds 500, or cotton produced in a certain county equals 500, explain the meaning of a Type I error, a Type II error, or a correct decision as specified.
   A) either a one-sided or a two-sided test could be used with equivalent results.
   B) a left-tailed test should be used.
   C) a two-tailed test should be used.
   D) a right-tailed test should be used.
   E) more information is necessary to determine what type of test should be used.

13) If an agronomist wishes to determine whether there is evidence that the average number of bales of cotton produced in a certain county exceeds 500, explain the meaning of a Type I error, a Type II error, or a correct decision as specified.
   A) a left-tailed test should be used.
   B) a two-tailed test should be used.
   C) either a one-sided or a two-sided test could be used with equivalent results.
   D) a right-tailed test should be used.
   E) more information is necessary to determine what type of test should be used.

For the given significance test, explain the meaning of a Type I error, a Type II error, or a correct decision as specified.

14) In the past, the mean running time for a certain type of radio battery has been 9.8 hours. The manufacturer has introduced a change in the production method and wants to perform a significance test to determine whether the mean running time has increased as a result. The hypotheses are:
   \[ H_0 : \mu = 9.8 \text{ hours} \]
   \[ H_a : \mu > 9.8 \text{ hours} \]
   Explain the meaning of a Type I error.
   A) Concluding that \( \mu = 9.8 \text{ hours} \) when in fact \( \mu > 9.8 \text{ hours} \)
   B) Concluding that \( \mu > 9.8 \text{ hours} \) when in fact \( \mu > 9.8 \text{ hours} \)
   C) Concluding that \( \mu > 9.8 \text{ hours} \) when in fact \( \mu = 9.8 \text{ hours} \)
   D) Concluding that \( \mu = 9.8 \text{ hours} \) when in fact \( \mu < 9.8 \text{ hours} \)
   E) Concluding that \( \mu < 9.8 \text{ hours} \) when in fact \( \mu > 9.8 \text{ hours} \)
15) A manufacturer claims that the mean amount of juice in its 16 ounce bottles is 16.1 ounces. A consumer advocacy group wants to perform a significance test to determine whether the mean amount is actually less than this. The hypotheses are:

\[ H_0 : \mu = 16.1 \text{ ounces} \]
\[ H_a : \mu < 16.1 \text{ ounces} \]

Explain the meaning of a Type I error.
A) Failing to reject the hypothesis that \( \mu = 16.1 \) ounces when in fact \( \mu < 16.1 \) ounces
B) Concluding that \( \mu = 16.1 \) ounces when in fact \( \mu < 16.1 \) ounces
C) Concluding that \( \mu < 16.1 \) ounces when in fact \( \mu < 16.1 \) ounces
D) Concluding that \( \mu < 16.1 \) ounces when in fact \( \mu = 16.1 \) ounces
E) Failing to reject the hypothesis that \( \mu = 16.1 \) ounces when in fact \( \mu = 16.1 \) ounces

Provide an appropriate response.

16) A state university wants to increase its retention rate of 4% for graduating students from the previous year. After implementing several new programs during the last two years, the university reevaluated its retention rate. Identify the Type I error in this context.
A) The university concludes that retention is on the rise, but in fact the new programs do not help retention.
B) The university stops all new programs, but in fact retention is on the rise and the programs help.
C) The product of the university’s sample size and sample proportion was less than 10.
D) The university sampled all students at the university.
E) The university concludes that retention is on the rise since the retention rate can only increase.

17) A weight loss center provided a loss for 72% of its participants. The center’s leader decides to test a new weight loss strategy. Identify the Type I error in this context.
A) The center concludes that proportion of weight loss is increasing since the weight loss level can only increase.
B) The center sampled all participants at the weight loss center.
C) The center stops the new strategy, but in fact weight loss is increasing and the strategy helps.
D) The product of the center’s sample size and sample proportion was less than 10.
E) The center concludes that the proportion of participants losing weight is increasing, but in fact the new strategy does not help weight loss.

18) The U.S. Department of Labor and Statistics released the current unemployment rate of 5.3% for the month in the U.S. and claims the unemployment has not changed in the last two months. However, the state’s statistics reveal that there is a reduction in the U.S. unemployment rate. Identify the Type II error in this context.
A) The product of the states sample size and sample proportion was less than 10.
B) The statewide report concludes that unemployment is on the decline, but in fact there is no change in unemployment.
C) The statewide report shows there in no change in unemployment, but in fact the unemployment rate is decreasing.
D) The statewide report concludes that unemployment is declining since the unemployment rate can only decrease.
E) The statewide report sampled only a dozen unemployed workers.
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

19) A social psychologist plans to conduct an experiment with a random sample of 49 children from a school district. Before conducting the experiment, the psychologist checks how this sample compares to national norms on several variables. The IQ scores for the 49 children have \( \bar{x} = 103 \) and \( s = 14 \). Nationally, the population mean IQ equals 100. Is it plausible that the mean \( \mu \) of the population of children in the school district from which these students were sampled equals 100?

a. Show all five steps of a test of \( H_0: \mu = 100 \) against \( H_a: \mu \neq 100 \) using a significance level of 0.05.
b. If the decision in (a) is an error, what type of error is it, Type I or Type II? Why?
c. What conclusion applies for each of the following significance levels: (i) \( \alpha = 0.20 \), (ii) \( \alpha = 0.10 \), (iii) \( \alpha = 0.01 \). Why is \( \alpha = 0.20 \) rare in practice?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Classify the conclusion of the significance test as a Type I error, a Type II error, or No error.

20) A manufacturer claims that the mean amount of juice in its 16 ounce bottles is 16.1 ounces. A consumer advocacy group wants to perform a significance test to determine whether the mean amount is actually less than this. The hypotheses are:

\[
\begin{align*}
H_0 &: \mu = 16.1 \text{ ounces} \\
H_a &: \mu < 16.1 \text{ ounces}
\end{align*}
\]

Suppose that the results of the sample lead to rejection of the null hypothesis. Classify that conclusion as a Type I error, a Type II error, or a correct decision, if in fact the mean amount of juice, \( \mu \), is less than 16.1 ounces.

A) Type I error  B) No error  C) Type II error  D) Neither

21) In the past, the mean running time for a certain type of flashlight battery has been 9.6 hours. The manufacturer has introduced a change in the production method and wants to perform a significance test to determine whether the mean running time has increased as a result. The hypotheses are:

\[
\begin{align*}
H_0 &: \mu = 9.6 \text{ hours} \\
H_a &: \mu > 9.6 \text{ hours}
\end{align*}
\]

Suppose that the results of the sample lead to nonrejection of the null hypothesis. Classify that conclusion as a Type I error, a Type II error, or a correct decision, if in fact the mean running time has increased.

A) No error  B) Type I error  C) Type II error  D) Neither

22) In the past, the mean running time for a certain type of flashlight battery has been 9.5 hours. The manufacturer has introduced a change in the production method and wants to perform a significance test to determine whether the mean running time has increased as a result. The hypotheses are:

\[
\begin{align*}
H_0 &: \mu = 9.5 \text{ hours} \\
H_a &: \mu > 9.5 \text{ hours}
\end{align*}
\]

Suppose that the results of the sample lead to rejection of the null hypothesis. Classify that conclusion as a Type I error, a Type II error, or a correct decision, if in fact the mean running time has not increased.

A) No error  B) Type I error  C) Type II error  D) Neither
1) A
2) E
3) C
4) D
5) E
6) B

7) a. $H_0: \mu = 0$, $H_a: \mu \neq 0$; b. $t = 2.341$; c. P-value = 0.0346; d. The approximate probability that $\bar{x}$ takes a value of greater than or equal to 10.70 or less than or equal to -10.70 if $H_0$ is true is 0.0346.

8) D
9) D
10) C
11) A
12) C
13) D
14) C
15) D
16) A
17) E
18) C

19) a. 1) Assumptions: (1) quantitative variable with $\mu =$population mean IQ, (2) random sample, (3) Since $n \geq 30$, the sampling distribution of the sample mean is approximately normal by the central limit theorem; 2) $H_0: \mu = 100$, $H_a: \mu \neq 100$; 3) $t = 1.5$; 4) 0.10 < P-value < 0.20; 5) At $\alpha = 0.05$, P-value > $\alpha$, fail to reject $H_0$, there is not sufficient evidence that $\mu \neq 100$; b. If the decision in (a) is an error, it would be a Type II error. The only way one can make a Type II error is to fail to reject a false null hypothesis and the only way one can make a Type I error is to reject a true null hypothesis; c. (i) P-value < $\alpha$, reject $H_0$, there is sufficient evidence that $\mu \neq 100$, (ii and iii) P-value > $\alpha$, fail to reject $H_0$, there is not sufficient evidence that $\mu \neq 100$. A significance level of 0.20 is rare in practice, because the significance level is the probability of making a Type I error given $H_0$ is true.

20) B
21) C
22) B