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

Find the requested value.

1) A researcher wishes to estimate the mean resting heart rate for long-distance runners. A random sample of 12 long-distance runners yields the following heart rates, in beats per minute.

<table>
<thead>
<tr>
<th>Heart Rate (beats per minute)</th>
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</thead>
<tbody>
<tr>
<td>76</td>
</tr>
<tr>
<td>58</td>
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<tr>
<td>69</td>
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<tr>
<td>78</td>
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<td>78</td>
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<td>82</td>
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<tr>
<td>58</td>
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<tr>
<td>60</td>
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<tr>
<td>63</td>
</tr>
</tbody>
</table>

Use the data to obtain a point estimate of the mean resting heart rate for all long distance runners.

2) Physiologists often use the forced vital capacity as a way to assess a person's ability to move air in and out of their lungs. A researcher wishes to estimate the forced vital capacity of people suffering from asthma. A random sample of 15 asthmatics yields the following data on forced vital capacity, in liters.

<table>
<thead>
<tr>
<th>Forced Vital Capacity (liters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3</td>
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<tr>
<td>4.4</td>
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<tr>
<td>5.3</td>
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<td>4.2</td>
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<tr>
<td>3.5</td>
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<tr>
<td>4.8</td>
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<tr>
<td>4.0</td>
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<tr>
<td>5.1</td>
</tr>
</tbody>
</table>

Use the data to obtain a point estimate of the mean forced vital capacity for all asthmatics.

Find the requested confidence interval.

3) A college statistics professor has office hours from 9:00 A.M. to 10:30 A.M. daily. A sample of waiting times to see the professor (in minutes) is 10, 12, 20, 15, 17, 10, 30, 28, 35, 28, 19, 27, 22, 33, 37, 14, 21, 20, 23. Assuming $\sigma = 7.84$, find the 95.44% confidence interval for the population mean.

4) A survey revealed the amount of pocket money held by each student in a sample of students from Statistics 205. The amounts (in dollars) are 5.50, 10.20, 3.15, 6.08, 4.85, 4.80, 4.70, 8.52, 7.90, 6.10, 3.50, 5.40, 7.10, 9.60, 6.20, and 4.28. Assuming $\sigma = 2.00$, find the 99.74% confidence interval for the population mean.

5) The data below consists of the test scores of 32 students. Assuming $\sigma = 13.36$, determine a 95.44% confidence interval for the population mean.

<table>
<thead>
<tr>
<th>Test Scores</th>
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</thead>
<tbody>
<tr>
<td>80</td>
</tr>
<tr>
<td>74</td>
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<td>61</td>
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<tr>
<td>65</td>
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<tr>
<td>84</td>
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<tr>
<td>91</td>
</tr>
</tbody>
</table>

Find the confidence interval specified.

6) The mean score, $\bar{x}$, on an aptitude test for a random sample of 2 students was 60. Assuming that $\sigma = 16$, construct a 95.44% confidence interval for the mean score, $\mu$, of all students taking the test.
7) Physiologists often use the **forced vital capacity** as a way to assess a person’s ability to move air in and out of their lungs. A researcher wishes to estimate the forced vital capacity of people suffering from asthma. A random sample of 15 asthmatics yields the following data on forced vital capacity, in liters.

\[ 3.0 \quad 4.8 \quad 5.3 \quad 4.6 \quad 3.6 \\
3.7 \quad 3.7 \quad 4.3 \quad 3.5 \quad 5.2 \\
3.2 \quad 3.5 \quad 4.8 \quad 4.0 \quad 5.1 \]

Use the data to obtain a 95.44% confidence interval for the mean forced vital capacity for all asthmatics. Assume that \( \sigma = 0.7 \).

8) A random sample of 106 light bulbs had a mean life of \( \bar{x} = 526 \) hours. Assume that \( \sigma = 29 \) hours. Construct a 90% confidence interval for the mean life, \( \mu \), of all light bulbs of this type.

**Solve the problem.**

9) A sample of 54 eggs yields a mean weight of 1.37 ounces. Assuming that \( \sigma = 0.28 \) ounces, find the margin of error in estimating \( \mu \) at the 95% level of confidence.

10) A sample of 35 washing machines yields a mean replacement time of 10.8 years. Assuming that \( \sigma = 2.5 \) years, find the margin of error in estimating \( \mu \) at the 90% level of confidence.

11) A sample of 74 college students yields a mean annual income of $3948. Assuming that \( \sigma = $870 \), find the margin of error in estimating \( \mu \) at the 99% level of confidence.

**Find the necessary sample size.**

12) Weights of women in one age group are normally distributed with a standard deviation \( \sigma \) of 18 lb. A researcher wishes to estimate the mean weight of all women in this age group. Find how large a sample must be drawn in order to be 90 percent confident that the sample mean will not differ from the population mean by more than 3.8 lb.

13) The weekly earnings of students in one age group are normally distributed with a standard deviation of 50 dollars. A researcher wishes to estimate the mean weekly earnings of students in this age group. Find the sample size needed to assure with 95 percent confidence that the sample mean will not differ from the population mean by more than 2 dollars.

**Find the specified \( t \)-value.**

14) For a \( t \)-curve with \( df = 23 \), find the \( t \)-value having area 0.10 to its left.

15) For a \( t \)-curve with \( df = 6 \), find the two \( t \)-values that divide the area under the curve into a middle 0.99 area and two outside areas of 0.005.

16) For a \( t \)-curve with \( df = 27 \), find the two \( t \)-values that divide the area under the curve into a middle 0.95 area and two outside areas of 0.025.

**Find the confidence interval specified. Assume that the population is normally distributed.**

17) A laboratory tested twelve chicken eggs and found that the mean amount of cholesterol was 243 milligrams with \( s = 16.2 \) milligrams. Construct a 95% confidence interval for the true mean cholesterol content of all such eggs.
18) Thirty randomly selected students took the calculus final. If the sample mean was 83 and the standard deviation was 14.1, construct a 99% confidence interval for the mean score of all students.

19) A sociologist develops a test to measure attitudes about public transportation, and 27 randomly selected subjects are given the test. Their mean score is 76.2 and their standard deviation is 21.4. Construct the 95% confidence interval for the mean score of all such subjects.

20) A savings and loan association needs information concerning the checking account balances of its local customers. A random sample of 14 accounts was checked and yielded a mean balance of $664.14 and a standard deviation of $297.29. Find a 90% confidence interval for the true mean checking account balance for local customers.

Perform a hypothesis test for the population mean. Assume that preliminary data analyses indicate that it is reasonable to apply the z-test.

21) The National Weather Service says that the mean daily high temperature for October in a large midwestern city is 56°F. A local weather service suspects that this value is not accurate and wants to perform a hypothesis test to determine whether the mean is actually lower than 56°F. A sample of mean daily high temperatures for October over the past 39 years yields $\bar{x} = 54^\circ F$. Assume that the population standard deviation is 5.6°F. Perform the hypothesis test at the $\alpha = 0.01$ significance level. Do the following:

a) Set up hypotheses
b) Determine $\alpha$
c) Compute Test Statistic
d) Find critical value(s)
e) Make decision about null hypothesis
f) Interpret the results of the hypothesis test.

22) The maximum acceptable level of a certain toxic chemical in vegetables has been set at 0.4 parts per million (ppm). A consumer health group measured the level of the chemical in a random sample of tomatoes obtained from one producer. The levels, in ppm, are shown below.

| 0.31 | 0.47 | 0.19 | 0.72 | 0.56 |
| 0.91 | 0.29 | 0.83 | 0.49 | 0.28 |
| 0.31 | 0.46 | 0.25 | 0.34 | 0.17 |
| 0.58 | 0.19 | 0.26 | 0.47 | 0.81 |

At the 5% significance level, do the data provide sufficient evidence to conclude that the mean level of the chemical in tomatoes from this producer is greater than the recommended level of 0.4 ppm? Assume that the population standard deviation of levels of the chemical in these tomatoes is 0.21 ppm. Do the following:

a) Set up hypotheses
b) Determine $\alpha$
c) Compute Test Statistic
d) Find critical value(s)
e) Make decision about null hypothesis
f) Interpret the results of the hypothesis test.
23) A brochure claims that the average maximum height a certain type of plant is 0.7 m. A gardener suspects that this estimate is not accurate locally due to soil conditions. A random sample of 49 mature plants is taken. The mean height of the plants in the sample is 0.65 m. Using a 1% level of significance, perform a hypothesis test to determine whether the population mean is different from 0.7 m. Assume that the population standard deviation is 0.2 m. Do the following:

a) Set up hypotheses
b) Determine \( \alpha \)
c) Compute Test Statistic
d) Find critical value(s)
e) Make decision about null hypothesis
f) Interpret the results of the hypothesis test.

Perform a one-sample \( z \)-test for a population mean using the \( P \)-value approach.

24) Last year, the mean running time for a certain type of flashlight battery was 8.5 hours. This year, the manufacturer has introduced a change in the production method which he hopes will increase the mean running time. A random sample of 40 of the new light bulbs was obtained and the mean running time was found to be 8.7 hours. Do the data provide sufficient evidence to conclude that the mean running time, \( \mu \), of the new light bulbs is larger than last year’s mean of 8.5 hours? Perform the appropriate hypothesis test using a significance level of 0.05. Assume that \( \sigma = 0.5 \) hours. Do the following:

a) Set up hypotheses
b) Determine \( \alpha \)
c) Compute Test Statistic
d) Find \( P \)-Value
e) Make decision about null hypothesis
f) Interpret the results of the hypothesis test.

25) In 2000, the average duration of long-distance telephone calls originating in one town was 9.4 minutes. A long-distance telephone company wants to perform a hypothesis test to determine whether the average duration of long-distance phone calls has changed from the 2000 mean of 9.4 minutes. They randomly sampled 50 calls originating in the town and found that the mean duration of these 50 calls was 8.6 minutes. Do the data provide sufficient evidence to conclude that the mean call duration, \( \mu \), has changed from the 2000 mean of 9.4 minutes? Perform the appropriate hypothesis test using a significance level of 0.01. Assume that \( \sigma = 4.8 \) minutes. Do the following:

a) Set up hypotheses
b) Determine \( \alpha \)
c) Compute Test Statistic
d) Find \( P \)-Value
e) Make decision about null hypothesis
f) Interpret the results of the hypothesis test.
26) 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 hypothesis test to determine whether the mean amount is actually less than this. The mean volume of juice for a random sample of 70 bottles was 15.94 ounces. Do the data provide sufficient evidence to conclude that the mean amount of juice for the 16-ounce bottles, \( \mu \), is less than 16.1 ounces? Perform the appropriate hypothesis test using a significance level of 0.10. Assume that \( \sigma = 0.9 \) ounces. Do the following:

a) Set up hypotheses  
b) Determine \( \alpha \)  
c) Compute Test Statistic  
d) Find P-Value  
e) Make decision about null hypothesis  
f) Interpret the results of the hypothesis test.

Preliminary data analyses indicate that it is reasonable to use a \( t \)-test to carry out the specified hypothesis test. Perform the \( t \)-test using the critical-value approach.

27) A test of sobriety involves measuring the subject's motor skills. The mean score for men who are sober is known to be 35.0. A researcher would like to perform a hypothesis test to determine whether the mean score for sober women differs from 35.0. Twenty randomly selected sober women take the test and produce a mean score of 41.0 with a standard deviation of 3.7. Perform the hypothesis test at the 0.01 level of significance. Do the following:

a) Set up hypotheses  
b) Determine \( \alpha \)  
c) Compute Test Statistic  
d) Find critical value(s)  
e) Make decision about null hypothesis  
f) Interpret the results of the hypothesis test.

28) A large software company gives job applicants a test of programming ability and the mean for that test has been 160 in the past. Twenty-five job applicants are randomly selected from a large university and they produce a mean score of 183 and standard deviation of 12. Use a 0.05 level of significance to test whether the mean score for students from this university is greater than 160. Do the following:

a) Set up hypotheses  
b) Determine \( \alpha \)  
c) Compute Test Statistic  
d) Find critical value(s)  
e) Make decision about null hypothesis  
f) Interpret the results of the hypothesis test.
29) In one state, the mean time served in prison by convicted burglars is 18.7 months. A researcher would like to perform a hypothesis test to determine whether the mean amount of time served by convicted burglars in her hometown is different from 18.7 months. She takes a random sample of 11 such cases from court files in her home town and finds that \( \bar{x} = 20.7 \) months and \( s = 7.7 \) months. Use a significance level of 0.05 to perform the test. Do the following:

a) Set up hypotheses

b) Determine \( \alpha \)

c) Compute Test Statistic

d) Find critical value(s)

e) Make decision about null hypothesis

f) Interpret the results of the hypothesis test.
Answer Key
Testname: TEST 3 REVIEW

1) 67.7 beats per minute
2) 4.31 liters
3) 18.8 to 25.8 minutes
4) $4.62 to $7.62
5) 75.19 to 84.63
6) 37.4 to 82.6
7) 3.79 to 4.51 liters
8) 521.4 to 530.6 hours
9) 0.07 oz
10) 0.7 years
11) $260
12) 61
13) 2401
14) -1.319
15) -3.707, 3.707
16) -2.052, 2.052
17) 232.7 to 253.3 milligrams
18) 75.91 to 90.09
19) 67.7 to 84.7
20) $523.43 to $804.85
21) \( H_0 : \mu = 56^\circ \text{F} \)
    \( H_a : \mu < 56^\circ \text{F} \)
    \( \alpha = 0.01 \)
    Test statistic: \( z = -2.23 \).
    Critical value \( z = -2.33 \).
    Since \(-2.23 > -2.33\), do not reject \( H_0 : \mu = 56^\circ \text{F} \).
    At the 1% significance level, the data do not provide sufficient evidence to conclude that the mean daily high temperature for October is less than 56°F.
22) \( H_0 : \mu = 0.4 \text{ ppm} \)
    \( H_a : \mu > 0.4 \text{ ppm} \)
    \( \alpha = 0.05 \)
    Test statistic: \( z = 0.95 \)
    Critical value \( z = 1.645 \)
    Since \( 0.95 < 1.645 \), do not reject \( H_0 : \mu = 0.4 \text{ ppm} \)
    At the 5% significance level, the data do not provide sufficient evidence to conclude that the mean level of the chemical in tomatoes from this producer is greater than the recommended level of 0.4 ppm.
23) \( H_0 : \mu = 0.7 \text{ m} \)
    \( H_a : \mu \neq 0.7 \text{ m} \)
    \( \alpha = 0.01 \)
    Test statistic: \( z = -1.75 \).
    Critical values: \( z = \pm 2.575 \).
    Since \( -2.575 < -1.75 < 2.575 \), do not reject \( H_0 : \mu = 0.7 \text{ m} \).
    At the 1% significance level, the data do not provide sufficient evidence to conclude that the mean height of the plants is different from 0.7 m.
24) $H_0: \mu = 8.5$ hours  
$H_a: \mu > 8.5$ hours  
$\alpha = 0.05$  
z = 2.53  
$P$-value = 0.0057  
Since 0.0057 < 0.05, reject $H_0$.  
At the 5% significance level, the data provide sufficient evidence to conclude that the mean running time, $\mu$, of the new light bulbs is larger than last year's mean of 8.5 hours. The evidence against the null hypothesis is very strong.

25) $H_0: \mu = 9.4$ minutes  
$H_a: \mu \neq 9.4$ minutes  
$\alpha = 0.01$  
z = -1.18  
$P$-value = 0.2380  
Since 0.2380 > 0.01, do not reject $H_0$.  
At the 1% significance level, the data do not provide sufficient evidence to conclude that the mean call duration has changed from the 2000 mean of 9.4 minutes. The evidence against the null hypothesis is weak or none.

26) $H_0: \mu = 16.1$ ounces  
$H_a: \mu < 16.1$ ounces  
$\alpha = 0.10$  
z = -1.49  
$P$-value = 0.0681  
Since 0.0681 < 0.10, reject $H_0$.  
At the 10% significance level, the data provide sufficient evidence to conclude that the mean amount of juice for the 16-ounce bottles is less than 16.1 ounces. The evidence against the null hypothesis is moderate.

27) $H_0: \mu = 35.0$. $H_a: \mu \neq 35.0$.  
$\alpha = 0.01$  
Test statistic: $t = 7.252$. Critical values: $t = -2.861, 2.861$. Reject the null hypothesis. At the 1% level of significance, there is sufficient evidence to conclude that the mean score for sober women differs from 35.0, the mean score for men.

28) $H_0: \mu = 160$. $H_a: \mu > 160$.  
$\alpha = 0.05$  
Test statistic: $t = 9.583$. Critical value: $t = 1.711$. Reject the null hypothesis. At the 5% level of significance, there is sufficient evidence to conclude that the mean score for students from this university is greater than 160.

29) $H_0: \mu = 18.7$ months. $H_a: \mu \neq 18.7$ months.  
$\alpha = 0.05$  
Test statistic: $t = 0.86$. Critical values: $t = \pm 2.228$. Do not reject $H_0$. At the 5% level of significance, there is not sufficient evidence to conclude that the mean amount of time served by convicted burglars in her hometown is different from 18.7 months.