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

Solve the problem.

1) What do you conclude about the claim below? Do not use formal procedures or exact calculations. Use only the rare event rule and make a subjective estimate to determine whether the event is likely.

Claim: A die is fair and in 100 rolls there are 63 sixes.

If the die is fair, the probability of obtaining 63 sixes in 100 rolls would be extremely small. Therefore, by the rare event rule, we conclude that the claim the die is fair is not correct.

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

Express the null hypothesis $H_0$ and the alternative hypothesis $H_1$ in symbolic form. Use the correct symbol ($\mu$, $p$, $\sigma$) for the indicated parameter.

2) An entomologist writes an article in a scientific journal which claims that fewer than 11 in ten thousand male fireflies are unable to produce light due to a genetic mutation. Use the parameter $p$, the true proportion of fireflies unable to produce light.

$H_0$: $p = 0.0011$

$H_1$: $p < 0.0011$

Assume that the data has a normal distribution and the number of observations is greater than fifty. Find the critical $z$ value used to test a null hypothesis.

3) $\alpha = 0.05$ for a two-tailed test.

A) $\pm 1.96$

B) $\pm 2.575$

C) $\pm 1.645$

D) $\pm 1.764$

Find the value of the test statistic $z$ using $z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$.

4) A claim is made that the proportion of children who play sports is less than 0.5, and the sample statistics include $n = 1158$ subjects with 30% saying that they play a sport.

A) $-27.78$

B) $27.78$

C) $-13.61$

D) $13.61$
Use the given information to find the P-value.

5) The test statistic in a right-tailed test is \( z = 0.52 \).

\[
S_{\text{value}} = \text{norm}(0.52, 1.00) = 0.3015
\]

A) 0.1950  
B) 0.3015  
C) 0.1915  
D) 0.5530

Assume that a hypothesis test of the given claim will be conducted. Identify the type I or type II error for the test.

6) An entomologist writes an article in a scientific journal which claims that fewer than 16 in ten thousand male fireflies are unable to produce light due to a genetic mutation. Identify the type I error for the test.

\[
\begin{align*}
H_0 & : p = \frac{16}{10,000} \\
H_a & : p < \frac{16}{10,000}
\end{align*}
\]

A) The error of rejecting the claim that the true proportion is less than 16 in ten thousand when it really is less than 16 in ten thousand.  
B) The error of rejecting the claim that the true proportion is at least 16 in ten thousand when it really is at least 16 in ten thousand.  
C) The error of failing to reject the claim that the true proportion is at least 16 in ten thousand when it is actually less than 16 in ten thousand.

Express the null hypothesis \( H_0 \) and the alternative hypothesis \( H_1 \) in symbolic form. Use the correct symbol \( \mu, p, \sigma \) for the indicated parameter.

7) An entomologist writes an article in a scientific journal which claims that fewer than 18 in ten thousand male fireflies are unable to produce light due to a genetic mutation. Use the parameter \( p \), the true proportion of fireflies unable to produce light.

\[
\begin{align*}
H_0 & : p = 0.0018 \\
H_1 & : p < 0.0018
\end{align*}
\]

A) \( H_0: p = 0.0018 \)  
B) \( H_0: p < 0.0018 \)  
C) \( H_0: p = 0.0018 \)  
D) \( H_0: p > 0.0018 \)

Find the value of the test statistic \( z \) using \( z = \frac{\hat{p} - p}{\sqrt{\frac{p(1-p)}{n}}} \).

8) A claim is made that the proportion of children who play sports is less than 0.5, and the sample statistics include \( n = 1694 \) subjects with 30% saying that they play a sport.

\[
\begin{align*}
z & = \frac{(0.3 - 0.5)}{\sqrt{\frac{0.3(0.7)}{1694}}} \\
& = -16.46
\end{align*}
\]

A) -33.61  
B) 16.46  
C) -16.46  
D) 33.61
Formulate the indicated conclusion in nontechnical terms. Be sure to address the original claim.

9) An entomologist writes an article in a scientific journal which claims that fewer than 19 in ten thousand male fireflies are unable to produce light due to a genetic mutation. Assuming that a hypothesis test of the claim has been conducted and that the conclusion is to reject the null hypothesis, state the conclusion in nontechnical terms.

\[ H_0 : p = \frac{19}{10,000} \quad \text{vs} \quad H_a : p < \frac{19}{10,000} \]

A) There is not sufficient evidence to support the claim that the true proportion is greater than 19 in ten thousand.

B) There is sufficient evidence to support the claim that the true proportion is less than 19 in ten thousand.

C) There is sufficient evidence to support the claim that the true proportion is greater than 19 in ten thousand.

D) There is not sufficient evidence to support the claim that the true proportion is less than 19 in ten thousand.

Assume that a hypothesis test of the given claim will be conducted. Identify the type I or type II error for the test.

10) An entomologist writes an article in a scientific journal which claims that fewer than 12 in ten thousand male fireflies are unable to produce light due to a genetic mutation. Identify the type I error for the test.

\[ H_0 : p = \frac{12}{10,000} \quad \text{vs} \quad H_a : p < \frac{12}{10,000} \]

A) The error of rejecting the claim that the true proportion is at least 12 in ten thousand when it really is at least 12 in ten thousand.

B) The error of failing to reject the claim that the true proportion is at least 12 in ten thousand when it is actually less than 12 in ten thousand.

C) The error of rejecting the claim that the true proportion is less than 12 in ten thousand when it really is less than 12 in ten thousand.

Determine whether the given conditions justify testing a claim about a population mean \( \mu \).

11) The sample size is \( n = 25 \), \( \sigma = 5.93 \), and the original population is normally distributed.

A) No

B) Yes
Determine whether the hypothesis test involves a sampling distribution of means that is a normal distribution, Student t distribution, or neither.

12) Claim: \( \mu = 959 \). Sample data: \( n = 25, \bar{x} = 951, s = 25 \). The sample data appear to come from a normally distributed population with \( \sigma = 28 \).

A) Neither  
B) Normal  
C) Student t

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

Assume that a simple random sample has been selected from a normally distributed population. Find the test statistic, P-value, critical value(s), and state the final conclusion.

13) 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 \( \alpha = 0.1 \).

Use the \( t \)-distribution.

\[
t_{\text{test}} = \frac{\bar{x} - \mu}{s / \sqrt{n}} = \frac{137 - 132}{14.2 / \sqrt{20}} = 1.575
\]

\( t_{\text{critical}} = 1.729 \), \( 1.575 < 1.729 \)

Test the given claim using the traditional method of hypothesis testing. Assume selected from a population with a normal distribution.

Ho: \( \mu = 132 \)  
Ha: \( \mu \neq 132 \)

To reject Ho: There is not sufficient evidence to reject the null hypothesis that \( \mu = 132 \).

\( t_{\text{critical}} = 1.729 \), \( 1.575 < 1.729 \)

Identify the null hypothesis, alternative hypothesis, test statistic, P-value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

14) Use a significance level of \( \alpha = 0.05 \) to test the claim that \( \mu \neq 32.6 \). The sample data consists of 15 scores for which \( \bar{x} = 39.7 \) and \( s = 5 \).

Use the \( t \)-distribution.

\[
t_{\text{test}} = \frac{\bar{x} - \mu}{s / \sqrt{n}} = \frac{39.7 - 32.6}{5 / \sqrt{15}} = 5.5
\]

P-value = 2.82 \times 10^{-5} < 0.05

Reject Ho: There is sufficient evidence that \( \mu \neq 32.6 \)

15) Various temperature measurements are recorded at different times for a particular city. The mean of 20°C is obtained for 40 temperatures on 40 different days. Assuming that \( \sigma = 1.5°C \), test the claim that the population mean is 23°C. Use a 0.05 significance level.

Ho: \( \mu = 23 \)  
Ha: \( \mu \neq 23 \)

\( \bar{x} = 25°C \), \( s = 1.5°C \)

Identify the null hypothesis, alternative hypothesis, test statistic, P-value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.