**AP Statistics Practice Exam- Chapters 9 - 10**

**Multiple Choice**
*Identify the choice that best completes the statement or answers the question.*

**Scenario 10-5**
Sixty-eight people from a random sample of 128 residents of Uppsala, Sweden, had blue eyes. 45 people from a random sample of 110 people from Preston, England, had blue eyes. Let \( p_1 \) represent the proportion of people in Uppsala with blue eyes, and let \( p_2 \) represent the proportion of people in Preston with blue eyes.

___ 1. Use Scenario 10-5. Which of the following conditions are necessary in order to perform the test in Question 1?
I. There must be at least 1280 people in Uppsala, Sweden and at least 1100 people in Preston, England.
II. \( np \) and \( n(1-p) \) must be large enough for Normal calculations to be reasonably accurate.
III. Two independent random samples must be taken.
A. III only
B. I and III are necessary
C. I only
D. II only
E. I, II, and III are all necessary

___ 2. In a test of \( H_0: p = 0.7 \) against \( H_a: p \neq 0.7 \), a sample of size 80 produces \( z = 0.8 \) for the value of the test statistic. Which of the following is closest to the \( P \)-value of the test?
A. 0.4681
B. 0.2119
C. 0.2090
D. 0.7881
E. 0.4238

**Scenario 9-2**
Resting pulse rate is an important measure of the fitness of a person's cardiovascular system, with a lower rate indicative of greater fitness. The mean pulse rate for all adult males is approximately 72 beats per minute. A random sample of 25 male students currently enrolled in the Agriculture School at a major university was selected and the mean resting pulse rate was found to be 80 beats per minute with a standard deviation of 20 beats per minute. The experimenter wishes to test if the students are less fit, on average, than the general population.

___ 3. Use Scenario 9-2. The null and alternative hypotheses are
A. \( H_0: \bar{x} = 72; H_a: \bar{x} < 72 \)
B. \( H_0: \mu = 72; H_a: \mu > 72 \)
C. \( H_0: \bar{x} = 80; H_a: \bar{x} > 72 \)
D. \( H_0: \mu = 80; H_a: \mu = 72 \)
E. \( H_0: \mu = 72; H_a: \mu < 72 \)
Scenario 10-3
The Excellent Drug Company claims its aspirin tablets will relieve headaches faster than any other aspirin on the market. To determine whether Excellent’s claim is valid, 30 volunteers who are suffering from headaches are randomly assigned to two groups. The subjects in one group are given Excellent’s aspirin, and the subjects in the other group are given aspirin from the Simple Drug company. The number of minutes required for each subject to recover from the headache is recorded. A 5% significance level test is performed to determine whether Excellent’s aspirin cures headaches significantly faster than Simple's aspirin. The data were analyzed with MINITAB, and the following output was obtained:

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>15</td>
<td>8.4</td>
<td>4.23</td>
<td>1.092</td>
</tr>
<tr>
<td>Simple</td>
<td>15</td>
<td>8.9</td>
<td>4.61</td>
<td>1.190</td>
</tr>
</tbody>
</table>

Difference = μ (Excellent) - μ (Simple)
Estimate for difference: -0.5
T-Test of difference = 0 (vs not =): T-Value = -0.380 P-Value = 0.3796 DF = 27.8

4. Use Scenario 10-3. If the company performing this test committed a Type II error, which of the following describes what happened?
A. The company concluded that Excellent aspirin works faster than Simple aspirin when it doesn’t.
B. The company failed to reject H₀ when the P-value was less than α.
C. The company rejected H₀ when the P-value was greater than α.
D. The company concluded that Excellent aspirin works faster than Simple aspirin when it does.
E. The company hasn’t concluded that Excellent aspirin works faster than Simple aspirin when it does.

5. Use Scenario 10-3. Which of the following is the most appropriate conclusion to draw at the α = 0.05 level?
A. Fail to reject H₀: there is insufficient evidence to conclude that Excellent cures headaches faster than Simple.
B. Accept H₀: there is insufficient evidence to conclude that Excellent cures headaches faster than Simple.
C. Fail to reject H₀: there is sufficient evidence that Excellent cures headaches faster than Simple.
D. Reject H₀: there is sufficient evidence that Excellent cures headaches faster than Simple.
E. Accept H₀: there is sufficient evidence that Excellent cures headaches faster than Simple.
6. Popular wisdom is that eating presweetened cereal tends to increase the number of dental caries (cavities) in children. A sample of children was (with parental consent) entered into a study and followed for several years. Each child was classified as a sweetened-cereal lover or an unsweetened cereal lover. At the end of the study, the amount of tooth damage was measured. Here are the summary data:

<table>
<thead>
<tr>
<th>Cereal preference</th>
<th>n</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweetened</td>
<td>10</td>
<td>6.41</td>
<td>5.0</td>
</tr>
<tr>
<td>Unsweetened</td>
<td>15</td>
<td>5.20</td>
<td>15.0</td>
</tr>
</tbody>
</table>

Assuming the necessary conditions for inference are met, which of the following is an approximate 95% confidence interval for the difference in the mean tooth damage?

A. 
\[
(6.41 - 5.20) \pm 2.262 \sqrt{\frac{25}{10} + \frac{225}{15}}
\]

B. 
\[
(6.41 - 5.20) \pm 1.96 \sqrt{\frac{25}{100} + \frac{225}{15}}
\]

C. 
\[
(6.41 - 5.20) \pm 1.96 \sqrt{\frac{25}{10} + \frac{225}{15}}
\]

D. 
\[
(6.41 - 5.20) \pm 2.145 \sqrt{\frac{25}{10} + \frac{225}{15}}
\]

E. 
\[
(6.41 - 5.20) \pm 2.262 \sqrt{\frac{5}{10} + \frac{15}{15}}
\]

7. An appropriate 95% confidence interval for \( \mu \) has been calculated as \((-0.73, 1.92)\) based on \( n = 15 \) observations from a population with a Normal distribution. If we wish to use this confidence interval to test the hypothesis \( H_0: \mu = 0 \) against \( H_a: \mu \neq 0 \), which of the following is a legitimate conclusion?

A. Fail to reject \( H_0 \) at the \( \alpha = 0.05 \) level of significance.
B. Reject \( H_0 \) at the \( \alpha = 0.10 \) level of significance.
C. Reject \( H_0 \) at the \( \alpha = 0.05 \) level of significance.
D. Fail to reject \( H_0 \) at the \( \alpha = 0.10 \) level of significance.
E. We cannot perform the required test since we do not know the value of the test statistic.

8. A significance test was performed to test the null hypothesis \( H_0: p = 0.5 \) versus the alternative \( H_a: p > 0.5 \). The test statistic is \( z = 1.40 \). Which of the following is closest to the \( P \)-value for this test?

A. 0.9192
B. 0.1492
C. 0.2984
D. 0.1616
E. 0.0808
Scenario 10-4
Phoebe has a theory that older students at her high school are more likely to bring a bag lunch than younger students, because they have grown tired of cafeteria food. She takes a simple random sample of 80 sophomores and finds that 52 of them bring a bag lunch. A simple random sample of 104 seniors reveals that 78 of them bring a bag lunch. Letting $p_1 =$ proportion of sophomores who bring a bag lunch, and $p_2 =$ proportion of seniors who bring a bag lunch, Phoebe tests the hypotheses

$H_0 : p_1 - p_2 = 0; H_a : p_1 - p_2 < 0$ at the $\alpha = 0.05$ level.

9. Use Scenario 10-4. Phoebe’s test statistic is -1.48. Which of the following is closest to the appropriate $P$-value for the test?
   A. 0.0808
   B. 0.1388
   C. 0.9306
   D. 0.8612
   E. 0.0694

10. A researcher wishes to determine if people are able to complete a certain pencil and paper maze more quickly while listening to classical music. Suppose previous research has established that the mean time needed for people to complete a certain maze (without music) is 40 seconds. The researcher, therefore, decides to test the hypotheses $H_0 : \mu = 40$ versus $H_a : \mu < 40$, where $\mu =$ the time in seconds needed to complete the maze while listening to classical music.
   To do so, the researcher has 10,000 people complete the maze with classical music playing. The mean time for these people is $\bar{x} = 39.92$ seconds, and the $P$-value of his significance test is 0.0002. Which statement below best describes the appropriate conclusion to draw from this study?
   A. The researcher has proved that listening to classical music substantially improves the time it takes to complete the maze.
   B. The researcher has strong evidence that listening to classical music substantially improves the time it takes to complete the maze.
   C. Although the researcher has obtained a statistically significant result, it appears to have little practical significance.
   D. Since the $P$-value is greater than the reciprocal of the sample size, this is not a significant result.
   E. The researcher has moderate evidence that listening to classical music substantially improves the time it takes to complete the maze.
Scenario 10-6
An experiment was conducted to assess the efficacy of spraying oats with malathion (at 0.25 lb/acre) to control the cereal leaf beetle. A sample of 10 farms was selected at random from southwest Manitoba. Each farm was assigned at random to either the control group (no spray) or the treatment group (spray). At the conclusion of the experiment, a plot on each farm was selected, the number of larvae per stem was measured, and a one-tailed test of significance was performed to determine if malathion reduced the number of beetles. Here are two possible outputs from MINITAB, only one of which is correct (some output hidden):

<table>
<thead>
<tr>
<th>Two-sample T for not spray vs spray</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>Not spray</td>
</tr>
<tr>
<td>Spray</td>
</tr>
</tbody>
</table>

Difference = mu (not spray) - mu (spray)
Estimate for difference: 1.04
T-Test of difference = 0 (vs > 0): T-Value = 1.896  P-Value = ****
DF = *****

<table>
<thead>
<tr>
<th>Paired T for not spray - spray</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>Not spray</td>
</tr>
<tr>
<td>Spray</td>
</tr>
</tbody>
</table>

Difference | 5  | 1.04 | **** | **** |

T-Test of mean difference = 0 (vs > 0): T-Value = 1.887  P-Value = ****

___ 11. Use Scenario 10-6. Which of the following is the appropriate test statistic and a possible P-value?
A. 1.896, 0.065
B. 1.887, 0.118
C. 1.887, 0.059
D. 1.896, 0.131
E. 1.896, 0.013

___ 12. Use Scenario 10-6. What does power refer to in this situation?
A. The ability to not detect an effect of malathion when in fact there is no effect.
B. The ability to detect an effect of malathion when in fact there is an effect.
C. The ability to not detect an effect of malathion when in fact there is an effect.
D. The ability to generalize the results of this controlled experiment to other insect pests besides the cereal leaf beetle.
E. The ability to detect an effect of malathion when in fact there is no effect.
**Scenario 9-1**
The water diet requires one to drink two cups of water every half hour from the time one gets up until one goes to bed, but otherwise allows one to eat whatever one likes. Four adult volunteers agree to test the diet. They are weighed prior to beginning the diet and after six weeks on the diet. The weights (in pounds) are

<table>
<thead>
<tr>
<th>Subject</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight before diet</td>
<td>180</td>
<td>125</td>
<td>240</td>
<td>150</td>
</tr>
<tr>
<td>Weight after 6 weeks</td>
<td>170</td>
<td>130</td>
<td>215</td>
<td>152</td>
</tr>
</tbody>
</table>

13. Use Scenario 9-1. Which of the following conditions must be met in order to use a $t$-procedure on these paired data?
   A. The distribution of both pre-diet weights and six-week weights must be approximately Normal.
   B. Only the distribution of differences (after 6 weeks – before) must be approximately Normal.
   C. Only the distribution of pre-diet weights must be approximately Normal.
   D. All three distributions—before diet, after 6 weeks, and the difference—must be approximately Normal.
   E. The distribution of pre-diet weights and the distribution of differences (after 6 weeks – before) must be approximately Normal.

14. All of us nonsmokers can rejoice—the mosaic tobacco virus that affects and injures tobacco plants is spreading! Meanwhile, a tobacco company is investigating if a new treatment is effective in reducing the damage caused by the virus. Eleven plants were randomly chosen. On each plant, one leaf was randomly selected, and one half of the leaf (randomly chosen) was coated with the treatment, while the other half was left untouched (control). After two weeks, the amount of damage to each half of the leaf was assessed. For purposes of comparing the damage, which of the following is the appropriate type of procedure?
   A. Two-sample $t$ procedures
   B. Matched pairs $t$ procedures
   C. Two-sample $z$ procedures
   D. Two proportion $t$ procedures
   E. Two-proportion $z$ procedures
Scenario 10-2
Janice and her cousin Linda are a little competitive about the relative merits of their home towns. One contest they had was to determine who had more rainy days. They found weather records on the internet and each of them randomly selected 60 days from the past 5 years. Janice found that there had been measurable rainfall on 17 of the 60 days she selected for Asheville, and Linda found that there had been measurable rainfall on 12 of the 60 days she selected for Lincoln. They intend to perform a test of significance on their data, using the hypotheses $H_0: p_A - p_L = 0$ versus $H_a: p_A - p_L \neq 0$ and the 0.05 significance level.

15. Use Scenario 10-2. Which of the following best describes what it would mean if Janice and Linda’s test resulted in a Type I error?

A. Choosing the wrong test procedure, such as using a $z$-test instead of a $t$-test.
B. Concluding that there is no difference in the proportion of rainy days in the two cities when there is a difference.
C. Accepting the alternative hypothesis instead of rejecting the null hypothesis.
D. Accepting the null hypothesis instead of rejecting the alternative hypothesis.
E. Concluding that there is a difference in the proportion of rainy days in the two cities when there is no difference.

16. Use Scenario 10-2. When calculating the test statistic, what expression would they use to estimate the standard deviation of the sampling distribution of the difference in proportions, $\hat{p}_A - \hat{p}_L$?

A. $\sqrt{\frac{(0.24)(0.76)}{60} + \frac{(0.24)(0.76)}{60}}$
B. $\sqrt{\frac{12}{60} + \frac{17}{60}}$
C. $\sqrt{\frac{(0.28)(0.72)}{60} + \frac{(0.2)(0.8)}{60}}$
D. $\sqrt{\frac{12^2}{60} + \frac{17^2}{60}}$
E. $\sqrt{\frac{(0.28)(0.72)}{60} + \frac{(0.2)(0.8)}{60}}$

17. Which of the following describes a situation in which it is safe to employ $t$-procedures

A. $n_1=35$, $n_2 = 40$; both samples are approximately normal, sample 2 has two outliers.
B. $n_1=6$, $n_2 = 6$; both samples are approximately normal.
C. $n_1=10$, $n_2 = 8$; sample 1 is approximately normal, while sample 2 is skewed right.
D. $n_1=10$, $n_2 = 40$; both samples are moderately skewed.
E. It is safe to use $t$-procedures in more than one of the situations above.
Scenario 9-3
A medical experiment compared the herb Echinacea with a placebo for preventing colds. The study used 50 different response variables usually associated with colds, such as low-grade fever, congestion, frequency of coughing, etc. The subjects were 40 women between 25 and 40 years of age.

18. Use Scenario 9-3. One response variable was “volume of nasal secretions” (if you have a cold, you blow your nose a lot). Take the average volume of nasal secretions in people without colds to be $\mu = 1$. An increase to $\mu = 3$ indicates a cold. Which of the following describes the significance level of a test of $H_0: \mu = 1$ versus $H_a: \mu > 1$?
A. The probability that the test fails to reject $H_0$ when $\mu = 3$ is true.
B. The probability that the test fails to reject $H_0$ when $\mu = 1$ is true.
C. The probability that the test rejects $H_0$ when $\mu = 1$ is true.
D. The probability that the test rejects $H_0$ when $\mu = 3$ is true.
E. None of the above

19. In a test of $H_0: \mu = 100$ against $H_a: \mu \neq 100$, a sample of size 10 produces a sample mean of 103 and a $P$-value of 0.08. Which of the following is true at the 0.05 level of significance?
A. There is sufficient evidence to conclude that $\mu \neq 100$.
B. There is insufficient evidence to conclude that $\mu \neq 100$.
C. There is sufficient evidence to conclude that $\mu = 100$.
D. There is insufficient evidence to conclude that $\mu = 100$.
E. There is sufficient evidence to conclude that $\mu > 103$.

20. A significance test was performed to test the null hypothesis $H_0: \mu = 2$ versus the alternative $H_a: \mu \neq 2$. A sample of size 28 produced a test statistic of $t = 2.051$. Assuming all conditions for inference were met, which of the following intervals contains the $P$-value for this test?
A. $0.01 \leq P < 0.02$
B. $0.02 \leq P < 0.05$
C. $0.05 \leq P < 0.10$
D. $0.025 \leq P < 0.05$
E. $0.025 \leq P < 0.05$

21. A test of $H_0: \mu = 60$ versus $H_a: \mu \neq 60$ produces a sample mean of $\bar{x} = 58$ and a $P$-value of 0.04. At an $\alpha = 0.05$ level, which of the following is an appropriate conclusion?
A. There is insufficient evidence to conclude that $\mu = 60$.
B. There is sufficient evidence to conclude that $\mu \neq 60$.
C. There is sufficient evidence to conclude that $\mu = 60$.
D. There is sufficient evidence to conclude that $\mu < 60$.
E. There is insufficient evidence to conclude that $\mu \neq 60$.
22. You collect test scores on four members of a population which you can safely assume is approximately Normally distributed and test the hypotheses $H_0: \mu = 100$ versus $H_a: \mu > 100$. You obtain a $p$-value of 0.052. Which of the following statements is true?
A. You can accept $H_a$ at the 5% significance level.
B. You have failed to obtain any evidence for $H_a$.
C. You can accept $H_0$ at the 10% significance level.
D. There is some evidence against $H_0$, and a study using a larger sample size may be worthwhile.
E. At the 5% significance level, you have proved that $H_0$ is true.

23. A medical researcher is working on a new treatment for a certain type of cancer. After diagnosis, the average survival time on the standard treatment is two years. In an early trial, she tries the new treatment on five subjects and finds that they have an average survival time of four years after diagnosis. Although the survival time has doubled, the results of a $t$-test for mean survival time are not statistically significant even at the 0.10 significance level. Which of the following is the best course of action for the researcher?
A. She should expand her research program to include more subjects—this was a very small sample.
B. She should use a $z$-test instead of a $t$-test.
C. She should increase the significance level of her test so that she rejects the null hypothesis, since the treatment clearly has a positive impact.
D. Since the test was not statistically significant, she should abandon study of this treatment and move on to more promising ones.
E. She should reexamine her computations—it is likely that she made an error.

24. The following are percents of fat found in 5 samples of each of two brands of ice cream:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5.7</td>
<td>5.7</td>
</tr>
<tr>
<td>2</td>
<td>4.5</td>
<td>5.7</td>
</tr>
<tr>
<td>3</td>
<td>6.2</td>
<td>5.9</td>
</tr>
<tr>
<td>4</td>
<td>6.3</td>
<td>6.4</td>
</tr>
<tr>
<td>5</td>
<td>7.3</td>
<td>5.1</td>
</tr>
</tbody>
</table>

Which of the following procedures is appropriate to test the hypothesis of equal average fat content in the two types of ice cream?
A. Two-proportion $z$ test
B. Two-sample $t$ test with 9 df.
C. Paired $t$ test with 4 df.
D. Paired $t$ test with 5 df.
E. Two-sample $t$ test with 4 df.

25. We want to test $H_0: \mu = 1.5$ vs. $H_a: \mu \neq 1.5$ at $\alpha = 0.05$. A 95% confidence interval for $\mu$ calculated from a given random sample is (1.4, 3.6). Based on this finding we
A. cannot make any decision at all because the value of the test statistic is not available.
B. cannot make any decision at all because (1.4, 3.6) is only a 95% confidence interval for $\mu$.
C. cannot make any decision at all because the distribution of the population is unknown.
D. reject $H_0$.
E. fail to reject $H_0$.
**Scenario 10-1**

Different varieties of fruits and vegetables have different amounts of nutrients. These differences are important when these products are used to make baby food. We wish to compare the carbohydrate content of two varieties of peaches. The data were analyzed with MINITAB, and the following output was obtained:

<table>
<thead>
<tr>
<th>Variety</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>33.6</td>
<td>3.781</td>
<td>1.691</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>25.0</td>
<td>10.392</td>
<td>3.927</td>
<td></td>
</tr>
</tbody>
</table>

Difference = \( \mu_1 \) (Variety 1) - \( \mu_2 \) (Variety 2)

Estimate for difference: 8.6

T-Test of difference = 0 (vs not =): T-Value = 2.011 P-Value = 0.0791 DF = 8

___ 26. Use Scenario 10-1. We wish to test if the two varieties are significantly different in their mean carbohydrate content. Which of the following are the appropriate null and alternative hypotheses for this situation?

A. \( H_0 \): \( \bar{x}_1 = \bar{x}_2 \); \( H_a \): \( \bar{x}_1 \neq \bar{x}_2 \)

B. \( H_0 \): \( \bar{x}_1 = \bar{x}_2 \); \( H_a \): \( \bar{x}_1 < \bar{x}_2 \)

C. \( H_0 \): \( \mu_1 = \mu_2 \); \( H_a \): \( \mu_1 < \mu_2 \)

D. \( H_0 \): \( \mu_1 = \mu_2 \); \( H_a \): \( \mu_1 > \mu_2 \)

E. \( H_0 \): \( \mu_1 = \mu_2 \); \( H_a \): \( \mu_1 \neq \mu_2 \)

___ 27. The infamous psychologist, Dr. Visegrips, claims that his secret sleep tapes cause people to become better at basic algebra. “All you have to do,” the doctor explains, “is listen to my tapes while you sleep at night, and you’ll be better at algebra in two months.” A math teacher at a local high school has expressed interest but demands evidence. Five people are randomly selected from students at the school. They take an algebra skills test, listen to Dr. Visegrips’ tape for two months while they sleep, and then take a second test. The test scores are as follows:

<table>
<thead>
<tr>
<th>Person</th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>68</td>
<td>70</td>
</tr>
<tr>
<td>B</td>
<td>69</td>
<td>68</td>
</tr>
<tr>
<td>C</td>
<td>74</td>
<td>75</td>
</tr>
<tr>
<td>D</td>
<td>71</td>
<td>72</td>
</tr>
<tr>
<td>E</td>
<td>65</td>
<td>68</td>
</tr>
</tbody>
</table>

Which of the following conditions must be met in order to use a \( t \)-procedure on these paired data?

A. Only the distribution of pre-test scores must be approximately Normal.

B. Only the distribution of differences (after – before) must be approximately Normal.

C. The distribution of pre-test scores and the distribution of differences (after – before) must be approximately Normal.

D. The distribution of both pre-test scores and post-test scores must be approximately Normal.

E. All three distributions—before, after, and the difference—must be approximately Normal.
28. Looking online, you find the salaries of all 25 players for the Chicago Cubs as of opening day of the 2005 baseball season. The club total was $87 million, eighth in the major leagues. Which inference procedure would you use to estimate the average salary of the Cubs players?

A. One-sample $z$ test
B. One-sample $t$ interval for $\mu$
C. One-sample $z$ interval for $\mu$
D. One-sample $t$ test
E. None of these—this is not a situation that calls for inference.
AP Statistics Practice Exam- Chapters 9 - 10
Answer Section

MULTIPLE CHOICE

1. ANS: E /E/Correct! Statements I and III both refer to the independence condition (statement I for finite populations, in particular). Statement II is the Normality condition for two-proportion z-procedures.

    PTS: 1       REF: Test 10C

2. ANS: E /C/Correct! Area under standard normal curve above $z = 0.8$ is 0.2119. Since the test is two-tailed, the $P$-value is $2 \times 0.2119 = 0.4238$.

    PTS: 1       REF: Test 9A

3. ANS: B /E/Correct! The question is whether the students in the Agriculture School are less fit, which means having a higher mean pulse rate. Thus $H_a$ should be greater than the null.

    PTS: 1       REF: Test 9C

4. ANS: E /B/Correct! Type II error is failing to reject $H_0$ when it’s false. So in this context, it is concluding that there is no difference in speed of pain relief when there is a difference.

    PTS: 1       REF: Test 10B

5. ANS: A /E/Correct! Since the $P$-value (0.3796) is larger than $\alpha$ (0.05), we have no convincing evidence against the null, so we cannot reject it. A test of significance only provides evidence against the null hypothesis—it does not provide for the alternative if the $P$-value is small or for the null if the $P$-value is large.

    PTS: 1       REF: Test 10B

6. ANS: A /B/Correct! The critical $t$ for 9 degrees of freedom is 2.262. The formula for the confidence interval is

   \[(\bar{x}_1 - \bar{x}_2) \pm t^* \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}.\]

    PTS: 1       REF: Test 10A

7. ANS: A /B/Correct! Since the null value of 0 is in the 95% confidence interval, we cannot reject $H_0$.

    PTS: 1       REF: Test 9A
8. ANS: E
A/Correct! Area under standard normal curve above $z = 1.40$ is 0.0808.

PTS: 1       REF: Test 9B

9. ANS: E
A/Correct! Percentile for $z = -1.48$ is 0.0694. Since this is a one-tailed test with a “<” alternative hypothesis, this is equivalent to the $P$-value.

PTS: 1       REF: Test 10B

10. ANS: C
D/Correct! A test with such a large sample size will often produce a significant result for a very small departure from the null value. There is little practical significance to a change in finish time of 0.08 seconds.

PTS: 1       REF: Test 9B

11. ANS: A
B/Correct! The appropriate test is the two-sample test, not the paired test, so $t = 1.896$. According to Table B, this test statistic with df = 4 yields a $P$-value between 0.05 and 0.10, and the only choice in that range is 0.065.

PTS: 1       REF: Test 10C

12. ANS: B
C/Correct! Power is $1 - P(\text{Type II error})$, so it’s the probability of rejecting $H_0$ when there is a difference in beetle density between the two groups.

PTS: 1       REF: Test 10C

13. ANS: B
B/Correct! Only the Normality of the differences is important, since we are testing the mean of the difference in weights, not the pre-diet and post-diet mean weights.

PTS: 1       REF: Test 9B

14. ANS: B
C/Correct! The “pairs” are the eleven sets of “leaf halves.” The parameter of interest is the mean difference between the amount of damage on the treatment side of the leaf versus the amount of damage on the control side.

PTS: 1       REF: Test 10B

15. ANS: E
A/Correct! Type I error is rejecting $H_0$ when it’s true, so in this context, it’s concluding that there is a difference in the proportion of rainy days when there is no difference.

PTS: 1       REF: Test 10A
16. ANS: A
/D/Correct! For tests of significance, use the combined estimate \( \hat{p} = \frac{x_1 + x_2}{n_1 + n_2} \) in the formula
 \[
\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}.
\]

PTS: 1  
REF: Test 10A

17. ANS: B
/C/Correct! We can use t-procedures with quite small samples if we have reason to believe that the populations of interest are normally distributed and the samples are similar in size. We cannot use t-procedures if there are outliers or if one or both samples are less than 15 and the population from which the small sample is taken is skewed.

PTS: 1  
REF: Test 10B

18. ANS: C
/A/Correct! Significance level is equivalent to the probability of making a Type I error, which in this case is rejecting \( \mu = 1 \) when it is correct.

PTS: 1  
REF: Test 9C

19. ANS: B
/D/Correct! Since the P-value is greater than \( \alpha \), we have insufficient evidence against \( H_0 \), so we cannot conclude that \( H_0 \) is false. The test only provides evidence against the null, not in support of the alternative.

PTS: 1  
REF: Test 9A

20. ANS: C
/E/Correct! \( t = 2.051 \) is between 0.025 and 0.05 on the t-table for 27 degrees of freedom. Since the test is two-tailed, we double the P-value, so it is between 0.05 and 0.10.

PTS: 1  
REF: Test 9C

21. ANS: B
/E/Correct! Since the P-value is less than \( \alpha \), we have sufficient evidence against \( H_0 \), to conclude that \( H_0 \) is not likely to be true. Since the test is two-tailed, we can conclude only that \( \mu \neq 50 \).

PTS: 1  
REF: Test 9B

22. ANS: D
/C/Correct! A test based on a sample of 4 individuals has very little power, so getting a P-value so close to 0.05 suggests that the likelihood of a Type II error is high. A larger sample would increase the power of the test.

PTS: 1  
REF: Test 9C

23. ANS: A
/E/Correct! A test with a sample size of 5 will have very little power, so the likelihood of a Type II error—not finding a significant different that is present—is very high.

PTS: 1  
REF: Test 9A
24. ANS: E
/B/Correct! These are samples from two independent populations with unknown \( \sigma \), so a two-sample \( t \)-test is appropriate. The conservation choice for degrees of freedom is 1 less than the smaller sample size, or 4.

PTS: 1
REF: Test 10C

25. ANS: E
/A/Correct! Since the null value of 1.5 is in the 95% confidence interval, we cannot reject \( H_0 \).

PTS: 1
REF: Test 9B

26. ANS: E
/C/Correct! The null ("no effect") hypothesis is that the means are the same, and "We wish to test if the two varieties are significantly different..." calls for a two-tailed test.

PTS: 1
REF: Test 10A

27. ANS: B
/D/Correct! Only the Normality of the differences is important, since we are testing the mean of the difference in heights, not the pre-drug and post-drug mean heights.

PTS: 1
REF: Test 9A

28. ANS: E
/E/Correct! Since we already know the salary of every member of this population, we can easily calculate the parameter value. There is no need for statistical inference.

PTS: 1
REF: Test 9C