AP Statistics — Name ____________________

Review Ch. 10 & 11

1. Which of the following would tend to decrease the width of a confidence interval?

I. Increasing the sample size
II. Using a higher confidence level
III. Using a lower confidence level

A. I only B. II only C. III only D. I and II only E. I and III only

2. Each individual in a random sample of 50 internet users was asked how many minutes he/she spends online in a typical day. The data was then used to construct a 99% confidence interval for the mean number of minutes spent online in a typical day for all internet users. The confidence interval was (80, 200) minutes per day. Which of the following is a correct interpretation of the confidence interval?

A. There is a 99% chance that the mean number of minutes spent online in a typical day of all internet users is between 80 and 200.
B. We are 99% confident that the sample mean is between 80 and 200 minutes.
C. We are 99% confident that for all internet users the mean number of minutes spent online in a typical day is between 80 and 200.
D. 99% of all internet users will spend between 80 and 200 minutes online in a typical day.
E. 99% of the people in the sample spent between 80 and 200 minutes online in a typical day.

3. Two-hundred visitors to a national park were selected at random and each was asked how far they had traveled to get to the park on that visit. Which of the following confidence intervals should be used to estimate the mean number of miles traveled by all visitors to the park?

A. $\bar{x} \pm (\text{t critical value})\frac{s}{\sqrt{n}}$ B. $\mu \pm (\text{t critical value})\frac{s}{\sqrt{n}}$ C. $\mu \pm (z\text{ critical value})\frac{\sigma}{\sqrt{n}}$

D. $\bar{x} \pm (\text{z critical value})\frac{\sigma}{\sqrt{n}}$ E. $\hat{p} \pm \left(\text{z critical value}\right)\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$

4. Suppose you take a simple random sample from a population known to be normally distributed, but the value of σ is unknown. Your sample size is n = 10. Which formula below should be used to find the 90% confidence interval for the mean?

A. $\bar{x} \pm 1.645\frac{s}{\sqrt{10}}$ B. $\bar{x} \pm 1.645\frac{\sigma}{\sqrt{10}}$ C. $\bar{x} \pm 1.833\frac{s}{\sqrt{10}}$

D. $\bar{x} \pm 1.812\frac{\sigma}{\sqrt{10}}$ E. $\bar{x} \pm 1.833\frac{\sigma}{\sqrt{10}}$

5. A large sample (n = 250) was used to compute $\bar{x} \pm \frac{s}{\sqrt{n}}$. This interval is equivalent to a

A. 50% confidence interval.
B. 68% confidence interval.
C. 84% confidence interval.
D. 90% confidence interval.
E. 95% confidence interval.

6. Which of the following is certain to reduce the width of a confidence interval?

A. larger sample size and higher confidence level
B. larger sample size and lower confidence level
C. smaller sample size and higher confidence level
D. smaller sample size and lower confidence level
E. None of the above.

7. What is the difference between a t-interval and z-interval?

A. z-intervals are used if you know the population's standard deviation and t-intervals are used when you do not know the population's standard deviation.
B. t-intervals are used if you know the population's standard deviation and z-intervals are used when you do not know the population's standard deviation.
C. t-intervals are used when the sample size is much larger than in z-intervals
D. z-intervals are used when the data are not normally distributed
E. t-intervals use the sample size where z-intervals use n-1 degrees of freedom

8. A researcher wants to find a reasonable interval of the mean time it takes to complete an order over the phone at a call center for a large retail company. He has selected a sample of 18 calls and recorded the time to completion on the phone to be 4.27 minutes with a standard deviation of 0.78 minutes. What is the appropriate interval if he wants to use a 98% confidence level?

A. $4.27 \pm 2.326\left(\frac{0.78}{\sqrt{18}}\right)$ B. $4.27 \pm 2.054\left(\frac{0.78}{\sqrt{17}}\right)$ C. $4.27 \pm 2.552\left(\frac{0.78}{\sqrt{18}}\right)$

D. $4.27 \pm 2.567\left(\frac{0.78}{\sqrt{18}}\right)$ E. $4.27 \pm 2.567\left(\frac{0.78}{\sqrt{17}}\right)$

9. The average number of minor medical needs at any Army hospital in Iraq over a 49-day period was found to be 11.2 with a standard deviation of 3.6 per day. With what degree of confidence can we say that the minor medical needs at the Army hospital per day is between 10.3 and 12.1?

A. 80% B. 85% C. 90% D. 95% E. 98%

10. What assumptions are necessary for a 95% t-interval with a sample size of 9 to be valid?

I. The sample was selected randomly from the population of interest.
II. The population standard deviation is known
III. The sample can be shown to be approximately normal with no skewness.

A. I only B. III only C. I and II only D. I and III only E. I, II and III

11. A 98% confidence interval for a population mean is found to be 127 ± 18. Which of the following is a correct interpretation of this level?

A. There is 98% probability that the true mean is contained in this interval.
B. There is 98% probability that the sample mean is contained in this interval.
C. There is 98% probability that another interval will give a true mean of 127.
D. If 100 samples of the same size are taken again, about 98 of them will contain the true mean value.
E. If 100 samples of the same size are taken again, about 98 of them will contain the true sample value.

12. When the sample size is increased what effect does this have on the size of the confidence interval?

A. It makes it wider. Depending on how much the sample is increased by, this will make the interval wider.
B. It will make the interval narrower. The larger the sample gets, the smaller the width of the interval.
C. It will have no effect on the width because this would only change based on the level of confidence.
D. It will double the width of the interval since you are now multiplying by and additional $\sqrt{n}$ size.
E. It will cut the interval in half since you are now dividing by an additional $\sqrt{n}$ size.

13. A test engineer wants to estimate the mean gas mileage μ (in miles per gallon) for a particular model of automobile. Eleven of these cars are subjected to a road test, and the gas mileage is computed for each car. A dotplot of the 11 gas-mileage values is roughly symmetrical and has no outliers. The mean and standard deviation of these values are 25.5 and 3.01, respectively. Assuming that these 11 automobiles can be considered a simple random sample of cars of this model, which of the following is a correct statement?

A. A 95% confidence interval for μ is $25.5 \pm 2.228\left(\frac{3.01}{\sqrt{11}}\right)$

B. A 95% confidence interval for μ is $25.5 \pm 2.201\left(\frac{3.01}{\sqrt{11}}\right)$

C. A 95% confidence interval for μ is $25.5 \pm 2.228\left(\frac{3.01}{\sqrt{10}}\right)$

D. A 95% confidence interval for μ is $25.5 \pm 2.201\left(\frac{3.01}{\sqrt{10}}\right)$

E. The results cannot be trusted; the sample is too small.

14. A random sample has been taken from a population. A statistician, using this sample, needs to decide whether to construct a 90 percent confidence interval for the population mean or a 95 percent confidence interval for the population mean. How will these intervals differ?

A. The 90 percent confidence interval will not be as wide as the 95 percent confidence interval.
B. The 90 percent confidence interval will be wider than the 95 percent confidence interval.
C. Which interval is wider will depend on how large the sample is.
D. Which interval is wider will depend on whether the sample is unbiased.
E. Which interval is wider will depend on whether a z-statistic or a t-statistic is used.

15. A quality control inspector must verify whether a machine that packages snack food is working correctly. The inspector will randomly select a sample of packages and weigh the amount of snack food in each. Assume that the weights of food in packages filled by this machine have a standard deviation of 0.30 ounce. An estimate of the mean amount of snack food in each package must be reported with 99.6 percent confidence and a margin of error of no more than 0.12 ounce. What would be the minimum sample size for the number of packages the inspector must select?

A. 8 B. 15 C. 25 D. 52 E. 60

16. An engineer for the Allied Steel Company has the responsibility of estimating the mean carbon content of a particular day's steel output, using a random sample of 15 rods from that day's output. The actual population distribution of carbon content is not known to be normal, but graphic displays of the engineer's sample results indicate that the assumption of normality is not unreasonable. The process is newly developed, and there are no historical data on the variability of the process. In estimating this day's mean carbon content, the primary reason the engineer should use a t-confidence interval rather than a z-confidence interval is because the engineer

A. is estimating the population mean using the sample mean
B. is using the sample variance as an estimate of the population variance
C. is using data, rather than theory, to judge that the carbon content is normal
D. is using data from a specific day only
E. has a small sample, and a z-confidence interval should never be used with a small sample

17. Based on a random sample of 50 students, the 90 percent confidence interval for the mean amount of money students spend on lunch at a certain high school is found to be (\$3.45, \$4.15). Which of the following statements is true?

A. 90% percent of the time, the mean amount of money that all students spend on lunch at this high school will be between \$3.45 and \$4.15.
B. 90% of all students spend between \$3.45 and \$4.15 on lunch at this high school.
C. 90% of all random samples of 50 students obtained at this high school would result in a sample mean amount of money students spend on lunch between \$3.45 and \$4.15.
D. 90% of all random samples of 50 students obtained at this high school would result in a 90% confidence interval that contain the true mean amount of money students spend on lunch.
E. Approximately 45 of the 50 students in the random sample will spend between \$3.45 and \$4.15 on lunch at this high school.

18. The National Honor Society at Central High School plans to sample a random group of 100 seniors from all high schools in the state in which Central High School is located to determine the average number hours per week spent on homework. A 95 percent confidence interval for the mean number of hours spent on homework will then be constructed using the sample data. Before selecting the sample, the National Honor Society decides that it wants to decrease the margin of error. Which of the following is the best way to decrease the margin of error?

A. Increase the confidence level to 99%
B. Use the population standard deviation
C. Use the sample standard deviation
D. Increase the sample size
E. Decrease the sample size

19. Suppose we have two SRSs from two distinct populations and the samples are independent. We measure the same variable for both samples. Suppose both populations of the values of these variables are normally distributed but the means and standard deviations are unknown. For purposes of comparing the two means, we use

A. Two-sample t procedures
B. Matched pairs t procedures
C. Two-proportion z procedures
D. The least-squares regression line
E. None of the above.

20. To use the two-sample t procedure to perform a significance test on the difference between two means, we assume that

A. the populations' standard deviations are known.
B. the samples from each population are independent.
C. the distributions are exactly Normal in each population.
D. the sample sizes are large.
E. all of the above

21. A study was conducted to estimate the effectiveness of doing assignments in an introductory statistics course. Students in one section, taught by Instructor A, received no assignments. Students in another section, taught by Instructor B, received assignments. The final grade of each student was recorded. A 95% confidence interval for the difference in the mean grades (Section A $-$ Section B) was computed to be -3.5 ± 1.8. This means that

A. there is evidence that doing assignments improves the average grade since the difference in the population means is less than zero.
B. there is little evidence that doing assignments improves the average grade since the 95% confidence interval does not cover 0.
C. there is evidence that doing assignments improves the average grade since the 95% confidence interval does not cover 0.
D. there is evidence that doing assignments does not improve the average grade since the 95% confidence interval does not cover 0.
E. there is little evidence that doing assignments does not improve the average grade since the 95% confidence interval does cover 0.

22. The average minutes of time spent listening to MP3 players by students was recorded in the table below by a record producer. The information was recorded by race as they were interested in knowing if the race of a student made a difference in the amount of time spent listening to music.

Race	**N**	**Mean Time (minutes)**	**Standard Deviation**
Black	152	168	12.5
White	108	157	15.8

What would a 95% confidence interval mean?

A. I am 95% confident that the sample mean difference is (7.4, 14.7) minutes.
B. I am 95% confident that the true mean difference in time spent listening to MP3 players is (7.4, 14.7) minutes.
C. I am 95% confident that the true proportional difference in time spent listening to MP3 players is (7.4, 14.7) minutes.
D. I know that 95 out of 100 times the mean difference in time is (7.4, 14.7) minutes.
E. 95 of the sample differences were (7.4, 14.7) minutes

23. A student working on a history project decided to find a 95 percent confidence interval for the difference in mean age at the time of election to office for former American Presidents versus former British Prime Ministers. The student found the ages at the time of election to office for the members of both groups, which included all the American Presidents and all of the British Prime Ministers and used a calculator to find the 95 percent confidence interval based on the t-distribution. This procedure is not appropriate in this context because

A. the sample sizes for the two groups are not equal
B. the entire population was measured in both cases, so the actual difference in means can be computed and a confidence interval should not be used
C. elections to office take place at different intervals in the two countries, so the distribution of ages cannot be the same
D. ages at the time of election to office are likely to be skewed rather than bell-shaped, so the assumptions for using this confidence interval formula are not valid
E. ages at the time of election to office are likely to have a few large outliers, so the assumptions for using this confidence interval formula are not valid

24. The manager of a large hotel must decide whether to hire additional front desk staff. He has decided to hire more staff if there is evidence that the average time customers must wait in line before being assisted with check-in is greater than 3 minutes. He decides to test H_0: $\mu = 3$ versus H_a: $\mu > 3$. Which of the following would be a consequence of making a Type II error?

A. Deciding not to hire additional staff when the wait time really is greater than 3 minutes.
B. Deciding not to hire additional staff when the wait time really is not greater than 3 minutes.
C. Deciding to hire additional staff when the wait time really is greater than 3 minutes.
D. Deciding to hire additional staff when the wait time really is not greater than 3 minutes.
E. Deciding that a wait time of greater than 3 minutes is acceptable.

25. The marketing department of a national department store chain designs its advertising to target 18 – 24 year-olds. The marketing manager worries that the average age of the chain's customers is greater than 24, in which case the marketing plan should be reconsidered. He decides to survey a random sample of 100 customers and will use the resulting data to test H_0: $\mu = 24$ versus H_a: $\mu > 24$, where μ is the mean customer age. Suppose that the P-value from this test was .03. Which of the following is a correct interpretation of this P-value?

A. The probability that the null hypothesis is true is .03.
B. The probability that the null hypothesis is false is .03.
C. When the null hypothesis is true, the probability of seeing results as or more extreme than what was observed in the sample is .03.
D. When the null hypothesis is false, the probability of seeing results as extreme as what was observed in the sample is .03.
E. Approximately 3% of the chain's customers are older than 24.

26. Which of the following affects the power of a test?

I. The sample size
II. The significance level of the test
III. The size of the discrepancy between the actual value and the hypothesized value of the population characteristic

A. I only
B. II only
C. III only
D. I and II only
E. I, II and III

27. In a test of H_0: $\mu = 100$ versus H_a: $\mu > 100$, the power of the test will be lowest when the true value of the population mean is

A. 101 B. 110 C. 120 D. 200 E. The power will be the same for any value greater than 100.

28. A psychologist runs a study and reports her results were statistically significant at the 0.05 level. This result means which of the following?

A. The P-value calculated was smaller than the α level of 0.05.
B. The P-value calculated was larger than the α level of 0.05.
C. The α level calculated was larger than 0.05.
D. The α level calculated was smaller than 0.05.
E. There is insufficient information to make a decision.

29. A Type I error occurs in which of the following?

A. The H_a is rejected when it should not be rejected.
B. The H_0 is not rejected when it should be rejected.
C. The H_0 is rejected when it should not be rejected.
D. The P-value is too small to reject the H_0.
E. The α level is too small to reject H_0.

30. A Type II error occurs in which of the following?

A. The H_0 is rejected when it should not be rejected.
B. The H_0 is not rejected when it should be rejected.
C. The H_a is not rejected when it should be rejected.
D. The P-value is too small to reject the H_0.
E. The α level is too small to reject H_0.

31. An animal rights group has been very supportive of a new silicon product that caps the nails on cats instead of surgically declawing the pets. The company who makes the caps claims they last for an average of 69 days before needing to be replaced. Before publically advertising their support of the product, the animal rights group plans to run a test to see if the caps last less than 69 days. What would be the appropriate hypotheses for this study?

A. H_0: $\mu = 69$ days, H_a: $\mu > 69$ days
B. H_0: $\mu = 69$ days, H_a: $\mu < 69$ days
C. H_0: $\mu = 69$ days, H_a: $\mu \neq 69$ days
D. H_0: $\bar{x} = 69$ days, H_a: $\bar{x} > 69$ days
E. H_0: $\bar{x} = 69$ days, H_a: $\bar{x} < 69$ days

32. The heights (in inches) of males in the United States are believed to be normally distributed with mean μ. The average height of a random sample of 25 American adult males is found to be 69.72 inches and the standard deviation of the 25 heights is found to be 4.15 inches. The standard error of the sample mean is

A. 0.17 B. 0.41 C. 0.69 D. 0.83 E. 2.04

Use the following to answer questions 33 through 36

An SRS of 100 postal employees found that the average amount of time these employees had worked for the U.S. Postal Service was $\bar{X} = 7$ years, with a standard deviation of $s = 2$ years. Assume the distribution of the time the population of all postal employees has worked for the Postal Service is approximately normal with mean μ. Do the observed data represent evidence that μ has changed from its value of 7.5 years of 20 years ago? To determine this, we test the hypotheses H_0: $\mu = 7.5$, H_a: $\mu \neq 7.5$ using the one-sample t test.

33. The appropriate degrees of freedom for this test are

A. 9 B. 10 C. 19 D. 99 E. 100

34. The P-value for the one-sample t test is

A. larger than 0.10. B. between 0.05 and 0.10. C. between 0.01 and 0.05. D. below 0.01. E. impossible to determine

35. A 95% confidence interval for the mean number of years μ that a current Postal Service employee has spent with the Postal Service is

A. 7 ± 2 B. 7 ± 1.984 C. 7 ± 0.4 D. 7 ± 0.3 E. 7 ± 0.2

36. Suppose the mean and standard deviation we obtained were based on a sample of 25 postal workers, rather than 100. The P-value would be

A. larger.
B. smaller.
C. unchanged, since the difference between the sample mean and the hypothesized value μ =7.5 is unchanged.
D. unchanged, since both groups of workers have the same type of job.
E. unchanged, since the variability measured by the standard deviation stays the same.

Use the following to answer questions 37 and 38:

Bags of a certain brand of tortilla chips are claimed to have a net weight of 14 ounces. Net weights actually vary slightly from bag to bag and are normally distributed with mean μ. A representative of a consumer advocate group wishes to see if there is any evidence that the mean net weight is less than advertised and so intends to test the hypotheses H_0: $\mu = 14$, H_a: $\mu < 14$.
To do this, he selects 16 bags of this brand at random and determines the net weight of each. He finds the sample mean to be $\bar{X} = 13.88$ ounces and the sample standard deviation to be $s = 0.24$ ounces.

37. Based on the data above,

A. we would reject Ho at significance level 0.10 and not a level 0.05.
B. we would reject Ho at significance level 0.05 and not a level 0.025.
C. we would reject Ho at significance level 0.025 and not a level 0.01.
D. we would reject Ho at significance level 0.01 and not a level 0.001.
E. we would reject Ho at significance level 0.001.

38. Referring to the information above, suppose we were not sure if the distribution of net weights was normal. In which of the following circumstances would it not be safe to use a t procedure in this problem?

A. The mean and median of the data are nearly equal.
B. A stemplot of the data is roughly bell-shaped.
C. A stemplot of the date displays a large outlier.
D. The sample standard deviation is large.
E. A histogram of the data displays moderate skewness.

39. What would be the appropriate hypotheses for a research company who wants to see if there is a difference in the mean vitamin potency (μ_b) of a name brand and the mean vitamin potency (μ_v) of a generic brand?

A. $Ho: \mu_b - \mu_v = 0, \quad Ha: \mu_b - \mu_v > 0$
B. $Ho: \mu_b - \mu_v = 0, \quad Ha: \mu_b - \mu_v < 0$
C. $Ho: \mu_b - \mu_v = 0, \quad Ha: \mu_b - \mu_v \neq 0$
D. $Ho: \bar{x}_b - \bar{x}_v = 0, \quad Ha: \bar{x}_b - \bar{x}_v > 0$
E. $Ho: \bar{x}_b - \bar{x}_v = 0, \quad Ha: \bar{x}_b - \bar{x}_v \neq 0$

40. The water diet requires the dieter to drink two cups of water every half hour from when he gets up until he goes to bed, but otherwise allows him to eat whatever he 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

Person	1	2	3	4
Weight before the diet	180	125	240	150
Weight after six weeks	170	130	215	152

For the population of all adults, assume that weight loss (in pounds) after six weeks on the diet (weight before beginning the diet – weight after six weeks on the diet) is normally distributed with mean μ. To determine if the diet leads to significant weight loss, we test the hypotheses H_0: $\mu = 0$, H_a: $\mu > 0$. Based on these data,

A. we would not reject H_0 at significance level 0.10.
B. we would reject H_0 at significance level 0.10 but not at level 0.05.
C. we would reject H_0 at significance level 0.05 but not at level 0.01.
D. we would reject H_0 at significance level 0.01 but not at level 0.001.
E. we would reject H_0 at significance level 0.001.

41. Two independent samples were studied. The statistics that were collected were $\bar{x}_1 = 10, s_{\bar{x}_1} = 2.1, n_1 = 108$ *and* $\bar{x}_2 = 15, s_{\bar{x}_2} = 2.9, n_2 = 78$. Which could be an appropriate test statistic for this study?

A. $z = \dfrac{10-15}{\sqrt{\dfrac{2.1}{108} + \dfrac{2.9}{78}}}$

B. $z = \dfrac{10-15}{\sqrt{\dfrac{2.1^2}{108} + \dfrac{2.9^2}{78}}}$

C. $t = \dfrac{10-15}{\sqrt{\dfrac{2.1}{108} + \dfrac{2.9}{78}}}$

D. $t = \dfrac{10-15}{\sqrt{\dfrac{2.1^2}{107} + \dfrac{2.9^2}{77}}}$

E. $t = \dfrac{10-15}{\sqrt{\dfrac{2.1^2}{108} + \dfrac{2.9^2}{78}}}$

42. A national survey found that the mean difference in the number of minutes boys and girls watch TV to have a t = 2.34 and a p = 0.01. If the alternative question was Ha: $\mu_b - \mu_g > 0$ and $\alpha = 0.05$, what conclusion could be drawn?

A. There was not a significant difference in the minutes of TV viewing between boys and girls
B. There is strong evidence that there is a difference in the minutes of TV viewing between boys and girls.
C. There is strong evidence that boys watch TV more than girls based on the data shown.
D. The proportion of boys watching TV is greater than the proportion of girls.
E. There is insufficient evidence that the proportion of boys and girls watching TV is different.

Questions 43 – 44 refer to the following set of data.
When a virus is placed on a tobacco leaf, small lesions appear on the leaf. To compare the mean number of lesions produced by two different strains of virus, one strain is applied to half of each of 8 tobacco leaves, and the other strain is applied to the other half of each leaf. The strain that goes on the right half of the tobacco leaf is decided by a coin flip. The lesions that appear on each half are then counted. The data are given below.

Leaf	1	2	3	4	5	6	7	8
Strain 1	31	20	18	17	9	8	10	7
Strain 2	18	17	14	11	10	7	5	6

43. What is the number of degrees of freedom associated with the appropriate t test for testing to see if there is a difference between the mean number of lesions per leaf produced by the two strains?

A. 7 B. 8 C. 11 D. 14 E. 16

44. Is the statistical evidence that one strain of the virus creates more lesions than the other strain?

A. Yes, at $\alpha = 0.01$. $Ho: \mu_1 - \mu_2 = 0$, $Ha: \mu_1 - \mu_2 \neq 0$ gives p = 0.26, df = 11; 0.26 > 0.01
B. No, at $\alpha = 0.01$. $Ho: \mu_1 - \mu_2 = 0$, $Ha: \mu_1 - \mu_2 \neq 0$ gives p = 0.26, df = 11; 0.26 > 0.01
C. No, at $\alpha = 0.01$. $Ho: \mu_1 = \mu_2$, $Ha: \mu_1 \neq \mu_2$ gives p = 0.26, df = 11; 0.26 > 0.01
D. Yes, at $\alpha = 0.01$. $Ho: \mu_d = 0$, $Ha: \mu_d \neq 0$ gives p = 0.034, df = 7; 0.034 < 0.01
E. No, at $\alpha = 0.01$. $Ho: \mu_d = 0$, $Ha: \mu_d \neq 0$ gives p = 0.034, df = 7; 0.034 > 0.01

45. Ten men and women were given a supplement for weight loss, and pounds of loss were measured at the end of one month. The data is shown below.

Subject	1	2	3	4	5	6	7	8	9	10
Male	5	8	12	7	9	11	10	16	8	14
Female	4	9	8	6	11	7	8	12	10	13

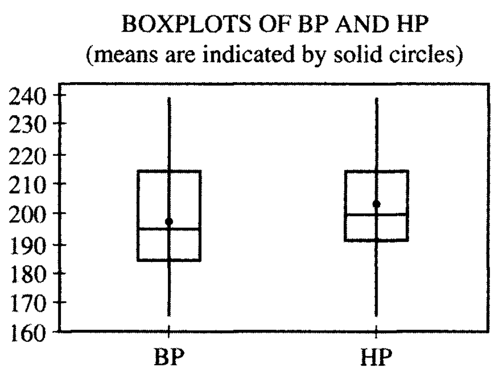
State an appropriate set of hypotheses if μ_m = men, μ_w = women, and μ_d = difference.

A. Ho: $\mu_m - \mu_w = 0$, Ha: $\mu_m - \mu_w \neq 0$
B. Ho: $\mu_m - \mu_w = 0$, Ha: $\mu_m - \mu_w > 0$
C. Ho: $\mu_m - \mu_w = 0$, Ha: $\mu_m - \mu_w < 0$
D. Ho: $\mu_d = 0$, Ha: $\mu_d \neq 0$
E. Ho: $\mu_d = 0$, Ha: $\mu_d > 0$

46. Dan, a trainer at the Popular Gym, was interested in comparing levels of physical fitness of students attending a nearby community college and those attending a 4-year college in town. He selected a random sample of 320 students from the community college. The mean and standard deviation of their fitness scores were 95 and 10, respectively. Dan also selected a random sample of 320 students from a 4-year college. The mean and standard deviation of their fitness scores were 92 and 13, respectively. He then conducted a two-sided *t*-test that resulted in a *t*-value of 3.27. Which of the following is an appropriate conclusion from this study?

A. Because the sample means only differed by 3, the population means are not significantly different.
B. Because the second group had a larger standard deviation, their mean fitness score is significantly higher.
C. Because the second group had a larger standard deviation, the mean fitness score of the first group is significantly higher.
D. Because the p-value is less than $\alpha = 0.05$, the mean fitness scores for the two groups of students are significantly different.
E. Because the p-value is greater than $\alpha = 0.05$, the mean fitness scores for the two groups of students are significantly different

47. In a study of the weights of college athletes, player weights for a random sample of baseball players (BP) and for an independent random sample of hockey players (HP) were compared. The computer output shown below gives the result of a test of H_0: $\mu_{BP} = \mu_{HP}$ *versus* H_a: $\mu_{BP} < \mu_{HP}$.



Two Sample T-Test and Confidence Interval

Two sample T for BP vs HP

	N	Mean	StDev	SE Mean
BP	37	197.8	19.4	3.2
HP	34	204.2	17.7	3.0

95% CI for μ BP − μ HP: (−15.1, 2.4)
T-Test μ BP = μ HP (vs <): T = −1.45 P = 0.076 DF = 69

Which of the following is the best conclusion that can be drawn from the analysis?

A. The mean weight of baseball players is not significantly lower than the mean weight of hockey players at the 0.05 level.
B. The mean weight of baseball players is not significantly lower than the mean weight of hockey players at the 0.10 level.
C. The mean weight of baseball players is significantly higher than the mean weight of hockey players at the 0.10 level.
D. The mean weight of baseball players is significantly lower than the mean weight of hockey players at the 0.05 level.
E. The mean weight of baseball players is significantly different from the mean weight of hockey players at the 0.05 level.

48. A study was conducted using data collected on the birth weights of a random sample of 10 pairs of identical twins to determine whether the twin born first tends to weigh more than the twin born second. Let μ_F represent the average birth weight of all twins born first, μ_S represent the average birth weight of all twin born second, and μ_D represent the average difference in birth weight (weight of first minus weight of second) for all pairs of twins. Which of the following would be the null and alternative hypotheses for this study?

A. H_0: $\mu_F = \mu_S$ and H_a: $\mu_F < \mu_S$
B. H_0: $\mu_F = \mu_S$ and H_a: $\mu_F \neq \mu_S$
C. H_0: $\mu_D = 0$ and H_a: $\mu_D > 0$
D. H_0: $\mu_F - \mu_S = \mu_D$ and H_a: $\mu_F - \mu_S > \mu_D$
E. H_0: $\mu_F - \mu_S = \mu_D$ and H_a: $\mu_F - \mu_S \neq \mu_D$

49. A manufacturer claims its Brand A battery lasts longer than its competitor's Brand B battery. Nine batteries of each brand are tested independently, and the hours of battery life are shown in the table below.

Brand *A*	88	85	80	81	72	90	85	85	84
Brand *B*	80	79	77	82	75	81	77	73	78

Provided that the assumptions for inference are met, which of the following tests should be conducted to determine if Brand A batteries do, in fact, last longer than Brand B batteries?

A. A one-sided, paired t-test
B. A one-sided, two-sample t-test
C. A two-sided, two-sample t-test
D. A one-sided, two-sample z-test
E. A two-sided, two-sample z-test

50. A statistics student wants to compare the mean times needed to access flight information for two major airlines. Twenty randomly selected students accessed one airline's Web site, and the time required to locate the flight information using the Web site had a mean of 2.5 minutes and a standard deviation of 0.8 minutes. Twenty different randomly selected students accessed the other airline's Web site, and the time required to locate the flight information using the Web site has a mean of 2.1 minutes and a standard deviation of 1.1 minutes. Assuming that the conditions for inference are met, which of the following statements about the p-value obtained from the data and the conclusion of the significance test is true?

A. The p-value is less than 0.01; therefore, there is a significant difference in mean search times on the two Web sites.
B. The p-value is greater than 0.01 but less than 0.05; therefore, there is a significant difference in mean search times on the two Web sites.
C. The p-value is greater than 0.05 but less than 0.10; therefore, there is a significant difference in mean search times on the two Web sites.
D. The p-value is greater than 0.10; therefore, there is no significant difference in mean search times on the two Web sites.
E. Since this is a matched-pairs situation, additional information is needed to perform a test of significance.

51. To determine whether employees at Site X have higher salaries, on average, than employees at Site Y of the same company do, independent random samples of salaries were obtained for the two groups. The data are summarized below.

	Site *X*	Site *Y*
Mean	\$61,234	\$60,529
Standard Deviation	\$4,352	\$3,456
n	235	183

Based on the data, which of the following statements is true?
A. At the 5% significance level, employees at Site Y have a significantly higher mean salary than employees at Site X do.
B. At the 1% significance level, employees at Site Y have a significantly higher mean salary than employees at Site X do.
C. At the 5% significance level, employees at Site X have a significantly higher mean salary than employees at Site Y do.
D. At the 1% significance level, employees at Site X have a significantly higher mean salary than employees at Site Y do.
E. At the 10% significance level, there is no significant difference in salaries between the employees at the two sites.

52. A randomized experiment was performed to determine whether two fertilizers, A and B, give different yields of tomatoes. A total of 33 tomato plants were grown; 16 using fertilizer A, and 17 using fertilizer B. The distributions of the data did not show marked skewness and there were no outliers in either data set. The results of the experiment are shown below.

	Fertilizer A	Fertilizer B
Average number of tomatoes per plant	19.54	23.39
Standard deviation	3.68	4.93
Number of plants	16	17

Which of the following statements best describes the conclusion that can be drawn from this experiment?

A. There is no statistical evidence of difference in the yields between fertilizer A and fertilizer B ($p > 0.15$).
B. There is a borderline statistically significant difference in the yields between fertilizer A and fertilizer B ($0.10 < p < 0.15$).
C. There is evidence of a statistically significant difference in the yields between fertilizer A and fertilizer B ($0.05 < p < 0.10$).
D. There is evidence of a statistically significant difference in the yields between fertilizer A and fertilizer B ($0.01 < p < 0.05$).
E. There is evidence of a statistically significant difference in the yields between fertilizer A and fertilizer B ($p < 0.01$).

Free Response

53. An AP coordinator in an urban school district mandates that AP students take a practice exam, called a Mock Exam, in the spring to help identify student potential scores on the upcoming exam in May. A random sample of AP students' Mock Exam was taken and the scores recorded. The results for 28 of the students were found to be:

AP Mock Exam Scores

58	76	74	80	88	74	65
97	66	95	77	63	83	73
64	71	60	68	70	63	71
57	75	74	52	71	81	82

a. Construct and interpret a 90% confidence interval for the mean score on the AP Mock Exams given in this district.

b. The district has found in previous years that their students tend to score a passing score on the national exam (that is 3-5) if the Mock scores are at least a 70. Can the AP coordinator feel confident in this year's results? Explain how you arrived at this conclusion.

54. Two types of fertilizer (type A and type B) for roses are being considered by a housing community for their landscaping needs. The community decided to test the fertilizer on 170 bushes to see if one yielded more rose growth than the other. The average growth, in centimeters, for each fertilizer was recorded. One fertilizer is less expensive and you have been asked to make a decision whether the two fertilizers are basically yielding the same amount of growth.

Fertilizer	**n**	**Mean Growth (cm)**	**Standard Deviation**
Type A	87	12.7	1.5
Type B	83	13.8	2.2

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a. Run an appropriate test to make this decision and explain to the community which type to buy and why.

b. Construct and interpret a 95% confidence interval for the mean difference in plant growth between the two populations of fertilizer type. No need to check your conditions again.

55. The following data show the sugar content (as percentage of weight) of several randomly selected boxes of children's and adults' cereal.

Children's cereals:

40.3	55	45.7	43.3	50.3	45.9	53.5	43	44.2	44	47.4	44	33.6	55.1
48.8	50.4	37.8	60.3	46.6									

Adults' cereals:

20	30.2	2.2	7.5	4.4	22.2	16.6	14.5	21.4	3.3	6.6	7.8	10.6	16.2
14.5	4.1	15.8	4.1	2.4	3.5	8.5	10	1	4.4	1.3	8.1	4.7	18.4

Is this good evidence that there is a difference in mean sugar content between children's cereal and adults' cereal?

56. A growing number of employers are trying to hold down the costs that they pay for medical insurance for their employees. As part of this effort, many medical insurance companies are now requiring clients to use generic brand medicines when filling prescriptions. An independent consumer advocacy group wanted to determine if there was a difference, in milligrams, in the amount of active ingredient between a certain "name" brand drug and its generic counterpart. Pharmacies may store drugs under different conditions. Therefore, the consumer group randomly selected ten different pharmacies in a large city and filled two prescriptions at each of these pharmacies, one for the "name" brand and the other for the generic brand of the drug. The consumer group's laboratory then tested a randomly selected pill from each prescription to determine the amount of active ingredient in the pill. The results are given in the following table.

ACTIVE INGREDIENT
(in milligrams)

Pharmacy	1	2	3	4	5	6	7	8	9	10
Name brand	245	244	240	250	243	246	246	246	247	250
Generic brand	246	240	235	237	243	239	241	238	238	234

Based on these results, what should the consumer group's laboratory report about the difference in the active ingredient in the two brands of pills? Give appropriate statistical evidence to support your response.

Answers

1. E	2. C	3. A	4. C	5. B	6. B	7. A	8. D
9. C	10. D	11. D	12. B	13. A	14. A	15. D	16. B
17. D	18. D	19. A	20. B	21. C	22. B	23. B	24. A
25. C	26. E	27. A	28. A	29. C	30. B	31. B	32. D
33. D	34. C	35. C	36. A	37. B	38. C	39. C	40. A
41. E	42. C	43. A	44. E	45. A	46. D	47. A	48. C
49. B	50. D	51. C	52. D				

53. a. **State**: Construct a 90% confidence interval μ, the mean score on the AP Mock Exam.
Plan: A 1 sample t interval for μ. Random: A random sample was taken. 10%: 28 < 1/10 all takers of the AP Mock exam. Normal/Large Sample: Since n = 28 which is less than 30 look at a graph. A dotplot of the data shows no major skewness or outliers.
Do: (69, 76)
Conclude: We are 90% confident that the interval 69 to 76 captures the true mean score on the AP Mock Exam.

b. Since the interval is from 69 to 76, I am 90% confident that the true mean AP Mock score is contained in this interval. Further, since the district is looking for students to score 70 and 70 is contained in the interval found; it is a reasonable conclusion that the district coordinator can be confident in the students' results this year.

54. a. **State:** Ho: $\mu_A - \mu_B$=0 and Ha: $\mu_A - \mu_B \neq 0$ where μ_A is the mean rose growth with fertilizer A and μ_B is the mean rose growth with fertilizer B. We will use α = .05.
Plan: We want to do a 2 sample t-test for $\mu_A - \mu_B$
Random – assuming plants were randomly assigned to the two different fertilizers. 10% -- Not needed.
Normal/Large Sample – Both samples are more than 30.
Do: t = -3.79 with df = 143 (calculator), P = 0.00022. **Conclude:** Since P-value < 0.05, W reject the null, there is convincing evidence that the fertilizers are not the same and one seems better than the other. I would recommend Type B since it seems to be better than A based on the samples

b. **State:** Construct 95% confidence interval for $\mu_A - \mu_B$. Same parameters as part a.
Plan: Same as part a, except a 2 sample t interval for $\mu_A - \mu_B$
Do: (-1.67, -0.53).
Conclude: We are 95% confident that the interval -1.67 and -0.53 centimeters contains the mean difference in plant growth between fertilizer A and fertilizer B. Since 0 is not contained in the interval, it seems that fertilizer B produces more plant growth than fertilizer A

55. **State:** Ho: $\mu_c - \mu_a$=0 and Ha: $\mu_c - \mu_a \neq 0$ where μ_c is the mean sugar content of children's cereal and μ_a is the mean sugar content of adults' cereal. We will use α= 0.05.
Plan: Do a 2 sample t-test for $\mu_c - \mu_a$. SRS -- The cereals were randomly selected. 10% -- 19 < 1/10 of all children's cereals and 28 < 1/10 of all adult cereals. Normality: Since both samples are less than 30 we look at the boxplot of each sample. Neither boxplot shows severe skewness or any outliers.
Do: $\bar{x}_1$ = 46.8, s_1 = 6.41, $\bar{x}_2$ = 10.15, s_2 = 7.61, df = 42.7787 (calc) 17 (non calc), t = 17.8,
P-value = 0
Conclude: Since the P-value is less than 0.05, we reject the null. We have convincing evidence that there is a difference in the mean sugar content of children's cereals and adult cereals.

56. 24. **State:** Ho: $\mu_d = 0$ and Ha: $\mu_d \neq 0$ where μ_d is the mean difference in amount of active ingredient (generic drug – name brand drug)

Plan: 1-sample t-test for μ_d. Random – the pharmacies and pills were randomly selected. 10%-- 10 < 1/10 all pharmacies in the large city. Normality – a boxplot of the differences is roughly symmetric and show no outliers.

Do: t = -3.96 and P-value = .00332

Conclude: Since P-value < 0.05, we reject the null, Ho. There is convincing evidence that the mean amount of active ingredient is not the same for the name brand and generic drugs.