

_____ 1. A company that produces paper towels continually monitors wet paper towel strength. If the mean strength from a sample drops below a specified level, the production process is halted, and the machinery inspected. Which of the following would result from a Type 1 error?

- (a) Halting the production process when sufficient customer complaints are received.
- (b) Halting the production process when the wet towel strength is below specifications
- (c) Halting the production process when the wet towel strength is within specifications
- (d) Allowing the production process to continue when the wet towel strength is below specifications.
- (e) Allowing the production process to continue when the wet towel strength is within specifications

_____ 2. A company will market a new hybrid luxury car only if they can sell it for more than \$50,000 (otherwise, it will lose money). They do a random survey of 50 potential customers and run a hypothesis test with $H_0: \mu = 50,000$ and $H_a: \mu > 50,000$. What would be the consequences of Type 1 and Type 2 errors?

- (a) Type 1 error: produce a non-profitable car; Type 2 error: fail to produce a profitable car.
- (b) Type 1 error: fail to produce a profitable car; Type 2 error: produce a non-profitable car;
- (c) Type 1 error: fail to produce a non-profitable car; Type 2 error: produce a profitable car
- (d) Type 1 error: fail to produce a profitable car; Type 2 error: produce a profitable car
- (e) Type 1 error: produce a non-profitable car; Type 2 error: fail to produce a non-profitable car

_____ 3. A manufacturer of heart-lung machines periodically checks a sample of its product and performs a major recalibration if readings are sufficiently off target. Similarly, a rug factory periodically checks the sizes of its throw rugs coming off an assembly line and halts production if measurements are sufficiently off target. In both situations, we have the null hypothesis that the production equipment is performing satisfactorily. For each situation, which is the more serious concern, a Type 1 or Type 2 error?

- (a) Machine producer: Type 1, Carpet Manufacturer: Type 1
- (b) Machine producer: Type 1, Carpet Manufacturer: Type 2
- (c) Machine producer: Type 2, Carpet Manufacturer: Type 1
- (d) Machine producer: Type 2, Carpet Manufacturer: Type 2
- (e) This is impossible to answer without making an expected value judgement between human life and accurate throw rug sizes.

_____ 4. An assembly line is supposed to turn out bowling balls with a diameter of 8.55 inches. Each day an SRS of five balls are pulled and measured. If their mean diameter is under 8.35 inches or over 8.75 inches, the machinery is stopped and an engineer is called to make adjustments before production is resumed. The quality control procedure may be viewed as a hypothesis test with $H_0: \mu = 8.55$ and $H_a: \mu \neq 8.55$. What would a type 2 error result in?

- (a) A warranted halt in production to adjust the machinery
- (b) An unnecessary stoppage of the production process
- (c) Continued production of wrong size bowling balls
- (d) Continued production of proper size bowling balls
- (e) Continued production of bowling balls that randomly are the right or wrong size.

_____ 5. When leaving for school on an overcast morning, you make a judgement on the null hypothesis: The weather will remain dry. What would the results be of Type 1 and Type 2 errors?

- (a) Type 1: get drenched; Type 2: needlessly carry around an umbrella
- (b) Type 1: needlessly carry around an umbrella; Type 2: get drenched
- (c) Type 1: carry an umbrella, and it rains; Type 2: Carry no umbrella but the weather remains dry
- (d) Type 1: get drenched; Type 2: Carry no umbrella but the weather remains dry
- (e) Type 1: get drenched; Type 2: Carry an umbrella and it rains

_____ 6. Which of the following are true statements?

- I. The probability of a type 2 error does not depend on the probability of a type 1 error.
- II. In conducting a hypothesis test, it is possible to simultaneously make both a type 1 and type 2 error.
- III. A type 2 error will result if one incorrectly assumes the data are normally distributed.

- (a) I only
- (b) II only
- (c) III only
- (d) I, II, and III
- (e) None are true

_____ 7. If all other variables remain constant, which of the following will increase the power of a hypothesis test?

- I. Increasing the sample size
- II. Increasing the significance level
- III. Increasing the probability of a type 2 error

- (a) I only
- (b) II only
- (c) III only
- (d) I and II
- (e) All are true

_____ 8. Consider the hypothesis test $H_0: \mu = 58$ and $H_a: \mu > 58$. Which of the following choices of significance level and sample size results in the greatest power of the test when $\mu = 60$?

- (a) $\alpha = 0.05$, $n = 20$
- (b) $\alpha = 0.01$, $n = 20$
- (c) $\alpha = 0.05$, $n = 25$
- (d) $\alpha = 0.01$, $n = 25$
- (e) There is no way of answering without knowing the strength of the given power.

_____ 9. Given that the power of a significance test against a particular alternative is 96 percent, which of the following is true?

- (a) The probability of mistakenly rejecting a true null hypothesis is less than 4 percent.
- (b) The probability of mistakenly rejecting a true null hypothesis is 4 percent.
- (c) The probability of mistakenly rejecting a true null hypothesis is greater than 4 percent.
- (d) The probability of mistakenly failing to reject a false null hypothesis is 4 percent.
- (e) The probability of mistakenly failing to reject a false null hypothesis is different from 4 percent.

_____ 10. What is the probability of a type 2 error when a hypothesis test is being conducted at the 5 percent significance level ($\alpha = 0.05$)?

- (a) 0.05
- (b) 0.10
- (c) 0.90
- (d) 0.95
- (e) There is insufficient information to answer this question.

_____ 11. Given an experiment with $H_0: \mu = 25$, $H_a: \mu > 25$, and a possible correct value of 26, which of the following will increase when the sample size n increases?

- I. The probability of a Type 1 error
- II. The probability of a Type 2 error
- III. The power of the test

- (a) I only
- (b) II only
- (c) III only
- (d) II and III
- (e) None will increase

- _____ 12. Which of the following are true statements?
- I. The significance level of a test is the probability of a type 2 error.
 - II. Given a particular alternative, the power of a test against that alternative is 1 minus the probability of the type 2 error associated with that alternative.
 - III. If the significance level remains fixed, increasing the sample size will reduce the probability of a type 2 error.
- (a) II only
(b) III only
(c) I and II
(d) I and III
(e) II and III

- _____ 13. Which of the following are true?
- I. The power of a test concerns its ability to detect an alternative hypothesis.
 - II. The significance level of a test is the probability of rejecting a true null hypothesis.
 - III. The probability of a type 1 error plus the probability of a type 2 error always equals 1.
- (a) I and II
(b) I and III
(c) II and III
(d) I, II, and III
(e) None are true

- _____ 14. Which of the following statements are true?
- I. It is helpful to examine your data before deciding whether to use a one-sided or a two-sided hypothesis test.
 - II. If the P-value is 0.05, the probability that the null hypothesis is correct is 0.05
 - III. The larger the P-value, the more evidence there is against the null hypothesis.
- (a) I only
(b) II only
(c) III only
(d) II and III
(e) None of the above gives the complete set of true responses.

- _____ 15. Which of the following are true statements?
- I. The P-value of a test is the probability of obtaining a result as extreme as the one obtained assuming the null hypothesis is true.
 - II. If the P-value for a test is 0.043, the probability that the null hypothesis is true is 0.043
 - III. When the null hypothesis is rejected, it is because it is not true
- (a) I only
(b) II only
(c) III only
(d) I and III
(e) None of the above gives the complete set of true responses

- _____ 16. Which of the following statements are true?
- I. If a population parameter is known, there is no reason to run a hypothesis test on that population parameter.
 - II. The P-value can be negative or positive depending upon whether the sample statistic is less than or greater than the claimed value of the population parameter in the null hypothesis.
 - III. The P-value is based on a specific test statistic so must be chosen before an experiment is conducted.
- (a) I only
(b) II only
(c) III only
(d) I and II
(e) None are true

- _____ 17. Which of the following are true statements?
- I. Tests of significance (hypothesis tests) are designed to measure the strength of evidence against the null hypothesis.
 - II. A well-planned test of significance should result in a statement either that the null hypothesis is true or that it is false.
 - III. The null hypothesis is one-sided and expressed using either $<$ or $>$ if there is interest in deviations in only one direction.
- (a) I and II
(b) I and III
(c) II and III
(d) I, II, and III
(e) None of the above gives the complete set of true responses.

- _____ 18. Vigorous exercise helps people live several years longer (on average). Whether mild activities like slow walking extend life is not clear. Suppose that the added life expectancy from regular slow walking is just 2 months. A statistical test is more likely to find a significant increase in mean life expectancy if
- (a) it is based on a very large random sample and a 5% significance level is used.
 - (b) it is based on a very large random sample and a 1% significance level is used.
 - (c) it is based on a very small random sample and a 5% significance level is used.
 - (d) it is based on a very small random sample and a 1% significance level is used.
 - (e) the size of the sample doesn't have any effect on the significance of the test.

- _____ 19. A researcher plans to conduct a test of hypotheses at the $\alpha = 0.01$ significance level. She designs her study to have a power of 0.90 at a particular alternative value of the parameter of interest. The probability that the researcher will commit a Type II error for the particular alternative value of the parameter at which she computed the power is
- (a) 0.01.
 - (b) 0.10.
 - (c) 0.89.
 - (d) 0.90.
 - (e) equal to the $1 - (P\text{-value})$ and cannot be determined until the data have been collected.

- _____ 20. A researcher plans to conduct a test of hypotheses at the $\alpha = 0.01$ significance level. She designs her study to have a power of 0.90 at a particular alternative value of the parameter of interest. The probability that the researcher will commit a Type I error is
- (a) 0.01.
 - (b) 0.10.
 - (c) 0.89.
 - (d) 0.90.
 - (e) equal to the P-value and cannot be determined until the data have been collected.

- _____ 21. A Type II error is
- (a) rejecting the null hypothesis when it is true.
 - (b) failing to reject the null hypothesis when it is false.
 - (c) incorrectly specifying the null hypothesis.
 - (d) incorrectly specifying the alternative hypothesis.
 - (e) more serious than a Type I error.

- _____ 22. If we reject the null hypothesis when, in fact, it is true, we have
- (a) committed a Type I error.
 - (b) committed a Type II error.
 - (c) a probability of being correct that is equal to the P-value.
 - (d) a probability of being correct that is equal to $1 - P\text{-value}$.
 - (e) set the α level too high.