

## Potential Errors When Performing Tests Quiz

1. Which of the following gives the probability of making a Type I error?
  - (A) The sample size
  - (B) The power
  - (C) The significance level
  - (D) The standard error
  - (E) The  $p$ -value
2. Consider the results of a hypothesis test, which indicate there is not enough evidence to reject the null hypothesis. Which of the following statements about error is correct?
  - (A) A Type I error could have been made, but not a Type II error.
  - (B) A Type II error could have been made, but not a Type I error.
  - (C) Both types of error could have been made, but the probability of a Type I error is greater than the probability of a Type II error.
  - (D) Both types of error could have been made, but the probability of a Type I error is less than the probability of a Type II error.
  - (E) The type of error that could have been made is not possible to determine without knowing the statement of the null hypothesis.
3. At a manufacturing company for medical supplies, machines produce parts used in highly specialized lasers. Company researchers are testing a new machine designed to improve the precision of the parts. The null hypothesis is that the new machine does not improve the precision. For the researchers, the more consequential error would be that the new machine actually improves the precision, but the test does not detect the improvement.

Which of the following should the researchers do to avoid the more consequential error?

- (A) Increase the significance level to increase the probability of a Type I error.
  - (B) Increase the significance level to decrease the probability of a Type I error.
  - (C) Decrease the significance level to increase the probability of a Type I error.
  - (D) Decrease the significance level to decrease the probability of a Type I error.
  - (E) Decrease the significance level to decrease the standard error.
4. Machines at a bottling plant are set to fill bottles to 12 ounces. The quality control officer at the plant periodically tests the machines to be sure that the bottles are filled to an appropriate amount. The null hypothesis of the test is that the mean is at least 12 ounces. The alternative hypothesis is that the mean is less than 12 ounces.

Which of the following describes a Type I error that could result from the test?

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- (A) The test does not provide convincing evidence that the mean is less than 12 ounces, but the actual mean is at least 12 ounces.
- (B) The test does not provide convincing evidence that the mean is less than 12 ounces, but the actual mean is less than 12 ounces.
- (C) The test does not provide convincing evidence that the mean is less than 12 ounces, but the actual mean is 12 ounces.
- (D) The test provides convincing evidence that the mean is less than 12 ounces, but the actual mean is at least 12 ounces.
- (E) The test provides convincing evidence that the mean is less than 12 ounces, but the actual mean is 11 ounces.
5. At a large company, employees can take a course to become certified to perform certain tasks. There is an exam at the end of the course that needs to be passed for certification. The current pass rate is 0.7, but a new program is being tested to help increase the pass rate. The null hypothesis of the test is that the pass rate for the new program is 0.7. The alternative is that the pass rate for the new program is greater than 0.7.

Which of the following describes a Type II error that could result from the test?

- (A) The test does not provide convincing evidence that the pass rate is greater than 0.7, but the actual pass rate is 0.8.
- (B) The test does not provide convincing evidence that the pass rate is greater than 0.7, but the actual pass rate is 0.7.
- (C) The test does not provide convincing evidence that the pass rate is greater than 0.7, but the actual pass rate is 0.6.
- (D) The test provides convincing evidence that the pass rate is greater than 0.7, but the actual pass rate is 0.8.
- (E) The test provides convincing evidence that the pass rate is greater than 0.7, but the actual pass rate is 0.6.
6. Consider a hypothesis test in which the significance level is  $\alpha = 0.05$  and the power of the test is 0.65. What is the probability of making a Type II error?
- (A) 0.95
- (B) 0.65
- (C) 0.60
- (D) 0.35
- (E) 0.05
7. Educators are testing a new program designed to help children improve their reading skills. The null hypothesis of the test is that the program does not help children improve their reading skills. For the educators, the more consequential error would be that the program does not help children improve their reading skills but the test indicated that it does help.

Which of the following should the researchers do to avoid the more consequential error?

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- (A) Increase the significance level to increase the probability of Type I error.
- (B) Increase the significance level to decrease the probability of Type I error.
- (C) Decrease the significance level to increase the probability of Type I error.
- (D) Decrease the significance level to decrease the probability of Type I error.
- (E) Decrease the significance level to decrease the standard error.

8. Show all your work. Indicate clearly the methods you use, because you will be scored on the correctness of your methods as well as on the accuracy and completeness of your results and explanations.

The distribution of pH levels for all community swimming pools in a large county is approximately normal with mean 7.5 and standard deviation 0.2. According to swimming pool studies, the safest pH levels for water in swimming pools are between 7.2 and 7.8.

(a) One community swimming pool in the county will be selected at random. What is the probability that the selected pool has a pH level that is not considered safe?

The county health inspector will select a random sample of 4 community swimming pools in the county to investigate the pH levels.

(b) Describe the sampling distribution of the sample mean for samples of size 4.

(c) Consider the situation in which the health inspector finds the sample mean of the 4 pools to be outside the safe pH levels. As a result, the inspector declares that the population mean is not 7.5. However, if the population mean really is 7.5, the inspector will have made an error. Such an error is called a Type I error. Find the probability that the inspector will make a Type I error with the sample of 4 pools. Show your work.

9. Medical researchers are testing a new surgical procedure designed to minimize the side effects of surgery. The null hypothesis is that the procedure is not effective in minimizing side effects. For the researchers, the more consequential error would be that the procedure actually is effective in minimizing the side effects, but the test does not detect the effectiveness of the procedure.

Which of the following should the researchers do to avoid the more consequential error?

- (A) Increase the significance level to increase the probability of a Type I error.
- (B) Increase the significance level to decrease the probability of a Type I error.
- (C) Decrease the significance level to increase the probability of a Type I error.
- (D) Decrease the significance level to decrease the probability of a Type I error.
- (E) Decrease the significance level to decrease the standard error.

10. If all else is constant, which of the following would result in a decrease of the probability of a Type II error?

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- (A) The true parameter is closer to the null.
- (B) The sample size is increased.
- (C) The significance level is decreased.
- (D) The standard error is increased.
- (E) Type II error cannot be decreased, only increased.

11. The following list shows three factors that can either increase or decrease the probability of a Type II error.

- I. The sample size is increased.
- II. The significance level is increased.
- III. The standard error is increased.

Which factors alone will cause the probability of a Type II error to increase?

- (A) I only
- (B) II only
- (C) III only
- (D) I and II only
- (E) I, II, and III

12. If all else is constant, which of the following results in an increase in the probability of a Type II error?

- (A) The significance level is increased.
- (B) The standard error is decreased.
- (C) The probability of a Type II error cannot be increased, only decreased.
- (D) The true parameter is farther from the null hypothesis.
- (E) The sample size is decreased.

13. Which of the following is the best interpretation of the power of a significance test?

- (A) Power is the probability of detecting an effect if no effect exists.
- (B) Power is the probability of detecting an effect if an effect exists.
- (C) Power is the probability of detecting an effect whether or not an effect exists.
- (D) Power is the probability of not detecting an effect if no effect exists.
- (E) Power is the probability of not detecting an effect if an effect exists.