Questions Module 4.4

The results of an election poll of 1000 likely voters are reported in the newspaper. The paper reports that 44% of likely voters are in favor of Candidate A. The margin of error is ± 3%, and the confidence level is 95%. Suppose that, instead of polling 1000 likely voters, 2000 likely voters were polled. Which of the following statements is true?

- *a.* Candidate A will win the election.
- *b.* The margin of error will be larger.
- *c.* The margin of error will be smaller.
- *d.* 95% of the voters will favor Candidate A.

Incorrect.
The correct answer is **c**. Assuming that nothing else changes, increasing the sample size results in a smaller margin of error. The resulting confidence interval will be narrower, so the estimate of your parameter will be more precise. In this case, the parameter is a proportion. Although the focus of this module is basic inferential methods for continuous data, you see how to compute the sample size for a confidence interval for a proportion in a practice.

You measure the diameter of 50 parts. The 95% confidence interval for the mean diameter is 16.1 to 16.5 mm. What is the margin of error?

- *a.* 0.4 mm
- *b.* 0.2 mm
- *c.* 95%
- *d.* 16.1 to 16.5 mm

Incorrect.
The correct answer is **b**. The width of the interval is 0.4 mm. The margin of error is the halfwidth of this interval, or 0.2 mm. The sample mean is in the middle of this interval, 16.3. So your estimate of the mean diameter is 16.3 ± 0.2mm.

Consider a scenario in which a medical test is conducted for a potentially fatal disease. The null hypothesis is that the patient doesn't have the disease. Match the potential outcome with the correct description.

- ☐ false positive
- ☐ true negative
- ☐ false negative
- ☐ true positive

a. The test is positive for the disease, but the patient doesn't have the disease.

b. The test is positive for the disease, and the patient has the disease.

c. The test is negative for the disease, and the patient doesn't have the disease.

d. The test is negative for the disease, but the patient has the disease.

Incorrect.
The correct answers from top to bottom are **a**, **c**, **d**, **b**.

Consider the medical test for a fatal disease described in the previous question. For this test, would you rather commit a false positive or a false negative? Why?

You wouldn't want to commit either, but if forced to choose, you would rather commit a false positive than a false negative. If you commit a false positive, you conclude that the patient has the disease when, in fact, he or she doesn't. The patient might be extremely worried and have to undergo unnecessary treatments. However, if you commit a false negative, you conclude that the patient doesn't have the disease, when he or she actually does have the disease. The patient might then go untreated for this fatal disease.

For the courtroom scenario, what are the consequences of committing a false positive? What are the consequences of committing a false negative? Is the legal system set up to commit fewer false positives or fewer false negatives?

The consequence of committing a false positive is wrongful imprisonment. That is, an innocent person is sent to prison. The consequence of committing a false negative is that a guilty person is set free. At least in the United States, the rule of law is innocent until proven guilty. The system favors false negatives.

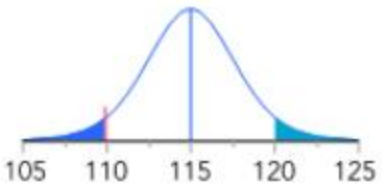
Consider the factors that influence the power of your statistical test. For each of the answers below, assume that the other factors do not change. Which of the following statements is true?

- *a.* The smaller your sample size is, the lower the power of your test.
- *b.* The higher the significance level is, the lower the power of your test.
- *c.* The more variable the population is, the higher the power of your test.
- *d.* The larger the difference is that you want to detect, the lower the power of your test.

Incorrect.
The correct answer is **a**. The less data you have, for a given significance level, population variation, and difference that you want to detect, the lower the power of your test.

You test a new, lower-cost method for producing a component. An important characteristic is the weight in grams. The target weight is 115 g. You conduct a two-tailed one-sample *t* test that the true mean is 115 units. Your results are shown here. What should you conclude?

Test Mean	
Hypothesized Value	115
Actual Estimate	109.917
DF	11
Std Dev	9.10003
t Test	
Test Statistic	-1.9351
Prob > |t|	0.0791
Prob > t	0.9604
Prob < t	0.0396*



- *a.* The new method produces parts that are on target for weight, on average. This new method should be adopted.
- *b.* The test is marginally significant, but you have a small sample size. You should collect more data.
- *c.* The new method produces parts that are not on target, on average. This method should not be used.
- *d.* The true component weight is 109.9. You should change your target.

Incorrect.
The correct answer is **b**. The test isn't significant at 0.05, but the *p*-value is less than 0.10. There is some evidence that the average weight is off target, but with only 12 observations, you don't have enough data to detect this.

Consider the following scenario. High-volume parts are produced on two machines, A and B. The target diameter and specifications are 7.000 mm, +/- 0.001 mm. The diameter of every part is automatically measured. You are concerned that the machines are not producing parts with the same mean diameter.

An analysis of the last 10,000 measurements on the two machines is conducted. The results of the analysis are shown below.

Summary of Fit

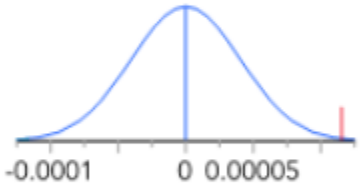
Rsquare	0.000813
Adj Rsquare	0.000713
Root Mean Square Error	0.002006
Mean of Response	7.000008
Observations (or Sum Wgts)	10000

Pooled t Test

B-A

Assuming equal variances

Difference	0.000115	t Ratio	2.852618
Std Err Dif	0.000040	DF	9998
Upper CL Dif	0.000195	Prob > |t|	0.0043*
Lower CL Dif	0.000036	Prob > t	0.0022*
Confidence	0.95	Prob < t	0.9978



Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
A	5600	6.99996	2.68e-5	6.9999	7.0000
B	4400	7.00007	0.00003	7.0000	7.0001

Std Error uses a pooled estimate of error variance

1. What type of statistical test was conducted?
2. What is the difference in the mean diameters between the two machines?
3. Based on the information provided and the test results shown, what should you conclude?

Solution:

1. You are comparing two independent samples. So, the appropriate test is a two-sample *t* test. This was a pooled two-sample *t* test.
2. The mean for machine B is 0.000115 mm higher than the mean for machine A.
3. The test is statistically significant. However, you have an extremely large sample size, so this is a very sensitive (powerful) test. You need to consider whether the difference (0.000115 mm) is of practical importance, based on your subject matter knowledge. The width of the specifications is 0.002 mm. The difference is very small relative to the specifications. Based on this information, you might determine that the difference is not practically significant.