# MOD 16 INTRODUCTION TO CONFIDENCE INTERVALS

Learning Goal

- Using the margin of error, to find a confidence interval to estimate a population proportion when conditions are met.
- Interpret the confidence interval in context

**Warm-up**

In this course, three criteria will determine which type of inference procedure we use.

a) Type of inference (*estimate a population value*, *test a claim about a population value,* or *compare two populations*)
b) The type of variable (*categorical* or *quantitative*)
c) The number of populations involved

**Directions:** Work alone to fill in the table below.

| Research Question | Variable<br>Identify the variable, and if it is categorical, state the categories | Variable type<br>○ Categorical<br>○ Quantitative | Question type<br>○ Make an estimate about a population<br>○ Test a claim about a population<br>○ Compare two populations |
|---|---|---|---|
| What proportion of U.S. adults support background checks in all gun purchases? | | | |
| Has the percentage of U.S. adults who view illegal drug use as a serious problem decreased from 32%? | | | |
| What is the average number of hours Cuyamaca students work each week? | | | |
| Are men more likely to register as a republican than women? | | | |
| Do the majority of Cuyamaca College students qualify for financial aid? | | | |

| | | | |
|---|---|---|---|
| Do older students at Cuyamaca College have a higher GPA than younger students? | | | |

Introduction to Confidence Intervals

1) In October 2017, Gallup conducted a survey of registered US voters and found that 86% of those polled favor universal background checks for all gun purchases in the U.S. (using a centralized database across all 50 states).

   a) Can we conclude from this statement that 86% of all registered voters in the United States favor universal background checks for all gun purchases? Why or why not?

   b) Does the 86% represent a categorical or quantitative variable? Identify the variable.

   c) Is the 86% a proportion or a mean? Explain.

2) Results of the Gallup poll in number 1) are based on telephone interviews conducted October 5 – 11, 2017, with a random sample of voters living in all 50 U.S. states and the District of Columbia. Gallup states that the margin of sampling error is $\pm$4% at the 95% confidence level.

   a) What do the folks at Gallup mean when they say that the sampling error is $\pm$4%?

   b) Use the sample proportion of 86% and the sampling error of $\pm$4% to construct an interval that is likely to contain the population proportion. Interpret the interval.

   c) Based on the information provided by Gallup, how confident are we that the population proportion will fall within the interval we found in part b).

3) Interpret the 95% confidence interval you found in number 2) above, and start your interpretation with, "We are 95% confident that between …"

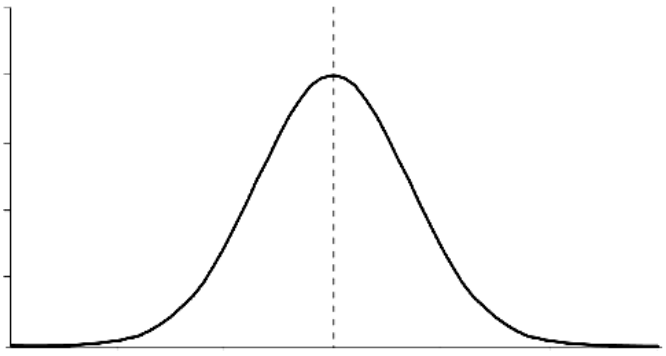
4) A Gallup poll in March 2017 found that 59% of respondents agreed that protecting the environment should be given priority over keeping energy cheap through increased production. Results are based on telephone interviews conducted March 1 – 5, 2017, with a random sample of 1,018 adults living in all 50 US states and the District of Columbia. The un-weighted margin of sampling error is $\pm 3$ percentage points at the 95% confidence level.

   a) Based on this information, find the 95% confidence interval. Then interpret the confidence interval and try to write like a statistician.

   b) Imagine that Gallup conducts this poll over and over again. Each time they obtain a new random sample of 1,018 US adults and record the percentage that favor protecting the environment over increasing energy production (to keep energy cheap). Further suppose they do this for all possible samples of 1,018 US adults and record each sample proportion.

      Recall that the population proportion is the mean of the sampling proportions. Since the population proportion is unknown, what can we use as an estimate?

      Determine whether the sampling proportions are normally distributed. If so, find the standard error (round to 3 decimal places) and construct the density curve.



      Now explain how the margin of error (MOE) and the 95% confidence interval from part a) are related to normal density curve.

We're still working with the survey in number 4) where 59% of the 1,018 adults polled agree that protecting the environment should be prioritized over energy production.

c) Recall that we used the unweighted margin of error (MOE) to find the boundaries for the 95% confidence interval. Also recall that the MOE is 3% (0.03). If you have not done so already, draw the margin of error on the normal density curve in part b).

   Hmmm … how many standard errors from the mean is the MOE at the 95% confidence level?

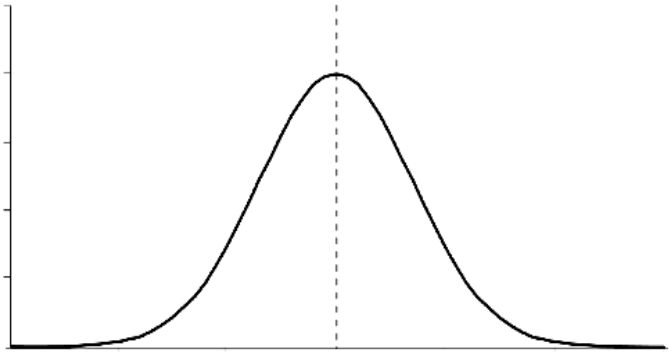
   So, inquiring minds want to know, can you use the fact that the MOE is 3% (0.03) to find the standard error (SE)?

d) How many standard errors away from the mean is the 99.7% confidence interval?

e) Find the margin of error for the 99.7% confidence level. Show your work.

f) Find and interpret the 99.7% confidence interval. Show your work.

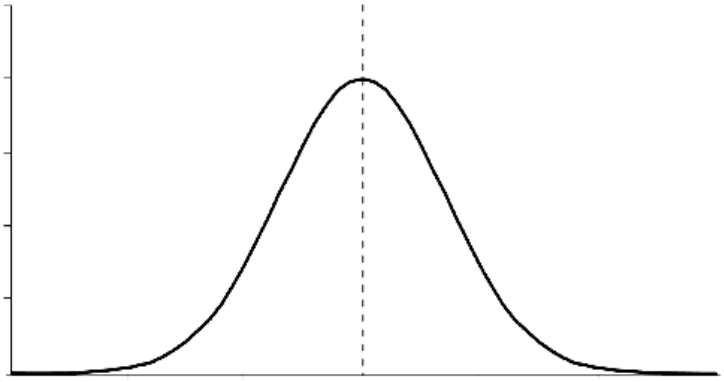
g) Once again, complete the normal density curve below. Then mark the margin of error for the 99.7% confidence interval on the graph.



5) A Gallup poll in October 2016 found that 44% of US adults believe the death penalty is not applied fairly. Results are based on telephone interviews conducted October 5 – 9, 2016, with a random sample of 1,017 adults living in all 50 US states and the District of Columbia.

a) If appropriate, build the normal density curve. (If it is not appropriate to build the normal density curve, move on to number 6.)

b) Use the normal density curve to find the margin of error (MOE) at the 99.7% confidence level. Then interpret the 99.7%



c) What is the MOE (margin of error) at the 95% confidence level?

d) Interpret the 95% confidence interval.

e) Suppose one of your classmates was late and just joined your group. Explain to your classmate how to find the MOE and the 95% confidence interval.