

Packet 5: Confidence Interval for the Population Proportion

Textbook pages: 428 – 442

After completing this material, you should be able to:

- construct a confidence interval for the proportion using the appropriate format.
- state when it is valid to use this procedure.
- explain what “confidence” means.
- calculate the sample size needed to estimate the proportion within a specified margin of error for a desired degree of confidence.

NKU and Murray State University are two regional state schools in Kentucky. While both of these schools draw from the surrounding states to fill its student body, most believe that the majority of students are from the state of Kentucky. The Council of Postsecondary Education would like to sample students from both schools to estimate the proportion of students from KY. A sample of 562 NKU students found that 400 were from KY. Similarly, a random sample of 485 Murray State students found that 354 were from KY.

Given only this information, what would your estimate be for the proportion of **all** NKU students that are from KY? What would the estimate be for **all** Murray State students that are from KY?

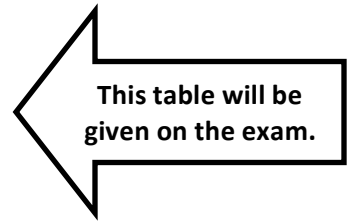
Do you have any confidence that these two estimates are *exactly* correct? What could be done to improve your estimate?

What is a confidence interval?

We want to develop a confidence interval which will be used to estimate the population proportion. What will the formula for this interval be?

When calculating the confidence interval, the margin of error requires a critical point from the normal distribution. Let's fill in the table below with critical values associated with common levels of confidence:

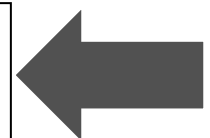
Level of confidence	90%	95%	96%	98%	99%
z critical value					



Steps in a Confidence Interval	Step 1:	Formula Alert!! This formula will be given on the formula sheet.
	Step 2:	
	Step 3:	



EVERY confidence interval we do will follow these same three steps – start to commit them to memory!!



Example: On the first page of the notes, we were given information about a sample of students from two regional universities in Kentucky. For each school, estimate the proportion of students from Kentucky with 95% confidence.

Northern Kentucky University	Step 1	
	Step 2	
	Step 3	

Murray State University	Step 1	
	Step 2	
	Step 3	

Based on your two intervals, can you draw any type of conclusion about the two schools with respect to the proportion of students from KY?

Example: The US Commission on Crime wants to estimate the proportion of crimes related to firearms in an area that has one of the highest crime rates in the country. The commission randomly selects 600 files of recently committed crimes in the area and finds that 388 involved the use of a firearm. Estimate the percentage of all crimes in this area in which a firearm was used with 99% confidence.

Would the confidence interval become wider or narrower if we lowered the level of confidence? Would the confidence interval become wider or narrower if we increased the sample size? Explain.

What *assumptions* must be satisfied for the interval to be valid?

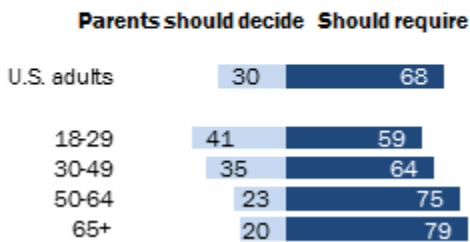
Calculating a Sample Size

Textbook pages: 496 – 497

The question of how large a sample to take is an important one – we recently decided that the larger the sample size, the smaller the margin of error. When estimating proportions, we can determine the sample size required to achieve a certain margin of error for a given level of confidence. Consider the following example:

In 2014, Pew Research Center conducted a survey to gauge public opinion on the topic of vaccination of children. The study was done as the number of measles cases linked to the California outbreak climbed to over 100. At that time, health officials were urging parents to properly immunize their children, citing unvaccinated individuals as a main contributor to the disease's spread. The results from this survey are summarized below:

% of U.S. adults who say parents should be able to decide not to vaccinate their children or that all children should be required to be vaccinated



The debate over vaccinations continues to receive national attention. To update the estimates, a new survey is planned for this year. Suppose the researchers would like to estimate the proportion of all US adults who feel vaccinations should be required with 95% confidence and a margin of error of no more than $\pm 3\%$. How large a sample should be taken given the estimates provided by the 2014 Pew Research study?

Would the required sample size be larger or smaller to achieve the same margin of error for adults between the ages of 18 and 29?

What if there is no prior estimate for the proportion which can be used as an estimate?

Example: The National Center for Educational Statistics keeps track of a variety of measures related to education in the United States. One area of interest is the proportion of full-time undergraduate students at public institutions who receive some form of financial aid. A statistician would like to estimate the percentage of these students receiving financial aid in the 2014-15 academic year.

- The statistician decides to use estimates from the 2006-07 academic year to help gauge how large a sample size should be taken. He would like to estimate the true proportion of full-time undergraduate students at public institutions who receive some form of financial aid with 95% confidence and a margin of error of $\pm 2.75\%$. If 75% of these students received financial aid in 2006, how large a sample size should be taken in 2014 to estimate the percentage with the desired margin of error?

- Realizing the proportion will have changed some in 2014, the statistician decides to take a random sample of 1,025 full-time undergraduate students at public institutions. In those sampled, he found 851 were receiving financial aid. Using this information, estimate the quantity of interest with 95% confidence.

- Give two reasons why the margin of error found when calculating the interval was different than the desired margin of error of 2.75%.