**Unit 8, Module 19: The Sampling Distribution for the Population Proportion**

The Gallup Organization surveyed people in over 100 countries in December 2010. They asked people about global warming. Global warming is the gradual increase in Earth’s average temperature. Gallup asked people if they think global warming is a serious threat to them or their family.

Gallup found that 42% of adults in the world believe that global warming is a serious threat to themselves and their family (Source: Gallup.com website article, Fewer Americans, Europeans View Global Warning as a Threat, April 20, 2011)

For this activity, imagine that 0.42 is the population proportion of adults worldwide who believe global warming is a threat. Also, suppose we select random samples of size 200 repeatedly or many times.

Go to this website: <http://www.rossmanchance.com/applets/OneProp/OneProp.htm>

Enter this information:

* The assumed population proportion,  (Probability of “Success”)
* The sample size, 
* Enter 1,000 for the number of samples
* Fill in the bubble that says “Proportion of Successes”

1) Describe the distribution of sample proportions. Specifically, describe the shape, center and spread of the distribution. When you talk about the spread, give the range of the sample proportions.

2) Identify the mean and estimate the standard deviation of the distribution of sample proportions.

3) Suppose we had a random sample of 200 adults. In this particular random sample, 34% responded that they believe global warming is a serious threat. What is the difference between this sample proportion and the assumed population proportion? This difference is the error in the sample proportion.

4) The simulation applet also helps you find the percentage of sample proportions in a given region by using the calculator “As extreme as” – can you locate that? Use it to calculate the percentage of sample proportions that are less than or equal to . Write your answer in a sentence.

5) Assume that the distribution of all sample proportions is normally distributed. Use the Empirical Rule to determine the interval that contains the middle 95% of sample proportions in the simulated distribution.

6) Using your answers to questions 4 and 5, answer this question: In a random sample of 200 adults, do you think it would be usual for 34% to feel that global warming is a serious threat?

**The Central Limit Theorem for Sample Proportions**

7) Clear out the data in the applet you were working with by clicking “Reset”. Then, enter the population proportion . Enter the sample size of 10 () and draw 1000 samples. Describe the shape of the distribution of sample proportions.

8) Repeat #7 using different sizes of *n*. Try 20, 50 and 100. Describe what happens to the shape of the distribution of sample proportions as the sample size increases, as well as the standard deviation. Use the table below to help keep track:

|  |  |  |
| --- | --- | --- |
| n | shape | estimated sd |
|   |   |   |
|   |   |   |
|   |   |   |
|   |   |   |

**Things you Need to Know**

The mean, , and standard deviation, , of a sampling distribution of sample proportions can be found by:



And



Where *p* is the population proportion and *n* is the sample size.

The first formula states that the mean of all sample proportions is equal to the population proportion, *p*. This tells us that although sample proportion tend to contain error as they estimate the population proportion, their mean is equal to the population proportion that they estimate.

Also, because the sample proportion, , is an estimate of the population proportion, *p*, any deviation of  from *p* is an error in the estimate. Because it is an error in the estimate, the standard deviation of the distribution of a sample proportion is referred to as the ***standard error***.

As we saw above, the distribution of the sample proportion becomes more Normal as the sample size increases.

The **Central Limit Theorem for Sample Proportions** states that sampling distributions of sample proportions are approximately normal with a mean of , and standard deviation, , whenever  and 

**More Practice with the Central Limit Theorem**

9) In a random sample of 400 adults worldwide, 180 respond that they believe global warming is a threat. What is the sample proportion?

**For questions 10-17, use the information about Global Warming again by setting , and the sample size to be 1000.**

10) What are the values of *np* and *n(1-p)*?

11) Does the sampling distribution of sample proportions satisfy the normality criteria?

12) Find the mean and compute the standard error of the sampling distribution of sample proportions.

13) Based on the mean and standard error, label the values of a through g on the normal distribution below. The values are 1 standard error apart.



14) Using the parameters of the sampling distribution, find the z-score for .

15) What percentage of samples in the sampling distribution are greater than or equal to ? (This time, use the Normal Distribution Calculator AND the simulator)

16) Using the Empirical Rule, determine the interval that contains the middle 95% of sample proportions in the sampling distribution.

17) Based on the sampling distribution and the simulated distribution, is it usual to have a random sample of size 400 adults in which 180 or more believe global warming is a serious threat?