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# Statistics Package Exercise: Calculating Confidence Intervals for the Population Proportion p

**Learning Objective: Explain what a confidence interval represents and determine how changes in sample size and confidence level affect the precision of the confidence interval.**

**Learning Objective: Find confidence intervals for the population mean and the population proportion (when certain conditions are met), and perform sample size calculations.**

The purpose of this activity is to learn how to use software to calculate a confidence interval for the population proportion p (for a given level of confidence). Software is particularly useful when raw data are given rather than data summaries, which are what you would usually encounter in practice.

**Background:** The U.S. federal ban on assault weapons expired in September 2004, which meant that after 10 years (since the ban was instituted in 1994) there were certain types of guns that could be manufactured legally again. A poll asked a random sample of 1,200 eligible voters (among other questions) whether they were satisfied with the fact that the law had expired. The datafile linked below contains the results of this poll (Data were generated based on a poll conducted by NBC news/Wall Street Journal Poll). We would like to estimate p, the proportion of U.S. eligible voters who were satisfied with the expiration of the law, with a 95% confidence interval.

Before analyzing the data, answer the following question:

## Learn By Doing (1/1 point)

Based on the sample size, what is the margin of error of this poll?

**Your Answer:**

1/sqrt(n) = 1/sqrt(1200) = 0.03

**Our Answer:**
The margin of error of this poll is 1 / sqrt(1,200) = .0289, which equals approximately 2.9%.

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- R StatCrunch TI Calculator Minitab Excel

**R Instructions**
To open R with the data set preloaded, right-click here and choose "Save Target As" to download the file to your computer. Then find the downloaded file and double-click it to open it in R.

The data have been loaded into the data frame

```
support
```

. Enter the command

```
support
```

to see the data. The variable name in the data frame is

```
opinion
```

.

This file contains 1,200 responses in the form "satisfied" and "not satisfied," which is too much to display. To check that all the data are loaded, count the data with the command:

- 
```
n=length(support$opinion);n
```

R should return 1,200 as the number of data. This is the sample size.

We can get the summary counts using the

```
table()
```

command.

- ```
  t=table(support$opinion);t
  ```

Notice the first entry in the table is the "not satisfied" opinion. If we just wanted that term we can extract it from the table:

- ```
  t[1]
  ```

We can also extract the second entry, "satisfied," from the table:

- ```
  t[2]
  ```

To calculate confidence intervals for a single proportion we can use the command

```
prop.test()
```

. Here is the 95% confidence interval for the proportion of the population that is "not satisfied" with the expired law:

- ```
  prop.test(t[1],n,conf.level=0.95)
  ```

Or we can calculate the 95% confidence interval for the proportion of the population that is "satisfied" with the expired law:

- ```
  prop.test(t[2],n,conf.level=0.95)$conf.int
  ```

**Note:** In R, be aware of the structure of your data at all times. In the created table

```
t
```
```

, the first

```
[1]
```

entry represented the "not satisfied" count, which is why

```
t[1]
```

extracted that value.

---

## Learn By Doing (1/1 point)

Based on the output: (a) How many of the 1,200 sampled voters were satisfied? (b) What is the sample proportion (p-hat) of those who were satisfied? (c) What is the 95% confidence interval for p? Interpret this interval.

**Your Answer:**

a. Only 142 in the sample were satisfied.
B. sample proportion = 11.83%
c.) (10.09% 13.83%). This means that we're 95% confident that the % of voters in the population who were satisfied is within 10.09% and 13.83%

**Our Answer:**

RStatCrunch TI CalculatorMinitabExcel R Here is the R output: (a) 142 of the 1,200 sampled voters answered that they were satisfied. (b) The sample proportion is therefore 0.118, or roughly 12% (142/1,200). (c) The 95% confidence interval for p is (0.10, 0.14) (rounded). We are 95% certain that the proportion of U.S. voters who were satisfied with the expiration of the federal ban on assault weapons is between 0.10 and 0.14 (or between 10% and 14%). StatCrunch Here is the StatCrunch output: (a) 142 of the 1,200 sampled voters answered that they were satisfied. (b) The sample proportion is therefore .118, or roughly 12% (142/1,200). (c) The 95% confidence interval for p is (.10, .14) (rounded). We are 95% certain that the proportion of U.S. voters who were satisfied with the expiration of the federal ban on assault weapons is between .10 and .14 (or between 10% and 14% ). TI Calculator If you enter: and choose CALCULATE, then press ENTER, you should see: (a) 142 of the 1,200 sampled voters answered that they were satisfied. (b) The sample proportion is therefore .118, or roughly 12% (142/1200). (c) The 95% confidence interval for p is (.100, .137) (rounded). We are 95% certain that the proportion of U.S. voters who are satisfied with the expiration of the federal ban on assault weapons is between .100 and .137 (or between 10% and 13.7%). Minitab Here is the Minitab output: (a) 142 of the 1,200 sampled voters answered that they were satisfied. (b) The sample proportion is therefore .118, or roughly 12% (142/1,200). (c) The 95% confidence interval for p is (.10, .14) (rounded). We are 95% certain that the proportion of U.S. voters who were satisfied with the expiration of the federal ban on assault weapons is between .10 and .14 (or between 10% and 14%). Excel Here is what we calculate using Excel: X = 142 p-hat = 142/1200 = 0.118 margin of error = 0.0186 (a) 142 of the 1,200 sampled voters answered that

they were satisfied. (b) The sample proportion is therefore .118, or roughly 12% (142/1,200). (c) The 95% confidence interval for p is (.10, .14) (rounded). We are 95% certain that the proportion of U.S. voters who are satisfied with the expiration of the federal ban on assault weapons is between .10 and .14 (or between 10% and 14%).

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## Learn By Doing (1/1 point)

In the first question you found that the margin of error of this poll was about 2.9%. What is the margin of error of the confidence interval you found in the second question? Comment on the apparent discrepancy.

**Your Answer:**

It was 0.018, so 1.8%. Here we made a more conservative estimate from starting on 1/sqrt(n).

**Our Answer:**

The 95% confidence interval for p, (0.10,0.14) has a width of 0.04, and therefore a margin of error of 0.02 (or 2%). In the first question, though, we found that the margin of error of this poll is roughly 2.9%. This is because in the first question, we calculated a "conservative" margin of error. The margin of error found in the first question was found using the conservative approach, and is the margin of error of the whole poll. What it says is:Based on this sample size, the margin of error for any of the questions in this poll will be no more than 2.9% regardless of what the sample proportions are.In the particular question from the poll in this example, the margin of error happened to be lower.

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