Technology Insights 10: Calculating Confidence Intervals

These notes will take a look at calculating confidence intervals for population proportions and population means.

Population Proportions with the TI84

Using the TI84 to calculate confidence intervals for a population proportion:

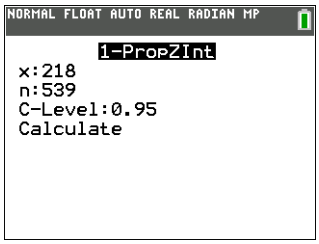
1) Press stat and move over to the **TESTS** menu.

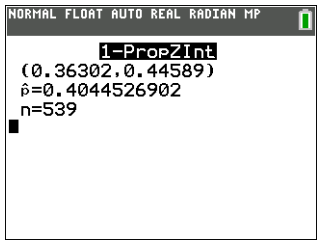
2) Scroll down to find **1-PropZInt**. This function uses the z-distribution (standard normal) to calculate the confidence interval:

$$\hat{p} - z_{\alpha/2} \cdot \sqrt{\frac{\hat{p}\hat{q}}{n}} < p < \hat{p} + z_{\alpha/2} \cdot \sqrt{\frac{\hat{p}\hat{q}}{n}}$$

Example 1 Find a 95% confidence interval for a population proportion using a survey of 539 people where 218 favored relaxing social distancing.

Solution: $x = 218$, $n = 539$, $\hat{p} = 218/539 \approx 0.404$





We are 95% confident the true proportion of people that want to relax social distancing is between 36.3% and 44.6%. We could also say, the survey indicate 40.4% with an error of about ±4%.

Population Proportions with EasyStats

Select **1-Sample Confidence Intervals for Proportions**, and enter the statistics into the yellow boxes:

Estimating Proportions

Sample Size: n=	539
x=	218
p-hat=	0.4045
Confidence Level=	0.95
α/2=	0.025
Critical Value=	1.9600
MOE=	0.0414

95%-Confidence Interval	
0.3630	0.4459

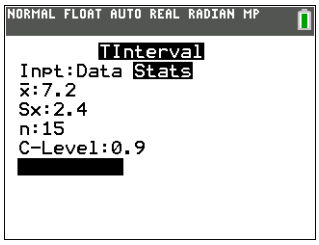
Confidence Intervals for a Population Mean with the TI-84

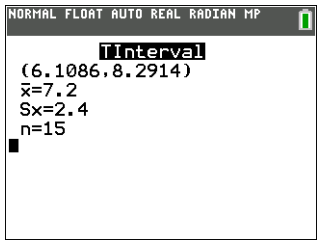
The TI-84 has two options to calculate confidence intervals for means, **ZInterval** and **TInterval**. Only use ZInterval when the population standard deviation is known. We'll use the TInterval in most situations.

In using the TInterval, you can either use summary statistics, or enter raw data into the stats editor and select Inpt:Data

Example 2 A sample of 15 salmon found a sample mean of 7.2 pounds with a standard deviation of 2.4. Assuming salmon weights are normally distributed, find a 90% confidence interval for the true mean weight.

Answer: $\bar{x} = 7.2,\ s = 2.4, n = 15, d.f. = 14$





We are 90% confident the mean weight of salmon is between 6.1 pounds and 8.3 pounds.

Confidence Intervals For a Population Mean with EasyStats

EasyStats will do calculations when σ is either known or not known (with data or with statistics). For σ known (this is very rare) select **4: 1-Sample Confidence Interval for Means: z-Distribution (σ Known)**. For σ not-known (most common) choose **5: 1-Sample Confidence Interval for Means: t-distribution (σ-not known)**.

Example 3 A sample of 15 salmon found a sample mean of 7.2 pounds with a standard deviation of 2.4. Assuming salmon weights are normally distributed, find a 90% confidence interval for the true mean weight.

Using the same summary statistics: $\bar{x} = 7.2,\ s = 2.4,\ n = 15$, select **5: 1-Sample Confidence Intervals for Means: t-distribution**

Estimating Means Using Statistics

Sample Mean=	7.2
Sample St. Dev.=	2.4
Sample Size=	15
Confidence Level=	0.9
α/2=	0.05
Critical Value $t_{\alpha/2}$=	1.7613
MOE=	1.0914

90%-Confidence Interval	
6.1086	8.2914

This agrees with the TI84 output in *Example 2*.

Sample Size Calculations with EasyStats

Unfortunately, the TI84 does not automatically calculate the sample size for a poll for proportions or means. However, EasyStats does both.

Example 4 A poll is to be conducted with using an error of 3% and a confidence level of 95%. A prior study indicates that the estimated population proportion is $p = 0.65$. Find the sample size for the new poll.

Answer: Select **6: Sample Size Calculations**, with p-hat = 0.65, confidence level of 0.95, and a Margin of Error of 0.03, we get:

Sample Size for Proportions

Estimate for p-hat=	0.65	(or leave blank)
Confidence Level=	0.95	
α/2=	0.025	
Margin of Error=	0.03	
Critical Value=	1.9600	

Sample Size
972

A minimum sample size of 972 would be required, so a good study would have a sample size of 1000.

If the prior study was knot known, we would either leave the estimate for p-hat blank or 0.5:

Sample Size for Proportions

Estimate for p-hat=	0.5	(or leave blank)
Confidence Level=	0.95	
α/2=	0.025	
Margin of Error=	0.03	
Critical Value=	1.9600	

Sample Size
1068

Here we can see that a sample size larger than 1000 is necessary. A sample size of about 1100 would be needed in this case.

Using the TI-84, we would need to solve the equation

$$E = z_{\alpha/2}\sqrt{\frac{\hat{p}\,\hat{q}}{n}}$$

for n using $z_{\alpha/2} = 1.96$, $E = 0.03$, $p = 0.65$, and $\hat{p} = 0.35$, or $0.03 = 1.96\sqrt{\frac{(0.65)(0.35)}{n}}$, $\Longrightarrow$ $n = 971.0711111$ which is rounded up to **972.** If p is not known, use 0.25 for $\hat{p}\,\hat{q}$.

Similar calculations are used for sample means using EasyStats or by hand.