# Using your TI-83/84/89 Calculator: Estimating a Population Mean ($\sigma$ Unknown)

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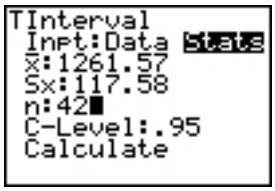
Statistics I

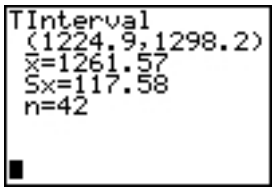
When the population standard deviation ($\sigma$) is not known (as is generally the case), a confidence interval estimate for a population mean ($\mu$) is constructed using a critical value from the Student's *t* distribution. The `TInterval` calculator function will generate this confidence interval using either raw sample data or summary statistics. Remember to confirm that the population is normally distributed and/or $n \geq 30$ before proceeding to generate any confidence intervals.

**Generating a *t* interval from summary statistics:**


1. Press [STAT] and [▶] to scroll right to select the `TESTS` menu option.
2. Scroll down to `8:TInterval` and press [ENTER].
3. To work with summary statistics, highlight `STATS` and press [ENTER].
4. Consider the following example. A introductory statistics class counted how many chocolate chips were in each of 42 bags of Chips Ahoy! cookies. They found $\bar{x} = 1261.57$ and $s = 117.58$ chocolate chips per bag. First, note that it is safe to apply the Central Limit Theorem because $n \geq 30$. Let's use the given summary statistics to find a 95% confidence interval estimate of the mean ($\mu$) number of chocolate chips in all bags of Chips Ahoy! cookies. At the prompts, enter the sample mean ($\bar{x}$), sample standard deviation ($s_x$), and the sample size ($n$). Enter `Ø.95` at the `C-Level` prompt, then highlight `Calculate` and press [ENTER].




5. Your calculator will give you the output screen shown to the right. The confidence interval is being reported in the form ($\bar{x}$ - $E$, $\bar{x}$ + $E$), which in this case is `(1224.9,1298.2)`. Because we are working with summary statistics, we would ordinarily round to the same number of decimal places as originally given for $\bar{x}$. In this case, your calculator rounds the confidence limits even further. That's okay; worry about rounding only when your calculator gives more decimal places than you started with for $\bar{x}$.




6. *What does this mean?* We are 95% confident that the interval from 1224.9 to 1298.2 actually does contain the mean ($\mu$) number of chocolate chips in all bags of Chips Ahoy! cookies.
7. Go back and experiment with varying the confidence level (`C-Level`). What happens to the size of the confidence interval when you use a 90% (`Ø.9Ø`) confidence level? A 99% (`0.99`) confidence level?
8. Another way to express a confidence interval estimate of $\mu$ is as $\bar{x}$ - $E < \mu < \bar{x} + E$, which would be $1224.9 < \mu < 1298.2$ for this example.
9. We could also report the confidence interval as $\bar{x} \pm E$. We already know that $\bar{x} = 1261.57$. We can find the margin of error ($E$) the same way we did last week when we were working with proportions. That is, we can use the formula $E = \frac{\text{upper confidence limit - lower confidence limit}}{2}$,

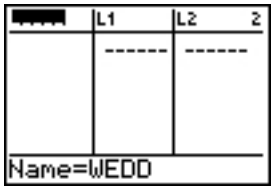
which gives us $E = \frac{1298.2-1224.9}{2} = 36.65$ for this example. Hence, we could also say that we are 95% confident that there are an average of 1261.57 ± 36.65 chocolate chips in all bags of Chips Ahoy! cookies.

**Generating a *t* interval from raw sample data:**

1. Suppose that *BRIDES* magazine reported the following wedding costs (in $) for a random sample of 20 recent U.S. weddings:

| | | | | |
|---|---|---|---|---|
| 12,113 | 16,406 | 10,929 | 7,171 | 11,077 |
| 20,423 | 13,820 | 21,905 | 26,698 | 20,513 |
| 22,715 | 5,977 | 25,795 | 35,263 | 16,670 |
| 24,886 | 33,023 | 27,667 | 13,700 | 12,127 |

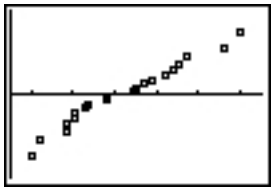
2. Press [STAT] [ENTER] to access the stat editor. Create a new list named WEDD by highlighting the L1 list name and then pressing [2nd] [DEL]. This command inserts a new list to the left of L1. Type in WEDD and press [ENTER] to name your list. Enter the 20 wedding costs given above into your list. Be sure to check your list for any typos.




3. Recall that we can only apply the Central Limit Theorem if we know the population is normally distributed and/or $n \geq 30$. In this case, the sample size is not large enough, and we don't know whether the population of all recent U.S. wedding costs is normally distributed. We can, however, check whether our sample data are normally distributed. If so, then it is a pretty safe bet that the population is also normally distributed. The easiest way to check is by plotting the data distribution and deciding whether it "looks" normal. You could do this with a histogram, boxplot, or stem-and-leaf plot, but the most accurate method is to use a **normal quantile plot**. This approach involves plotting the observed *x* values vs. the values expected for a variable that is normally distributed. If the resulting plot is a reasonably straight line, we can assume that our population is normally distributed and proceed with generating a confidence interval.

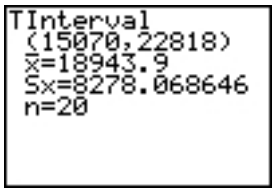
4. Here's how to generate a normal quantile plot. Press [2nd] [Y=] to bring up the [STAT PLOT] menu. Make sure all the plots are turned off, then select 1:Plot1 and press [ENTER]. Turn this plot On, choose the last option as the plot Type (see screen shot to the right), indicate that you want to plot the data stored in your WEDD list, select X as the data axis, and pick your mark (I like the open square).


5. Next, press [ZOOM] and scroll down to 9:ZoomStat. Press [ENTER], and your calculator will display the normal quantile plot shown to the right. For this example, the plot is reasonably linear, so we are safe to assume that the population of all recent U.S. wedding costs is normally distributed. Now we can apply the Central Limit Theorem to find the 95% confidence interval estimate of the mean cost of all recent U.S. weddings. Press [STAT] and scroll right to TESTS. Then,



scroll down to `8:TInterval` and press ENTER. This time, select the `Data` option. Enter the name of the list where you stored the sample data (`WEDD` for this example) and desired confidence level at the prompts, highlight `Calculate`, and press ENTER.


6. Your calculator will display the output screen shown to the right. Note that it reports both $\bar{x}$ (which is the best point estimate of $\mu$) and the sample standard deviation ($s_x$) in addition to the confidence interval. Because we used the original sample data (as opposed to summary statistics), round the confidence interval limits to one more decimal place than we had for the raw data whenever necessary. For this example, we could report the 95% confidence interval estimate for the mean ($\mu$) cost of all recent U.S. weddings as either ($15070, $22818) or $15070 < $\mu$ < $22818.



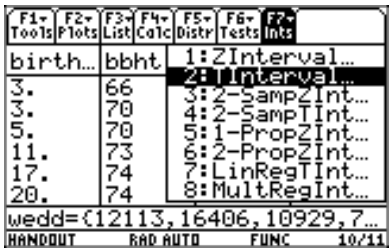

7. *What does this mean?* We are 95% confident that the mean cost of all recent U.S. weddings is contained in the interval ranging from $15,070 to $22,818.

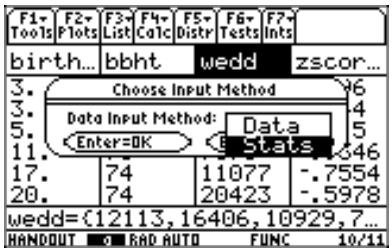
8. Find the margin of error ($E$) for this confidence interval. Using the upper and lower confidence limits given by your calculator, you can compute $E = \frac{\text{upper confidence limit - lower confidence limit}}{2}$, which is $E = \frac{22818-15070}{2} = 3874$ for this example. Now, you can express the 95% confidence interval as $\bar{x} \pm E$, which is $18943.9 \pm $3874. Note that this approach yields a slightly different confidence interval than we found using the other two methods. That's okay; report the values as given by your calculator, rounding only when your calculator reports more digits than are specified by our rounding rules.

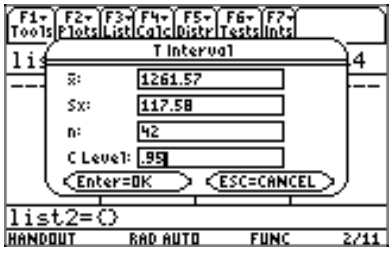
**Using the TI-89**

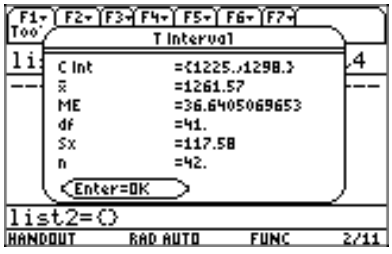
The above discussion also applies to the TI-89 calculator. I have included screenshots to illustrate the specific commands to use on the TI-89.

***Generating a t interval from summary statistics:***



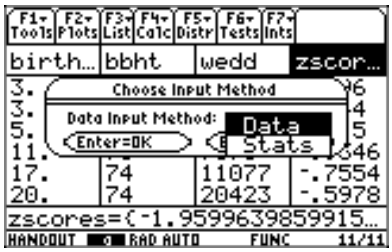



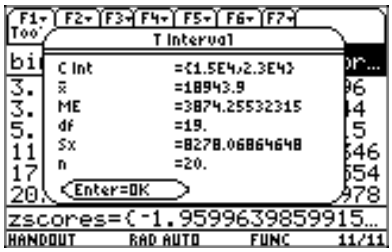



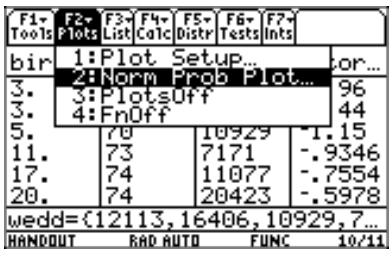
***Generating a t interval from raw sample data:***



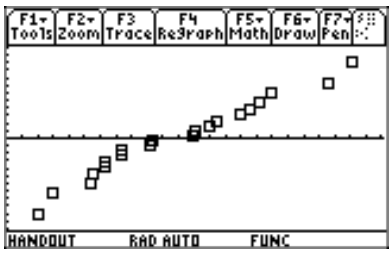





***Generating a normal quantile plot:***







Note that the TI-89 computes the margin of error (ME) for you. It also rounds differently, so be sure to indicate when you have used a TI-89 on a quiz or exam.