Chapter 9
Estimation using a single sample

9.0 Estimation

Estimation on the TI, as is the case with estimation by "hand" statistically is is a process of understanding the problem situation, choosing the correct procedure, and turning the mathematical crank. Estimation, the topic of this chapter, and hypothesis testing, to come in Chapter 10, are two methods used to make inferences about a population from analyzing the data from a random sample. The TI-83 lumps both types of procedures under "tests", and these procedures are found after these keystrokes:

Stat > Tests

Pressing those keys will get you to the screen shown at the right. One might be pardoned for breathing something of a sigh of relief here – there's only 1 of those unmatched-left-parenthesis options! Unfortunately, your sigh will be short-lived; see those little dots after all those other choices? Those are whole screens of places for you to provide information. The choices look a bit overwhelming now, but upon study some patterns will emerge:

```
EDIT CALC TESTS
1:Z-Test…
2:T-Test…
3:2-SampZTest…
4:2-SampTTest…
5:1-PropZTest…
6:2-PropZTest…
7:ZInterval…
8:T-Interval…
9:2-SampZInt…
0:2-SampTInt…
A:1-PropZInt…
B:2-PropZInt…
C:X²-Test…
D:2-SampFTest…
E:LinRegTTest…
F:ANOVA(
```

1. Many choices are "1-" and "2-" Samp" choices. These indicate options for statistical procedures based on sampling from 1 population or 2 populations.

2. Many choices are "Prop" choices. These indicate options for inference about proportions.

3. Many of the choices are "T" or "Z" options. These indicate the statistic you will be using – either the "*t*" statistic or the "*z*" statistic.

You may not be too reassured at this point if you have not studied these topics. We are telling you about these commonalities so that you get a sense that many of these options are similar in one or more characteristics – and as you master 1 or 2 of these, the remaining choices will be increasingly simple to digest.

9.1A Large-Sample Confidence Interval for a Population Proportion.

Example 9.5: Violent Behavior in the Workplace.

An Associated Press article on potential violent behavior reported the results of a survey of 750 workers who were employed full time. Of those surveyed 125 indicated that they were so angered by a coworker during the past year that he or she felt like hitting the person (but didn't). Assuming that it is reasonable to regard this sample of 750 as a random sample from the population of full-time workers, we can use this information to construct an estimate of π, the true proportion of full-time workers so angered in the last year that they wanted to hit a colleague.

For this sample

$$p = \frac{125}{750} = .167$$

Since $np = 125$ and $n(1-p) = 625\,n$ are both greater than or equal to 10, the sample size is large enough to use the formula for a large-sample confidence interval. A 90% confidence interval for π is then

$$\begin{aligned} p \pm (z \text{ critical value})\sqrt{\frac{p(1-p)}{n}} &= .167 \pm 1.645\sqrt{\frac{(.167)(.833)}{750}} \\ &= .167 \pm (1.645)(.014) \\ &= .167 \pm .022 \\ &= (.145, .189) \end{aligned}$$

Based on this sample data, we can be 90% confident that the true proportion of full-time workers who have been angry enough in the last year to consider hitting a coworker is between .145 and.189. We have used a *method* to construct this interval estimate that has a 10% error rate.

Up front we need to remind you that checking the assumptions is a critical part of the estimation procedure. Then we need to inform you that the TI-89 does not check these – it's your responsibility as the data analyst to do so. Having reminded and informed (and thereby absolved ourselves of any culpability in this matter) we will suggest that finding the 90% confidence interval on the TI is a matter of just a few keystrokes…

Stat > `Tests` > ...

Now we are looking in that huge list for something that suggests a single sample, an interval, and a *z*-statistic. Hmmm.

A:1-PropZInt…

would seem to fit the bill. Pick this option and you should be presented with the single proportion *z*-interval screen such as the one at right:

```
1-PropZInt
x:0
n:0
C-Level: .95
Calculate
```

Naturally enough, the TI is requesting all the information we need for constructing a confidence interval: (a) how many successes were in our sample, (b) what was our sample size, and (c) what is our confidence level? The defaults are 0 and 0 for the number of successes and sample size, and the confidence level is initially assumed to be 95%. From the information in the problem we can supply the relevant information as follows:

```
1-PropZInt
x:125
n:750
C-Level: .90
Calculate
```

After supplying the needed information, arrow down to the Calculate line

▼ `Calculate` > **ENTER**

and your results will be presented:

```
1-PropZInt
 (.14428,.18905)
 p̂ = .1666666667
 n=750
```

From the window we can interpret these results as "the 90% confidence interval is (.14428, .18905), and the point estimate, $\hat{p}$ in TI lingo, is .1666666667." If wish to present the interval in a plus/minus form, we can find the middle of the interval by finding the midpoint of the interval. The amount to add and subtract is, of course, half the length of the interval on either side of the midpoint:

$$.166665 \pm .022385$$

9.2 A Confidence Interval for a Population Mean

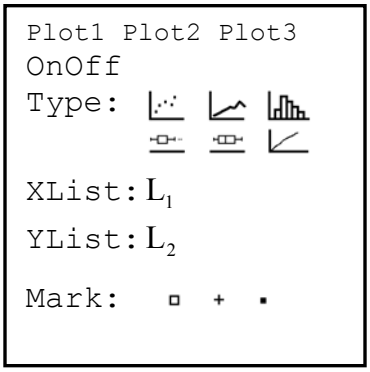
Example 9.9: Walking a straight line.

The confidence interval for a population mean unfolds on the calculator much as the procedure for finding the confidence interval for a population proportion. There is one added nice feature, though – the TI can help check the assumption of normality using either a box plot or a normal probability plot. For our example we will use Example 9.9, Walking a straight line, and the normal probability plot to check the assumption of normality. Enter the following numbers in, say, List1:

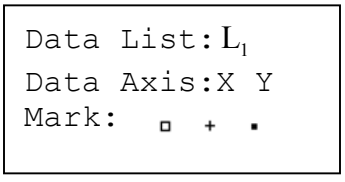
A study of the ability of individuals to walk in a straight line reported the accompanying data on *cadence* (strides per second) for a sample of $n = 20$ randomly selected healthy men.

.95	.85	.92	.95	.93	.86	1.00	.92	.85	.81
.78	.93	.93	1.05	.93	1.06	1.06	.96	.81	.96

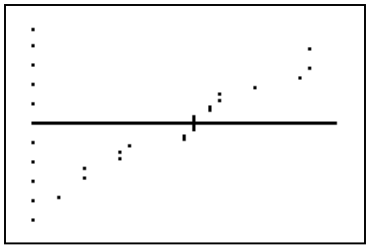
With the data entered we are ready to check the credibility of the assumption of a normal population. We could use a box plot for this purpose, but the normal probability plot gives more detail, and the TI-83 does the normal probability plot with no more effort. If you have not portrayed data graphically you may wish to review our discussion in Chapter 3 – if you are ready now, return to the Stat Plot menu, pick a plot, and we once gain find ourselves at the Plot Choice screen.



Select the normal probability plot by choosing the icon in the lower right. At that point the selections at the bottom of the Plot Choice screen should change to the following:



Since we have stored our data in List1, we will leave that the choice for data list. The data axis refers to which axis – horizontal or vertical -- you wish to have the data; the other axis will serve as the *z*-axis. Since we are only interested in the straightness of the normal probability plot, you can choose either `X` or `Y` for the data axis. To be consistent with Figure 9.9 in POD, we will choose `X` for the Data Axis. Our preference for the Mark in a normal probability plot is the little dot on the right. At this point we can do our **ZoomStat** keypress and get the normal probability plot:



The plot is reasonably straight, so we can proceed to the calculation of the confidence interval. The procedure at this point is remarkably similar to the procedure for the confidence interval for a sample proportion that we used earlier:

STAT > `TESTS` > `TInterval`

resulting in the following screen choices:

```
Tinterval
 Inpt:Data Stats
 List: L1
 Freq:1
 C-Level:.99
 Calculate
```

Since we have entered our raw data into List1 we will choose **`Data`** and L_1. Leave the **`Freq`** at 1. (This is a feature of the TI that we have never used, and probably will never use. If you are interested, take a look in the manual.) On our calculator the **`C-Level`** is already set at .99, so we don't need to change the confidence level. Now for the confidence interval. Arrow down to the **`Calculate`** option and press **Enter**.

```
TInterval
(.87372,.97728)
x̄=.9255
Sx =.0809467011
n=20
```

As with the confidence interval for the population proportion, this interval can be converted to plus/minus form easily.

9.3 Conclusion

As we have seen, calculating confidence intervals on the TI is very quick and easy. As you progress to other statistics and use your calculator to construct confidence intervals, the process will be very similar to what we have done here. That similarity across different statistics is one of the excellent features that makes the TI-83 easy to learn.