Using the TI-83 in Biostatistics

**Introduction.** This section is not intended as a comprehensive description of the calculator. Rather it is meant to be a quick reference to supplement the *TI-83 Graphing Calculator Guidebook* published by Texas Instruments. Basic calculator instructions are followed by sections on topic of Biostatistics that will be studied in the course.

**Entering information.** Keys on the calculator are indicated using square brackets. For example, you start the calculator with the [ON] key, you clear the screen using the [CLEAR] key and you enter information followed by the [ENTER] key.

**Procedures.** A procedure is given for each of the sections or processes being done. Generally, there will be two columns. On the far left will be the keys to press and in the center will be the result that appears on the screen. Each line of keys indicates which keys to press in what sequence. The keys to press will be within square brackets. When notes are required, they will be given in normal type.

In many cases, a procedure may be done only once. An example is [README]. Some procedures are for reference. An example is [WINDOW] which is used for different types of graphs. Once WINDOW is set, there is no need to change the settings unless the properties of the graph change. Some procedures or commands will be done frequently. An example is [STAT] which is used for preparing data for statistical calculations.

How to CLEAR things

**Clearing the screen**

[CLEAR] Result is a blank screen

**Clearing the graphing screen**

[2nd][DRAW]

<table>
<thead>
<tr>
<th>[1:]ClrDraw</th>
<th>[ENTER]</th>
<th>ClrDraw</th>
<th>Done</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1:</td>
</tr>
<tr>
<td>[1:]ClrDraw</td>
<td>[ENTER]</td>
<td>ClrDraw</td>
<td>Done</td>
</tr>
<tr>
<td>[ENTER]</td>
<td></td>
<td></td>
<td>2:</td>
</tr>
<tr>
<td></td>
<td>[ENTER]</td>
<td></td>
<td>[1:}</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[DRAW]</td>
</tr>
<tr>
<td></td>
<td>[ENTER]</td>
<td>ClrDraw</td>
<td>Done</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Line(</td>
</tr>
<tr>
<td>[ENTER]</td>
<td></td>
<td></td>
<td>3: Horizontal</td>
</tr>
<tr>
<td>[ENTER]</td>
<td></td>
<td></td>
<td>4: Vertical</td>
</tr>
<tr>
<td>[ENTER]</td>
<td></td>
<td></td>
<td>5: Tangent(</td>
</tr>
<tr>
<td>[ENTER]</td>
<td></td>
<td></td>
<td>6: DrawF</td>
</tr>
<tr>
<td>[ENTER]</td>
<td></td>
<td></td>
<td>7: Shade(</td>
</tr>
</tbody>
</table>

Be very careful using commands such as Delete, Clear Entries and ClrAllLists. They will remove things permanently from the memory. This is especially bad if you have collected and stored data for two months for your project and accidentally delete it.
Entering your name to identify your calculator

Creating a program

This procedure will create for you a program called README which contains your name, address, telephone number or whatever else you want to use to identify your calculator.

[PRGM][>]>[>] EXEC EDIT [NEW]
[1:]Create New

[ENTER] PROGRAM
Name=

[2nd][A-LOCK][R][E][A][D][M][E][ENTER]

PROGRAM: README

Using the [2nd][CATALOG] key, scroll through the CATALOG of all commands until you find Disp. Put the marker next to Disp and [ENTER]. Then type something appropriate in quotes after the command. If the line is too long, it will wrap around. You can get a new line using [ENTER]. Here are typical results.

```
PROGRAM: README
:Disp "RETURN TO"
:Disp "FRANK OSBORNE"
:Disp "KEAN U BIO DEPT"
:Disp "SCIENCE C"
```

Use [2nd][QUIT] when you are done entering your information.

Testing the program

[PRGM]

[ENTER]

[ENTER]
Clearing a list

[STAT]

[1]: Edit

Move the marker up to L1 then do [CLEAR] followed by [ENTER]. All data in the selected list is erased.

Entering data

Move the marker down to the first line. Note that it says L1(1)= at the bottom of the window where the data is entered. Enter data items one per line using [ENTER] after each.

Use the data from page 19 which are reproduced below.

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>1.5</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>2.1</td>
<td>2.2</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>3.0</td>
<td>3.0</td>
<td>3.2</td>
<td>3.4</td>
<td>4.0</td>
<td></td>
</tr>
</tbody>
</table>

After entering all the data, go back NOW and make sure that each entry is correct. It is a really good idea to check your work like this every time you enter data. If we assume that the average person makes one mistake every 20 keystrokes, there should be six errors. Checking your data entry at this point every time will save you a lot of grief later on. Remember, a 95% correctness rate means a 5% error rate.
Sorting the data in ascending order (lowest to highest)

[STAT]
[2:]SortA(

\[\text{EDN} \quad \text{CALC TESTS} \]
\[1: \text{Edit...} \quad 2: \text{SortA(} \quad 3: \text{SortD(} \quad 4: \text{ClrList} \quad 5: \text{SetUpEditor} \]

[ENTER]

[2nd][L1]
[ENTER]

\text{Done}

Done tells you that the activity has been completed. Note that [STAT] EDIT also permits you to sort a list in descending order from highest to lowest.

\text{SortA( is a function.} On the TI-83 calculator, it is generally not necessary to close the statement using the [)] key. But, in some cases, when working with complicated equations, it is a really good idea to make sure that your parentheses are balanced.

Displaying data graphically

The TI-83 calculator can display a variety of graph on the graphics screen. In STAT PLOT are six types of graphs identified by characteristic symbols. The graphs are:

- Scatterplot (used for regression and correlation)
- Frequency Polygon
- Histogram
- Modified Box Plot
- Box Plot
- Normal Probability Plot

Before using the [GRAPH] key it is necessary to make sure that the correct settings are entered in STAT PLOT and WINDOW.
Graphing the Histogram and Box Plot

We will use the data in L1 used in the previous procedures (page A3) to graph a Histogram and a Box Plot. Then we will construct new lists to use with the Frequency Polygon.

Settings for STAT PLOT

[2nd][STAT PLOT]

Plot 1:  Move down to the first row. Select On. Press [ENTER]
Move down to Type. Use the [>] key to select Histogram. Press [ENTER]
Note that the rest of the screen self-adjusts.

Settings for WINDOW

[WINDOW]

Use the down arrow key and enter each of the values shown.

Xmin is the minimum value
Xmax is the maximum value
Xscl is the class width
Graphing the Histogram

The histogram is plotted using GRAPH.

When TRACE is used, it gives you information about each bar. In this case the marker is on the bar centered at 4.5. Using TRACE you can learn some information about each of the bars in the histogram. For example you could make two lists, L2 and L3 with the center of the class interval in L2 and the frequency in L3.

L2: 0.5 1.5 2.5 3.5 4.5 5.5
L3: 0 8 17 4 1 0

Graphing the Frequency Polygon

Enter the data above into L2 and L3 as shown.

After the data are entered, the next thing to do is to tell STAT PLOT what the changes will be. It is often necessary to change WINDOW as well. It is a good habit to check STAT PLOT and WINDOW every time you plan to do a graph.
After the settings are changed, note the selection of the Frequency Polygon Type. The lists being used are L2 for Xlist and L3 for Ylist.

[GRAPH]

GRAPH will display your Frequency Polygon. It only displays up to X=5 because of the selections in WINDOW. In order to get more X values, it is necessary to change Xmax.

Changing Xmax to 7 permits the entire Frequency Polygon to fit on the screen. TRACE also works with frequency polygons.
Graphing the Box Plot

The calculator permits two types of box plots, Modified (ModBoxplot) and normal Boxplot (Boxplot). The selections are shown below.

```
<table>
<thead>
<tr>
<th>Plot1</th>
<th>Plot2</th>
<th>Plot3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type:</td>
<td>Off</td>
<td></td>
</tr>
<tr>
<td>List:</td>
<td>L1</td>
<td></td>
</tr>
<tr>
<td>Freq:</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Mark:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

- **ModBoxplot**
- **Boxplot**

Modified Boxplot draws its whisker mark at points 1.5 times the interquartile range. The interquartile range is the difference between Q3 and Q1, thereby making the formula $1.5 \times (Q_3 - Q_1)$. Any points outside this zone are shown separately. This helps you to determine if there are any values among the data which may cause the sample not to be normally distributed.

Normal Boxplot draws its whisker marks at Xmin and Xmax. Therefore, outliers are not shown and the whiskers may be longer. The plots below use the same data as before in L2 and L3 except that one is ModBoxplot which shows outliers and the other is normal Boxplot.

```
<table>
<thead>
<tr>
<th>Plot1</th>
<th>Plot2</th>
<th>Plot3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type:</td>
<td>Off</td>
<td></td>
</tr>
<tr>
<td>List:</td>
<td>L1</td>
<td></td>
</tr>
<tr>
<td>Freq:</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
```

- **ModBoxplot**
- **Boxplot**

Graphing the Normal Probability Plot

The Normal Probability Plot is used to determine if a set of data is normally distributed. This type of analysis is very important in Biostatistics because one of the fundamental assumptions on which it is based is that the data are normally distributed.

In order to determine normality of the data the Normal Probability Plot is used. The plot consists of data value vs. z score. A straight line, or nearly so, indicates normality.
Graphing the normal probability plot

The Table below lists heights (mm) of 52 corn seedlings measured in the biology laboratory when the seedlings were 10 days old.

<table>
<thead>
<tr>
<th>49</th>
<th>77</th>
<th>78</th>
<th>78</th>
<th>82</th>
<th>85</th>
<th>87</th>
<th>93</th>
<th>93</th>
</tr>
</thead>
<tbody>
<tr>
<td>94</td>
<td>105</td>
<td>106</td>
<td>106</td>
<td>109</td>
<td>110</td>
<td>110</td>
<td>111</td>
<td>114</td>
</tr>
<tr>
<td>114</td>
<td>118</td>
<td>119</td>
<td>120</td>
<td>121</td>
<td>121</td>
<td>122</td>
<td>122</td>
<td>122</td>
</tr>
<tr>
<td>123</td>
<td>130</td>
<td>151</td>
<td>151</td>
<td>151</td>
<td>152</td>
<td>154</td>
<td>160</td>
<td>160</td>
</tr>
<tr>
<td>160</td>
<td>161</td>
<td>165</td>
<td>169</td>
<td>180</td>
<td>185</td>
<td>189</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Enter these data into L1 and sort in ascending order. Then set STAT PLOT and WINDOW as shown below.

**Settings for STAT PLOT**

- **Type:** Plot1
- **Data List:** L1
- **Data Axis:** X, Y
- **Mark:** *

**Settings for WINDOW**

- **Xmin=40**
- **Xmax=190**
- **Xscl=10**
- **Ymin=-4**
- **Ymax=4**
- **Yscl=1**
- **Xres=1**

Once the settings are made use [GRAPH] to display the Normal Probability Plot

![Graph of Normal Probability Plot](image-url)
Calculating Basic Statistics

We will calculate basic statistics for the data in L1 which were entered earlier. These data were used to make the Histogram, the Frequency Polygon and the Box plots.

[STAT][>] EDIT TESTS
1: 1-Var Stats
2: 2-Var Stats
3: Med-Med
4: LinReg(ax+b)
5: QuadReg
6: CubicReg
7: QuartReg

[ENTER]

[2nd][L1]

[ENTER]

1-Var Stats

\[ n = 30 \]
\[ \text{MinX} = 1 \]
\[ Q_1 = 1.5 \]
\[ \text{Med} = 2 \]
\[ Q_3 = 2.2 \]
\[ \text{MaxX} = 4 \]

The resulting information takes up two screens. Use the up and down arrows to move around between them. We find the values of \( Q_1 \) and \( Q_3 \) which were used in the formula \( 1.5 \times (Q_3 - Q_1) \) when Modified Boxplot was determined. Note that there is a difference between \( Sx \) and \( ax \). The value of \( Sx \) is calculated using the standard deviation formula for the sample \( (n-1) \) is used in the denominator) whereas \( ax \) is calculated using the population formula which has \( N \) in the denominator.

The calculator retains these values until another set of 1-Var Stats is done. Some of the values are used automatically in other functions and calculations, such as construction of confidence intervals and hypothesis tests.
There are 16 statistical tests built into STAT TESTS which do most of the tests we study in Biostatistics. The tests begin using [STAT]. References are in the Table below.

Table of STAT TESTS.

<table>
<thead>
<tr>
<th>Test</th>
<th>What it does</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Z-Test</td>
<td>$z$ hypothesis test of a population mean</td>
<td>A12</td>
</tr>
<tr>
<td>2: T-Test</td>
<td>$t$ hypothesis test of a population mean</td>
<td>A13</td>
</tr>
<tr>
<td>3: 2-SampZTest</td>
<td>$z$ hypothesis test of two means</td>
<td>A14</td>
</tr>
<tr>
<td>4: 2-SampTTest</td>
<td>$t$ hypothesis test of two means</td>
<td>A15</td>
</tr>
<tr>
<td>5: 1-PropZTest</td>
<td>Hypothesis test of a population proportion</td>
<td>A16</td>
</tr>
<tr>
<td>6: 2-PropZTest</td>
<td>Hypothesis test of two population proportions</td>
<td>A17</td>
</tr>
<tr>
<td>7: ZInterval</td>
<td>Confidence interval using $z$</td>
<td>A18</td>
</tr>
<tr>
<td>8: TInterval</td>
<td>Confidence interval using $t$</td>
<td>A19</td>
</tr>
<tr>
<td>9: 2-SampZInt</td>
<td>CI using $z$ for the difference between two means</td>
<td>A20</td>
</tr>
<tr>
<td>0: 2-SampTInt</td>
<td>CI using $t$ for the difference between two means</td>
<td>A21</td>
</tr>
<tr>
<td>A: 1-PropZInt</td>
<td>CI for a population proportion</td>
<td>A22</td>
</tr>
<tr>
<td>B: 2-PropZInt</td>
<td>CI for difference of two population proportions</td>
<td>A23</td>
</tr>
<tr>
<td>C: $\chi^2$-Test</td>
<td>$\chi^2$-Test for a contingency table</td>
<td>A24</td>
</tr>
<tr>
<td>D: 2-SampFTest</td>
<td>F test for two variances</td>
<td>A25</td>
</tr>
<tr>
<td>E: LinRegTTest</td>
<td>$t$ test of a linear regression</td>
<td>A26</td>
</tr>
<tr>
<td>F: ANOVA(</td>
<td>One-way ANOVA calculation</td>
<td>A27</td>
</tr>
</tbody>
</table>

Many of these tests can Calculate a value or Draw a picture of the results. When using Draw, make sure that other pictures do not interfere by doing STAT PLOT, and selecting 4: PlotsOff before using Draw to display the picture.
Stat Tests
1: Z-Test

This is a hypothesis test of a single population mean. The test statistic is

\[ z = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}} \]

Usually you will do the following steps.

a. Enter the data into an appropriate list, such as L1.
b. Sort the list and run 1-VarStats
c. The calculator will remember some values which it will use in the
calculation of the hypothesis test, if the form of input is Stats.

Select Stats as the form of input
Inpt:Data [Stats]
Enter the values for \( \mu_0 \) and \( \sigma \) (in this example, square root of 20 was used)
Note that \( \bar{x} \) and \( n \) are the sample values just calculated using 1-VarStats on L1.
Select the hypothesis test being made
\[ \mu = \mu_0 \quad \text{or} \quad \mu > \mu_0 \]
Select Calculate or Draw

[STAT][TESTS]
[1:][ENTER]

[ENTER]

Results: Calculate

Note that the \( z \) score and \( p \) value are given in each case.
Refer to page 93 for details of this procedure.
A13

Stat Tests
2: T-Test

This is a hypothesis test of a single population mean. The test statistic is

\[ t = \frac{\bar{x} - \mu_0}{s / \sqrt{n}} \]

Which is used when the population variance is unknown. Usually you will do the following steps.

a. Enter the data into an appropriate list, such as L1.
b. Sort the list and run 1-VarStats
c. The calculator will remember some values which it will use in the calculation of the hypothesis test, if the form of input is Stats.

Select Stats as the form of input

Inpt:Data [Stats]
Enter the value for \( \mu_0 \)
Note that \( x, Sx \) and \( n \) are the sample values just calculated using 1-VarStats on L1.
Select the hypothesis test being made

\[ \mu = \mu_0 \quad < \mu_0 \quad > \mu_0 \]
Select Calculate or Draw

[STAT][TESTS]
[2:][ENTER]

Results:

Calculate

\[
\begin{align*}
\text{T-Test} \\
\mu & = 35 \\
\bar{x} & = 30.5 \\
Sx & = 10.63918736 \\
n & = 14 \\
\mu & = \mu_0 \quad < \mu_0 \quad > \mu_0 \\
\text{Calculate} & \text{ Draw}
\end{align*}
\]

[ENTER]

Draw

\[
\begin{align*}
\text{T-Test} \\
\mu & = 35 \\
t & = -1.582588751 \\
p & = 0.1375303411 \\
\bar{x} & = 30.5 \\
Sx & = 10.63918736 \\
n & = 14
\end{align*}
\]

Note that the \( t \) value and \( p \) value are given in each case.
Refer to page 100 for details of this procedure.
Stat Tests
3: 2-SampZTest

This is a hypothesis test of the difference between two population means. The test statistic is

\[ z = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)_0}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \]

and is used when the variances of the two populations are known (p109) or when the variances are unknown but the sample sizes are large (p112). Usually you will do the following steps:

a. Enter the data into appropriate lists, such as L1 and L2
b. Sort each list and run 1-VarStats on each one

The sample mean, hypothesized population mean, population variance and sample size for each population are known.

Select Stats as the form of input

Inpt:Data [Stats]

Enter the values for \( \sigma, x \) and \( n \) for each sample

Select the hypothesis test being made

\[ \mu_1 = \mu_2 \quad < \mu_1 \quad > \mu_2 \]

Select Calculate or Draw

[STAT][TESTS]
[3:][ENTER]

Results:

Calculate

2-SampZTest
Inpt:Data Stats
\( \sigma_1 = 1 \)
\( \sigma_2 = 1.224744871 \)
\( x_1 = 4.5 \)
\( n_1 = 12 \)
\( x_2 = 3.4 \)
\( n_2 = 15 \)
\( \mu_1 \neq \mu_2 \quad < \mu_2 \quad > \mu_2 \)
Calculate Draw

Draw

2-SampZTest
\( z = 2.569046516 \)
\( p = .0101979331 \)
\( x_1 = 4.5 \)
\( x_2 = 3.4 \)
\( n_1 = 12 \)

Note that the \( t \) value and \( p \) value are given in each case.
Refer to page 109 for details of this procedure.
Stat Tests
4: 2-SampTTest

This is a hypothesis test of the difference between two population means. The test statistic is

\[ t = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2) \delta}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \]

Which is used when the population variances are unknown but equal. Usually you will do the following steps.

a. Enter the data into appropriate lists, such as L1 and L2
b. Sort each list and run 1-VarStats on each one

The sample mean, sample standard deviation and sample size for each population are known.

Select Stats as the form of input

Inpt:Data [Stats]

Enter the values for x-bar, Sx and n for each sample as shown

Select the hypothesis test being made

\( \mu_1 = \mu_0 \lessgtr \mu_0 \) \( < \mu_0 \) \( > \mu_0 \)

Select Pooled: No [Yes]

Pooled variances are used when it is assumed that the population variances are equal, even though they are unknown.

Select Calculate or Draw

[STAT][TESTS]
[4:][ENTER]

Results: Calculate

2-SampTTest
\( \mu_1 > \mu_2 \)
\( t = 2.657325715 \)
\( p = 0.0070372461 \)
\( df = 23 \)
\( x_1 = 17.5 \)
\( n_1 = 16 \)
\( s_1 = 4.4711 \)
\( s_1 = 4.8492 \)
\( s_1 = 4.60613463 \)
\( n_2 = 9 \)

Draw

Note that the t value and p value are given in each case.

Refer to page 112 for details of this procedure.
5: 1-PropZTest

This is a hypothesis test of a single population proportion. The formula is

\[ z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} \]

Enter \( p_0 \), the proportion being tested, the number, \( x \), and the sample size, \( n \).

Note that the calculator uses \( x \), the number of individuals making up the proportion, and not the proportion itself. If the proportion is given, you must find out the value of \( x \) in order to use the calculator to test it.

Select the hypothesis test being made

\[ \text{prop} = \neq p_0 \quad < p_0 \quad > p_0 \]

Select Calculate or Draw

[STAT][TESTS]
[5][ENTER]

1-PropZTest
\( p_0: .05 \)
x: 18
n: 423
\( \text{prop} \neq p_0 \quad \text{prop} < p_0 \quad \text{prop} > p_0 \)
Calculate Draw

Results: Calculate

1-PropZTest
\( \text{prop} < .05 \)
z: -7027382055
\( \hat{p} = .0425531915 \)
n: 423
\( p = .2411093826 \)

Note that the \( z \) score and \( p \) value are given in each case.

Refer to page 122 for details of this procedure.
Stat Tests
6: 2-PropZTest

This is the hypothesis test of the difference between two population proportions. The formula is
\[ z = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)_0}{\sqrt{\hat{p}_1(1-\hat{p}_1)/n_1 + \hat{p}_2(1-\hat{p}_2)/n_2}} \]

Enter the number and sample size for each population
Select the hypothesis test being made
- \( \text{prop} =/ p_0 \quad < p_0 \quad > p_0 \)
Select Calculate or Draw

[STAT][TESTS][6][ENTER]

Results:
Calculate

\[
\begin{align*}
\text{2-PropZTest} \\
\hat{p}_1 = & 0.4363636364 \\
\hat{p}_2 = & 0.2941176471 \\
n_1 = & 55 \\
n_2 = & 149 \\
(\hat{p}_1 - \hat{p}_2) & = 0.1422460577 \\
z & = 2.709047504 \\
p & = 0.0033738843 \\
\sigma_{\hat{p}_1 - \hat{p}_2} & = 0.0337388433
\end{align*}
\]

Note that the \( z \) score and \( p \) value are given in each case.
Refer to page 125 for details of this procedure.
This is a construction of a confidence interval of a single population mean. The formula is

$$\bar{x} \pm z \frac{\sigma}{\sqrt{n}}$$

Usually you will do the following steps.

a. Enter the data into an appropriate list, such as L1.

b. Sort the list and run 1-VarStats

Select Stats as the form of input

Enter the value for $\sigma$

Note that $\bar{x}$ and $n$ are the sample values just calculated using 1-VarStats on L1.

Enter the confidence level

Calculate

[STAT][TESTS]
[7][ENTER]

Results:

Refer to page 54 for detail of this procedure.
Stat Tests
8: TInterval

This is a construction of a confidence interval of a single population mean. The formula is

\[ \bar{x} \pm t \frac{s}{\sqrt{n}} \]

Usually you will do the following steps.

a. Enter the data into an appropriate list, such as L1.

b. Sort the list and run 1-VarStats

Select Stats as the form of input
Inpt::Data [Stats]
Note that \( \bar{x} \), \( s \) and \( n \) are the sample values just calculated using 1-VarStats on L1.

Enter the Confidence Level then select Calculate

[STAT][TESTS]
[8:][ENTER]

Results:

Refer to page 58 for details of this procedure.
Stat Tests
9: 2-SampZInt

This is a construction of a confidence interval for the difference between two population means. The formula is

\[
(\bar{X}_1 - \bar{X}_2) \pm t_{(1-\alpha/2)} \sqrt{\frac{S_p^2}{n_1} + \frac{S_p^2}{n_2}}
\]

It is necessary to know \(\mu_1, \mu_2, n_1\) and \(n_2\) for each of the populations. Enter the information as shown.

[STAT][TESTS]
[9:][ENTER]

Results:

Refer to page 61 for details of this procedure.
Stat Tests
0: 2-SampTInt

This is a construction of a confidence interval for the difference between two population means. The formula is

\[ (\bar{X}_1 - \bar{X}_2) \pm t_{(1-\alpha/2)} \sqrt{\frac{S_p^2}{n_1} + \frac{S_p^2}{n_2}} \]

It is necessary to know \( x \), \( Sx \) and \( n \) for each of the populations.
Enter the information as shown.

[STAT][TESTS]
[0:][ENTER]

```
[2-SampTInt]
Inpt:Data
x1:21
Sx1:4.9
n1:13
x2:12.1
Sx2:5.6
n2:17

C-Level:.95
Pooled:No
```

Results:

```
[2-SampTInt]
(4.8915,12.909)
df=28
```

Refer to page 63 for details of this procedure.
This test constructs a confidence interval for a population proportion. The formula is

\[ \hat{p} \pm z_{(1-\alpha/2)} \sqrt{\hat{p} (1 - \hat{p})/n} \]

It is necessary to know the number and the sample size. Enter the information as shown. Note that if the proportion is given, it is necessary to derive the number corresponding to it first.

Enter the information as shown.

Refer to page 65 for details of this procedure.
Stat Tests
B: 2-PropZInt

This test constructs a confidence interval for the difference between two population proportions. The formula is

\[
(\hat{p}_1 - \hat{p}_2) \pm z_{(1-\alpha/2)} \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}
\]

It is necessary to know the number and the sample size for each population. Enter the information as shown.

[STAT][TESTS]
[B][ENTER]

Results:

Refer to page 67 for details of this procedure.
Stat Tests
C: x²-Test

This x²-test is done on observed and expected matrices related to contingency tables. Using the data on page 158, a 2X2 matrix is entered.

Preparing the matrix

```
[1 45 159]
[10 138]
```

Make sure that 2X2 is entered for both A and B since the calculator will use B to store the result.

Repeatedly pressing [ENTER] cycles through all of the positions allowing the numbers to be changed.

Calculating the χ² value

```
χ²-Test
Observed: [A]
Expected: [B]
Calculate Draw
```

Select Calculate

```
χ² = 74.0447447
p = 7.636627E-18
df = 1
```
Stat Tests
D: 2-SampFTest

This is hypothesis testing of the ratio of two population variances. The test statistic is the variance ratio.

\[ V.R. = \frac{s_1^2}{s_2^2} \]

It is necessary to know sample standard deviation and sample size for each of the two populations.

\[ s_1 = 21.4 \quad n_1 = 12 \]
\[ s_2 = 12.4 \quad n_2 = 5 \]

[STAT][TESTS]
[D:][ENTER]

![2-SampFTest]

Results:

Calculate

\[ F = 2.9784 \quad p = .1517 \]
\[ Sx1 = 21.4 \quad n1 = 12 \]
\[ Sx2 = 12.4 \quad n2 = 5 \]

Refer to page 81 for details of this procedure.
Stat Tests
E: LinRegTTest

This performs a \( t \) test on a linear regression to determine its significance. The data are entered into two lists. List L1 contains the x values and L2 contains the y values. This is the same way that data are entered for the linear regression calculation LinReg(ax+b).

\[
\begin{array}{|c|c|}
\hline
L1 & L2 \\
\hline
9 & 48.5 \\
12 & 46 \\
15 & 59.8 \\
18 & 86 \\
21 & 86.5 \\
24 & 119 \\
27 & 124 \\
\hline
\end{array}
\]

Once the data are entered the linear regression \( t \) test is calculated.

[STAT] [>] [>] [TESTS] [E:] LinRegTTest [ENTER]

Select the type of test and Calculate.

\[
\begin{align*}
\text{LinRegTTest} \\
\text{Xlist:} \text{L1} \\
\text{Ylist:} \text{L2} \\
\text{Freq:} 1 \\
8 \& \ r < 0 \Rightarrow \text{RegEQ: Calculate}
\end{align*}
\]

Results appear on two screens. Use the arrow keys to move between them. See page 149.
Stat Tests
F:ANOVA(

This test will calculate a one-way ANOVA. The data used will be the same used on page 140 for the ANOVA explanation. It consists of six sets of numbers which will be entered into the lists L1 through L6.

<table>
<thead>
<tr>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>50</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>54</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>62</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>66</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>72</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>78</td>
<td>104</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>L4</th>
<th>L5</th>
<th>L6</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>70</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>82</td>
<td>104</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>94</td>
<td>112</td>
<td></td>
</tr>
<tr>
<td>82</td>
<td>104</td>
<td>116</td>
<td></td>
</tr>
<tr>
<td>98</td>
<td>112</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>108</td>
<td>118</td>
<td>128</td>
<td></td>
</tr>
<tr>
<td>114</td>
<td>122</td>
<td>132</td>
<td></td>
</tr>
</tbody>
</table>

Then the ANOVA calculation is performed.

[STAT]
[>]][>][TESTS]
[F:]ANOVA(

Type in [2nd][L1][,][2nd][L2][,][2nd][L3][,][2nd][L4][,][2nd][L5][,][2nd][L6][)]

ANOVA(L1, L2, L3, L4, L5, L6)

[ENTER]
The results appear on two screens.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>V.R.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>47</td>
<td>49253</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>GROUP</td>
<td>5</td>
<td>28982</td>
<td>5796.4</td>
<td>12.00970845</td>
</tr>
<tr>
<td>ERROR</td>
<td>42</td>
<td>20271</td>
<td>482.6428571</td>
<td>—</td>
</tr>
</tbody>
</table>

Note that the calculator does not give the df or SS for TOTAL.