Statistics with the TI-83 Plus (and Silver Edition)

The TI-83 Plus and TI-83 Plus Silver Edition Manuals, besides coming with your calculator, can be downloaded or read in a browser in Adobe Acrobat Reader form from http://education.ti.com/product/pdf/gb/83m$book-eng.pdf.

Working with Lists

Editing lists with the TI-83 Plus. Open the Stat Package by hitting [STAT]. EDIT is darkened on the top line of the display. See Figure 1. Hit the one (1) key to choose 1:Edit to get to the Stat List Editor. There are six lists that are usually opened by default, named **L1** through **L6**. To reset to this default condition, with all lists empty, hit [STAT]-> 5:SetUpEditor, and then hit [ENTER]. Lists are saved to list variables. Any legal variable name can be used, provided it begins with a letter and contains a maximum of 5 characters. To enter a list called PROT in the Stat List Editor, whose elements are listed below, use the up arrow key to move the cursor to the top row, and then the right arrow key to move horizontally until you reach a blank column. Name= appears at the bottom of the screen and the calculator is in alpha-lock mode, so type PROT (see Figure 2) and hit [ENTER], followed by [▼].

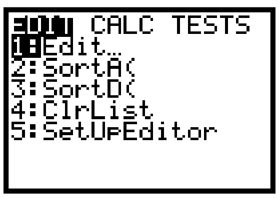

Figure 1

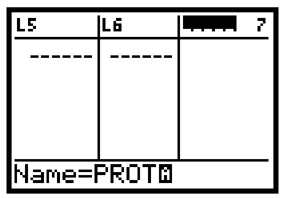

Figure 2

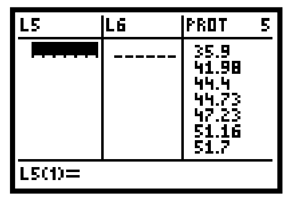

Figure 3

Now successively punch in each of the 61 elements in the list, each followed by [▼] or [ENTER].

35.90	41.98	44.40	44.73	47.23	51.16	51.70	53.07	54.07	54.38	54.41	55.05	55.47
57.68	57.73	57.90	58.50	59.20	59.36	59.76	61.10	61.70	61.90	62.20	62.32	62.80
63.96	66.60	67.10	67.20	69.91	70.17	71.50	72.10	72.20	72.30	73.50	73.53	74.78
76.33	77.40	77.63	78.15	79.55	82.60	83.82	84.70	85.40	86.24	88.17	88.78	91.47
95.06	95.33	100.36	106.00	109.30	114.79	128.40	149.49	153.56				

When editing an already entered list, use the arrow keys to move horizontally to the list you want to work with. Then edit the list, adding or changing items as necessary. You can delete any element of a list by hitting the [DEL] key when the cursor is on that element. To choose a different list to work with, use the arrow keys to move horizontally onto the list you want. If the list you want to work with is not displayed in the list editor, move to a blank spot in the top line, or hit [2nd][INS] to insert the list to the left of the one whose name you are currently on, and then enter the list name as described above. For a previously entered list, the elements of the list now appear below the list name. In either case, now hit [▼] or [ENTER]. You can remove a list and all its elements from the editor by hitting the [DEL] key when the cursor is on the list's name, noting that this does not delete the list from the calculator's memory.. To sort the list PROT into ascending order, hit [STAT]-> 2:SortA(to place SortA(on the home page, then hit [2nd][LIST][▶][▲]->B: **L** followed by PROT to complete the command on the screen to SortA(**L** PROT) (see Figure 4) and then hit [ENTER]. Returning to the list editor, the list PROT should now be in ascending order (see Figure 3).

Figure 4

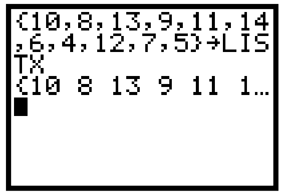

Figure 5

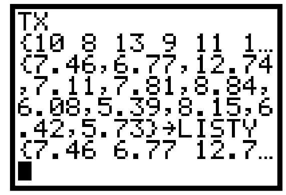

Figure 6

Entering lists on the home page. Lists can be entered manually on the home page by beginning with a left brace "{" (hit [2nd] [(]), typing in the numbers separated by commas, and ending with a right brace "}" (hit [2nd] [)]). Suppose you have two lists as follows:

x	10	8	13	9	11	14	6	4	12	7	5
y	7.46	6.77	12.74	7.11	7.81	8.84	6.08	5.39	8.15	6.42	5.73

Also, suppose you want to save the x list as LISTX and the y list as LISTY since these lists will be used later. Start with the x list. After hitting [CLEAR] to clear the entry line, type in the first list. To save the list as LISTX, hit the [STO▶] key. Then hit [2nd] [ALPHA] LISTX [ALPHA] [ENTER]. See Figure 5. ([2nd] [ALPHA] puts one in alpha lock and the last [ALPHA] releases that mode.) The y list can similarly be entered as LISTY. See Figure 6.

Random Numbers on the TI-83 Plus

Random number commands native to the operating system of the TI-83 Plus are:

[MATH][▶][▶][▶] ->1:rand. This moves one to the PRB submenu of the MATH menu and places rand on the home page. Pressing [ENTER] returns a random number > 0 and < 1. Continuing to punch [ENTER] generates more random numbers. The command rand(20), for instance, will generate a list of 20 random numbers. The command n [STO▶] rand resets the seed to the system default if n is 0 and generates a variable seed if n is not 0. This can be used for repeatability in experiments.

[MATH][▶][▶][▶] ->5:randInt(. The command randInt((*lower, upper*,[*numtrials*])returns a random list of *numtrials* integers between the integers *lower* and *upper*, inclusively. If *numtrials* is omitted, a single random integer is returned.

[MATH][▶][▶][▶] ->6:randNorm(. The command randNorm(μ,σ,[*numtrials*])returns *numtrials* random real numbers from a normal distribution specified by mean μ and standard deviation σ.

[MATH][▶][▶][▶] ->7:randBin(. The command RandBin(*numtrials, prob*,[*numsimulations*]) returns *numsimulations* random integers for the number of successes from a binomial distribution where the number of trials *numtrials* ≥ 1 and 0 ≤ probability of success *prob* ≤ 1.

You can find more about this on pages 2-20 to 2-22 of the TI-83 Plus Manual and pages 92-96 of the TI-83 Plus Silver Edition Manual.

Descriptive Statistics

One variable statistics with the TI-83 Plus. Suppose you wish to find the descriptive statistics for the list PROT. Assuming that the list PROT is properly prepared, hit [STAT] [▶] ->1:1-Var Stats. The right arrow first moves you to the CALC submenu of the STAT package (see Figure 7). Choosing 1:1-Var Stats places 1-Var Stats on the home page, where you should complete the command to 1-Var Stats ʟPROT (see Figure 8) before pressing [ENTER] to get the statistics (see Figure 9). You can get any hidden results by hitting [▼] or [▲]. From top to bottom you have the mean, the sum of the data entries, the sum of the data entries squared, the sample standard deviation, the population standard deviation, the number of data points, the minimum value, the first quartile value, the median, the third quartile value, and the maximum value. When you are finished viewing the statistics, hit [ENTER].

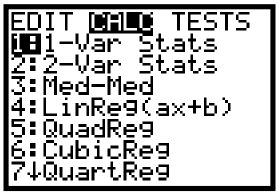

Figure 7

Figure 8

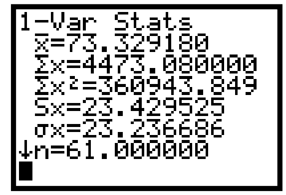

Figure 9

Two variable statistics with the TI-83 Plus. This is similar to one variable statistics with the exception that two lists need to be entered as arguments. Where data is paired, such as with LISTX and LISTY, a scatter plot of the data may be prepared. Press [2nd] [Y=] to reach STAT PLOTS, and with the cursor on 1:Plot1 (or any other plot you prefer), hit [ENTER]. First choose ON. Under TYPE, choose the scatter plot (upper left option). For Xlist enter LISTX, and for Ylist enter LISTY. Then choose the mark you wish to use (the box here) and press [ENTER] (see Figure 10). At this point, hit [ZOOM]->9:ZoomStat to get the scatter plot in a window selected to show all of the data points. See Figure 10. You can choose a window of your choice by hitting [WINDOW] and, for instance, entering in succession 0, 15, 1, 0, 15, 1, 1, and then pressing [GRAPH] (see Figure 12). We see this window shows the axes along with the points. To return to the home page, hit [2nd] QUIT.

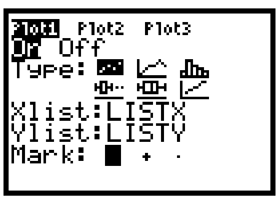

Figure 10

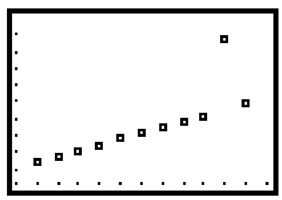
Figure 11

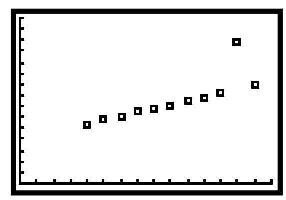
Figure 12

Regression with the TI-83 Plus. The TI-83 Plus supports several types of regression, among which are linear, quadratic, cubic, quartic, logarithmic, exponential, and power. All of them work pretty much the same, so linear regression will be used as an example.

Use the lists LISTX (the x's) and LISTY (the y's) entered earlier. You have seen the scatter plot in the previous section. Before finding any regression equation, first hit [2nd][CATALOG], then scroll to DiagnosticOn and hit [ENTER] twice. This allows for more complete regression results. To find the linear regression equation, hit [STAT] [▸] ->8:LinReg(a+bx). Complete the command to LinReg(a+bx) ʟLISTX, ʟLISTY, Y_1 (see Figure 13) and then press [ENTER] to get the results. However, to get the Y_1, you need to hit [VARS][▸] (see Figure 14) ->1:Function (see Figure 15) -> 1:Y_1 (or whichever other Y you want to use as a graphing variable to paste the regression equation to).

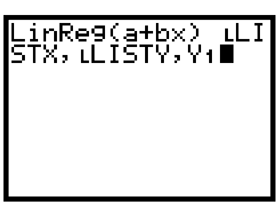

Figure 13

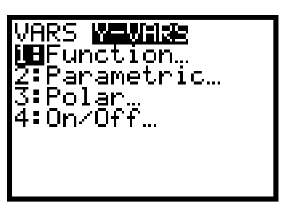

Figure 14

Figure 15

The regression equation is y=3.002455+.499727x (see Figure 16), the coefficient of determination is r^2=.666324 and the correlation coefficient is r=.816287. When you are finished looking at the results, hit [2nd][LIST], and under NAMES (you may need to hit [▾] several times) you will notice a new list named

RESID, the residuals of the regression (see Figure 17).

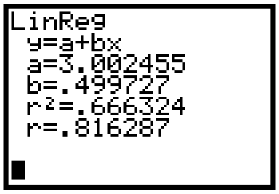

Figure 16

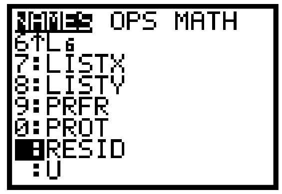

Figure 17

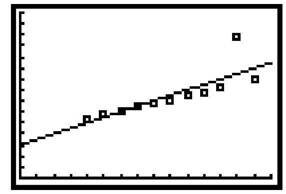

Figure 18

At this point, if you hit [GRAPH], you now get the scatter plot with the regression line. See Figure 18. We will next plot the residuals. First, hit [Y=], and for each function with a darkened "=" sign (meaning it is selected and will appear in any plot), use the arrow key to move the cursor onto each such "=" sign, and then hit [ENTER] to deselect the function, keeping it in memory but preventing it from graphing. Next go back to STAT PLOT and in Plot1 change the Ylist to RESID (see Figure 19). Then obtain the residual plot by hitting [ZOOM]->9:ZoomStat. See Figure 20.

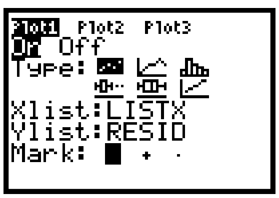

Figure 19

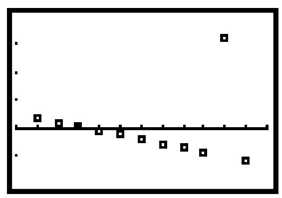

Figure 20

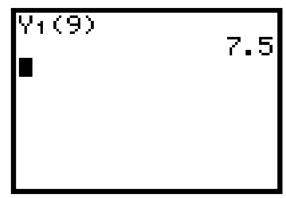

Figure 21

You can estimate and predict based on the regression equation. Suppose you wish to do this for x values of 9 and 15. Go to your home page by hitting [2nd][QUIT]. Then, assuming you saved the regression equation to equation variable Y1, hit [VARS][▸] -> 1:Function -> 1:Y1. This places Y1 on the home page, which you should complete to Y1(9). Then press [ENTER] to get the result of 7.5. See Figure 21. To get Y1(15), you can press [2nd][ENTRY][◂][◂]15) to get Y1 (15)=10.49836364.

Probability Distribution Functions on the TI-83 Plus

Binomial Distribution. Assume that for a sample of n=15 you have that p = .75. You want to find first P(X=6 | 15, .75). We can compute this probability by using the **binomial probability density function**

$$f(x) = \binom{n}{x} p^x (1-p)^{n-x}, x = 0 \ldots n.$$

Hitting [2nd] [DISTR] opens the distribution menu seen in Figure 22. Choose the option 0:binompdf(, and complete the command on the home page to binompdf(15,.75,6). Then hit [ENTER] to get the results screen in Figure 23. You see that P(X=6 | 15, .75)=.003398. If a value for X is omitted, you get instead a list of all the Pdf values, from X=0 to X=15 (see Figure 24). By using [STO▸], you can choose to save these values as a list.,

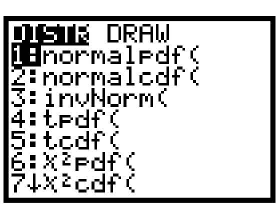

Figure 22

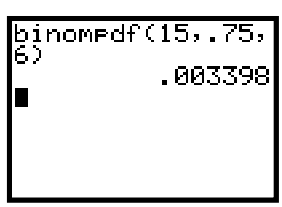

Figure 23

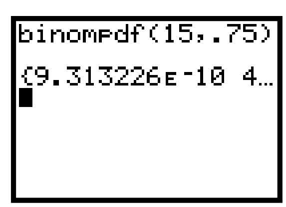

Figure 24

To find P(X≤5 | 15, .75), use the **binomial cumulative density function**. Similar to what you did above, hit [2nd] [DISTR] -> A:binomcdf(, and complete the command on the home page to binomcdf(15,.75,5). Then hit [ENTER] to get the results screen in Figure 25. You see that P(X≤5| 15, .75)=.0007949490. Again, omitting a value for X results in a list of all the Cdf values. See Figure 26.

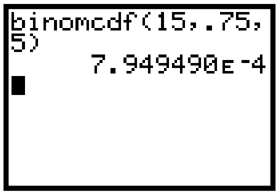

Figure 25

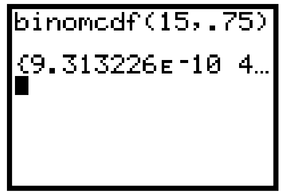

Figure 26

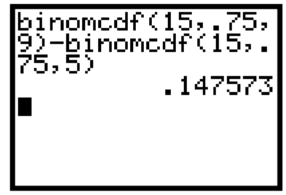

Figure 27

To find P(6≤X≤9 | 15, .75), use P(X≤9 | 15, .75) – P(X≤5 | 15, .75). On the TI home screen, this would be binomcdf(15,.75,9) – binomcdf(15,.75,5). See Figure 27.

Poisson Distribution. Assume that λ = .5. You want to find P(X=1 | .5). You can compute this probability by using the **Poisson probability density function**

$$f(x) = \frac{e^{-\lambda}\lambda^x}{x!}, x = 0,1,2,\ldots.$$

To get this density function, hit [2nd] [DISTR] -> B:poissonpdf(. This places poissonpdf(on the home screen. Complete this to poissonpdf(.5,1) and hit [ENTER]. You get that first P(X=1 | .5) = .303265. See Figure 28. Instead of putting in the parameter X=1, you may enter a list of X's instead.

To find P(X≤7 | 2.2), use the **Poisson cumulative density function**. After clearing your screen, hit [2nd] [DISTR] -> C:poissoncdf(. Complete this to poissoncdf(2.2,7) and hit [ENTER]. You get that P(X≤7 | 2.2) = .998022. See Figure 29. Instead of putting in the parameter X =7, you may enter a list of X 's instead.

To find P(4≤X≤9 | 2.2), use P(X≤9 | 2.2) – P(X≤3 | 2.2). On the TI home screen, this would be poissoncdf(2.2,9) – poissoncdf(2.2,3). See Figure 30.

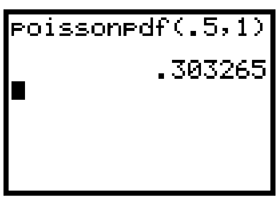

Figure 28

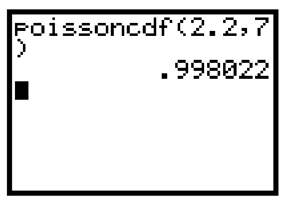

Figure 29

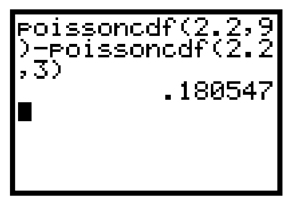

Figure 30

Normal Distribution. The **normal probability density function** is given by

$$f(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{\frac{-(x-\mu)^2}{2\sigma^2}}, \sigma > 0.$$

Assume μ = 100 and σ = 20. You wish to plot the normal curve for these parameters. First go to [WINDOW] and set the window, based on our parameters, to Xmin=40, Xmax=160, Xscl=20, Ymin=0, Ymax=.05, Yscl=1, and Xres=1. This will allow you to see the curve a distance of three standard deviations from the mean in both directions and cause tick marks to be placed along the x-axis at intervals of one standard deviation. Now hit [Y=] and then select and clear Y_1=. Then hit [2nd][DISTR] -> 1:normalpdf(. This leaves you with Y_1=normalpdf(showing on the screen. Complete this to \y1=normalpdf(X,100,20). You get the X by pressing the [X,T,Θ,n] key, which chooses the appropriate selection by context. See Figure 31. Not including the mean and standard deviation will result in the assumption of the standard normal distribution. Then hit [GRAPH] to get a screen like that of Figure 32.

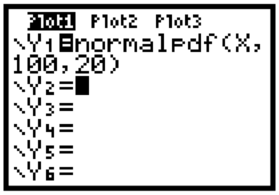

Figure 31

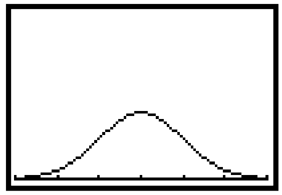
Figure 32

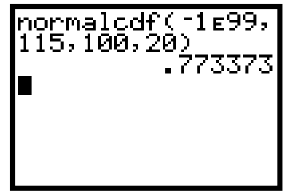

Figure 33

To find P(X≤115), you need to use the **normal cumulative density function**. After clearing your screen, hit 2nd [DISTR] -> 2:normalcdf(. This places normalcdf(on the home screen. Now complete this to normalcdf(-1E 99,115,100,20) – you get the E by hitting 2nd EE, with 1E 99 representing ∞ – and hit ENTER. You get that P(X≤115) = .773373. See Figure 33. Again, not including the mean and standard deviation will result in the assumption of the standard normal distribution. To find P(X≥95), you would complete the command to normalcdf(95,1E 99,100,20). To find P(90≤X≤135), complete the command to normalcdf(90,135,100,20).

To find X_1 such that P(X≤ X_1) = .6523, after clearing the screen, hit 2nd [DISTR] -> 3:invNorm(. This is for the **inverse normal distribution function**. . This places invNorm(on the home screen. Now complete this to invNorm(.6523,100,20) and hit ENTER. You get that X_1 = 107.830749. See Figure 34.

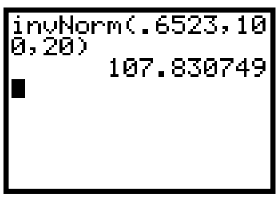

Figure 34

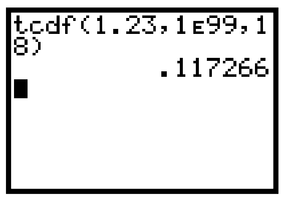

Figure 35

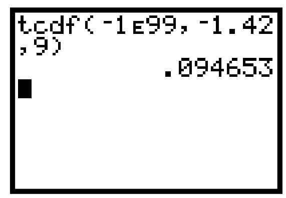

Figure 36

Student's *t* Distribution. The ***t* probability distribution function** is applied similar to that of the normal probability distribution function, but beginning with 2nd [DISTR] -> 4:tpdf(. The **cumulative *t* distribution** can be used to compute probabilities such as P(*t*≥1.23|df=18) or P(*t*<–1.42|df=9). To find the former, hit 2nd [DISTR] -> 5:tcdf(and complete the command to tcdf(1.23, 1E99,18) to get P(*t*≥1.23|df=18) = .117266. See Figure 35. To find the latter, hit 2nd [DISTR] -> 5:tcdf(and complete the command to tcdf(-1E99, -1.42, 9) to get P(*t*<–1.42|df=9) = .094643. See Figure 36.

χ^2 Distribution. The **χ^2 probability distribution function** is applied similar to that of the normal probability distribution function, but beginning with 2nd [DISTR] -> 6: χ^2pdf(. The **cumulative χ^2 distribution** can be used to compute probabilities such as P(χ^2 ≥24|df=16). To find this, hit 2nd [DISTR] -> 7: χ^2cdf(and complete the command to χ^2cdf(24, 1E99,16) to get P(χ^2 ≥24|df=16) = .089504. See Figure 37.

F Distribution. The **F probability distribution function** is applied similar to that of the normal probability distribution function, but beginning with 2nd [DISTR] -> 8: Fpdf(. The **cumulative F distribution** can be used to compute probabilities such as P(F ≥20|num df=3,denom df=6). To find this, hit 2nd [DISTR] -> 9: Fcdf(and complete the command to Fcdf (20, 1E99,3,6) to get P(F ≥20|num df=3,denom df=6)= .001586. See Figure 38.

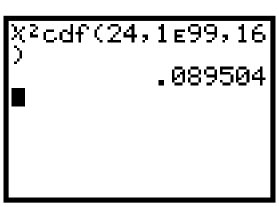

Figure 37

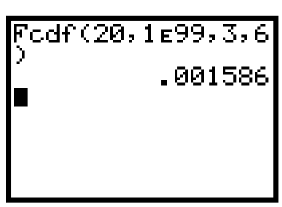

Figure 38

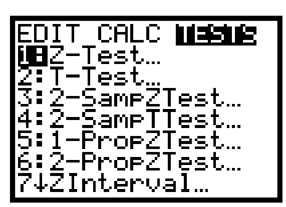

Figure 39

Inferential Statistics on the TI-83 Plus

Begin by entering two lists of data from two independent samples. As an example, cadmium level determinations were made on the placentas of two groups of mothers in nanograms per gram. The first group of 18 mothers were nonsmokers (NS), while the second group of 14 mothers were smokers (SM).

NS: 10.0 8.4 12.8 25.0 11.8 9.8 12.5 15.4 23.5 9.4 25.1 19.5 25.5 9.8 7.5 11.8 12.2 15.0

SM: 30.0 30.1 15.0 24.1 30.5 17.8 16.8 14.8 13.4 28.5 17.5 14.4 12.5 20.4

NS has a mean of 14.72 and a standard deviation of 6.20, while SM has a mean of 20.41 and a standard deviation 6.81.

Confidence Interval for a Population Mean. To find a 95% confidence interval for the mean of NS, hit [STAT][▸][▸] to reach the STAT TESTS menu (see Figure 39). Then choose 8:TInterval. In the window that comes up, move the flashing cursor, if necessary, onto Data by using the left arrow. Do this since the data has been entered as a list. Now hit [ENTER] followed by the down arrow, hit DEL as many times as necessary to get rid of any previous list name, then type [ALPHA][ALPHA]NS. Now hit the down arrow twice and type .95 see Figure 40). Finally, down arrow onto Calculate, and press [ENTER]. You are given (11.640,17.805) as the confidence interval, along with n=18 and the mean and standard deviation. See Figure 41.

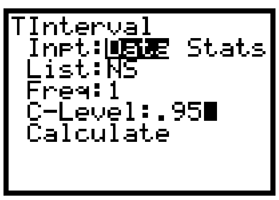

Figure 40

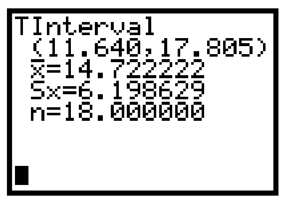

Figure 41

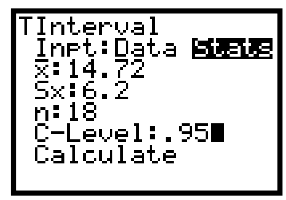

Figure 42

If the data list wasn't in the calculator, but you know the standard deviation and mean, when you get to the choice of Data vs. Stats, rightarrow to Stats, hit [ENTER], and then down arrow. See Figure 42. Type in 14.72 for the mean x-bar, down arrow, type in 6.20 for the standard deviation Sx, down arrow, type in 18 for n, down arrow, type in .95 for C-Level, down arrow onto Calculate, and press [ENTER]. Here you get a confidence interval of (11.637,17.803), just a bit different from above since more rounding was done here for the mean and standard deviation.

If the population standard deviation is known, one can use 7:ZInterval instead of 8:TInterval, making use of the normal distribution.

Confidence Interval for the Difference Between Two Population Means. Use NS and SM as data. To find a 95% confidence interval for the difference of the means of NS and SM, hit [STAT][▸][▸]0:2-SampTInt. In the window that comes up, move the flashing cursor, if necessary, onto Data by using the left arrow. Again, do this since the data has been entered as a list. Now hit [ENTER] followed by the down arrow. Enter NS for List1, SM for List2, 1 for both Freq1 and Freq2, and .95 for C-Level. For Pooled (pooled variance), assuming that it is not known that the population variances are equal, put the flashing cursor on NO (YES for equal variances), hit [ENTER], down arrow onto Calculate, and press [ENTER]. You are given a confidence interval of (-10.49, -.8987) along with other relevant results.

If the population standard deviations are known, one can use 9:2-SampZInt instead of 0:2-SampTInt, making use of the normal distribution.

Confidence Interval for a Population Proportion. You want a 99% confidence interval for the proportion of a certain population of boys who have attempted suicide. Of a sample of 96 boys, 18 had attempted suicide. Hit [STAT][▶][▶]A:1-PropZInt. For x, enter 18; for n, enter 96; and for C-Level, enter .99. Then down arrow onto Calculate, and press [ENTER]. You are given an interval of (.08489,.29011) with a p-hat of .1875.

Confidence Interval for the Difference between Two Population Proportions. 60 of 123 girls from a related population have attempted suicide. Hit [STAT][▶][▶]B:2-PropZInt. For x1, enter 18; for n1, enter 96; for x2, enter 60; for n2, enter 123; and for C-Level, enter .99. Then down arrow onto Calculate, and press [ENTER]. You are given an interval of (-.4552,-.1454) with a p-hat1 of .187500 and a p-hat2 of .487805.

Hypothesis Testing for a Single Population Mean. Use as a null hypothesis H_0: μ = 14 for the data set NS and use a t-test. Hit [STAT][▶][▶]2:T-Test. See Figure 43. Choose Data by placing the flashing cursor on it and pressing [ENTER]. Put 14 for μ0, NS for List, 1 for Freq, and ≠μ0 for μ. Then choose Calculate and hit [ENTER] to get t=.494324 and p=.627404 along with other results. See Figure 44.

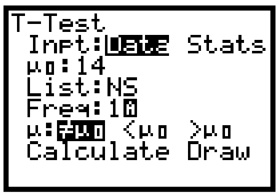

Figure 43

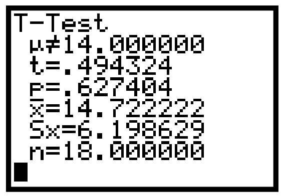

Figure 44

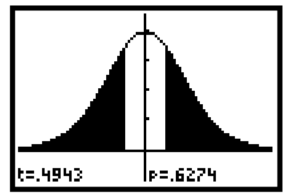

Figure 45

To get a graphical representation instead, choose Draw instead of Calculate. The t and p values are given below the graph, the shaded area equalling the value of p. See Figure 45. For this to work, all Plots need to be off and you need to have deselected or deleted any functions under Y=.

Hypothesis Testing for the Difference between Two Population Means. Use as a null hypothesis H_0: μ1 = μ2 for the data sets NS and SM and use a t-test. Hit [STAT][▶][▶]4:2-SampTTest. Choose Data by placing the flashing cursor on it and pressing [ENTER]. Put NS for List1, SM for List2, 1 for Freq1 and Freq2, ≠μ2 for μ1, and No for Pooled. Then choose Calculate and hit [ENTER] to get that t=-2.437946 and p=.021724 along with other results.

To get a graphical representation instead, choose Draw instead of Calculate. The t and p values are given below the graph. For this to work, all Plots need to be off and you need to have deselected or deleted any functions under Y=.

Hypothesis Testing for comparing Two Standard Deviations. Use as a null hypothesis H_0: σ1 = σ2 for the data sets NS and SM and use an F-test. We will also use as an alternate hypothesis H_A: σ1 < σ2 . Hit [STAT][▶][▶]D:2-SampFTest. See Figure 46. Choose Data by placing the flashing cursor on it and pressing [ENTER]. Put NS for List1, SM for List2, 1 for Freq1 and Freq2, and <σ2 for σ1. Then choosing Calculate and hitting [ENTER] gives us F=.827510 and p=.351256 along with other results. See Figure 47.

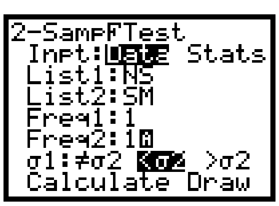

Figure 46

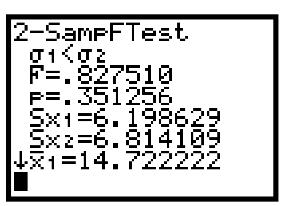

Figure 47

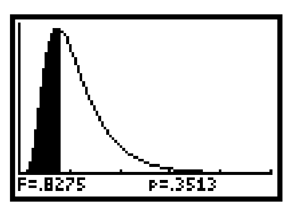

Figure 48

To get a graphical representation instead, choose Draw instead of Calculate. See Figure 48. The F and p values are given below the graph. For this to work, all Plots need to be off and you need to have deselected or deleted any functions under Y=.

Hypothesis Testing for a Single Population Proportion. In a survey of injection drug users in a large city, 18 out of 423, i.e. p-hat = .0426, were HIV positive. Can one conclude that fewer than 5% of the population of injection drug users in the city are HIV positive. Use H_0: p = .05, so H_A: p < .05. Hit [STAT]▶▶5:1-PropZTest. See Figure 49. Put in .05 for p0, 18 for x, 423 for n, move the cursor over <p0 for prop, and then choose Calculate and hit [ENTER]. You get as a result that z=-.702738 with a p-value of .241109. See Figure 50.

To get a graphical representation instead, choose Draw instead of Calculate. The z and p values are given below the graph. See Figure 51. For this to work, all Plots need to be off and you need to have deselected or deleted any functions under Y=.

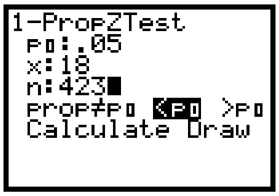

Figure 49

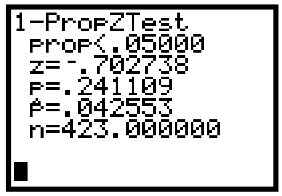

Figure 50

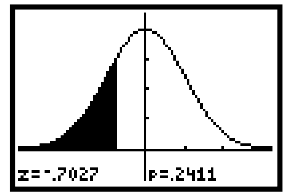

Figure 51

Hypothesis Testing for the Difference between Two Population Proportions. Return to the situation where 18 of 96 boys and 60 of 123 girls attempted suicide. Use as a null hypothesis H_0: p1 = p2 with H_A: p1 < p2. Hit [STAT]▶▶6:2-PropZTest. For x1, enter 18; for n1, enter 96; for x2, enter 60; for n2, enter 123; and for p1, enter <p2. Then choose Calculate and hit [ENTER]. For your result, you get that z=-4.604853 with a p-value of .000002065938.

One-Way Anova. Enter three lists in the calculator, L1={7, 4, 6, 6, 5}, L2={6,5,5,8,7}, and L3={4,7,6,7,6}. The null hypothesis here is H_0: $\mu_1=\mu_2=\mu_3$ with H_A: not all of μ_1, μ_2, μ_3 are equal. To run the test, hit [STAT]▶▶F:ANOVA. This pastes ANOVA(on your home page. Complete the command to ANOVA(L1,L2,L3) (see Figure 52), then hit [ENTER]. You are given an F score of .311111 with a p-value of .738367 along with other relevant information. See Figure 53. Press the down arrow key several times to get the rest of the information. See Figure 54.

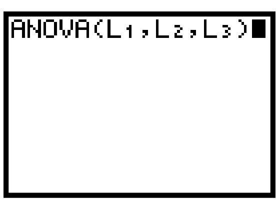

Figure 52

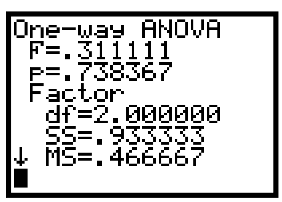

Figure 53

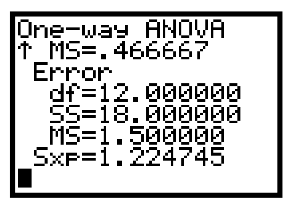

Figure 54

Chi-Square. First enter a matrix of observed values. Call this matrix A. Here use $A = \begin{bmatrix} 23 & 4 & 10 \\ 10 & 14 & 35 \end{bmatrix}$.

To enter the matrix, hit [2nd][MATRIX]▶▶ to get the EDIT submenu under MATRIX, then choose 1:[A] then hit 2 [ENTER] 3 [ENTER] 23 [ENTER]. Then continue by hitting each number in succession followed by [ENTER]. See Figure 55. When you are finished, hit [2nd][MATRIX] and enter the matrix of expected values as matix B. Here that matrix will be $B = \begin{bmatrix} 12.72 & 6.94 & 17.34 \\ 20.28 & 11.06 & 27.66 \end{bmatrix}$. The null hypothesis is that there is no association between the row and column variable, with the alternative hypothesis being that the variables are related. Hit [STAT]▶▶C: χ^2-Test. For Observed, type in [A], and for Expected, type in [B]. See Figure 56. Then choose Calculate and hit ENTER. You get a χ^2 of 20.606172 and a p-value of .00003352947, with a df of 2.

Figure 55

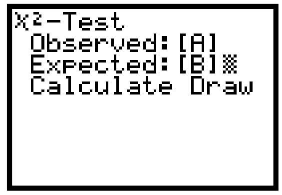

Figure 56

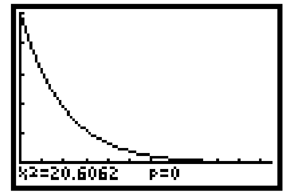

Figure 57

To get a graphical representation instead, choose Draw instead of Calculate. The χ^2 and p values are given below the graph. See Figure 57. For this to work, all Plots need to be off and you need to have deselected or deleted any functions under Y=.

Hypothesis Testing for the slope and correlation coefficient in Linear Regression using *t*. Return to the earlier linear regression example using LISTX and LISTY. LinRegTTest (linear regression *t* test) computes a linear regression on the given data and a *t* test on the value of slope β and the correlation coefficient ρ for the theoretical regression equation $y=\alpha+\beta x$. It tests the null hypothesis H_0: β=0 (equivalently, ρ=0) against one of the following alternatives: H_A: β≠0 and ρ≠0, H_A: β<0 and ρ<0, or H_A: β>0 and ρ>0. The first option will be used here. To run the test, hit STAT ▸ ▸ E:LinRegTTest. Fill in the window that opens as in Figure 58. Then hit Calculate followed by ENTER to get the results. See Figures 59 and 60. You see that you get t=4.239372 and p=.002176. Thus you can conclude that there is a linear relationship between the variables. You can see that the regression equation is y=3.002455+.499727x with a standard error of the estimate s=1.23631, and that the coefficient of determination r^2=.666324 and the correlation coefficient is r=.816287. The list of residuals of the regression is also saved as a list named RESID.

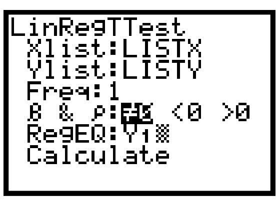

Figure 58

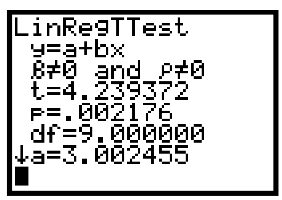

Figure 59

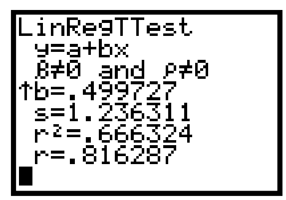

Figure 60