

## 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](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  $\boxed{\text{STAT}}$ . 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  $\boxed{\text{STAT}}$ -> 5:SetUpEditor, and then hit  $\boxed{\text{ENTER}}$ . 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  $\boxed{\text{ENTER}}$ , followed by  $\boxed{\nabla}$ .

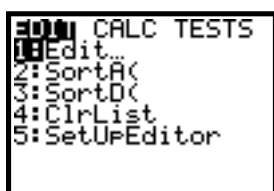


Figure 1

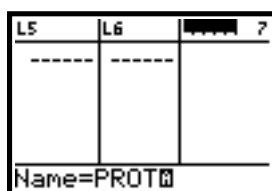


Figure 2

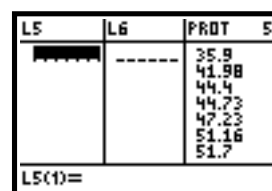


Figure 3

Now successively punch in each of the 61 elements in the list, each followed by  $\boxed{\nabla}$  or  $\boxed{\text{ENTER}}$ .

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  $\boxed{\text{DEL}}$  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  $\boxed{2\text{nd}}\boxed{[\text{INS}]}$  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  $\boxed{\nabla}$  or  $\boxed{\text{ENTER}}$ . You can remove a list and all its elements from the editor by hitting the  $\boxed{\text{DEL}}$  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  $\boxed{\text{STAT}}$ -> 2:SortA( to place SortA( on the home page, then hit  $\boxed{2\text{nd}}\boxed{[\text{LIST}]}\boxed{\blacktriangleright}\boxed{\blacktriangleup}$ ->B: L followed by PROT to complete the command on the screen to SortA(L PROT) (see Figure 4) and then hit  $\boxed{\text{ENTER}}$ . Returning to the list editor, the list PROT should now be in ascending order (see Figure 3).



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]**.

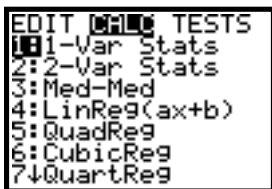


Figure 7

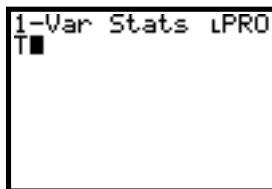


Figure 8

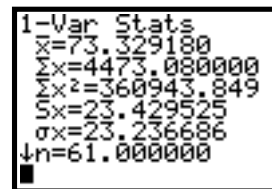


Figure 9

**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

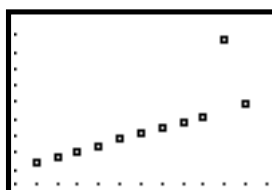


Figure 11

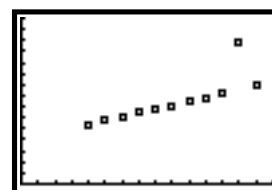


Figure 12

**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] [right arrow] ->8:LinReg(a+bx)**. Complete the command to **LinReg(a+bx)** **[left arrow]LISTX, [left arrow]LISTY, Y1** (see Figure 13) and then press **[ENTER]** to get the results. However, to get the Y1, you need to hit **[VARS][right arrow]** (see Figure 14) **->1:Function** (see Figure 15) **-> 1:Y1** (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 **[down arrow]** several times) you will notice a new list named

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

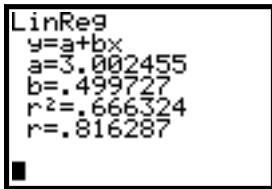


Figure 16

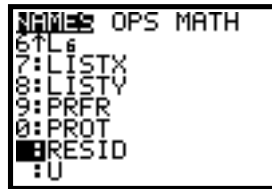


Figure 17

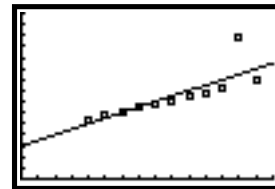


Figure 18

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

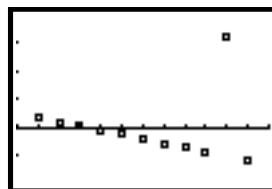


Figure 20

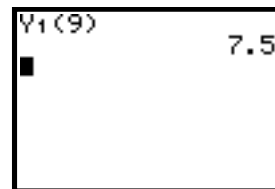


Figure 21

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**

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

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

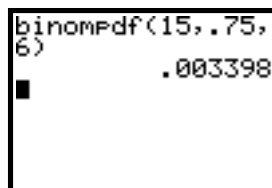


Figure 23

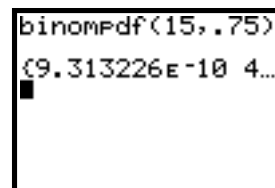


Figure 24

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  $P(X \leq 5 | 15, .75) = .0007949490$ . Again, omitting a value for X results in a list of all the Cdf values. See Figure 26.

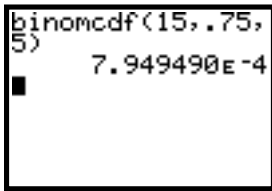


Figure 25

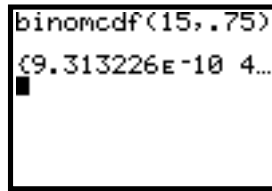


Figure 26

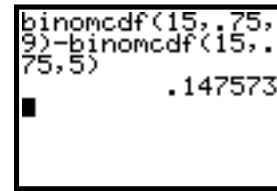


Figure 27

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

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

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

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  $P(X \leq 7 | 2.2)$ , 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  $P(X \leq 7 | 2.2) = .998022$ . See Figure 29. Instead of putting in the parameter  $X=7$ , you may enter a list of X's instead.

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

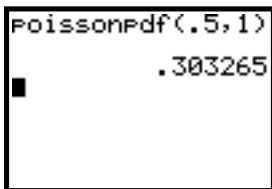


Figure 28

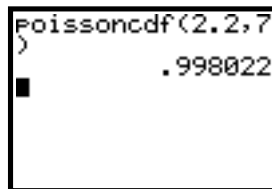


Figure 29

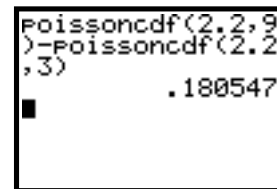


Figure 30

**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  $\mu = 100$  and  $\sigma = 20$ . 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 Y1=. Then hit **2nd**[DISTR] -> 1:normalpdf(. This leaves you with Y1=normalpdf( showing on the screen. Complete this to y1=normalpdf(X,100,20). You get the X by pressing the **X,T,θ,η** 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.

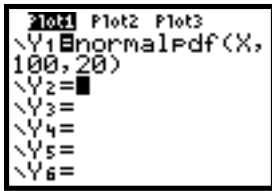


Figure 31

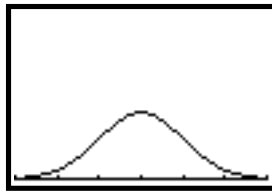


Figure 32

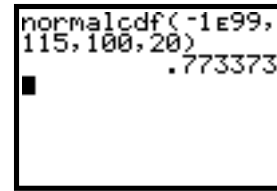


Figure 33

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

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

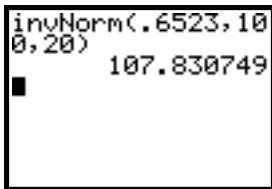


Figure 34

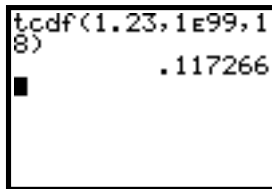


Figure 35

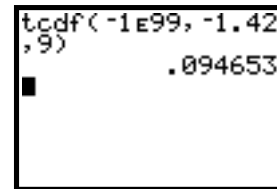


Figure 36

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

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

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

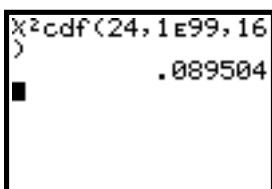


Figure 37

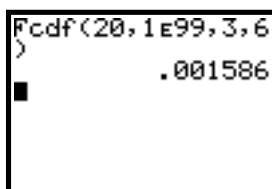


Figure 38



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.

```

TInterval
Inpt: Data Stats
List: NS
Freq: 1
C-Level: .95
Calculate
    
```

Figure 40

```

TInterval
(11.640, 17.805)
x̄=14.722222
Sx=6.198629
n=18.000000
    
```

Figure 41

```

TInterval
Inpt: Data Stats
x̄: 14.72
Sx: 6.2
n: 18
C-Level: .95
Calculate
    
```

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  $\bar{x}$ , down arrow, type in 6.20 for the standard deviation  $S_x$ , 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  $\boxed{\text{STAT}} \boxed{\rightarrow} \boxed{\rightarrow} \text{A:1-PropZInt}$ . For x, enter 18; for n, enter 96; and for C-Level, enter .99. Then down arrow onto Calculate, and press  $\boxed{\text{ENTER}}$ . 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  $\boxed{\text{STAT}} \boxed{\rightarrow} \boxed{\rightarrow} \text{B:2-PropZInt}$ . 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  $\boxed{\text{ENTER}}$ . 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  $H_0: \mu = 14$  for the data set NS and use a t-test. Hit  $\boxed{\text{STAT}} \boxed{\rightarrow} \boxed{\rightarrow} \text{2:T-Test}$ . See Figure 43. Choose Data by placing the flashing cursor on it and pressing  $\boxed{\text{ENTER}}$ . Put 14 for  $\mu_0$ , NS for List, 1 for Freq, and  $\neq \mu_0$  for  $\mu$ . Then choose Calculate and hit  $\boxed{\text{ENTER}}$  to get  $t=.494324$  and  $p=.627404$  along with other results. See Figure 44.

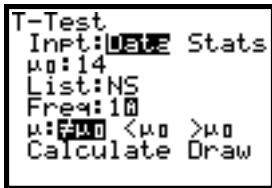


Figure 43

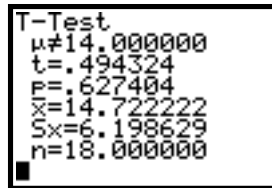


Figure 44

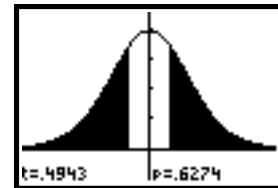


Figure 45

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  $H_0: \mu_1 = \mu_2$  for the data sets NS and SM and use a t-test. Hit  $\boxed{\text{STAT}} \boxed{\rightarrow} \boxed{\rightarrow} \text{4:2-SampTTest}$ . Choose Data by placing the flashing cursor on it and pressing  $\boxed{\text{ENTER}}$ . Put NS for List1, SM for List2, 1 for Freq1 and Freq2,  $\neq \mu_2$  for  $\mu_1$ , and No for Pooled. Then choose Calculate and hit  $\boxed{\text{ENTER}}$  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  $H_0: \sigma_1 = \sigma_2$  for the data sets NS and SM and use an F-test. We will also use as an alternate hypothesis  $H_A: \sigma_1 < \sigma_2$ . Hit  $\boxed{\text{STAT}} \boxed{\rightarrow} \boxed{\rightarrow} \text{D:2-SampFTest}$ . See Figure 46. Choose Data by placing the flashing cursor on it and pressing  $\boxed{\text{ENTER}}$ . Put NS for List1, SM for List2, 1 for Freq1 and Freq2, and  $< \sigma_2$  for  $\sigma_1$ . Then choosing Calculate and hitting  $\boxed{\text{ENTER}}$  gives us  $F=.827510$  and  $p=.351256$  along with other results. See Figure 47.



Figure 46

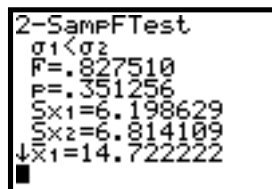


Figure 47

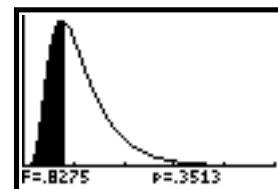


Figure 48

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.  $\hat{p} = .0426$ , 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  $p_0$ , 18 for  $x$ , 423 for  $n$ , move the cursor over **<p<sub>0</sub>** 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=**.

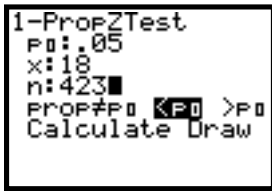


Figure 49

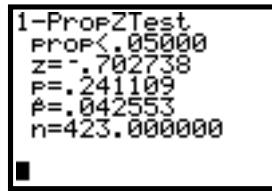


Figure 50



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  $H_0: p_1 = p_2$  with  $H_A: p_1 < p_2$ . Hit **[STAT]****[▶]****[▶]****6:2-PropZTest**. For  $x_1$ , enter 18; for  $n_1$ , enter 96; for  $x_2$ , enter 60; for  $n_2$ , enter 123; and for  $p_1$ , enter **<p<sub>2</sub>**. 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,  $L_1 = \{7, 4, 6, 6, 5\}$ ,  $L_2 = \{6, 5, 5, 8, 7\}$ , and  $L_3 = \{4, 7, 6, 7, 6\}$ . The null hypothesis here is  $H_0: \mu_1 = \mu_2 = \mu_3$  with  $H_A$ : not all of  $\mu_1, \mu_2, \mu_3$  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.

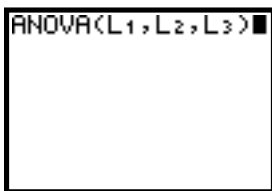


Figure 52

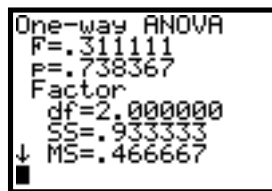


Figure 53

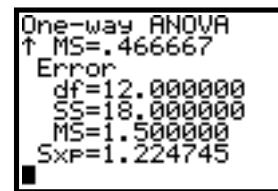


Figure 54

**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 matrix 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:  $\chi^2$ -Test**. For **Observed**, type in **[A]**, and for **Expected**, type

in [B]. See Figure 56. Then choose **Calculate** and hit **ENTER**. You get a  $\chi^2$  of 20.606172 and a p-value of .00003352947, with a df of 2.

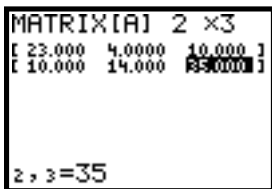


Figure 55

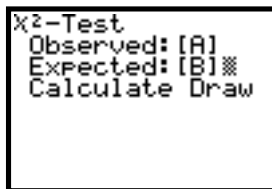


Figure 56

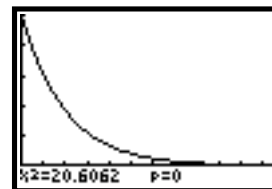


Figure 57

To get a graphical representation instead, choose **Draw** instead of **Calculate**. The  $\chi^2$  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  $\beta$  and the correlation coefficient  $\rho$  for the theoretical regression equation  $y=\alpha+\beta x$ . It tests the null hypothesis  $H_0: \beta=0$  (equivalently,  $\rho=0$ ) against one of the following alternatives:  $H_A: \beta \neq 0$  and  $\rho \neq 0$ ,  $H_A: \beta < 0$  and  $\rho < 0$ , or  $H_A: \beta > 0$  and  $\rho > 0$ . 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**.

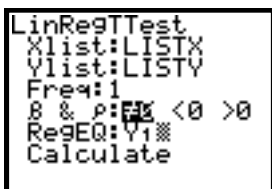


Figure 58

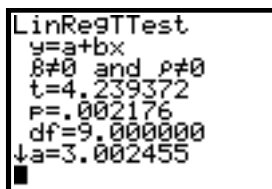


Figure 59

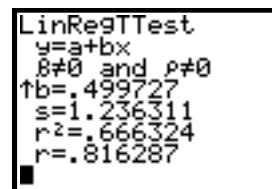


Figure 60