

A Quick Guide to the Statistical Capabilities of the TI-86

4/2012

Though the TI-86 does not come from the factory with all of the statistical capabilities of the TI-83 and TI-84, the missing capabilities can be easily copied from the TI-86 calculator at the front desk of the MRC. (Because of the Flash technology of the TI-86, these capabilities were downloaded from the Web.) Directions for copying the Distribution Functions to your calculator are on the last page of this document. Ask a member of the MRC staff for assistance.

STAT is located above the + key on the calculator.

DISTR, if you have received it from the MRC, is located in MATH (above the x symbol) – STAT – DISTR

List names

The TI-86 has 3 built-in names for statistics lists: xStat, yStat, and fStat. You can also insert lists with names such as L1, L2, etc.: STAT – EDIT; move your cursor up to the xStat list name. Press 2nd INS. Where the A is flashing, type the letter L, followed by the number 1. ENTER. A new list named L1 should have appeared to the left of the xStat list. Add L2 and L3 in the same manner if you wish.

Returning to the home screen

Press 2nd and QUIT (which is located above the EXIT button),

or

press the EXIT button, as many times as necessary.

Typing/Accessing a list name

When you are in the Home Screen you can access an existing list name by: 2nd LIST (above the subtraction button) and then NAMES (with F3). You will see all the available list names. Choose the list name by pressing the appropriate F key.

Clearing data from a list

While in STAT – EDIT, move the cursor to the very top of the column where the name of the list exists. When the cursor is on the list name, such as L1, press the CLEAR button and then press ENTER. The list should now be cleared.

Re-inserting a list that has accidentally been deleted

Sometimes when you want to clear a list, you might accidentally delete it instead. This occurs when we accidentally use DEL when we should have used CLEAR. Then the list seems to disappear completely. You can re-instate the list by: Placing the cursor on the very top of the next list, the list that is after your insertion point. For instance, if L2 is missing, place the cursor on the very top of L3. Press 2nd INS and then press 2nd L2. ENTER. Your list should reappear in the appropriate position.

Getting started:

If you have not already done so, create L1, L2, and L3. Now, enter some specific data into L1, L2, and L3, for our problems in this packet: Go to STAT – EDIT: Enter the data below into **L1**:

| | | | | | |
|-----|-----|-----|-----|-----|-----|
| 117 | 122 | 125 | 134 | 138 | 146 |
| 139 | 143 | 148 | 148 | 149 | 172 |

Go to STAT – EDIT: Enter this data into **L2**: 0 1 2 3 4

Go to STAT – EDIT : Enter this data into **L3**: 4 5 8 2 1

Histograms

1. Draw a histogram for the following data you have entered into L1. The data represent the weights of all students in a weight training class. Use these classes: 110-119, 120-129, 130-139, 140-149, 150-159, 160-169, 170-179, 180-189.

Set the graph window with GRAPH – WIND: (GRAPH is a key in the left column of the calculator keyboard.)

The key facts for setting the window are:

- Xmin must be the smallest number in the first class (110 in this example).
- Xmax must be large enough to accommodate the largest value in the list.
- Xscl must be the size of the classes (10 in this example).
- Ymin, Ymax, and Yscl must relate to the frequencies.

A suggested window for this data is:

Xmin = 110 Ymin = -2

Xmax = 190 Ymax = 7

Xscl = 10 Yscl = 1

Draw the histogram:

STAT – PLOT – Plot1 with F1 – On

For Type, choose HIST with F4 – Xlist is L1 – Freq is 1

Press the GRAPH button on the calculator and then choose GRAPH from the on-screen menu (with F5).

Check out what is going on: Choose TRACE at F4, and press the right arrow, noticing the numbers at the bottom of the screen.

2. Draw a **frequency histogram** of the data you have placed into L2 and L3. The data represent the number of children in 20 families.

| Number of Children | Frequency |
|--------------------|-----------|
| 0 | 4 |
| 1 | 5 |
| 2 | 8 |
| 3 | 2 |
| 4 | 1 |

Set the window. A suggested window for this data is:

Xmin = 0 Ymin = -3

Xmax = 5 Ymax = 9

Xscl = 1 Yscl = 1

Draw the histogram:

STAT – PLOT – PLOT1 – On

For Type, choose HIST – Xlist is L1 – Freq is L2

Press the GRAPH button on the calculator and then press GRAPH at F5.

Check out what is going on: Press TRACE and press the right arrow, noticing the numbers at the bottom of the screen.

Factorials, combinations

- Find 5!

Starting on the home screen, type the number 5.

To get to the exclamation mark for factorial, do: MATH (located above the multiplication symbol of the keyboard) – PROB at F2 – ! – ENTER

The result should be 120.

- Find $\binom{5}{3}$. This combination can also be written as ${}_5C_3$.

Starting at the home screen, type the 5. To find the combination capability, do this:

MATH – PROB – nCr – type the number 3. Your screen will look like: **5 nCr 3**.

Press ENTER.

The result for this exercise should be 10.

Mean, standard deviation, median, quartiles

Find the **mean**, the **standard deviation**, and the **five number summary** of the weight training class data you have in L1:

To calculate: STAT – CALC – OneVa

We need the screen to look like: **OneVar L1**. To get the L1, press LIST (above the subtraction key), choose NAMES and pick L1.

ENTER.

The following information should show on the screen:

$\bar{x} = 140.0833333$
 $\Sigma x = 1681$
 $\Sigma x^2 = 237877$
 $\downarrow Sx = 14.76148757$

Using the down arrow will allow us to see more of the information:

$\uparrow \sigma x = 14.1330483$
 $n = 12$
 $\min X = 117$
 $\downarrow Qrtl1 = 129.5$

Using the down arrow again will allow us to see the remainder of the screen.

$\uparrow Qrtl1 = 129.5$
 $\text{Med} = 141$
 $Qrtl3 = 148$
 $\max X = 172$

From this window we see that the Mean (\bar{x}) is 140.083; the Standard Deviation of this population (σ) is 14.133; the Median (Med) is 141; the Quartiles (Q1, Med, Q3) are 129.5, 141, and 148.

The Mode can be found most easily by sorting the data into ascending order:

- (1) In the home screen, go to LIST – OPS – sortA – NAMES at 2nd F3 – Choose L1 – ENTER.
Now look at the list on the screen to find the number that occurs the most.
- (2) Once your re-ordered list is displayed on the home screen, press the STO key (the key above the ON button). Make your home screen look like this: **Ans→L1**, by choosing the L1 with LIST – NAMES. Press ENTER. Now if you look back at your L1 in STAT – EDIT, the data are re-organized there. You can easily scroll down to find that the mode is 148.

Boxplots

Draw a boxplot for the weight training data in L1:

Set up the boxplot: STAT – PLOT – Plot1 – On

Type: Choose BOX at F5.

Xlist Name is L1.

Freq = 1.

ENTER.

To set up the appropriate window: GRAPH – ZOOM – ZDATA.

Press TRACE and use the left and right arrows to review the 5-number summary.

Turning off a STAT PLOT

There are 3 possibilities:

1. STAT - PLOT (with F3) - Go into the Plot you wish to turn off, such as Plot1, with F1, and place the cursor on Off. Press ENTER.
or
2. Press the GRAPH key and choose $y(x)=$. At the top of the screen, if Plot1, Plot2, or Plot3 have a dark box, then they are turned on. To turn off a particular plot, put the cursor on the Plot to be turned off and then press ENTER. (This is just a toggle, so pressing ENTER again will turn the StatPlot on again.)
or
3. STAT – PLOT – PLOff - ENTER (This will turn off all plots.) If you wish to turn off particular plots, such as Plot1 and Plot2, then have your screen look like PLOff(1,2).

Distribution Functions (All are found in MATH – STAT – DISTR)

Be sure that you have obtained the DISTRIBUTION function capability for your TI-86, from a member of the MRC staff. That capability will enable you to do the following problems.

- **bipdf (n, p, x)** finds the probability of a particular outcome in a binomial situation.
Example: Suppose it is known that 23% of the people that take a particular medication become drowsy. Out of 8 people, what is the probability that *exactly* 3 will become drowsy?

We know that $n = 8$, $p = .23$, and $x = 3$. In **DISTR**, choose **bipdf**, using the MORE key as necessary.

The screen should be made to look like **bipdf (8, .23, 3)**

ENTER.

The result should be .184427279894.

Therefore, the probability that exactly 3 people will become drowsy is approximately .18.

- **bipdf (n, p, x)** can be used to find a probability distribution in a binomial situation.
Example: It is known that 23% of the people that take a particular medication become drowsy. Create the *probability distribution* for a sample of 8 people.

We know that $n = 8$ and $p = .23$.

Enter the values 0 through 8 into L1 in STAT – EDIT.

2nd QUIT to the Home Screen.

Access **bipdf** in the **DISTR** menu.

Make the screen look like: **bipdf (8, .23)**. Do not press ENTER yet. We want the answer to store in L2. Make your screen look like **bipdf (8, .23) → L2**. The STO key is the key above ON. Find the L2 in LIST – NAMES.

ENTER.

2nd Quit to return to the Home Screen. Then look at the lists in STAT – EDIT.

The distribution will show as:

| L1 | L2 |
|----|----------|
| 0 | .1235736 |
| 1 | .2952928 |
| 2 | .3087152 |
| 3 | .1844273 |
| 4 | .0688608 |
| 5 | .0164551 |
| 6 | .0024576 |
| 7 | 2.097E-4 |
| 8 | 7.831E-6 |

Remember what the E means: 2.097E-4 means 2.097×10^{-4} , or .0002097.

- bicdf (n,p,x)** finds cumulative probability in a binomial situation.

Example: It is known that 23% of people that take a particular medication become drowsy. Out of 8 people, what is the probability that at most 3 people will become drowsy?

We know that $n = 8$, $p = .23$, and $x = 3$. In DISTR, choose **bicdf**.

The screen should be made to look like **bicdf (8, .23, 3)**

ENTER.

The result should be .912008966757.

Therefore, the probability that at most 3 people will become drowsy is approximately .912.

NOTE: **cdf** means *cumulative density function*, so think left to right.
- nmcdf (lower, upper, μ , σ)** finds area between a lower value and an upper value, given the mean and standard deviation.

Example: The weights of all the students in a weight training class have a mean weight of 175 lbs. and a standard deviation of 12 lbs. If the weights are normally distributed, find the *percentage* of students that weigh *less than* 180 lbs. We know that the lower bound is $-\infty$ and we will use -10^{99} . We know the upper bound is 180, the mean is 175, and the standard deviation is 12. In MATH – STAT – DISTR, choose **nmcdf**.

The home screen of the calculator should look like: **nmcdf (-10⁹⁹, 180, 175, 12)**

ENTER.

The result should be: .661538843341.

So, the percentage of students who weigh less than 180 lbs. is approximately 66.2%.

NOTE: **cdf** means *cumulative density function*, so think left to right.
- tcdf (lower, upper, df)** finds the area between a lower value and an upper value in a t-distribution, given the degrees of freedom.

Example: Determine the area to the right of $t=2.5$ if $n = 16$. We know that the lower bound is 2.5. The upper bound is ∞ and we will use 10^{99} . The degrees of freedom is 15. In MATH – STAT – DISTR, choose **tcdf**.

The home screen of the calculator should look like: **tcdf (2.5, 10⁹⁹, 15)**

The result should be .0122529014. So, the area to the right of $t=2.5$ is approximately .0122.
- invnm (area)** finds the z-score, given the area to its left, in a standard normal distribution.

Example: Find $z_{.05}$. In other words, determine the z value for which the area to the *right* is .05.

Since the calculator “thinks” *left to right* on the statistical calculations, we must use the area to the left, .95. We also know the mean is 0 and the standard deviation is 1. In MATH – STAT – DISTR, choose **invnm**.

The word “area” refers to area from *left to right*.

Your screen should look like: **invnm(.95)** We do not need to enter the 0 or 1 since this is a standard normal distribution .

ENTER.

The result is: 1.64485362591.

So, the area to the right of $z = 1.645$ is .05.
- invnm (area, μ , σ)** finds the numerical value, given the area to its left, in a normal distribution. The word “area” refers to area from *left to right*.

Example: The weights of all the students in a weight training class have a mean weight of 175 lbs. and a standard deviation of 12 lbs. The weights are normally distributed. 95% of the weights are less than ? lbs. We know the area to the left is .95, the mean is 175, and the standard deviation is 12.

In MATH – STAT – DISTR, choose **invnm**. The screen should look like: **invnm (.95, 175, 12)**. ENTER.

The result is approximately 194.74 lbs. So, 95% of the students have a weight less than 194.74 lbs.

Confidence Intervals and Hypothesis Tests (All are found in MATH →STAT→TESTS)

- **ZTest** (Hypothesis Test) at MATH – STAT – TESTS – F1

| | |
|--|---|
| <p>Inpt: Data</p> <p>μ_0 = State the original mean, μ_o</p> <p>σ = Type in the population standard deviation</p> <p>List = Find the list name at LIST → NAMES</p> <p>Freq = Type in the frequency, either the number 1 or a list name at LIST – NAMES.</p> <p>Choose: 2-tailed ($\neq \mu_0$), left-tailed ($< \mu_0$), or right-tailed ($> \mu_0$).</p> <p>Calculate by pressing F1 for Calc</p> | <p>Inpt: Stats</p> <p>μ_0 = State the original mean, μ_o</p> <p>σ = Type in the population standard deviation</p> <p>\bar{x} = Enter the sample mean</p> <p>n = Enter the number of data</p> <p>Choose: 2-tailed ($\neq \mu_0$), left-tailed ($< \mu_0$), or right-tailed ($> \mu_0$).</p> <p>Calculate by pressing F1 for Calc</p> |
|--|---|

The results state the z-test statistic and the p-value. The conclusion is left to the student.

- **TTest** (Hypothesis Test) at MATH – STAT – TESTS – F2

| | |
|--|--|
| <p>Inpt: Data</p> <p>μ_0 = State the original mean, μ_o</p> <p>List = Find the list name at LIST → NAMES</p> <p>Freq = Type in the frequency, either the number 1, or a list name, in LIST, above the minus sign</p> <p>Choose: 2-tailed ($\neq \mu_0$), left-tailed ($< \mu_0$), or right-tailed ($> \mu_0$).</p> <p>Calculate by pressing F1 for Calc</p> | <p>Inpt: Stats</p> <p>μ_0 = State the original mean, μ_o</p> <p>\bar{x} = Enter the sample mean</p> <p>Sx = Enter the sample standard deviation</p> <p>n = Enter the number of data</p> <p>Choose: 2-tailed ($\neq \mu_0$), left-tailed ($< \mu_0$), or right-tailed ($> \mu_0$).</p> <p>Calculate by pressing F1 for Calc</p> |
|--|--|

The results state the t-test statistic and the p-value. The conclusion is left to the student.

- **ZPrp1** (1-Proportion Z Test) at MATH – STAT – TESTS – F5

State the original population proportion, p_o

State the x (the number that have the specified attribute).

State the n (sample size).

Choose 2-tailed ($\neq p_o$), left-tailed ($< p_o$), or right-tailed ($> p_o$).

Calculate, at F1.

The results state the z test statistic and the p-value. The conclusion is left to the student.

- **ZInt1** (Confidence Interval) at MATH – STAT – TESTS – MORE – F2

| | |
|--|--|
| <p>Inpt: Data</p> <p>σ = State the population standard deviation</p> <p>List = Find the list name at LIST → NAMES</p> <p>Freq = Type in the frequency, either the number 1, or a list name, in LIST, above the minus sign</p> <p>C-Level = State the confidence level.</p> <p>Calculate by pressing F1 for Calc.</p> | <p>Inpt: Stats</p> <p>σ = State the population standard deviation</p> <p>\bar{x} = Enter the sample mean</p> <p>n = Enter the number of data</p> <p>C-Level = State the confidence level.</p> <p>Calculate by pressing F1 for Calc.</p> |
|--|--|

The result is the confidence interval in interval form.

- **Tint1** (Confidence Interval) at MATH – STAT – TESTS – MORE – F3

| | |
|---|---|
| <p>Inpt: Data</p> <p>List = Find the list name at LIST → NAMES</p> <p>Freq = Type in the frequency, either the number 1, or a list name, in LIST, above the minus sign</p> <p>C-Level = State the confidence level.</p> <p>Calculate by pressing F1 for Calc.</p> | <p>Inpt: Stats</p> <p>\bar{x} = Enter the sample mean</p> <p>Sx = Enter the sample standard deviation</p> <p>n = Enter the number of data</p> <p>C-Level = State the confidence level.</p> <p>Calculate by pressing F1 for Calc.</p> |
|---|---|

- **Chitst** (Chi Square Independence Test) at MATH – STAT – TESTS – MORE – MORE – F3

Before accessing the χ^2 Test, put the original data matrix into matrix A in the calculator:

- 2nd MATRX (above 7)
- EDIT
- Name the matrix with a letter.
- State the size of the matrix (e.g. 4 x 3 is a matrix with 4 rows and 3 columns)
- Enter the data into the matrix.
- 2nd QUIT

Find the χ^2 Test in MATH – STAT – MORE – MORE – F3 :

- At Observed, type the name of the matrix, such as A, such as B.
- Calculate at F1 with CALC.

The result states the χ^2 test statistic and the p-value. The conclusion is left to the student.

Regression

Example: Calculate the **linear regression equation** for the following data representing both the number of hours a group of students studied for a test and their resulting test scores. Plot the ordered pairs and the regression equation. Determine the correlation coefficient.

| | | | | | | | | | | | | | | |
|-----------------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Number of hours of studying | 10 | 12 | 11 | 13 | 15 | 20 | 11 | 17 | 8 | 6 | 7 | 10 | 12 | 11 |
| Test score | 82 | 91 | 88 | 89 | 90 | 99 | 85 | 94 | 75 | 65 | 62 | 89 | 88 | 95 |

1. Enter the number of hours and the tests scores into L1 and L2 respectively, with STAT – EDIT.
Go to the Home Screen with 2nd QUIT.

Calculate the regression equation: STAT – CALC – LinR.

Now make the screen look like this:

LinR L1, L2, y1 (L1 and L2 can be found in LIST – NAMES. **y1** can be typed in with 2nd ALPHA – y, and then the number 1. Be sure to use the lower case **y**.)

ENTER.

(NOTE: If you use the **y1** as indicated, then the regression equation will automatically be pasted into y1).

Your screen should look like this:

```
LinReg
y = a+ bx
a = 57.6903201
b = 2.35788662
↓corr = .821530236
```

Now mentally plug the “a” and “b” values into the equation $y=a + bx$, and that is your regression equation.

Take a look at **y(x)=** in GRAPH. Your equation should be there, because you specified that the calculator should paste the regression equation into y1. It should look like $y1 = 57.690320092557 + 2.3578866178172x$.

The regression equation (with rounded values and in $y=mx+b$ form would be $y = 2.36x + 57.69$.

2. **Plot the ordered pairs and the regression equation:**

STAT – PLOT – PLOT1 – On

Choose the scatterplot, with SCAT.

Xlist Name : L1 and Ylist Name : L2.

The little square is a good mark.

Go back to the **y(x)=** screen with the GRAPH button on the calculator keyboard.

If your regression equation is there and the **Plot1** at the top of the screen has a black box, then both the points and the line are ready to graph.
Choose a good window with GRAPH – ZOOM – ZDATA.
You should now see the points and the regression line.

3. Determine the **correlation coefficient, r**.

STAT – CALC – LinR

Now make the screen look like this: **LinR L1, L2** (L1 and L2 can be found in LIST – NAMES.)
ENTER.

Your screen should look like this:

```
LinReg
y = a+ bx
a = 57.6903201
b = 2.35788662
corr = .821530236
```

We see the correlation coefficient, r , is approximately .82. The coefficient of determination, r^2 , can be calculated by squaring the r value of .82. The result for r^2 is approximately .67.

The TI-86 Inferential Statistics and Distribution Functions can be downloaded from the web, because of the Flash technology of the TI-86; or, once the functions are loaded on to one TI-86, the Link cable can be used to copy the functions onto other TI-86 calculators.

Instructions to copy the TI-86 Inferential Statistics and Distribution Functions from one TI-86 to another TI-86.

- Use the black TI-Link cable to copy* the following programs from one TI-86 to another:

Infstats
exstats
exstats2
statedit

Directions:

Plug the calculator cable into each calculator, firmly.

On the receiving calculator, access LINK and then RECV.

On the sending calculator, access LINK and then SEND – PROGRAM.

Arrow down to the choices listed about and press SELCT for each of them.

XMIT.

You should see the names of each of the programs, and DONE.

- Once all four programs have been copied to the new calculator, the functions must be **installed**:
Begin in the Home Screen. Then:
 1. Paste **Asm** to a blank line on the Home Screen by selecting **Asm** from the CATALOG.
 2. Paste **Infstats** to the Home Screen as an argument, by selecting **Infstat** from the PRGM NAMES. Your screen should look like: **Asm(Infstats)**
 3. Run the installation program by pressing ENTER.
You will see a Caution statement. To continue, simply press F1.

Now that you have installed and activated the inferential statistics and distribution functions onto your TI-86, you will find these new capabilities in **MATH – STAT**. (You'll have to use the MORE key once.)

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