Ti 89

The position of the graphically represented keys can be found by moving your mouse on top of the graphic.

Turn your calculator on

Press ON.

Clearing the memory

This is not that much an issue as the TI-89 has tons of memory. Simply give your new list a different name. However, you cannot use a name if it's already in use, so you might want to delete a list if you're done with it.

Press 2ND − (it says VAR-LINK above the key). Press ▼ until the cursor is on the list you want to delete. Press F1 1. Delete any other lists, if necessary. Then press ESC to get back to the main screen.

Entering data

one variable

Press APPS. A menu will appear on the screen. Press 6 (Data/Matrix Editor), then press 3 (New). You'll see a window that says *Type:*. If it already says *Type: Data*, press ▼ to accept. If not, press ▶ to view the other options and pick *Data* then press ▼ to accept. The cursor should now be on *Folder: Main*. Press ▼ to accept. Pick an arbitrary name (say M) for the list. If it's in use, either choose another name or delete the list (see above for instructions). To choose M, type ALPHA 5 (you should see M above the 5 key). Then press ENTER ENTER (twice) to accept and verify the name. A table should appear with c1, c2, c3 over the columns. Use c1 for one variable data. Enter the first number. Press ENTER. Enter the second number. Press ENTER. Continue until all the data has been entered.

two variables

Press APPS. A menu will appear on the screen. Press 6 (Data/Matrix Editor), then press 3 (New). You'll see a window that says *Type:*. If it already says *Type: Data*, press ▼ to accept. If not, press ▶ to view the other options and pick *Data* then press ▼ to accept. The cursor should now be on *Folder: Main*. Press ▼ to accept. Press ALPHA , (D) (we're calling our dataset D; call it whatever you want using the alpha-numeric keys; if you want to delete a list so you can reuse the name, use the Clear Memory instructions above). Then press ENTER ENTER (twice) to accept and verify the name. A table should appear with c1, c2, c3 over the columns. Use c1 for the x-variable. Enter the first x-value, then press ▼. Enter the second x-value, then ▼. Continue until all the x-values have been entered . Press ▶ to move the cursor to c2 for the y-variable. Press ▲ as many times as necessary to get the cursor next to the first x-value. Enter the first y-value, then ▼. Enter the second y-value, then ▼. Continue until all the y-values have been entered. Make sure they line up with the corresponding x-values.

Calculating one-variable statistics

mean (x)

Press F5 (CALC). You'll see a row that says *calculation type*. Press ▶. Press 1 (for One Var). Press ▼. You'll see x........and a box. Type ALPHA) (for C). Press ENTER ENTER and you'll see a chart. The first item in the chart is x, the mean.

standard deviation for populations (σ or σ_n)

Press F5 (CALC). You'll see a row that says *calculation type*. Press ▶. Press 1 (for One Var). You'll see a screen with x, Σx, Σx^2, etc. Oddly enough, σx for the population is not on the list. However, it has been calculated. To locate it, return to the home screen by pressing APPS 1. At the bottom of the screen, type in ♦ (ALPHA 3 (s), X, then ENTER. On the screen, you'll see σx.

standard deviation for samples (s or σ_{n-1})

Press [F5] (CALC). You'll see a row that says *calculation type*. Press [▶]. Press [1] (for One Var). Press [▼]. You'll see x........and a box. Type [ALPHA] [)] (for C). Press [ENTER] [ENTER] and you'll see a chart. Look for sx - that's the sample standard deviation.

Calculating two-variable statistics

r (correlation)

Press [F5] (CALC). You'll see a row that says *calculation type*. Press [▶] [5] (for Lin Reg). Press [ALPHA] [)] (for c) [1] [▼] [ALPHA] [)] [2] [ENTER] to tell the calculator which variables to do the regression on. Then press [ENTER] again to tell it to run the regression. You'll see a screen with a =, b =, corr =, R^2 = . The corr is what we're looking for here. R^2 is the square of the correlation.

regression coefficients

slope

Press [F5] (CALC). You'll see a row that says *calculation type*. Press [▶] [5] (for Lin Reg). Press [ALPHA] [)] (for c) [1] [▼] [ALPHA] [)] [2] [ENTER] to tell the calculator which variables to do the regression on. Then press [ENTER] again to tell it to run the regression. You'll see a screen with a =, b =, corr =, R^2 = . The b value is the slope of the regression line.

y-intercept

Press [F5] (CALC). You'll see a row that says *calculation type*. Press [▶] [5] (for Lin Reg). Press [ALPHA] [)] (for c) [1] [▼] [ALPHA] [)] [2] [ENTER] to tell the calculator which variables to do the regression on. Then press [ENTER] again to tell it to run the regression. You'll see a screen with a =, b =, corr =, R^2 = . The a value is the y-intercept.

Calculating combinations and permutations

combinations (nCr)

Press 2ND 5 (MATH is written above the key). You should see several options on the screen. Press 7 (PROB). You will see more options. nCr is the third option, so press 3. Enter the n value, then press ,. Enter the r value, then press the) key. Finally press ENTER.

permutations (nPr)

Press 2ND 5 (MATH is written above the key). You should see several options on the screen. Press 7 (PROB). You will see more options. nPr is the second option, so press 2. Enter the n value, then press ,. Enter the r value, then press the) key. Finally press ENTER.

Turning the calculator off

Press 2ND ON.

Worked Out Examples

In the following examples, we list the exact key sequence used to find the answer. We will list the keys by the main symbol on the key. In parentheses, we will list a helpful mnemonic, e.g. we will list e^x as SHIFT LN (e^x).

A: What is the mean and standard deviation of the following list of numbers?

15 16 20 21

1: To start 2ND − (VAR-LINK) ▼ (as necessary) F1 1 ESC

2: Enter Data	APPS 6 3 ▼ ▼ ALPHA , (D, although this is arbitrary) 1 5 ENTER 1 6 ENTER 2 0 ENTER 2 1 ENTER
3: Compute the mean	F5 ▶ 1 ▼. You'll see x........and a box. Type ALPHA) (for C). Press ENTER ENTER
4: Compute the standard deviation (population)	APPS 1 ◆ (ALPHA 3 (s) X ENTER
5: Compute the standard deviation (sample)	F5 ▶ 1 ▼. You'll see x........and a box. Type ALPHA) (for C). Press ENTER ENTER

You should get a mean of 18, population standard deviation of 2.549509757 and a sample standard deviation of 2.943920289.

B: Find the linear regression line for the following table of numbers. Also find the correlation.

x	1	2	3	4
y	2	4	5	7

1: To start	2ND − (VAR-LINK) ▼ (as necessary) F1 1 ESC APPS 6 3 ▼ ▼ ALPHA , ENTER ENTER
2: Enter Data	APPS 6 3 ▼ ▼ ALPHA , (D, but this is arbitrary) ENTER ENTER 1 ENTER 2 ENTER 3 ENTER 4 ENTER ▶ ▲ ▲ ▲ ▲ 2 ENTER 4 ENTER 5 ENTER 7 ENTER
3: Compute the slope of the regression line	F5 ▶ 5 ALPHA) 1 (C1) ENTER ALPHA) 2 (C2) ENTER ENTER
4: Compute the y-intercept of the regression line	F5 ▶ 5 ALPHA) 1 (C1) ENTER ALPHA) 2 (C2) ENTER ENTER
5: Compute the correlation	F5 ▶ 5 ALPHA) 1 (C1) ENTER ALPHA) 2 (C2) ENTER ENTER

You should get a slope of 1.6, a y-intercept of 0.5, and a correlation of 0.992277876.
The regression line would be: y = 1.6x+0.5.

C: Find ${}_{10}C_6$ and ${}_{9}P_5$.

1: Compute ${}_{10}C_6$ — 2ND 5 (MATH) 7 (PROB) 3 (nCr) 1 0 , 6) ENTER

2: Compute ${}_{9}P_5$ — 2ND 5 (MATH) 7 (PROB) 2 (nPr) 9 , 5) ENTER

You should get ${}_{10}C_6 = 210$ and ${}_{9}P_5 = 15120$.

Sample Problems

During the summer, T.J. participates in a Thursday night softball league. Throughout the eight week season, he kept track of the number of times he struck out per game. Here is his data:

week:	1	2	3	4	5	6	7	8
strikeouts:	4	2	5	3	7	4	5	2

1. Find his average (mean) number of strikeouts per game this season.
2. Find the standard deviation of the strikeout data.

T.J.'s girlfriend (with whom he's struck out many times as well) thinks he'd play better if he didn't drink beer right before the game. Throughout the eight week season, she kept track of how many beers he consumed before playing. Here is her data:

week:	1	2	3	4	5	6	7	8
# beers:	4	1	3	2	4	1	5	2

3. Let X equal the number of beers and let Y equal the number of strikeouts. Find the regression line Y = mX+b.
4. What is the correlation between beer consumption and strikeouts? (Numerically, we mean. We know what your opinion is.)

T.J. has been demoted to manager. He has to decide which 9 players (out of the 20 malcontents on the team) he wants for the game on Saturday.

5. How many different options does he have for making up a team?

Now that T.J. has chosen his team of nine players, he needs to decide the opening line-up of four players.

6. How many different line-ups are there for him to choose from?

The full line up consists of all nine players.

7. How many full line-ups are there?

1. The mean number of strikeouts is 4.
2. The population standard deviation is 1.58113883.
   The sample standard deviation is 1.690308509.
3. The regression line is: y = 0.774193548 x + 1.870967742.
   In practice, we would write it as y = 0.77 x + 1.87.
4. The correlation (r) is 0.681554201. This means there is a moderately strong linear relationship between number of beers and number of strikeouts. The fact that r is positive indicates that a high number of beers corresponds to a high number of strikeouts and vice versa.
5. The number of options is ${}_{20}C_9$ = 167,960.
6. The number of different lineups is ${}_{9}P_4$ = 3024.
7. The full line up can be arranged in 9! = 362880. (Note: 9! = ${}_{9}P_9$.)

Getting Started with your TI-89 for Statistics

This is a first draft of these TI-89 basic instructions for statistics.
If you find errors, please tell me so that I can make any necessary corrections.
For instructions on all statistical calculations and tests, refer to the TI-89 stats/list editor manual.

Thank you to Susan Dean at De Anza College for contributing some of the TI-89 instructions from her on-line handouts for distance learning.

To see if you have the Statistics List Editor on your TI-89 calculator

Press APPS, highlight **1:FlashApps** and press ENTER
Highlight the **Stats/List Editor** and press ENTER

If you do not have the Statistics List Editor on your TI-89 calculator, download it from the TI website.
http://education.ti.com/us/product/apps/statsle.html
You will need to use the graphlink cable that connects your calculator to the computer in order to install the statistics list editor application on your calculator after you have downleaded it to a computer. Follow TI's instructions for download and installation.

To download the TI Statistics List Editor Manual as a PDF file to your computer, from the TI website
http://education.ti.com/us/product/apps/statsle.html

To access the Statistics List Editor on your TI-89 calculator

(or if you do something that throws you out of the list editor at any time, follow these instructions to get back):

Press APPS, highlight **1:FlashApps** and press ENTER

Highlight the **Stats/List Editor** and press ENTER

Your screen will now contain the list editor showing lists:
You can add, delete, or rename list if you wish – check the stats/list editor manual for instructions

list1	list2	list3	list4

and function menus across the top:

F1 Tools
F2 Plots *for statistics plots*
F3 List *for more list editor functions, especially* 1:Names
F4 Calc for statistics calculations such as
- 1: 1 variable statistics
- 3: Regressions
- 4: Probability
- 6: Show stats

F5 Distr *for probability distributions*
F6 Tests *for hypothesis tests*
F7 Ints *for confidence intervals*

Generating Random Numbers on the TI-89

To generate *n* random integers between a *lower* bound and an *upper* bound while in the Statistics/List Editor

APPS   Press 1: FlashApps Highlight Stats/List Editor and press ENTER *to access list editor*

F4: Calc   4: Probability   5:RandInt   ENTER   *lower, upper, n*) to generate random integers

To generate ONE random integer between *1* and an *upper* bound while in the HOME SCREEN and NOT in the Statistics/List Editor

TI-89: Press 2nd MATH. Press 7:Probability. Press 4:rand(enter *upper bound*) and press ENTER You will see the first random number. Keep pressing ENTER to get more random numbers between 1 and your *upper bound* inclusive.

To generate random values from a Binomial or Normal Distribution, while in the Statistics/List Editor:

APPS   Press 1: FlashApps Highlight Stats/List Editor and press ENTER *to access list editor*

6:randNorm (μ , σ , k) generates k random values from a Normal probability distribution with mean μ and standard deviation σ. Use appropriate values for μ σ k

7:randBin (n , p , k) generates k random values from a Binomial probability distribution with n trials and p = probability of success.

Working with One Variable (Univariate) Data in the Statistics List Editor on the TI-89

Enter data into the list editor using the list editor screen

list1	list2	list3	list4

Clear lists by moving up the list to highlight the *listname* and then press CLEAR
This will erase the list contents and keep the list. You can then use the empty list for more data.

> Using the delete option on the F3: list menu then F1:list manager on the will delete the whole list, title and all, from the editor and the space formerly displayed for that list will disappear from your screen. The list will no longer be available so you will not be able to put data into it.
> Don't do this unless you are absolutely 100% sure that you want to make the entire list go away!!

Sorting Data in a list

Do NOT sort data if you are using a frequency list. Only sort data where all frequencies = 1

Press [F3 (for List)] [2 (for 2:Ops)] [1 (for 1:Sort List)]. If you see your list name, press [ENTER]. If the correct list name is not there, then enter it suing the alpha key to toggle between letters and numbers as necessary. Press [ENTER].
You should see your list in sorted order.

To find one variable statistics

If you have data in "list 1" and frequencies in "list 2"
[F4: Calc] [1:1-Var Stats]

List:	list 1
Freq:	list 2
Category List:	leave blank
Include Categories:	leave blank
Press ENTER	

If you have data in "list 1" not frequency list
[F4: Calc] [1:1-Var Stats]

List:	list 1
Freq:	leave blank
Category List:	leave blank
Include Categories:	leave blank
Press ENTER	

One variable statistics will appear on your screen, scroll down using the cursor keys to see additional summary statistics. Pressing enter will close the screen that shows the summary statistics.

To make a histogram or boxplot

F2: Plots   1:Plot Setup

* Make sure there are no checks next to any other plots. If there are, arrow to the plot and press F4 to uncheck them. Then arrow back to Plot 1.

Press F1:Define *to define the highlighted Plot**

On the define plot screen that comes up, use right cursor arrow to display plot types:

select desired type from

1:Scatter
2: xc line
3: Box plot
4: Histogram
5: Mod*ified* **Box Plot**

enter desired interval width in the **Hist bucket Width** field

enter list name for data into **x**

x *data list name*
y *leave blank*

move the cursor to the **Use Freq and Categories?** field:

If you are not using a frequency list, set to **NO**

Frequencies *blank*

If you are using a frequency list , set to **YES** and enter the list containing the frequencies

Frequencies *frequency list name*

Press F5: Zoom data to have the calculator graph the plot in a window it deems appropriate for the data

Notes:

To enter list names into an input field:

position cursor in the desired field and then:

either use the 2nd and alpha keys to toggle between letters and numbers and to change case, and type in the list names directly

or

paste the name in by pressing 2nd VAR-LINK (above − key) to display the VAR-LINK [All] menu. Highlight appropriate *list name* then press ENTER to paste the appropriate *list name* into the appropriate field on the set up menu

If you get an error message, check your MODE and make sure that the **Graph** mode is set to **Function**

To find the distributions menu: Press $\boxed{\text{F5: Distr}}$

- Shade Menu
  - Shade Normal
  - Shade t
  - Shade Chi-square
  - Shade F
- Inverse Menu
  - Inverse Normal
  - Inverse t
  - Inverse Chi-square
  - Inverse F
- Normal Pdf
- Normal Cdf
- t Pdf
- t Cdf
- Chi-square Pdf
- Chi-square Cdf
- F Pdf
- F Cdf
- Binomial Pdf
- Binomial Cdf
- Poisson Pdf
- Poisson Cdf
- Geometric Pdf
- Geometric Cdf

> Enter parameters and values into input fields as prompted by your calculator
> Then press $\boxed{\text{ENTER}}$ and wait for answers to appear on an output screen

To find the hypothesis tests menu: Press $\boxed{\text{2nd}}$ $\boxed{\text{F6: Tests}}$ *using the F1 key*

- Z-Test
- T-Test
- 2-SampZTest
- 2-SampTTest
- 1-PropZTest
- 2-PropZTest
- Chi2 GOF
- Chi2 2-way
- 2-SampFTest
- LinRegTTest
- MultRegTests
- ANOVA
- ANOVA2-Way3

> Enter required information into input fields as prompted by your calculator
> Then press $\boxed{\text{ENTER}}$ and wait for answers to appear on an output screen

To find the confidence intervals menu: Press $\boxed{\text{2nd}}$ $\boxed{\text{F7: Intervals}}$ *using the F2 key*

- ZInterval
- TInterval
- 2-SampZInt
- 2-SampTInt
- 1-PropZInt
- 2-PropZInt
- LinRegTInt
- MultRegInt

> Enter required information into input fields as prompted by your calculator
> Then press $\boxed{\text{ENTER}}$ and wait for answers to appear on an output screen

PROBABILITY DISTRIBUTIONS SUMMARY on the TI − 83, 83+, 84+, 86, 89

TI-83 and 84, press 2nd DISTR

TI-86 press 2nd MATH MORE; then press F2 or F3 for the STAT menu; press F2:DISTR

TI-89 press APPS; Press 1: FlashApps; highlight Stats/List Editor press ENTER F5: Distr

DISCRETE PROB ABILITY DISTRIBUTIONS: pdf gives P(x = specified value)
cdf gives P(X ≤ specified value)

function & input	parameters	Description
TI 83,4: binompdf(n,p,r) TI 86: bipdf(n,p,r) TI 89: binomial Pdf	n = number of trials p = probability of success r = number of success	**Binomial probability** P(X = r) **of exactly r successes in n independent trials**, with probability of success p for a single trial. If r is omitted, gives a list of all probabilities from 0 to n
TI 83,4: binomcdf(n,p,r) TI 86: bicdf(n, p, r) TI 89: binomial Cdf	n = number of trials p = probability of success r = number of success	**Binomial cumulative probability** P(X ≤ r) **of r or fewer successes in n independent trials**, with probability of success p for a single trial. If r is omitted, gives a list of all cumulative probabilities from 0 to n
TI 83,4: geometpdf(p,n) TI 86:gepdf(p,n) TI 89:geometric Pdf	p = probability of success n = number of trials	**Geometric probability** P(X = n) **that the first success occurs on the nth trial in a series of independent trials**, with probability of success p for a single trial.
TI 83,4: geometcdf(p,n) TI 86:gedf(p,n) TI 89: geometric Cdf	p = probability of success n = number of trials	**Geometric cumulative probability** P(X ≤ n) **that the first success occurs on or before the nth trial in a series of independent trials**, with probability of success p for a single trial.
TI 83,4: poissonpdf(μ ,r) TI 86: pspdf(μ,k) TI 89:Poisson Pdf	μ = mean r = number of occurrences	**Poisson probability** P(X = r) **of exactly r occurrences** for a Poisson distribution with mean μ
TI 83,4: poissoncdf(μ,r) TI 86:psdf(μ,r) TI 89:Poisson cdf	μ = mean r = number of occurrences	**Poisson cumulative probability** P(X ≤ r) **of r or fewer occurrences** for Poisson distribution with mean μ

CONTINUOUS PROB ABILITY DISTRIBUTIONS
"cdf" functions find the probability as area under the curve, above x axis within a specified interval of x values. "pdf" functions find the height of the curve above the x axis at a single x value; the "pdf" functions do not find probabilities, but they enable the calculator to draw or graph the curves for the probability distributions.
The inverse functions find the value of a percentile. The only inverse function on the TI-83 and TI-86 is the inverse normal. The TI-84 and 89 have expanded selections of inverse functions.

function & input	parameters	Description
TI 83,4: normalcdf (c, d, μ, σ) TI 86:nmcdf (c, d, μ, σ) TI 89:Normal Cdf	c = lower bound d = upper bound μ = mean σ = standard deviation	P(c < X < d) for a normal distribution with mean μ and standard deviation σ. To find P(X>c) use upper bound = 10 ^ 99. To find P(X < d) use lower bound = (−) 10^ 99, using (−) key to indicate a negative number.
TI 83,4: invNorm(p, μ, σ) TI 86:invNm(p, μ, σ) TI 89: 2:Inverse ▸ 1: Inverse Normal	p = percentile = area to the left μ = mean σ = standard deviation	Finds the value of x =c for which P(X < c) = p for a normal distribution with mean μ and standard deviation σ.
TI 83,4: tcdf(a, b, df)	a = lower bound b = upper bound df = degrees of freedom	Probability that a value lies between a and b for a Student's t distribution with the specified degrees of freedom To find P(X > a), use upper bound = 10 ^ 99. To find P(X < b), use lower bound = (−) 10 ^ 99, using (−) key to indicate a negative number.
TI 83,4: χ^2 cdf(a, b, df) TI 86:chicdf(a, b, df) TI 89:Chi-square Cdf	a = lower bound b = upper bound df = degrees of freedom	Probability that a value lies between a and b for a χ^2 chi-square distribution with the specified degrees of freedom To find P(X > a), use upper bound = 10 ^ 99. To find P(X < b), use lower bound = 0.

Binomial, Geometric, Poisson Distributions on the TI − 83, 83+, 84+, 86, 89:

TI-83 and 84, press 2nd DISTR
TI-86 press 2nd MATH MORE and then press F2 or F3 for the STAT menu item F2:DISTR
(*menu location of STAT may vary on different calculators*)
TI-89 press APPS; pPress 1: FlashApps; highlight Stats/List Editor press ENTER F5: Distr

pdf stands for probability distribution function and gives the probability P(x = r)

cdf stands for cumulative distribution function and gives the probability P(x ≤ r)

Binomial Distribution

	TI − 83, 84	TI−86	TI-89
P(x = r)	binompdf(n,p,r)	bipdf(n,p,r)	binomial pdf(n,p,r)
P(x ≤ r)	binomcdf(n,p,r)	bicdf(n,p,r)	binomial cdf(n,p,r)
P(x < r)	binomcdf(n,p,r−1)	bicdf(n,p,r−1)	binomial cdf(n,p,r−1)
P(x > r)	1− binomcdf(n,p,r)	1− bicdf(n,p,r)	1− binomial cdf(n,p,r)
P(x ≥ r)	1− binomcdf(n,p,r−1)	1− bicdf(n,p,r−1)	1− binomial cdf(n,p,r−1)

Geometric Distribution

	TI − 83, 84	TI−86	TI-89
P(x = n)	geometpdf(p,n)	geopdf(p,n)	geometric pdf(p,n)
P(x ≤ n)	geometcdf(p,n)	geocdf(p,n)	geometric cdf(p,n)
P(x < n)	geometcdf(p,n−1)	geocdf(p,n−1)	geometric cdf(p,n−1)
P(x > n)	1− geometcdf(p,n)	1− geocdf(p,n)	1− geometric cdf(p,n)
P(x ≥ n)	1− geometcdf(p,n−1)	1− geocdf(p,n−1)	1− geometric cdf(p,n−1)

Poisson Distribution

	TI − 83, 84	TI−86	TI-89
P(x = r)	poissonpdf(mu,r)	pspdf(mu,r)	poisson pdf(mu,r)
P(x ≤ r)	poissoncdf(mu,r)	pscdf(mu,r)	poisson cdf(mu,r)
P(x < r)	poissoncdf(mu,r−1)	pscdf(mu,r−1)	poisson cdf(mu,r−1)
P(x > r)	1− poissoncdf(mu,r)	1− pscdf(mu,r)	1− poisson cdf(mu,r)
P(x ≥ r)	1− poissoncdf(mu,r−1)	1− pscdf(mu,r−1)	1− poisson cdf(mu,r−1)

TESTS FUNCTIONS SUMMARY on the TI − 83, 83+, 84+, 86, 89

TI-83: STAT ▸▸ TESTS

TI-86: 2^{nd} MATH MORE F2 or F3:STAT F1:TESTS
(menu location of STAT may vary on different calculators)

TI-89: APPS 1: FlashApps Highlight Stats/List Editor and press ENTER 2^{nd} F6: Tests

Z-Test **ZTest**	Hypothesis test for a single mean, population standard deviation known
T-Test **TTest**	Hypothesis test for a single mean, population standard deviation unknown, underlying populations approximately normally distributed
2-SampZTest **Zsam2**	Hypothesis test of the equality of two population means, independent samples, population standard deviations known
2-SampTTest **Tsam2**	Hypothesis test of the equality of two population means, independent samples, population standard deviations unknown, underlying populations approximately normally distributed
1-PropZTest **ZPrp1**	Hypothesis test of a single proportion
2-PropZTest **ZPrp2**	Hypothesis test of the equality of two population proportions
ZInterval ZInt1	Confidence interval for a single mean, population standard deviation known
TInterval TInt1	Confidence interval for a single mean, population standard deviation unknown, underlying populations approximately normally distributed
2-SampZ Int ZInt2	Confidence interval for the difference between two means, population standard deviations known
2-SampT Int TInt2	Confidence interval for the difference between two means, population standard deviations unknown, underlying populations approximately normally distributed
1-PropZInt ZInt1	Confidence Interval for a single population proportion
2-PropZInt ZInt2	Confidence Interval for the difference between two population proportions
χ^2 Test **Chitst** **Chi2 2-way**	Hypothesis test of independence for a contingency table stored in a matrix. Expected values are calculated and placed in a separate matrix
χ^2 GOF Test (TI-84 & 89 Only)	Hypothesis test for Goodness of Fit Observed and expected data counts must be placed in lists
2-SampFTest Fsam2	Hypothesis test of the equality of two population standard deviations
LinRegTTest **TLinR**	Hypothesis test of the signficance of the correlation coefficient in linear regression
ANOVA	Hypothesis test of the equality of means of multiple populations using one way analysis of variance for sample data entered into lists

LINEAR REGRESSION:

Example demonstrating Linear Regression, Correlation and Scatter Plot

Given the data set: (3, 5), (6, 8), (9,7), (5, 20).

The xlist is 3, 6, 9, 5 and the ylist is 5, 8, 7, 20.
Put the xlist into L1 and the ylist into L2.

Constructing a Scatter Plot:

Make sure you are in the Stat/List Editor (see page 1 of these instructions) and that you have entered your lists in L1 and L2
Press F2:Plots 1:Plot Setup Highlight Plot 1 and make sure there are no checks next to any other plots. If there are, arrow to the plot and press F4 to uncheck them. Then arrow back to Plot 1.
Press F1:Define. to define the plot
For Plot Type, press the right arrow and press 1:Scatter.
Arrow down, press the right arrow and press 1:Box.
Arrow down to x. Press alpha L1. Arrow down to y and press alpha L2.
Arrow down to "Use Freq and Categories?" and use the right arrow. Highlight NO and press Enter.
Press Enter again.
Press F5 Zoomdata. You should see the scatterplot. Press F3 to trace and the arrow keys to see the coordinates of the points.

Calculating the Regression Equation: METHOD 1

Make sure you are in the Stat/List Editor (see page 1 of these instructions)
Press F4: Calc 3:Regressions 1:LinReg (ax+b)
For x List, enter alpha L1. Arrow down. For y List, enter alpha L2.
For "Store RegEqn to:", arrow right and arrow down to y1(x) (or any one of the y's) and press Enter.
Press Enter.
You should see a screen with a, b, r^2, and r on it. The regression is complete.
Write down the equation from the information and press Enter.
The linear regression is yhat = 11.2267 - .2133x

Calculating the Regression Equation: METHOD 2 Linear Regression T-Test

Make sure you are in the Stat/List Editor (see page 1 of these instructions)
Press 2nd F6: Test A:LinRegTTest
For x List, enter alpha L1. Arrow down. For y List, enter alpha L2
For Freq, enter 1
For "Alternate Hyp", arrow right and arrow down to the alternate hypothesis you wish to use in your hypothesis test of the significance of the correlation coefficient (generally ≠) and press Enter
For "Store RegEqn to" arrow right and arrow down to y1 to store the regression equation as equation y1 (or make another selection if you wish); then press Enter.
For "Results" arrow right and arrow down to Calculate and press Enter.
Press Enter again to perform the regression.
You should see a screen withy = a + bx at the top. The screen contains the results of the hypothesis test of the correlation coefficient, the regression equation, the correlation coefficient and coefficient of determination, and the standard error s. The regression is complete.

Drawing the Regression Line:

Press the key with the green diamond on it (it is below the 2nd key) and press Y= (above the F1 key).
The regression equation should appear in your equation editor. If it does not, enter it in y1(x).
Make sure all other equations are cleared out.
Press the key with the green diamond on it and press GRAPH (above the F3 key). The line will be drawn.

Graphical Representation of Outliers for Linear Regression

You need to have used Method 2 of performing the linear regression in order to obtain the value of the standard error s
Enter the equation editor and input two new equations.

Y2 = Y1 − 2*(value of s)
Y3 = Y1 + 2*(value of s)
You should input the value of s that you obtained by performing linear regression using method 2 with the LinRegTTest

Press the key with the green diamond on it and press GRAPH (above the F3 key).
The calculator will then draw 3 lines. The linear regression line will be the middle line. The lines for equations Y2 and Y3 are drawn at a distance of 2 standard deviations below and above the linear regression line. Any points lying between the two outer lines are NOT outliers.
Any points lying above the upper line or below the lower line are outliers. Use trace to identify the data values for the outliers.

Outlier Calculations for Linear Regression (for *Collaborative Statistics* by Dean/Illowsky):

When you do Linear Regression, a list called "resid" is created automatically.
This list has the "y – yhat" values in it.
Go into Flashapps and into your lists.
Arrow to "resid" so you see it.
Then, arrow to the list name L3. Press F3.
Press 1:names. Arrow down to STATVARS. If it is not checked, press F4.
Then, arrow down to resid. Press Enter. Press ^2. Press Enter. L3 will have the (y - yhat)^2 values.
Press HOME and Press F1 8 to clear it.
Press 2nd MATH. Press 3:List. Press 6:Sum. Press alpha L3).
Depending on how you have MODE Display Digits set, you should see approximately 137.1467. This is the SSE.
Calculate s. (You should be HOME.) Press clear.
Press the square root symbol and enter 137.1467/2). (You get the denominator by taking the number of data points and subtracting 2: 4 - 2 = 2.)
Press Enter. You should see 8.2809 (to 4 decimal places).
Press the times key and enter 1.9. Press Enter. You should see 15.7337.
Press clear. Press 2nd VAR-LINK.
Arrow down to resid (it is below STAT VARS). Press Enter. Press Enter again.
Arrow up to the list. Scroll through the list using the arrow keys.
Compare 15.7337 to the absolute values of the numbers in the list. If any absolute value is greater than or equal to 15.7337, then the corresponding point is an outlier.
Absolute values of the numbers in the list are approximately 5.59, 1.95, 2.31, 9.84.
None of them are greater than or equal to 15.7337.
Therefore, for this data set, no point is an outlier.

Thank you to Susan Dean at De Anza College for to the contributing TI-89 instructions for linear regression.

CHI SQUARE TEST FOR INDEPENDENCE on the TI-89

To Create a Matrix to use in a Test of Independence on the TI-89

Press APPS 6:Data/Matrix Editor
Press 3:New
Arrow over and down to 2:Matrix.
Press Enter
Arrow down to Folder. Either use the one that is there or arrow over and down to another folder name (don't use statvars) and press Enter.
Arrow down to Variable and enter a name you will remember.
Arrow down to Row dimension and enter the number of rows you want.
Arrow down to Column dimension and enter the number of columns you want.
(Note: You can change these numbers if you want for a different problem.)
Press Enter until you will see your matrix with zeroes as the entries. Fill in your matrix with the data from the table.

To change the size of your matrix, press APPS 6:Matrix/Data Editor 2:Open.
Then fill in the OPEN screen with Matrix, the correct folder, and the correct name of your matrix.
Press Enter until you see your matrix.
To resize it, press F6 Util 6:Resize Matrix. Enter the row dimension and arrow down to column dimension and enter that number. Press Enter until you see your resized matrix.

To Perform a Chi Square Test of Independence

Press APPS
Press 1:Flashapps
Press Enter
Press F6 TESTS
Press 8:Chi2 2-way
Enter the name of your matrix at Observed Mat:
Press Enter.
You should see the screen with the test statistic and the p-value.

Thank you to Susan Dean at De Anza College for to the contributing TI-89 instructions for chi square tests.

TI 89 TITANIUM

Hypothesis Tests and Confidence Intervals

The position of the graphically represented keys can be found by moving your mouse on top of the graphic. The row of function keys: f1, f2, etc. do not count as a row. Row 1 starts with the blue 2nd key.

Entering data

Press [APPS], then arrow over to the Stats/List Editor. (It should be 3 down arrows and two right arrows.) Press [ENTER][ENTER]. Now follow the instructions below.

one variable

Enter the x-values one by one, pressing [ENTER] after each one.

two variables

Enter the x-values one by one, pressing [ENTER] after each one. Press [▶] to get to the second column. Enter the y-values one by one, pressing [ENTER] after each one.

Running hypothesis tests

The problem is to test the hypothesis - H_0: $\mu = \mu_0$ We are doing a double sided test. Assume the standard deviation is σ

Z-Test

1. Press [2ND][F1] (The F6 menu should drop).
2. Now press [1] for *Z-Test...*.
3. Press [ENTER] to accept Data input method as *Data*.
4. Enter μ_0 and press [▼].
5. Enter σ and press [▼].
6. Enter *list1* in the List: area. You only have to do this once. The calculator will remember it for future calculations.
7. Press [▼] to accept 1 as *Freq*.
8. Press [▶] if you wish to choose a different hypothesis test. Arrow to your choice and

press [ENTER]. (Choices are $\mu \neq \mu_0$, $\mu < \mu_0$, and $\mu > \mu_0$.)

9. Press [ENTER] to signal *OK*. A list in a new window will appear. The z-value appears in the second entry. The P Value appears in the third. See the below example for interpretation.

T-Test

Exactly as above, except press [2] for *T-Test...* (step 2) instead of [1].

Computing confidence intervals

Z Interval

1. Press [2ND][F2] (The F7 menu should drop).
2. Now press [1] for *ZInterval....*
3. Press [ENTER] to accept Data input method as *Data*.
4. Enter σ and press [▼].
5. Enter *list1* in the List: area. You only have to do this once. The calculator will remember it for future calculations.
6. Press [▼] to accept 1 as *Freq*.
7. Enter a C Level (that is, confidence level. This will generally be .95 or .99.) Press [ENTER] to signal *OK*.
8. A list in a new window will appear. The confidence level is the first entry.

T Interval

1. Press [2ND][F2] (The F7 menu should drop).
2. Now press [2] for *TInterval....*
3. Press [ENTER] to accept Data input method as *Data*.
4. Enter *list1* in the List: area. You only have to do this once. The calculator will remember it for future calculations.
5. Press [▼] to accept 1 as *Freq*.

6. Enter a C Level (that is, confidence level. This will generally be .95 or .99.) Press [ENTER] Press [ENTER] again to signal *OK*. (If the correct C Level is already there, you only need to press [ENTER] once.
7. A list in a new window will appear. The confidence level is the first entry.

Worked Out Examples

In the following examples, we list the exact key sequence used to find the answer. We will list the keys by the main symbol on the key. In parentheses, we will list a helpful mnemonic, e.g. we will list e^x as [SHIFT] [LN] (e^x).

Run a Z-test on this list of numbers to test the hypothesis that $\mu = 88$. Assume that $\sigma = 2.7$.

87 89 91 93 88 90 94 92 92 85

Solution:

[2ND] [F1] (F6 menu) [1] (*Z-Test...*) [ENTER] (Data) [8] [8] (μ_0) [▼] [2] [.] [7] (σ) [▼] *list1, (if necessary)* [▼] [▼] [▼] (to accept the two sided test) [ENTER]

You should get a z value of 2.45954929 and a P Value of .013911171. Because P < 0.05, we reject the null hypothesis and conclude that the mean is not 88.

Run a T-test on this list of numbers to test the hypothesis that μ=54.

51 60 54 57 54 55 59 52 52 58

Solution:

[2ND] [F1] (F6 menu) [2] (*T-Test...*) [ENTER] (Data) [5] [4] (μ_0) [▼] *list1, (if necessary)* [▼]

[▼] [▼] (to accept the two sided test) [ENTER]

You should get a t-value of 1.20267559 and a P Value of 0.259786095. Since P > 0.05, we cannot conclude that μ does not equal 54.

Find a 99% z-confidence interval for the row of numbers. Assume σ is 2.7.

87	89	91	93	88	90	94	92	92	85

Solution:

[2ND] [F2] (F7 menu) [1] (*ZInterval...*) [ENTER] (*Data*) [2] [.] [7] (σ) [▼] *list1 (if necessary)* [▼] [.] [9] [9] [ENTER] [ENTER]

You should get a confidence interval of {87.9,92.3}.

Find a 95% t-confidence interval for the row of numbers.

3	1	4	1	5	9	2	6	5	3

Solution:

[2ND] [F2] (F7 menu) [2] (*TInterval...*) [ENTER] (*Data*) *list1 (if necessary)* [▼] [.] [9] [9] [ENTER] [ENTER]

You should get a confidence interval of {2.133, 5.667}.