Solving Samples of Statistics Problems

Using

CASIO FX-CG50 CALCULATOR

Casio Middle East - GAKUHAN

This booklet aims to help you through the Statistical methods using Casio's FX-CG50. As the FX-CG50 is a powerful and rich tool all in one calculator. It will help you tremendously in performing a large number of operations.

The booklet assumes some basic skills in working with the FX-CG50.

Please note that there may be other methods to attain the same results. The methods presented here are not necessarily the finest or the simplest of the choices available.

fx-CG50

The status bar will display messages and current status like battery level, angle mode, fraction results, complex mode, or input/output settings.

Select the desired icon by highlighting it and pressing [EXE] or pressing the number or letter in the upper right corner.

The function keys allow you to access the tab (soft key) menus that appear at the bottom of the screen. When an (>) appears above the [F6] key, selecting [F6] will offer more on-screen choices.

The [MENU] key displays every mode the calculator has. To select a mode, press [▶] [▼] to the desired icon and press [EXE] or press the number or letter in the upper right hand corner of the icon.

The [EXIT] key operates like the back arrow on a web browser; it will take you back one screen each time you select it. The [EXIT] key will not take you to the icon menu.

The [SHIFT] key activates any function displayed on or above the calculator buttons that is yellow. For example, to find the square root of a number, you would need to press [SHIFT], then [x^2]. [SHIFT] [5] gives you access to on-screen color formatting.

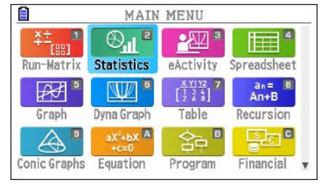
The [AC/ON] key will power the unit on. To turn the unit off, press [SHIFT] [AC/ON].

The [ALPHA] key activates any function displayed on or above the calculator buttons that is in red. For example, to type the letter A, press [ALPHA], then [X,θ,T].

The [EXE] key executes operations. When data is entered, the [EXE] button must be pressed to store the data.

Basic Commands

Consider the data set: {15, 22, 32, 31, 52, 41, 11}

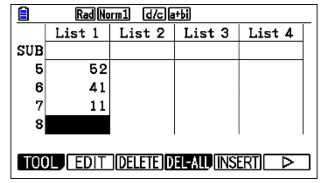


Entering Data:

Enter the data in Lists on the calculator.

Use your arrow keys to move between lists

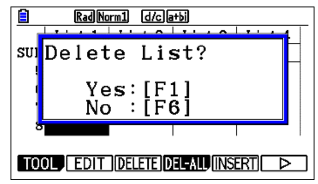
[MENU] [2] [1] [5] [EXE] [2] [2] [EXE] [3] [2] [EXE] [3] [1] [EXE] [5] [2] [EXE] [4] [1] [EXE] [1] [1] [EXE]



Clearing Data:

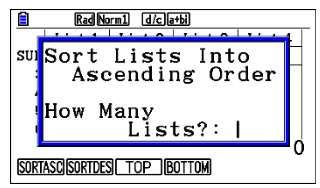
To clear all data from a list: (*use [F6] to change options at the bottom of the screen*)

[F4] [F1]



To clear an individual entry: Select the value and press DEL.

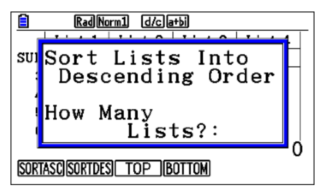
To edit an individual entry: Select the value and press [F2] Edit.



Sorting Data: (helpful when finding the mode)

Ascending order (lowest to highest) Or Descending order (highest to lowest).

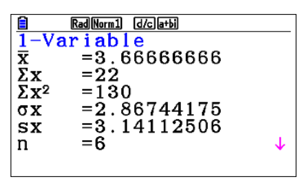
Tools [F1] then Ascending order [F1] Or Descending [F2]

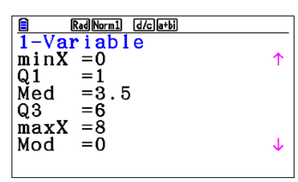


One Variable Statistical Calculations:

For the previous information:

- Press [F6] button, Then Choose [F2] CALC . Select 1-Var Stats [F1].
- Use the down arrow ⯆ to view all the information.





$\bar{x}$ ....mean

Σx ....sum

Σx^2 ....sum of squares

σx ....population standard deviation

sx ....sample standard deviation

n ....number of data items

minX............minimum

Q1 ....first quartile

Med.............median

Q3 ....third quartile

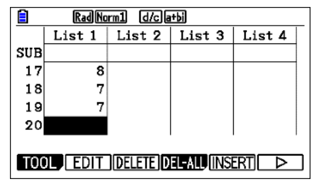
maxX...........maximum

Mod.............mode

Mod:n ....number of data mode items

Mod:F ....data mode frequency

Mean, Mode, Median

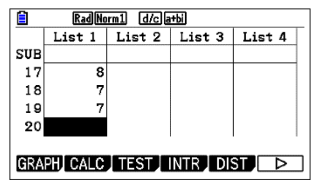


Example: Given the data set {13, 3, 10, 9, 7, 10, 12, 8, 6, 3, 9, 6, 11, 5, 9, 13, 8, 7, 7}

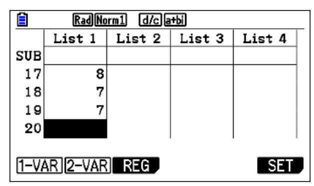
find the mean, median and mode.

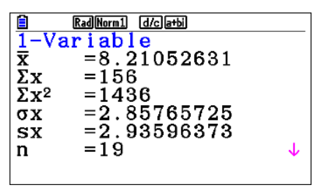
- Go to Statistics application [MENU] [2] then enter the data into a list.

  (See Basic Commands for entering data.)



- Clear old data and enter the new data into the lists [F6] [◄] [F4] [F1]
- Press [F6] [F6] [F2] [F1] 1-Var Stats.
- Arrow up and down the screen to see the statistical information about the data.

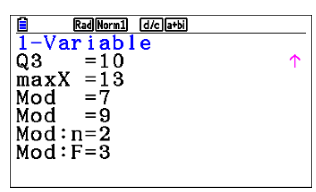




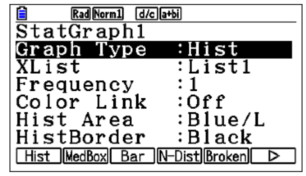
Mean $\bar{x} = 8.2$

Median (Med) = 8

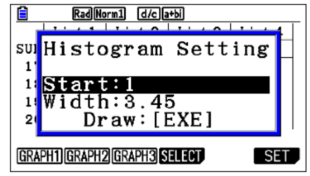
Mode = 7,9

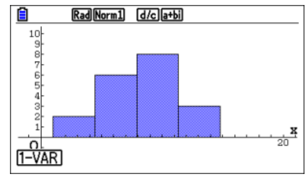


Create a histogram for previous data



- Go back and choose graph then set to select Histogram
  EXIT EXIT F1 F6 ▼ F6 F1
- Draw the graph EXIT F1 1 EXE EXE



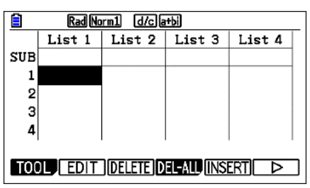


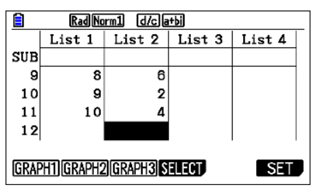
Example: From a Frequency Table:

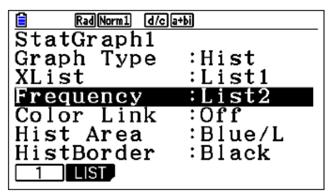
Number	0	1	2	3	4	5	6	7	8	9	10
Frequency	3	4	7	4	10	9	7	3	6	2	4

- Clear old data and enter the new data into the lists MENU 2 EXIT EXIT F6 ◀ F4 F1
- enter the data values in L1. enter their frequencies in L2.

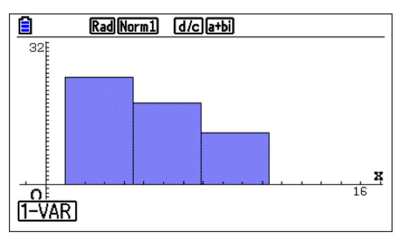
- Draw the histogram. Press F6 F6 F1 F6 ▼ ▼ ▼ F2 2 EXE to choose list 2 as frequency, then press EXIT F1 EXE to see the graph.







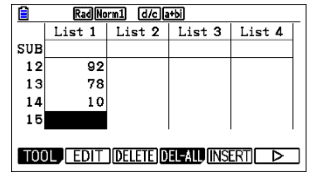
- To see the statistics calculation, press F1 1-Var.



Box and Whisker Plots

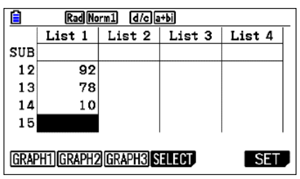
Example: given the data set

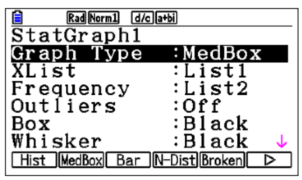
{85, 100, 97, 84, 73, 89, 73, 65, 50, 83, 79, 92, 78, 10},

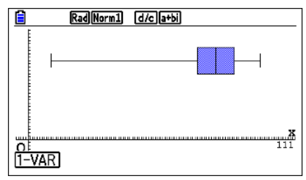


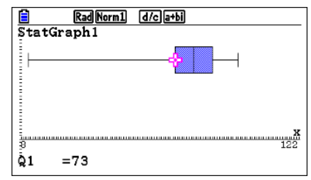
- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] ◀ [F4] [F1].
- Enter the data into the lists.
- Change the functions to see GRAPH by using [F6] then [F1] [F6] ▼ [F6] [F2] ▼ ▼ [F1] [EXIT] [F1].
- Seeing the graph: Press [SHIFT] [F1] the TRACE key to see on-screen data about the box-and-whisker plot.

  The box itself is defined
- by Q1, the median and Q3.
- The spider will jump from the minimum value to Q1, to median, to Q3 and to the maximum value.



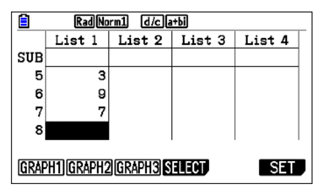






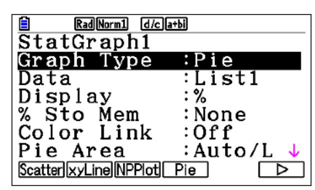
Pi Chart

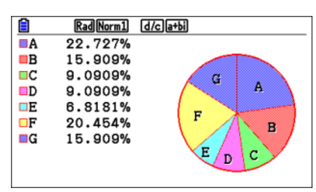
Example: suppose one of the questions asked on a survey was “What type of cars do you have?”, and the results from 44 people are shown in this table. Construct a pie chart and a bar chart of these data.



Car	Toyota	Lexus	Mercedes	BMW	Ferrari	Kia	GMC
Frequency	10	7	4	4	3	9	7

- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] ◀ [F4] [F1]
- .
- Enter the data into the lists.
- To draw the graph [F1] [F6] ▼ [F4] [EXE] [F1]





Scatter Plots

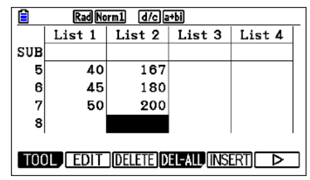
A scatter plot is a graph used to determine whether there is a relationship between paired data.

In many real-life situations, scatter plots follow patterns that are approximately linear. If y tends to increase as x increases, then the paired data are said to be a positive correlation. If y tends to decrease as x increases, the paired data are said to be a negative correlation. If the points show no linear pattern, the paired data are said to have relatively no correlation.

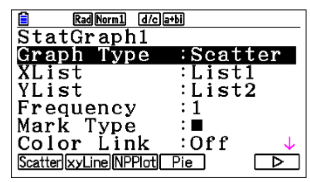
To set up a scatter plot:

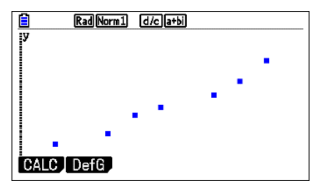
- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] [◄] [F4] [F1]
- Enter the X data values in L1. Enter the Y data values in L2, being careful that each X data value and its matching Y data value are entered on the same horizontal line.

X	10	20	25	30	40	45	50
Y	120	130	148	155	167	180	200



- Change the functions to see GRAPH by using [F6] then
- Activate the scatter plot [F1] [F6] [▼] [F1].
- To see the scatter plot, [EXIT] [F1]





The linear based regression models on the graphing calculator:

• Linear (LinReg)	$y = ax + b$	The graph of x versus y is linear.
Fits Linear by Transformations:		
• Logarithmic (LnReg)	$y = a + b\ln(x)$	The graph of $\ln(x)$ versus y is linear. Calculates a and b using linear least squares on lists of $\ln(x)$ and y instead of x and y.
• Exponential (ExpReg)	$y = a\,(b^x)$	The graph of x versus $\ln(y)$ is linear. Calculates A and B using linear least squares on lists of x and $\ln(y)$ instead of x and y, and then $a = e^A$ and $b = e^B$.
• Power (PwrReg)	$y = a\,(x^b)$	The graph of $\ln(x)$ versus $\ln(y)$ is linear. Calculates A and b using liner least squares on list of $\ln(x)$ and $\ln(y)$ instead of x and y, and then $a = e^A$.

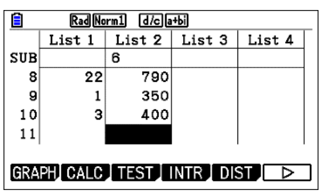
Other models available on the graphing calculator:

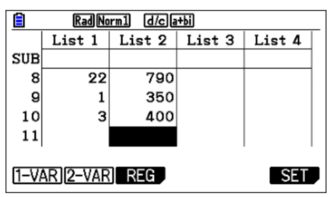
• Quadratic (QuadReg)	$y = ax^2 + bx + c$	For three points, fits a polynomial to the data. For more than three points, fits a polynomial regression.
• Cubic (CubicReg)	$y = ax^3 + bx^2 + cx + d$	For four points, fits a polynomial to the data. For more than four points, fits a polynomial regression.
• Quartic (QuartReg)	$y = ax^4 + bx^3 + cx^2 + dx + e$	For five points, fits a polynomial to the data. For more than five points, fits a polynomial regression.
• Logistic (Logistic)	$y = \dfrac{c}{(1 + ae^{-bx})}$	Fits equation to data using iterative least-squares fit.
• Sinusoidal (SinReg)	$y = a\sin(bx + c) + d$	Fits sine wave to data using iterative least-squares fit.

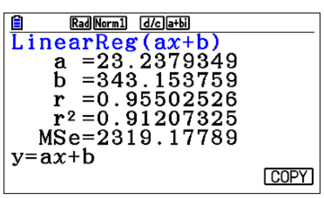
Example: determine a linear regression model equation to represent this data.

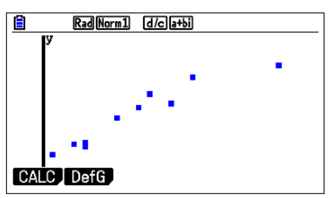
- Clear old data and enter the new data into the lists MENU 2 EXIT EXIT F6 ◀ F4 F1
- Choose Linear Regression Model from **CALC** F6 F6 F2 F3 F1 F2
- Create a scatter plot (**GRAPH**) of the data to graph the regression. EXIT EXIT EXIT EXIT F1 F6 ▼ F1 EXIT F1
- Draw the regression F1 F2 F1 F6

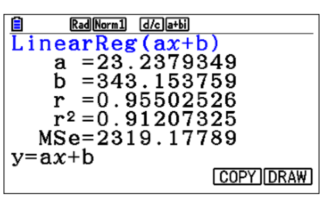
Hours Spent Studying	Math Score
4	390
9	580
10	650
14	730
4	410
7	530
12	600
22	790
1	350
3	400

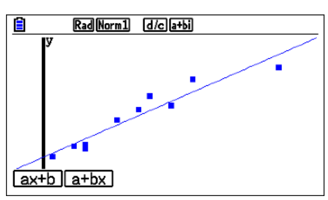






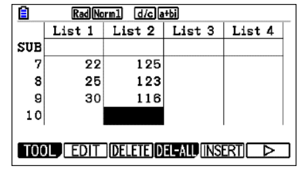




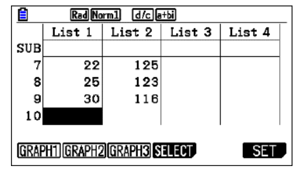


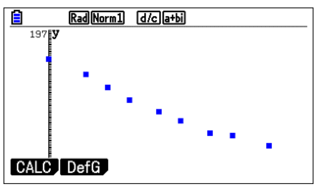
Exponential Regression Model Example

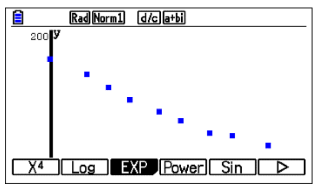
Time (mins)	0	5	8	11	15	18	22	25	30
Temp (F)	179	168	158	149	141	134	125	123	116

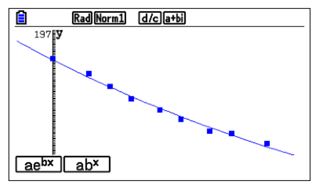


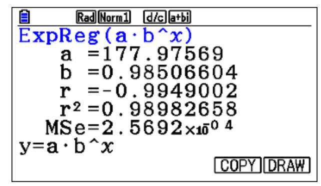
- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] [◄] [F4] [F1]
- Create a scatter plot of the data [F6] [F6] [F1] [F6] [▼] [F1] [EXIT] [F1].
- Choose Exponential Regression [F1] [F6] [F3] [F2]
- Graph the Exponential Regression [F6]



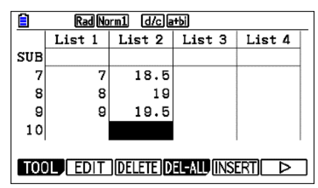






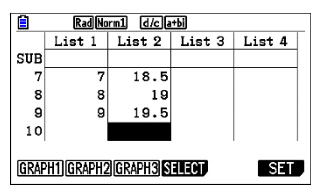


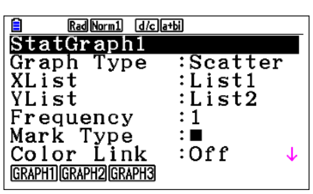
Logarithmic Regression Model Example

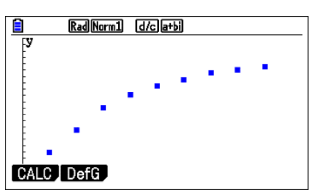


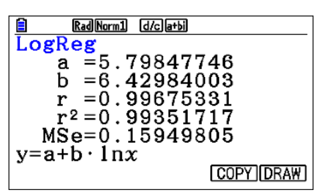
Age of Tree	1	2	3	4	5	6	7	8	9
Height	6	9.5	13	15	16.5	17.5	18.5	19	19.5

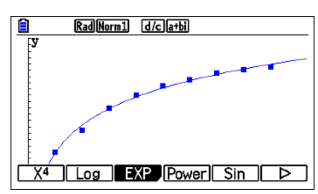
- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] [◄] [F4] [F1]
- Create a scatter plot of the data [F6] [F6] [F1] [F6] [▼] [F1] [EXIT] [F1].
- Choose Logarithmic Regression [F1] [F6] [F2]
- Graph the Logarithmic Regression [F6]







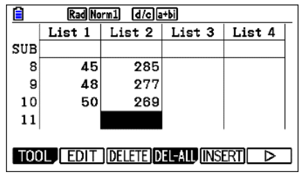


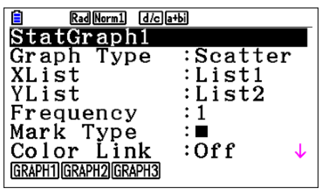


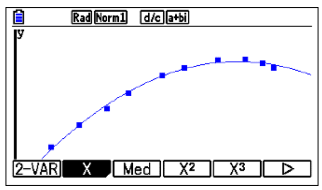
Quadratic Regression Model Example

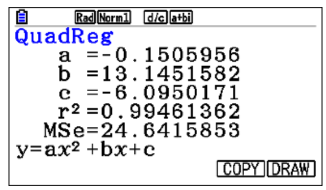
- Clear old data and enter the new data into the lists. MENU 2 EXIT EXIT F6 ◀ F4 F1
- Create a scatter plot of the data F6 F6 F1 F6 ▼ F1 EXIT F1.
- Choose Quadratic Regression F1 F4
- Graph the Quadratic Regression F6

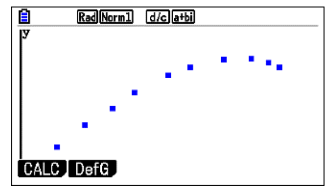
Angle	Distance (feet
10°	115
15°	157
20°	189
24°	220
30°	253
34°	269
40°	284
45°	285
48°	277
50°	269









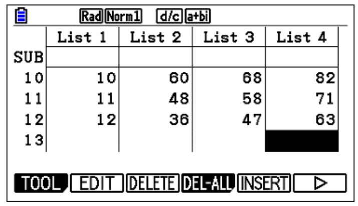


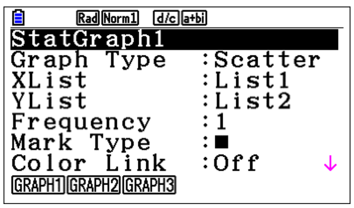
Sine Regression Model Example

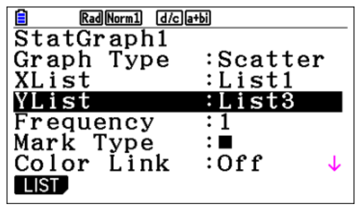
Example: The table below shows the highest daily temperatures (in degrees Fahrenheit) averaged over the month.

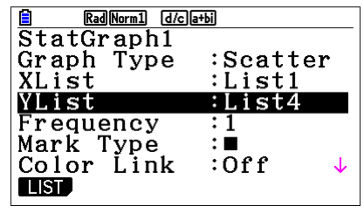
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1	2	3	4	5	6	7	8	9	10	11	12
Tokyo	32	34	43	57	69	78	82	80	72	60	48	36
Hiroshima	43	47	56	67	75	84	88	87	80	68	58	47
Nagasaki	62	65	72	80	87	92	96	97	91	82	71	63

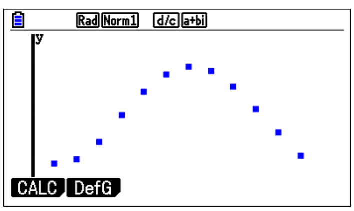
- Clear old data and enter the new data into the lists(list1, list2, list3, list4). MENU 2 EXIT EXIT F6 ◄ F4 F1
- Create a scatter plot of the data for all cities (list1 with list2 , list1 with list3, list1 with list4)
  F6 F6 F1 F6 ▼ ▼ ▼ F1 (2 3 4) EXIT. To choose color EXE ▼ ▼ ▼ ▼ F1
- Choose Sin Regression for each pair of lists F1 F1 F6 F5
- Draw the Sin Regression F6 (*do these steps for all pairs of lists list1 with list2, list1 with list3, list1 with list4*).

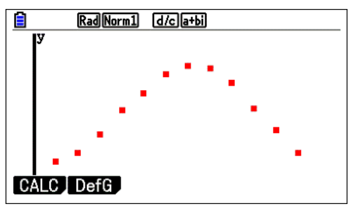


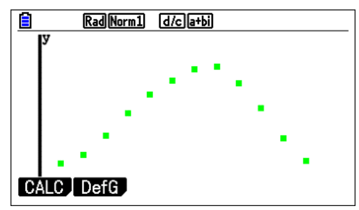


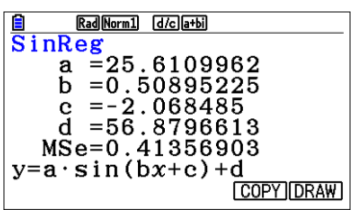


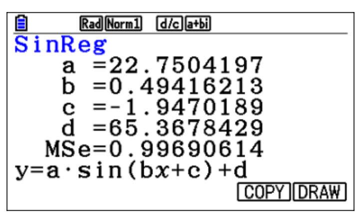


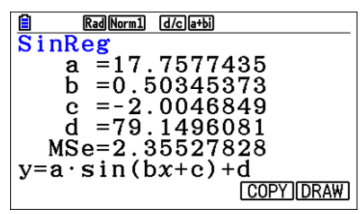


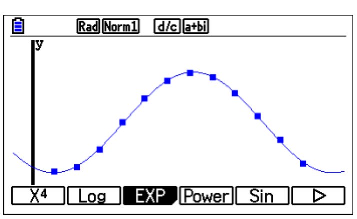


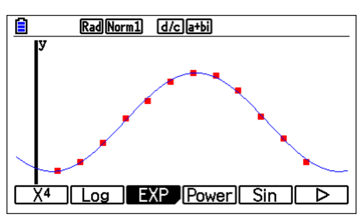


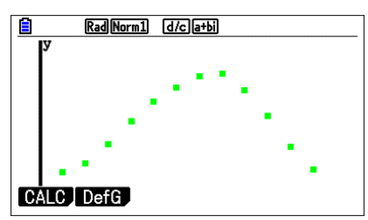












Normal Probability Distribution

The Distribution functions:

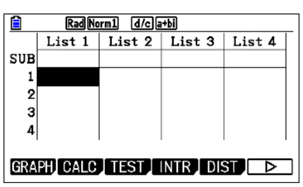
1. *pdf = Probability Density Function*
   This function returns the probability of a single value of the random variable *x*. Use this to graph a normal curve. Using this function returns the *y*-coordinates of the normal curve.
   normal pdf (x, mean, standard deviation)

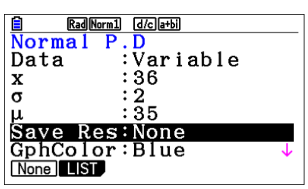
2. *cdf = Cumulative Distribution Function*
   This function returns the cumulative probability from zero up to some input value of the random variable *x*. Technically, it returns the percentage of area under a continuous distribution curve from negative infinity to the *x*. You can, however, set the lower bound.
   normal cdf (lower bound, upper bound, mean, standard deviation)

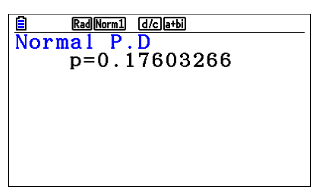
3. *inv = Inverse Normal Probability Distribution Function*
   This function returns the *x*-value given the probability region to the left of the *x*-value.
   ($0 \leq$ area ≤ 1 must be true.) The inverse normal probability distribution function will find the precise value at a given percent based upon the mean and standard deviation.
   invNorm (probability, mean, standard deviation)

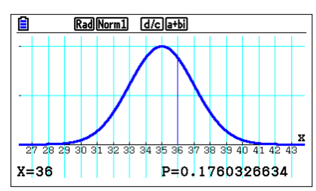
Example: calculate the normal probability density for a specific parameter value when $x = 36$, $\sigma = 2$ and $\mu = 35$.

- Use the following steps [MENU] [2] [EXIT] [EXIT] [F5] [F1] [F1] [F2] [▼] [3] [6] [EXE] [2] [EXE] [3] [5] [EXE] [EXE]
- To draw [EXIT] [▼] [▼] [▼] [F6]





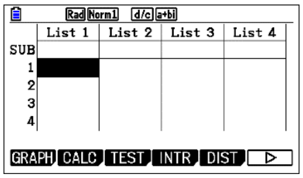


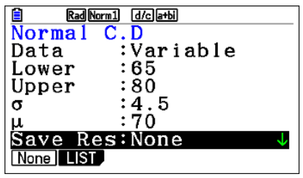


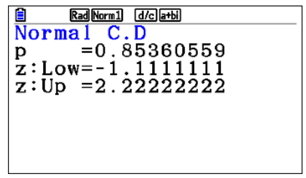
Example: given a normal distribution of values for which the mean is 70 and the standard deviation is 4.5. Find:

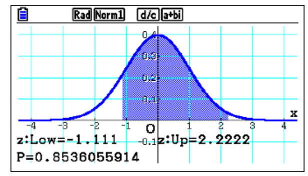
a) the probability that a value is between 65 and 80, inclusive.
b) the probability that a value is greater than or equal to 75.
c) the probability that a value is less than 62.
d) the 90th percentile for this distribution.

a) MENU 2 EXIT EXIT F5 F1 F2 ▼ 6 5 EXE 8 0 EXE 4 • 5 EXE 7 0 EXE F1 EXE EXIT ▼ ▼ F6



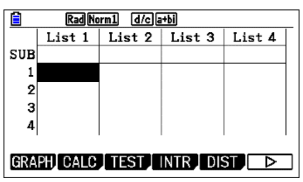


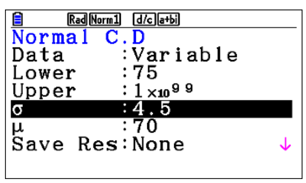


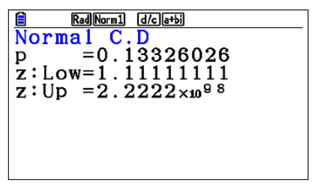


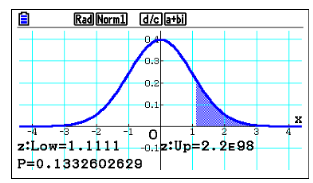
b) The upper boundary in this problem will be positive infinity. Type 10^99 to represent positive infinity

EXIT ▲ ▲ ▲ ▲ 7 5 EXE 1 x10^x 9 9 EXE EXE EXIT ▼ ▼ ▼ ▼ F6



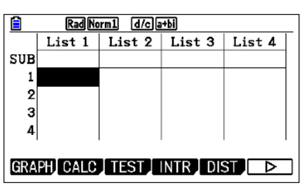


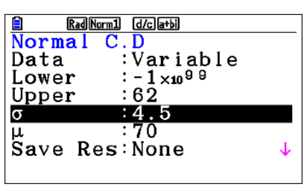


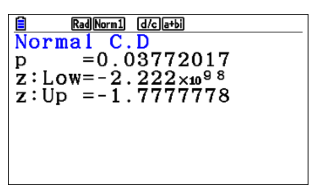


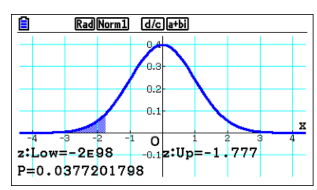
c) The lower boundary in this problem will be negative infinity -1 x 10^{99}

EXIT ▲ ▲ (−) 1 x10^x 9 9 EXE 6 2 EXE EXE EXIT ▼ ▼ ▼ ▼ F6

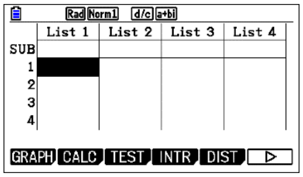


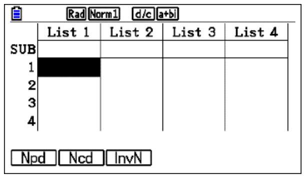


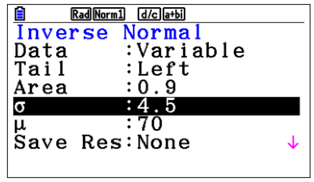


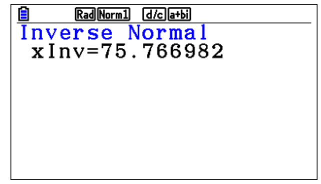


d) Given a probability region to the left of a value determine the value using invNorm.
[EXIT] [EXIT] [F5] [F1] [F3] [▼] [▼] [0] [•] [9] [EXE] [EXE]





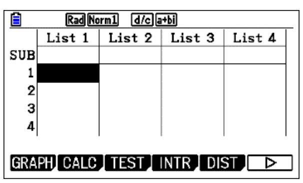


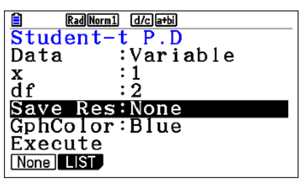


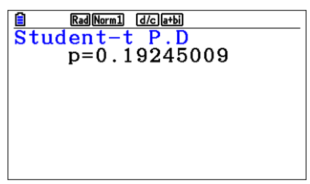
T - Distribution

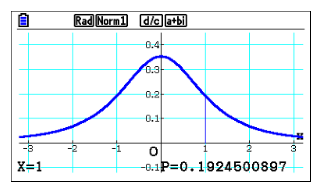
Example: calculate Student-*t* probability density for a specific parameter value when *x* = 1 and degrees of freedom = 2.

Use the following steps [MENU] [2] [EXIT] [EXIT] [F5] [F2] [F1] [F2] [▼] [1] [EXE] [2] [EXE] [EXE] [EXIT] [▼] [▼] [F6]



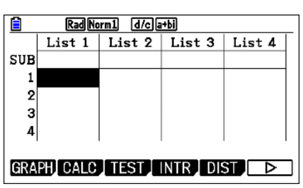


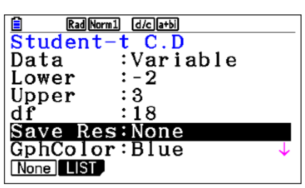


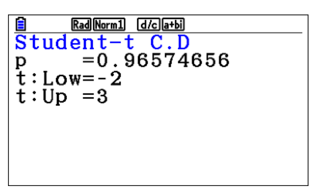


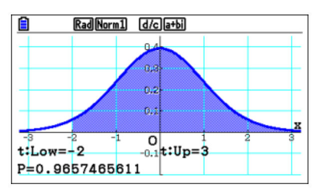
Example: calculate Student-*t* distribution probability for a specific parameter value, we will calculate Student-*t* distribution probability when lower boundary = –2, upper boundary = 3, and degrees of freedom = 18**.**

Use the following steps [MENU] [2] [EXIT] [EXIT] [F5] [F2] [F2] [F2] [▼] [—] [2] [EXE] [3] [EXE] [1] [8] [EXE] [EXE] [EXIT] [▼] [▼] [F6]



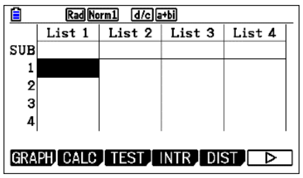


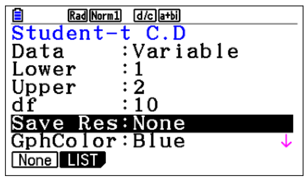


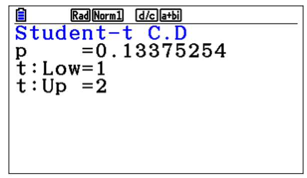


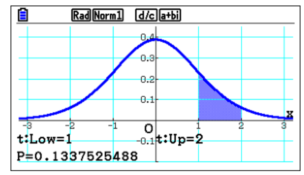
Example: Find the area under a T curve with degrees of freedom 10 for P(1 ≤ X ≤ 2).

- Select tcd [MENU] [2] [EXIT] [EXIT] [F5] [F2] [F2].
- Enter the lower and upper bounds, and the degrees of freedom. The lower bound is the lowest number and the upper bound is the highest number: 1,2,10
- Press [EXE] the answer is .133752549, or about 13.38%.
- To draw [EXIT] [▼] [▼] [F6]



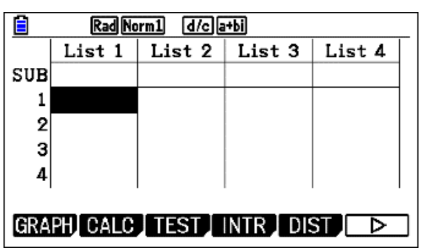


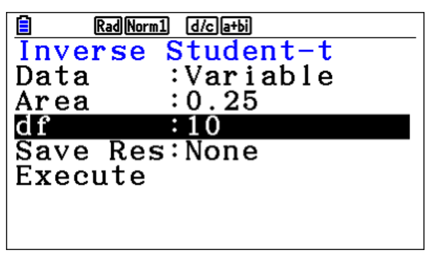


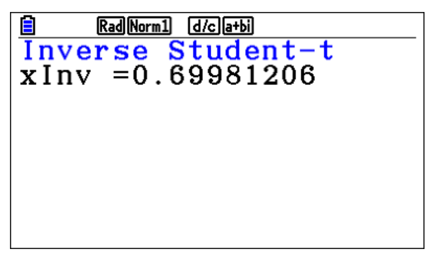


Example: find the T score with a value of 0.25 to the left and df of 10.

- select Invt [MENU] [2] [EXIT] [EXIT] [F5] [F2] [F3].
- Enter 0.25 in the Area. [▼] [0] [•] [2] [5] [EXE] [EXE]
- Enter 10 in the Deg of Freedom, df.





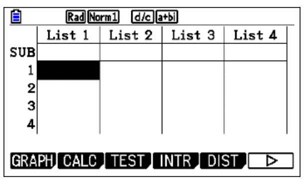


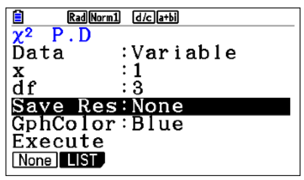
Chi-square Distribution

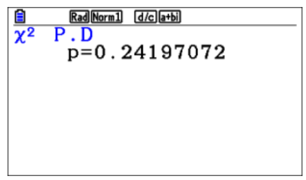
Example: calculate χ^2 probability density for a specific parameter value, we will calculate χ^2 probability density when *x* = 1 and degrees of freedom = 3.

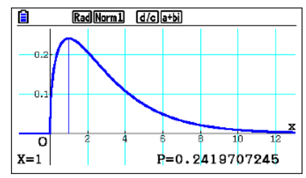
Use the following steps: MENU 2 EXIT EXIT F5 F3 F1 F2 ▼ 1 EXE 3 EXE EXE

To draw: EXIT ▼ ▼ ▼ F6





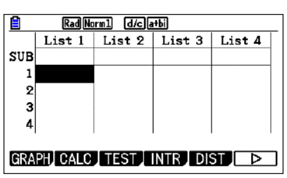


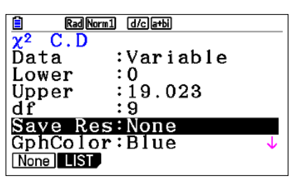


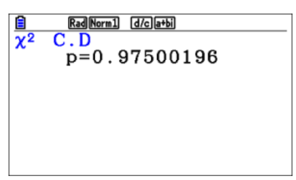
Example: calculate χ^2 distribution probability for a specific parameter value, we will calculate χ^2 distribution probability when lower boundary = 0, upper boundary = 19.023, and degrees of freedom = 9.

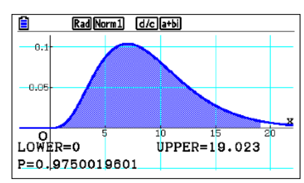
To calculate: MENU 2 EXIT EXIT F5 F3 F2 F2 ▼ 0 EXE 1 9 • 0 2 3 EXE 9 EXE EXE

To draw: EXIT ▼ ▼ F6









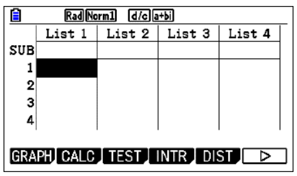
F- distribution probability

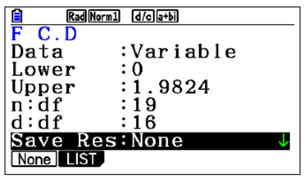
F distribution probability calculates the probability of *F* distribution data falling between two specific values.

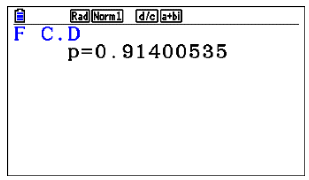
Example: calculate *F* distribution probability for a specific parameter value, we will calculate *F* distribution probability when lower boundary = 0, upper boundary = 1.9824, *n-df* = 19 and *d-df* = 16.

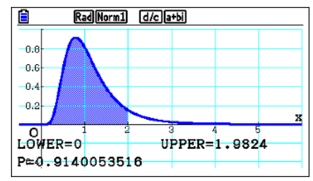
To calculate: MENU 2 EXIT EXIT F5 F4 F2 F2 ▼ 0 EXE 1 • 9 8 2 4 EXE 1 9 EXE 1 6 EXE EXE

To draw: EXIT ▼ ▼ F6







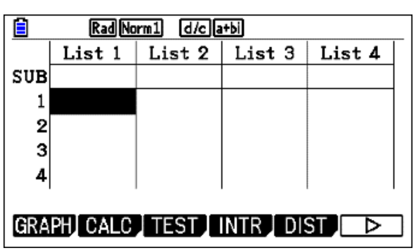


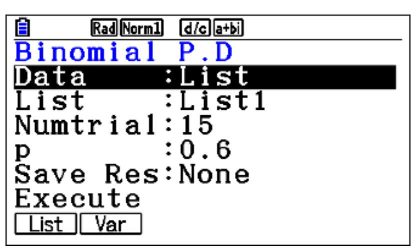
Binomial probability

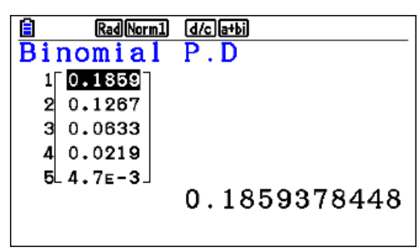
Binomial probability calculates a probability at specified value for the discrete binomial distribution with the specified number of trials and probability of success on each trial.

Example: For data = {10, 11, 12, 13, 14} when Numtrial = 15 and success probability = 0.6. calculate binomial probability for one list of data.

- Fill the data MENU 2 EXIT EXIT
- Calculate Binomial P.D F5 F5 F1 F1 ▼ ▼ 1 5 EXE 0 • 6 EXE EXE







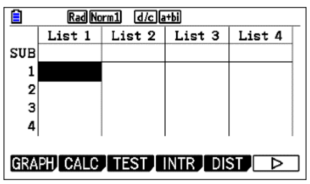
Example: A six-sided die is rolled twelve times and the number of sixes rolled is counted.

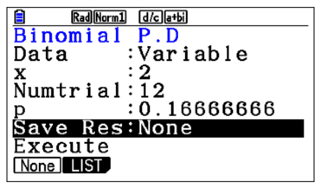
a) What is the probability of rolling exactly two sixes?
b) What is the probability of rolling more than two sixes?

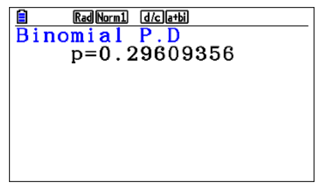
This number of sixes can be modelled as a binomial distribution: x ~ B (12, $\frac{1}{6}$).

Solution:

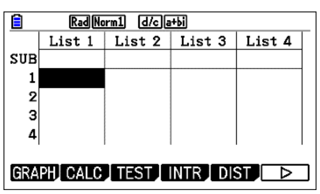
a) Using Bpd [MENU] [EXIT] [MENU] [2] [EXIT] [EXIT] [F5] [F5] [F1] [F2] [▼] [2] [EXE] [1] [2] [EXE] [1] [fraction] [6] [EXE] [EXE]

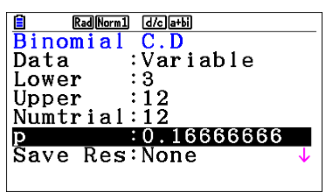


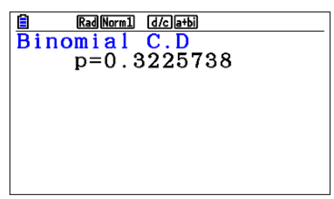




b) Find P (x1 ≤ X ≤ x2) using Bcd [EXIT] [F5] [F5] [F2] [F2] [▼] [3] [EXE] [1] [2] [EXE] [1] [2] [EXE] [EXE]







Poisson probability

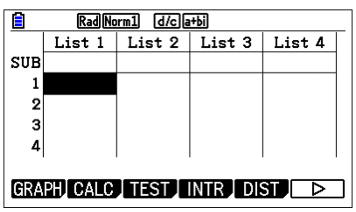
Poisson probability calculates a probability at specified value for the discrete Poisson distribution with the specified mean.

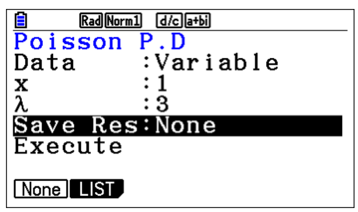
Example: Customers enter a shop at an average of three per minute. The number of customers entering the shop in a given minute can be modelled by a Poisson distribution: X ~ P(3)

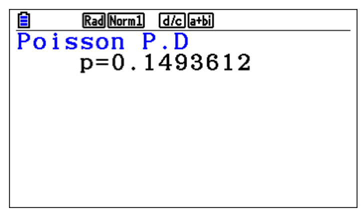
- What is the probability of exactly one customer entering the shop in a minute?
- What is the probability of five or fewer customers entering the shop in a minute?

Find P(X=x) using Ppd: [MENU] [2] [EXIT] [EXIT] [F5] [F6] [F1] [F1]

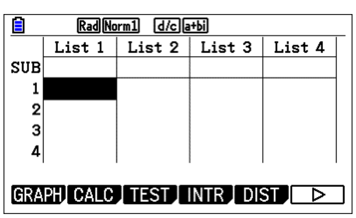
Fill the required data [F2] [▼] [1] [EXE] [3] [EXE] [EXE]

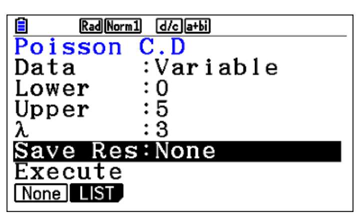


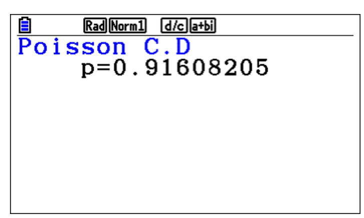




- Using Pcd [MENU] [2] [EXIT] [EXIT] [F5] [F6] [F1] [F2]
- Fill the required data [F2] [▼] [0] [EXE] [5] [EXE] [3] [EXE] [EXE]

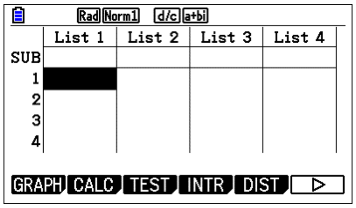


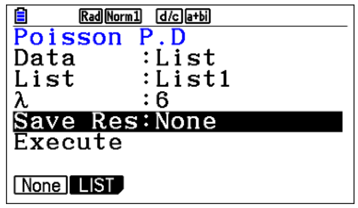


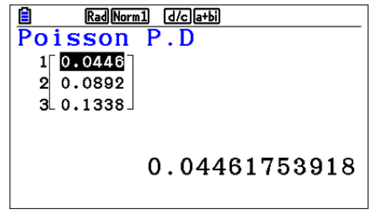


Example: Calculate Poisson probability for one list of data, we will calculate Poisson probability for data = {2, 3, 4} when λ = 6.

- Fill the list: [MENU] [2] [EXIT] [EXIT] [F6] [F4] [F1] [2] [EXE] [3] [EXE] [4] [EXE] [F6] [F6]
- To Calculate [F5] [F6] [F1] [F1] [F1] [▼] [▼] [6] [EXE] [EXE]





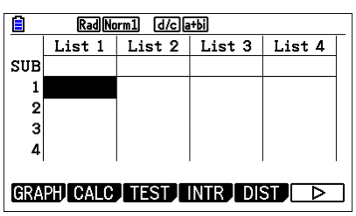


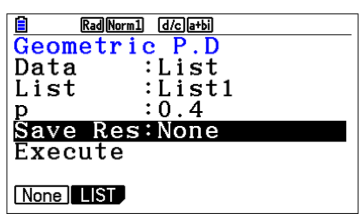
Geometric probability

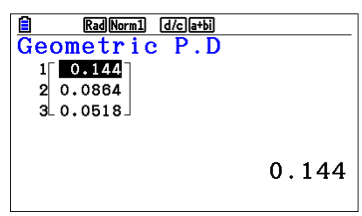
Geometric probability calculates a probability at specified value, the number of the trial on which the first success occurs, for the discrete geometric distribution with the specified probability of success.

Example: calculate geometric probability for one list of data, we will calculate geometric probability for data = {3, 4, 5} when p = 0.4.

- Fill the list: [MENU] [2] [EXIT] [EXIT] [F6] [F4] [F1] [3] [EXE] [4] [EXE] [5] [EXE]
- To Calculate [F6] [F6] [F5] [F6] [F2] [F1] [▼] [▼] [0] [•] [4] [EXE] [EXE]







Tests

The Z Test provides a variety of different standardization-based tests. They make it possible to test whether a sample accurately represents the population when the standard deviation of a population (such as the entire population of a country) is known from previous tests. Z testing is used for market research and public opinion research, that need to be performed repeatedly.

1-Sample Z Test: tests for the unknown population mean when the population standard deviation is known.

2-Sample Z Test: tests the equality of the means of two populations based on independent samples when both population standard deviations are known.

1-Prop Z Test: tests for an unknown proportion of successes.

2-Prop Z Test: tests to compare the proportion of successes from two populations.

The t Test: tests the hypothesis when the population standard deviation is unknown. The hypothesis that is the opposite of the hypothesis being proven is called the null hypothesis, while the hypothesis being proved is called the alternative hypothesis. The t Test is normally applied to test the null hypothesis. Then a determination is made whether the null hypothesis or alternative hypothesis will be adopted.

1-Sample t Test: tests the hypothesis for a single unknown population mean when the population standard deviation is unknown.

2-Sample t Test: compares the population means when the population standard deviations are unknown.

LinearReg t Test: calculates the strength of the linear association of paired data.

The χ^2 test, a number of independent groups are provided, and a hypothesis is tested relative to the probability of samples being included in each group.

The χ^2 GOF test (χ^2one-way Test): tests whether the observed count of sample data fits a certain distribution. For example, it can be used to determine conformance with normal distribution or binomial distribution.

The χ^2 two-way test: creates a cross-tabulation table that structures mainly two qualitative variables (such as “Yes” and “No”), and evaluates the independence of the variables.

2-Sample F Test: tests the hypothesis for the ratio of sample variances. It could be used, for example, to test the carcinogenic effects of multiple suspected factors such as tobacco use, alcohol, vitamin deficiency, high coffee intake, inactivity, poor living habits, etc.

ANOVA: tests the hypothesis that the population means of the samples are equal when there are multiple samples. It could be used, for example, to test whether or not different combinations of materials have an effect on the quality and life of a final product.

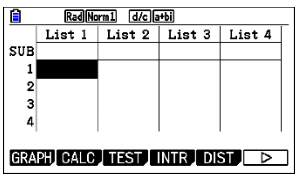
One-Way ANOVA: is used when there is one independent variable and one dependent variable.

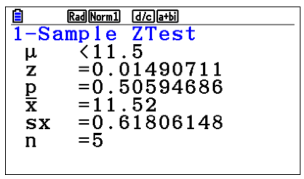
Two-Way ANOVA: is used when there are two independent variables and one dependent variable.

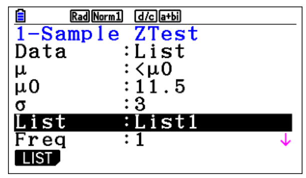
1-Sample Z test

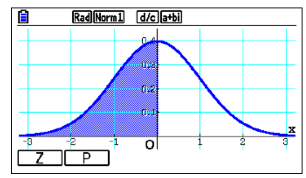
Example: Perform a 1-Sample *Z* Test for one list of data $\mu < \mu 0$ test for the data List1 = {11.2, 10.9, 12.5, 11.3, 11.7}, when μ = 11.5 and σ = 3.

- Fill the data with list1 [MENU] [2] [EXIT] [EXIT]
- 1-sample Z [F3] [F1] [F1]
- Fill the values of μ and σ [F1] [▼] [F2] [▼] [1] [1] [•] [5] [EXE] [3] [EXE]
- Draw the graph [EXIT] [▼] [▼] [▼] [▼] [F6]



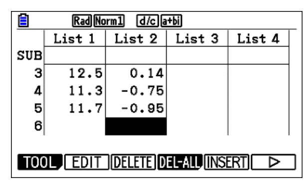






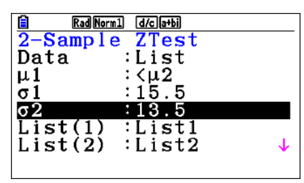
2-Sample Z test

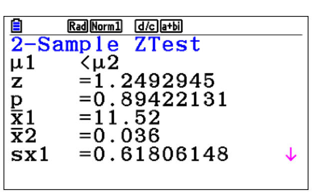
Example: Perform a 2-Sample *Z* Test when two lists of data are input, we will perform a $\mu 1 < \mu 2$ test for the data List1 = {11.2, 10.9, 12.5, 11.3, 11.7} and

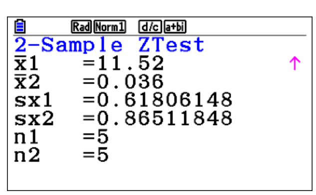


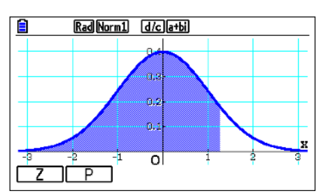
List2 = {0.84, 0.9, 0.14, –0.75, –0.95}, when σ1 = 15.5 and σ2 = 13.5.

- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] [◀] [F4] [F1]
- Z 2-samples [F6] [F6] [F3] [F1] [F2] [▼] [▼] [1] [5] [•] [5] [EXE] [1] [3] [•] [5] [EXE] [EXE]
- To draw [EXIT] [▼] [▼] [▼] [▼] [▼] [▼] [▼] [F6]





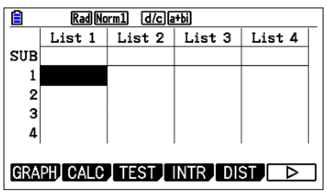


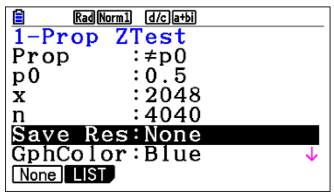


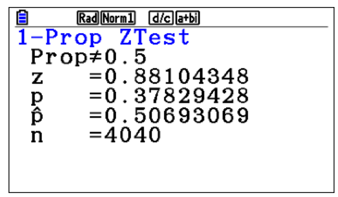
1-Prop Z test

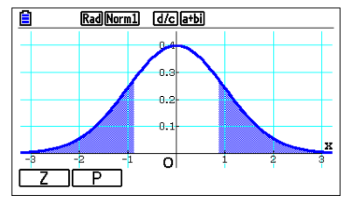
Example: To perform a 1-Prop *Z* Test for specific expected sample proportion, data value, and sample size
Perform the calculation using: *p*0 = 0.5, *x* = 2048, *n* = 4040.

- 1-Prop Z test MENU 2 EXIT EXIT F3 F1 F3
- Fill the data ▼ 0 • 5 EXE 2 0 4 8 EXE 4 0 4 0 EXE EXE
- To draw EXIT ▼ ▼ F6





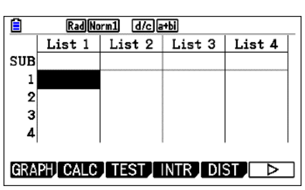


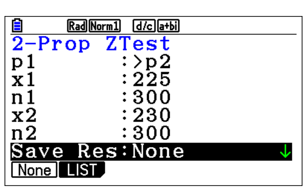


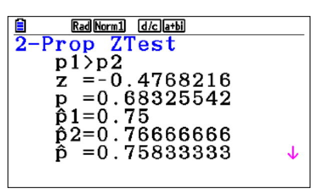
2-Prop Z test

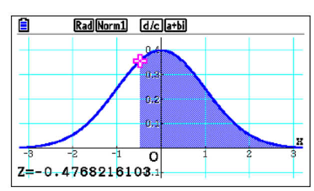
Example: To perform a *p*1 > *p*2 2-Prop *Z* Test for expected sample proportions, data values, and sample sizes
Perform a *p*1 > *p*2 test using: *x*1 = 225, *n*1 = 300, *x*2 = 230, *n*2 = 300.

- 2-Prop Z test MENU 2 EXIT EXIT F3 F1 F4 •
- Fill the required data F3 2 2 5 EXE 3 0 0 EXE 2 3 0 EXE 3 0 0 EXE EXE
- To draw EXIT ▼ ▼ F6 F1





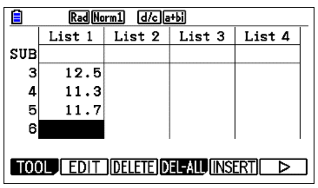


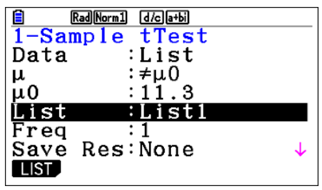


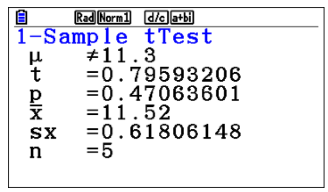
1-Sample T test

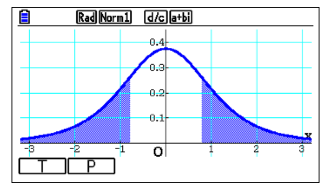
Example: Perform a 1-Sample *t* Test for one list of data where $\mu \neq \mu_0$, List1 = {11.2, 10.9, 12.5, 11.3, 11.7}, when $\mu_0 = 11.3$.

- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] [◄] [F4] [F1]
- 1-sample T [F6] [F6] [F3] [F2] [F1] [▼] [F1] [▼] [1] [1] [.] [3] [EXE] [EXE]
- To see the graph [EXIT] [▼] [▼] [▼] [▼] [F6]





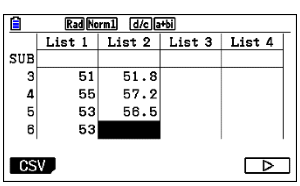


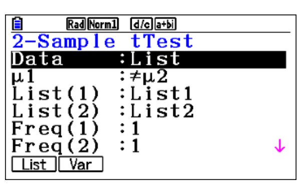


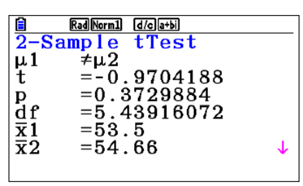
2-Sample T test

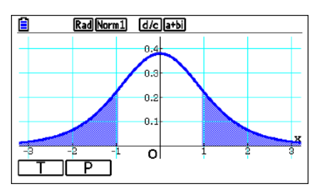
Example: Perform a 2-Sample T Test when two lists of data are input for $\mu 1 \neq \mu 2$, List1 = {55, 54, 51, 55, 53, 53, 54, 53} and List2 = {55.5, 52.3,51.8, 57.2, 56.5} when pooling is not in effect.

- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] [◄] [F4] [F1]
- 2-sample T [F6] [F6] [F3] [F2] [F2] [EXE]
- For graphing [EXIT] [▼] [▼] [▼] [▼] [▼] [▼] [▼] [▼] [▼] [F6]





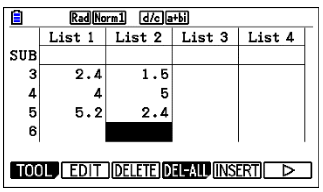


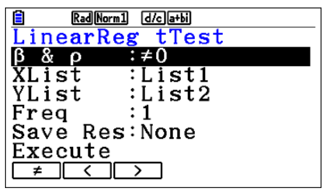


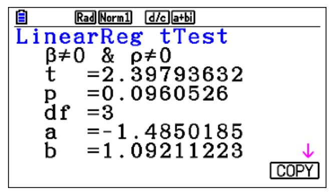
LinearReg t Test

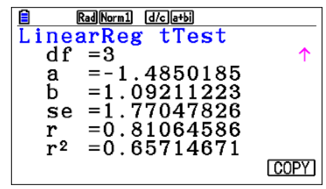
Example: Perform a LinearReg *t* Test when two lists of data are input for this example, we will perform a LinearReg *t* Test for *x*-axis data {0.5, 1.2, 2.4, 4, 5.2} and *y*-axis data {–2.1, 0.3, 1.5, 5, 2.4}.

- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] [◀] [F4] [F1]
- T test LinearReg [F6] [F6] [F3] [F2] [F3] [EXE]







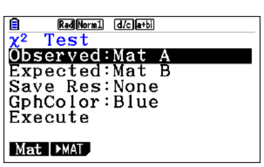


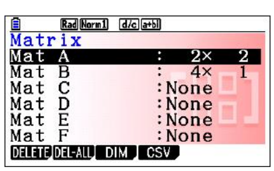
Chi-Square Test

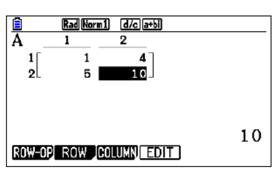
χ^2 Test sets up several independent groups and tests hypotheses related to the proportion of the sample included in each group. The χ^2 Test is applied to dichotomous variables (variable with two possible values, such as yes/no).

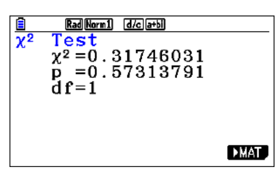
Example: To perform a χ^2 Test on a specific matrix cell, we will perform a χ^2 Test for Mat A, which contains the following data. $\begin{matrix} 1 & 4 \\ 5 & 10 \end{matrix}$

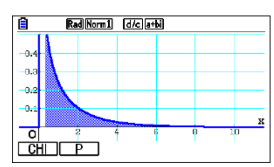
- χ^2 Test -2 way [MENU] [2] [EXIT] [EXIT] [F3] [F3] [F2]
- Observed matrix to fill the data [F2] [F3] [2] [EXE] [2] [EXE] [EXE] [1] [EXE] [4] [EXE] [5] [EXE] [1] [0] [EXE]
- Calculate the value [EXIT] [EXIT] [▲] [F1] Draw the graph [EXIT] [F6]







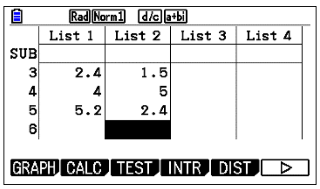


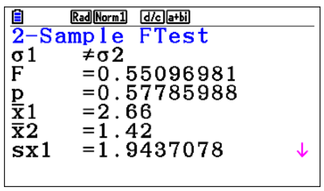


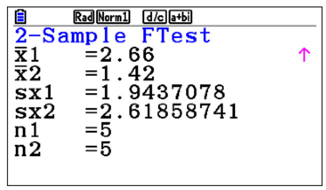
2-Sample *F* Test

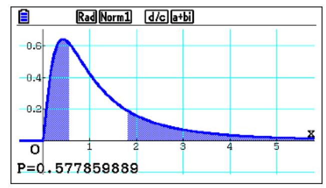
Example: Perform a 2-Sample *F* Test when two lists of data are input for this example, we will perform a 2-Sample *F* Test for the data List1 = {0.5, 1.2, 2.4, 4, 5.2} and List2 = {–2.1, 0.3, 1.5, 5,2.4}.

- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] [◀] [F4] [F1] [F6] [F6]
- Sample *F* Test [F3] [F4] [F1] [▲] [F1]
- Draw the graph [EXIT] [F6] [F2]





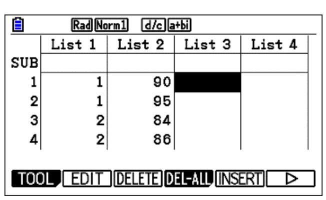


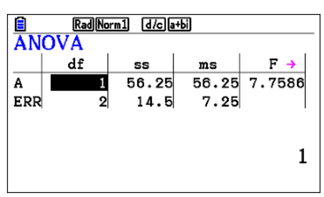


ANOVA tests

Example: Perform one-way ANOVA (analysis of variance) when three lists of data are input for this example, we will perform analysis of variance for the data List1 = {1,1,2,2} List2 = {90,95,84,86}.

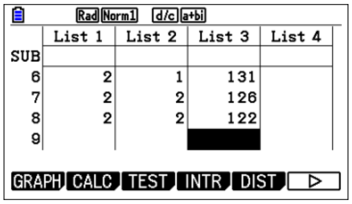
- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] [◀] [F4] [F1]
- Sample *F* Test [F6] [F6] [F3] [F5] [F1] [▼] [▼] [F1] [2] [EXE] [EXE]

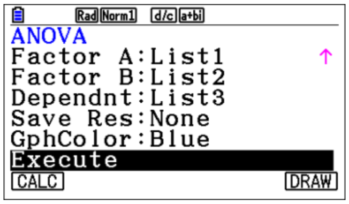


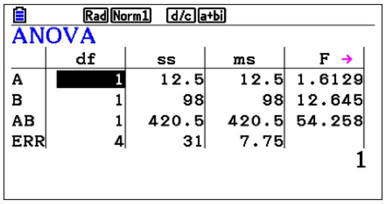


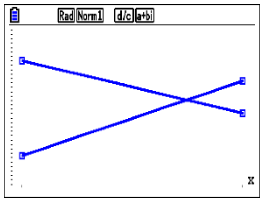
Example: Perform two-way ANOVA (analysis of variance) when three lists of data are input For this example, we will perform analysis of variance for the data List1 = {1,1,1,1,2,2,2,2}, List2 = {1,1,2,2,1,1,2,2,} and List3 = {113,116,139,132,133,131,126,122}.

- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] [◀] [F4] [F1] [F6] [F6]
- Sample *F* Test [F3] [F5] [F2] [▼] [▼] [▼] [F1] [3] [EXE] [EXE]
- Draw the graph [EXIT] [▲] [▲] [▲] [▲] [F6]







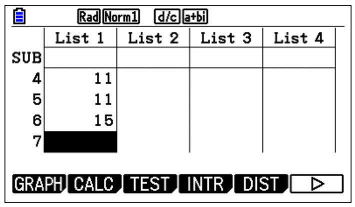


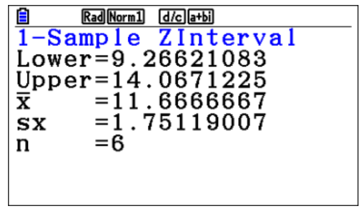
Confidant Intervals

- **1-Sample *Z* Interval** calculates the confidence interval when the population standard deviation is known.
- **2-Sample *Z* Interval** calculates the confidence interval when the population standard deviations of two samples are known.
- **1-Prop *Z* Interval** calculates the confidence interval when the proportion is not known.
- **2-Prop *Z* Interval** calculates the confidence interval when the proportions of two samples are not known.
- **1-Sample *t* Interval** calculates the confidence interval for an unknown population mean when the population standard deviation is unknown.
- **2-Sample *t* Interval** calculates the confidence interval for the difference between two population means when both population standard deviations are unknown.

Example: To calculate the 1-Sample *Z* Interval for one list of data, we will obtain the *Z* Interval for the data {11, 10, 12, 11, 11,15}, when C-Level = 0.95 (95% confidence level) and σ = 3.

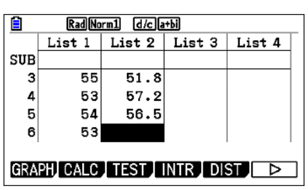
- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] [◀] [F4] [F1] [F6] [F6]
- Z-INTR 1-sample to calculate the interval [F4] [F1] [F1] [F1] [▼] [0] [.] [9] [5] [EXE] [3] [EXE] [EXE]

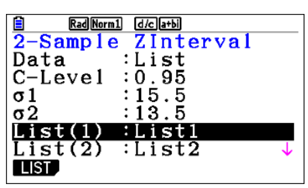


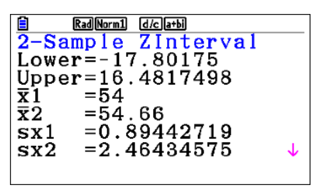


Example: To calculate the 2-Sample Z Interval when two lists of data are input for this example, we will obtain the 2-Sample Z Interval for the data 1 = {55, 54, 51, 55, 53, 53, 54, 53} and data 2 = {55.5, 52.3,51.8, 57.2, 56.5} when C-Level = 0.95 (95% confidence level), σ1 = 15.5, and σ2 = 13.5.

- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] [◀] [F4] [F1] [F6] [F6]
- 2-sample Z-INTR to calculate the interval [F4] [F1] [F2] [▼] [▼] [1] [5] [.] [5] [EXE] [1] [3] [.] [5] [EXE] [EXE]

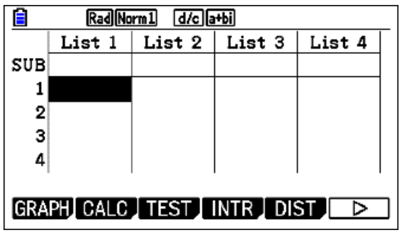


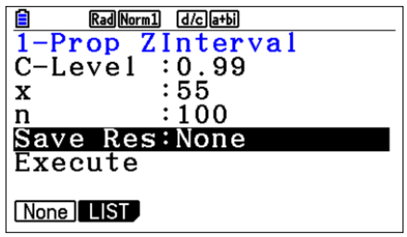


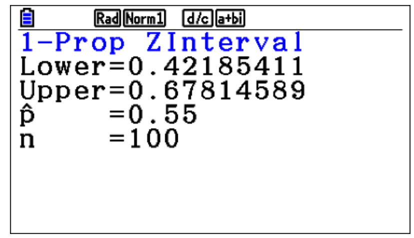


Example: To calculate the 1-Prop *Z* Interval using parameter value specification for this example, we will obtain the 1-Prop *Z* Interval when C-Level = 0.99, *x* = 55, and *n* = 100.

- Fill the data for 1-Prop Z-INTR to calculate the interval
  [EXIT] [EXIT] [F4] [F1] [F3] [0] [•] [9] [9] [EXE] [5] [5] [EXE] [1] [0] [0] [EXE] [EXE]

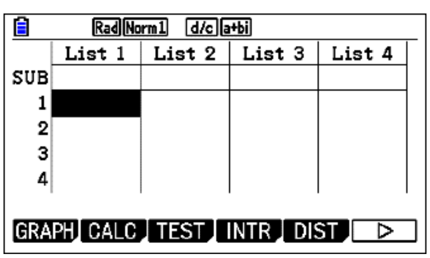


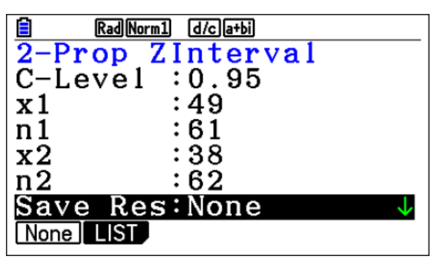


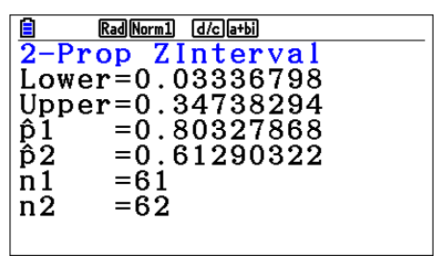


Example: To calculate the 2-Prop *Z* Interval using parameter value specification for this example, we will obtain the 2-Prop *Z* Interval when C-Level = 0.95, *x*1 = 49, *n*1 = 61, *x*2 = 38 and *n*2 = 62.

- Fill the data for 1-Prop Z-INTR to calculate the interval
  [MENU] [2] [EXIT] [EXIT] [F4] [F1] [F4] [0] [•] [9] [2] [EXE] [4] [9] [EXE] [6] [1] [EXE] [3] [8] [EXE] [6] [2] [EXE] [EXE]

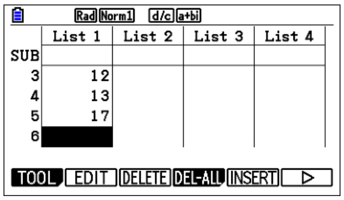


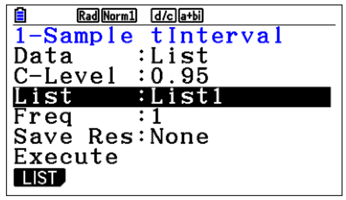


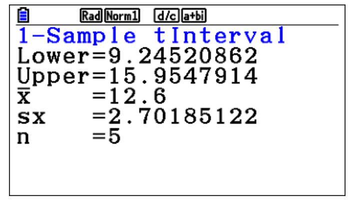


Example: To calculate the 1-Sample *t* Interval for one list of data, we will obtain the 1-Sample *t* Interval for data = {11, 10, 12, 13, 17} when C-Level = 0.95.

- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] [◀] [F4] [F1]
- To calculate the interval (INTR) [F6] [F6] [F4] [F2] [F1] [F1] [▼] [0] [•] [9] [5] [EXE] [EXE]







Example: To calculate the 2-Sample *t* Interval when two lists of data are input, we will obtain the 2-Sample *t* Interval for data 1 = {55, 54, 51, 55, 53, 53, 54, 53} and data 2 = {55.5, 52.3, 51.8, 57.2, 56.5} without pooling when C-Level = 0.95.

- Clear old data and enter the new data into the lists [MENU] [2] [EXIT] [EXIT] [F6] [◀] [F4] [F1]
- To calculate the interval (INTR) [F6] [F6] [F4] [F2] [F2] [F1] [▼] [0] [•] [9] [5] [EXE] [EXE]