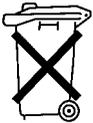


ALGEBRA FX 2.0 PLUS
FX 1.0 PLUS

User's Guide 2
(Additional Functions)

NL

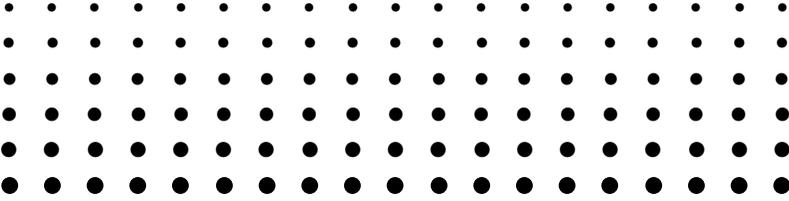
Batterij niet weggooien,
maar inleveren als
KCA



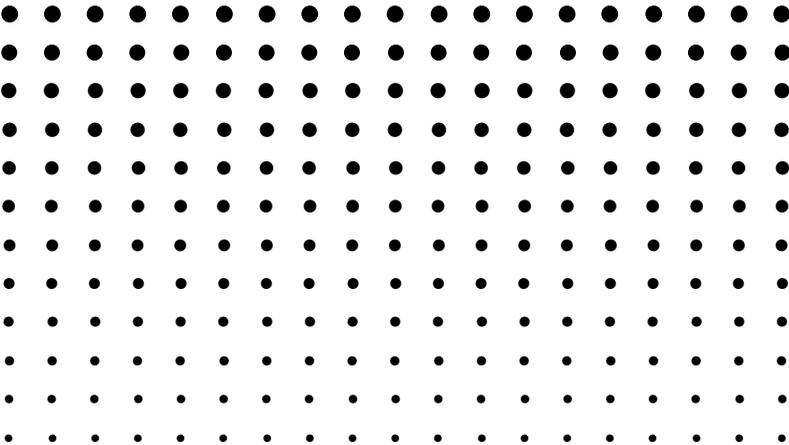
CASIO ELECTRONICS CO., LTD.
Unit 6, 1000 North Circular Road,
London NW2 7JD, U.K.

Important!

Please keep your manual and all information handy for future reference.



ALGEBRA FX 2.0 PLUS
FX 1.0 PLUS
(Additional Functions)



Contents

Chapter 1 Advanced Statistics Application

1-1	Advanced Statistics (STAT)	1-1-1
1-2	Tests (TEST)	1-2-1
1-3	Confidence Interval (INTR).....	1-3-1
1-4	Distribution (DIST).....	1-4-1

Chapter 2 Financial Calculation (TVM)

2-1	Before Performing Financial Calculations	2-1-1
2-2	Simple Interest	2-2-1
2-3	Compound Interest	2-3-1
2-4	Cash Flow (Investment Appraisal)	2-4-1
2-5	Amortization	2-5-1
2-6	Interest Rate Conversion	2-6-1
2-7	Cost, Selling Price, Margin	2-7-1
2-8	Day/Date Calculations	2-8-1
2-9	Depreciation	2-9-1
2-10	Bonds	2-10-1
2-11	TVM Graph	2-11-1

Chapter 3 Differential Equations

3-1	Using the DIFF EQ Mode	3-1-1
3-2	Differential Equations of the First Order	3-2-1
3-3	Linear Differential Equations of the Second Order	3-3-1
3-4	Differential Equations of the Nth Order	3-4-1
3-5	System of First Order Differential Equations	3-5-1

Chapter 4 E-CON

4-1	E-CON Overview	4-1-1
4-2	EA-100 Setup	4-2-1
4-3	Setup Memory	4-3-1
4-4	Program Converter	4-4-1
4-5	Starting a Sampling Operation	4-5-1

Index

Chapter

1

1

Advanced Statistics Application

- 1-1 Advanced Statistics (STAT)
- 1-2 Tests (TEST)
- 1-3 Confidence Interval (INTR)
- 1-4 Distribution (DIST)

1-1 Advanced Statistics (STAT)

•Function Menu

The following shows the function menus for the STAT Mode list input screen.



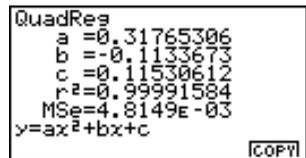
Pressing a function key that corresponds to the added item displays a menu that lets you select one of the functions listed below.

- **F3** (TEST) ... Test (page1-2-1)
- **F4** (INTR) ... Confidence interval (page1-3-1)
- **F5** (DIST) ... Distribution (page1-4-1)

Sort and **JUMP** functions are located in the **TOOL** menu (**F6**(▷)**F7**(TOOL)).

•Calculation of the Coefficient of Determination (r^2) and MSE

You can use the STAT Mode to calculate the coefficient of determination (r^2) for quadratic regression, cubic regression, and quartic regression. The following types of MSE calculations are also available for each type of regression.



- Linear Regression ...
$$MSE = \frac{1}{n-2} \sum_{i=1}^n (y_i - (ax + b))^2$$
- Quadratic Regression ...
$$MSE = \frac{1}{n-3} \sum_{i=1}^n (y_i - (ax^2 + bx + c))^2$$
- Cubic Regression ...
$$MSE = \frac{1}{n-4} \sum_{i=1}^n (y_i - (ax^3 + bx^2 + cx + d))^2$$
- Quartic Regression ...
$$MSE = \frac{1}{n-5} \sum_{i=1}^n (y_i - (ax^4 + bx^3 + cx^2 + dx + e))^2$$

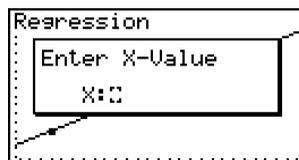
- Logarithmic Regression ... $MSE = \frac{1}{n-2} \sum_{i=1}^n (y_i - (a + b \ln x_i))^2$
- Exponential Regression ... $MSE = \frac{1}{n-2} \sum_{i=1}^n (\ln y_i - (\ln a + bx_i))^2$
- Power Regression ... $MSE = \frac{1}{n-2} \sum_{i=1}^n (\ln y_i - (\ln a + b \ln x_i))^2$
- Sin Regression ... $MSE = \frac{1}{n-2} \sum_{i=1}^n (y_i - (a \sin(bx_i + c) + d))^2$
- Logistic Regression ... $MSE = \frac{1}{n-2} \sum_{i=1}^n \left(y_i - \frac{C}{1 + ae^{-bx_i}} \right)^2$

• Estimated Value Calculation for Regression Graphs

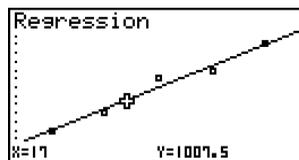
The STAT Mode also includes a Y-CAL function that uses regression to calculate the estimated y -value for a particular x -value after graphing a paired-variable statistical regression.

The following is the general procedure for using the Y-CAL function.

1. After drawing a regression graph, press **F6** (\triangleright) **F2** (Y-CAL) to enter the graph selection mode, and then press **EXE**.
If there are multiple graphs on the display, use \blacktriangle and \blacktriangledown to select the graph you want, and then press **EXE**.
- This causes an x -value input dialog box to appear.



2. Input the value you want for x and then press **EXE**.

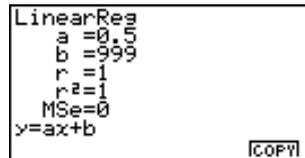


- This causes the coordinates for x and y to appear at the bottom of the display, and moves the pointer to the corresponding point on the graph.
3. Pressing **X,0,T** or a number key at this time causes the x -value input dialog box to reappear so you can perform another estimated value calculation if you want.

4. After you are finished, press **ESC** to clear the coordinate values and the pointer from the display.
- The pointer does not appear if the calculated coordinates are not within the display range.
 - The coordinates do not appear if [Off] is specified for the [Coord] item of the [SETUP] screen.
 - The Y-CAL function can also be used with a graph drawn by using DefG feature.

●Regression Formula Copy Function from a Regression Calculation Result Screen

In addition to the normal regression formula copy function that lets you copy the regression calculation result screen after drawing a statistical graph (such as Scatter Plot), the STAT Mode also has a function that lets you copy the regression formula obtained as the result of a regression calculation. To copy a resulting regression formula, press **F6** (COPY).



```

LinearReg
a =0.5
b =999
r =1
r^2=1
MSe=0
y=ax+b
COPY
  
```

■ Tests, Confidence Interval, and Distribution Calculations

The STAT Mode includes functions for performing tests, and confidence interval and distribution calculations. You can find explanations of each of these functions in the following sections: 1-2 Tests, 1-3 Confidence Interval, and 1-4 Distribution.

●Parameter Settings

The following describes the two methods you can use to make parameter settings for test, confidence interval, and distribution calculations.

- Selection

With this method, you press the function key that corresponds to the setting you want to select from the function menu.
- Value Input

With this method, you directly input the parameter value you want to input. In this case, nothing appears in the function menu.
- Pressing **ESC** returns to the list input screen, with the cursor in the same position it was at before you started the parameter setting procedure.
- Pressing **SHIFT** **ESC** (QUIT) returns to the top of list input screen.
- Pressing **EXE** without pressing **F1** (CALC) under "Execute" item advances to calculation execution. To return to the parameter setting screen, press **ESC**, **AC**, or **EXE**.

●Common Functions

- The symbol “■” appears in the upper right corner of the screen while execution of a calculation is being performed and while a graph is being drawn. Pressing **AC** during this time terminates the ongoing calculation or draw operation (AC Break).
- Pressing **ESC** or **EXE** while a calculation result or graph is on the display returns to the parameter setting screen. Pressing **SHIFT** **ESC** (QUIT) returns to the top of list input screen.
- Pressing **AC** while a calculation result is on the display returns to the parameter setting screen.
- Pressing **CTRL** **F5** (G↔T) after drawing a graph switches to the parameter setting screen (G↔T function). Pressing **CTRL** **F5** (G↔T) again returns to the graph screen.
- The G↔T function is disabled whenever you change a setting on the parameter setting screen, or when you perform a **CTRL** **F3** (SET UP) or **SHIFT** **OPTN** (V-Window) operation.
- You can perform the PICT menu's screen save or recall functions after drawing a graph.
- The ZOOM function and SKETCH function are disabled.
 - The TRACE function is disabled, except for the graph display of two-way ANOVA.
 - The graph screen cannot be scrolled.
- After drawing a graph, you can use a Save Result feature to save calculation results to a specific list. Basically, all items are saved as they are displayed, except for the first line title.
- Each time you execute Save Result, any existing data in the list is replaced by the new results.



1-2 Tests (TEST)

The **Z Test** provides a variety of different standardization-based tests. They make it possible to test whether or not 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.

χ^2 Test tests hypothesis concerning the proportion of samples included in each of a number of independent groups. Mainly, it generates cross-tabulation of two categorical variables (such as yes, no) and evaluates the independence of these variables. It could be used, for example, to evaluate the relationship between whether or not a driver has ever been involved in a traffic accident and that person's knowledge of traffic regulations.

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.



The following pages explain various statistical calculation methods based on the principles described above. Details concerning statistical principles and terminology can be found in any standard statistics textbook.

On the initial STAT Mode screen, press $\boxed{\text{F3}}$ (TEST) to display the test menu, which contains the following items.

- $\boxed{\text{F3}}$ (TEST) $\boxed{1}$ (Z) ... Z Tests (p. 1-2-2)
 - $\boxed{2}$ (T) ... *t* Tests (p. 1-2-10)
 - $\boxed{3}$ (χ^2) ... χ^2 Test (p. 1-2-18)
 - $\boxed{4}$ (F) ... 2-Sample *F* Test (p. 1-2-20)
 - $\boxed{5}$ (ANOVA) ... ANOVA (p. 1-2-22)

■ Z Tests

● Z Test Common Functions

You can use the following graph analysis functions after drawing a graph.

- $\boxed{\text{F1}}$ (Z) ... Displays *z* score.

Pressing $\boxed{\text{F1}}$ (Z) displays the *z* score at the bottom of the display, and displays the pointer at the corresponding location in the graph (unless the location is off the graph screen).

Two points are displayed in the case of a two-tail test. Use \leftarrow and \rightarrow to move the pointer.

Press $\boxed{\text{ESC}}$ to clear the *z* score.

- $\boxed{\text{F2}}$ (P) ... Displays p-value.

Pressing $\boxed{\text{F2}}$ (P) displays the p-value at the bottom of the display without displaying the pointer.

Press $\boxed{\text{ESC}}$ to clear the p-value.

● 1-Sample Z Test

This test is used when the population standard deviation is known to test the hypothesis. The **1-Sample Z Test** is applied to the normal distribution.

$$Z = \frac{\bar{x} - \mu_0}{\frac{\sigma}{\sqrt{n}}}$$

\bar{x} : mean of sample

μ_0 : assumed population mean

σ : population standard deviation

n : size of sample



The following V-Window settings are used for drawing the graph.

$X_{min} = -3.2$, $X_{max} = 3.2$, $X_{scale} = 1$,

$Y_{min} = -0.1$, $Y_{max} = 0.45$, $Y_{scale} = 0.1$

Executing an analysis function automatically stores the *z* and p values in alpha variables Z and P, respectively.

Perform the following key operations from the statistical data list.

- F3** (TEST)
- 1** (Z)
- 1** (1-Smpl)



The following shows the meaning of each item in the case of list data specification.

- Data data type
- μ population mean value test conditions (“ $\neq \mu_0$ ” specifies two-tail test, “ $< \mu_0$ ” specifies lower one-tail test, “ $> \mu_0$ ” specifies upper one-tail test.)
- μ_0 assumed population mean
- σ population standard deviation ($\sigma > 0$)
- List list whose contents you want to use as data (List 1 to 20)
- Freq frequency (1 or List 1 to 20)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation or draws a graph

The following shows the meaning of parameter data specification items that are different from list data specification.



- \bar{x} mean of sample
- n size of sample (positive integer)

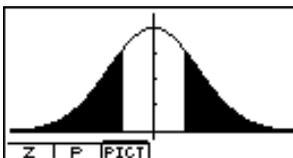
After setting all the parameters, align the cursor with [Execute] and then press one of the function keys shown below to perform the calculation or draw the graph.

- **F1** (CALC) ... Performs the calculation.
- **F6** (DRAW) ... Draws the graph.

Calculation Result Output Example

```

1-Sample ZTest
μ≠11.4
z =0.72242196
p =0.47003508
x̄ =11.82
xσn-1=0.81975606
n =5
    
```



- $\mu \neq 11.4$ direction of test
- z z score
- p p-value
- \bar{x} mean of sample
- $x\sigma_{n-1}$ sample standard deviation
(Displayed only for Data: List setting.)
- n size of sample



[Save Res] does not save the μ condition in line 2.



●2-Sample Z Test

This test is used when the standard deviations for two populations are known to test the hypothesis. The **2-Sample Z Test** is applied to the normal distribution.

$$Z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$

\bar{x}_1 : mean of sample 1

\bar{x}_2 : mean of sample 2

σ_1 : population standard deviation of sample 1

σ_2 : population standard deviation of sample 2

n_1 : size of sample 1

n_2 : size of sample 2

Perform the following key operations from the statistical data list.

F3 (TEST)

1 (Z)

2 (2-Smpl)

```

2-Sample ZTest
Data :List
μ1 :≠μ2
σ1 :1
σ2 :1
List(1) :List1
List(2) :List2
LISTIVAR
    
```

```

Freq(1) :1
Freq(2) :1
Save Res:None
Execute
    
```

The following shows the meaning of each item in the case of list data specification.

Data data type

μ population mean value test conditions (“ $\neq \mu_2$ ” specifies two-tail test, “ $< \mu_2$ ” specifies one-tail test where sample 1 is smaller than sample 2, “ $> \mu_2$ ” specifies one-tail test where sample 1 is greater than sample 2.)

σ_1 population standard deviation of sample 1 ($\sigma_1 > 0$)

σ_2 population standard deviation of sample 2 ($\sigma_2 > 0$)

List(1) list whose contents you want to use as sample 1 data (List 1 to 20)

List(2) list whose contents you want to use as sample 2 data (List 1 to 20)

Freq(1) frequency of sample 1 (1 or List 1 to 20)

Freq(2) frequency of sample 2 (1 or List 1 to 20)

Save Res list for storage of calculation results (None or List 1 to 20)

Execute executes a calculation or draws a graph

The following shows the meaning of parameter data specification items that are different from list data specification.

```

x̄1 :0
n1 :0
x̄2 :0
n2 :0
    
```

1-2-6
Tests (TEST)

- \bar{x}_1 mean of sample 1
- n_1 size (positive integer) of sample 1
- \bar{x}_2 mean of sample 2
- n_2 size (positive integer) of sample 2

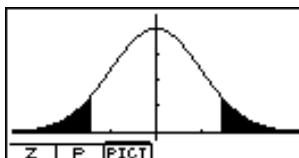
After setting all the parameters, align the cursor with [Execute] and then press one of the function keys shown below to perform the calculation or draw the graph.

- **[F1]** (CALC) ... Performs the calculation.
- **[F6]** (DRAW) ... Draws the graph.

Calculation Result Output Example

```

2-Sample ZTest
μ1 ≠ μ2
Z      =-1.4567248
P      =0.14519235
x̄1     =11.5
x̄2     =15
n1     =10
    
```



- $\mu_1 \neq \mu_2$ direction of test
- z z score
- p p-value
- \bar{x}_1 mean of sample 1
- \bar{x}_2 mean of sample 2
- $x_1\sigma_{n-1}$ standard deviation of sample 1
(Displayed only for Data: List setting.)
- $x_2\sigma_{n-1}$ standard deviation of sample 2
(Displayed only for Data: List setting.)
- n_1 size of sample 1
- n_2 size of sample 2



[Save Res] does not save the μ_1 condition in line 2.

●1-Prop Z Test

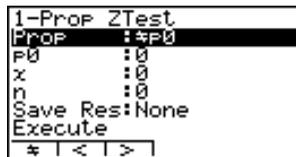
This test is used to test for an unknown proportion of successes. The **1-Prop Z Test** is applied to the normal distribution.

$$Z = \frac{\frac{x}{n} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$

p_0 : expected sample proportion
 n : size of sample

Perform the following key operations from the statistical data list.

- F3** (TEST)
- 1** (Z)
- 3** (1-Prop)

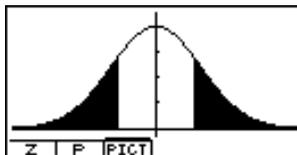
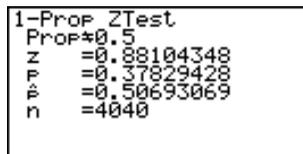


- Prop sample proportion test conditions (“≠ p_0 ” specifies two-tail test, “< p_0 ” specifies lower one-tail test, “> p_0 ” specifies upper one-tail test.)
- p_0 expected sample proportion ($0 < p_0 < 1$)
- x sample value ($x \geq 0$ integer)
- n size of sample (positive integer)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation or draws a graph

After setting all the parameters, align the cursor with [Execute] and then press one of the function keys shown below to perform the calculation or draw the graph.

- **F1** (CALC) ... Performs the calculation.
- **F6** (DRAW) ... Draws the graph.

Calculation Result Output Example



- Prop≠0.5 direction of test
- z z score
- p p-value
- \hat{p} estimated sample proportion
- n size of sample



[Save Res] does not save the Prop condition in line 2.

●2-Prop Z Test

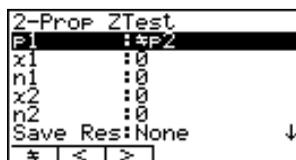
This test is used to compare the proportion of successes. The **2-Prop Z Test** is applied to the normal distribution.

$$Z = \frac{\frac{x_1}{n_1} - \frac{x_2}{n_2}}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

x_1 : data value of sample 1
 x_2 : data value of sample 2
 n_1 : size of sample 1
 n_2 : size of sample 2
 \hat{p} : estimated sample proportion

Perform the following key operation from the statistical data list.

- [F3]** (TEST)
- [1]** (Z)
- [4]** (2-Prop)



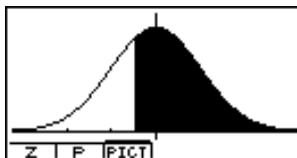
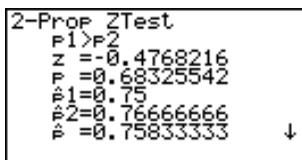
[Execute]

- p_1 sample proportion test conditions (" $\neq p_2$ " specifies two-tail test, "< p_2 " specifies one-tail test where sample 1 is smaller than sample 2, "> p_2 " specifies one-tail test where sample 1 is greater than sample 2.)
- x_1 data value ($x_1 \geq 0$ integer) of sample 1
- n_1 size (positive integer) of sample 1
- x_2 data value ($x_2 \geq 0$ integer) of sample 2
- n_2 size (positive integer) of sample 2
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation or draws a graph

After setting all the parameters, align the cursor with [Execute] and then press one of the function keys shown below to perform the calculation or draw the graph.

- **[F1]** (CALC) ... Performs the calculation.
- **[F6]** (DRAW) ... Draws the graph.

Calculation Result Output Example



1-2-9
Tests (TEST)

- $p_1 > p_2$ direction of test
- z z score
- p p-value
- \hat{p}_1 estimated proportion of sample 1
- \hat{p}_2 estimated proportion of sample 2
- \hat{p} estimated sample proportion
- n_1 size of sample 1
- n_2 size of sample 2



[Save Res] does not save the p_1 condition in line 2.

■ t Tests

• t Test Common Functions

You can use the following graph analysis functions after drawing a graph.

- **F1** (T) ... Displays t score.

Pressing **F1** (T) displays the t score at the bottom of the display, and displays the pointer at the corresponding location in the graph (unless the location is off the graph screen).

Two points are displayed in the case of a two-tail test. Use **◀** and **▶** to move the pointer.

Press **ESC** to clear the t score.

- **F2** (P) ... Displays p-value.

Pressing **F2** (P) displays the p-value at the bottom of the display without displaying the pointer.

Press **ESC** to clear the p-value.



The following V-Window settings are used for drawing the graph.

$Xmin = -3.2$, $Xmax = 3.2$, $Xscale = 1$,
 $Ymin = -0.1$, $Ymax = 0.45$, $Yscale = 0.1$

Executing an analysis function automatically stores the t and p values in alpha variables T and P, respectively.

●1-Sample *t* Test

This test uses the hypothesis test for a single unknown population mean when the population standard deviation is unknown. The **1-Sample *t* Test** is applied to *t*-distribution.

$$t = \frac{\bar{x} - \mu_0}{\frac{x\sigma_{n-1}}{\sqrt{n}}}$$

- \bar{x} : mean of sample
- μ_0 : assumed population mean
- $x\sigma_{n-1}$: sample standard deviation
- n : size of sample

Perform the following key operations from the statistical data list.

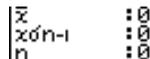
- F3**(TEST)
- 2**(T)
- 1**(1-Smpl)



The following shows the meaning of each item in the case of list data specification.

- Data data type
- μ population mean value test conditions (“ $\neq \mu_0$ ” specifies two-tail test, “ $< \mu_0$ ” specifies lower one-tail test, “ $> \mu_0$ ” specifies upper one-tail test.)
- μ_0 assumed population mean
- List list whose contents you want to use as data (List 1 to 20)
- Freq frequency (1 or List 1 to 20)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation or draws a graph

The following shows the meaning of parameter data specification items that are different from list data specification.



- \bar{x} mean of sample
- $x\sigma_{n-1}$ sample standard deviation ($x\sigma_{n-1} > 0$)
- n size of sample (positive integer)

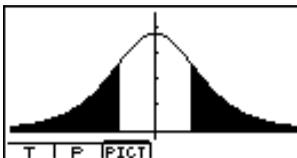
After setting all the parameters, align the cursor with [Execute] and then press one of the function keys shown below to perform the calculation or draw the graph.

- **F1**(CALC) ... Performs the calculation.
- **F6**(DRAW) ... Draws the graph.

Calculation Result Output Example

```

1-Sample tTest
μ ≠ 11.3
t = 0.79593206
p = 0.47063601
x̄ = 11.52
xσn-1 = 0.61806148
n = 5
    
```



- $\mu \neq 11.3$ direction of test
- t t score
- p p-value
- \bar{x} mean of sample
- $x\sigma_{n-1}$ sample standard deviation
- n size of sample



[Save Res] does not save the μ condition in line 2.



●2-Sample *t* Test

2-Sample *t* Test compares the population means when the population standard deviations are unknown. The **2-Sample *t* Test** is applied to *t*-distribution.

The following applies when pooling is in effect.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{x_p \sigma_{n-1}^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

$$x_p \sigma_{n-1} = \sqrt{\frac{(n_1-1)x_1 \sigma_{n-1}^2 + (n_2-1)x_2 \sigma_{n-1}^2}{n_1 + n_2 - 2}}$$

$$df = n_1 + n_2 - 2$$

\bar{x}_1 : mean of sample 1
 \bar{x}_2 : mean of sample 2
 $x_1 \sigma_{n-1}$: standard deviation of sample 1
 $x_2 \sigma_{n-1}$: standard deviation of sample 2
 n_1 : size of sample 1
 n_2 : size of sample 2
 $x_p \sigma_{n-1}$: pooled sample standard deviation
 df : degrees of freedom

The following applies when pooling is not in effect.

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{x_1 \sigma_{n-1}^2}{n_1} + \frac{x_2 \sigma_{n-1}^2}{n_2}}}$$

$$df = \frac{1}{\frac{C^2}{n_1-1} + \frac{(1-C)^2}{n_2-1}}$$

$$C = \frac{x_1 \sigma_{n-1}^2}{\left(\frac{x_1 \sigma_{n-1}^2}{n_1} + \frac{x_2 \sigma_{n-1}^2}{n_2} \right)}$$

\bar{x}_1 : mean of sample 1
 \bar{x}_2 : mean of sample 2
 $x_1 \sigma_{n-1}$: standard deviation of sample 1
 $x_2 \sigma_{n-1}$: standard deviation of sample 2
 n_1 : size of sample 1
 n_2 : size of sample 2
 df : degrees of freedom

Perform the following key operations from the statistical data list.

- [F3] (TEST)
- [2] (T)
- [2] (2-Smpl)

```

2-Sample tTest
Data      :List
n1        :n2
List(1)   :List1
List(2)   :List2
Freq(1)   :1
Freq(2)   :1
LISTIVAR1

Pooled    :Off
Save Res :None
Execute
    
```

The following shows the meaning of each item in the case of list data specification.

Data	data type
μ_1	sample mean value test conditions (" $\neq \mu_2$ " specifies two-tail test, "< μ_2 " specifies one-tail test where sample 1 is smaller than sample 2, "> μ_2 " specifies one-tail test where sample 1 is greater than sample 2.)
List(1)	list whose contents you want to use as data of sample 1 (List 1 to 20)
List(2)	list whose contents you want to use as data of sample 2 (List 1 to 20)
Freq(1)	frequency of sample 1 (1 or List 1 to 20)
Freq(2)	frequency of sample 2 (1 or List 1 to 20)
Pooled	pooling On (in effect) or Off (not in effect)
Save Res	list for storage of calculation results (None or List 1 to 20)
Execute	executes a calculation or draws a graph

The following shows the meaning of parameter data specification items that are different from list data specification.

```

| $\bar{x}_1$       :0
| $x_1\sigma_{n-1}$  :0
| $n_1$       :0
| $\bar{x}_2$       :0
|-----|
| $x_2\sigma_{n-1}$  :0
| $n_2$       :0
|-----|

```

\bar{x}_1	mean of sample 1
$x_1\sigma_{n-1}$	standard deviation ($x_1\sigma_{n-1} > 0$) of sample 1
n_1	size (positive integer) of sample 1
\bar{x}_2	mean of sample 2
$x_2\sigma_{n-1}$	standard deviation ($x_2\sigma_{n-1} > 0$) of sample 2
n_2	size (positive integer) of sample 2

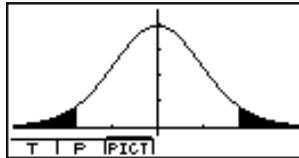
After setting all the parameters, align the cursor with [Execute] and then press one of the function keys shown below to perform the calculation or draw the graph.

- **[F1]** (CALC) ... Performs the calculation.
- **[F6]** (DRAW) ... Draws the graph.

Calculation Result Output Example

```

2-Sample tTest
#1 #2
t =1.84674715
P =0.08602732
df =14
x̄1 =107.5
x̄2 =97.5
    
```



- $\mu_1 \neq \mu_2$ direction of test
- t t score
- p p-value
- df degrees of freedom
- \bar{x}_1 mean of sample 1
- \bar{x}_2 mean of sample 2
- $x_1\sigma_{n-1}$ standard deviation of sample 1
- $x_2\sigma_{n-1}$ standard deviation of sample 2
- $x_p\sigma_{n-1}$ pooled sample standard deviation (Displayed only when Pooled: On setting.)
- n_1 size of sample 1
- n_2 size of sample 2



[Save Res] does not save the μ_1 condition in line 2.

● **LinearReg t Test**

LinearReg t Test treats paired-variable data sets as (x, y) pairs, and uses the method of least squares to determine the most appropriate a, b coefficients of the data for the regression formula $y = a + bx$. It also determines the correlation coefficient and t value, and calculates the extent of the relationship between x and y .

$$b = \frac{\sum_{i=1}^n (x - \bar{x})(y - \bar{y})}{\sum_{i=1}^n (x - \bar{x})^2} \quad a = \bar{y} - b\bar{x} \quad t = r \sqrt{\frac{n-2}{1-r^2}}$$

a : intercept
 b : slope of the line
 n : size of sample ($n \geq 3$)
 r : correlation coefficient
 r^2 : coefficient of determination

Perform the following key operations from the statistical data list.

- [F3] (TEST)
- [2] (T)
- [3] (LinReg)



The following shows the meaning of each item in the case of list data specification.

- β & ρ p-value test conditions (“ $\neq 0$ ” specifies two-tail test, “ < 0 ” specifies lower one-tail test, “ > 0 ” specifies upper one-tail test.)
- XList list for x -axis data (List 1 to 20)
- YList list for y -axis data (List 1 to 20)
- Freq frequency (1 or List 1 to 20)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- [F1] (CALC) ... Performs the calculation.



You cannot draw a graph for LinearReg t Test.

Calculation Result Output Example

```

LinearRes tTest
β≠0 & ρ≠0
t =2.39793632
P =0.0960526
df =3
a =-1.4850185
b =1.09211223
    
```

- β ≠ 0 & ρ ≠ 0 direction of test
- t t score
- p p-value
- df degrees of freedom
- a constant term
- b coefficient
- s standard error
- r correlation coefficient
- r² coefficient of determination

Pressing **[F6]** (COPY) while a calculation result is on the display copies the regression formula to the graph formula editor.

```

Graph Func
V1:
V2:
V3:
V4:
V5:
V6:
    
```

When there is a list specified for the [Resid List] item on the SET UP screen, regression formula residual data is automatically saved to the specified list after the calculation is finished.



[Save Res] does not save the β & ρ conditions in line 2.

When the list specified by [Save Res] is the same list specified by the [Resid List] item on the SET UP screen, only [Resid List] data is saved in the list.

■ χ^2 Test

χ^2 Test sets up a number of independent groups and tests hypothesis 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).

Expected counts

$$F_{ij} = \frac{\sum_{i=1}^k x_{ij} \times \sum_{j=1}^{\ell} x_{ij}}{\sum_{i=1}^k \sum_{j=1}^{\ell} x_{ij}}$$

$$\chi^2 = \sum_{i=1}^k \sum_{j=1}^{\ell} \frac{(x_{ij} - F_{ij})^2}{F_{ij}}$$

Perform the following key operations from the statistical data list.

F3 (TEST)

3 (χ^2)



Next, specify the matrix that contains the data. The following shows the meaning of the above item.

- Observed name of matrix (A to Z) that contains observed counts (all cells positive integers)
- Expected name of matrix (A to Z) that is for saving expected frequency
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation or draws a graph



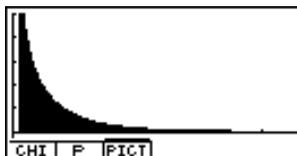
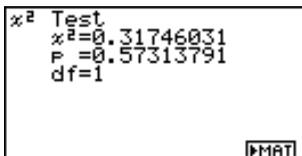
The matrix must be at least two lines by two columns. An error occurs if the matrix has only one line or one column.

Pressing **F2** (▶MAT) while setting parameters enters the MATRIX editor, which you can use to edit and view the contents of matrices.

After setting all the parameters, align the cursor with [Execute] and then press one of the function keys shown below to perform the calculation or draw the graph.

- **[F1]** (CALC) ... Performs the calculation.
- **[F6]** (DRAW) ... Draws the graph.

Calculation Result Output Example



χ^2 χ^2 value
 p p-value
 df degrees of freedom

You can use the following graph analysis functions after drawing a graph.

- **[F1]** (CHI) ... Displays χ^2 value.

Pressing **[F1]** (CHI) displays the χ^2 value at the bottom of the display, and displays the pointer at the corresponding location in the graph (unless the location is off the graph screen).

Press **[ESC]** to clear the χ^2 value.

- **[F2]** (P) ... Displays p-value.

Pressing **[F2]** (P) displays the p-value at the bottom of the display without displaying the pointer.

Press **[ESC]** to clear the p-value.



Pressing **[F6]** (▶MAT) while a calculation result is displayed enters the MATRIX editor, which you can use to edit and view the contents of matrices.

The following V-Window settings are used for drawing the graph.

$Xmin = 0$, $Xmax = 11.5$, $Xscale = 2$,

$Ymin = -0.1$, $Ymax = 0.5$, $Yscale = 0.1$

Executing an analysis function automatically stores the χ^2 and p values in alpha variables C and P, respectively.

2-Sample F Test

2-Sample F Test tests the hypothesis for the ratio of sample variances. The F Test is applied to the F distribution.

$$F = \frac{x_1 \sigma_{n-1}^2}{x_2 \sigma_{n-1}^2}$$

Perform the following key operations from the statistical data list.

F3 (TEST)

4 (F)

```
2-Sample FTest
Data      :List
σ1       :σ2
List(1)  :List1
List(2)  :List2
Freq(1)  :1
Freq(2)  :1
LISTIVAR
```

Save Res:None
Execute

The following is the meaning of each item in the case of list data specification.

- Data data type
- σ_1 population standard deviation test conditions (“ $\neq \sigma_2$ ” specifies two-tail test, “ $< \sigma_2$ ” specifies one-tail test where sample 1 is smaller than sample 2, “ $> \sigma_2$ ” specifies one-tail test where sample 1 is greater than sample 2.)
- List(1) list whose contents you want to use as data of sample 1 (List 1 to 20)
- List(2) list whose contents you want to use as data of sample 2 (List 1 to 20)
- Freq(1) frequency of sample 1 (1 or List 1 to 20)
- Freq(2) frequency of sample 2 (1 or List 1 to 20)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation or draws a graph

The following shows the meaning of parameter data specification items that are different from list data specification.

```
x1σn-1  :0
n1      :0
x2σn-1  :0
n2      :0
```

- $x_1 \sigma_{n-1}$ standard deviation ($x_1 \sigma_{n-1} > 0$) of sample 1
- n_1 size (positive integer) of sample 1
- $x_2 \sigma_{n-1}$ standard deviation ($x_2 \sigma_{n-1} > 0$) of sample 2
- n_2 size (positive integer) of sample 2

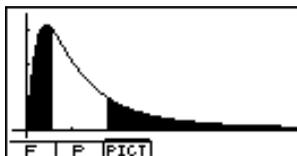
After setting all the parameters, align the cursor with [Execute] and then press one of the function keys shown below to perform the calculation or draw the graph.

- **[F1]** (CALC) ... Performs the calculation.
- **[F6]** (DRAW) ... Draws the graph.

Calculation Result Output Example

```

2-Sample FTest
σ1 ≠ σ2
F = 0.55096981
p = 0.57785988
x̄1 = 2.66
x̄2 = 1.42
x1σn-1 = 1.9437078
    
```



- $\sigma_1 \neq \sigma_2$ direction of test
- F F value
- p p-value
- \bar{x}_1 mean of sample 1 (Displayed only for Data: List setting.)
- \bar{x}_2 mean of sample 2 (Displayed only for Data: List setting.)
- $x_1\sigma_{n-1}$ standard deviation of sample 1
- $x_2\sigma_{n-1}$ standard deviation of sample 2
- n_1 size of sample 1
- n_2 size of sample 2

You can use the following graph analysis functions after drawing a graph.

- **[F1]** (F) ... Displays F value.

Pressing **[F1]** (F) displays the F value at the bottom of the display, and displays the pointer at the corresponding location in the graph (unless the location is off the graph screen).

Two points are displayed in the case of a two-tail test. Use **[Left Arrow]** and **[Right Arrow]** to move the pointer.

Press **[ESC]** to clear the F value.

- **[F2]** (P) ... Displays p-value.

Pressing **[F2]** (P) displays the p-value at the bottom of the display without displaying the pointer.

Press **[ESC]** to clear the p-value.



[Save Res] does not save the σ condition in line 2.

V-Window settings are automatically optimized for drawing the graph.

Executing an analysis function automatically stores the F and p values in alpha variables F and P, respectively.

■ ANOVA

ANOVA tests the hypothesis that the population means of the samples are equal when there are multiple samples.

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.

Perform the following key operations from the statistical data list.

- [F3] (TEST)
- [F5] (ANOVA)



The following is the meaning of each item in the case of list data specification.

- How Many selects One-Way ANOVA or Two-Way ANOVA (number of levels)
- Factor A category list (List 1 to 20)
- Dependnt list to be used for sample data (List 1 to 20)
- Save Res first list for storage of calculation results (None or List 1 to 16)*1
- Execute executes a calculation or draws a graph (Two-Way ANOVA only)

The following item appears in the case of Two-Way ANOVA only.

- Factor B category list (List 1 to 20)

After setting all the parameters, align the cursor with [Execute] and then press one of the function keys shown below to perform the calculation or draw the graph.

- [F1] (CALC) ... Performs the calculation.
- [F6] (DRAW) ... Draws the graph (Two-Way ANOVA only).

Calculation results are displayed in table form, just as they appear in science books.



*1 [Save Res] saves each vertical column of the table into its own list. The leftmost column is saved in the specified list, and each subsequent column to the right is saved in

the next sequentially numbered list. Up to five lists can be used for storing columns. You can specify an first list number in the range of 1 to 16.

Calculation Result Output Example

ANOVA				
	df	SS	MS	F →
A	2	28.215	14.107	5.6338
ERR	15	37.561	2.5041	

2

ANOVA				
	df	SS	MS	F →
A	2	1316.8	658.43	86.635
B	4	2634.1	658.53	86.649
AB	8	78.466	9.8083	1.2905
ERR	15	113.99	7.5999	

2

One-Way ANOVA

Line 1 (A) Factor A *df* value, *SS* value, *MS* value, *F* value, p-value

Line 2 (ERR) Error *df* value, *SS* value, *MS* value

Two-Way ANOVA

Line 1 (A) Factor A *df* value, *SS* value, *MS* value, *F* value, p-value

Line 2 (B) Factor B *df* value, *SS* value, *MS* value, *F* value, p-value

Line 3 (AB) Factor A × Factor B *df* value, *SS* value, *MS* value, *F* value, p-value

*Line 3 does not appear when there is only one observation in each cell.

Line 4 (ERR) Error *df* value, *SS* value, *MS* value

F *F* value

p p-value

df degrees of freedom

SS sum of squares

MS mean squares

With Two-Way ANOVA, you can draw Interaction Plot graphs. The number of graphs depends on Factor B, while the number of X-axis data depends on the Factor A. The Y-axis is the average value of each category.

You can use the following graph analysis function after drawing a graph.

- **F1** (TRACE) ... Trace function

Pressing **◀** or **▶** moves the pointer on the graph in the corresponding direction. When there are multiple graphs, you can move between graphs by pressing **▲** and **▼**.

Press **ESC** to clear the pointer from the display.



Graphing is available with Two-Way ANOVA only. V-Window settings are performed automatically, regardless of SET UP screen settings.

Using the TRACE function automatically stores the number of conditions to alpha variable A and the mean value to variable M, respectively.

■ ANOVA (Two-Way)

●Description

The nearby table shows measurement results for a metal product produced by a heat treatment process based on two treatment levels: time (A) and temperature (B). The experiments were repeated twice each under identical conditions.

B (Heat Treatment Temperature) A (Time)	B1	B2
A1	113 , 116	139 , 132
A2	133 , 131	126 , 122

Perform analysis of variance on the following null hypothesis, using a significance level of 5%.

H_0 : No change in strength due to time

H_0 : No change in strength due to heat treatment temperature

H_0 : No change in strength due to interaction of time and heat treatment temperature

●Solution

Use two-way ANOVA to test the above hypothesis.
Input the above data as shown below.

List1={1,1,1,1,2,2,2,2}

List2={1,1,2,2,1,1,2,2}

List3={113,116,139,132,133,131,126,122}

Define List 3 (the data for each group) as Dependent. Define List 1 and List 2 (the factor numbers for each data item in List 3) as Factor A and Factor B respectively.

Executing the test produces the following results.

- Time differential (A) level of significance $P = 0.2458019517$
The level of significance ($p = 0.2458019517$) is greater than the significance level (0.05), so the hypothesis is not rejected.
- Temperature differential (B) level of significance $P = 0.04222398836$
The level of significance ($p = 0.04222398836$) is less than the significance level (0.05), so the hypothesis is rejected.
- Interaction (A \times B) level of significance $P = 2.78169946e-3$
The level of significance ($p = 2.78169946e-3$) is less than the significance level (0.05), so the hypothesis is rejected.

The above test indicates that the time differential is not significant, the temperature differential is significant, and interaction is highly significant.

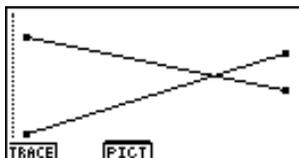
•Input Example

```
ANOVA
How Many:2
Factor A:List1
Factor B:List2
Dependnt>List3
Save Res:None
Execute
CALC [DRAW]
```

•Results

ANOVA					
	df	SS	mS	F	→
A	1	18	18	1.8461	
B	1	84.5	84.5	8.6666	
AB	1	420.5	420.5	43.128	
ERR	4	39	9.75		1

ANOVA					
	← SS	mS	F	P	
A	18	18	1.8461	0.2458	
B	84.5	84.5	8.6666	0.0422	
AB	420.5	420.5	43.128	2.7E-3	
ERR	39	9.75			
0.2458019517					



1-3 Confidence Interval (INTR)

A confidence interval is a range (interval) that includes a statistical value, usually the population mean.

A confidence interval that is too broad makes it difficult to get an idea of where the population value (true value) is located. A narrow confidence interval, on the other hand, limits the population value and makes it difficult to obtain reliable results. The most commonly used confidence levels are 95% and 99%. Raising the confidence level broadens the confidence interval, while lowering the confidence level narrows the confidence level, but it also increases the chance of accidentally overlooking the population value. With a 95% confidence interval, for example, the population value is not included within the resulting intervals 5% of the time.

When you plan to conduct a survey and then t test and Z test the data, you must also consider the sample size, confidence interval width, and confidence level. The confidence level changes in accordance with the application.

1-Sample Z Interval calculates the confidence interval for an unknown population mean when the population standard deviation is known.

2-Sample Z Interval calculates the confidence interval for the difference between two population means when the population standard deviations of two samples are known.

1-Prop Z Interval calculates the confidence interval for an unknown proportion of successes.

2-Prop Z Interval calculates the confidence interval for the difference between the proportion of successes in two populations.

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.

On the initial STAT Mode screen, press **F4** (INTR) to display the confidence interval menu, which contains the following items.

- **F4** (INTR) **1** (Z) ... Z intervals (p. 1-3-3)
- 2** (T) ... t intervals (p. 1-3-8)



There is no graphing for confidence interval functions.

●General Confidence Interval Precautions

Inputting a value in the range of $0 \leq \text{C-Level} < 1$ for the C-Level setting sets you value you input. Inputting a value in the range of $1 \leq \text{C-Level} < 100$ sets a value equivalent to your input divided by 100.



Inputting a value of 100 or greater, or a negative value causes an error (Ma ERROR).

Z Interval

1-Sample Z Interval

1-Sample Z Interval calculates the confidence interval for an unknown population mean when the population standard deviation is known.

The following is the confidence interval.

$$Left = \bar{x} - Z\left(\frac{\alpha}{2}\right) \frac{\sigma}{\sqrt{n}}$$

$$Right = \bar{x} + Z\left(\frac{\alpha}{2}\right) \frac{\sigma}{\sqrt{n}}$$

However, α is the level of significance. The value $100(1 - \alpha)\%$ is the confidence level.

When the confidence level is 95%, for example, inputting 0.95 produces $1 - 0.95 = 0.05 = \alpha$.

Perform the following key operations from the statistical data list.

F4(INTR)

1(Z)

1(1-Smpl)

```

1-Sample ZInterval
Data      :List
C-Level   :0.95
σ         :1
List      :List1
Freq      :1
Save Res  :None
LISTVAR1
  
```

Execute

The following shows the meaning of each item in the case of list data specification.

Data data type
 C-Level confidence level ($0 \leq \text{C-Level} < 1$)
 σ population standard deviation ($\sigma > 0$)
 List list whose contents you want to use as sample data
 (List 1 to 20)
 Freq sample frequency (1 or List 1 to 20)
 Save Res list for storage of calculation results (None or List 1 to 20)
 Execute executes a calculation

The following shows the meaning of parameter data specification items that are different from list data specification.

```

x̄      :0
n      :0
  
```

\bar{x} mean of sample
 n size of sample (positive integer)

Confidence Interval (INTR)

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- **[F1]**(CALC) ... Performs the calculation.

Calculation Result Output Example

```
1-Sample ZInterval
Left =57.7260809
Right=70.8739191
x̄ =64.3
n =20
```

Left interval lower limit (left edge)

Right interval upper limit (right edge)

\bar{x} mean of sample

$s\sigma_{n-1}$ sample standard deviation
(Displayed only for Data: List setting.)

n size of sample

• 2-Sample Z Interval

2-Sample Z Interval calculates the confidence interval for the difference between two population means when the population standard deviations of two samples are known. The following is the confidence interval. The value $100(1 - \alpha)\%$ is the confidence level.

$$Left = (\bar{x}_1 - \bar{x}_2) - Z\left(\frac{\alpha}{2}\right) \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

$$Right = (\bar{x}_1 - \bar{x}_2) + Z\left(\frac{\alpha}{2}\right) \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

\bar{x}_1 : mean of sample 1

\bar{x}_2 : mean of sample 2

σ_1 : population standard deviation
of sample 1

σ_2 : population standard deviation
of sample 2

n_1 : size of sample 1

n_2 : size of sample 2

Perform the following key operations from the statistical data list.

[F4](INTR)

[1](Z)

[2](2-Smpl)

```
2-Sample ZInterval
Data :List
C-Level :0.95
σ1 :1
σ2 :1
List(1) :List1
List(2) :List2
LISTVAR1
Freq(1) :1
Freq(2) :1
Save Res:None
Execute
```

The following shows the meaning of each item in the case of list data specification.

Data	data type
C-Level	confidence level ($0 \leq \text{C-Level} < 1$)
σ_1	population standard deviation of sample 1 ($\sigma_1 > 0$)
σ_2	population standard deviation of sample 2 ($\sigma_2 > 0$)
List(1)	list whose contents you want to use as data of sample 1 (List 1 to 20)
List(2)	list whose contents you want to use as data of sample 2 (List 1 to 20)
Freq(1)	frequency of sample 1 (1 or List 1 to 20)
Freq(2)	frequency of sample 2 (1 or List 1 to 20)
Save Res	list for storage of calculation results (None or List 1 to 20)
Execute	executes a calculation

The following shows the meaning of parameter data specification items that are different from list data specification.

\bar{x}_1	:	0
n_1	:	0
\bar{x}_2	:	0
n_2	:	0

\bar{x}_1	mean of sample 1
n_1	size (positive integer) of sample 1
\bar{x}_2	mean of sample 2
n_2	size (positive integer) of sample 2

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- **[F1]** (CALC) ... Performs the calculation.

Calculation Result Output Example

```

2-Sample ZInterval
Left = 6.30341903
Right = 25.696581
x1 = 410
x2 = 402
n1 = 40
n2 = 50
  
```

Left	interval lower limit (left edge)
Right	interval upper limit (right edge)
\bar{x}_1	mean of sample 1
\bar{x}_2	mean of sample 2
$x_1\sigma_{n-1}$	standard deviation of sample 1 (Displayed only for Data: List setting.)
$x_2\sigma_{n-1}$	standard deviation of sample 2 (Displayed only for Data: List setting.)
n_1	size of sample 1
n_2	size of sample 2

●1-Prop Z Interval

1-Prop Z Interval uses the number of data to calculate the confidence interval for an unknown proportion of successes.

The following is the confidence interval. The value $100(1 - \alpha)\%$ is the confidence level.

$$\text{Left} = \frac{x}{n} - Z \left(\frac{\alpha}{2} \right) \sqrt{\frac{1}{n} \left(\frac{x}{n} \left(1 - \frac{x}{n} \right) \right)}$$

n : size of sample
 x : data

$$\text{Right} = \frac{x}{n} + Z \left(\frac{\alpha}{2} \right) \sqrt{\frac{1}{n} \left(\frac{x}{n} \left(1 - \frac{x}{n} \right) \right)}$$

Perform the following key operations from the statistical data list.

- [F4]** (INTR)
- [1]** (Z)
- [3]** (1-Prop)

```
1-Prop ZInterval
C-Level :0.95
x      :0
n      :0
Save Res:None
Execute
```

Data is specified using parameter specification. The following shows the meaning of each item.

- C-Level confidence level ($0 \leq \text{C-Level} < 1$)
- x data (0 or positive integer)
- n size of sample (positive integer)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- **[F1]** (CALC) ... Performs the calculation.

Calculation Result Output Example

```
1-Prop ZInterval
Left =0.71056582
Right=0.78943417
p      =0.75
n      =800
```

- Left interval lower limit (left edge)
- Right interval upper limit (right edge)
- \hat{p} estimated sample proportion
- n size of sample

● 2-Prop Z Interval

2-Prop Z Interval uses the number of data items to calculate the confidence interval for the difference between the proportion of successes in two populations.

The following is the confidence interval. The value $100(1 - \alpha)\%$ is the confidence level.

$$\text{Left} = \frac{x_1}{n_1} - \frac{x_2}{n_2} - Z\left(\frac{\alpha}{2}\right) \sqrt{\frac{\frac{x_1}{n_1}\left(1 - \frac{x_1}{n_1}\right)}{n_1} + \frac{\frac{x_2}{n_2}\left(1 - \frac{x_2}{n_2}\right)}{n_2}}$$

n_1, n_2 : size of sample
 x_1, x_2 : data

$$\text{Right} = \frac{x_1}{n_1} - \frac{x_2}{n_2} + Z\left(\frac{\alpha}{2}\right) \sqrt{\frac{\frac{x_1}{n_1}\left(1 - \frac{x_1}{n_1}\right)}{n_1} + \frac{\frac{x_2}{n_2}\left(1 - \frac{x_2}{n_2}\right)}{n_2}}$$

Perform the following key operations from the statistical data list.

[F4] (INTR)

[1] (Z)

[4] (2-Prop)

```

2-Prop ZInterval
C-Level: 0.95
x1      : 0
n1      : 0
x2      : 0
n2      : 0
Save Res: None

```

[Execute]

Data is specified using parameter specification. The following shows the meaning of each item.

C-Level confidence level ($0 \leq \text{C-Level} < 1$)

x_1 data value ($x_1 \geq 0$) of sample 1

n_1 size (positive integer) of sample 1

x_2 data value ($x_2 \geq 0$) of sample 2

n_2 size (positive integer) of sample 2

Save Res list for storage of calculation results (None or List 1 to 20)

Execute executes a calculation

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

• **[F1]** (CALC) ... Performs the calculation.

Calculation Result Output Example

```

2-Prop ZInterval
Left = -0.0743882
Right = 0.1943882
#1    = 0.66
#2    = 0.6
n1    = 200
n2    = 150

```

- Left interval lower limit (left edge)
- Right interval upper limit (right edge)
- \hat{p}_1 estimated sample proportion for sample 1
- \hat{p}_2 estimated sample proportion for sample 2
- n_1 size of sample 1
- n_2 size of sample 2

■ *t* Interval

● 1-Sample *t* Interval

1-Sample *t* Interval calculates the confidence interval for an unknown population mean when the population standard deviation is unknown.

The following is the confidence interval. The value 100 (1 - α) % is the confidence level.

$$Left = \bar{x} - t_{n-1} \left(\frac{\alpha}{2} \right) \frac{s\sigma_{n-1}}{\sqrt{n}}$$

$$Right = \bar{x} + t_{n-1} \left(\frac{\alpha}{2} \right) \frac{s\sigma_{n-1}}{\sqrt{n}}$$

Perform the following key operations from the statistical data list.

- F4** (INTR)
- 2** (T)
- 1** (1-Smpl)

```

1-Sample tInterval
Data      :List
C-Level   :0.95
List      :List1
Freq      :1
Save Res  :None
Execute
LISTVAR
    
```

The following shows the meaning of each item in the case of list data specification.

- Data data type
- C-Level confidence level (0 ≤ C-Level < 1)
- List list whose contents you want to use as sample data
(List 1 to 20)
- Freq sample frequency (1 or List 1 to 20)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation

The following shows the meaning of parameter data specification items that are different from list data specification.

```

 $\bar{x}$       :0
 $s\sigma_{n-1}$  :0
n        :0
    
```

- \bar{x} mean of sample
 $x\sigma_{n-1}$ sample standard deviation ($x\sigma_{n-1} \geq 0$)
 n size of sample (positive integer)

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- **[F1]**(CALC) ... Performs the calculation.

Calculation Result Output Example

```

1-Sample tInterval
Left =60.9628946
Right=71.6371054
x̄ =66.3
xσn-1 =8.4
n =12

```

- Left interval lower limit (left edge)
Right interval upper limit (right edge)
 \bar{x} mean of sample
 $x\sigma_{n-1}$ sample standard deviation
 n size of sample

• 2-Sample t Interval

2-Sample t Interval calculates the confidence interval for the difference between two population means when both population standard deviations are unknown. The t interval is applied to t distribution.

The following confidence interval applies when pooling is in effect. The value $100(1 - \alpha)\%$ is the confidence level.

$$Left = (\bar{x}_1 - \bar{x}_2) - t_{n_1+n_2-2} \left(\frac{\alpha}{2} \right) \sqrt{x_p \sigma_{n-1}^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}$$

$$Right = (\bar{x}_1 - \bar{x}_2) + t_{n_1+n_2-2} \left(\frac{\alpha}{2} \right) \sqrt{x_p \sigma_{n-1}^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}$$

$$x_p \sigma_{n-1} = \sqrt{\frac{(n_1-1)x_1 \sigma_{n-1}^2 + (n_2-1)x_2 \sigma_{n-1}^2}{n_1 + n_2 - 2}}$$

Confidence Interval (INTR)

The following confidence interval applies when pooling is not in effect. The value $100(1 - \alpha)\%$ is the confidence level.

$$\text{Left} = (\bar{x}_1 - \bar{x}_2) - t_{df} \left(\frac{\alpha}{2} \right) \sqrt{\left(\frac{x_1 \sigma_{n-1}^2}{n_1} + \frac{x_2 \sigma_{n-1}^2}{n_2} \right)}$$

$$\text{Right} = (\bar{x}_1 - \bar{x}_2) + t_{df} \left(\frac{\alpha}{2} \right) \sqrt{\left(\frac{x_1 \sigma_{n-1}^2}{n_1} + \frac{x_2 \sigma_{n-1}^2}{n_2} \right)}$$

$$df = \frac{1}{\frac{C^2}{n_1 - 1} + \frac{(1 - C)^2}{n_2 - 1}}$$

$$C = \frac{\frac{x_1 \sigma_{n-1}^2}{n_1}}{\left(\frac{x_1 \sigma_{n-1}^2}{n_1} + \frac{x_2 \sigma_{n-1}^2}{n_2} \right)}$$

Perform the following key operations from the statistical data list.

F4 (INTR)

2 (T)

2 (2-Smpl)

```

2-Sample tInterval
Data      :List
C-Level   :0.95
List(1)   :List1
List(2)   :List2
Freq(1)   :1
Freq(2)   :1
LISTVAR1
Pooled    :Off
Save Res  :None
Execute
  
```

The following shows the meaning of each item in the case of list data specification.

Data data type
 C-Level confidence level ($0 \leq \text{C-Level} < 1$)
 List(1) list whose contents you want to use as data of sample 1
 (List 1 to 20)
 List(2) list whose contents you want to use as data of sample 2
 (List 1 to 20)
 Freq(1) frequency of sample 1 (1 or List 1 to 20)
 Freq(2) frequency of sample 2 (1 or List 1 to 20)
 Pooled pooling On (in effect) or Off (not in effect)
 Save Res list for storage of calculation results (None or List 1 to 20)
 Execute executes a calculation

The following shows the meaning of parameter data specification items that are different from list data specification.

```

x1       :0
x1σn-1  :0
n1       :0
x2       :0
x2σn-1  :0
n2       :0
  
```

Confidence Interval (INTR)

- \bar{x}_1 mean of sample 1
 $x_1\sigma_{n-1}$ standard deviation ($x_1\sigma_{n-1} \geq 0$) of sample 1
 n_1 size (positive integer) of sample 1
 \bar{x}_2 mean of sample 2
 $x_2\sigma_{n-1}$ standard deviation ($x_2\sigma_{n-1} \geq 0$) of sample 2
 n_2 size (positive integer) of sample 2

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- **[F1]** (CALC) ... Performs the calculation.

Calculation Result Output Example

```

2-Sample tInterval
Left = -7.5088264
Right = -0.0911735
df = 7.29033011
x1 = 88.4
x2 = 84.2
x1σn-1 = 2.07364414 ↓
  
```

- Left interval lower limit (left edge)
 Right interval upper limit (right edge)
 df degrees of freedom
 \bar{x}_1 mean of sample 1
 \bar{x}_2 mean of sample 2
 $x_1\sigma_{n-1}$ standard deviation of sample 1
 $x_2\sigma_{n-1}$ standard deviation of sample 2
 $x_p\sigma_{n-1}$ pooled sample standard deviation
 (Displayed only when Pooled: On setting.)
 n_1 size of sample 1
 n_2 size of sample 2

1-4 Distribution (DIST)

There is a variety of different types of distribution, but the most well-known is “normal distribution,” which is essential for performing statistical calculations. Normal distribution is a symmetrical distribution centered on the greatest occurrences of mean data (highest frequency), with the frequency decreasing as you move away from the center. Poisson distribution, geometric distribution, and various other distribution shapes are also used, depending on the data type.

Certain trends can be determined once the distribution shape is determined. You can calculate the probability of data taken from a distribution being less than a specific value.

For example, distribution can be used to calculate the yield rate when manufacturing some product. Once a value is established as the criteria, you can calculate normal probability when estimating what percent of the products meet the criteria. Conversely, a success rate target (80% for example) is set up as the hypothesis, and normal distribution is used to estimate the proportion of the products will reach this value.

Normal probability density calculates the probability density of normal distribution from a specified x value.

Normal distribution probability calculates the probability of normal distribution data falling between two specific values.

Inverse cumulative normal distribution calculates a value that represents the location within a normal distribution for a specific cumulative probability.

Student- t probability density calculates t probability density from a specified x value.

Student- t distribution probability calculates the probability of t distribution data falling between two specific values.

Like t distribution, distribution probability can also be calculated for χ^2 , F , **Binomial**, **Poisson**, and **Geometric** distributions.

On the initial STAT Mode screen, press **F5** (DIST) to display the distribution menu, which contains the following items.

- **F5** (DIST) **1** (Norm) ... Normal distribution (p. 1-4-3)
 - 2** (T) ... Student- t distribution (p. 1-4-7)
 - 3** (χ^2) ... χ^2 distribution (p. 1-4-9)
 - 4** (F) ... F distribution (p. 1-4-12)
 - 5** (Binmal) ... Binomial distribution (p. 1-4-16)
 - 6** (Poisn) ... Poisson distribution (p. 1-4-19)
 - 7** (Geo) ... Geometric distribution (p. 1-4-21)

● Common Distribution Functions

After drawing a graph, you can use the P-CAL function to calculate an estimated p-value for a particular x value.

The following is the general procedure for using the P-CAL function.

1. After drawing a graph, press **F1** (P-CAL) to display the x value input dialog box.
2. Input the value you want for x and then press **EXE**.
 - This causes the x and p values to appear at the bottom of the display, and moves the pointer to the corresponding point on the graph.
3. Pressing **DEL** or a number key at this time causes the x value input dialog box to reappear so you can perform another estimated value calculation if you want.
4. After you are finished, press **ESC** to clear the coordinate values and the pointer from the display.



Executing an analysis function automatically stores the x and p values in alpha variables X and P, respectively.

Normal Distribution

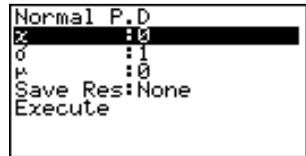
Normal Probability Density

Normal probability density calculates the probability density of normal distribution from a specified x value. Normal probability density is applied to standard normal distribution.

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

Perform the following key operations from the statistical data list.

- [F5] (DIST)
- [1] (Norm)
- [1] (P.D)



Data is specified using parameter specification. The following shows the meaning of each item.

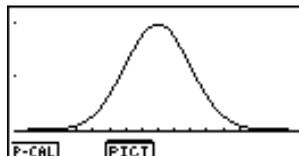
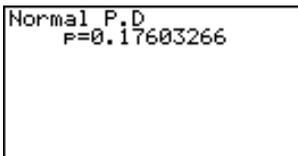
- x data
- σ standard deviation ($\sigma > 0$)
- μ mean
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation or draws a graph

- Specifying $\sigma = 1$ and $\mu = 0$ specifies standard normal distribution.

After setting all the parameters, align the cursor with [Execute] and then press one of the function keys shown below to perform the calculation or draw the graph.

- [F1] (CALC) ... Performs the calculation.
- [F6] (DRAW) ... Draws the graph.

Calculation Result Output Example



- p normal probability density



V-Window settings for graph drawing are set automatically when the SET UP screen's [Stat Wind] setting is [Auto]. Current V-

Window settings are used for graph drawing when the [Stat Wind] setting is [Manual].

●Normal Distribution Probability

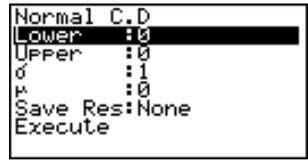
Normal distribution probability calculates the probability of normal distribution data falling between two specific values.

$$p = \frac{1}{\sqrt{2\pi}\sigma} \int_a^b e^{-\frac{(x-\mu)^2}{2\sigma^2}} dx$$

a : lower boundary
b : upper boundary

Perform the following key operations from the statistical data list.

- [F5] (DIST)
- [1] (Norm)
- [2] (C.D)



Data is specified using parameter specification. The following shows the meaning of each item.

- Lower lower boundary
- Upper upper boundary
- σ standard deviation (σ > 0)
- μ mean
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- [F1] (CALC) ... Performs the calculation.



There is no graphing for normal distribution probability.

Calculation Result Output Example

```
Normal C.D
P =0.09184805
z:Low=1
z:Up =1.5
```

p normal distribution probability
z:Low z:Low value (converted to standardize z score for lower value)
z:Up z:Up value (converted to standardize z score for upper value)

● Inverse Cumulative Normal Distribution

Inverse cumulative normal distribution calculates a value that represents the location within a normal distribution for a specific cumulative probability.

$\int_{-\infty}^{\alpha} f(x)dx = p$ <p>Tail: Left upper boundary of integration interval $\alpha = ?$</p>	$\int_{\alpha}^{+\infty} f(x)dx = p$ <p>Tail: Right lower boundary of integration interval $\alpha = ?$</p>	$\int_{\alpha}^{\beta} f(x)dx = p$ <p>Tail: Central upper and lower boundaries of integration interval $\alpha = ? \quad \beta = ?$</p>
---	--	--

Specify the probability and use this formula to obtain the integration interval.

Perform the following key operations from the statistical data list.

- F5** (DIST)
- 1** (Norm)
- 3** (Invrse)

```
Inverse Normal
Tail :Left
Area :0
σ :1
μ :0
Save Res:None
Execute
LEFT RIGHT CENTER
```

Data is specified using parameter specification. The following shows the meaning of each item.

Tail probability value tail specification (Left, Right, Central)
Area probability value ($0 \leq \text{Area} \leq 1$)
 σ standard deviation ($\sigma > 0$)
 μ mean
Save Res list for storage of calculation results (None or List 1 to 20)
Execute executes a calculation

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- **F1** (CALC) ... Performs the calculation.

Calculation Result Output Examples

```
Inverse Normal  
x=1.64485363
```

```
Inverse Normal  
x:Low=-0.0627067  
x:UP =0.0627067
```

x inverse cumulative normal distribution
(Tail:Left upper boundary of integration interval)
(Tail:Right lower boundary of integration interval)
(Tail:Central upper and lower boundaries of integration interval)



There is no graphing for inverse cumulative normal distribution.



Student-*t* Distribution

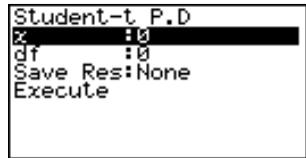
Student-*t* Probability Density

Student-*t* probability density calculates *t* probability density from a specified *x* value.

$$f(x) = \frac{\Gamma\left(\frac{df+1}{2}\right)\left(1 + \frac{x^2}{df}\right)^{-\frac{df+1}{2}}}{\Gamma\left(\frac{df}{2}\right)\sqrt{\pi df}}$$

Perform the following key operations from the statistical data list.

- F5**(DIST)
- 2**(T)
- 1**(P.D)



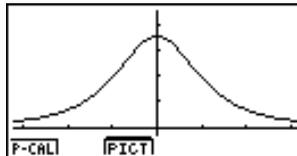
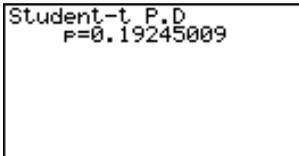
Data is specified using parameter specification. The following shows the meaning of each item.

- x* data
- df* degrees of freedom (*df* > 0)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation or draws a graph

After setting all the parameters, align the cursor with [Execute] and then press one of the function keys shown below to perform the calculation or draw the graph.

- F1**(CALC) ... Performs the calculation.
- F6**(DRAW) ... Draws the graph.

Calculation Result Output Example



p Student-*t* probability density



Current V-Window settings are used for graph drawing when the SET UP screen's [Stat Wind] setting is [Manual]. The V-Window settings below are set automatically

when the [Stat Wind] setting is [Auto].
*X*_{min} = -3.2, *X*_{max} = 3.2, *X*_{scale} = 1,
*Y*_{min} = -0.1, *Y*_{max} = 0.45, *Y*_{scale} = 0.1

● Student-*t* Distribution Probability

Student-*t* distribution probability calculates the probability of *t* distribution data falling between two specific values.

$$p = \frac{\Gamma\left(\frac{df+1}{2}\right)}{\Gamma\left(\frac{df}{2}\right)\sqrt{\pi df}} \int_a^b \left(1 + \frac{x^2}{df}\right)^{-\frac{df+1}{2}} dx$$

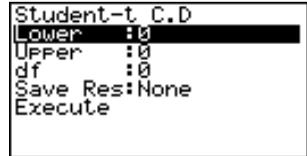
a : lower boundary
b : upper boundary

Perform the following key operations from the statistical data list.

[F5](DIST)

[2](T)

[2](C.D)



Data is specified using parameter specification. The following shows the meaning of each item.

Lower lower boundary

Upper upper boundary

df degrees of freedom (*df* > 0)

Save Res list for storage of calculation results (None or List 1 to 20)

Execute executes a calculation

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- **[F1]**(CALC) ... Performs the calculation.



There is no graphing for Student-*t* distribution probability.

Calculation Result Output Example

```
Student-t C.D
P =0.0548831
t:Low=1.7
t:Up =1E+99
```

p Student-*t* distribution probability
t:Low t:Low value (input lower value)
t:Up t:Up value (input upper value)

■ χ^2 Distribution

● χ^2 Probability Density

χ^2 probability density calculates the probability density function for the χ^2 distribution at a specified x value.

$$f(x) = \frac{1}{\Gamma\left(\frac{df}{2}\right)} \left(\frac{1}{2}\right)^{\frac{df}{2}} x^{\frac{df}{2}-1} e^{-\frac{x}{2}}$$

Perform the following key operations from the statistical data list.

- [F5] (DIST)
- [3] (χ^2)
- [1] (P.D)

```
 $\chi^2$  P.D
x : 10
df : 10
Save Res:None
Execute
```

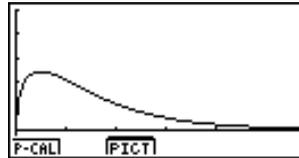
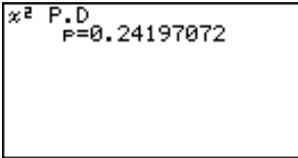
Data is specified using parameter specification. The following shows the meaning of each item.

x data
 df degrees of freedom (positive integer)
Save Res list for storage of calculation results (None or List 1 to 20)
Execute executes a calculation or draws a graph

After setting all the parameters, align the cursor with [Execute] and then press one of the function keys shown below to perform the calculation or draw the graph.

- [F1] (CALC) ... Performs the calculation.
- [F6] (DRAW) ... Draws the graph.

Calculation Result Output Example



p χ^2 probability density



Current V-Window settings are used for graph drawing when the SET UP screen's [Stat Wind] setting is [Manual]. The V-Window settings below are set automatically

when the [Stat Wind] setting is [Auto].
 $X_{min} = 0$, $X_{max} = 11.5$, $X_{scale} = 2$,
 $Y_{min} = -0.1$, $Y_{max} = 0.5$, $Y_{scale} = 0.1$

● χ^2 Distribution Probability

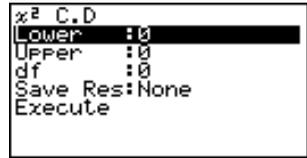
χ^2 distribution probability calculates the probability of χ^2 distribution data falling between two specific values.

$$p = \frac{1}{\Gamma\left(\frac{df}{2}\right)} \left(\frac{1}{2}\right)^{\frac{df}{2}} \int_a^b x^{\frac{df}{2}-1} e^{-\frac{x}{2}} dx$$

a : lower boundary
b : upper boundary

Perform the following key operations from the statistical data list.

- [F5]** (DIST)
- [3]** (χ^2)
- [2]** (C.D)



Data is specified using parameter specification. The following shows the meaning of each item.

- Lower lower boundary
- Upper upper boundary
- df* degrees of freedom (positive integer)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation

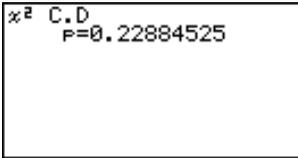
After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- **[F1]** (CALC) ... Performs the calculation.



There is no graphing for χ^2 distribution probability.

Calculation Result Output Example



p χ^2 distribution probability

F Distribution

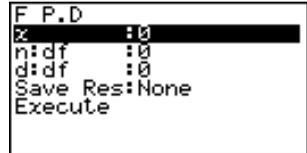
F Probability Density

F probability density calculates the probability density function for the F distribution at a specified x value.

$$f(x) = \frac{\Gamma\left(\frac{n+d}{2}\right)}{\Gamma\left(\frac{n}{2}\right)\Gamma\left(\frac{d}{2}\right)} \left(\frac{n}{d}\right)^{\frac{n}{2}} x^{\frac{n}{2}-1} \left(1 + \frac{nx}{d}\right)^{-\frac{n+d}{2}}$$

Perform the following key operations from the statistical data list.

- [F5] (DIST)
- [4] (F)
- [1] (P.D)



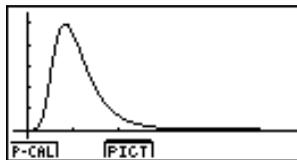
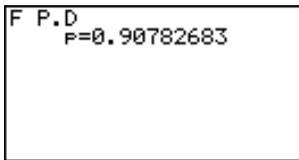
Data is specified using parameter specification. The following shows the meaning of each item.

- x data
- n:df numerator degrees of freedom (positive integer)
- d:df denominator degrees of freedom (positive integer)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation or draws a graph

After setting all the parameters, align the cursor with [Execute] and then press one of the function keys shown below to perform the calculation or draw the graph.

- [F1] (CALC) ... Performs the calculation.
- [F6] (DRAW) ... Draws the graph.

Calculation Result Output Example



p F probability density



V-Window settings for graph drawing are set automatically when the SET UP screen's [Stat Wind] setting is [Auto]. Current V-

Window settings are used for graph drawing when the [Stat Wind] setting is [Manual].



● **F Distribution Probability**

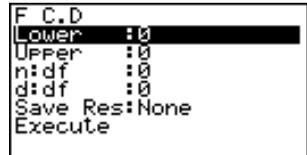
F distribution probability calculates the probability of F distribution data falling between two specific values.

$$p = \frac{\Gamma\left(\frac{n+d}{2}\right)}{\Gamma\left(\frac{n}{2}\right)\Gamma\left(\frac{d}{2}\right)} \left(\frac{n}{d}\right)^{\frac{n}{2}} \int_a^b x^{\frac{n}{2}-1} \left(1 + \frac{nx}{d}\right)^{-\frac{n+d}{2}} dx$$

a : lower boundary
b : upper boundary

Perform the following key operations from the statistical data list.

- [F5]** (DIST)
- [4]** (F)
- [2]** (C.D)



Data is specified using parameter specification. The following shows the meaning of each item.

- Lower lower boundary
- Upper upper boundary
- n:df numerator degrees of freedom (positive integer)
- d:df denominator degrees of freedom (positive integer)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- **[F1]** (CALC) ... Performs the calculation.



There is no graphing for F distribution probability.

Calculation Result Output Example

```
F C.D  
P=0.91400535
```

p *F* distribution probability



Binomial Distribution

Binomial Probability

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

$$f(x) = {}_n C_x p^x (1-p)^{n-x} \quad (x = 0, 1, \dots, n) \quad p : \text{success probability} \\ (0 \leq p \leq 1) \\ n : \text{number of trials}$$

Perform the following key operations from the statistical data list.

- [F5]**(DIST)
- [5]**(Binmal)
- [1]**(P.D)

```
Binomial P.D
Data :List
List :List1
Numtrial:0
P      :0
Save Res:None
Execute
LISTVAR
```

The following shows the meaning of each item when data is specified using list specification.

- Data data type
- List list whose contents you want to use as specified data
(List 1 to 20)
- Numtrial number of trials
- p success probability ($0 \leq p \leq 1$)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation

The following shows the meaning of a parameter data specification item that is different from list data specification.

- x integer from 0 to n

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- **[F1]**(CALC) ... Performs the calculation.



There is no graphing for binomial distribution.

Calculation Result Output Example

```
Binomial P.D
1 0.0000
2 0.4799
3 0.1599
0.36
```

```
Binomial P.D
P=0.48
```

p binomial probability

●Binomial Cumulative Density

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

Perform the following key operations from the statistical data list.

- [F5] (DIST)
- [5] (Binmal)
- [2] (C.D)

```
Binomial C.D
Data :List
List :List1
Numtrial:0
P :0
Save Res:None
Execute
LISTVAR
```

The following shows the meaning of each item when data is specified using list specification.

- Data data type
- List list whose contents you want to use as specified data (List 1 to 20)
- Numtrial number of trials
- p success probability ($0 \leq p \leq 1$)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation

The following shows the meaning of a parameter data specification item that is different from list data specification.

|x :0 |
x integer from 0 to n

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- **[F1]** (CALC) ... Performs the calculation.

Calculation Result Output Example

```
Binomial C.D
1 [ ]
2 0.999
3 0.9843
4 0.8964
5 0.6328
1
```

```
Binomial C.D
P=0.984375
```

p probability of success



■ Poisson Distribution

● Poisson Probability

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

$$f(x) = \frac{e^{-\mu} \mu^x}{x!} \quad (x = 0, 1, 2, \dots) \quad \mu : \text{mean } (\mu > 0)$$

Perform the following key operations from the statistical data list.

- [F5]** (DIST)
- [6]** (Poissn)
- [1]** (P.D)



The following shows the meaning of each item when data is specified using list specification.

- Data data type
- List list whose contents you want to use as specified data
(List 1 to 20)
- μ mean ($\mu > 0$)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation

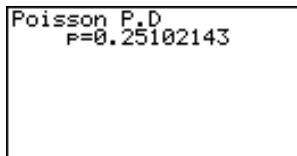
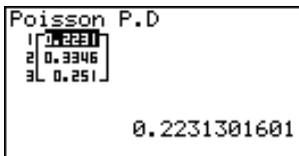
The following shows the meaning of a parameter data specification item that is different from list data specification.

- x ($x \geq 0$)

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- **[F1]** (CALC) ... Performs the calculation.

Calculation Result Output Example



- p Poisson probability



There is no graphing for Poisson distribution.

● **Poisson Cumulative Density**

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

Perform the following key operations from the statistical data list.

- [F5] (DIST)
- [6] (Poissn)
- [2] (C.D)



The following shows the meaning of each item when data is specified using list specification.

- Data data type
- List list whose contents you want to use as specified data (List 1 to 20)
- μ mean ($\mu > 0$)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation

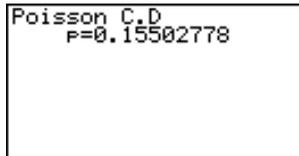
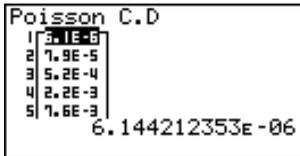
The following shows the meaning of a parameter data specification item that is different from list data specification.

- x ($x \geq 0$)

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- [F1] (CALC) ... Performs the calculation.

Calculation Result Output Example



- p Poisson cumulative probability

■ Geometric Distribution

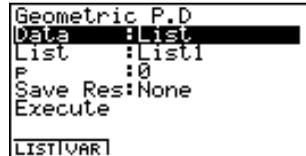
● Geometric Probability

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

$$f(x) = p(1-p)^{x-1} \quad (x = 1, 2, 3, \dots)$$

Perform the following key operations from the statistical data list.

- [F5]** (DIST)
- [7]** (Geo)
- [1]** (P.D)



The following shows the meaning of each item when data is specified using list specification.

- Data data type
- List list whose contents you want to use as specified data (List 1 to 20)
- p success probability ($0 \leq p \leq 1$)
- Save Res list for storage of calculation results (None or List 1 to 20)
- Execute executes a calculation

The following shows the meaning of a parameter data specification item that is different from list data specification.

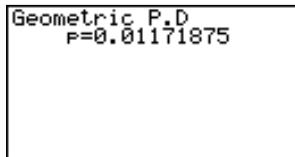
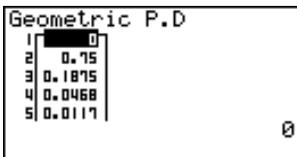
|x : 0 |

- x positive integer ($x \geq 1$)

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- **[F1]** (CALC) ... Performs the calculation.

Calculation Result Output Example



- p geometric probability



There is no graphing for geometric distribution.

Positive integer number is calculated whether list data (Data:List) or x value (Data:variable) is specified.

●Geometric Cumulative Density

Geometric cumulative density calculates a cumulative 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.

Perform the following key operations from the statistical data list.

[F5] (DIST)

[7] (Geo)

[2] (C.D)

```

Geometric C.D
Data      :List
List     :List1
P        :0
Save Res:None
Execute
LISTVAR
    
```

The following shows the meaning of each item when data is specified using list specification.

Data data type

List list whose contents you want to use as specified data
(List 1 to 20)

p success probability ($0 \leq p \leq 1$)

Save Res list for storage of calculation results (None or List 1 to 20)

Execute executes a calculation

The following shows the meaning of a parameter data specification item that is different from list data specification.

x positive integer ($x \geq 1$)

After setting all the parameters, align the cursor with [Execute] and then press the function key shown below to perform the calculation.

- **[F1]** (CALC) ... Performs the calculation.

Calculation Result Output Example

```

Geometric C.D
1 0.45
2 0.8749
3 0.9375
0.75
    
```

```

Geometric C.D
P=0.875
    
```

p geometric cumulative probability



Positive integer number is calculated whether list data (Data:List) or x value (Data:variable) is specified.