Chapter 6

Statistical Graphs and Calculations

This chapter describes how to input statistical data into lists, and how to calculate the mean, maximum and other statistical values. It also tells you how to perform regression calculations.

Important!

- This chapter contains a number of graph screen shots. In each case, new data values were input in order to highlight the particular characteristics of the graph being drawn. Note that when you try to draw a similar graph, the unit uses data values that you have input using the List function. Because of this, the graphs that appear on the screen when you perform a graphing operation will probably differ somewhat from those shown in this manual.

6-1 Before Performing Statistical Calculations

From the Main Menu, enter the STAT Mode and display the statistical data lists.

Use the statistical data lists to input data and to perform statistical calculations.

Use ▲, ▼, ◀ and ▶ to move the highlighting around the lists.

Once you input data, you can use it to produce a graph and check for tendencies. You can also use a variety of different regression calculations to analyze the data.

■ Inputting Data into Lists

●●●●●

Example **To input the following two data groups**

0.5, 1.2, 2.4, 4.0, 5.2
–2.1, 0.3, 1.5, 2.0, 2.4

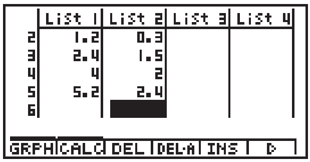
[0] [•] [5] [EXE] [1] [•] [2] [EXE]

[2] [•] [4] [EXE] [4] [EXE] [5] [•] [2] [EXE]

▶

[(–)] [2] [•] [1] [EXE] [0] [•] [3] [EXE]

[1] [•] [5] [EXE] [2] [EXE] [2] [•] [4] [EXE]



Once data is input, you can use it for graphing and statistical calculations.

Except for complex numbers, calculation results can be input as statistical data.

You can use the ▲, ▼, ◀ and ▶ keys to move the highlighting to any cell in the lists for data input.

■ Changing Graph Parameters

Use the following procedures to specify the graph draw/non-draw status, the graph type, and other general settings for each of the graphs in the graph menu (GPH1, GPH2, GPH3).

While the statistical data list is on the display, press F1(GRPH) to display the graph menu, which contains the following items.

- {**S-Gph1**}/{**S-Gph2**}/{**S-Gph3**} ... graph {1}/{2}/{3} drawing[*1]
- {**Select**} ... {simultaneous graph (GPH1, GPH2, GPH3) selection} (You can specify the multiple graphs.)
- {**Set**} ... {graph settings (graph type, list assignments)}

1. General graph settings [GRPH]-[Set]

This section describes how to use the general graph settings screen to make the following settings for each graph (GPH1, GPH2, GPH3).

• Graph Type

The initial default graph type setting for all the graphs is scatter graph. You can select one of a variety of other statistical graph types for each graph.

• List

The initial default statistical data is List 1 for single-variable data, and List 1 and List 2 for paired-variable data. You can specify which statistical data list you want to use for x-data and y-data.

• Frequency

Normally, each data item or data pair in the statistical data list is represented on a graph as a point. When you are working with a large number of data items however, this can cause problems because of the number of plot points on the graph. When this happens, you can specify a frequency list that contains values indicating the number of instances (the frequency) of the data items in the corresponding cells of the lists you are using for x-data and y-data. Once you do this, only one point is plotted for the multiple data items, which makes the graph easier to read.

[*1] The initial default graph type setting for all the graphs (Graph 1 through Graph 3) is scatter diagram, but you can change to one of a number of other graph types.

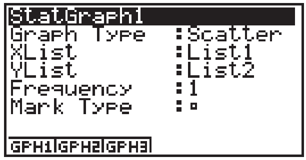
You can specify the graph draw/non-draw status, the graph type, and other general settings for each of the graphs in the graph menu (GPH1, GPH2, GPH3).

• **Mark Type**

This setting lets you specify the shape of the plot points on the graph.

• To display the general graph settings screen **[GRPH]-[Set]**

Pressing F1 (GRPH) 5 (Set) displays the general graph settings screen.



- The settings shown here are examples only. The settings on your general graph settings screen may differ.

• **StatGraph (statistical graph specification)**

- {**GPH1**}/{**GPH2**}/{**GPH3**} ... graph {1}/{2}/{3}

• **Graph Type (graph type specification)**

- {**Scat**}/{xy}/{**NPP**} ... {scatter diagram}/{xy line graph}/{normal probability plot}
- {**Hist**}/{**Box**}/{**ModB**}/{**N·Dis**}/{**Brkn**} ... {histogram}/{med-box graph}/{modified-box graph}/{normal distribution curve}/{line graph}
- {**X**}/{**Med**}/{**X^2**}/{**X^3**}/{**X^4**} ... {linear regression graph}/{Med-Med graph}/{quadratic regression graph}/{cubic regression graph}/{quartic regression graph}
- {**Log**}/{**Exp**}/{**Pwr**}/{**Sin**}/{**Lgst**} ... {logarithmic regression graph}/{exponential regression graph}/{power regression graph}/{sinusoidal regression graph}/{logistic regression graph}

• **XList (x-axis data list)**

- {**LIST**} ... {List 1 to 20}

• **YList (y-axis data list)**

- {**LIST**} ... {List 1 to 20}

• **Frequency (number of times a value occurs)**

- {**1**} ... {1-to-1 plot}
- {**LIST**} ... contents of these lists indicate the frequency of XList and YList data

• **Mark Type (plot mark type)**

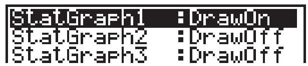
- {□}/{×}/{•} ... scatter diagram plot points

2. Graph draw/non-draw status [GRPH]-[Select]

The following procedure can be used to specify the draw (On)/non-draw (Off) status of each of the graphs in the graph menu.

• To specify the draw/non-draw status of a graph

1. Pressing [F1](GRPH) [4](Select) displays the graph On/Off screen.



- Note that the StatGraph1 setting is for Graph 1 (GPH1 of the graph menu), StatGraph2 is for Graph 2, and StatGraph3 is for Graph 3.

2. Use the cursor keys to move the highlighting to the graph whose status you want to change, and press the applicable function key to change the status.

- {**On**}/{**Off**} ... {On (draw)}/{Off (non-draw)}
- {**DRAW**} ... {draws all On graphs}

3. To return to the graph menu, press [ESC].

View Window parameters are normally set automatically for statistical graphing. If you want to set View Window parameters manually, you must change the Stat Wind item to “Manual”.
While the statistical data list is on the display, perform the following procedure.

[CTRL] [F3](SET UP) [F2](Man)

[ESC](Returns to previous menu.)

The default setting automatically uses List 1 data as x-axis (horizontal) values and List 2 data as y-axis (vertical) values. Each set of x/y data is a point on the scatter diagram.

Pressing [CTRL] [0] does not hide the menu while a statistical graph is on the display.

6-2 Calculating and Graphing Single-Variable Statistical Data

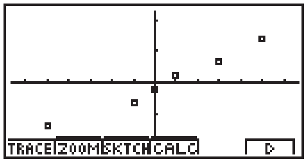
Single-variable data is data with only a single variable. If you are calculating the average height of the members of a class for example, there is only one variable (height).

Single-variable statistics include distribution and sum. The following types of graphs are available for single-variable statistics.

You can also use the procedures under “Changing Graph Parameters” on page 6-1-2 to make the settings you want before drawing each graph.

■ Normal Probability Plot (NPP)

This plot compares the data accumulated ratio with a normal distribution accumulated ratio. XList specifies the list where data is input, and Mark Type is used to select from among the marks {□ / × / • }you want to plot.

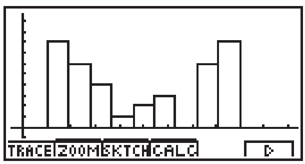


Press ESC or SHIFT ESC(QUIT) to return to the statistical data list.

■ Histogram (Bar Graph) (Hist)

XList specifies the list where the data is input, while Freq specifies the list where the data frequency is input. 1 is specified for Freq when frequency is not specified.

⇒
EXE(Draw)

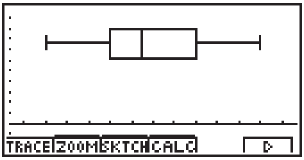


The display screen appears as shown above before the graph is drawn. At this point, you can change the Start and pitch values.

■ Med-box Graph (Box)

This type of graph lets you see how a large number of data items are grouped within specific ranges. A box encloses all the data in an area from the 25th percentile to the 75th percentile, with a line drawn at the 50th percentile. Lines (called whiskers) extend from either end of the box up to the minimum and maximum of the data.

XList specifies the list where the data is input, while Freq specifies the list where the data frequency is input. 1 is specified for Freq when frequency is not specified.

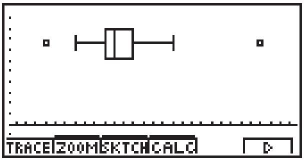


■ Modified Box Graph (ModB)

The modified box graph omits everything in the range past 1.5 × IQR (IQR = Q3 – Q1, Q3: 3rd quartile, Q1: 1st quartile) from the med-box 4th quartile and draws whiskers.

Outliers are displayed as plot points.

XList specifies the list where the data is input, while Freq specifies the list where the data frequency is input. 1 is specified for Freq when frequency is not specified.



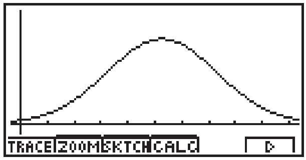
Input a positive integer for frequency data. Other types of values (decimals, etc.) cause an error.

■ Normal Distribution Curve (N•Dis)

The normal distribution curve is graphed using the following normal distribution function.

$$y = \frac{1}{\sqrt{(2\,\pi)}\;x\sigma_n}\;e^{-\frac{(x-\bar{x})^2}{2x\sigma_n{}^2}}$$

XList specifies the list where the data is input, while Freq specifies the list where the data frequency is input. 1 is specified for Freq when frequency is not specified.

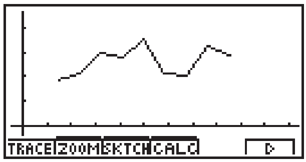


■ Line Graph (Brkn)

Lines connect center points of a histogram bar.

XList specifies the list where the data is input, while Freq specifies the list where the data frequency is input. 1 is specified for Freq when frequency is not specified.

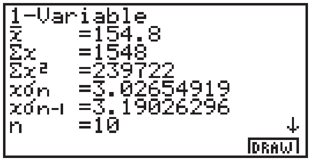
⇒
EXE (Draw)



The display screen appears as shown above before the graph is drawn. At this point, you can change the Start and pitch values.

■ Displaying the Calculation Results of a Drawn Single-Variable Graph

Single-variable statistics can be expressed as both graphs and parameter values. When these graphs are displayed, the single-variable calculation results appear as shown below when you press F4(CALC) 1(1VAR).



- Use ▼ to scroll the list so you can view the items that run off the bottom of the screen.

The following describes the meaning of each of the parameters.

$\bar{x}$ .... mean
Σx .... sum
Σx^2 .... sum of squares
$x\sigma_n$ .... population standard deviation
$x\sigma_{n-1}$ .... 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

- Press F6(DRAW) to return to the original single-variable statistical graph.

When Mod has multiple solutions, they are all displayed.

6-3 Calculating and Graphing Paired-Variable Statistical Data

■ Drawing a Scatter Diagram and *xy* Line Graph

Description

The following procedure plots a scatter diagram and connects the dots to produce an *xy* line graph.

Set Up

1. From the Main Menu, enter the STAT Mode.

Execution

2. Input the data into a list.
3. Specify Scat (scatter diagram) or *xy* (*xy* line graph) as the graph type, and then execute the graph operation.

Press ESC or SHIFT ESC (QUIT) to return to the statistical data list.

• • • • •
Example **Input the two sets of data shown below. Next, plot the data on a scatter diagram and connect the dots to produce an *xy* line graph.**

0.5, 1.2, 2.4, 4.0, 5.2,
–2.1, 0.3, 1.5, 2.0, 2.4

Procedure

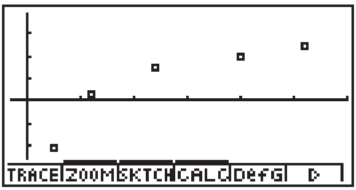
① MENU STAT

② 0 • 5 EXE 1 • 2 EXE
2 • 4 EXE 4 EXE 5 • 2 EXE
▶
(–) 2 • 1 EXE 0 • 3 EXE
1 • 5 EXE 2 EXE 2 • 4 EXE

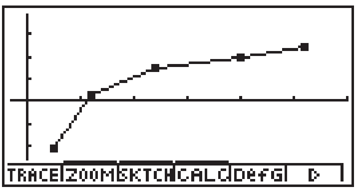
③ (Scatter diagram) F1 (GRPH) 5 (Set) ▼ F1 (Scat) ESC
F1 (GRPH) 1 (S-Gph1)

③ (*xy* line graph) F1 (GRPH) 5 (Set) ▼ F2 (*xy*) ESC
F1 (GRPH) 1 (S-Gph1)

Result Screen



(Scatter diagram)



(*xy* line graph)

Drawing a Regression Graph

Description

Use the following procedure to input paired-variable statistical data, perform a regression calculation using the data, and then graph the results.

Set Up

1. From the Main Menu, enter the STAT Mode.

Execution

2. Input the data into a list, and plot the scatter diagram.
3. Select the regression type, execute the calculation, and display the regression parameters.
4. Draw the regression graph.

You can perform trace on a regression graph.
You cannot perform trace scroll.

● ● ● ● ●

Example **Input the two sets of data shown below and plot the data on a scatter diagram. Next, perform logarithmic regression on the data to display the regression parameters, and then draws the corresponding regression graph.**

0.5, 1.2, 2.4, 4.0, 5.2,

–2.1, 0.3, 1.5, 2.0, 2.4

Procedure

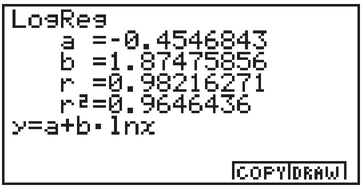
① [MENU] STAT

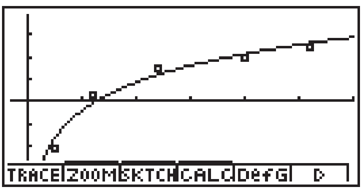
② [0] [•] [5] [EXE] [1] [•] [2] [EXE]
[2] [•] [4] [EXE] [4] [EXE] [5] [•] [2] [EXE]
[▶]
[(–)] [2] [•] [1] [EXE] [0] [•] [3] [EXE]
[1] [•] [5] [EXE] [2] [EXE] [2] [•] [4] [EXE]
[F1] (GRPH) [5] (Set) [▼] [F1] (Scat) [ESC]
[F1] (GRPH) [1] (S-Gph1)

③ [F4] (CALC) [7] (Log)

④ [F6] (DRAW)

Result Screen





■ Selecting the Regression Type

After you graph paired-variable statistical data, press F4(CALC). Then you can use the function menu at the bottom of the display to select from a variety of different types of regression.

- {**2VAR**} ... {paired-variable statistical results}
- {**Linear**}/{**MedMed**}/{**Quad**}/{**Cubic**}/{**Quart**}/{**Log**}/{**Exp**}/{**Power**}/{**Sin**}/{**Lgstic**}
  ... {linear regression}/{Med-Med}/{quadratic regression}/{cubic regression}/{quartic regression}/{logarithmic regression}/{exponential regression}/{power regression}/{sinusoidal regression}/{logistic regression} calculation and graphing

■ Displaying Statistical Calculation Results

Whenever you perform a regression calculation, the regression formula parameter (such as a and b in the linear regression $y = ax + b$) calculation results appear on the display. You can use these to obtain statistical calculation results.

Regression parameters are calculated as soon as you press a function key to select a regression type while a graph is on the display.

■ Graphing Statistical Calculation Results

While the parameter calculation result is on the display, you can graph the displayed regression formula by pressing F6(DRAW).

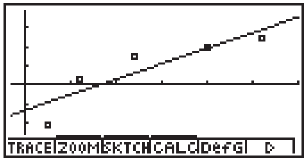
■ Linear Regression Graph

Linear regression uses the method of least squares to plot a straight line that passes close to as many data points as possible, and returns values for the slope and y - intercept (y -coordinate when x = 0) of the line.

The graphic representation of this relationship is a linear regression graph.

[F4](CALC) [2] (Linear)

[F6](DRAW)



The following is the linear regression model formula.

$y = ax + b$

a .... regression coefficient (slope)

b .... regression constant term (intercept)

r .... correlation coefficient

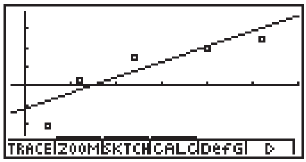
r^2 .... coefficient of determination

■ Med-Med Graph

When it is suspected that there are a number of extreme values, a Med-Med graph can be used in place of the least squares method. This is similar to linear regression, but it minimizes the effects of extreme values.

[F4](CALC) [3] (MedMed)

[F6](DRAW)



The following is the Med-Med graph model formula.

$y = ax + b$

a .... Med-Med graph slope

b .... Med-Med graph intercept

\# Input a positive integer for frequency data.
Other types of values (decimals, etc.) cause an error.

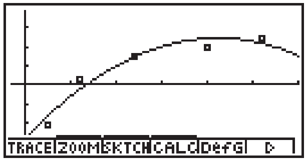
Quadratic/Cubic/Quartic Regression Graph

A quadratic/cubic/quartic regression graph represents connection of the data points of a scatter diagram. It uses the method of least squares to draw a curve that passes close to as many data points as possible. The formula that represents this is quadratic/cubic/quartic regression.

Ex. Quadratic regression

F4(CALC) 4 (Quad)

F6(DRAW)



Quadratic regression

Model formula ..... $y = ax^2 + bx + c$

a .... regression second coefficient

b .... regression first coefficient

c .... regression constant term (intercept)

Cubic regression

Model formula ..... $y = ax^3 + bx^2 + cx + d$

a .... regression third coefficient

b .... regression second coefficient

c .... regression first coefficient

d .... regression constant term (intercept)

Quartic regression

Model formula ..... $y = ax^4 + bx^3 + cx^2 + dx + e$

a .... regression fourth coefficient

b .... regression third coefficient

c .... regression second coefficient

d .... regression first coefficient

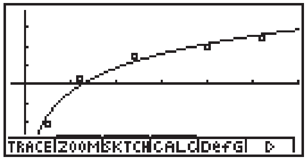
e .... regression constant term (intercept)

■ Logarithmic Regression Graph

Logarithmic regression expresses y as a logarithmic function of x. The standard logarithmic regression formula is $y = a + b \times \ln x$, so if we say that $X = \ln x$, the formula corresponds to linear regression formula $y = a + bX$.

F4(CALC) 7 (Log)

F6(DRAW)



The following is the logarithmic regression model formula.

$y = a + b \cdot \ln x$

a .... regression constant term

b .... regression coefficient

r .... correlation coefficient

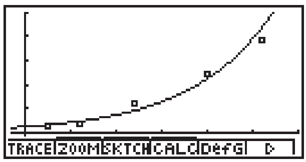
r^2 .... coefficient of determination

■ Exponential Regression Graph

Exponential regression expresses y as a proportion of the exponential function of x. The standard exponential regression formula is $y = a \times e^{bx}$, so if we take the logarithms of both sides we get $\ln y = \ln a + bx$. Next, if we say $Y = \ln y$, and $a = \ln a$, the formula corresponds to linear regression formula $Y = a + bx$.

F4(CALC) 8 (Exp)

F6(DRAW)



The following is the exponential regression model formula.

$y = a \cdot e^{bx}$

a .... regression coefficient

b .... regression constant term

r .... correlation coefficient

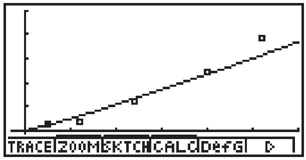
r^2 .... coefficient of determination

■ Power Regression Graph

Power regression expresses y as a proportion of the power of x. The standard power regression formula is $y = a \times x^b$, so if we take the logarithms of both sides we get In y = In a + $b \times$ In x. Next, if we say X = In x, Y = In y, and a = In a, the formula corresponds to linear regression formula Y = $a + b$X.

F4 (CALC) 9 (Power)

F6 (DRAW)



The following is the power regression model formula.

$y = a \cdot x^b$

a .... regression coefficient

b .... regression power

r .... correlation coefficient

r^2 .... coefficient of determination

■ Sinusoidal Regression Graph

Sinusoidal regression is best applied for cyclical data.

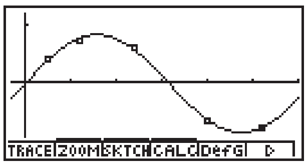
The following is the sinusoidal regression model formula.

$y = a \cdot \sin(bx + c) + d$

While the statistical data list is on the display, perform the following key operation.

F4 (CALC) X,θ,T (Sin)

F6 (DRAW)



Drawing a sinusoidal regression graph causes the angle unit setting of the calculator to automatically change to Rad (radians). The angle unit does not change when you perform a sinusoidal regression calculation without drawing a graph.

- Certain types of data may take a long time to calculate. This does not indicate malfunction.

■ Logistic Regression Graph

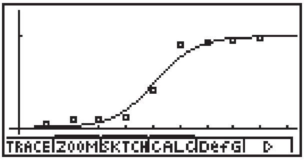
Logistic regression is best applied for time-based phenomena in which there is a continual increase until a saturation point is reached.

The following is the logistic regression model formula.

$$y = \frac{c}{1 + ae^{-bx}}$$

F4(CALC) log(Lgstic)

F6(DRAW)



• Certain types of data may take a long time to calculate. This does not indicate malfunction.

■ Residual Calculation

Actual plot points (y-coordinates) and regression model distance can be calculated during regression calculations.

While the statistical data list is on the display, recall the SET UP screen to specify a LIST ("List 1" through "List 20") for "Resid List". Calculated residual data is stored in the specified list.

The vertical distance from the plots to the regression model will be stored in the list.

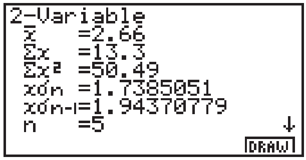
Plots that are higher than the regression model are positive, while those that are lower are negative.

Residual calculation can be performed and saved for all regression models.

Any data already existing in the selected list is cleared. The residual of each plot is stored in the same precedence as the data used as the model.

■ Displaying the Calculation Results of a Drawn Paired-Variable Graph

Paired-variable statistics can be expressed as both graphs and parameter values. When these graphs are displayed, the paired-variable calculation results appear as shown below when you press F4 (CALC) 1 (2VAR).



- Use ▼ to scroll the list so you can view the items that run off the bottom of the screen.

$\bar{x}$ .... mean of data stored in xList
Σx .... sum of data stored in xList
Σx^2 .... sum of squares of data stored in xList
$x\sigma_n$ .... population standard deviation of data stored in xList
$x\sigma_{n-1}$ .... sample standard deviation of data stored in xList
n .... number of data
$\bar{y}$ .... mean of data stored in yList
Σy .... sum of data stored in yList
Σy^2 ...... sum of squares of data stored in yList
$y\sigma_n$ ...... population standard deviation of data stored in yList
$y\sigma_{n-1}$ .... sample standard deviation of data stored in yList
Σxy ..... sum of data stored in xList and yList
minX ... minimum of data stored in xList
maxX .. maximum of data stored in xList
minY ... minimum of data stored in yList
maxY .. maximum of data stored in yList

■ Copying a Regression Graph Formula to the GRPH•TBL Mode

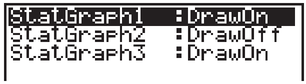
You can copy regression formula calculation results to the GRPH • TBL Mode graph formula area, and store and compare.

1. Press F5 (COPY) to copy the regression formula that produced the displayed data to the GRPH • TBL Mode graph formula area*1.
2. Press EXE to save the copied graph formula and return to the previous regression calculation result display.

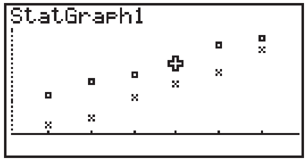
*1 You cannot edit regression formulas for graph formulas in the GRPH•TBL Mode.

■ Multiple Graphs

You can draw more than one graph on the same display by using the procedure under "Changing Graph Parameters" to set the graph draw (On)/non-draw (Off) status of two or all three of the graphs to draw On, and then pressing F6(DRAW)(see page 6-1-4). After drawing the graphs, you can select which graph formula to use when performing single-variable statistic or regression calculations.

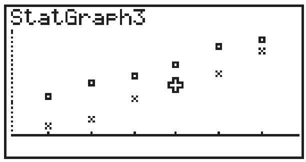


F4(CALC)
2(Linear)

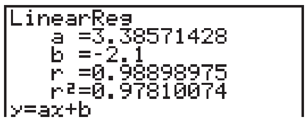


• The text at the top of the screen indicates the currently selected graph (StatGraph1 = Graph 1, StatGraph2 = Graph 2, StatGraph3 = Graph 3).

1. Press ▼. The graph name at the top of the screen changes when you do.



2. When graph you want to use is selected, press EXE.



Now you can use the procedure under "Displaying the Calculation Results of a Drawn Paired-Variable Graph" on page 6-3-11 to perform statistical calculations.

■ Overlaying a Function Graph on a Statistical Graph

Description

You can overlay a paired-variable statistical graph with any type of function graph you want.

Set Up

1. From the Main Menu, enter the STAT Mode.

Execution

2. Input the data into a list, and draw the statistical graph.
3. Display the Graph Function menu, and input the function you want to overlay on the statistical graph.
4. Graph the function.

• • • • •
Example **Input the two sets of data shown below. Next, plot the data on a scatter diagram and overlay a function graph y = 2ln x.**

0.5, 1.2, 2.4, 4.0, 5.2,

–2.1, 0.3, 1.5, 2.0, 2.4

Procedure

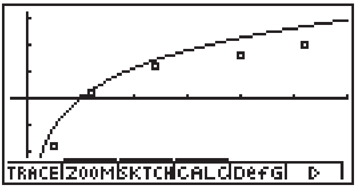
① MENU STAT

② 0 • 5 EXE 1 • 2 EXE
2 • 4 EXE 4 EXE 5 • 2 EXE
▶
(–) 2 • 1 EXE 0 • 3 EXE
1 • 5 EXE 2 EXE 2 • 4 EXE
F1(GRPH) 1(S-Gph1)

③ F5(DefG)
2 ln X,θ,T EXE (Register Y1 = 2ln x)

④ F6(DRAW)

Result Screen



You can also perform trace, etc. for drawn function graphs.
Graphs of types other than rectangular coordinate graphs cannot be drawn.

Pressing ESC while inputting a function returns the expression to what it was prior to input. Pressing SHIFT ESC (QUIT) clears the input expression and returns to the statistical data list.

6-4 Performing Statistical Calculations

All of the statistical calculations up to this point were performed after displaying a graph. The following procedures can be used to perform statistical calculations alone.

• To specify statistical calculation data lists

You have to input the statistical data for the calculation you want to perform and specify where it is located before you start a calculation. Display the statistical data and then press [F2] (CALC) [4] (Set).

The following is the meaning for each item.

1Var XList .... location of single-variable statistic x values (XList)

1Var Freq .... location of single-variable frequency values (Frequency)

2Var XList .... location of paired-variable statistic x values (XList)

2Var YList .... location of paired-variable statistic y values (YList)

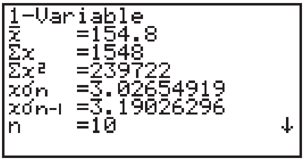
2Var Freq .... location of paired-variable frequency values (Frequency)

• Calculations in this section are performed based on the above specifications.

■ Single-Variable Statistical Calculations

In the previous examples from “Drawing a Normal Probability Plot” and “Histogram (Bar Graph)” to “Line Graph,” statistical calculation results were displayed after the graph was drawn. These were numeric expressions of the characteristics of variables used in the graphic display.

These values can also be directly obtained by displaying the statistical data list and pressing F2 (CALC) 1 (1VAR).



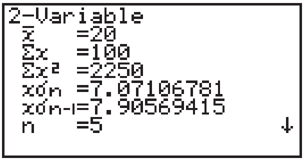
After this, pressing ▲ or ▼ scrolls the statistical calculation result display so you can view variable characteristics.

For details on the meanings of these statistical values, see “Displaying the Calculation Results of a Drawn Single-Variable Graph” (page 6-2-4).

■ Paired-Varia-ble Statistical Calculations

In the previous examples from “Linear Regression Graph” to “Logistic Regression Graph,” statistical calculation results were displayed after the graph was drawn. These were numeric expressions of the characteristics of variables used in the graphic display.

These values can also be directly obtained by displaying the statistical data list and pressing F2 (CALC) 2 (2VAR).



After this, pressing ▲ or ▼ scrolls the statistical calculation result display so you can view variable characteristics.

For details on the meanings of these statistical values, see “Displaying the Calculation Results of a Drawn Paired-Variable Graph” (page 6-3-11).

■ Regression Calculation

In the explanations from “Linear Regression Graph” to “Logistic Regression Graph,” regression calculation results were displayed after the graph was drawn. Here, each coefficient value of the regression line and regression curve is expressed as a number.

You can directly determine the same expression from the data input screen.

Pressing F2 (CALC) 3 (REG) displays the pull-up menu, which contains the following items.

- {**Linear**}/{**MedMed**}/{**Quad**}/{**Cubic**}/{**Quart**}/{**Log**}/{**Exp**}/{**Power**}/{**Sin**}/{**Lgstic**} ...
  {linear regression}/{Med-Med}/{quadratic regression}/{cubic regression}/
  {quartic regression}/{logarithmic regression}/{exponential regression}/
  {power regression}/{sinusoidal regression}/ {logistic regression} parameters

● ● ● ● ●

Example To display single-variable regression parameters

F2 (CALC) 3 (REG) 1 (Linear)

```
LinearReg
   a =0.56
   b =997.4
   r =0.98260736
   r²=0.96551724
y=ax+b
```

The meanings of the parameters that appear on this screen are the same as those for “Linear Regression Graph” to “Logistic Regression Graph”.

■ Estimated Value Calculation ($\hat{x}$, $\hat{y}$)

After drawing a regression graph with the **STAT Mode**, you can use the **RUN • MAT Mode** to calculate estimated values for the regression graph's x and y parameters.

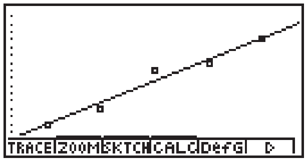
● ● ● ● ●

Example **To perform power regression using the nearby data and estimate the values of $\hat{y}$ and $\hat{x}$ when xi = 20 and yi = 1000**

xi	yi
10	1003
15	1005
20	1010
25	1011
30	1014

1. From the Main Menu, enter the STAT Mode.

2. Input data into the list and draw the linear regression graph.



3. From the Main Menu, enter the RUN • MAT Mode.

4. Press the keys as follows.

[2] [0] (value of xi)
[OPTN] [F6] (▷) [F4] (STAT) [2] ($\hat{y}$) [EXE]

```
20ŷ
                1008.6
```

The estimated value $\hat{y}$ is displayed for xi = 20.

[1] [0] [0] [0] (value of yi)
[F4] (STAT) [1] ($\hat{x}$) [EXE]

```
20ŷ
                1008.6
1000x̂
           4.642857143
```

The estimated value $\hat{x}$ is displayed for yi = 1000.

You cannot obtain estimated values for a Med-Med, quadratic regression, cubic regression, quartic regression, sinusoidal regression, or logistic regression graph.

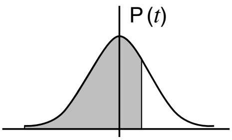
■ Probability Distribution Calculation

You can calculate probability distributions for single-variable statistics with the RUN • MAT Mode.

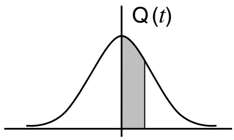
Press OPTN F6 (▷) F1 (PROB) to display a function menu, which contains the following items.

- {**P(**}/{**Q(**}/{**R(**} ... obtains probability {P(t)}/{Q(t)}/{R(t)} value
- {***t*(**} ... {obtains normalized variate $t(x)$ value}

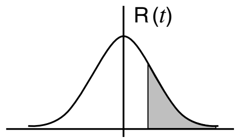
- Probability P(t), Q(t), and R(t), and normalized variate $t(x)$ are calculated using the following formulas.



$$\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{t} e^{-\frac{t^2}{2}}dt$$



$$\frac{1}{\sqrt{2\pi}}\int_{0}^{t} e^{-\frac{t^2}{2}}dt$$



$$\frac{1}{\sqrt{2\pi}}\int_{t}^{+\infty} e^{-\frac{t^2}{2}}dt$$

$t(x)$

$$t = \frac{x - \bar{x}}{x\sigma n}$$

● ● ● ● ●

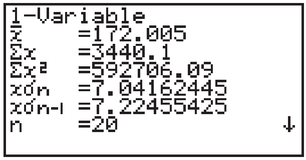
Example **The following table shows the results of measurements of the height of 20 college students. Determine what percentage of the students fall in the range 160.5 cm to 175.5 cm. Also, in what percentile does the 175.5 cm tall student fall?**

Class no.	Height (cm)	Frequency
1	158.5	1
2	160.5	1
3	163.3	2
4	167.5	2
5	170.2	3
6	173.3	4
7	175.5	2
8	178.6	2
9	180.4	2
10	186.7	1

1. Input the height data into List 1 and the frequency data into List 2.

2. Perform the single-variable statistical calculations.[*1]

F2 (CALC) 4 (Set)
▼ F2 (LIST) 2 EXE ESC
F2 (CALC) 1 (1VAR)



3. Press MENU, select the RUN • MAT menu, press OPTN F6 (▷) F1 (PROB), and recall the probability calculation (PROB) menu.

F1 (PROB) 8 (t() 1 6 0 • 5) EXE
(Normalized variate t for 160.5cm) Result: –1.633855948
(≒ –1.634)

F1 (PROB) 8 (t() 1 7 5 • 5) EXE
(Normalized variate t for 175.5cm) Result: 0.4963343361
(≒ 0.496)

F1 (PROB) 5 (P() 0 • 4 9 6) −
F1 (PROB) 5 (P() (−) 1 • 6 3 4) EXE
(Percentage of total) Result: 0.638921
(63.9% of total)

F1 (PROB) 7 (R() 0 • 4 9 6) EXE
(Percentile) Result: 0.30995
(31.0 percentile)

[*1] You can obtain the normalized variate immediately after performing single-variable statistical calculations only.

■ Drawing a Probability Distribution Graph

Description

You can draw a probability distribution graph using manual graphing with the RUN • MAT Mode.

Set Up

1. From the Main Menu, enter the RUN • MAT Mode.

Execution

2. Input the commands to draw a rectangular coordinate graph.
3. Input the probability value.

●●●●●
Example **To draw a probability P (0.5) graph.**

Procedure

① MENU RUN • MAT
② OPTN F6(▷) F6(▷) F2(SKTCH) 1(Cls) EXE
F2(SKTCH) 4(GRPH) 1(Y=)
③ OPTN F6(▷) F1(PROB) 5(P() 0 • 5 EXE

Result Screen