Chapter 18

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!

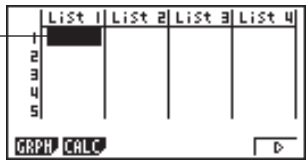
- This chapter contains a number of graph screen shots. In each case, new data values were input in order to highlight the particular characteristics of the graph being drawn. Note that when you try to draw a similar graph, the unit uses data values that you have input using the List function. Because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

18-1 Before Performing Statistical Calculations

In the Main Menu, select the **STAT** icon to 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.



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F1 (GRPH) .... Graph menu

F2 (CALC) ..... Statistical calculation menu

F6 (▷) ..... Next menu

F6(▷)

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F1 (SRT•A) .... Ascending sort

F2 (SRT•D) ... Descending sort

F3 (DEL) ..... Single data item delete

F4 (DEL•A) .... Delete all data

F5 (INS) ..... Insert data item

F6 (▷) ..... Previous menu

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- The procedures you should use for data editing are identical to those you use with the list function. For details, see “17. List Function”.

18-2 Paired-Variable Statistical Calculation Examples

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.

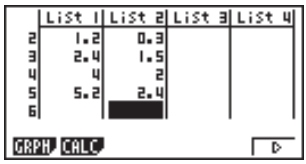
Example **To input the following two data groups and perform statistical calculations**

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

■ Inputting Data into Lists

Input the two groups of data into List 1 and List 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]



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

- Input values can be up to 10 digits long.
- You can use the [▲], [▼], [◀] and [▶] keys to move the highlighting to any cell in the lists for data input.

■ Plotting Data

Example **To specify Graph 1 as non-draw (Off) and Graph 3 as draw (On) and use Graph 3 to plot the data you input into statistical data List 1 and List 2 above**

While the statistical data list is on the display, press [F1] (GRPH) to display the graph menu.

[F1](GRPH)

[F1] (GPH1) ..... Graph 1 draw
[F2] (GPH2) ..... Graph 2 draw
[F3] (GPH3) ..... Graph 3 draw
[F4] (SEL) ..... Graph (GPH1, GPH2, GPH3) selection
[F6] (SET) ..... Graph settings (graph type, list assignments)

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- 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).
- You can press any function key ([F1], [F2], [F3]) to draw a graph regardless of the current location of the highlighting in the statistical data list.
- 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.

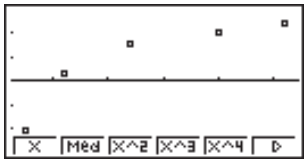
■ Plotting a Scatter Diagram

It is often difficult to spot the relationship between two sets of data (such as height and shoe size) by simply looking at the numbers. Such relationships often become clear however, when we plot the data on a graph, using one set as *x*-values and the other set as *y*-values.

●To plot a scatter diagram

Example **To plot the data we input in statistical data List 1 and List 2**

[F1](GPH1)



- The default setting automatically uses List 1 data as *x*-axis values and List 2 data as *y*-axis values. Each set of *x*/*y* data is a point on the scatter diagram.
- To return to the statistical data list, press [EXIT] or [SHIFT] [QUIT].

■ 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).

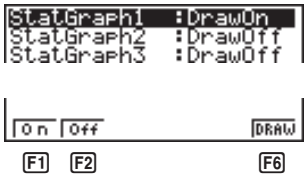
1. Graph draw/non-draw status (SELECT)

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. While the graph menu is on the display, press [F4] (SEL) to display the graph On/Off screen.

   [F1](GRPH)
   [F4](SEL)



   [F1] (On) ..... Graph On (graph draw)
   [F2] (Off) ..... Graph Off (graph non-draw)
   [F6] (DRAW) .... Draw all On graphs

   • 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.

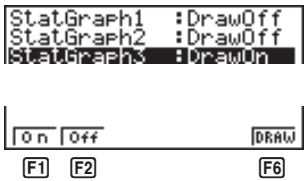
2. Use ▲ and ▼ to move the highlighting to the graph whose draw (On)/non-draw (Off) status you want to change and press [F1] (On) or [F2] (Off).

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

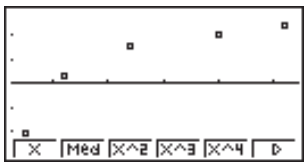
●To draw a graph

Example **To draw a scatter diagram of Graph 3 only**

   [F1](GRPH) [F4](SEL)
   [F2](Off)
   ▼ ▼ [F1](On)



   [F6](DRAW)



2. General graph settings (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 is statistical data 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.

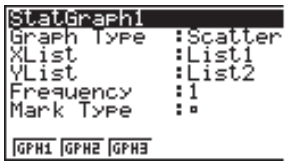
• Mark Type

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

●To display the general graph settings (SET) screen

While the graph menu is on the display, press [F6] (SET) to display the general graph settings screen.

[F1](GRPH)
[F6](SET)



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

●To select the StatGraph area

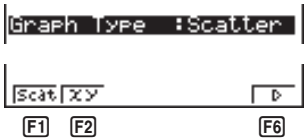
1. While the general graph settings screen is on the display, use ▲ and ▼ to move the highlighting to the StatGraph item.

2. Use the function key menu to select the StatGraph area you want to select.

   F1 (GPH1) ..... Graph 1
   F2 (GPH2) ..... Graph 2
   F3 (GPH3) ..... Graph 3

●To select the graph type (Graph Type)

1. While the general graph settings screen is on the display, use ▲ and ▼ to move the highlighting to the Graph Type item.



2. Use the function key menu to select the graph type you want to select.

   F1 (Scat) ..... Scatter diagram
   F2 (*xy*) ..... *xy* line graph
   F6 (▷) ..... Next menu

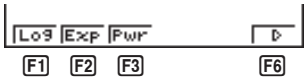
   F6(▷)

   F1 (Hist) ..... Histogram (bar graph)
   F2 (Box) ..... Med-box graph
   F3 ($\overline{\text{Box}}$) ..... Mean-box graph
   F4 (N•Dis) ..... Normal distribution curve
   F5 (Brkn) ..... Line graph
   F6 (▷) ..... Next menu

   F6(▷)

   F1 (X) ..... Linear regression graph
   F2 (Med) ..... Med-Med graph
   F3 (X^2) ..... Quadratic regression graph
   F4 (X^3) ..... Cubic regression graph
   F5 (X^4) ..... Quartic regression graph
   F6 (▷) ..... Next menu

F6(▷)



F1 (Log) ..... Logarithmic regression graph
F2 (Exp) ..... Exponential regression graph
F3 (Pwr) ..... Power regression graph
F6 (▷) ..... Previous menu

●To select the *x*-axis data list (XList)

1. While the graph settings screen is on the display, use ▲ and ▼ to move the highlighting to the XList item.

2. Use the function key menu to select the name of the statistical data list whose values you want on the *x*-axis of the graph.

F1 (List1) ..... List 1
F2 (List2) ..... List 2
F3 (List3) ..... List 3
F4 (List4) ..... List 4
F5 (List5) ..... List 5
F6 (List6) ..... List 6

●To select the *y*-axis data list (YList)

1. While the graph settings screen is on the display, use ▲ and ▼ to move the highlighting to the YList item.

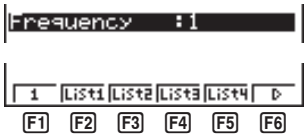
2. Use the function key menu to select the name of the statistical data list whose values you want on the *y*-axis of the graph.

F1 (List1) ..... List 1
F2 (List2) ..... List 2

F3 (List3) ..... List 3
F4 (List4) ..... List 4
F5 (List5) ..... List 5
F6 (List6) ..... List 6

●To select the frequency data list (Frequency)

1. While the general graph settings screen is on the display, use ▲ and ▼ to move the highlighting to the Frequency item.



2. Use the function key menu to select the frequency setting you want.
   F1 (1) ..... Plot all data (1-to-1)
   F2 (List1) ..... List 1 data is frequency data.
   F3 (List2) ..... List 2 data is frequency data.
   F4 (List3) ..... List 3 data is frequency data.
   F5 (List4) ..... List 4 data is frequency data.
   F6 (▷) ..... Next menu

   F6(▷)

   F1 (List5) ..... List 5 data is frequency data.
   F2 (List6) ..... List 6 data is frequency data.
   F6 (▷) ..... Previous menu

●To select the plot mark type (Mark Type)

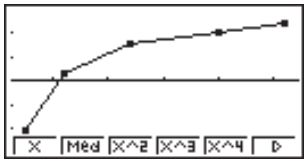
1. While the general graph settings screen is on the display, use ▲ and ▼ to move the highlighting to the Mark Type item.

2. Use the function key menu to select the plot mark you want to select.
   F1 (□) ..... Plot using □
   F2 (X) ..... Plot using X
   F3 (▪) ..... Plot using •

P.289
(Graph Type)
(*xy*)

■ Drawing an *xy* Line Graph

Paired data items can be used to plot a scatter diagram. A scatter diagram where the points are linked is an *xy* line graph.



Press [EXIT] or [SHIFT] [QUIT] to return to the statistical data list.

■ Selecting the Regression Type

After you graph statistical data, you can use the function menu at the bottom of the display to select from a variety of different types of regression.

[F1] (X) ..... Linear regression graph
[F2] (Med) ..... Med-Med graph
[F3] (X^2) ..... Quadratic regression graph
[F4] (X^3) ..... Cubic regression graph
[F5] (X^4) ..... Quartic regression graph
[F6] (▷) ..... Next menu

[F6](▷)

[F1] (Log) ..... Logarithmic regression graph
[F2] (Exp) ..... Exponential regression graph
[F3] (Pwr) ..... Power regression graph
[F4] (2VAR) ..... Paired-variable statistical results
[F6] (▷) ..... Previous menu

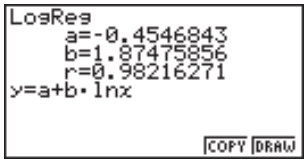
■ Displaying Statistical Calculation Results

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.

Example **To display logarithmic regression parameter calculation results while a scatter diagram is on the display**

F6(▷)F1(Log)



■ Graphing Statistical Calculation Results

You can use the parameter calculation result menu to graph the displayed regression formula.

F5 F6

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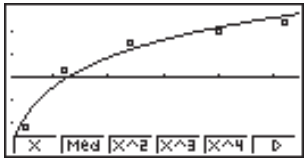
F5 (COPY) .... Stores the displayed regression formula as a graph function

F6 (DRAW).... Graphs the displayed regression formula

Example **To graph a logarithmic regression**

While logarithmic regression parameter calculation results are on the display, press F6 (DRAW).

F6(DRAW)



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For details on the meanings of function menu items at the bottom of the display, see “Selecting the Regression Type”.

18-3 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 five types of graphs are available for single-variable statistics.

■ Drawing a Histogram (Bar Graph)

From the statistical data list, press F1 (GRPH) to display the graph menu, press F6 (SET), and then change the graph type of the graph you want to use (GPH1, GPH2, GPH3) to histogram (bar graph).

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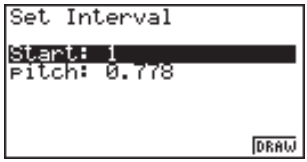
Data should already be input in the statistical data list (see “Inputting Data into List”). Draw the graph using the procedure described under “Plotting Data”.

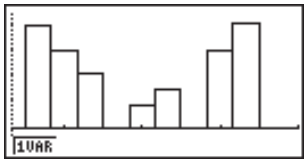
P.289
(Graph Type)
(Hist)



F6

⇒

F6 (DRAW)



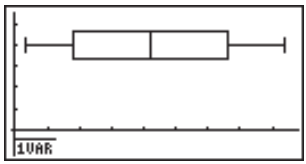
The display screen appears as shown above before the graph is drawn. At this point, you can change the Start and pitch values.

■ Med-box Graph (Med-Box)

P.289
(Graph Type)
(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.

From the statistical data list, press F1 (GRPH) to display the graph menu, press F6 (SET), and then change the graph type of the graph you want to use (GPH1, GPH2, GPH3) to med-box graph.



■ Mean-box Graph

P.289
(Graph Type)
(Box)

This type of graph shows the distribution around the mean when there is a large number of data items. A line is drawn at the point where the mean is located, and then a box is drawn so that it extends below the mean up to the standard deviation and above the mean up to the standard deviation. Lines (called whiskers) extend from either end of the box up to the minimum and maximum of the data.

From the statistical data list, press F1 (GRPH) to display the graph menu, press F6 (SET), and then change the graph type of the graph you want to use (GPH1, GPH2, GPH3) to mean-box graph.

Note :

This function is not usually used in the classrooms in U.S. Please use Med-box Graph, instead.

P.289
(Graph Type)
(N•Dis)

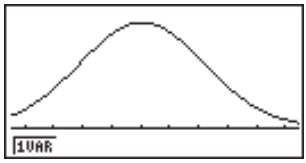
■ Normal Distribution Curve

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

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

The distribution of characteristics of items manufactured according to some fixed standard (such as component length) fall within normal distribution. The more data items there are, the closer the distribution is to normal distribution.

From the statistical data list, press F1 (GRPH) to display the graph menu, press F6 (SET), and then change the graph type of the graph you want to use (GPH1, GPH2, GPH3) to normal distribution.

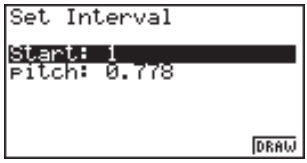


P.289
(Graph Type)
(Brkn)

■ Line Graph

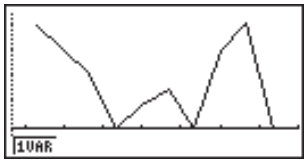
A line graph is formed by plotting the data in one list against the frequency of each data item in another list and connecting the points with straight lines.

Calling up the graph menu from the statistical data list, pressing F6 (SET), changing the settings to drawing of a line graph, and then drawing a graph creates a box graph.



F6

⇒
F6 (DRAW)



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

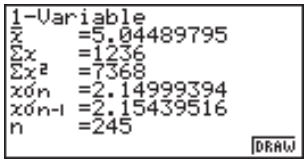
■ Displaying Single-Variable Statistical Results

Single-variable statistics can be expressed as both graphs and parameter values. When these graphs are displayed, the menu at the bottom of the screen appears as below.

F1 (1VAR) ..... Single-variable calculation result menu

Pressing F1 (1VAR) displays the following screen.

F1(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 of data
Σx ..... Sum of data
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
$\bar{x}-x\sigma_n$ ..... Data mean – Population standard deviation
$\bar{x}+x\sigma_n$ ..... Data mean + Population standard deviation
maxX ..... Maximum
Mod ..... Mode

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

18-4 Calculating and Graphing Paired-Variable Statistical Data

Under "Plotting a Scatter Diagram," we displayed a scatter diagram and then performed a logarithmic regression calculation. Let's use the same procedure to look at the six regression functions.

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■ Linear Regression Graph

Linear regression plots 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.

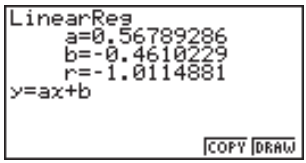
The graphic representation of this relationship is a linear regression graph.

(Graph Type) SHIFT QUIT F1(GRPH) F6(SET) ▼

(Scatter) F1(Scat)

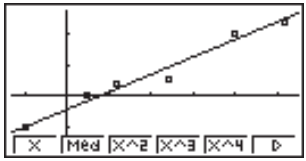
(GPH1) SHIFT QUIT F1(GRPH) F1(GPH1)

(X) F1(X)



F6

F6(DRAW)



The following are the meanings of the above parameters.

a ..... Regression coefficient (slope)

b ..... Regression constant term (intercept)

r ..... Correlation coefficient

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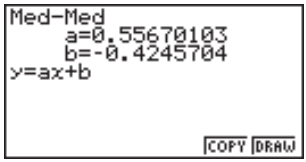
■ Med-Med Graph

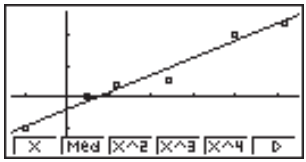
When it is suspected that there are a number of extreme values, a Med-Med graph can be used in place of the least squares method. This is also a type of linear regression, but it minimizes the effects of extreme values. It is especially useful in producing highly reliable linear regression from data that includes irregular fluctuations, such as seasonal surveys.

F2(Med)



F6

F6(DRAW)



The following are the meanings of the above parameters.

a ..... Med-Med graph slope

b ..... Med-Med graph intercept

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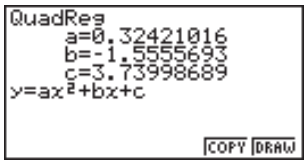
■ Quadratic/Cubic/Quartic Regression Graph

A quadratic/cubic/quartic regression graph represents connection of the data points of a scatter diagram. It actually is a scattering of so many points that are close enough together to be connected. The formula that represents this is quadratic/cubic/quartic regression.

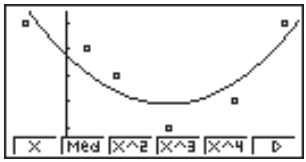
Ex. Quadratic regression

F3(X^2)



F6

F6(DRAW)



The following are the meanings of the above parameters.

Quadratic regression

a ..... Quadratic regression coefficient

b ..... Linear regression coefficient

c ..... Regression constant term (intercept)

Cubic regression

a ..... Cubic regression coefficient

b ..... Quadratic regression coefficient

c ..... Linear regression coefficient

d ..... Regression constant term (intercept)

Quartic regression

- a ..... Quartic regression coefficient
- b ..... Cubic regression coefficient
- c ..... Quadratic regression coefficient
- d ..... Linear regression coefficient
- e ..... Regression constant term (intercept)

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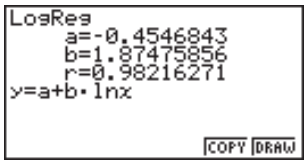
■ Logarithmic Regression Graph

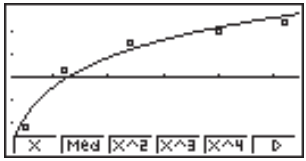
Logarithmic regression expresses y as a logarithmic function of x. The standard logarithmic regression formula is $y = a + b \times \log x$, so if we say that $X = \log x$, the formula corresponds to linear regression formula $y = a + bX$.

F6 (▷) F1 (Log)



F6

F6 (DRAW)



The following are the meanings of the above parameters.

- a ..... Regression constant term (intercept)
- b ..... Regression coefficient (slope)
- r ..... Correlation coefficient

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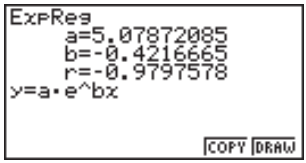
■ Exponential Regression Graph

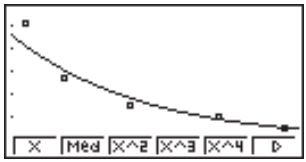
Exponential regression expresses y as a proportion of the exponential function of x. The standard exponential regression formula is $y = a \times e^{bx}$, so if we take the logarithms of both sides we get $\log y = \log a + bx$. Next, if we say $Y = \log y$, and $a = \log a$, the formula corresponds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

F6 (▷) F2 (Exp)



F6

F6(DRAW)



The following are the meanings of the above parameters.

a ..... Regression coefficient

b ..... Regression constant term

r ..... Correlation coefficient

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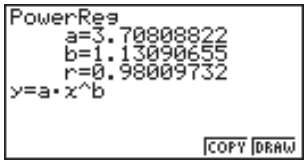
■ Power Regression Graph

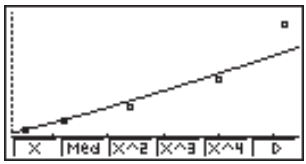
Exponential regression expresses y as a proportion of the power of x. The standard power regression formula is $y = a \times x^b$, so if we take the logarithms of both sides we get $\log y = \log a + b \times \log x$. Next, if we say X = log x, Y = log$y$, and a = log$a$, the formula corresponds to linear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

F6(▷)F3(Pwr)



F6

F6(DRAW)



The following are the meanings of the above parameters.

a ..... Regression coefficient

b ..... Regression power

r ..... Correlation coefficient

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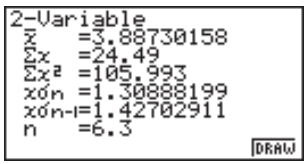
■ Displaying Paired-Variable Statistical Results

Paired-variable statistics can be expressed as both graphs and parameter values. When these graphs are displayed, the menu at the bottom of the screen appears as below.

F4(2VAR) ..... Paired-variable calculation result menu

Pressing F4 (2VAR) displays the following screen.

F4(2VAR)



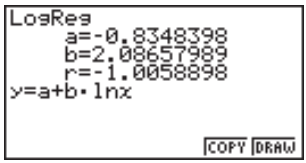
- Use ▼ to scroll the list so you can view the items that run off the bottom of the screen. The following describes the meaning of each of the parameters.

$\overline{x}$ ..... Mean of *x*List data
Σx ..... Sum of *x*List data
Σx^2 ..... Sum of squares of *x*List data
$x\sigma_n$ ..... Population standard deviation of *x*List data
$x\sigma_{n-1}$ ..... Sample standard deviation of *x*List data
n ..... Number of *x*List data items
$\overline{y}$ ..... Mean of *y*List data
Σy ..... Sum of *y*List data
Σy^2 ..... Sum of squares of *y*List data
$y\sigma_n$ ..... Population standard deviation of *y*List data
$y\sigma_{n-1}$ ..... Sample standard deviation of *y*List data
Σxy ..... Sum of *x*List and *y*List data
minX ..... Minimum of *x*List data
maxX ..... Maximum of *x*List data
minY ..... Minimum of *y*List data
maxY ..... Maximum of *y*List data

■ Copying a Regression Graph Formula to the Graph Mode

After you perform a regression calculation, you can copy its formula to the **GRAPH Mode**.

The following are the functions that are available in the function menu at the bottom of the display while regression calculation results are on the screen.



F5 F6

F5 (COPY) .... Stores the displayed regression formula to the **GRAPH Mode**

F6 (DRAW).... Graphs the displayed regression formula

1. Press F5 (COPY) to copy the regression formula that produced the displayed data to the **GRAPH Mode**.

F5(COPY)

Note that you cannot edit regression formulas for graph formulas in the **GRAPH Mode**.

2. Press EXE to save the copied graph formula and return to the previous regression calculation result display.

■ Multiple Graphs

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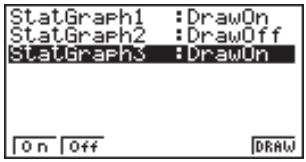
You can draw more than one graph on the same display by using the procedure under “Changing Graph Parameters” to set the graph draw (On)/non-draw (Off) status of two or all three of the graphs to draw (On), and then pressing F6 (DRAW). After drawing the graphs, you can select which graph formula to use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



F6

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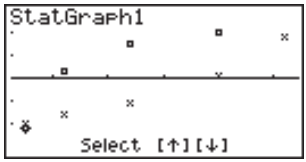
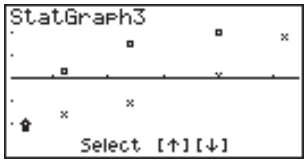
F6(DRAW)
F1(X)



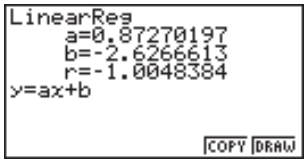
- The text at the top of the screen indicates the currently selected graph (StatGraph1 = Graph 1, StatGraph2 = Graph 2, StatGraph3 = Graph 3).

1. Use ▲ and ▼ to change the currently selected graph. The graph name at the top of the screen changes when you do.

▼



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



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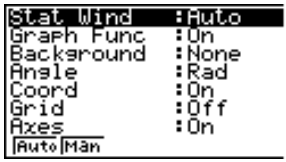
Now you can use the procedures under “Displaying Single-Variable Statistical Results” and “Displaying Paired-Variable Statistical Results” to perform statistical calculations.

18-5 Other Graphing Functions

■ Manual Graphing

In all of the graphing examples up to this point, values were calculated in accordance with View Window settings and graphing was performed automatically. This automatic graphing is performed when the Stat Wind item of the View Window is set to “Auto” (auto graphing). You can also produce graphs manually, when the automatic graphing capabilities of this calculator cannot produce the results you want.

[SHIFT] [SETUP]



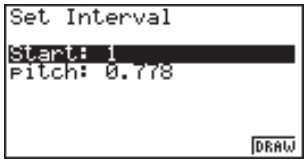
[F2]

[F2] (Man)

Performing this setting does not change View Window values, and the graph is drawn using the values currently set in the View Window.

■ Setting the Width of a Histogram/Line Graph

Selecting histogram or line graph as the graph type causes the following screen to appear before the graph is drawn.



The following are the meanings of the items that appear in this screen.

Start..... Histogram/line graph start point (x-coordinate)

pitch..... Bar spacing, or point spacing (specify as scale unit)

- When “Auto” is specified for the statistical graph window setting (Stat Wind), the calculator automatically calculates standard values for Start and pitch.

Example **Start: 0, pitch: 10**

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

[SHIFT] [SETUP] [F2] (Man)

[EXIT] (Returns to previous menu.)

[F1] (GRPH) [F1] (GPH1)

[0] [EXE] (Start value is x = 0.)

[1] [0] [EXE] (pitch = 10)

18-6 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. While the statistical data is on the display, perform the following procedure.

F2(CALC) F6(SET)

The following is the meaning for each item.

1Var XList ..... Specifies list where single-variable statistic *x* values (XList) are located.

1Var Freq ..... Specifies list where single-variable frequency values (Frequency) are located.

2Var XList ..... Specifies list where paired-variable statistic *x* values (XList) are located.

2Var YList ..... Specifies list where paired-variable statistic *y* values (YList) are located.

2Var Freq ..... Specifies list where paired-variable frequency values (Frequency) are located.

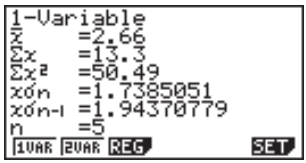
- Calculations in this section are performed based on the above specifications.

■ Single-Variable Statistical Calculations

In the previous examples from “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.

The following operation produces the same values directly from the statistical data list.

F2(CALC) F1(1VAR)



Now you can press ▲ and ▼ to view variable characteristics.

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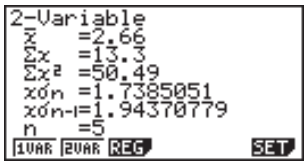
For details on the meanings of these statistical values, see “Displaying Single-Variable Statistical Results”.

■ Paired-Variable Statistical Calculations

In the previous examples from “Linear Regression Graph” to “Power 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.

The following operation produces the same values directly from the statistical data list.

F2(CALC) F2(2VAR)



Now you can press ▲ and ▼ to view variable characteristics.

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For details on the meanings of these statistical values, see “Displaying Paired-Variable Statistical Results”.

■ Regression Calculation

In the explanations from “Linear Regression Graph” to “Power Regression Graph,” regression calculation results were displayed after the graph was drawn. Here, the regression line and regression curve is represented by mathematical expressions.

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

Perform the following key operation.

F2(CALC) F3(REG)
F1(X)

Single variable regression parameters are displayed.

Next, you can use the following.

F1 (X) ..... Linear regression
F2 (Med) ..... Med-Med regression
F3 (X^2) ..... Quadratic regression
F4 (X^3) ..... Cubic regression
F5 (X^4) ..... Quartic regression
F6 (▷) ..... Next menu

F1 (Log) ..... Logarithmic regression
F2 (Exp) ..... Exponential regression
F3 (Pwr) ..... Power regression
F6 (▷) ..... Previous menu

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

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

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

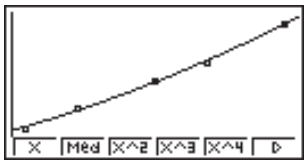
• Note that you cannot obtain estimated values for a Med-Med, quadratic regression, cubic regression, or quartic regression graph.

Example **To perform power regression using the following data and estimate the values of $\hat{y}$ and $\hat{x}$ when xi = 40 and yi = 1000**

xi	yi
28	2410
30	3033
33	3895
35	4491
38	5717

1. In the Main Menu, select the **STAT** icon and enter the STAT Mode.

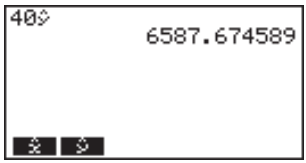
2. Input data into the list and draw the power regression graph*.



3. In the Main Menu, select the **RUN** icon and enter the RUN Mode.

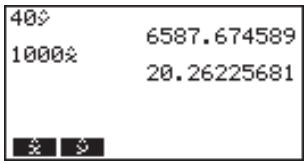
4. Press the keys as follows.

4 0 (value of *xi*)
OPTN F5 (STAT) F2 ($\hat{y}$) EXE



The estimated value $\hat{y}$ is displayed for xi = 40.

1 0 0 0 (value of *yi*)
F1 ($\hat{x}$) EXE



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

*

(Graph Type)	F1 (GRPH) F6 (SET) ▼
(Scatter)	F1 (Scat) ▼
(XList)	F1 (List1) ▼
(YList)	F2 (List2) ▼
(Frequency)	F1 (1) ▼
(Mark Type)	F1 (□) EXIT
(Auto)	SHIFT SETUP F1 (Auto) EXIT F1 (GRPH) F1 (GPH1) F6 (▷)
(Pwr)	F3 (Pwr) F6 (DRAW)

■ Probability Distribution Calculation and Graphing

You can calculate and graph probability distributions for single-variable statistics.

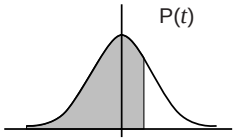
●Probability distribution calculations

You can perform probability distribution calculations in the **RUN Mode**. Pressing OPTN in the RUN Mode displays a menu of probability distribution functions.

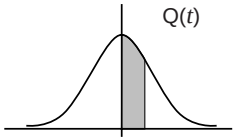
OPTN F6 (▷) F3 (PROB) F6 (▷)

F1 (P() ..... Calculation of probability P(*t*) value
F2 (Q() ..... Calculation of probability Q(*t*) value
F3 (R() ..... Calculation of probability R(*t*) value
F4 (*t*() ..... Calculation of normalized variate *t*(*x*) value

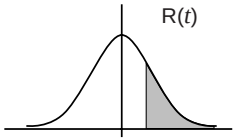
- Probability P(t), Q(t), and R(t), and normalized variate $t(x)$ are calculated using the following formulas.



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



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



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

$$t(x)$$

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

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?**

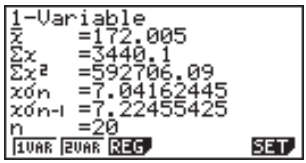
Class no.	Height (cm)	Frequency
1	158.5	1
2	160.5	1
3	163.3	2
4	167.5	2
5	170.2	3
6	173.3	4
7	175.5	2
8	178.6	2
9	180.4	2
10	186.7	1

1. In the **STAT Mode**, input the height data into List 1 and the frequency data into List 2.

	List 1	List 2
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

2. Use the **STAT Mode** to perform the single-variable statistical calculations.

F2(CALC) F6(SET)
▼ F3(List2) EXIT F1(1VAR)



3. Press MENU to display the Main Menu, and then enter the **RUN Mode**.

4. In the **RUN Mode**, display the probability calculation menu.

- You obtain the normalized variate immediately after performing single-variable statistical calculations only.

OPTN F6(▷) F3(PROB) F6(▷)

F4

F4(*t*() 1 6 0 • 5) EXE
(Normalized variate *t* for 160.5cm) Result: –1.633855948
(≒ –1.634)

F4(*t*() 1 7 5 • 5) EXE
(Normalized variate *t* for 175.5cm) Result: 0.4963343361
(≒ 0.496)

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

F3(R() 0 • 4 9 6) EXE
(Percentile) Result: 0.30995
(31.0 percentile)

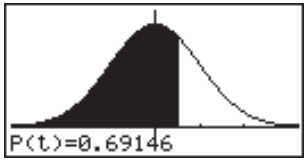
■ Probability Graphing

You can graph a probability distribution with Graph Y = in the Sketch Mode.

Example **To graph probability P(0.5)**

Perform the following operation in the **RUN Mode**.

[SHIFT] [F4] (Sketch) [F1] (Cls) [EXE]
[F5] (GRPH) [F1] (Y=) [OPTN] [F6] (▷) [F3] (PROB)
[F6] (▷) [F1] (P() [0] [•] [5] [)] [EXE]



The following shows the View Window settings for the graph.