

Chapter

7

Statistical Graphs and Calculations

7

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.

1. **Before Performing Statistical Calculations**
2. **Statistical Calculation Examples**
3. **Calculating and Graphing Single-Variable Statistical Data**
4. **Calculating and Graphing Paired-Variable Statistical Data**
5. **Manual Graphing**
6. **Performing Statistical Calculations**

Important!

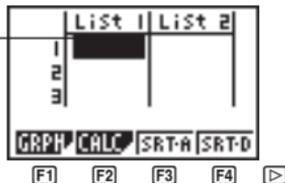
- This chapter contains a number of graph screen shots. In each case, new data values were input in order to highlight the particular characteristics of the graph being drawn. Note that when you try to draw a similar graph, the unit uses data values that you have input using the List function. Because 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.

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 \uparrow , \downarrow , \leftarrow and \rightarrow to move the highlighting around the lists.



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- F1** (GRPH) Graph menu
- F2** (CALC) Statistical calculation menu
- F3** (SRT•A) Ascending sort
- F4** (SRT•D) Descending sort



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- F1** (DEL) Single data item delete
- F2** (DEL•A) Delete all data
- F3** (INS) Insert data item

Press \rightarrow to return to the 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 "Chapter 6 List Function".

2. 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.

	List 1	List 2
4	4	2
5	5.2	2.4
6		

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

- Input values can be up to 10 digits long (9-digit mantissa and 2-digit exponent when using exponential format). Values in statistical data table cells are shown only up to six digits.
- 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 (GRPH) to display the graph menu.

(GRPH)

<input type="text" value="GRPH1"/>	<input type="text" value="GRPH2"/>	<input type="text" value="GRPH3"/>
------------------------------------	------------------------------------	------------------------------------

(GPH1) Graph 1 draw

(GPH2) Graph 2 draw

(GPH3) Graph 3 draw

<input type="text" value="SEL"/>	<input type="text" value="SET"/>
----------------------------------	----------------------------------

(SEL) Graph (GPH1, GPH2, GPH3) selection

(SET) Graph settings (graph type, list assignments)

Press to return to the previous menu.

- 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 (, ,) 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.

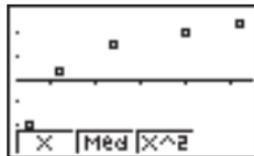
■ Plotting a Scatter Diagram

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 **[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 **[>]** **[F1]** (SEL) to display the graph On/Off screen.

[F1](GRPH)

[>] **[F1]**(SEL)



[F1] (On) Graph On (graph draw)

[F2] (Off) Graph Off (graph non-draw)

[F4] (DRAW) Draw all On graphs

- Note that the S-Grph1 setting is for Graph 1 (GPH1 of the graph menu), S-Grph2 is for Graph 2, and S-Grph3 is for Graph 3.

- Use \blacktriangle and \blacktriangledown 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).
- To return to the graph menu, press $QUIT$.

•To draw a graph

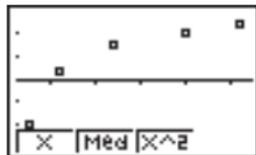
Example To draw a scatter diagram of Graph 3 only

$F1$ (GRPH) \blacktriangleright $F1$ (SEL)

$F2$ (Off)

\blacktriangledown \blacktriangledown $F1$ (On)

$F4$ (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 or Data

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 to draw the graph.

• 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 \blacktriangleright **F4** (SET) to display the general graph settings screen.

F1 (GRPH)
 \blacktriangleright **F4** (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 \blacktriangle and \blacktriangledown 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

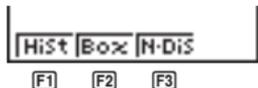
•To select the graph type (G-Type)

1. While the general graph settings screen is on the display, use \blacktriangle and \blacktriangledown to move the highlighting to the G-Type item.

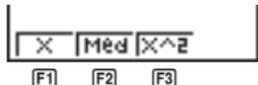


2. Use the function key menu to select the graph type you want to select.

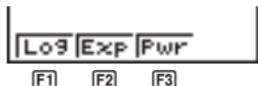
F1 (Scat) Scatter diagram
F2 (xy) xy line graph
F3 (Pie) Pie chart
F4 (Stck) Stacked bar chart



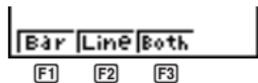
- F1** (Hist) Histogram
- F2** (Box) Med-box graph
- F3** (N•Dis) Normal distribution curve



- F1** (X) Linear regression graph
- F2** (Med) Med-Med graph
- F3** (X²) Quadratic regression graph



- F1** (Log) Logarithmic regression graph
- F2** (Exp) Exponential regression graph
- F3** (Pwr) Power regression graph



- F1** (Bar) Bar graph
- F2** (Line) Line graph
- F3** (Both) Bar graph and line graph

Press to return to the previous menu.

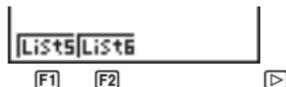
●To select the x-axis data list (XList)

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



- F1** (List5) List 5
F2 (List6) List 6

Press to return to the previous menu.

●**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



- F1** (List5) List 5
F2 (List6) List 6

Press to return to the previous menu.

●To select the frequency data list (Freq)

1. While the general graph settings screen is on the display, use \blacktriangle and \blacktriangledown to move the highlighting to the Freq 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.



- F1** (List4) List 4 data is frequency data.
- F2** (List5) List 5 data is frequency data.
- F3** (List6) List 6 data is frequency data.

Press **▶** to return to the previous menu.

●To select the plot mark type (M-Type)

1. While the general graph settings screen is on the display, use \blacktriangle and \blacktriangledown to move the highlighting to the M-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 •

•To select the data list for a pie chart, stacked bar chart, bar graph or line graph (Data)

1. While the graph settings screen is on the display, use \blacktriangle and \blacktriangledown to move the highlighting to the Data item.



2. Use the function key menu to select the name of the statistical data list whose values you want to use.

F1 (List1) List 1

F2 (List2) List 2

F3 (List3) List 3

F4 (List4) List 4



F1 (List5) List 5

F2 (List6) List 6

Press  to return to the previous menu.

•To select the data list for a combined bar graph and line graph (Both)

1. While the graph settings screen is on the display, use \blacktriangle and \blacktriangledown to move the highlighting to the Bar item.



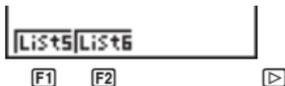
2. Use the function key menu to select the name of the statistical data list whose values you want to use.

F1 (List1) List 1

F2 (List2) List 2

F3 (List3) List 3

F4 (List4) List 4



F1 (List5) List 5

F2 (List6) List 6

Press  to return to the previous menu.

3. Use \blacktriangle and \blacktriangledown to move the highlighting to the Line item.



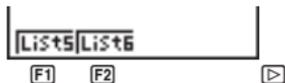
4. Use the function key menu to select the name of the statistical data list whose values you want to use.

F1 (List1) List 1

F2 (List2) List 2

F3 (List3) List 3

F4 (List4) List 4



F1 (List5) List 5

F2 (List6) List 6

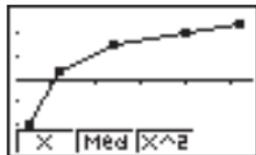
Press \blacktriangleright to return to the previous menu.



P.100
(G-Type)
(xy)

■ Drawing an xy Line Graph

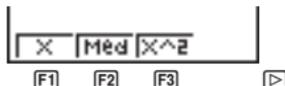
Paired data items can be used to plot a scatter diagram. A scatter diagram where the points are linked is an xy line graph.



Press **QUIT** to return to the statistical data list.

■ Selecting the Regression Type

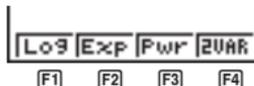
After you graph statistical data, you can use the function menu at the bottom of the display to select from a variety of different types of regression.



F1 (X) Linear regression

F2 (Med) Med-Med line

F3 (X^2) Quadratic regression



- F1** (Log) Logarithmic regression
- F2** (Exp) Exponential regression
- F3** (Pwr) Power regression
- F4** (2VAR) Paired-variable statistical results

Press to return to the previous menu.

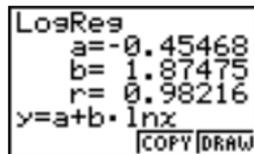
■ Displaying Statistical Calculation Results

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

F1 (Log)



■ Graphing statistical calculation results

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



- F3** (COPY) Stores the displayed regression formula as a graph function
- F4** (DRAW) Graphs the displayed regression formula

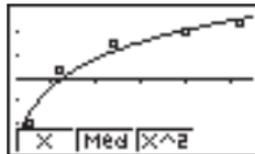


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Example To graph a logarithmic regression

While logarithmic regression parameter calculation results are on the display, press **F4** (DRAW).

F4(DRAW)



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


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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).

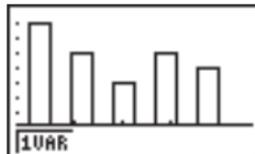
Single-variable statistics include distribution and sum. The following three types of graphs are available for single-variable statistics.

■ Histogram

From the statistical data list, press **F1** (GRPH) to display the graph menu, press **F4** (SET), and then change the graph type of the graph you want to use (GPH1, GPH2, GPH3) to histogram.

Input data into a list, make the required settings, and then draw the graph.


P.101
(G-Type)
(Hist)

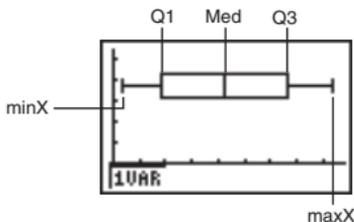


■ Box Graph

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 first quartile (Q1) to the third quartile (Q3), with a line drawn at the median (Med). 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 **F4** (SET), and then change the graph type of the graph you want to use (GPH1, GPH2, GPH3) to box graph.


P.101
(G-Type)
(Box)



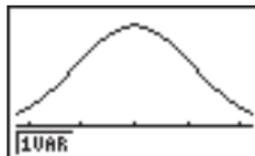
Normal Distribution Curve

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

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

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 **F4** (SET), and then change the graph type of the graph you want to use (GPH1, GPH2, GPH3) to normal distribution.



Displaying Single-Variable Statistical Results

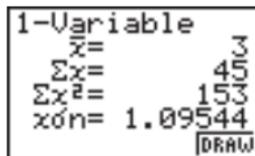
Single-variable statistics can be expressed as both graphs and parameter values. When these graphs are displayed, the menu at the bottom of the screen appears as below.



F1 (1VAR) Single-variable calculation result menu

Pressing **F1** (1VAR) displays the following screen.

F1(1VAR)



P.101
(G-Type)
(N•Dis)

The following describes the meaning of each of the parameters.

- \bar{x} Mean of data
- Σx Sum of data
- Σx^2 Sum of squares
- σ_{Pop} Population standard deviation
- σ_{Smp} Sample standard deviation
- n Number of data items
- minX Minimum
- Q1 First quartile
- Med Median
- Q3 Third quartile
- maxX Maximum
- Mod Mode

- Press **F4** (DRAW) to return to the original single-variable statistical graph.

P.100
(G-Type)
(Pie)

■ Pie Chart

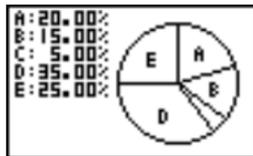
From the statistical data list, press **F1** (GRPH) to display the graph menu, press **F4** (SET), and then change the graph type of the graph you want to use (GPH1, GPH2, GPH3) to pie chart. Next, move the highlighting to "Display" and then press **F1** or **F2** to select the pie chart data format.

- F1** (%) Displayed values show what percentage of the total data each pie segment represents.
- F2** (Data) Displayed values show actual data.

Press **QUIT** to draw the chart.

Example To input the following data into List 1 and use it to draw a pie chart: 18.0, 13.5, 4.5, 31.5, 22.5

- F1**(GRPH) **F4** (SET)
- F1**(GPH1) **▼**
- F3**(Pie) **▼**
- F1**(List1) **▼**
- F1**(%) **QUIT**
- F1**(GRPH) **F1**(GPH1)



- A pie chart can have up to eight data items. Attempting to draw a pie chart for a list that has more than eight data items causes an error (Dim ERROR).
- Only positive data can be included in a pie chart. Attempting to draw a pie chart for a list that includes negative data causes an error (Ma ERROR).
- View Window settings are not applied to pie charts.
- A pie chart cannot be superimposed with another graph.
- Values appearing on a pie chart are automatically assigned to the corresponding variables (A, B, C, etc.)

- Performing a trace operation (SHIFT F1 (TRCE)) while a pie chart is on the display causes the pointer to appear at the topmost segment. Pressing \blacktriangleright and \blacktriangleleft moves the pointer to neighboring segments.
- While a pie graph is on the display, you can toggle between the two data formats (percent and data) by pressing SHIFT F4 (CHNG).
- You cannot draw multiple pie charts on the same screen.
- Percent values shown on pie charts are cut off to two decimal places.

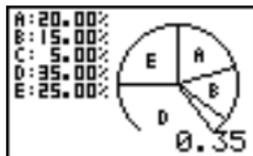
• Performing Mathematical Operations Using Pie Chart Data

Pressing SHIFT F3 (GSLV) causes the cursor to appear at the bottom of the screen. You can then perform mathematical operations using the chart's data.

Example To perform the operation $A + B$

After drawing the pie chart, perform the following operation.

SHIFT F3 (GSLV)
 ALPHA A $+$ ALPHA B
 EXE



The result shows that A and B account for 35% of the data.



P.100
 (G-Type)
 (Stck)

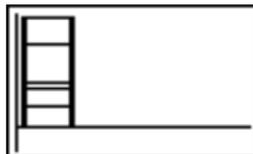
■ Stacked Bar Chart

From the statistical data list, press F1 (GRPH) to display the graph menu, press \blacktriangleright F4 (SET), and then change the graph type of the graph you want to use (GPH1, GPH2, GPH3) to stacked bar chart.

Press QUIT to draw the chart.

Example To input the following data into List 1 and use it to draw a stacked bar chart: 18.0, 13.5, 4.5, 31.5, 22.5

F1 (GRPH) \blacktriangleright F4 (SET)
 F1 (GPH1) \blacktriangledown
 F4 (Stck) \blacktriangledown
 F1 (List1) QUIT
 F1 (GRPH) F1 (GPH1)



- A stacked bar chart can have up to eight data items. Attempting to draw a stacked bar chart for a list that has more than eight data items causes an error (Dim ERROR).

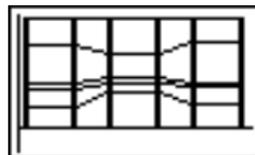
- Only positive data can be included in a stacked bar chart. Attempting to draw a stacked bar chart for a list that includes negative data causes an error (Ma ER-ROR).
- A stacked bar chart cannot be superimposed with another graph.
- View Window settings are not applied to stacked bar charts.
- The following display shows what happens if you perform a trace operation (SHIFT F1 (TRCE)) while a stacked bar chart is on the display.



- Pressing ▲ and ▼ moves the highlighting up and down within the same graph.
- If you have multiple stacked bar charts on the screen, use ◀ and ▶ to move between them.

• Linking the Segments of Stacked Bar Charts with Connecting Lines

While multiple stacked bar charts are on the display, press SHIFT F4 (CNCT) to link their segments with connecting lines.



Redraw the stacked bar charts to clear the connecting lines.


P.101
 (G-Type)
 (Bar)

■ Bar Graph

From the statistical data list, press F1 (GRPH) to display the graph menu, press ▶ F4 (SET), and then change the graph type of the graph you want to use (GPH1, GPH2, GPH3) to bar graph.

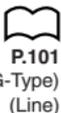
Press QUIT to draw the graph.

Example To input the following data into List 1 and use it to draw a bar graph: 18.0, 13.5, 4.5, 31.5, 22.5

F1 (GRPH) > F4 (SET)
 F1 (GPH1) ▾
 > > > > F1 (Bar) ▾
 F1 (List1) QUIT
 F1 (GRPH) F1 (GPH1)



- A bar graph can have up to 14 data items. Attempting to draw a bar graph for a list that has more than 14 data items causes an error (Dim ERROR).
- The x -axis of a bar graph is fixed. The y -axis is controlled by View Window settings only when Man (manual) is specified for the S-Wind (Statistical Graph View Window Setting) on the Set Up screen.
- A bar graph can be superimposed with a line graph only. This is done by selecting F3 (Both) while specifying the graph type.
- Pressing **SHIFT** F1 (TRCE) while a bar graph is on the display activates the trace operation. Use **◀** and **▶** to move the pointer.
- You cannot draw multiple bar graphs on the same screen.



Line Graph

From the statistical data list, press F1 (GRPH) to display the graph menu, press F4 (SET), and then change the graph type of the graph you want to use (GPH1, GPH2, GPH3) to line graph.

Press QUIT to draw the graph.

Example To input the following data into List 1 and use it to draw a line graph: 18.0, 13.5, 4.5, 31.5, 22.5

F1 (GRPH) > F4 (SET)
 F1 (GPH1) ▾
 > > > > F2 (Line) ▾
 F1 (List1) QUIT
 F1 (GRPH) F1 (GPH1)



- A line graph can have up to 14 data items. Attempting to draw a line graph for a list that has more than 14 data items causes an error (Dim ERROR).
- The x -axis of a line graph is fixed. The y -axis is controlled by View Window settings only when Man (manual) is specified for the S-Wind (Statistical Graph View Window Setting) on the Set Up screen.
- A line graph can be superimposed with a bar graph only. This is done by selecting F3 (Both) while specifying the graph type.



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(G-Type)
(Both)

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- Pressing **[SHIFT]** **[F1]** (TRCE) while a line graph is on the display activates the trace operation. Use **[◀]** and **[▶]** to move the pointer.
- You cannot draw multiple line graphs on the same screen.

■ Bar Graph and Line Graph

From the statistical data list, press **[F1]** (GRPH) to display the graph menu, press **[▶]** **[F4]** (SET), and then change the graph type of the graph you want to use (GPH1, GPH2, GPH3) to Both.

When Auto is specified for the S-Wind (Statistical Graph View Window Setting) item on the Set Up screen, you can next move the highlighting to the AutoWin item and press **[F1]**, **[F2]**, or **[F3]** to make one of the following settings.

- [F1]** (Sep.G) This setting causes each graph to be drawn in different areas of the display, without superimposing them. The two graphs share the same *x*-coordinates, however, and the *x*-axis is displayed for the bar graph only.
- [F2]** (O.Lap) This setting superimposes the two graphs on each other. Each graph, however, can have its own independent *y*-axis values.
- [F3]** (Norm) This setting also superimposes the two graphs, with both using the same *x*- and *y*-coordinates.

Press **[QUIT]** to draw the graph.

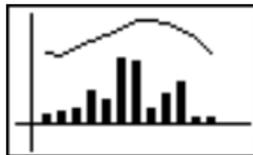
Example

Draw a graph that shows precipitation in a certain city as a bar graph and average temperature as a line graph. Input the precipitation data into List 1 and the temperature data into List 2. Use the following procedure to draw the graph.

	List 1	List 2
1	100	5
2	150	4
3	200	11
4	400	16
5	300	20
6	800	24
7	750	31
8	200	32
9	350	29
10	500	24
11	80	18
12	80	6

```

[F1](GRPH)[▶] [F4](SET)
[F1](GPH1)▼
[▶] [▶] [▶] [▶] [F3](Both)▼
[F1](List1)▼
[F2](List2)▼
[F1](Sep.G) [QUIT]
[F1](GRPH)[F1](GPH1)
    
```



- Pressing **[SHIFT]** **[F1]** (TRCE) while the graph is on the display activates the trace operation. Use **[◀]** and **[▶]** to move the pointer.
- You cannot draw multiple bar and line graphs on the same screen.

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.

(G-Type)
(Scat)
(GPH1)
(X)

QUIT **F1**(GRPH) **▶** **F4**(SET) **▼**

F1(Scat)

QUIT **F1**(GRPH) **F1**(GPH1)

F1(X)

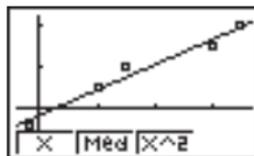
```

LinearReg
a= 0.62748
b=-0.20437
r= 0.98146
y=ax+b
    
```

COPY **DRAW**

F4

F4(DRAW)



The following are the meanings of the above parameters.

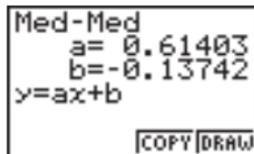
- a Regression coefficient (slope)
- b Regression constant term (y-intercept)
- r Correlation coefficient



■ Med-Med Graph

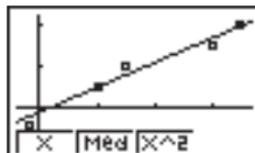
When it is suspected that there are a number of extreme values, a Med-Med graph can be used in place of the least squares method. This is also a type of linear regression, but it minimizes the effects of extreme values. It is especially useful in producing highly reliable linear regression from data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

F2(Med)



F4

F4(DRAW)



The following are the meanings of the above parameters.

a Med-Med graph slope

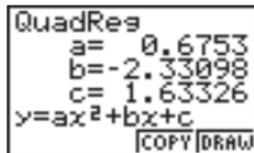
b Med-Med graph y -intercept



■ Quadratic Regression Graph

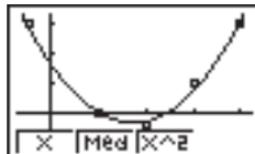
A quadratic regression graph represents connection of the data points of a scatter diagram. It actually is a scattering of so many points that are close enough together to be connected. The formula that represents this is quadratic regression.

F3(X^2)



F4

F4(DRAW)





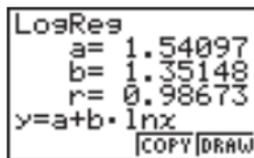
The following are the meanings of the above parameters.

- a..... Regression second coefficient
- b..... Regression first coefficient
- c..... Regression constant term (y-intercept)

■ Logarithmic Regression Graph

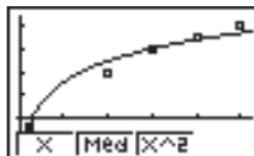
Logarithmic regression expresses y as a logarithmic function of x . The standard logarithmic regression formula is $y = a + b \times \log x$, so if we say that $X = \log x$, the formula corresponds to linear regression formula $y = a + bX$.

\square \square (Log)



\square (F4)

\square (DRAW)



The following are the meanings of the above parameters.

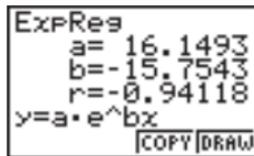
- a..... Regression constant term
- b..... Regression coefficient (slope)
- r..... Correlation coefficient



■ Exponential Regression Graph

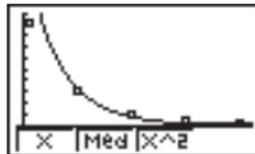
Exponential regression expresses y as a proportion of the exponential function of x . The standard exponential regression formula is $y = a \times e^{bx}$, so if we take the logarithms of both sides we get $\log y = \log a + bx$. Next, if we say $Y = \log y$, and $A = \log a$, the formula corresponds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

\square \square (Exp)



\square (F4)

[F4](DRAW)



The following are the meanings of the above parameters.

- a Regression coefficient
- b Regression constant term
- r Correlation coefficient

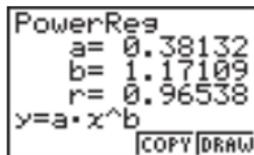


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■ Power Regression Graph

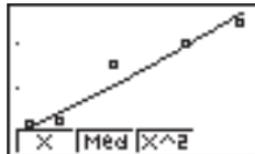
Exponential regression expresses y as a proportion of the power of x . The standard power regression formula is $y = a \times x^b$, so if we take the logarithms of both sides we get $\log y = \log a + b \times \log x$. Next, if we say $X = \log x$, $Y = \log y$, and $A = \log a$, the formula corresponds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

[F3](Pwr)



[F4]

[F4](DRAW)



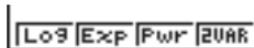
The following are the meanings of the above parameters.

- a Regression coefficient
- b Regression power
- r Correlation coefficient



■ Displaying Paired-Variable Statistical Results

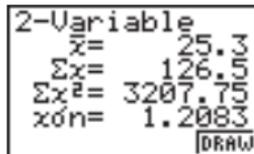
Paired-variable statistics can be expressed as both graphs and parameter values. When these graphs are displayed, the menu at the bottom of the screen appears as below.



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.

\bar{x}	Mean of <i>x</i> List data
Σx	Sum of <i>x</i> List data
Σx^2	Sum of squares of <i>x</i> List data
$x\sigma_n$	Population standard deviation of <i>x</i> List data
$x\sigma_{n-1}$	Sample standard deviation of <i>x</i> List data
<i>n</i>	Number of <i>x</i> List data items
\bar{y}	Mean of <i>y</i> List data
Σy	Sum of <i>y</i> List data
Σy^2	Sum of squares of <i>y</i> List data
$y\sigma_n$	Population standard deviation of <i>y</i> List data
$y\sigma_{n-1}$	Sample standard deviation of <i>y</i> List data
Σxy	Sum of the product of data stored in <i>x</i> List and <i>y</i> List
minX	Minimum of <i>x</i> List data
maxX	Maximum of <i>x</i> List data
minY	Minimum of <i>y</i> List data
maxY	Maximum of <i>y</i> 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.

```

LogReg
a= 1.54097
b= 1.35148
r= 0.98673
y=a+b·lnx
COPY DRAW
    
```

F3 **F4**

F3 (COPY) Stores the displayed regression formula to the GRAPH Mode

F4 (DRAW) Graphs the displayed regression formula

1. Press **F3** (COPY) to copy the regression formula that produced the displayed data to the GRAPH Mode.

F3(COPY)

```

G-Func :Y=
Y1:
Y2:
Y3:
Y4:
Store[EXE]
    
```

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.



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■ 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 **F4** (DRAW). After drawing the graphs, you can select which graph formula to use when performing single-variable statistic or regression calculations.

```

S-Grph1:On
S-Grph2:Off
S-Grph3:On
On Off DRAW
    
```

F4

F4(DRAW)

F1(X)

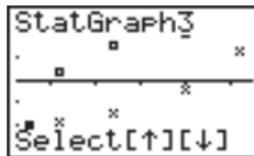


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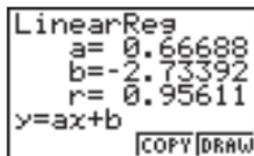
```

StatGraph1
. . . . .
. . . . .
. . . . .
Select[↑][↓]
    
```

- The text at the top of the screen indicates the currently selected graph (StatGraph 1 = Graph 1, StatGraph 2 = Graph 2, StatGraph 3 = Graph 3).
- Use \blacktriangle and \blacktriangledown to change the currently selected graph. The graph name at the top of the screen changes when you do.



- When the graph you want to use is selected, press $\boxed{\text{EXE}}$.



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


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5. 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 S-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.

■ Setting the Width of a Histogram

When the S-Wind item of the View Window is set to “Man” (manual graphing), a screen appears so you can specify the starting point and spacing of histogram bars.

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



$\boxed{\text{F2}}$

- F2** (Man)
- QUIT** (Returns to previous menu.)
- F1** (GRPH) **F1** (GPH1)

Here we will illustrate this operation by making histogram settings for Graph 1.



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

- Strt Histogram start point (x -coordinate)
- ptch Bar spacing (specify as scale unit)

Example Strt: 0, ptch: 10

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

- SHIFT** **SETUP** **F2** (Man)
- QUIT** (Returns to previous menu.)
- F1** (GRPH) **F1** (GPH1)
- 0** **EXE** (Start value is $x = 0$.)
- 1** **0** **EXE** (pitch = 10)

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) **F4** (SET)



The following is the meaning for each item.

- 1VarX Specifies list where single-variable statistic x values (XList) are located.
- 1VarF Specifies list where single-variable frequency values (Frequency) are located.
- 2VarX Specifies list where paired-variable statistic x values (XList) are located.
- 2VarY Specifies list where paired-variable statistic y values (YList) are located.
- 2VarF Specifies list where paired-variable frequency values (Frequency) are located.

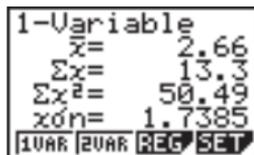
- Calculations in this section are performed based on the above specifications.

■ Single-Variable Statistical Calculations

In the previous examples from “Histogram” to “Normal Distribution Curve,” 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.

$\boxed{F2}$ (CALC) $\boxed{F1}$ (1VAR)



Now you can press \blacktriangle and \blacktriangledown to view variable characteristics.

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 scatter diagram 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.

$\boxed{F2}$ (CALC) $\boxed{F2}$ (2VAR)





Now you can press \blacktriangle and \blacktriangledown to view variable characteristics.

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 (X²) Quadratic regression



F1 (Log) Logarithmic regression

F2 (Exp) Exponential regression

F3 (Pwr) Power regression

The meaning 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 Med-Med graph and quadratic regression graph.



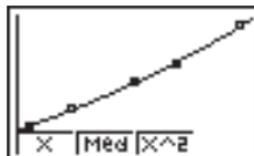
Example To perform power regression using the following data and estimate the values of \hat{y} and \hat{x} when $xi = 40$ and $yi = 1000$

xi (List 1)	yi (List 2)
28	2410
30	3033
33	3895
35	4491
38	5717

- In the Main Menu, select the **STAT** icon and enter the STAT Mode.
- Input data into the list and draw the power regression graph.

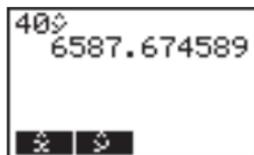
(G-Type)
(Scat)
(XList)
(YList)
(Freq)
(M-Type)
(Auto)
(Pwr)

F1(GRPH) **F4**(SET) **F1**(Scat) **F1**(List1) **F2**(List2) **F1**(1) **F1**(a) **QUIT**
SHIFT **SETUP** **F1**(Auto) **QUIT** **F1**(GRPH) **F1**(GPH1) **F3**(Pwr) **F4**(DRAW)



- In the Main Menu, select the **RUN** icon and enter the RUN Mode.
- Press the keys as follows.

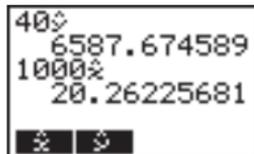
4 **0** (value of xi)
OPTN **F3**(STAT) **F2**(\hat{y}) **EXE**



F1 **F2**

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 $yi = 1000$.