Calculator Instructions

Casio fx-9860G PLUS

Contents:

A BASIC FUNCTIONS

GROUPING SYMBOLS (BRACKETS)

The Casio has bracket keys that look like [( ] and [ )].

Brackets are regularly used in mathematics to indicate an expression which needs to be evaluated before other operations are carried out.

For example, to evaluate $2 \times (4+1)$ we type 2 [×] [( ] 4 [+] 1 [ )] [EXE].

We also use brackets to make sure the calculator understands the expression we are typing in.

For example, to evaluate $\frac{2}{4+1}$ we type 2 [÷] [( ] 4 [+] 1 [ )] [EXE].

If we typed 2 [÷] 4 [+] 1 [EXE] the calculator would think we meant $\frac{2}{4}+1$.

In general, it is a good idea to place brackets around any complicated expressions which need to be evaluated separately.

POWER KEYS

The Casio has a power key that looks like [∧]. We type the base first, press the power key, then enter the index or exponent.

For example, to evaluate 25^3 we type 25 [∧] 3 [EXE].

Numbers can be squared on the Casio using the special key [x^2].

For example, to evaluate 25^2 we type 25 [x^2] [EXE].

ROOTS

To enter roots on the Casio we need to use the secondary function key [SHIFT].

We enter square roots by pressing [SHIFT] [x^2].

For example, to evaluate $\sqrt{36}$ we press [SHIFT] [x^2] 36 [EXE].

You can press the right arrow key [►] to move the cursor out of the square root sign. For example, to evaluate $\sqrt{18}+5$ we type [SHIFT] [x^2] 18 [►] [+] 5 [EXE].

Cube roots are entered by pressing [SHIFT] [( ].

For example, to evaluate $\sqrt[3]{8}$ we press [SHIFT] [( ] 8 [EXE].

Higher roots are entered by pressing [SHIFT] [∧].

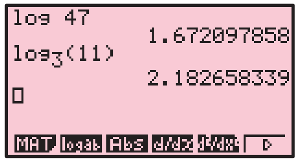
For example, to evaluate $\sqrt[4]{81}$ we press 4 [SHIFT] [∧] 81 [EXE].

LOGARITHMS

We can perform operations involving logarithms in base 10 using the [log] button.

To evaluate $\log(47)$ press [log] 47 [EXE].

To evaluate $\log_3 11$, press [F4] (**MATH**) [F2] (**logab**). Then press 3 [▶] 11 [EXE].



INVERSE TRIGONOMETRIC FUNCTIONS

The inverse trigonometric functions $\sin^{-1}$, $\cos^{-1}$, and $\tan^{-1}$ are the secondary functions of [sin], [cos], and [tan] respectively. They are accessed by using the secondary function key [SHIFT].

For example, if $\cos x = \frac{3}{5}$, then $x = \cos^{-1}\left(\frac{3}{5}\right)$.

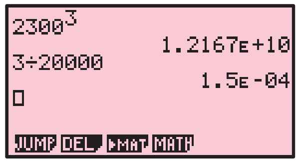
To calculate this, press [SHIFT] [cos] [(] 3 [÷] 5 [)] [EXE].

SCIENTIFIC NOTATION

If a number is too large or too small to be displayed neatly on the screen, it will be expressed in scientific notation, which is the form $a \times 10^k$ where $1 \leqslant a < 10$ and k is an integer.

To evaluate 2300^3, press 2300 [∧] 3 [EXE]. The answer displayed is 1.2167E+10, which means 1.2167×10^{10}.

To evaluate $\frac{3}{20\,000}$, press 3 [÷] 20 000 [EXE]. The answer displayed is 1.5E−04, which means 1.5×10^{-4}.



You can enter values in scientific notation using the [EXP] key. For example, to evaluate $\frac{2.6 \times 10^{14}}{13}$, press 2.6 [EXP] 14 [÷] 13 [EXE]. The answer is 2×10^{13}.

SECONDARY FUNCTION AND ALPHA KEYS

The **shift function** of each key is displayed in yellow above the key. It is accessed by pressing the [SHIFT] key followed by the key corresponding to the desired shift function.

For example, to calculate $\sqrt{36}$, press [SHIFT] [x^2] ($\sqrt{\ }$) 36 [EXE].

The **alpha function** of each key is displayed in red above the key. It is accessed by pressing the [ALPHA] key followed by the key corresponding to the desired letter. The main purpose of the alpha keys is to store values which can be recalled later.

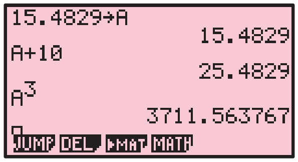
B MEMORY

Utilising the memory features of your calculator allows you to recall calculations you have performed previously. This not only saves time, but also enables you to maintain accuracy in your calculations.

SPECIFIC STORAGE TO MEMORY

Values can be stored into the variable letters A, B, ..., Z. Storing a value in memory is useful if you need that value multiple times.

Suppose we wish to store the number 15.4829 for use in a number of calculations. To store this number in variable A, type in the number then press [→] [ALPHA] [X,θ,T] **(A)** [EXE] .



We can now add 10 to this value by pressing [ALPHA] [X,θ,T] [+] 10 [EXE] , or cube this value by pressing [ALPHA] [X,θ,T] [^] 3 [EXE] .

ANS VARIABLE

The variable **Ans** holds the most recent evaluated expression, and can be used in calculations by pressing [SHIFT] [(−)] . For example, suppose you evaluate 3×4, and then wish to subtract this from 17. This can be done by pressing 17 [−] [SHIFT] [(−)] [EXE] .

If you start an expression with an operator such as [+] , [−] , etc, the previous answer **Ans** is automatically inserted ahead of the operator. For example, the previous answer can be halved simply by pressing [÷] 2 [EXE] .

If you wish to view the answer in fractional form, press [F↔D] .

RECALLING PREVIOUS EXPRESSIONS

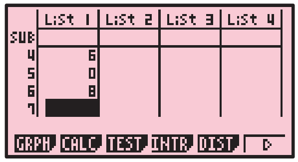
Pressing the up cursor key [▲] allows you to access the most recently evaluated expressions, and is useful if you wish to repeat a calculation with a minor change, or if you have made an error in typing.

Suppose you have evaluated $100+\sqrt{132}$. If you now want to evaluate $100+\sqrt{142}$, instead of retyping the command, it can be accessed by pressing the [▲] key. Move the cursor between the 3 and the 2, then press [DEL] 4 to remove the 3 and change it to a 4. Press [EXE] to re-evaluate the expression.

C LISTS

Lists enable us to store sets of data, which we can then analyse and compare.

CREATING A LIST



Selecting **STAT** from the Main Menu takes you to the **list editor** screen.

To enter the data {2, 5, 1, 6, 0, 8} into **List 1**, start by moving the cursor to the first entry of **List 1**. Press 2 EXE 5 EXE .... and so on until all the data is entered.

DELETING LIST DATA

To delete a list of data from the list editor screen, move the cursor to anywhere on the list you wish to delete, then press F6 (▷) F4 (**DEL-A**) F1 (**Yes**).

REFERENCING LISTS

Lists can be referenced using the List function, which is accessed by pressing SHIFT **1**.

For example, if you want to add 2 to each element of **List 1** and display the results in **List 2**, move the cursor to the heading of **List 2** and press SHIFT **1** (**List**) 1 + 2 EXE .

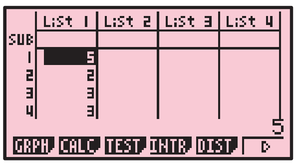
Casio models without the List function can do this by pressing OPTN F1 (**LIST**) F1 (**List**) 1 + 2 EXE .

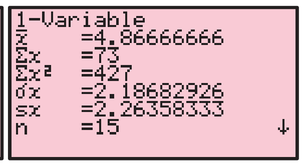
D STATISTICS

Your graphics calculator is a useful tool for analysing data and creating statistical graphs.

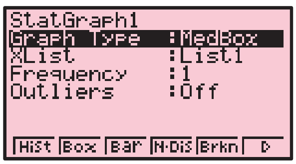
We will first produce descriptive statistics and graphs for the data set 5 2 3 3 6 4 5 3 7 5 7 1 8 9 5.

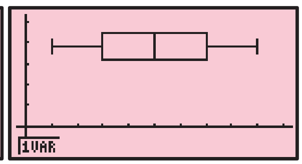
Enter the data into **List 1**. To obtain the descriptive statistics, press F6 (▷) until the **GRPH** icon is in the bottom left corner of the screen, then press F2 (**CALC**) F1 (**1 VAR**).



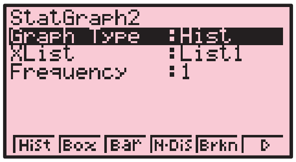


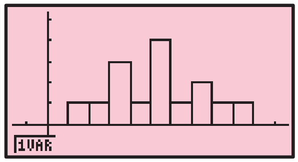
To obtain a boxplot of the data, press EXIT EXIT F1 (**GRPH**) F6 (**SET**), and set up **StatGraph 1** as shown. Press EXIT F1 (**GPH1**) to draw the boxplot.





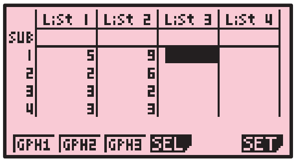
To obtain a vertical bar chart of the data, press EXIT F6 (**SET**) F2 (**GPH 2**), and set up **StatGraph 2** as shown. Press EXIT F2 (**GPH 2**) to draw the bar chart (set Start to 0, and Width to 1).

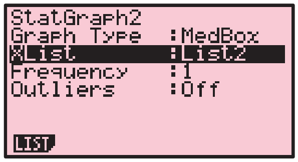


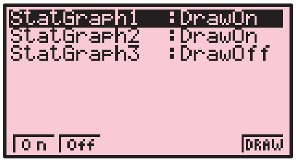


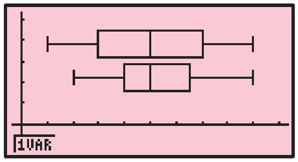
We will now enter a second set of data, and compare it to the first.

Enter the data set 9 6 2 3 5 5 7 5 6 7 6 3 4 4 5 8 4 into **List 2**, then press F6 (**SET**) F2 (**GPH2**) and set up **StatGraph 2** to draw a boxplot of this data set as shown. Press EXIT F4 (**SEL**), and turn on both **StatGraph 1** and **StatGraph 2**. Press F6 (**DRAW**) to draw the side-by-side boxplots.







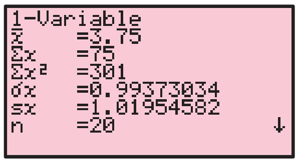


STATISTICS FROM GROUPED DATA

To obtain descriptive statistics for the data in the table alongside, enter the data values into **List 1**, and the frequency values into **List 2**.

Data	*Frequency*
2	3
3	4
4	8
5	5

Press F2 (**CALC**) F6 (**SET**), and change the **1 Var Freq** variable to **List 2**. Press EXIT F1 (**1 Var**) to view the statistics.



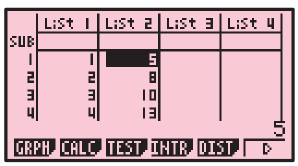
E LINEAR MODELLING

Given a set of bivariate data, we can use our calculator to draw a scatter diagram of the data, find Pearson's correlation coefficient r, and find the line of best fit for the data.

Consider the bivariate data:

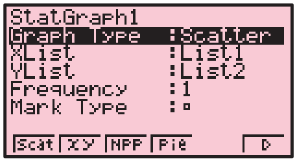
x	1	2	3	4	5	6	7
y	5	8	10	13	16	18	20

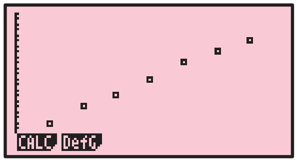
We first enter the x values into **List 1** and the y values into **List 2**.



DRAWING A SCATTER DIAGRAM

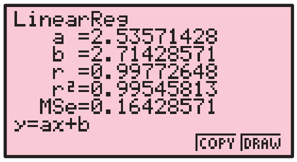
To produce a scatter diagram for the data, press F1 **(GRPH)** F6 **(SET)**, and set up **StatGraph1** as shown. Press EXIT F1 **(GPH 1)** to draw the scatter diagram.





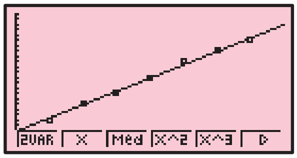
FINDING r AND THE LINE OF BEST FIT

To find r and the line of best fit, from the scatter diagram press F1 **(CALC)** F2 **(X)** F1 **(aX+b)**.



We can see that $r \approx 0.998$, and the line of best fit is given as $y \approx 2.54x + 2.71$.

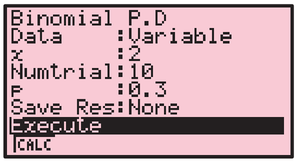
Press F6 **(DRAW)** to view the line of best fit.



F PROBABILITY

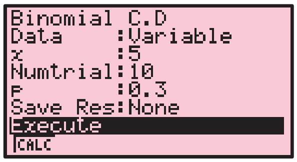
BINOMIAL PROBABILITIES

To find $P(X = 2)$ for $X \sim B(10, 0.3)$, select **STAT** from the Main Menu and press F5 **(DIST)** F5 **(BINM)** F1 **(Bpd)**. Set up the screen as shown. Go to **Execute** and press EXE to display the result, which is 0.233.



To find $P(X \leqslant 5)$ for $X \sim B(10, 0.3)$, select **STAT** from the Main Menu and press F5 **(DIST)** F5 **(BINM)** F2 **(Bcd)**. Set up the screen as shown.

Go to **Execute** and press EXE to display the result, which is 0.953.

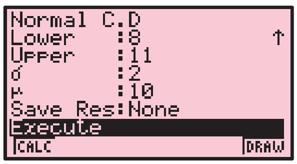


NORMAL PROBABILITIES

Suppose X is normally distributed with mean 10 and standard deviation 2.

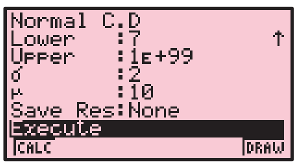
To find $P(8 \leqslant X \leqslant 11)$, select **STAT** from the Main Menu and press F5 **(DIST)** F1 **(NORM)** F2 **(Ncd)**.

Set up the screen as shown. Go to **Execute** and press EXE to display the result, which is 0.533.



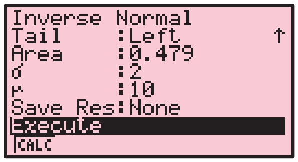
To find $P(X \geqslant 7)$, select **STAT** from the Main Menu and press F5 **(DIST)** F1 **(NORM)** F2 **(Ncd)**.

Set up the screen as shown. Go to **Execute** and press EXE to display the result, which is 0.933.



To find a such that $P(X \leqslant a) = 0.479$, select **STAT** from the Main Menu and press F5 (**DIST**) F1 (**NORM**) F3 (**InvN**).

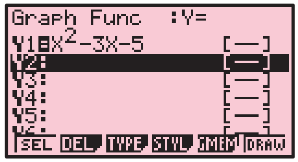
Set up the screen as shown. Go to **Execute** and press EXE to display the result, which is $a \approx 9.89$.



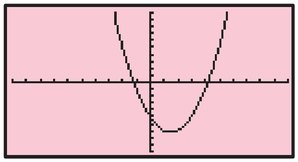
G WORKING WITH FUNCTIONS

GRAPHING FUNCTIONS

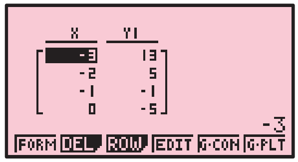
Selecting **GRAPH** from the Main Menu takes you to the Graph Function screen, where you can store functions to graph. Delete any unwanted functions by scrolling down to the function and pressing DEL F1 (**Yes**).



To graph the function $y = x^2 - 3x - 5$, move the cursor to **Y1** and press X,θ,T x^2 $-$ 3 X,θ,T $-$ 5 EXE. This stores the function into **Y1**. Press F6 (**DRAW**) to draw a graph of the function.



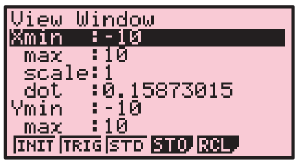
To view a table of values for the function, press MENU and select **TABLE**. Press F6 (**TABL**) to view the table. You can adjust the table settings by pressing EXIT and then F5 (**SET**) from the Table Function screen.



ADJUSTING THE VIEWING WINDOW

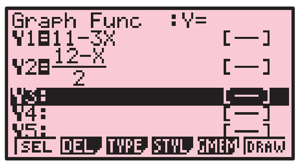
When graphing functions it is important that you are able to view all the important features of the graph. As a general rule it is best to start with a large viewing window to make sure all the features of the graph are visible. You can then make the window smaller if necessary.

The viewing window can be adjusted by pressing SHIFT F3 (**V-Window**). You can manually set the minimum and maximum values of the x and y axes, or press F3 (**STD**) to obtain the standard viewing window $-10 \leqslant x \leqslant 10$, $-10 \leqslant y \leqslant 10$.



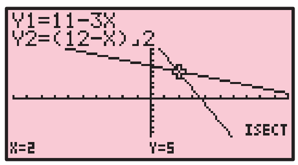
FINDING POINTS OF INTERSECTION

To find the intersection point of $y = 11 - 3x$ and $y = \frac{12 - x}{2}$, select **GRAPH** from the Main Menu, then store $11 - 3x$ into **Y1** and $\frac{12 - x}{2}$ into **Y2**. Press F6 (**DRAW**) to draw a graph of the functions.

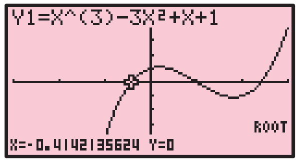


To find their point of intersection, press F5 (**G-Solv**) F5 (**ISCT**). The graphs intersect at $(2, 5)$.

If there is more than one point of intersection, the remaining points of intersection can be found by pressing ►.



FINDING x-INTERCEPTS



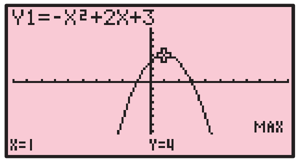
To find the x-intercepts of $f(x) = x^3 - 3x^2 + x + 1$, select **GRAPH** from the Main Menu and store $x^3 - 3x^2 + x + 1$ into **Y1**. Press F6 (**DRAW**) to draw the graph.

To find the x-intercepts, press F5 (**G-Solv**) F1 (**ROOT**). The first x-intercept $x \approx -0.414$ is given.

Press ▶ to find the remaining x-intercepts $x = 1$ and $x \approx 2.41$.

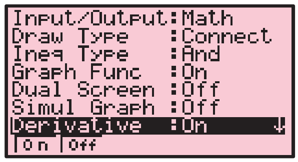
TURNING POINTS

To find the turning point or vertex of $y = -x^2 + 2x + 3$, select **GRAPH** from the Main Menu and store $-x^2 + 2x + 3$ into **Y1**. Press F6 (**DRAW**) to draw the graph.

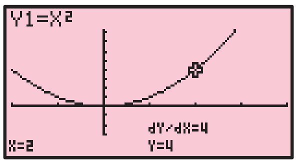


From the graph, it is clear that the vertex is a maximum, so to find the vertex press F5 (**G-Solv**) F2 (**MAX**). The vertex is $(1, 4)$.

THE TANGENT TO A FUNCTION

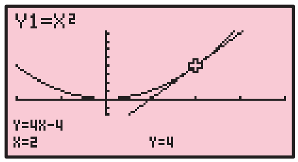


To find the gradient of the tangent to $y = x^2$ when $x = 2$, we first press SHIFT MENU (**SET UP**), and change the **Derivative** setting to **On**.



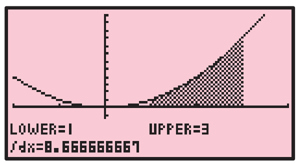
Draw the graph of $y = x^2$, then press SHIFT F4 (**Sketch**) F2 (**Tang**).

Press 2 EXE . We can see that the tangent has a gradient of 4 at this point.



Press EXE again to draw the tangent. The equation of the tangent is $y = 4x - 4$.

DEFINITE INTEGRALS



To calculate $\int_1^3 x^2\,dx$, we first draw the graph of $y = x^2$. Press F5 (**G-Solv**) F6 F3 ($\int$ $\boldsymbol{dx}$) to select the integral tool. Press 1 EXE 3 EXE to specify the lower and upper bounds of the integral.

So, $\int_1^3 x^2\,dx = 8\frac{2}{3}$.

Alternatively, select **RUN•MAT** from the Main Menu, press F4 (**MATH**) F6 F1 ($\int$ $\boldsymbol{dx}$) and set up the screen as shown.