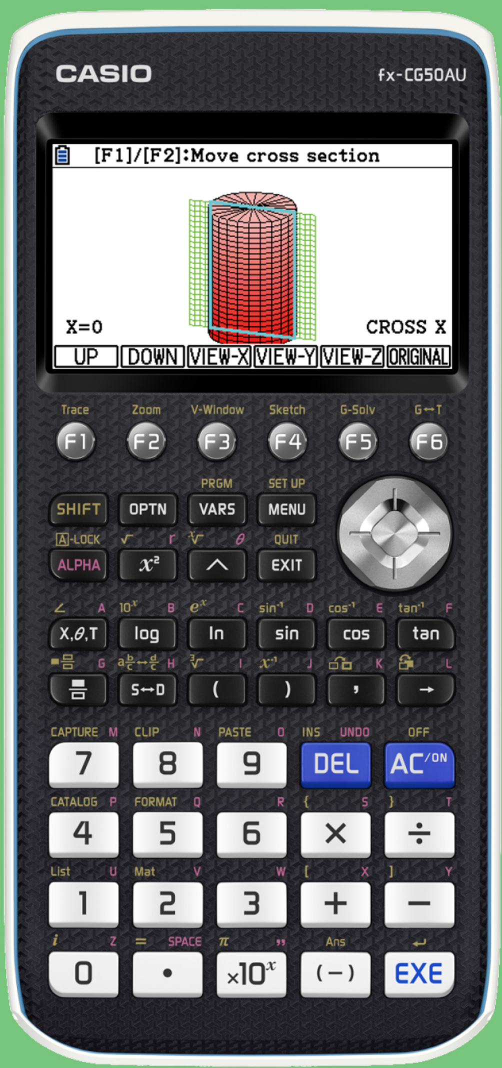
How Do I ……… on a CASIO fx-CG50 AU

A useable manual



- Getting started
- Displaying functions
- Analysing data
- Calculus
- Probability
- Matrices

Team Steps

Made in Australia

How Do I …….. on a
CASIO fx - CG50 AU

First published in 2017.

Questions about this publication should be directed to support@stepsinlogic.com

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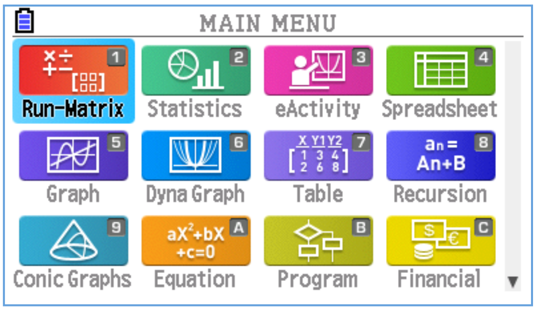
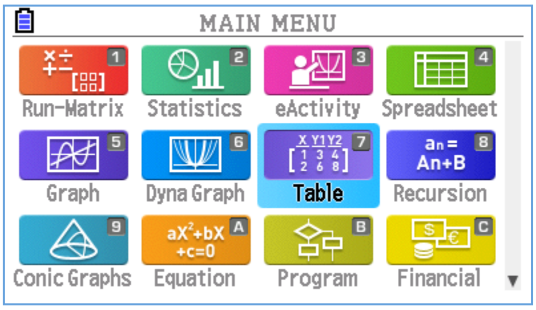
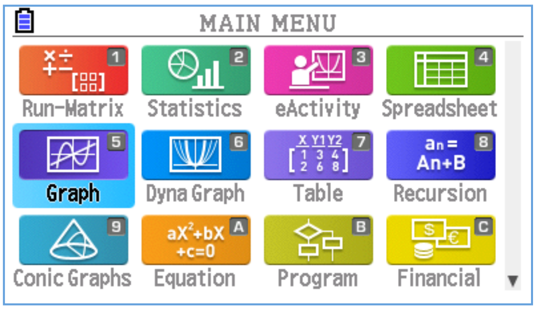
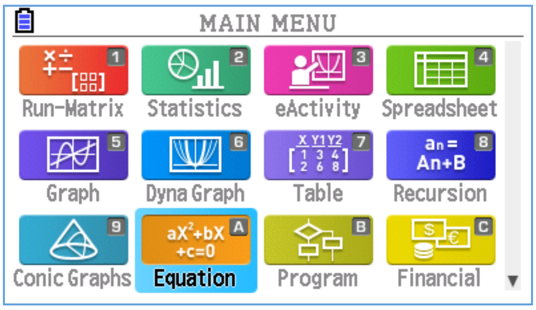
Contents

1. Out of the box









In this chapter we assume you have just taken the calculator out of the box and have not changed any of the out-of-the-box (aka factory) settings. If your calculator is not out-of-the-box, see section 1.2.

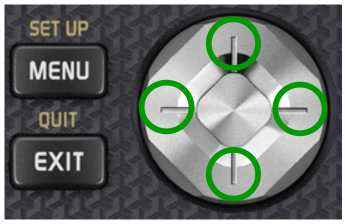
1.1 Straight out of the box

1. Put in the four AAA batteries.

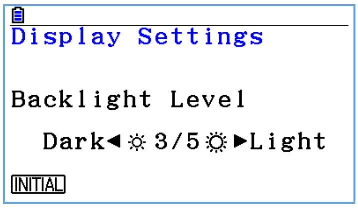
2. See if the machine has turned on. If it has you will see the screen shown below.

3. If you do not see the screen above, carefully insert a thin blunt object into the Restart button on the back of the calculator and press gently.

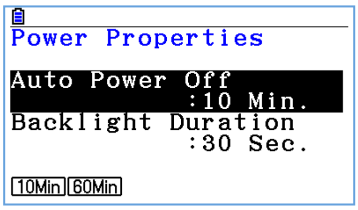
   Your calculator has a four-way navigation pad: left, right, up and down. We will use the symbols, ◀ ▶ ▲ ▼, to represent these keys. Use the ▶, ◀, ▼ and ▲ keys to move the cursor as required.



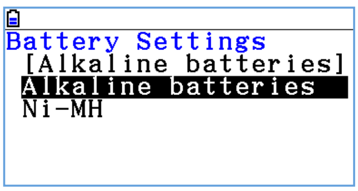
4. Position the pink arrow alongside the language in which you want messages to be displayed and press SELECT (F1) to that language, then press Next (F6) to move to the screen:



5. Use the ◀ ▶ keys to choose the brightness level you prefer, then press Next (F6) to move to the screen:



6. Choose either 10Min (F1) or 60Min (F2) for the Auto Power Off setting.
   Then press ▼ and choose 30Sec (F1), 1Min (F2) or 3Min (F3) as the length of time before the backlight dims.
   Press Next (F6) to move to the screen:

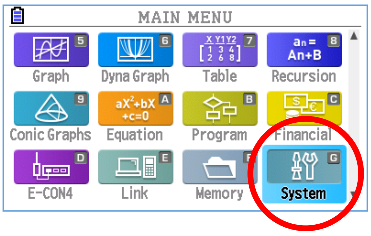


7. Select the type of batteries you have inserted and press SELECT (F1), press F1 again once you read the message and then Finish (F6).

   You are ready to start!

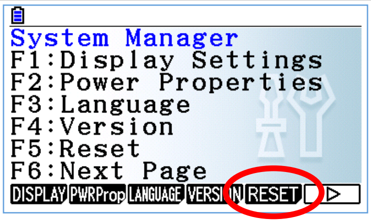
1.2 Not straight out of the box

If your calculator is not straight from the box, some of the calculator settings may be different to the factory (or default) settings. Before continuing in this book, please do the following *carefully*.

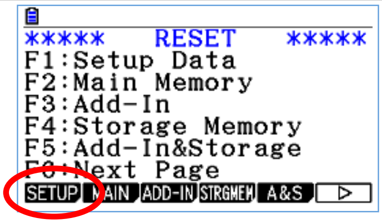


Use the ▶, ◀, ▼ and ▲ keys to navigate the MAIN MENU.

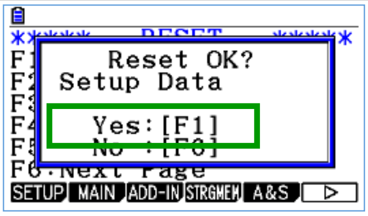
Navigate to the System application (it may not be visible on the screen so use the ▼ key) and EXE.



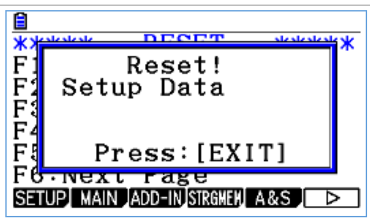
Choose RESET (F5)



Choose SETUP (F1)

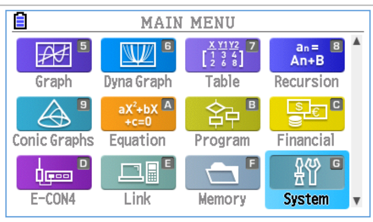


Choose Yes (F1).



All calculator settings will now be back to the factory (or default) settings.

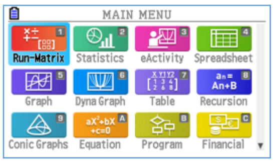
EXIT (just below the grey MENU key).



MENU to return to the MAIN MENU.

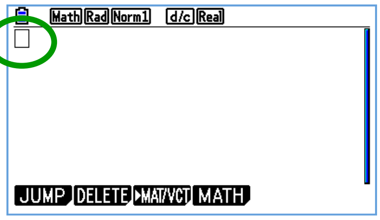
You are ready to start!

1.3 Some first steps



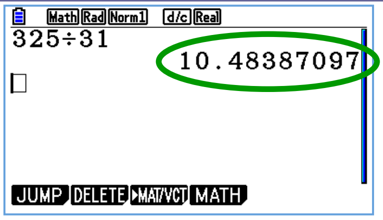
Select the Run-Matrix icon and [EXE] to launch the application.

An almost empty screen awaits you.



Notice the flashing cursor that flashes to the left of an empty box. This signifies the calculator is ready for you to enter a calculation.

Let's calculate **325 ÷ 31**.
Enter [3] [2] [5] [÷] [3] [1]

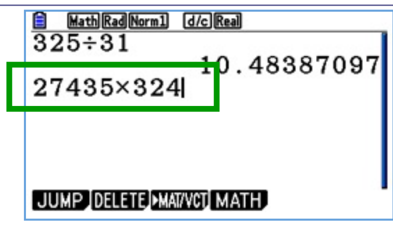


To have a calculation performed and the result displayed, press the blue [EXE] at the bottom right corner of the calculator.

The result is 10.48387097 and this is shown on the right side of the screen.

The cursor is now flashing in an empty input line waiting for your next calculation.

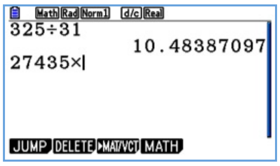
Let's calculate **27435 × 324**.
Enter [2] [7] [4] [3] [5] [×] [3] [2] [4] but do *NOT* press the EXE button.



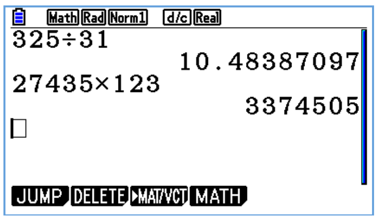
Suppose you made an entry error and we wanted **123** not **324**.

To delete characters in an input line, we use the [DEL] key.

Press it three times.



Now enter [1] [2] [3] and press the blue [EXE] key to calculate and see the result.

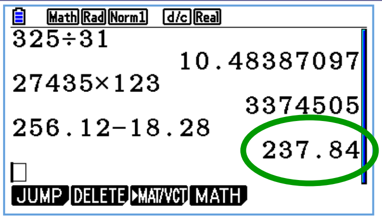


Now calculate **256.12 – 18.28**.

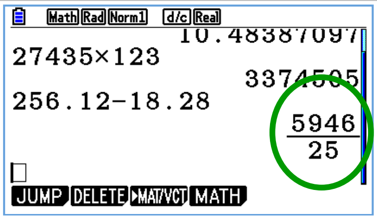
Enter [2] [5] [6] [•] etc.

Press [EXE] to calculate and see the result.

The decimal **237.84** results.



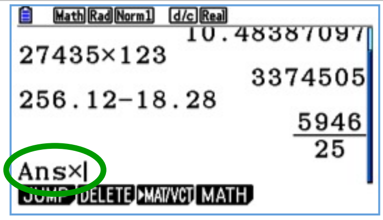
To see the fractional form of this decimal, press the [S⇔D] key.



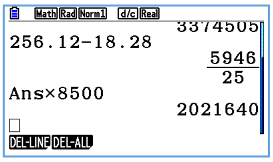
Suppose we wish to multiple our previous result by 8500.

Press the [×] key. Look what happened. The calculator automatically enters Ans×.

Enter [8] [5] [0] [0].

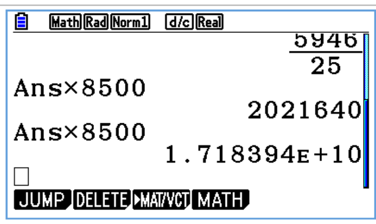


Press [EXE] for the result.



Press [EXE] again and you will see that the previous operation ($\times 8500$) is applied to the previous answer (2021640) automatically.

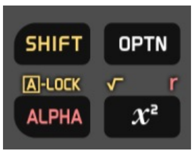
Note that 1.718394E+10 means 1.718394×10^{10}.



Let's calculate $\sqrt{32254}$.

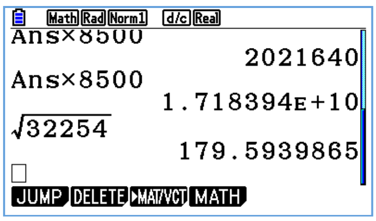
The square root entry is *above* the squaring key. It is yellow.

The squaring key has more than one function. To make it enter a square root we must first press the SHIFT key.



The SHIFT key is *not* like a computer shift key. Just press and release it, do not hold it down.

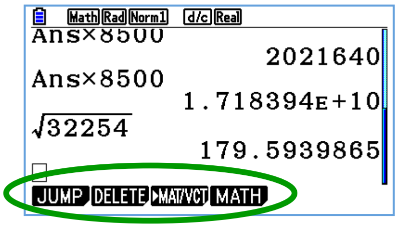
Enter [SHIFT] [x^2] (√) [3] [2] [2] [5] [4] [EXE] to see the result.



1.4 Deleting all, screen menus & F keys

This section follows on directly from the last section.

On the right, you can see the collection of calculations from the previous section.

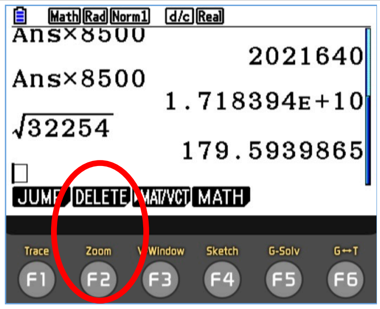


To delete all these calculations (i.e. clear the screen) we need to use one of the menus along the bottom of the screen.

We will call these menus the **screen menus**.

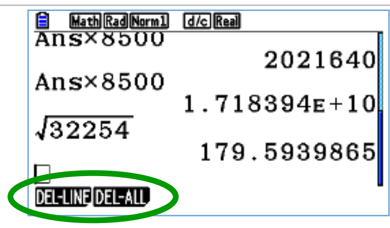
Note that the DEL key does not help with this process.

The screen menus are operated by the F keys that are directly below them. You will use this process a great deal as we proceed.

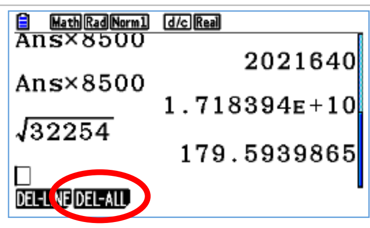


For example to use/open the DELETE menu you would press F2 because it is directly below DELETE.

Open the DELETE (F2) menu. Notice that the screen menus have changed.

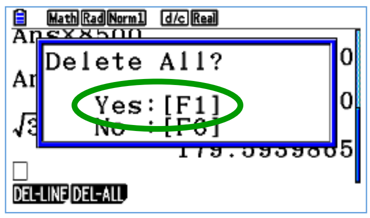


Two options exist. DEL-LINE (delete a single calculation line) and DEL-ALL (delete all calculations on the screen).

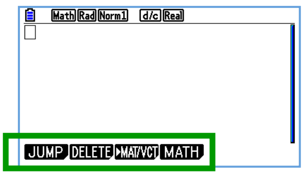


Open the DEL-ALL (F2) menu.

Now choose Yes by pressing F1.



A cleared screen results.

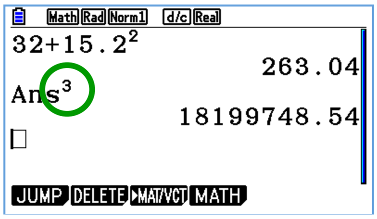


Note that the screen menus have returned to the *first level* set of options.

1.5 Editing, deleting & the EXIT key

Continuing in the 

application let's calculate $32+15.2^2$ and then find the cube of the result.

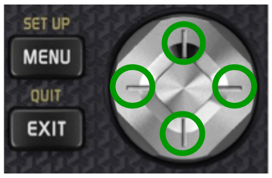


Enter the calculations seen on the screen to the right.

To enter the square, use the [x^2] key.

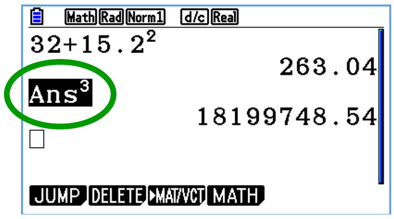
To cube the previous result press [^] followed by [3].

Suppose we wanted the 4th power of the previous answer and not the third. Previous calculations can be easily edited if mistakes have been made or changes are required. Your calculator has a four-way navigation pad: left, right, up and down.

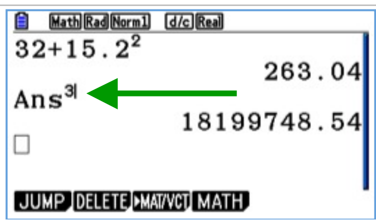


We will use these symbols to represent these keys: ◀ ▶ ▲ ▼

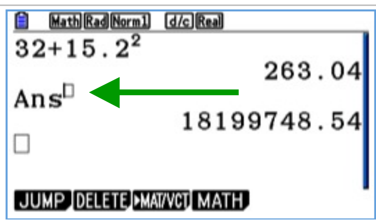
Press ▲ twice move the cursor up and select the last input we made.



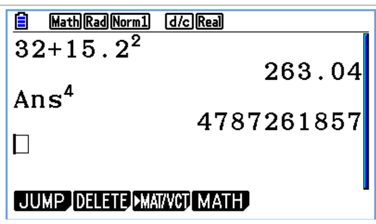
Use the ◀ or ▶ keys to move the cursor so it is flashing to the right of the 3 and is the same height of the 3.



Use the grey [DEL] key (not F2) to delete the 3.

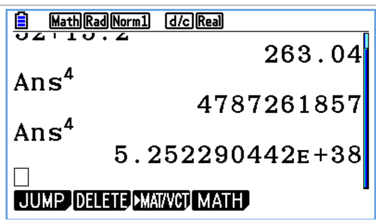


Enter [4] and then [EXE].

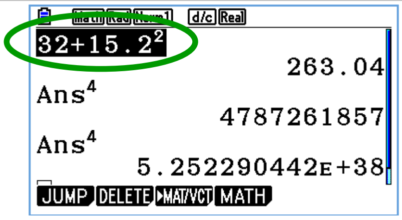


[EXE] again and you will see the previous operation is applied to the previous answer automatically.

Note that 5.252290442E+38 is the way the calculator displays the result in scientific notation (i.e. 5.252290442×10^{38}).



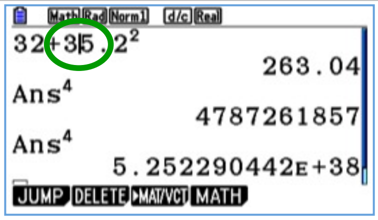
▲ ▲ ▲ ▲ ▲ ▲ to select the first input we entered.



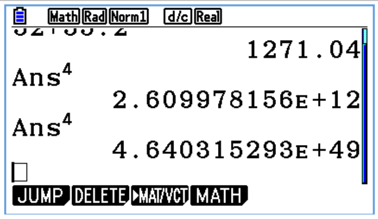
Use the ◀ or ▶ keys to move the cursor so it is flashing to the right of the 1 in 15.

Use the grey DEL key (*not* F2) to delete the 1

Enter 3 to make the 15 become 35.

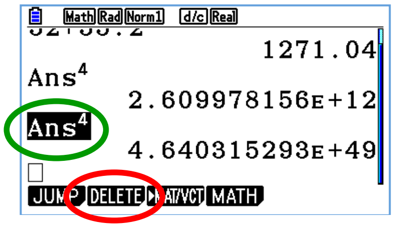


Press EXE and all calculations, below where the cursor was positioned, will be recalculated.

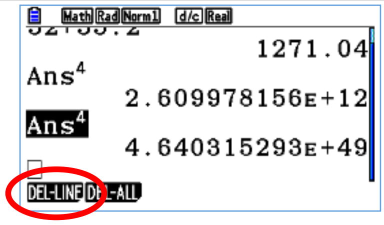


Previous calculations can be deleted one at a time or all at once.

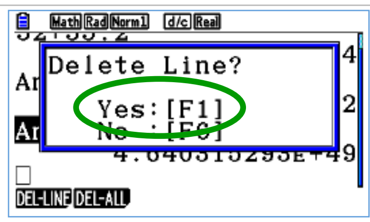
To delete just the last calculation line, use the ▲ key to select the input line, and then open DELETE (F2).



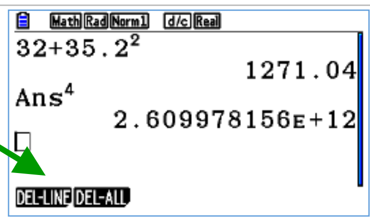
Now DEL-LINE (F1)



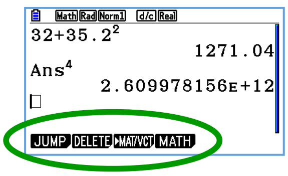
Finally choose Yes (F1).



Note that the screen menus are still as they were.



Press EXIT and the screen menus will return to the first level of options.



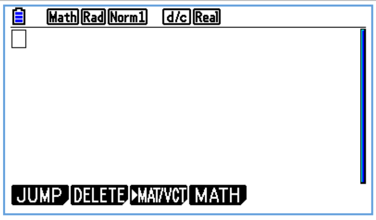
Delete all calculations now.

Open DELETE (F2).

Then open DEL-ALL (F2)

Then choose Yes (F1).

Note that the screen menus return to the first level automatically.

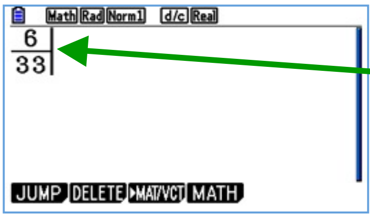


1.6 Fractions & decimal approximations

Fractions show the *exact* form of a number. For example, we know that $\frac{6}{33}+\frac{5}{33}$ is exactly equal to $\frac{1}{3}$ and that the decimal 0.333 (correct to 3 d.p) is an approximation for $\frac{1}{3}$.

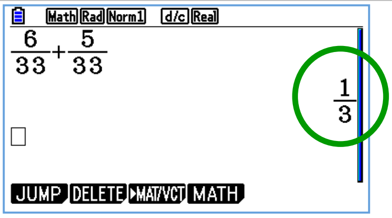
If the MAIN MENU is not showing, press [MENU]. Open the [Run-Matrix] application.

Calculate $\frac{6}{33}+\frac{5}{33}$ on the calculator. We will be using the fraction key, [$\frac{\square}{\square}$].



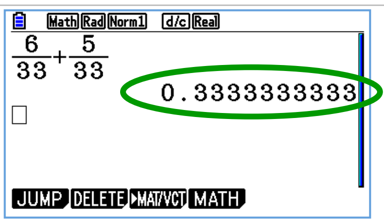
Enter [6] then [$\frac{\square}{\square}$] then [3] [3].

Use the [▶] to move the cursor out of the denominator so that it is flashing the full length of the fraction.



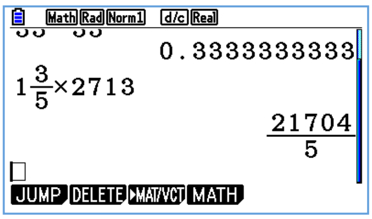
Enter the [+], then finish off the entry.

[EXE] to have the calculation performed and see the result. Note we get a number in exact form.



We can change the fraction to a decimal approximation by pressing the 'fraction to decimal' key, [S⇔D].

Calculate $1\frac{3}{5}\times 2713$ on the calculator.



To enter the mixed number $1\frac{3}{5}$,

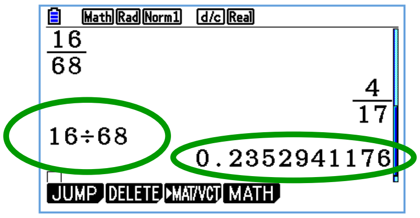
press [SHIFT] [$\frac{\square}{\square}$] ($\blacksquare\frac{\square}{\square}$) and then [1].

Use the [▶] and [▼] to move the cursor and enter the [3] and [5] and then use [▶] to move the cursor out of the denominator so that it is *flashing the full length of the fraction* and then complete the entry and [EXE].

The fraction key, , behaves a little differently to the ÷ .

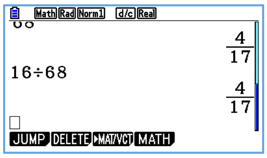
Enter the fraction $\frac{16}{68}$, using the key and then EXE .

Then enter the calculation $16 \div 68$ using the ÷ key and then EXE .

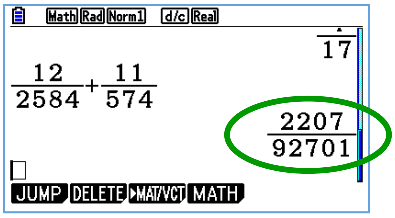


If you use the division operator (÷) as opposed to entering a fraction, the calculator assumes you want a decimal approximation.

S⇔D will convert the decimal to a fraction.

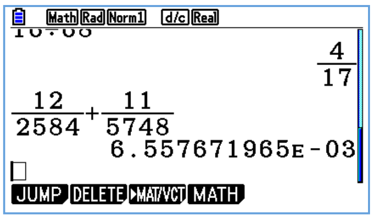


Calculate $\frac{12}{2548} + \frac{11}{574}$.



In this case, a fractional output is given.

Edit the previous calculation.
Change the 574 to 5748.



Changing the 574 to 5748 results in a decimal approximation being given.

Note that S⇔D will *not* provide a fraction in this case.

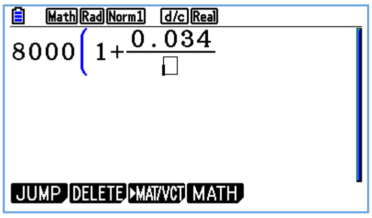
1.7 A financial calculation

Suppose we wish to calculate the value of an investment of $8000, five years after investing it in an account that pays interest of 3.4% p.a. compounded monthly. We can use the formula

$$A = P\left(1+\frac{r}{100}\right)^n.$$

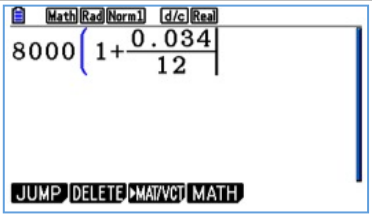
So, calculate $8000\left(1+\frac{0.034}{12}\right)^{60}$ on your calculator.

If the MAIN MENU is not showing, press MENU. Open the Run-Matrix application.



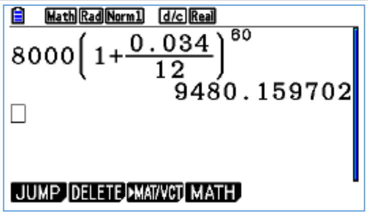
When entering the fraction, enter 0.034 and then press ▭.

The fraction structure appears and the cursor is flashing in the denominator ready for the next entry.



Enter 1 2.

Press the ▶ key to move the cursor to the right of the fraction.

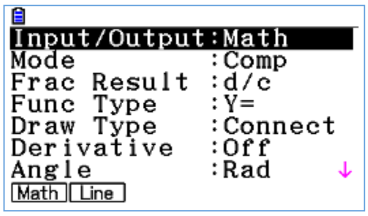


Enter the) then ^ then 6 0.

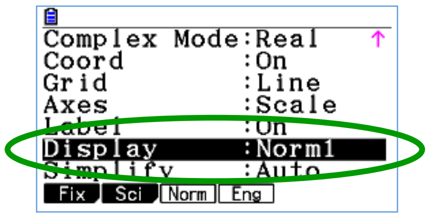
EXE to calculate and display the result.

It is possible to set up the calculator to display the result correct to two decimal places, a good idea for many financial calculations. This can be done in the SET UP menu.
Look above the MENU key, you will see SET UP.

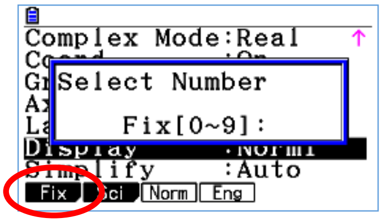
To enter the SET UP menu press (and release) SHIFT then MENU.
A list of settings that you can change will be displayed.



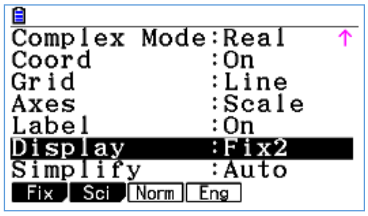
Use the ▼ or ▲ keys to locate the Display setting.



Here you can fix the number of decimal places to 2.
Open Fix (F1)

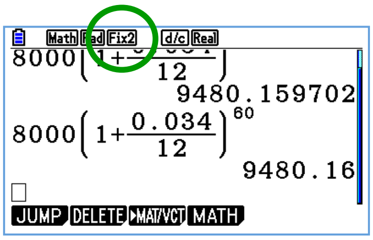


Enter 2 and then EXE. Display is now set to 'Fix2'.



Press EXIT to leave the settings list and then EXE to recalculate the previous calculation. Note it is now correct to 2 decimal places.

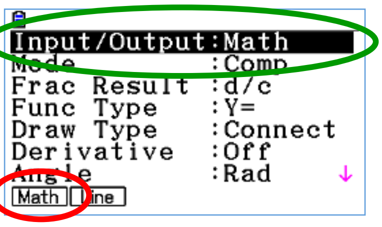
Also notice that the Display setting, Fix2, is displayed in the 'message bar' at the top of the screen.



Fix2 rounds the result correct to 2 decimal places. It does not truncate the result. There are two Norm (F3) settings, Norm1 and Norm2. One difference is that Norm1 displays positive numbers smaller than 0.01 in scientific notation whereas Norm2 displays positive numbers smaller than 0.000000001 in scientific notation. For most purposes Norm2 is the most useful display.

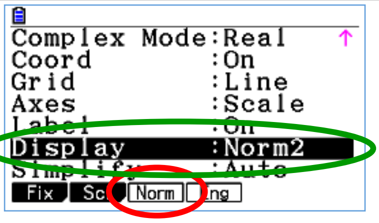
1.8 Math mode

In the Run-Matrix application, enter the SET UP menu by pressing (and releasing) SHIFT then MENU. We will check that Math Mode is selected and the Display is set to Norm2.



This calculator has two Input/Output modes, Math and Linear mode.
The factory mode is Math. We have been using this mode in the previous sections.

If Math is not already chosen, choose Math (F1) to choose it.

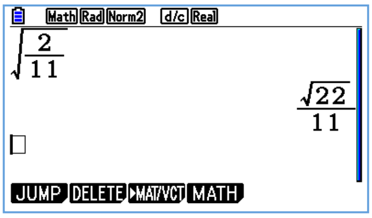


Use the ▲ key to select the Display setting. Set it to Norm2, if it is not already selected.
To do this, press Norm (F3) twice.

EXIT to leave the SET UP menu.

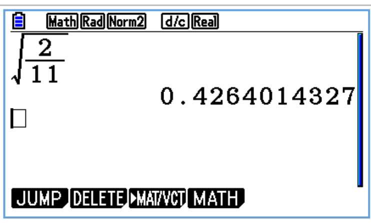
Math mode provides an input method that results in calculations having the form we would use on paper. It also provides results that involve square roots – numbers in exact form.

Enter $\sqrt{\dfrac{2}{11}}$ into the calculator.



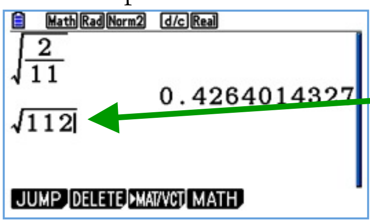
SHIFT then x^2 ($\sqrt{\ }$) followed by 2 and ▭ and then 1 1.

EXE to see the result. Note that $\sqrt{\dfrac{2}{11}} = \dfrac{\sqrt{2}}{\sqrt{11}} \times \dfrac{\sqrt{11}}{\sqrt{11}} = \dfrac{\sqrt{22}}{11}$

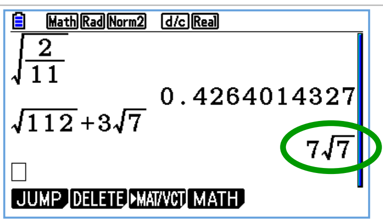


S⇔D will provide the decimal approximation.

Find a simplified form for $\sqrt{112} + 3\sqrt{7}$.



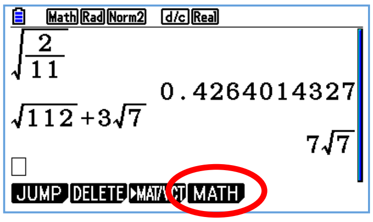
After entering the first part, the cursor is 'inside' the square root, it needs to be 'outside' the square root before continuing. Use the ▶ to move it outside.



We again get an exact form for this result.

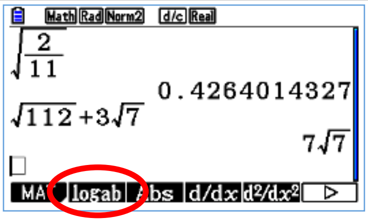
Note that $\sqrt{112} + 3\sqrt{7} = \sqrt{16 \times 7} + 3\sqrt{7} = 4\sqrt{7} + 3\sqrt{7} = 7\sqrt{7}$.

Calculate $\log_3 19683$.

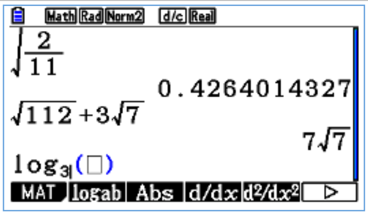


To enter this we need to use a screen menu.

Open MATH (F4).



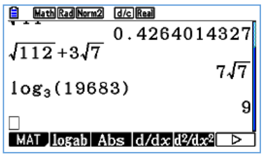
Choose logab (F2).



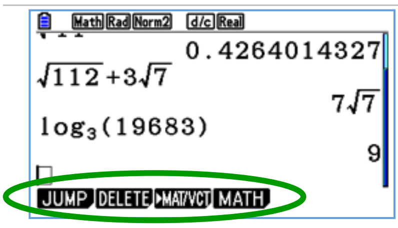
Enter 3.

Notice that the cursor is flashing in the *base* section of the calculation. Use the right cursor key (▶) to move the cursor into the location for the number and enter 1 9 6 8 3.

EXE to complete the calculation.

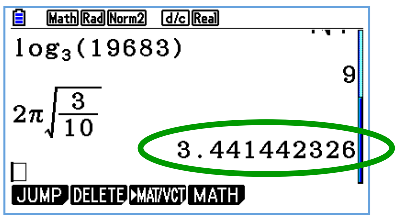


Note that the screen menus still show the options just used.



Press EXIT to return the screen menus to the first level.

Find a simplified form for $2\pi\sqrt{\frac{3}{10}}$.



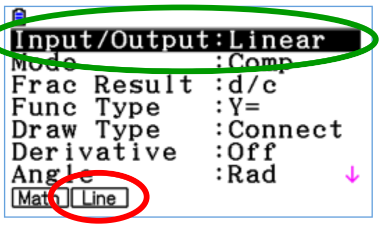
π is attached to the EXP key, so to enter it press SHIFT then EXP.

Note that we do not always get an exact form first.

Also note that pressing S⇔D in this case does not convert this decimal approximation to an exact form.

1.9 Linear mode

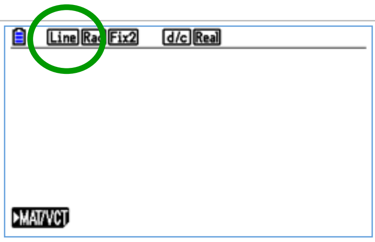
In the Run-Matrix application, enter the SET UP menu by pressing (and releasing) SHIFT then MENU.



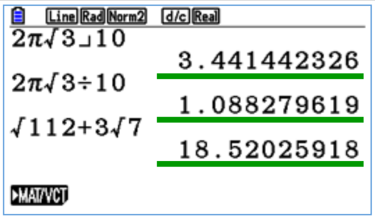
Set the Input/Output mode to Linear using Line (F2).

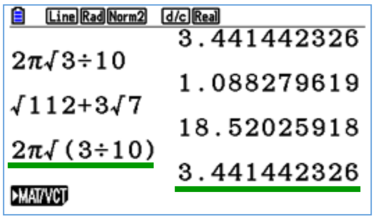
Linear mode is the input/output method used by 'older' calculators.

Press EXIT.



Notice that when you exit, all previous calculations done in Math mode have disappeared and the base menu is different. Linear Mode is essentially a different calculator than we were using in Math mode. There is a cursor flashing, ready for input. Also note that Line is displayed in the 'message' bar.





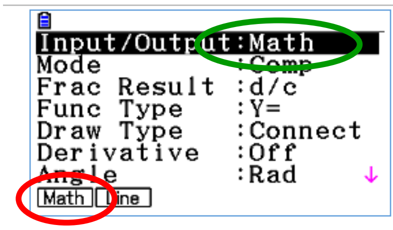
Enter the calculations on the left using the same keys used for this calculation earlier.

The ⌟ symbol is the 'old' fraction symbol.
Enter it with the key.

Note how the use of the division sign forced a different action. If you are unsure of how the machine will calculate, use brackets to avoid confusion in this mode.

A decimal approximation is given in all cases and the S⇔D key does *not* provide an exact form as was the case (sometimes) with Math mode.

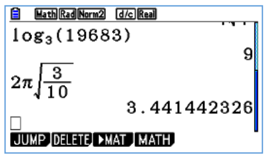
Linear mode mostly produces decimal approximations.



Revert back to Math mode.
Enter the SET UP menu by pressing (and releasing) SHIFT then MENU.

Then choose Math (F1). EXIT to leave the SET UP menu.

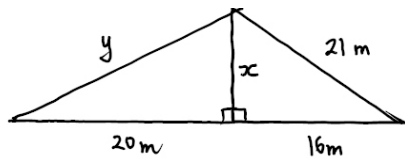
You will see the previous calculations are ready and waiting for you.



Input/Output:Math
All calculations performed in this book, following this point, will be done with the calculator operating in Math mode.

1.10 Square roots - Pythagoras

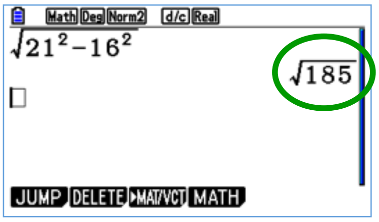
Suppose we need to determine the lengths of the currently unknown sides in the construction shown below. We could proceed as follows:



$$c^2 = a^2 + b^2$$
$$\Rightarrow 21^2 = 16^2 + x^2$$
$$\Rightarrow x = \sqrt{21^2 - 16^2}$$

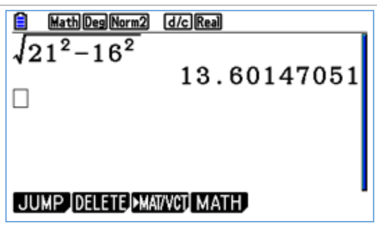
$$y^2 = 20^2 + x^2$$
$$\Rightarrow y = \sqrt{20^2 + x^2}$$

We can calculate a simplified form for x and y in the  application.

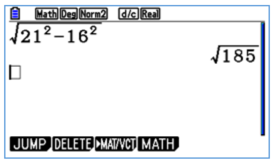


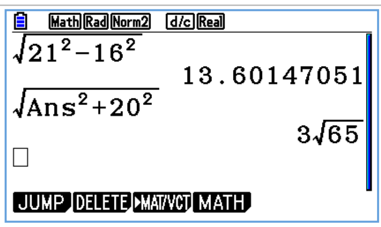
Enter the calculation as follows: SHIFT then x^2 ($\sqrt{\ }$) then 2 1 then x^2 then − then 1 6 then x^2. EXE to see the result of the calculation.

We get the length in simplified exact form.



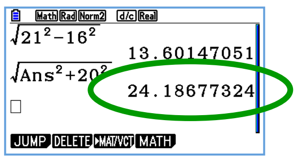
Pressing the S⇔D key repeatedly, will toggle the display between exact form and a decimal approximation.





The previous result can be used in the next calculation line by using the Ans function (SHIFT then (−)).

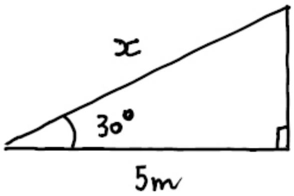
Pressing the S⇔D key provides a decimal approximation for the length of the hypotenuse.



So we find $x = \sqrt{185}$ m ≈ 13.6 m (correct to 1 d.p.)
and that $y = 3\sqrt{65}$ m ≈ 24.2 m (correct to 1 d.p.).

1.11 Trigonometric calculations

Suppose you are required to find the length of the currently unknown side in the diagram below. We could proceed as follows:

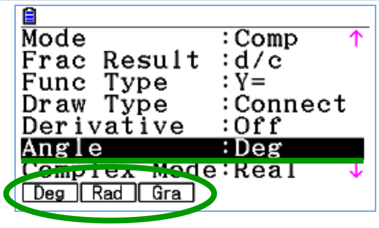


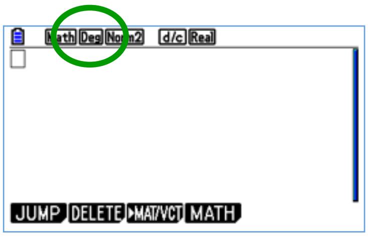
$$\cos\theta = \frac{A}{H}$$

$$\Rightarrow \cos 30^\circ = \frac{5}{x}$$

$$\Rightarrow x = \frac{5}{\cos 30^\circ}$$

We can calculate a simplified form for *x* in the  application.



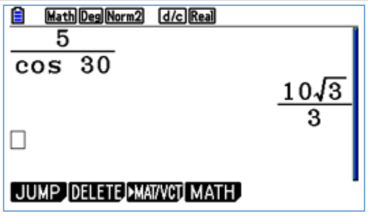


Trigonometric calculations require us to know what unit for an angle measurement the calculator is assuming.

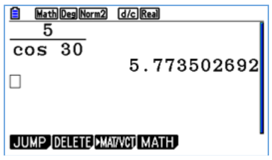
We can change this setting in the SET UP menu.

To enter the SET UP menu press (and release) SHIFT then MENU. Use the ▼ or ▲ keys to locate the Angle setting. There are three options: Degree, Radian and Gradian.

Choose Degree (F1) and then EXIT.
Note that Degree is displayed in the 'message' bar.

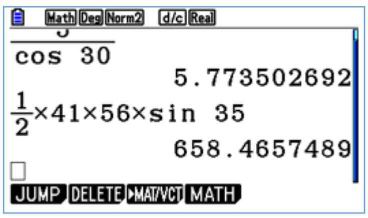


Enter 5 $a\frac{b}{c}$ and then cos 3 0. Then EXE.
Using S⇔D we see the decimal approximation.



So $x = \frac{10\sqrt{3}}{3}$ m ≈ 5.8 m (correct to 1 d.p.).

Look at the result of the calculation below, a decimal approximation results first.



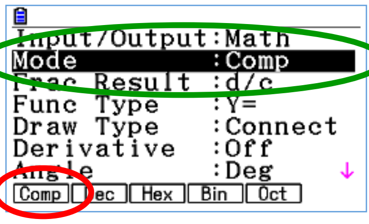
In the calculation above, the calculator recognised $\cos 30^\circ$ as having a simple exact value, $\frac{\sqrt{3}}{2}$.

However, in the calculation shown left, it cannot calculate an exact value for $\sin 35^\circ$ and so the output is shown as a decimal approximation.

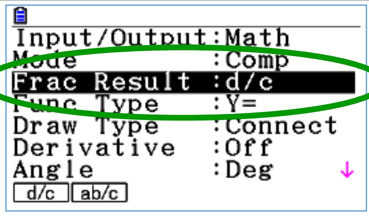
S⇔D does not reveal an exact value for this result.

1.12 The SET UP menu in Run-Matrix

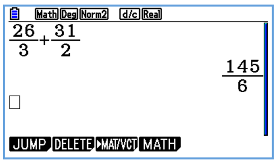
In the  application, enter the SET UP menu by pressing (and releasing) SHIFT then MENU. Use the cursor keys (▲, ▼) to move up and down the list of settings.

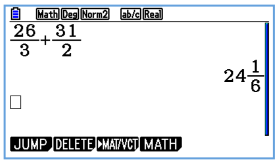


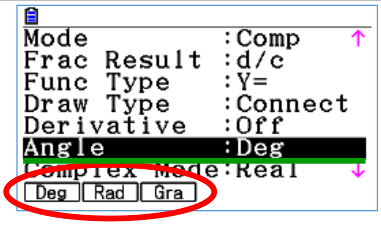
The factory setting for the calculation Mode is Comp. This is the mode to use for base 10 calculations, which is the vast majority of calculations performed in school mathematics. Choose Comp (F1) if Comp is not selected.



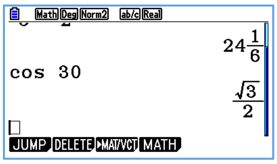
Frac Result is the setting that determines the form of a fraction's output that is larger than 1 or smaller than -1; d/c for improper fractions or ab/c for mixed numbers. Choose d/c (F1) or ab/c (F2) as required.



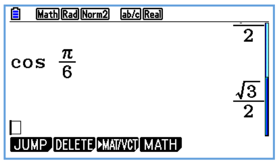




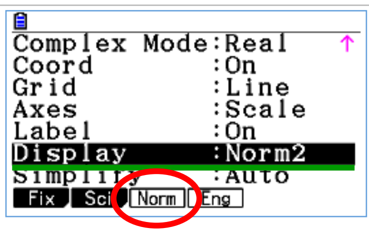
Angle is the setting that informs the calculator which angle unit you want it to use in calculations. There are three options: Degree, Radian and Gradian. Choose Deg for middle school work. Choose Deg (F1).



Degrees

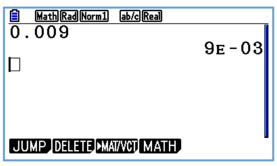


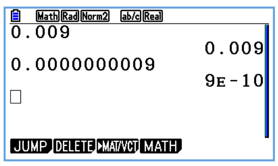
Radians



Display is the setting that provides information to the calculator about the accuracy/form of a numerical output. Repeatedly pressing Norm (F3) changes the setting between Norm1 and Norm2.

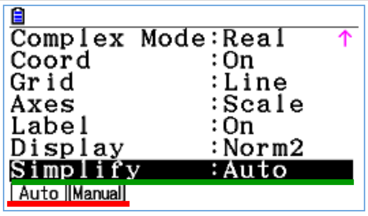
Norm1 displays positive numbers smaller than 0.01 in scientific notation. Norm2 displays positive numbers smaller than 0.000000001 in scientific notation.





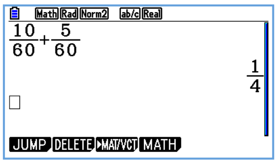
Note that 9E-3 is the calculators form of scientific notation (9×10^{-3}) which is equivalent to 0.009.

For most purposes, Norm2 is the most useful display. Choose Norm2.

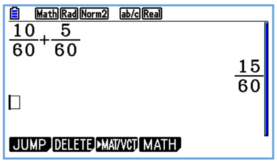


Simplify is the setting that informs the calculator whether or not you want fraction results displayed in simplest form automatically. Choose Auto (F1) or Manual (F2) to select Automatic or Manual.

If Auto is selected then:



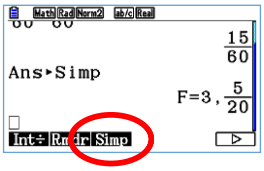
If Manual is selected then:

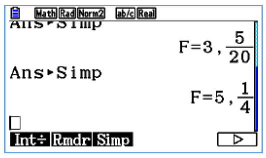


You can then see a series of steps of simplification using the Simp command.

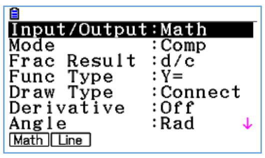
To find this command, press OPTN then open CALC (F4) then ▷ (F6) then ▷ (F6) and then choose Simp (F3).

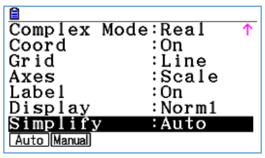
EXE to see one simplification and then EXE again to see the second.





The factory settings for the  are shown below.





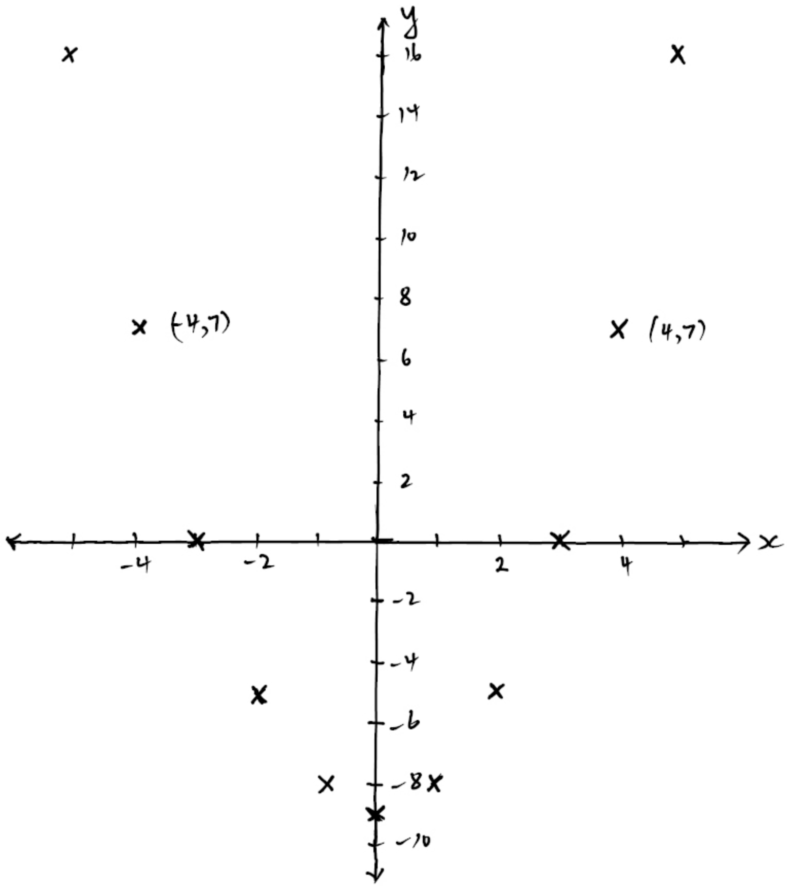
Simplify :Auto

All calculations performed in this book, following this point, will be done with the calculator set to Simplify Automatically.

1.13 A first table of values and a graph

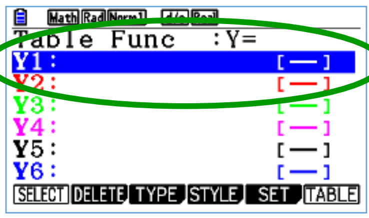
$y = x^2 - 9$ is a quadratic function. What does the graph of $y = x^2 - 9$ look like? We will begin as follows, calculating each value mentally and then plotting.

x	−5	−4	−3	−2	−1	0	1	2	3	4	5
y	16	7	0	−5	−8	−9	−8	−5	0	7	16



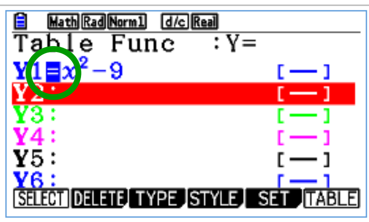
Now let's see if you can replicate this table of values and graph on your calculator.

If the MAIN MENU is not showing, press MENU. Open the  application.



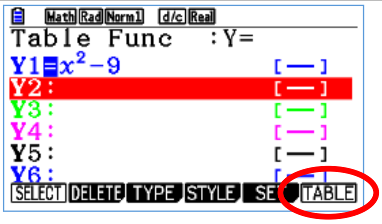
Note that the Y1 location is selected and the calculator is waiting for you to enter a function.

To enter an x for graph or table purposes we use the X,θ,T key.

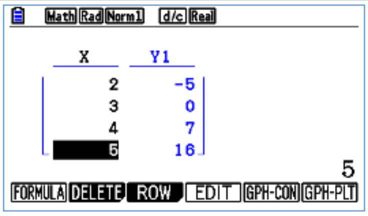


Enter X,θ,T , x^2 , − , 9 and EXE to lock it in.

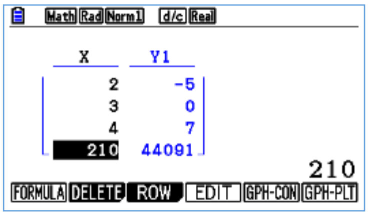
Note that the equals sign appears as = rather than =. This tells us Y1 is active (or selected) and a table will be made if requested.



Now make the TABLE (F6).



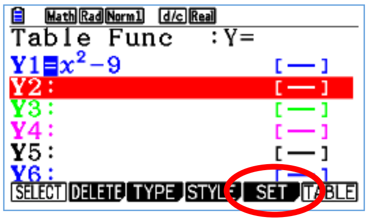
Use the cursor keys (▲, ▼, ◀, ▶) to navigate the table. Note that the table includes only integer values for $1 \le x \le 5$. This is the factory set of x values that are used by the calculator.

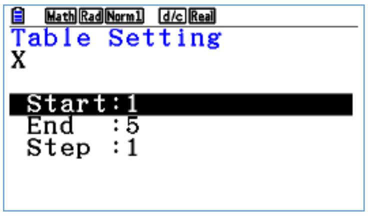


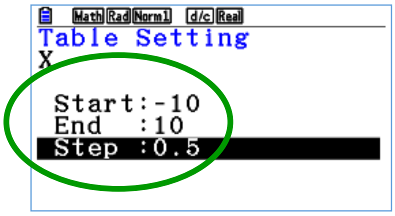
If you want to find the value of the function for a different value of x then you can use the cursor keys (▲, ▼, ◀, ▶) to select an x position in the table, type in the value (2 1 0 in this case) and then EXE.

Press EXIT to leave the table.

Instead of over-typing to find values, we can change the first x value, the last x value and the gap between the x values in the table.



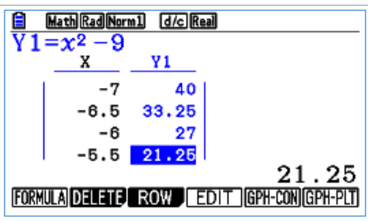




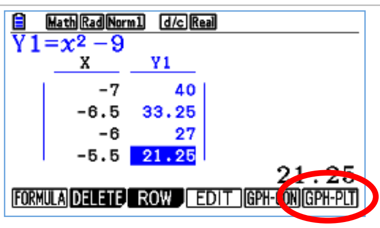
SET (F5) the Start, End and Step values to those shown above.

EXE after each entry.

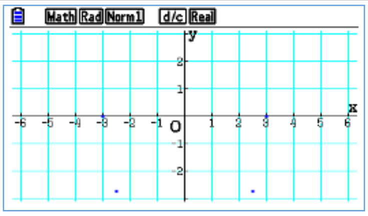
EXIT and make the table again.



Use the cursor keys (▲, ▼, ◀, ▶) to navigate the table.



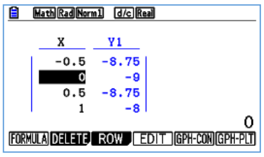
GPH-PLT (F6) will produce a graph of the values in the table.

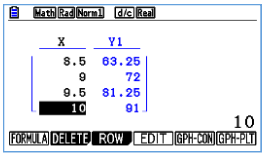


Not such a good view of the graph! You can see just two points.

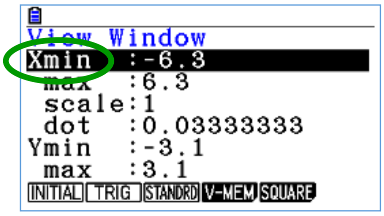
From the table you can see that this function produces values as small as -9 and as large as 91.

The endpoints of the axes (or the view-window settings) are not set up sensibly.





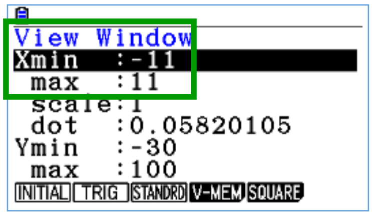
Now let's set the axes/view-window sensibly.



To see how the current axes are set up, we need to look at the View-Window settings.
To do this, press (and release) SHIFT then F3.

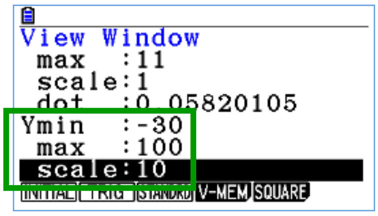
You can change the values of the axes endpoints, the left end (Xmin), right end (Xmax) and the scale (the distance between marks on the axis) of the *x*-axis and similar for the *y*.

Use the ▼ and ▲ arrows to move.



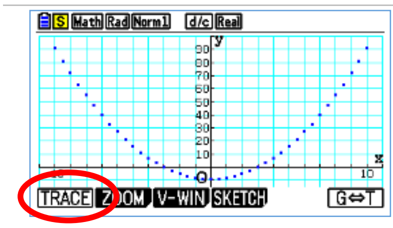
Change the values to those seen left.

EXE after each change.



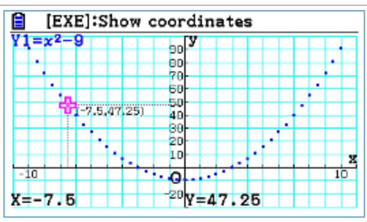
Note they are set a little 'outside' the *x* values of the table and outside the minimum and maximum values of the function.

The scale on the *y* axis will now show a tick mark every 10 units.



EXIT to leave the settings, choose TABLE (F6) and then GPH-PLT (F6).

Press SHIFT to reveal the options of the screen menu.
You can Trace (F1) along the graph.



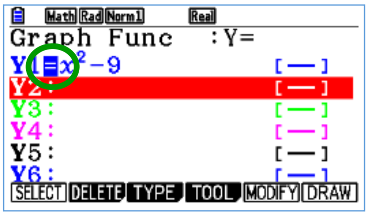
Use the ◀ and ▶ keys to move. Note the co-ordinates of the position of the cursor are shown at the base of the screen.
EXIT when you are finished.

1.14 From function directly to graph

It is possible to draw a graph of a function without first having made a table of values on the screen. If the MAIN MENU is not showing, press [MENU]. Open the 

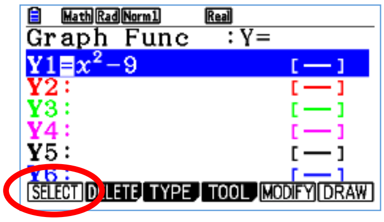
application.

The function entered previously in the Table application is also present here.
Use the [▼] to move the cursor off this function.



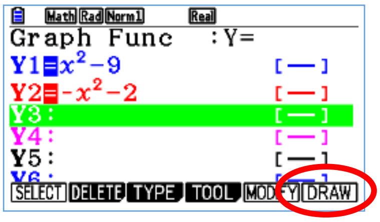
Y1 is currently 'selected'. You can tell this by noting that the equals sign appears as ▬ rather than =.
If selected, this function will be graphed.
In this case we want to graph a different function.

Now de-select Y1.



Rather than delete this function we will simply deselect it.
Place the cursor on Y1 ([▲]) and then deSELECT ([F1]).

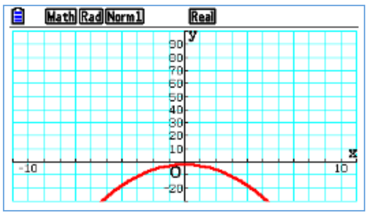
Define Y2 $= -x^2 - 2$.



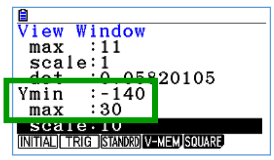
Move [▼] to position the cursor in Y2 and enter [(−)] [X,θ,T] [x^2] [−] [2].
[EXE] locks in the entry and also automatically selects this function to be the one that will be graphed.

DRAW ([F6]) the graph.

There is a lot of wasted space, so let's change the axes endpoints.

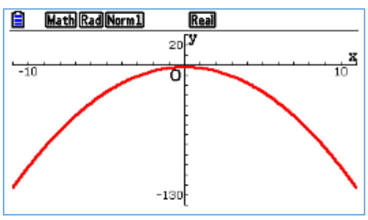


To change the endpoints of the axes, press (and release) [SHIFT] then [F3] to access the V-Window settings and change the endpoints to those shown below. -140 was chosen by doing a quick mental calculation, $(-11)^2 - 2$ and then decreasing this to give a little more space.



[EXIT] and DRAW ([F6]).

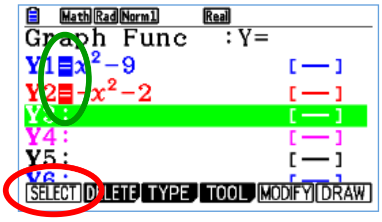
That is better!



Note that a 'continuous' graph is drawn in this case. The calculator has actually made a table of lots of values in its 'head' - and then draws all the points. However they are so close together (and there are so few pixels on the screen) that the illusion of continuity is achieved.

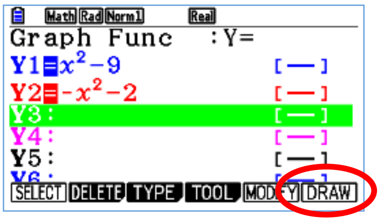
It is possible to draw more than one graph on the same axes.

EXIT from the graph and select both the functions that are entered.



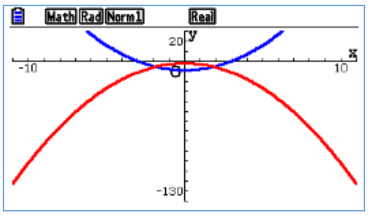
SELECT Y1, so that both functions, Y1 and Y2, are selected.

Now draw both graphs.

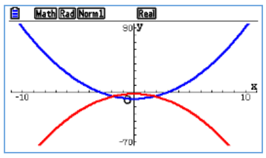


DRAW (F6) the graph of both functions.

Once drawn we can change the axes endpoints by small amounts easily.

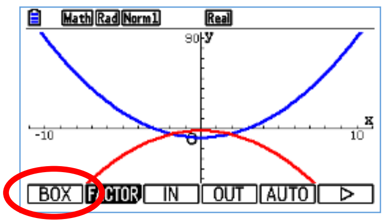


Once we have a graph, we can make small changes to the axes by using the ▲, ▼, ◀, ▶ keys. Try it out.



These two graphs seem to intersect. To gain a clearer view of this we could alter our axes endpoints in the View-Window settings or, we could use the Zoom options.

Now zoom into a section.

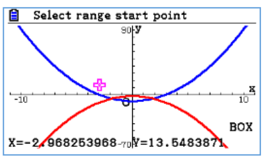


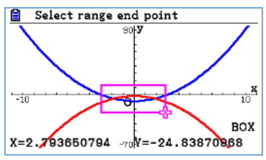
SHIFT then ZOOM (F2) and choose BOX (F1).

Use the cursors keys (▲, ◀) to move the cursor to the spot (approximately) shown below.

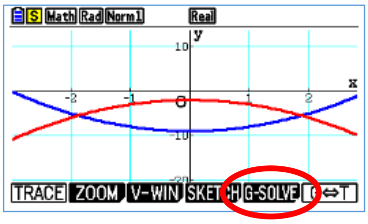
Then EXE and use the cursor keys (▶, ▼) to draw a rectangle similar to that shown below.

Then EXE to produce the graph, in the zoomed area.

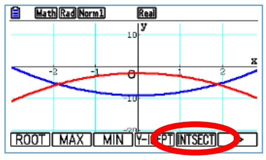




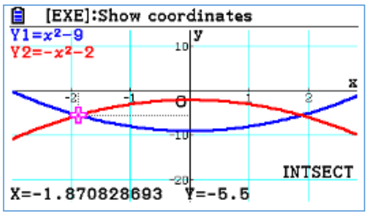
Now locate the points of intersection.



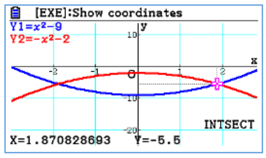
SHIFT reveals some options at the base of the screen. Choose G-SOLVE (F5) to reveal a series of things connected to the graphs that can be calculated. To find the intersection points, use INTSECT (F5).



Notice the cursor at the intersection points. You can select both.



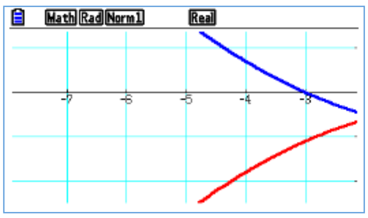
▶ to move the cursor to the other intersection point.

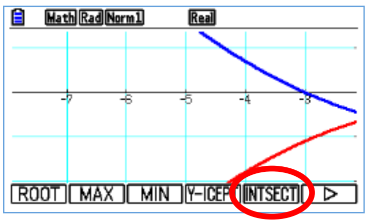


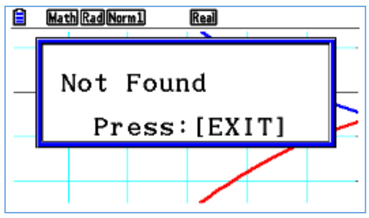
Use the ◀ and ▶ keys to move between the intersection points.

EXIT when done.

Below, the two graphs from above have been redrawn, but the ◀ key has been used to change the axes end points so that neither of the intersection points are on screen. Note what happens when we try to calculate them.







Key features of graphs, like maximum values, intersection points and so on will not be calculated by this calculator unless they are visible on the screen.

1.15 Solving an equation in Equation

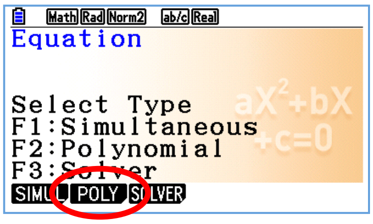
In the previous section we found the intersection points of the graphs of the functions $y = x^2 - 9$ and $y = -x^2 - 2$. Decimal approximations for the points of intersection were found. We could have approached this by solving the equation $x^2 - 9 = -x^2 - 2$ as follows:

$$
\begin{aligned}
& x^2 - 9 = -x^2 - 2 \\
\Rightarrow\ & 2x^2 - 9 = -2 \\
\Rightarrow\ & 2x^2 = 7 \\
\Rightarrow\ & x^2 = \tfrac{7}{2} \\
\Rightarrow\ & x = \pm\sqrt{\tfrac{7}{2}} \\
\Rightarrow\ & x = \pm\frac{\sqrt{14}}{2}
\end{aligned}
$$

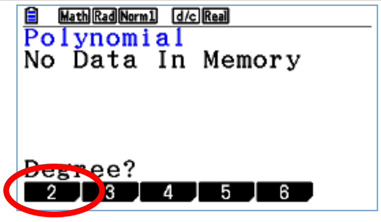
aside $\sqrt{\frac{7}{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{14}}{2}$

The calculator can produce the solutions to an equation like this without the use of a graph. It can also give the exact form, as in the solution above.

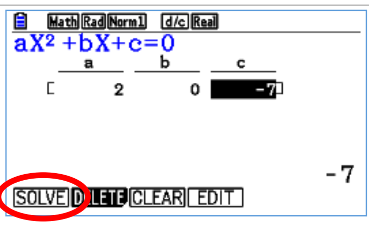
If the MAIN MENU is not showing, press MENU and then launch the Equation application.



This application can find solutions to simultaneous equations and polynomial equations, as well as some other equations that fall into neither of these two categories.
A quadratic equation is a polynomial, so open POLY (F2).

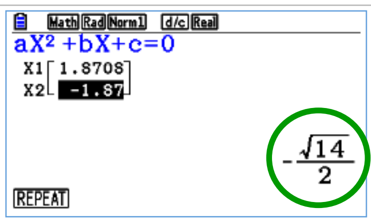


A quadratic is a 2nd degree polynomial, so choose 2 (F1).

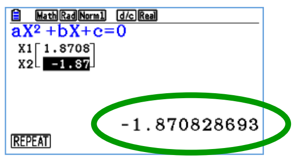


A matrix is supplied to enter the coefficients of the quadratic equation when in the form $ax^2 + bx + c = 0$.
So in this case we enter the coefficients 2, 0 and -7.
EXE after each entry.

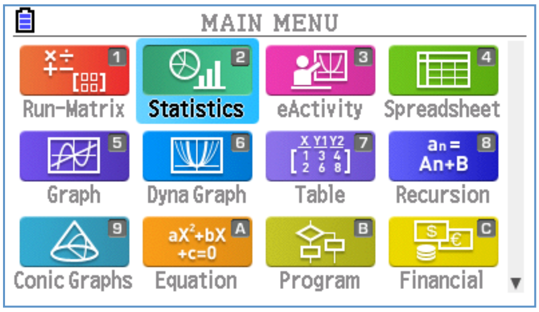
Now SOLVE (F1) the equation.

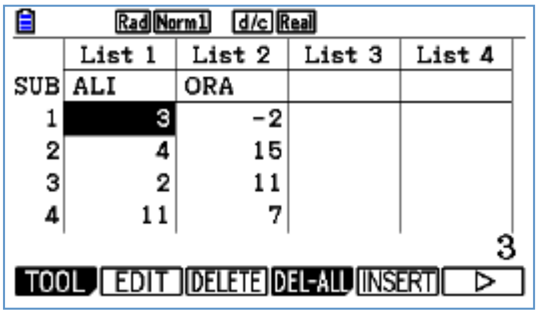


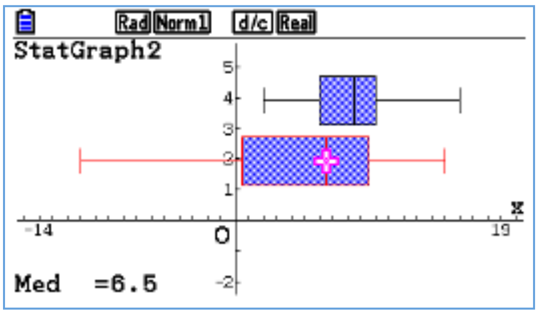
Both solutions to the equation are shown. Use the ▼ and ▲ keys to select the solution for which you want to see the exact result.
S⇔D changes the exact form to a decimal approximation with more decimal places than shown in the table.



2. Working with data in Statistics





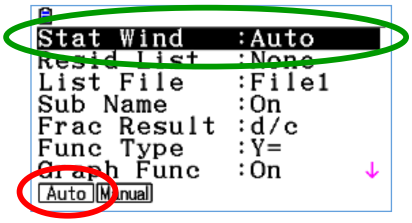


2.1 SET UP in Statistics

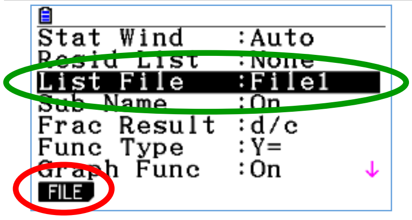
Launch the Statistics application.

Enter the SET UP menu by pressing (and releasing) SHIFT then MENU.

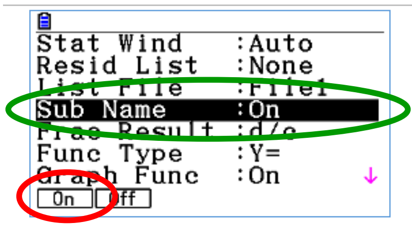
Use the cursor keys (▲, ▼) to move up and down the list of settings.



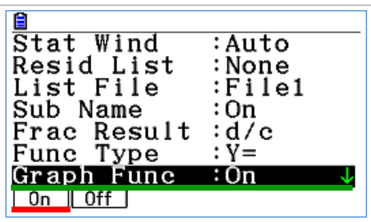
When the Stat Wind setting is set to Automatic, the calculator will determine a sensible set of values for the axes end values, based on the data entered.
Automatic is the most helpful setting in most cases.
Choose Auto (F1) to set this to Automatic.



When the List File setting is set to File1, the calculator is displaying the 26 lists that are collectively called File1.
Six files of twenty six lists exist.
Choose FILE (F1) to change the set of lists being displayed.



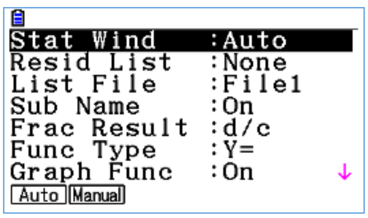
When the Subject Name setting is set to On, each list is able to be given a text name. This is most useful.
Choose On (F1) if this setting is not set to On.

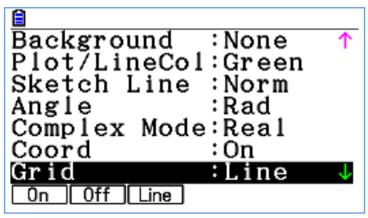


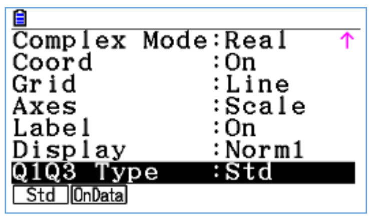
When the Graph Func setting is set to On, the name of the graph drawn will be displayed when it is being drawn or traced.
Choose On (F1) if this setting is not set to On.

Press EXIT to leave the SET UP menu.

The factory settings for the Statistics are shown below.







2.2 From data to boxplot

Ali and Ora compete in a challenge to see who can best estimate one quarter of the length of a strip of paper.

They are each presented with 16 paper strips 210 mm long. Each strip is held in front of them, one at a time, and they must cut the strip with scissors. They are not allowed to measure or take a lot of time. Rapid fire cutting and estimating is required.

52.5 mm is exactly one quarter of 210 mm. Not surprisingly, the lengths Ali and Ora cut were not all this length, but they varied.

52.5 mm was subtracted from each length cut by Ali and Ora to determine the error in each estimate. The data is shown below.

Ali's errors (mm)	3	4	2	11	9	9	11	11	8	5	8	9	8	16	7	9
Ora's errors (mm)	-2	15	11	7	2	9	5	9	15	6	-3	10	-11	-1	6	7

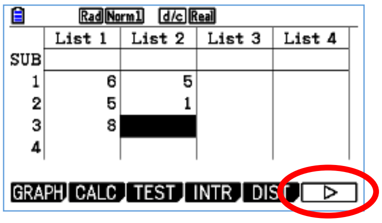
Who do you think is the better estimator of one quarter, based on these data?

To help us decide we will draw some plots and calculate some summary statistics.

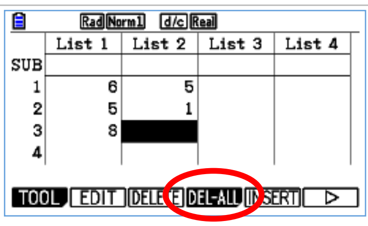
If the MAIN MENU is not showing, press MENU. Launch the 

application.

If data already exists in the lists then we need to delete it.

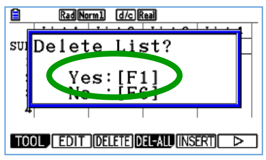


The deleting tools are in the screen menus that are currently hidden. To reveal them press ▷ (F6).



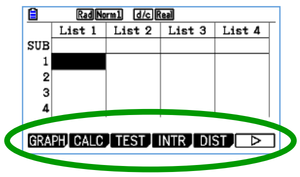
Place the cursor in the List in which the data you want to delete resides and open DEL-ALL (F4).

Choose Yes (F1).

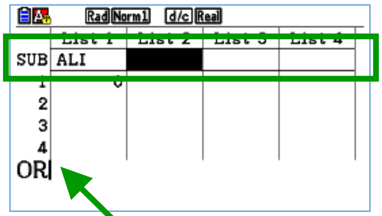


Repeat until all data is deleted from at least List 1 and List 2.

Press ▷ (F6) twice to return the first set of screen menus.



We can now enter the data.
We will start by entering the people's names in the SUBject line.



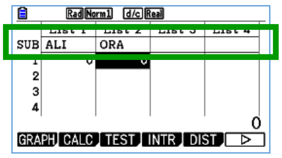
Use the cursor keys (▲, ▼, ◀, ▶) to place the cursor in the SUBject line of a list.

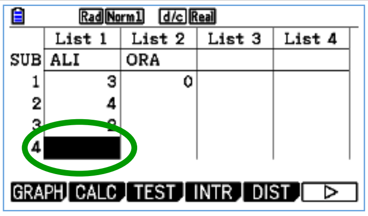
A key can be used to enter a text character if it has a red letter above it.

The red ALPHA key must be pressed first.
Or SHIFT then ALPHA to lock text mode on.

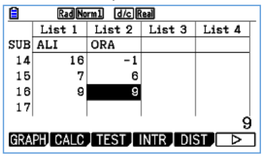
Press SHIFT and ALPHA to turn the lock text mode on.

Type in the name and press EXE to finish.

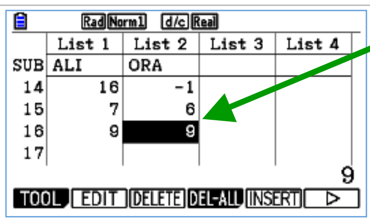




Place the cursor in cell 1 of List 1 and begin entering the data.
Press EXE between each entry.



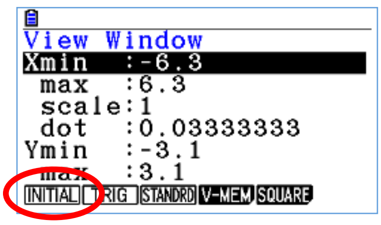
But what if I make a data entry error? See below for help.



If you make a data entry error, place the cursor on the error and type the correct value and press EXE.
If you need to delete a value, use ▷ (F6) to reveal the editing screen menu.
Place the cursor on the number in error.
Use DELETE (F3) to delete it.
Note you can use INSERT (F5) to insert a number in a list.

Make sure you have entered all of Ali and Ora's data seen on the previous page.

Set the axes endpoints (View-Window settings) to the initial settings.

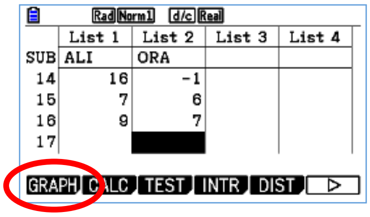


SHIFT then F3
Choose INITIAL (F1).

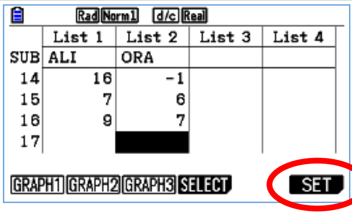
Even though the graphs drawn in Statistics will auto scale as a rule, doing this is wise as for some plots the scale marks are not auto scaled.

EXIT to leave the View-Window settings menu.

Now make a graphical display to compare the data. We will draw two boxplots, side by side.

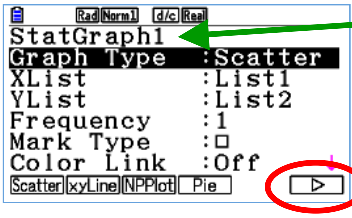


Open the GRAPH (F1) menu.



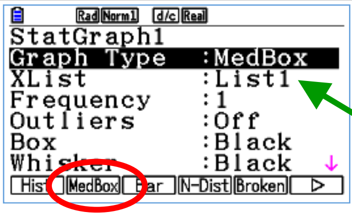
Open the Set (F6) menu.

We have to tell the calculator what type of plots we want.



Here we set up StatGraph1.
▼ to the Graph Type setting.

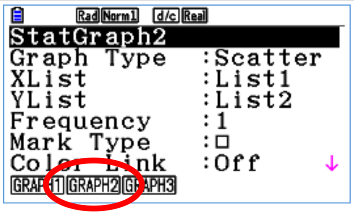
Use ▷ (F6) to reveal other options.



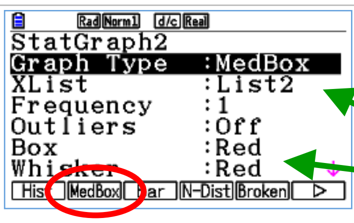
Choose MedBox (F2).

The Graph Type setting should say MedBox.

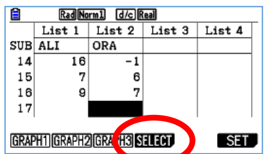
The XList should be set to List1.



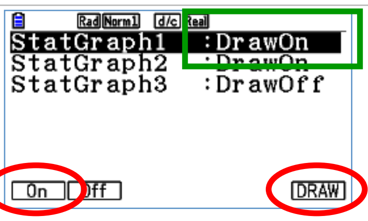
▲ to move the cursor to the top position. Now we set up StatGraph2.
Choose GRAPH2 (F2).



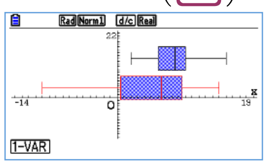
▼ to the Graph Type setting. Use ▷ (F6) to reveal other options.
Choose MedBox (F2).
The XList should be set to List2. ▼ and change.
Change the colour of the Box and Whisker to Red.
EXIT to leave this menu.



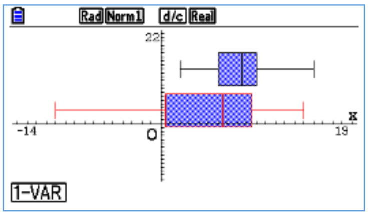
Now open SELECT (F4) to choose which plots to draw.



Set StatGraph1 and StatGraph2 to be DrawOn.
Choose On (F1). Then DRAW (F6) to see the plots.

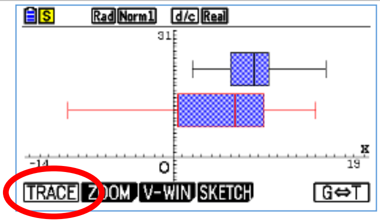


We will now trace the boxplots to see what they reveal.



First notice the Cartesian plane axes are 'in the way'.

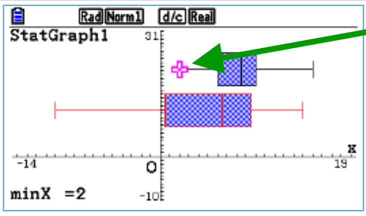
However, the *x*-axis is helpful in displaying the key values displayed by the boxplot.



Use ▲ to reposition the boxplots.

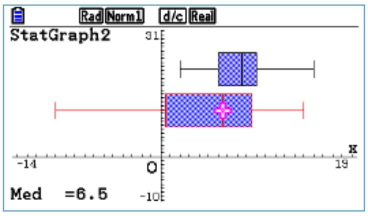
Press SHIFT to open some useful screen menus.

Choose TRACE (F1).



The cursor appears on the minimum value of StatGraph1's boxplot.

Use the ◀ ▶ keys to see other critical statistics.

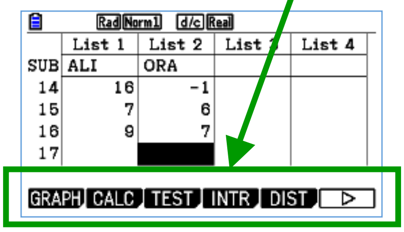


Use the ▼ ▲ keys to swap between boxplots.

Write down the 5-number summary for each person's data.

Do these values help you decide who is the better estimator of one quarter of the length of a 210 mm paper strip?

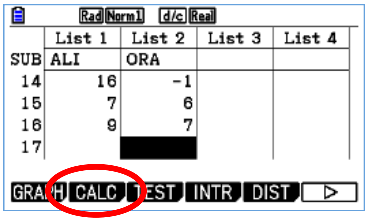
EXIT EXIT to leave the plot screen and return the screen menus to the first level for the STAT application.



2.3 From data to summary statistics

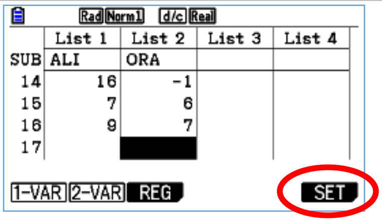
In this section we assume you have entered the data from Ali and Ora's challenge seen in section 2.2. If you have not, then go to section 2.2 and enter the data.

We will now see how to calculate a set of summary statistics for Ali's data (List 1).



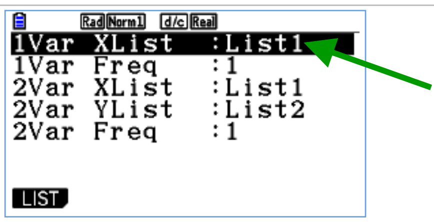
Be sure you can see the screen menus shown opposite. If not press EXIT until you can.
If you reach a point where EXIT does nothing and you cannot see these menus, press F6.

Open the CALC (F2) menu.



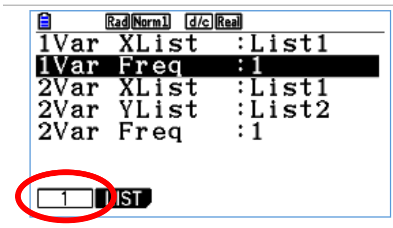
Open the Set (F6) menu.

We have set which list we want the calculator to calculate with.



We will focus on one variable at a time.

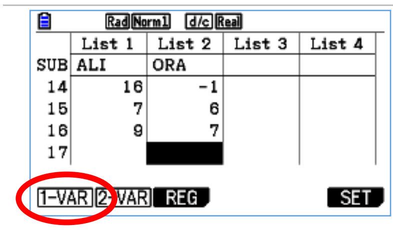
Set 1Var XList to be List1.
Open LIST (F1) if it is not set correctly.



to 1 Var Freq. It should be set to 1.
Use 1 (F1) if it is not set correctly.

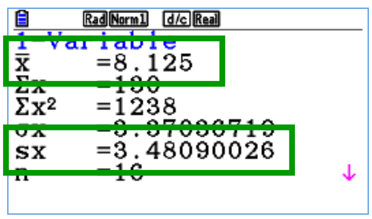
This setting means that each number in the list is a single strip of paper (in this case).

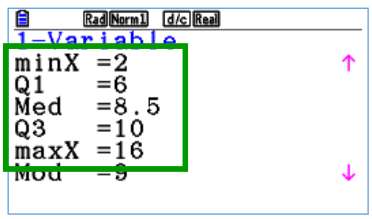
EXIT this screen.

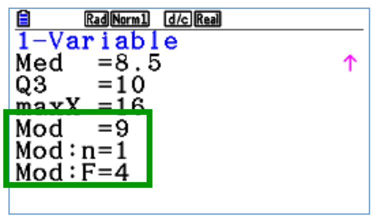


Use 1VAR (F1) to calculate the summary statistics.

Use the and keys to navigate up and down the list.

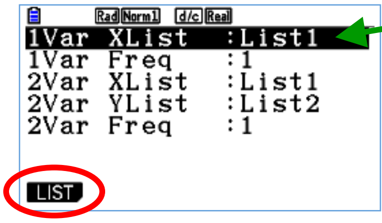






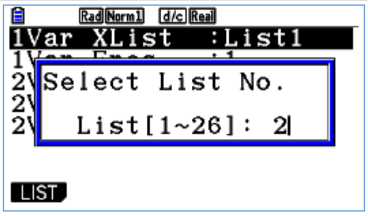
Highlighted above are the **sample mean** ($\bar{x}$), **sample standard deviation** (s), **5-number summary** and **mode**. The summary also tells us there is a single mode (n=1) and there are 4 values of that modal score.
EXIT to leave this screen.

Repeat this process for Ora's data (List 2).



Should be List 2, not List 1.

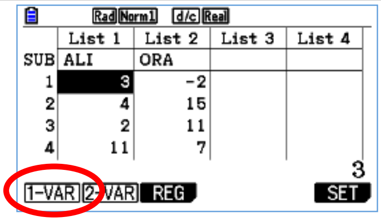
Open LIST (F1).



2

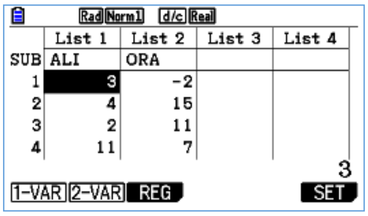
EXE

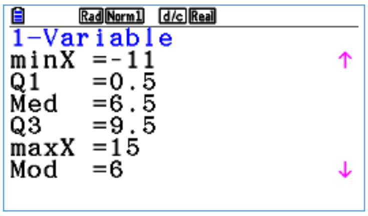
EXIT

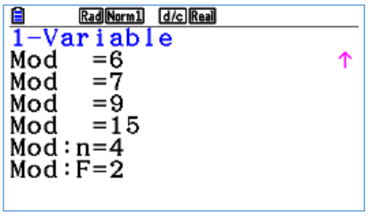


1VAR (F1)

Check your results against those seen below.







EXIT EXIT to leave this screen and return the screen menus to the first level for STAT.

2.4 From data to scatter plot

Suppose the following data results from a process where the value of y is partially determined by the value of x. Therefore, we might assume we could determine a rule for calculating y if given x.

Take a look at the data.

x	1	2	3	4	5	6	7	8
y	12	22.4	26.1	35	46.1	55	59	68

Can you determine a rule from looking at the data?
If you think about it, you might be able to.

x	1	2	3	4	5	6	7	8
y	12	22.4	26.1	35	46.1	55	59	68

10.4   3.7   8.9   11.1   8.9   4   9

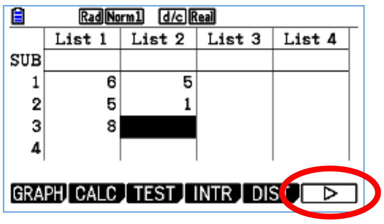
Average jump – 8 . Maybe it is a linear rule?

Maybe $y = 8x + 4$?

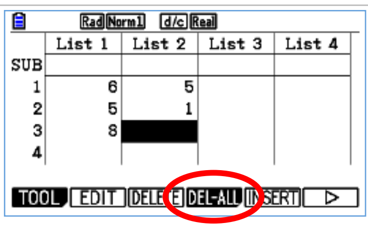
Let's now proceed by making a scatter plot of this data and seeing what it looks like.

If the MAIN MENU is not showing, press MENU . Launch the  application.

If data already exists in the lists then we need to delete it.

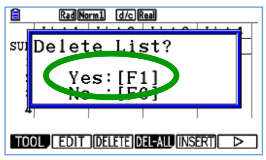


The deleting tools are in the screen menus that are currently hidden. To reveal them press ▷ (F6).



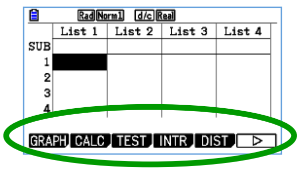
Place the cursor in the List in which the data you want to delete resides and open DEL-ALL (F4).

Choose Yes (F1).

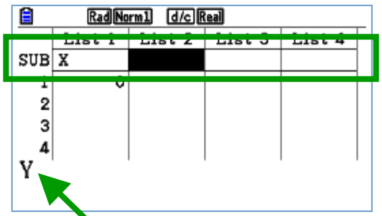


Repeat until all data is deleted from at least List 1 and List 2.

Press ▷ (F6) twice to return the first set of screen menus.



We can now enter the data.
We will start by entering the variables names in the SUBject line.



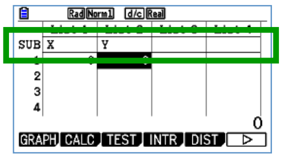
Use the cursor keys (▲, ▼, ◀, ▶) to place the cursor in the SUBject line of a list.

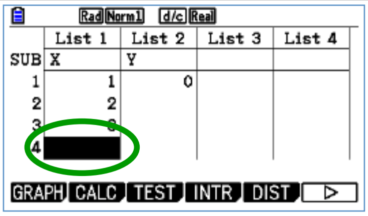
A key can be used to enter a text character if it has a red letter above it.

The red ALPHA key must be pressed first.
Or, SHIFT ALPHA to lock text mode on.

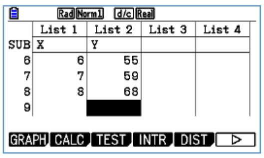
Press SHIFT and ALPHA to turn the text lock on.

Type in the name and press EXE to finish.

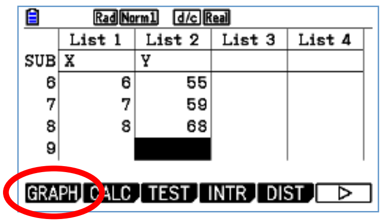




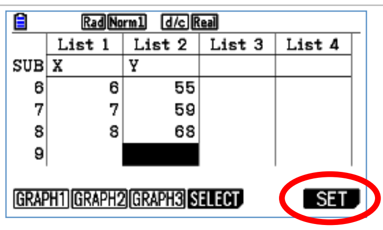
Place the cursor in cell 1 of List 1 and begin entering the data.
Press EXE between each entry.



We will now set up and draw a scatter plot.

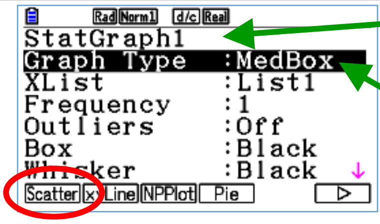


Open the GRAPH (F1) menu.



Open the Set (F6) menu.

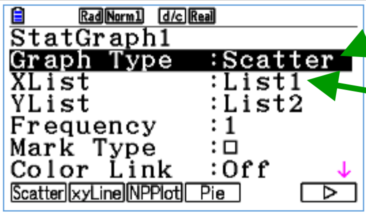
We have to tell the calculator what type of plot we want.



Here we set up StatGraph1.
to the Graph Type setting.

Note this screen shows MedBox now – wrong!

Choose Scatter (F1) to change it to Scatter.

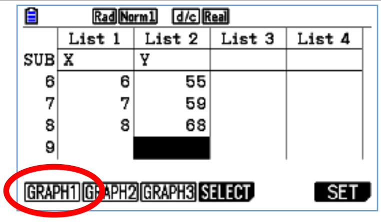


Now Graph Type is correct, Scatter.

The XList should be set to List1.
The YList should be set to List2.

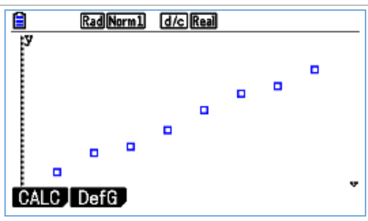
If not, open LIST (F1) and change them.

EXIT from this screen.



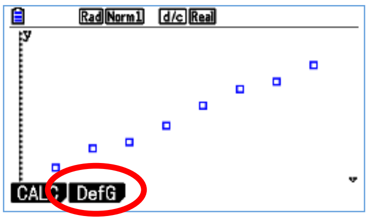
We can now draw the scatter plot. Since we are only drawing one graph, we do *not* need to SELECT and turn graphs on.

Simply use GRAPH1 (F1) to draw the scatter plot.

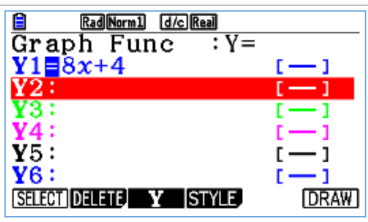


So, it appears as if the data may be related linearly.

Remember I thought that the rule might be $y = 8x + 4$. Let's draw that function over the data and see if my thinking was correct.

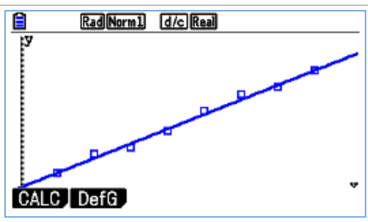


Open the DefG (F2) menu.



Note to enter an x for a function we use the X,θ,T key.
Enter 8 X,θ,T + 4.
EXE to lock it in (select it so it is active).

Now use DRAW (F6) to draw the graph.



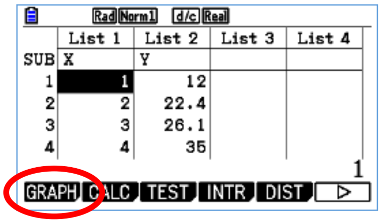
Not bad!

EXIT EXIT to leave the graph screen and return the screen menus to the first level for STAT.

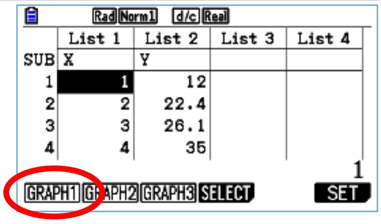
2.5 Least squares line

In this section we assume you have entered the data from section 2.4 and worked through the process it illustrated. If you have not, go back to section 2.4.

The calculator can calculate the least squares line (a straight line of best fit).
First we make the scatterplot.



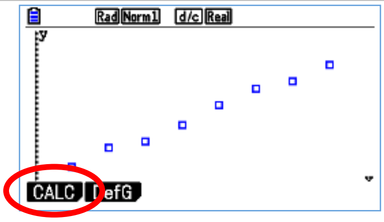
Open the GRAPH (F1) menu.



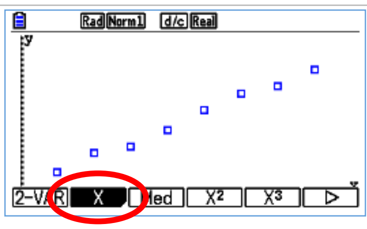
Use GRAPH1 (F1) to draw make the scatterplot.

We have already set this up in Section 2.3.

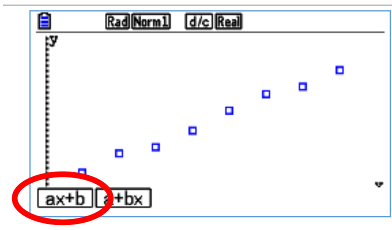
We have to tell the calculator what type of plot we want.



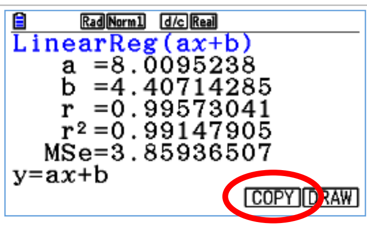
Open the CALC (F1) menu.



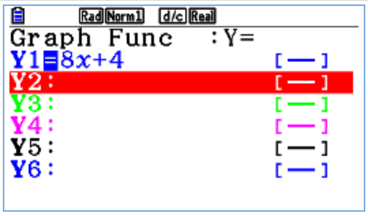
Open the X (F2) menu. This is the least squares menu.



Choose ax+b (F1).

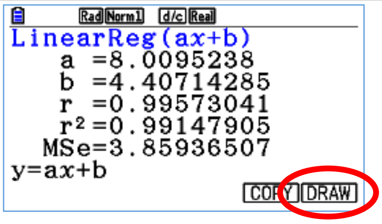


The details of the least squares line is given.
Pretty close to my original thinking!
We can copy the equation into a function slot for later use.
Choose COPY (F5).

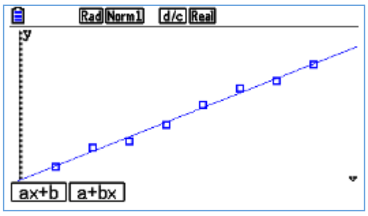


▼ to the Y2 position.

EXE will perform the copying process.



DRAW (F6) the scatterplot with the least squares line over the top.



Of course just because we have a line of best fit, does not mean is it a good model for the data. To be a good model, we would want the data to be randomly scattered above and below the line, no patterns. And we would not want the data points to be too far from the line (vertically).

To see how this data fares in this sense, we could look at the residuals and a residual plot.

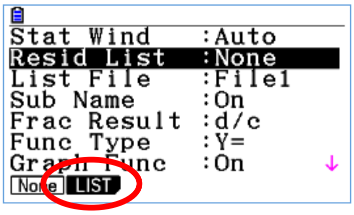
EXIT EXIT EXIT EXIT to leave the graph screen and return the screen menus to the first level for Statistics.

2.6 Residuals and a residual plot

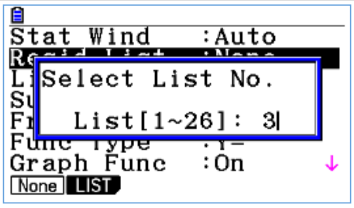
In this section we assume you have entered the data from section 2.4 and worked through the processes illustrated in section 2.4 and 2.5. If you have not, go back to sections 2.4 and 2.5.

The calculator can calculate the residuals associated with a least squares line. First we turn on the residual mode in SET UP.

Open the Statistics application and enter the SET UP menu by pressing (and releasing) SHIFT then MENU. Use the cursor keys (▲, ▼) to move up and down the list of settings.

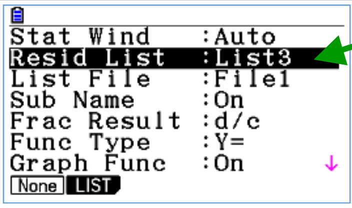


Currently Resid List is set to None.
Open the LIST (F2) menu.



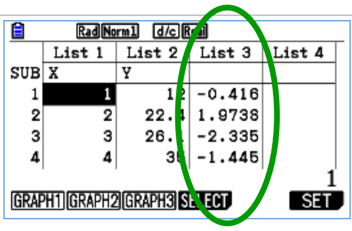
Enter 3 to store the residuals that are calculated in List 3.

EXE



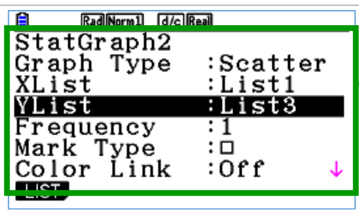
List 3 should now be chosen.

EXIT to leave this screen.

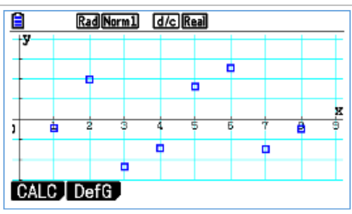


Open GRAPH (F1) menu.
Choose GRAPH1 (F1)
Open CALC (F1) menu.
Open the X (F2) menu.
Choose ax+b (F1).
EXIT and the residuals should have been calculated.

Open SET (F6) to set up a graph of the residuals.

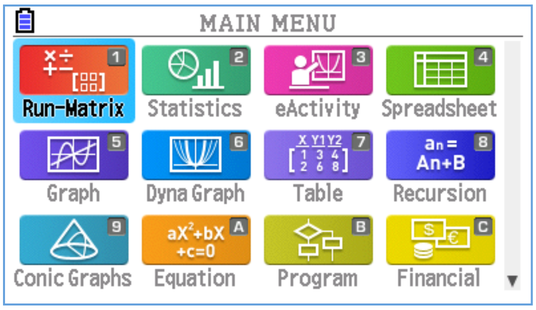


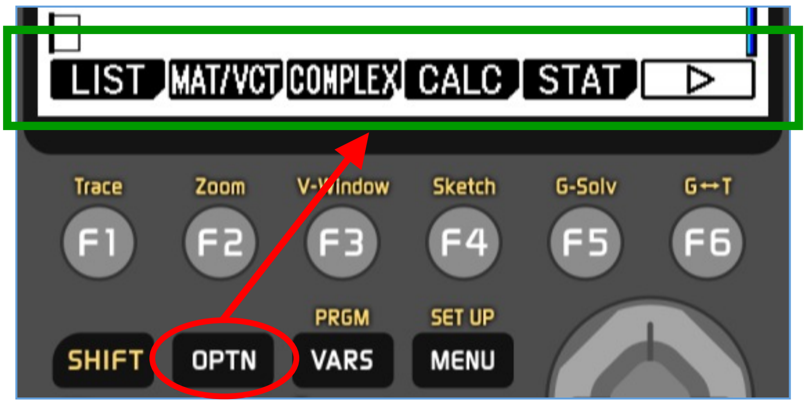
To set up StatGraph2, choose GRAPH2 (F2).
Change each setting as required to be the same as those shown left.
EXIT to leave this screen.
Use GRAPH2 (F2) to draw the residual plot.



And there it is; a residual plot to consider.

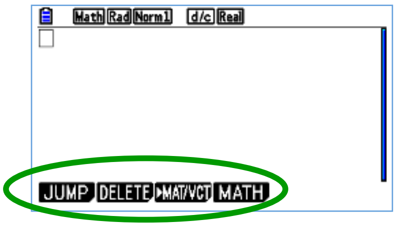
3. OPTN key, random numbers, histograms





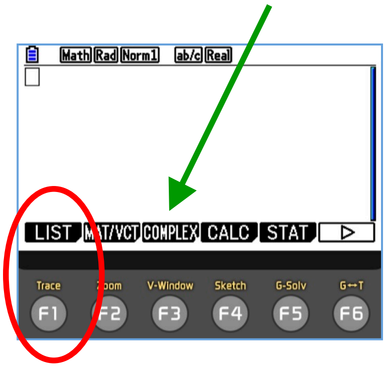
3.1 Navigating the OPTN menus

Open the  application.



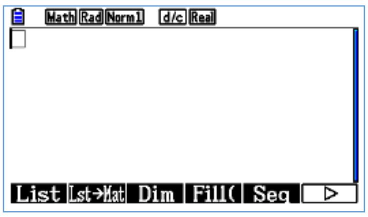
You can see the first level of screen menus for this application.

Press the option key, OPTN, on your keypad. It is just right of the yellow SHIFT key. You will notice that the screen menus change to the OPTN set.



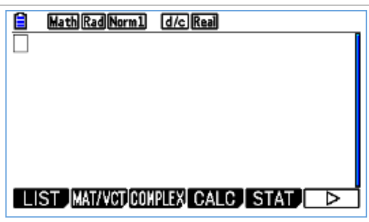
Notice the style of the first five options.
White text on a black rectangle with the corner cut off.
This indicates that the option is a menu and can be opened to reveal more options.
The menus can be opened by pressing the F keys directly below them

Open the LIST menu (F1).

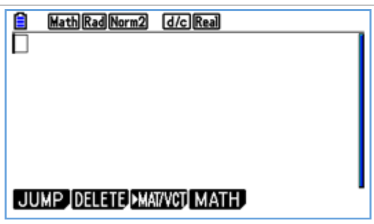


Notice the options now take a different form. No corner is cut off the rectangle.

This indicates it is a command as opposed to a menu.



Press EXIT to close the menu you are currently in (i.e. to go back one step in the menus).

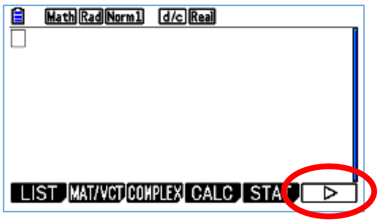


Press EXIT to close the menu you are currently in. This time we arrive back to the first level screen menu for the

application.

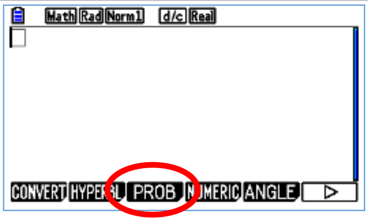
3.2 Random numbers

Launch the  application. Press OPTN key.

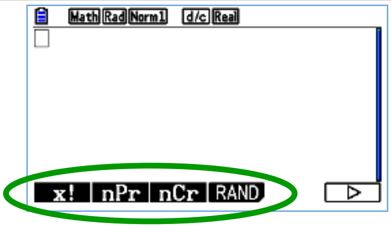


The sixth option, ▷, indicates there are more options at this level hiding around the corner. We will represent this option with ▷ (F6).

Press ▷ (F6).



Open the PROB (F3) menu.



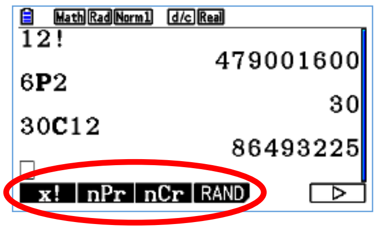
We can see three commands, one menu (RAND) and ▷. The three commands are the factorial command, the permutation command and the combination command.

Calculate

a) 12!

b) P_2^6

c) C_{12}^{30}

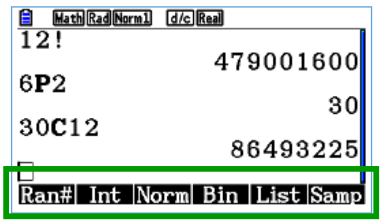


Enter 1 2 x! (F1) EXE.

Enter 6 nPr (F2) 2 EXE.

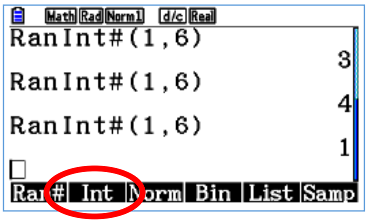
Enter 3 0 nCr (F3) 1 2 EXE.

Open the RAND (F4) menu.



This menu provides a variety of options associated with generating pseudo-random numbers.

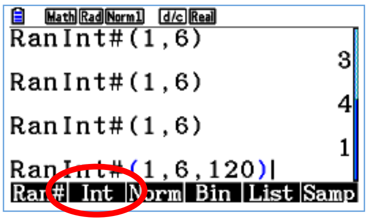
Let’s simulate the rolling of a fair die. To do this, we will generate pseudo-random integers between 1 and 6 inclusive.
The answers you receive will be different to mine, due to the pseudo-random process used.



Enter:
Int (F2) and then 1 , 6) EXE.

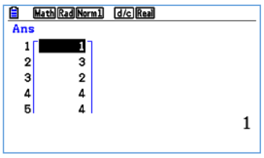
Pressing EXE repeatedly performs the previous calculation and so we can roll many dice!

We can also generate a list of simulated dice rolls.



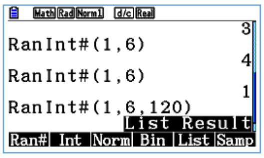
Enter:
Int (F2) 1 , 6 , 1 2 0).

Press EXE.

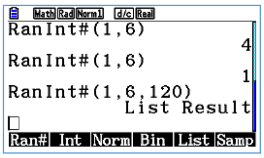


A list of 120 ‘dice rolls’ is produced. Use the ▲ and ▼ keys to navigate.

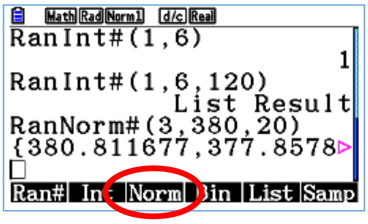
Press EXIT to leave the list.



▼ to enter the next working line.



Simulate the production of 20 cans of soft drink; well, the volumes in the cans at least. Suppose the volumes are distributed normally with standard deviation 3 ml and mean 380 ml.



Enter:
Norm (F3) and then
3 , 3 8 0 , 2 0)

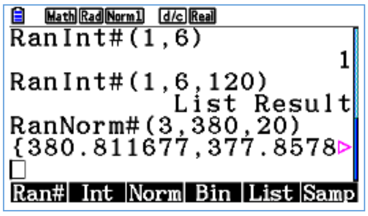
EXE to make the list.

Note that this time the list is big enough to be presented on the screen. Use the ▲ and then ◀ and ▶ to navigate the list.

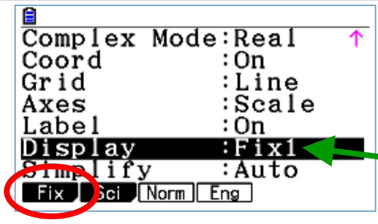
It would be nice to be able to analyse data like this, maybe make a histogram or boxplot of the data. We will do this in the next section.

3.3 Random numbers and the histogram

This section follows from the previous so we assume you have completed section 3.2.
Notice that the number generated in the last calculation below has 8 digits after the decimal.



For our purpose, the volumes of cans of soft drink, this is a tad extreme. ☺

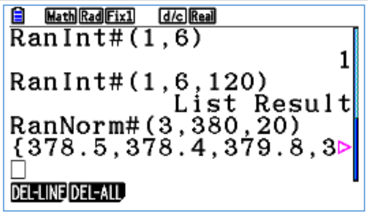


Open the SET UP menu.

SHIFT and MENU.

Change the Display setting to Fix 1, so that the values produced will only have 1 digit after the decimal place.

EXIT to leave this menu.



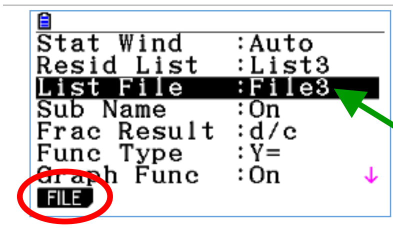
▲ to select the previous input line.

EXE to recalculate.

Note the values are now rounded correct to 1 decimal place.

We can analyse data like that calculated above in the Statistics application.

Press MENU and open the Statistics application.



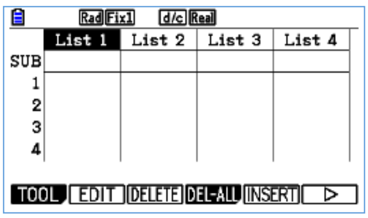
Open the SET UP menu.

SHIFT and MENU.

Change the List File setting to File3 using File.
File3 is a set of 26 lists. We do this in case you had data in the File set that was chosen previously.

EXIT to leave this menu.

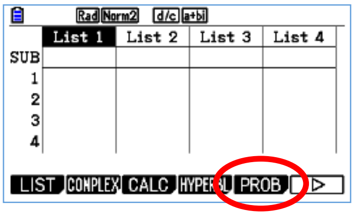
Let's 'roll' a dice 120 times and collect the results.



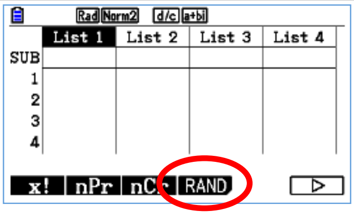
▲ the cursor to be positioned in the header of List 1.

The cursor *must* be in this position when entering a *command* that will *fill* a list with data automatically.

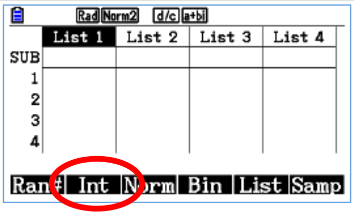
Now we need List 1 to be filled with 120 'dice rolls'. Open the OPTN menu.



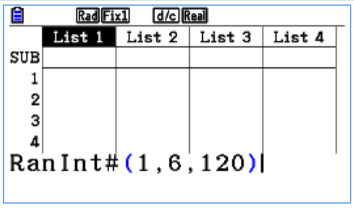
Open the PROB (F5) menu.



Open the RAND (F4) menu.

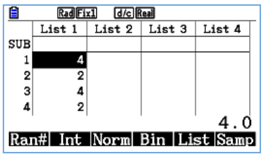


We will use the Int (F2) command.



Enter:
Int (F2) 1 , 6 , 1 2 0) .

EXE to fill the list.

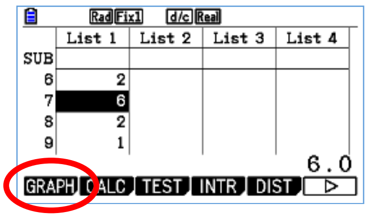


Use the ▲ and ▼ keys to navigate the rolls.

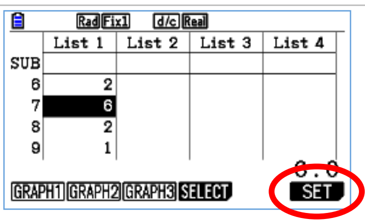
EXIT EXIT EXIT to return to the first level of menus for the

application.

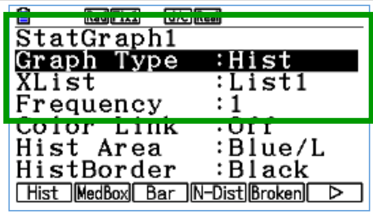
Many people believe a six is hardest to roll on a dice. Is it really? How many sixes did you roll? To find out we will make a histogram of our 'rolled' data.



Open the GRAPH (F1) menu.

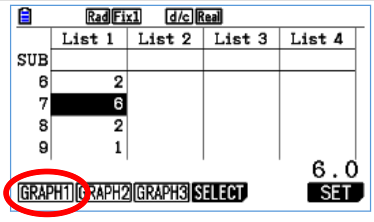


Open the SET (F6) menu.

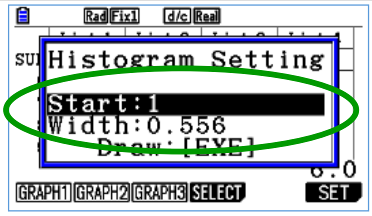


Set up StatGraph1 as shown opposite.
Graph Type: Histogram.
XList: List 1
Frequency: 1.

EXIT to leave this screen.

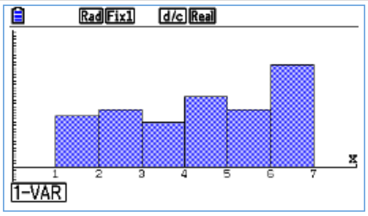


Use GRAPH1 (F1) to draw the histogram.



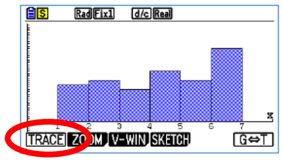
The calculator will ask for the starting value of the first 'bin' and then the 'bin width'. Set each to 1 since our data are integers from 1 to 6.

EXE to draw the histogram.

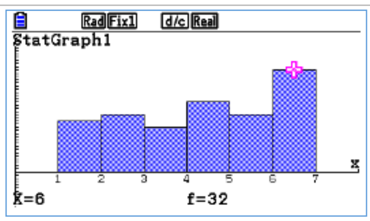


But how do we know the number of rolls that were a six?

Press SHIFT to reveal the shift menus of the F keys.



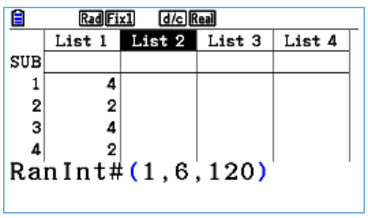
Use Trace (F1) and the ◀ and ▶ keys to navigate the histogram.

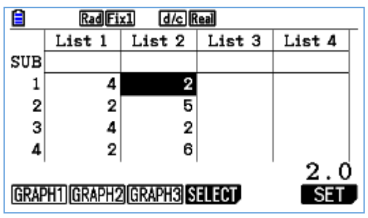


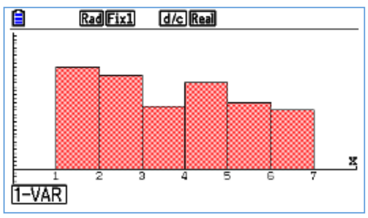
So you can see that we got 32 sixes. You will have got a different number though as your pseudo-random numbers will be different to mine!

So, do you think a six is the hardest number to roll on a dice?

Now fill List 2 with another 120 'dice rolls'. Make a histogram and see if the results are different. Remember to set up StatGraph 2, *not* StatGraph1, keep that for List 1.







3.4 Summing two lists.

This section assumes that you have carried out the task in the previous section.

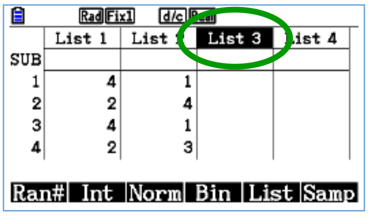
If we rolled two dice 120 times and summed the faces of each roll, what would be the most frequent sum returned? If you think about it I bet you can work it out.

	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

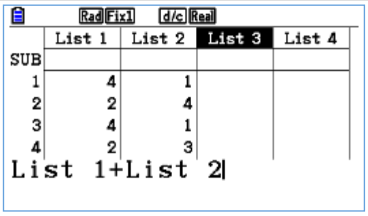
Looks like it maybe 7!

Let's see if practice matches the theory.

Open the Statistics application.



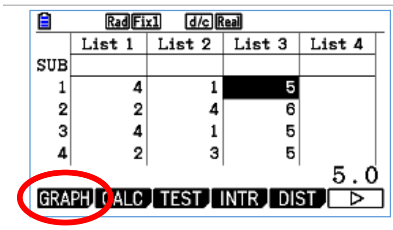
Position the cursor in the header of List 3.



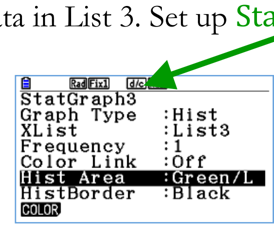
Look above the number 1 key on the calculator. You will see the word List. It is activated using the SHIFT key.

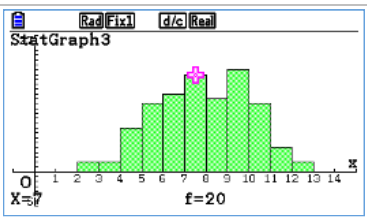
We will use this to enter our commands for List 3. Enter:
SHIFT 1 1 + SHIFT 1 2

EXE to see the resulting sums.



Open the GRAPH (F1) menu and set about making a histogram of the data in List 3. Set up StatGraph3.





Well, in my single set of rolls it looks like the practice did not match the theory, this time. Twenty of my rolls ended in a sum of 7, fewer than summed to 9. How did your experiment turn out?

3.5 Leaking bags – binomial distribution

It is claimed that 1 in every 10 plastic bags made by a company are not water-tight – they leak. The bags are sold in packets of 50 bags.

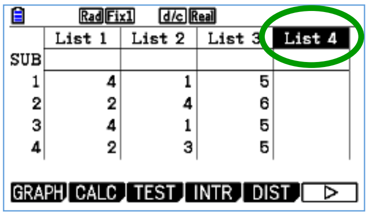
If I was to buy 100 packets, how many 'leakers' might I expect in each of my 100 packets? My guess would be around 5 in each packet. Would yours?

If we assume that the packaging process is a random-like process, then we could use the binomial distribution to help us think about what might happen.

Let's simulate the process. We can do this in the Statistics application.

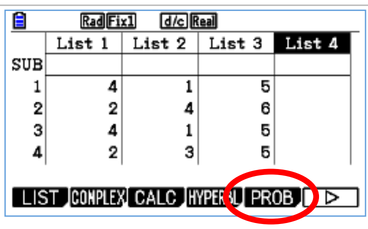
Press MENU and open the Statistics application.

Find an empty list. We will use List 4.

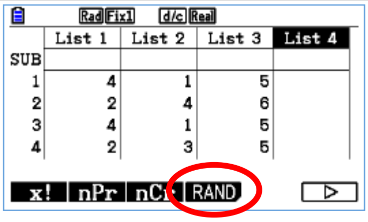


Position the cursor in the header of List 4.

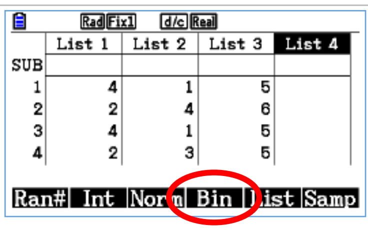
Press OPTN.



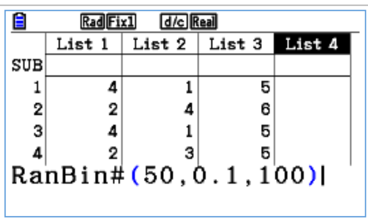
Open the PROB (F5) menu from the OPTN menu.



Open the RAND (F4) menu.



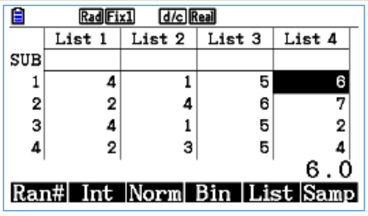
We will use the Bin (F4) command.



Remember bags are sold in packets of 50 (n=50), 1 in 10 are said to leak (p=0.1) and I decided to buy 100 bags. Enter:

Bin (F4) and then
5 0 , 0 . 1 , 1 0 0).

EXE to fill the list. (Be patient if it takes a few seconds.)



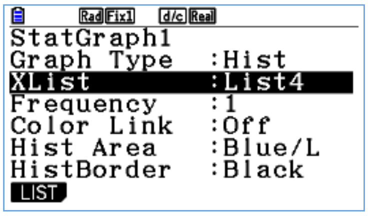
Use the  and  keys to navigate the table.

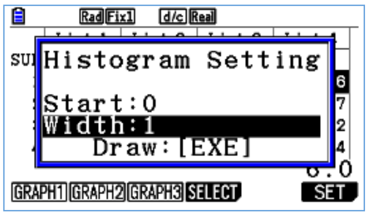
EXIT EXIT EXIT to return the screen menus to the first level.

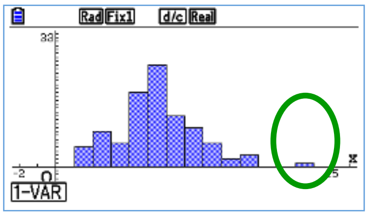
Open the GRAPH (F1) menu and set about making a histogram of the data in List 4.

We can only set up three StatGraphs and so we will have to use one we have already set up.

Use StatGraph1.







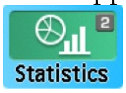
Your 100 packets will of course be different to ours. But the general shape should look similar. Note we have one quite ‘bad’ packet with 13 leakers in it! We will send that one back. ☺

3.6 Square root of a normal distribution

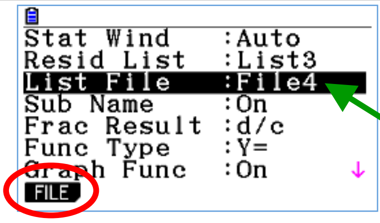
If you were to randomly sample 100 data points from a variable that was normally distributed and then square root each value, what would the distribution look like?
If you thought about it, I bet you could work it out. This time, let's just use the calculator to do this and see what it looks like and then try to reason why.

We can do this in the 

application.

Press [MENU] and open the 

application.

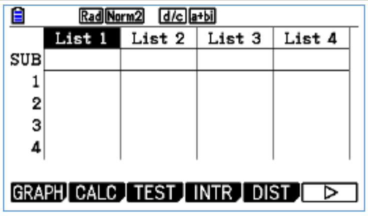


Open the SET UP menu.

[SHIFT] and [MENU].

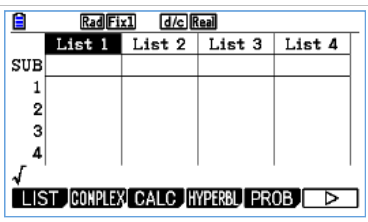
Use FILE to change the List File setting to File4.
File4 is a set of 26 lists. We do this in case you had data in the File set that was chosen previously.

[EXIT] to leave this menu.



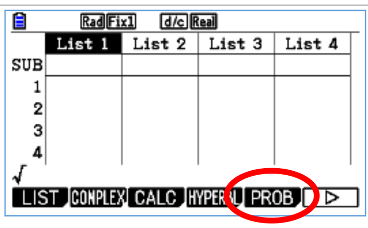
[▲] the cursor to be positioned in the header of List 1.

The cursor *must* be in this position when entering a *command* that will *fill* a list with data automatically.

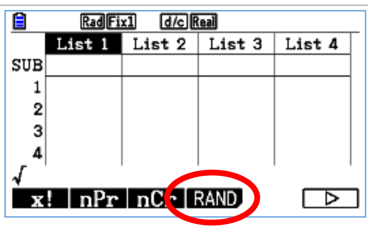


Start by entering a square root sign:
[SHIFT] [x^2].

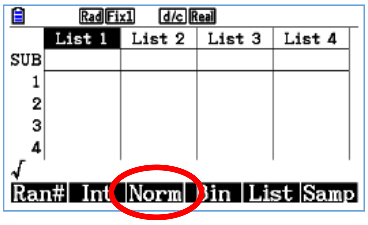
Then press [OPTN].



Open the PROB ([F5]) menu.

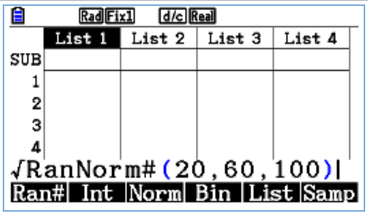


Open the RAND ([F4]) menu.



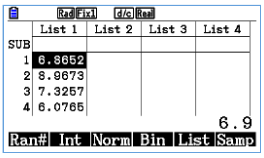
We will use the Norm (F3) command.

We are going to use a normal distribution with standard deviation 20, mean 60 and we will sample 100 values.



Enter:
Norm (F3) 2 0 , 6 0 , 1 0 0).

EXE to fill the list.

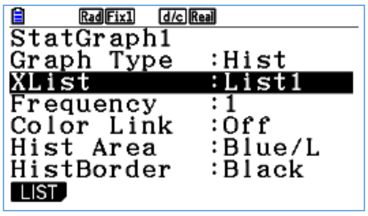


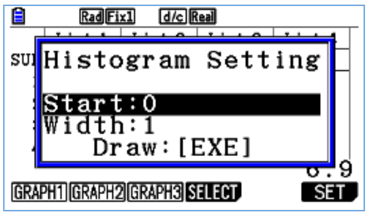
Use the ▲ and ▼ keys to look at the data.

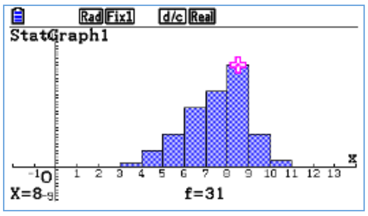
EXIT EXIT EXIT to return to the first level of menus for the

application.

Now draw a histogram of the data in List 1.

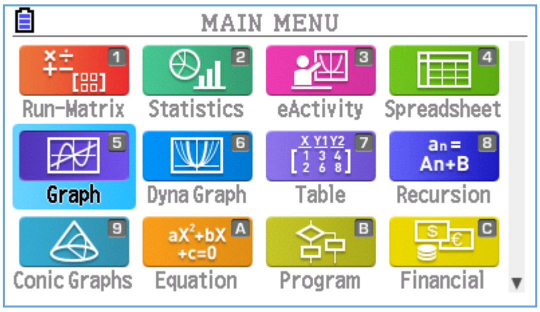


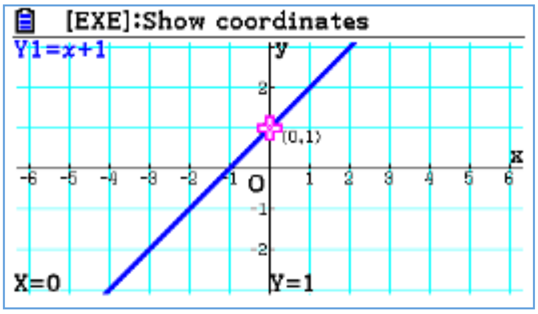


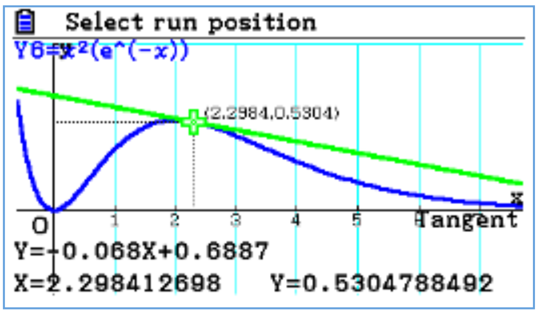


We see that the distribution is skewed in shape. Can you explain why? Think about the difference in magnitude between a number and its square root, and the shape of a normal distribution.

4. Working with graphs in Graph

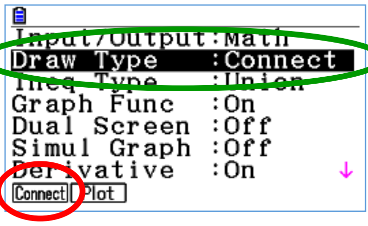




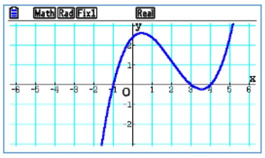


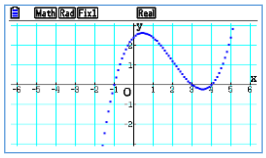
4.1 SET UP in Graph

Launch the  application. Enter the SET UP menu by pressing (and releasing) SHIFT then MENU. Use the cursor keys (▲, ▼) to move up and down the list of settings. There are some critical things you have to set correctly if you are to have success in producing graphs.

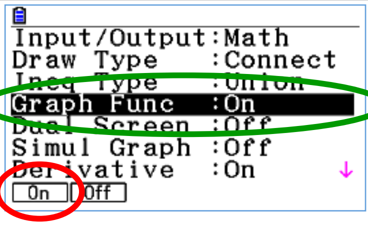


Draw Type can be set to either Connect, which produces a continuous line representation of the graph or Plot, which provides a set of points that are not joined.
So when drawing the graph of $y = 0.2(x-3)(x+1)(x-4)$ we can see either of the two representations below.

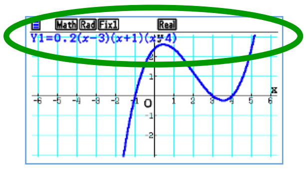


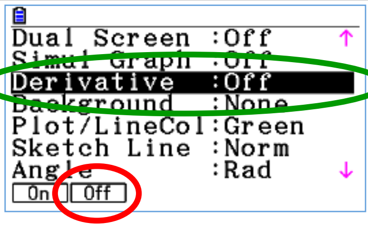


Select Connect (F1).

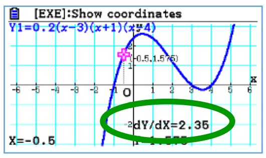


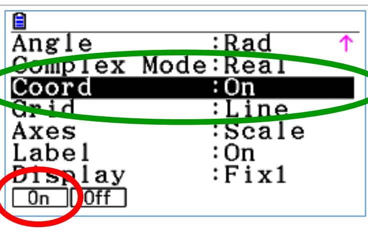
Graph Func can be set to On (F1) which means that *while* the graph is being drawn (see below) the equation is also displayed.
Select On (F1).



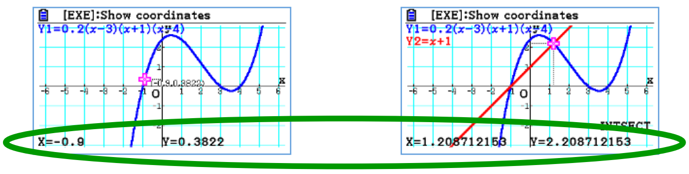


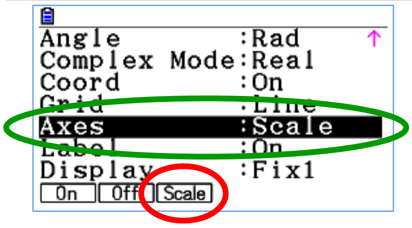
Derivative can be set to On which means that when a graph is being traced (see below) the derivative of the function at that point is displayed also. Or, it can be set to Off (F2).
Select Off (F2).





Coordinates can be set to On which means that *while* the cursor is active on a graph, like when tracing or locating points of intersection (see below), the coordinates of the cursor's location are displayed.
Select On (F1).

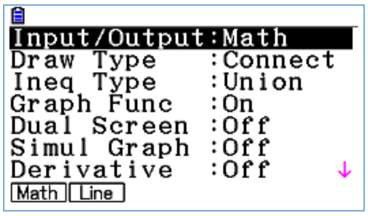


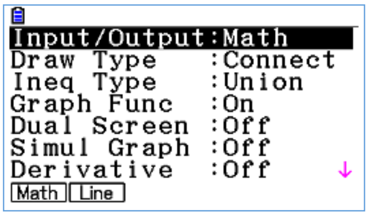


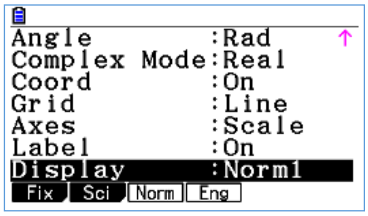
Axes can be set to Scale, which means a set of axes will be visible on the Cartesian plane and numbers will be displayed as well.

Select Scale (F1).

The factory settings for the  are shown below.





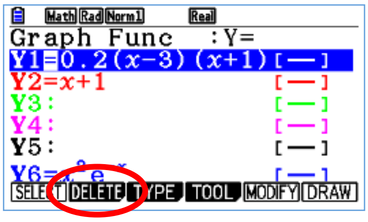


4.2 Square view – 1:1 aspect

Launch the 

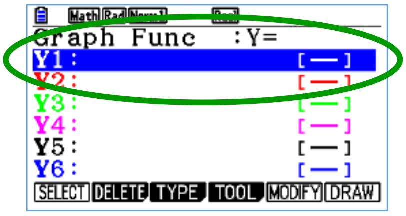
application.

We will begin by drawing the graph of a simple function so we can illustrate certain aspects of drawing graphs in digital environments (like this calculator), in particular the way graphs appear depending on how you set the axes.

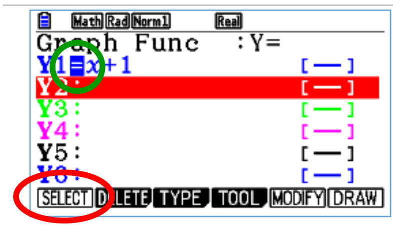


If you have a function, or more than one function, already entered, as screen opposite, use the ▼, ▲ keys to position the cursor on it and then use DELETE (F2) to delete it.

Enter the function $y=x+1$.



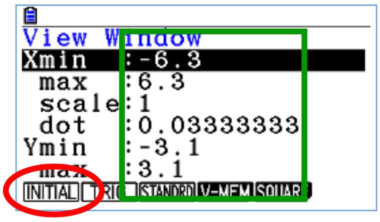
The Y1 location should be awaiting an entry.
To enter an x for graphing purposes we use the X,θ,T key.



Enter:
X,θ,T + 1 .

Press EXE to 'lock it in'.
Note that the equals sign appears as ▬ rather than =. This tells us Y1 is active (or selected) and a graph will be drawn if requested. You can select or deselect using SELECT (F1).

Before we draw the graph, set the endpoints of the axes on which the graph will be drawn.



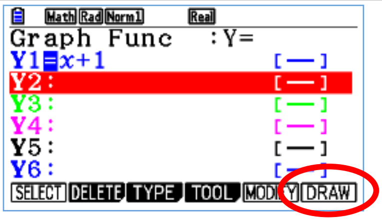
Look above the F3 key. You will see an option called View-Window.
Press SHIFT then F3 to open the View Window menu.

Use INITIAL (F1) to set the endpoints of the axes to those set by the factory.

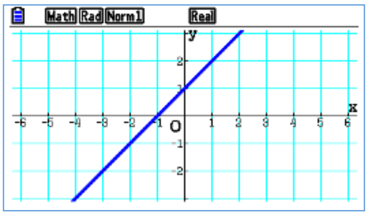
Study these set of numbers, they may seem a little strange. They are set this way because the calculator screen is rectangular, 384 pixels horizontally and 216 pixels vertically.

Using this setup will ensure that 1 unit in the x direction is the same physical distance as 1 unit in the y direction. Therefore a graph with a slope of 1, for example, will look like it has a slope of 1. Such a setup is said to be 'square'.

EXIT to leave this screen.



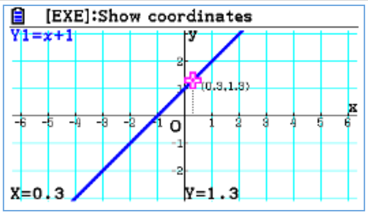
DRAW (F6) the graph.



Note it makes a 45 degree angle with the x axis thanks to the 'square' View-Window settings.

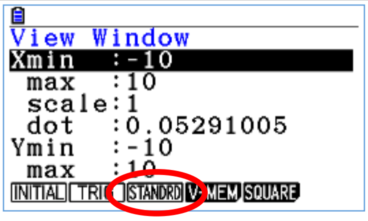
Look above the F1 key, you will see the Trace function.

Press SHIFT the F1 to activate Trace mode.



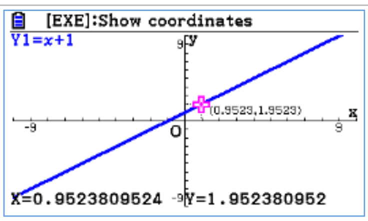
Use the ◀ and ▶ keys to travel along the graph.

Note that the trace steps are 'nice', 0.1 steps in the *x* direction. This is due to the axes endpoints selected as part of the INITIAL set up.



Press SHIFT then F3 to open the View-Window menu.

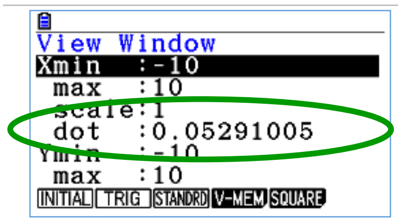
Use STANDARD (F3) to set the endpoints of the axes. Note that on both axes, the values range from -10 to 10. Given the screen is a rectangle, the graph will not be 'square'.



You can clearly see that the angle this graph makes with the *x* axis is less than 45 degrees, even though it has a slope of 1.

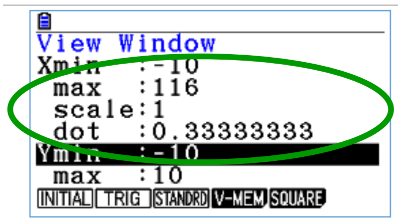
Also notice that the trace steps are not at all 'nice'. This is because the number of pixels on the screen does not match nicely to the endpoints chosen.

Open the View-Window menu again – SHIFT then F3.



The dot value is in fact one-third of the value of the trace step from one pixel to the next.

You can change this value, but if you do the Xmax value will change accordingly as the number of pixels on the screen is fixed.



You can see opposite we have changed the dot value to $\frac{1}{3}$ and the Xmax value has automatically changed to 116. Trace steps will be 1 unit.

4.3 Make a useable graph - manually

To make a useful graph of a function on paper, or a calculator, you need to determine the domain that will be of use (the set of x values that are interesting to study) and the minimum and maximum y values for that domain.

Sometimes you will be told what domain to study. Other times you will need to think about it for yourself.

We will study the function $y = x^5 \times \frac{1}{2^x}$, the product of a polynomial function and an exponential function.

Before starting on the calculator, we should think a little about the function. After all, a graph is just a picture of lots of y values for a given x. This thinking may also help us to explain the shape later on.

$y = x^5 \cdot \frac{1}{2^x}$

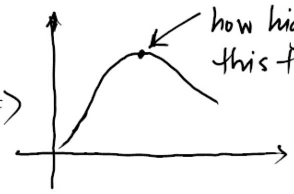
Start by thinking about small positive x values

$x = 2 \quad y = \frac{32}{4} = 8$

$x = 10 \quad y = \frac{10^5}{2^{10}} < 1$

$x = 1 \quad y = \frac{1}{2}$

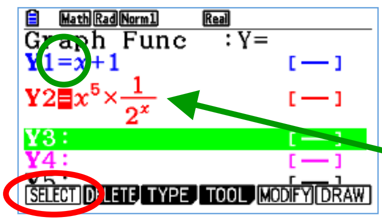
$\Rightarrow$



how high is this though?

Also, x^5 rises fast while $\frac{1}{2^x}$ becomes small as x becomes large. They are fighting each other!

Launch the  application.



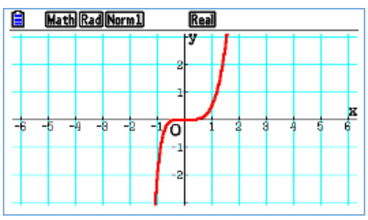
Position the cursor on Y1 and de-SELECT (F1) it.

Enter the function above as Y2.

Be careful entering the indices here. The multiplication is not in the index level.

What we tell you to do next is most likely what NOT to do, but many people probably try it.

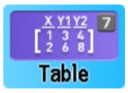
DRAW (F6) the function and **hope** – without doing anything to the View-Window settings.

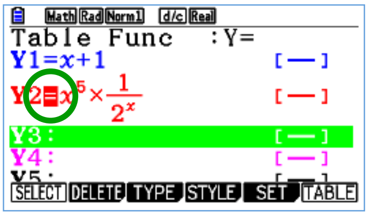


Well, we can see something – but it is hardly helpful, particularly given the thinking above.

Let’s try something else.

Remember, we think this graph will rise and fall, but exactly how high does it rise before it falls. One way to find out would be to make a table of values for this function.

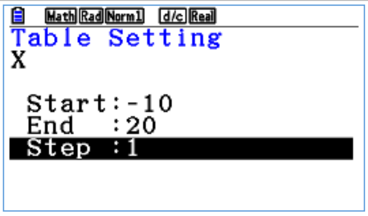
Press MENU and launch the  application.



Position the cursor on Y1 and de-SELECT (F1) it.

Check that Y2 is selected.

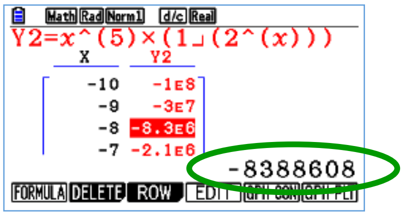
Open the SET menu (F5).

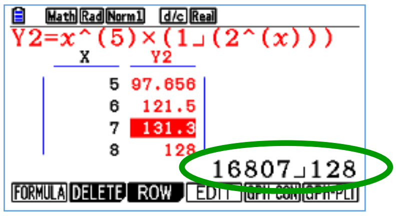


Set the Start, End and Step as shown opposite.

Choosing the start and end can often be a little bit of trial and error. But from our previous thinking 20 should be enough.

EXIT to leave the Table Setting screen and then use TABLE (F6) to make the table.
Position the cursor in the list of y values so you can see the values more accurately.

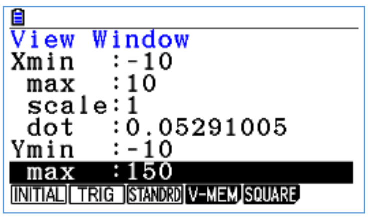




By looking at our table the function rises as high as about 131. We cannot be sure of the value of x that provides the greatest y, but it seems to be between 6 and 8. This gives us a good idea of the values of the axes endpoints to produce a useful graph. Note for negative x, y is very negative.
EXIT to leave the table screen.

Press MENU and launch the  application.

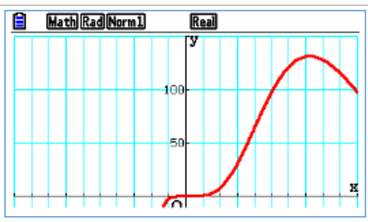
Open the View-Window menu – SHIFT then F3.



Set the values to those seen opposite.

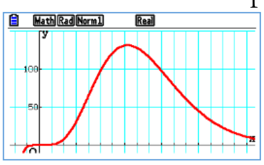
Note we have not worried too much at this point about negative x region as the y values get very small very quickly.

EXIT to leave this menu. Then DRAW (F6) the graph.



Not bad, but still a lot of wasted space and it would be good to see more of the positive domain.

Press the ▶ to fine tune the axes set up.

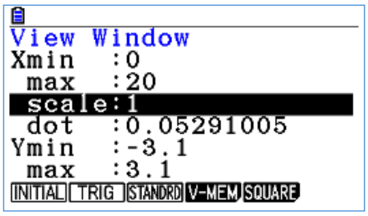


4.4 Make a useable graph – zoom auto

This section follows on direct from section 4.3. If you have not studied section 4.3, do so before starting this section.

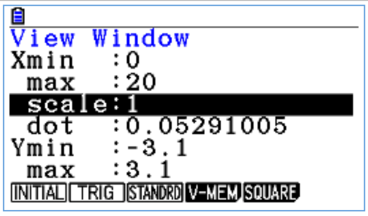
This method offers an alternative to that seen in section 4.3 when drawing a useable graph. Suppose we have done the prior thinking we did earlier, but had not made the table of values.

We can focus our attention on the positive domain to start with and set the Xmin and Xmax to a fairly large domain, say between 0 and 20.
Open your View-Window menu, press SHIFT then F3.



Set the Xmin and Xmax to 0 and 20 respectively and the Ymin and Ymax to -3.1 and 3.1 respectively.

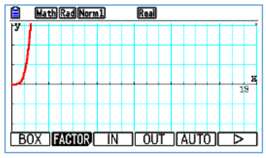
EXIT from this menu and DRAW (F6) the graph.



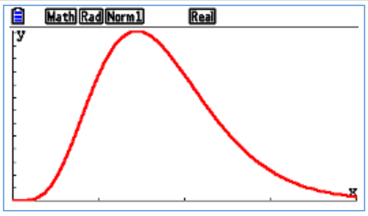
Hardly impressive! But do not panic.

Look above the F2 key and you will see Zoom.

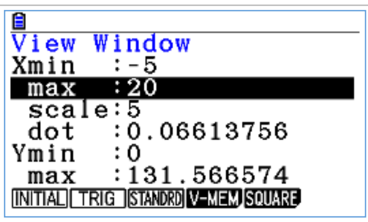
Press SHIFT and then F2 to reveal the Zoom options.



Use AUTO (F5) and see what happens.



The zoom AUTO process does not change the domain you set. It simply searches for the maximum and minimum values of y for the domain you set and adjusts the Ymin and Ymax accordingly.



Change Xmin to -5.
EXIT
DRAW (F6)
Perform an AUTO zoom.

Oh dear, that is not so good. You must think hard about the domain before using auto zoom.

Note that a zoom PREVIOUS option exists to take you back to the previous set up. Enter:
SHIFT F2 ▷ (F6) PREVIOUS(F5).

4.5 Working on a graph – G-SOLV

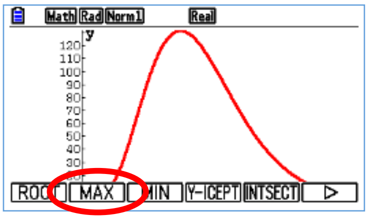
Here we continued to work with the function from the previous section.

What is the maximum value of the function $y = x^5 \times \frac{1}{2^x}$?

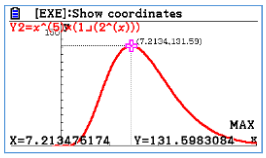
Produce a useable graph of this function.

Look above the F5 key. You will see G-Solv.

Press SHIFT and then F5 to open the G-Solv menu.

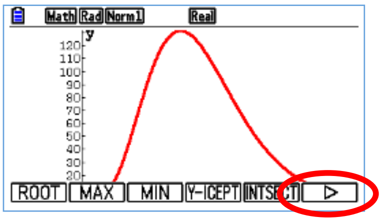


Use MAX (F2) to calculate the maximum value.

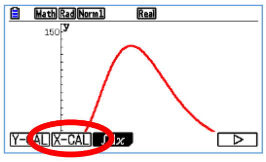


So we see the maximum value is 131.6 when x = 7.2 (values correct to 1 decimal place).
Press EXE to have the maximum's coordinates printed on the screen.

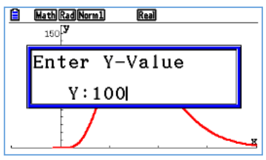
If $y = x^5 \times \frac{1}{2^x}$, find x if y=100.



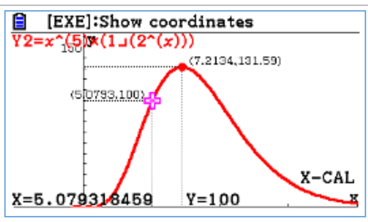
From the G-Solv menu choose ▷ (F6) to reveal more options.



Choose X·CAL (F2).



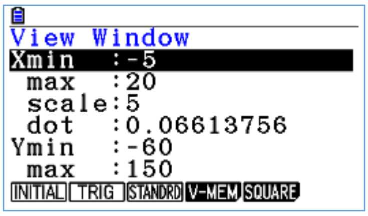
EXE to find the value of x.



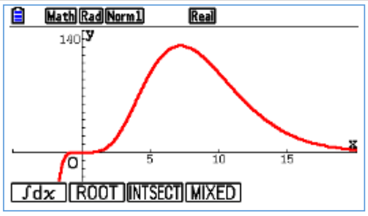
So if y = 100, x = 5.1 (correct to 1 decimal place).

Press EXE to have the coordinates of the point printed on the screen.

Find a decimal approximation for $\int_2^5 x^5 \times \frac{1}{2^x}\,dx$.

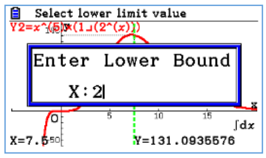


Set the View-Window settings as shown opposite.
EXIT from this menu.
DRAW (F6) the graph.

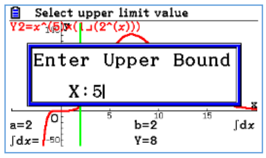


From the G-Solv menu choose ▷← (F6) to reveal more options.

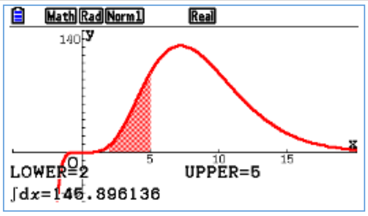
Open the $\int dx$ menu (F3) and then choose $\int dx$ (F1) and then press 2 for the lower limit



EXE and enter 5



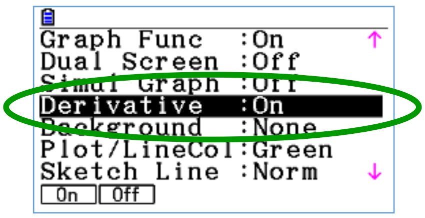
EXE again.



And so $\int_2^5 x^5 \times \frac{1}{2^x}\,dx = 145.9$ correct to 1 decimal place.

EXIT from this graph.

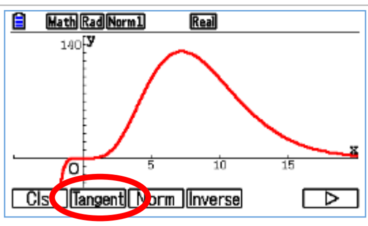
Find the equation of the tangent to $y = x^5 \times \frac{1}{2^x}$ at x=7.



SHIFT then MENU to enter the SET UP menu.

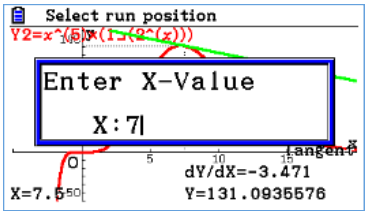
Set the Derivative to On.

EXIT and then DRAW (F6) the graph.



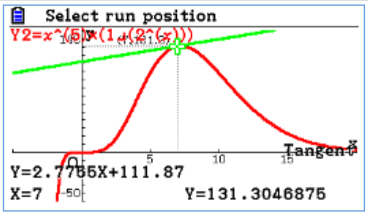
Look above the F4 key and you will see Sketch.
SHIFT then F4.

Choose Tangent (F2).



Press 7 from the keyboard.

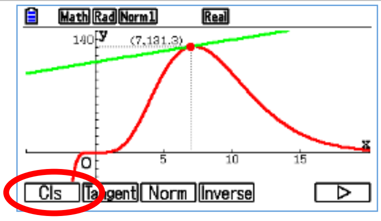
The EXE to accept the 7 and draw the tangent and EXE again to 'print' the tangent and calculate its equation.



So the equation is $y = 2.78x + 111.87$.

EXIT from the graph screen.

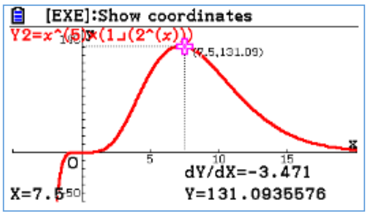
Re-DRAW (F6) the graph.



Notice on re-graphing, the tangent is still visible.

From the Sketch menu, choose Cls (F1) to clear the screen of the tangent.

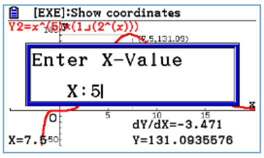
If $y = x^5 \times \frac{1}{2^x}$ find the value of $\frac{dy}{dx}$ if x=5.



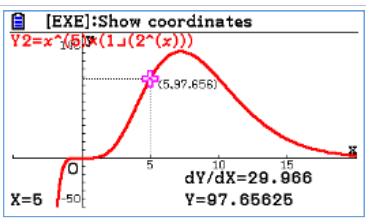
With the Derivative option set to On in the SET UP of the Graph application, we can Trace a function and the derivative at the location of the cursor will be shown.

DRAW (F6) the function and Trace it: SHIFT the F1.

To jump to x=5, simply type 5.

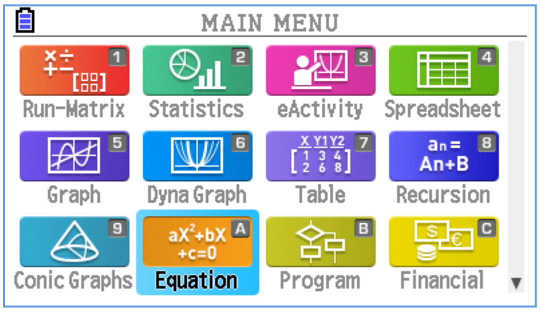


EXE to calculate the value.



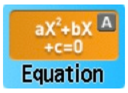
So for $x = 5$, $\frac{dy}{dx} = 30$ (to the nearest whole number).

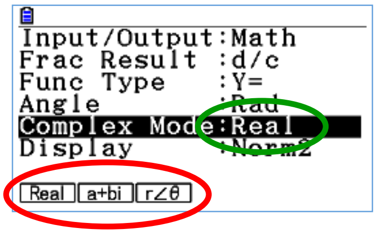
5. Solving equations in Equation



5.1 SET UP in Equation

Some of the settings chosen in the SET UP menu of the  application affect the processes in other applications. They are said to be *global* settings. To help though, each application has its own SET UP menu. Some settings are replicated in a number of applications.

Launch the  application. Enter the SET UP menu by pressing (and releasing) [SHIFT] then [MENU] . Use the cursor keys (▲, ▼) to move up and down the list of settings.



Notice that there are only six settings that can be changed in this application.

Complex Mode determines whether or not complex solutions to an equation, should they exist, will be displayed.

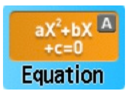
If Complex Mode is set to Real, by pressing Real ([F1]), only real number solutions will be displayed.

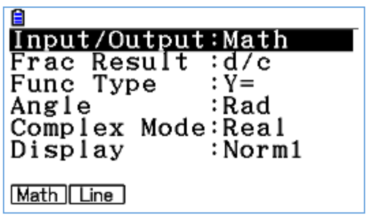
If Complex Mode is set to a+bi, by pressing a+bi ([F2]), real and complex solutions will be displayed. Complex shown in Cartesian form.

If Complex Mode is set to $r\angle\theta$, by pressing $r\angle\theta$ ([F3]), real and complex solutions will be displayed. Complex shown in polar form.

Set Complex Mode to Real.

Also check that Display is set to Norm2.

The factory settings for  are shown below.



5.2 Working with a formula

The volume of a cone can be calculated using the formula $V = \frac{1}{3}\pi r^2 h$.

Calculate the base radius of a cone with volume 200 cubic cm and height 30 cm. We could proceed as follows:

$$V = \frac{1}{3}\pi r^2 h$$

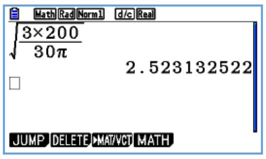
$$\Rightarrow \quad 3V = \pi r^2 h$$

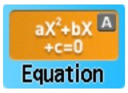
$$\Rightarrow \quad r^2 = \frac{3V}{\pi h}$$

$$\Rightarrow \quad r = \sqrt{\frac{3V}{\pi h}} \quad \text{(ignoring the } -\text{ve } \sqrt{\ } \text{ as } r > 0.\text{)}$$

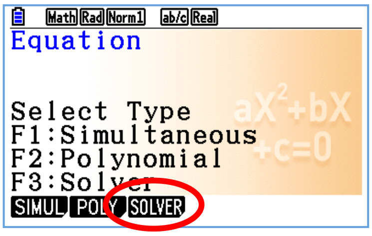
$$\Rightarrow \quad r = \sqrt{\frac{3 \times 200}{30\pi}}$$

$$\Rightarrow \quad r \approx 2.52 \text{ cm} \quad \text{(correct to 2 d.p.)}$$

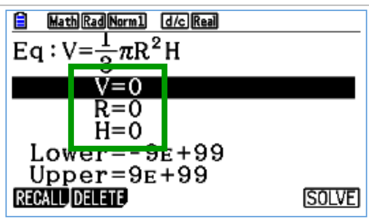


Alternatively, the 

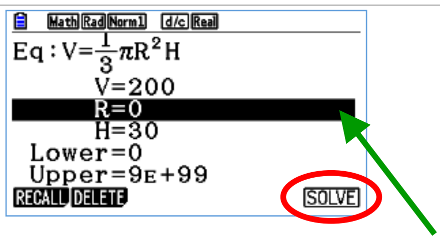
application efficiently handles calculations associated with many formulae.



Open the SOLVER (F3) menu.

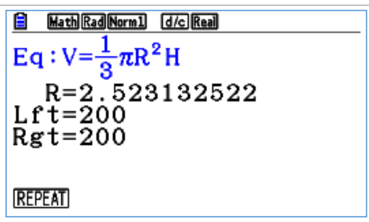


Enter the formula. Make use of the red ALPHA key and the red letters above the keys.
You will find the = sign above the decimal key, use SHIFT then • . Press EXE to finish and you will see the variables are laid out under the equation.



Enter the value of each variable.
EXE after each entry.
The Lower and Upper values are the range of values over which the calculator will search for a solution.
In this case set Lower to 0.

Position the cursor on the variable with unknown value.
Choose SOLVE (F6) to find calculate the value of r.



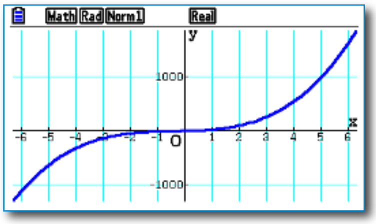
We see the same result as achieved using the algebraic method, seen above. Note the extra information on the screen:
Lft=200, Rgt=200.
This is the calculator's way of telling you that if the value for r that it determined is substituted into the equation, the left side of the equal sign is equal to 200 and the right side is also equal to 200; so the value of r is a solution to the equation.

5.3 Solving a cubic equation

Find the values of x such that $6x^3 + 7x^2 + 12x - 5 = 0$.

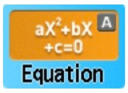
It is a good idea to first graph the function $y = 6x^3 + 7x^2 + 12x - 5$ to see where it cuts the x axis.

Here it is using an INITIAL set up View-Window and then zoom AUTO.

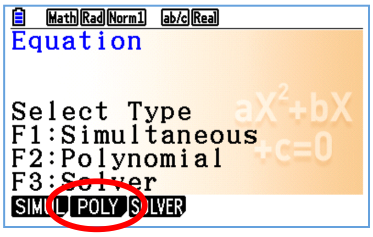


All cubics have at least one real solution.

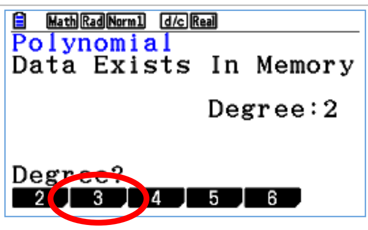
Can we confirm in our mind what the graph shows? Some thought tells us that for large positive x, the function will produce large positive values and for 'large' negative x, it will produce 'large' negative values. So it seems this cubic has only one real solution (root) and two complex roots. Let's find them.

Open the 

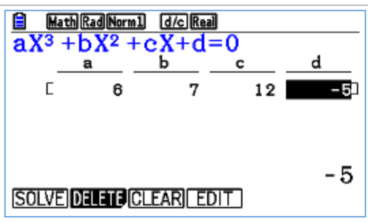
application.



Open the POLY (F2) menu.

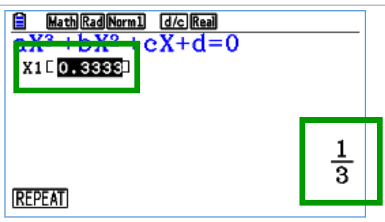


Choose Degree 3 ().



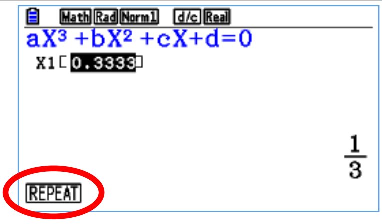
In this application, all polynomial equations must first be in the form f(x)=0. We then enter the coefficients of each term, from highest power of x to the constant.

Choose SOLVE (F1) to find the solutions.



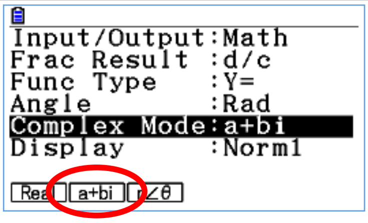
Note the solution is given in both decimal approximation and exact form.

Now, what about the complex roots?



Choose REPEAT (F1).

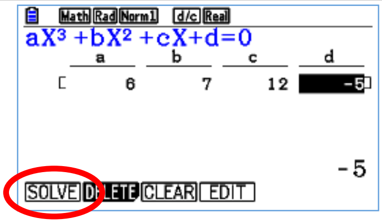
First we must set the application to show complex solutions.



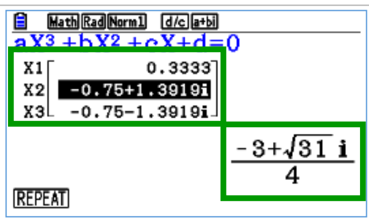
Enter the SET UP menu.
SHIFT and then MENU.
Select the Complex Mode setting.

Choose a+bi (F2).

EXIT from this menu.

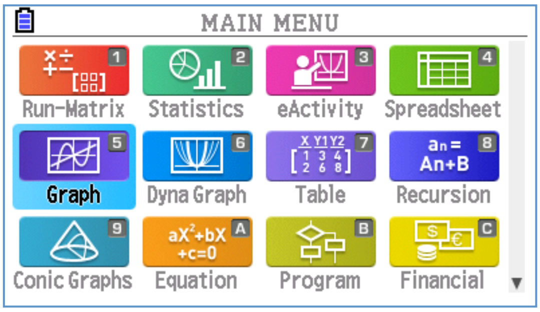


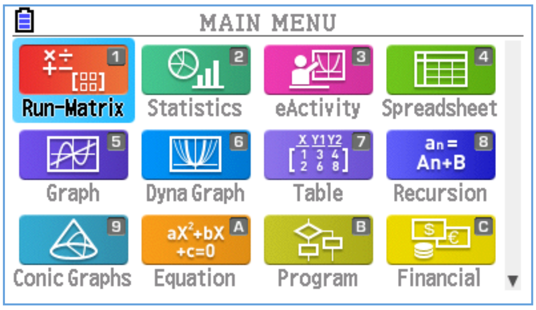
Choose SOLV (F1) to find the solutions.



Note that now we get both the real and complex roots and each are shown in both decimal and exact form.

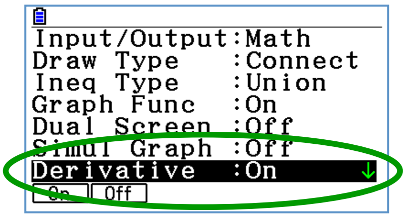
6. Differential calculus





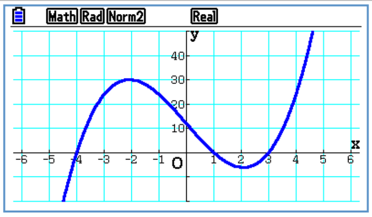
6.1 Derivative at a point - graphically

If $y = x^3 - 13x + 12$ calculate the value of $\frac{dy}{dx}$ when $x = 4$.

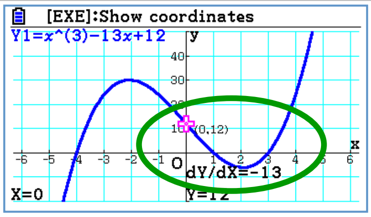


Open the  application and open the SET UP menu by pressing (and releasing) SHIFT then MENU.

Turn the Derivative option On.

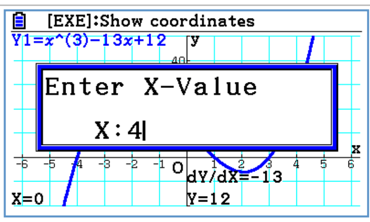


Make a useable graph of $y = x^3 - 13x + 12$.

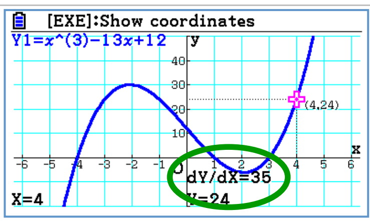


Press SHIFT then Trace (F1), which places the cursour on the graph of the function at the x value that is the centre of the viewing domain, 0 in this case.

We see value of $\frac{dy}{dx}$ when $x = 0$ is -13.



To find the value of $\frac{dy}{dx}$ when $x = 4$, simply press 4.



Press EXE to complete the calculation.

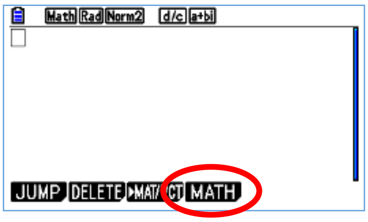
So $\frac{dy}{dx}$, when $x = 4$, is equal to 35.

The value of the derivative for other values of x can be found by entering the value of x required using the number keys.

Note that calculations of this type will always produce decimal approximations for the quantities being calculated.

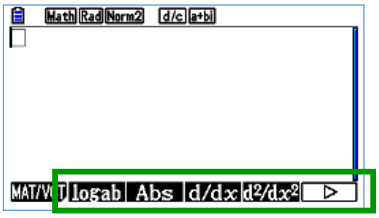
6.2 Derivative at a point – in Run-Matrix

Calculate the value of $\frac{dy}{dx}$ for $y = x^3 - 13x + 12$ when $x = 4$.

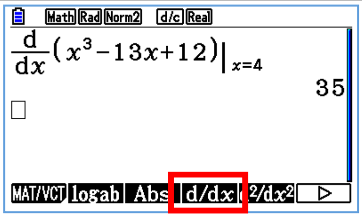


Open the  application.

Open the MATH (F4) menu.



Notice there are four functions available: logarithm with choice of base, absolute value, first derivative at a point, and second derivative at a point.



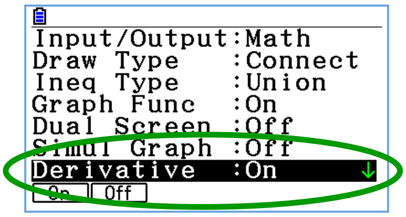
Use the d/dx (F4) to enter the calculation required.

So $\frac{dy}{dx}$, when $x = 4$, is equal to 35.

Note that calculations of this type will always produce decimal approximations for the quantities being calculated.

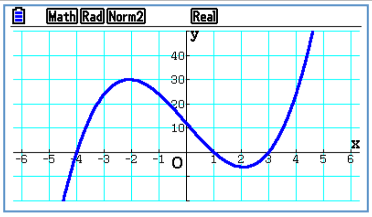
6.3 Equation of a tangent to a curve

Calculate the equation of the tangent to $y = x^3 - 13x + 12$ when $x = -1$.

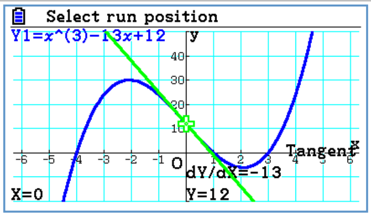


Open the  application and open the SET UP menu by pressing (and releasing) SHIFT then MENU.

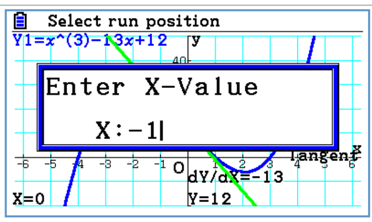
Turn the Derivative option On.



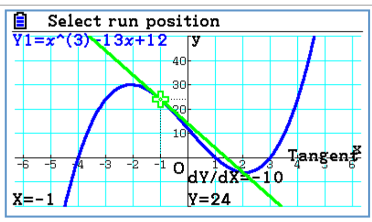
Make a useable graph of $y = x^3 - 13x + 12$.



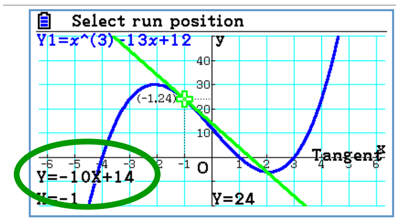
Press SHIFT then Sketch (F4) and then Tangent (F2). A tangent is drawn at the x value that is the centre of the viewing domain, 0 in this case.



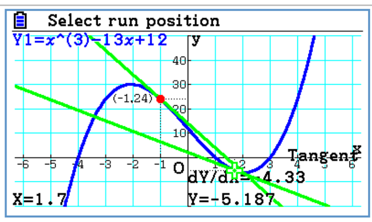
To draw the tangent to the curve at $x = -1$, simply press − 1.



Press EXE to draw the tangent.



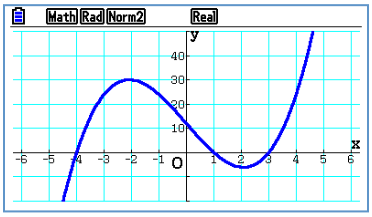
Pressing EXE again will leave a 'print' of the tangent on the screen and display its equation, $y = -10x + 14$.



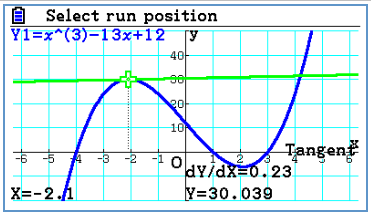
The ◀ and ▶ keys can also be used to move the tangent to different places on the curve. It will move one pixel at a time, but it does move quite quickly. Important ways of thinking can be developed using this approach.

6.4 Stationary points

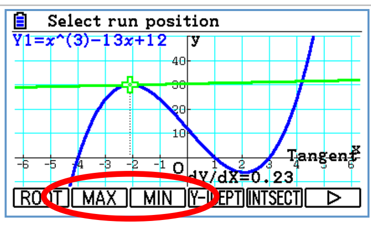
Calculate the co-ordinates of the stationary points of $y = x^3 - 13x + 12$.



Make a useable graph of $y = x^3 - 13x + 12$.

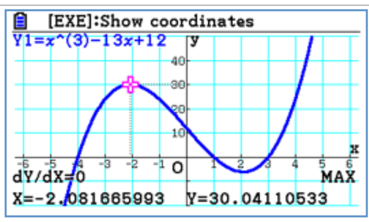


By moving a tangent along the curve we can see there are two stationary points, one at approximately $x = -2$ (a maximum) and one at approximately $x = 2$ (a minimum).

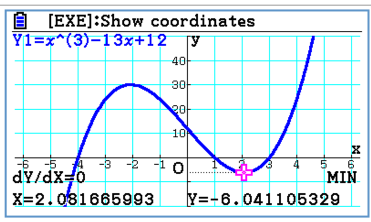


Press SHIFT and then G-Solv (F5) to open the G-Solv menu.

You will see the MAX and MIN functions.



Use MAX (F2) to find the co-ordinates the stationary point that is a maximum, (-2.08, 30.04)



Press SHIFT and then G-Solv (F5) to open the G-Solv menu and then use MIN (F3) to find the co-ordinates of the stationary point that is a minimum, (2.08, -6.04) – interesting!

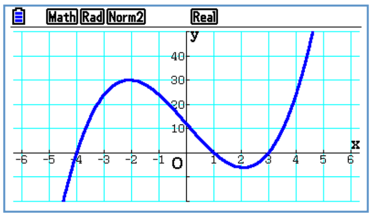
Only stationary points with x values in the visible domain (i.e. between the Xmin and Xmax values of the view window settings) can be found using the MAX and MIN functions.

So you need to be sure there are no other stationary points outside of the visible domain.

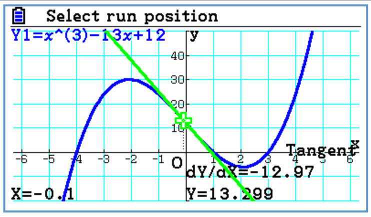
Note that calculations of this type will always produce decimal approximations for the quantities being calculated.

6.5 Point of inflection

Calculate the co-ordinates of the point of inflection of $y = x^3 - 13x + 12$.



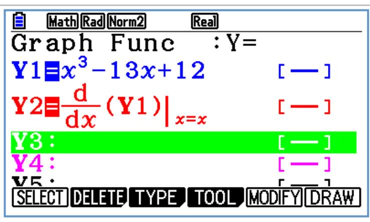
Make a useable graph of $y = x^3 - 13x + 12$.



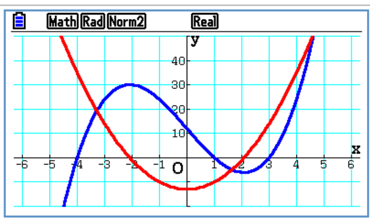
By moving a tangent along the curve we can see there appears to be a point of inflection at approximately $x = 0$.

The slope of the tangent seems to decrease in value from $x = -2.08$ to approximately $x = 0$ and then increase in value for positive values of x.

If this is true, the graph of the first derivative should have a stationary point at the same value of x where the function has a point of inflection.

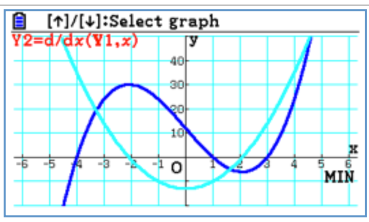


Define Y2 to be the derivative of Y1, as follows.
Press EXIT to return the function editor.
Press OPTN to open the option menu.
Use CALC (F2) to open the calculus functions.
Using d/dx (F1) and then Y (F1), 1 and X,θ,T to complete the definition shown left.
Press EXE.



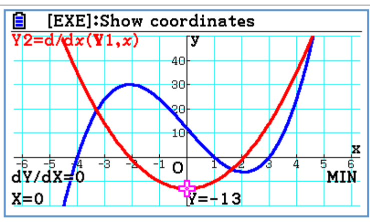
Use DRAW (F6) to draw graphs of both functions.

There we see a stationary point at approximately $x = 0$.



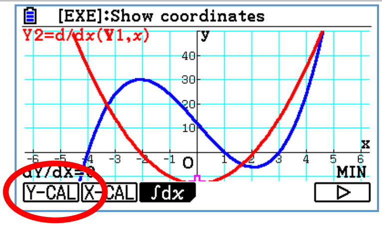
Press SHIFT and then G-Solv (F5) to open the G-Solv menu and then use Min (F3) to find the co-ordinates the stationary point.

Because we have two functions drawn, the calculator will 'flash' on a function to ask if this is the one you wish to calculate the minimum value for, use ▼ to change between functions.



When Y2 is 'flashing' press EXE.

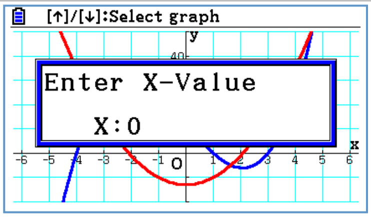
The calculator reports the point of inflection at $x = 0$. But what about the y co-ordinate?



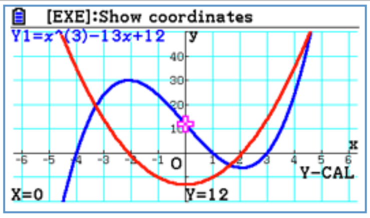
Press SHIFT and then G-Solv (F5) to open the G-Solv menu and then use ▷ (F6) to reveal more functions.

Use Y-CAL (F1) to find the y co-ordinate of Y1 ($y = x^3 - 13x + 12$) when $x = 0$.

When Y1 is 'flashing' press EXE.



Enter 0.

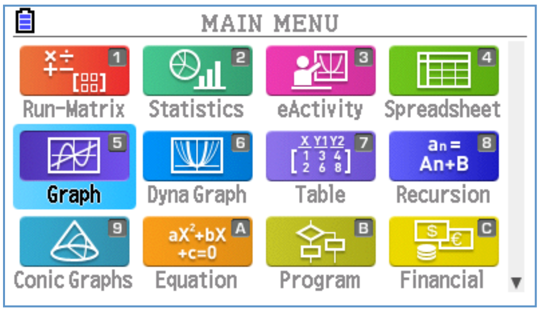


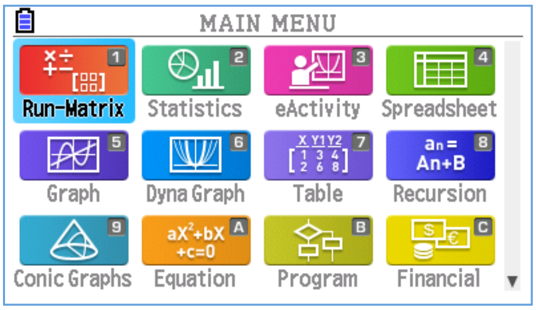
Press EXE to complete the calculation.

We can now conclude that $y = x^3 - 13x + 12$ has a point of inflection at (0 , 12).

The cubic function is point-symmetric about its point of inflection.
We previously noted, with interest, that the stationary points of $y = x^3 - 13x + 12$ were located at $x = -2.08$ and $x = 2.08$, symmetrically positioned about $x = 0$.
Hopefully you can now see why this is the case.

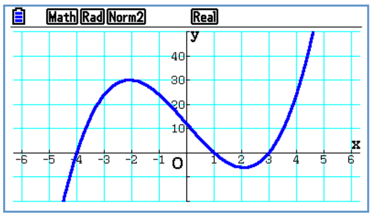
6. Integral calculus



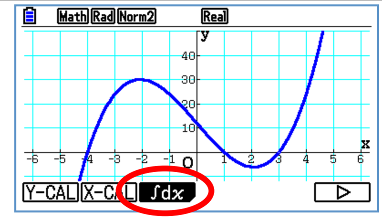


7.1 Definite integral - graphically

Calculate $\int_0^3 x^3 - 13x + 12 \, dx$.

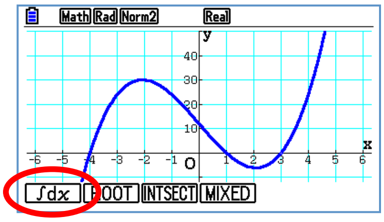


Make a useable graph of $y = x^3 - 13x + 12$.

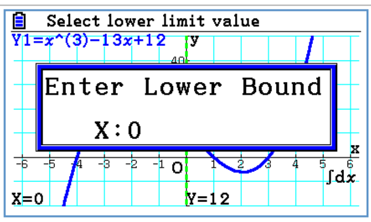


Press SHIFT and then G-Solv (F5) to open the G-Solv menu and then use ▷ (F6) to reveal more functions.

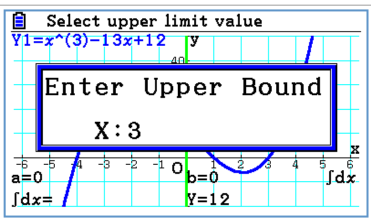
Use $\int dx$ (F3) to show the integral functions.



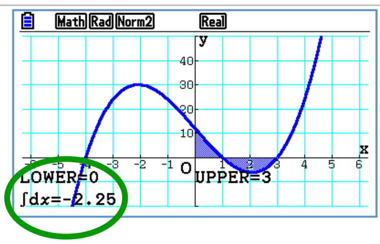
Use $\int dx$ (F1) to start the calculation.



The calculator will ask you to input the lower limit.
Enter 0.



Press EXE to move to entering the upper limit.
Enter 3.



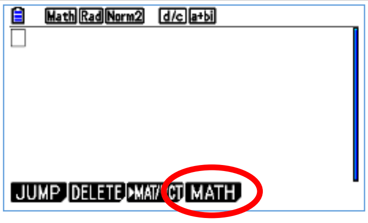
Press EXE to complete the calculation.

We can conclude that $\int_0^3 x^3 - 13x + 12 \, dx = -2.25$, correct to 2 decimal places.

Note that calculations of this type will always produce decimal approximations for the quantities being calculated.

7.2 Definite integral – in Run-Matrix

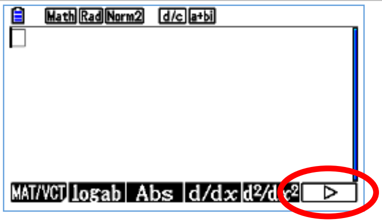
Calculate $\int_0^3 x^3 - 13x + 12 \; dx$.



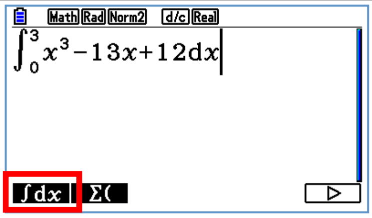
Open the 

application.

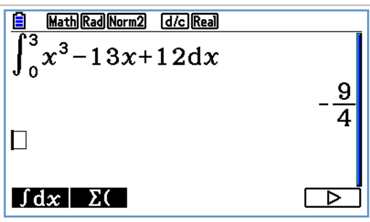
Open the MATH (F4) menu.



Use ▷ (F6) to reveal more functions.



Use $\int dx$ (F1) to enter the calculation required.



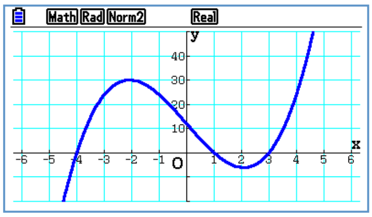
Press EXE to complete the calculation.

We can conclude that $\int_0^3 x^3 - 13x + 12 \; dx = -\frac{9}{4}$

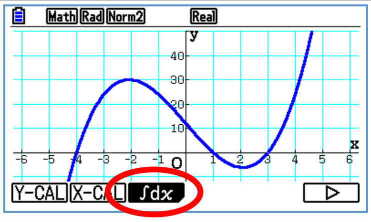
An exact value (fraction) is returned using this calculation method.
This will not always be the case. In some cases a decimal approximation will be returned.

7.3 Area 'under' a function

Calculate the area enclosed by the function $y = x^3 - 13x + 12$ and the x-axis for $0 \le x \le 3$.

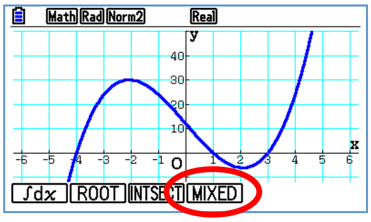


Make a useable graph of $y = x^3 - 13x + 12$.

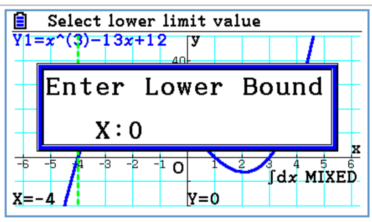


Press SHIFT and then G-Solv (F5) to open the G-Solv menu and then use ▷ (F6) to reveal more functions.

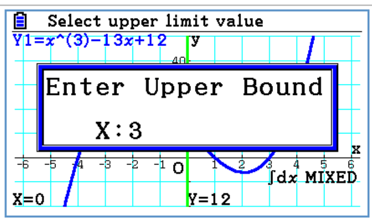
Use $\int dx$ (F3) to show the integral functions.



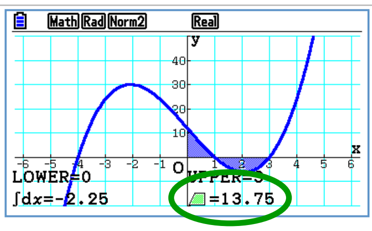
Use MIXED (F4) to start the calculation.



The calculator will ask you to input the lower limit.
Enter 0.



Press EXE to move to entering the upper limit.
Enter 3.



Press EXE to complete the calculation.

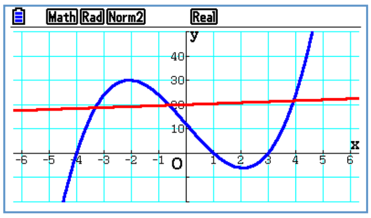
The corresponding definite integral value is also displayed.

We can conclude that the area enclosed by the function $y = x^3 - 13x + 12$ and the x-axis for $0 \le x \le 3$ is 13.75 square units, correct to 2 decimal places.

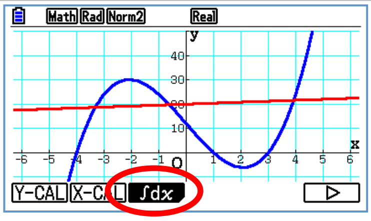
Note that calculations of this type will always produce decimal approximations for the quantities being calculated.

7.4 Area between two functions

Calculate the area bounded by the function $y = x^3 - 13x + 12$ and $y = \frac{2}{5}x + 20$ for $x \in \mathbb{R}$.

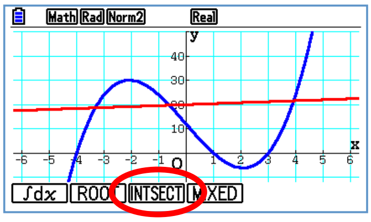


Make a useable graph of $y = x^3 - 13x + 12$ and $y = \frac{2}{5}x + 20$.

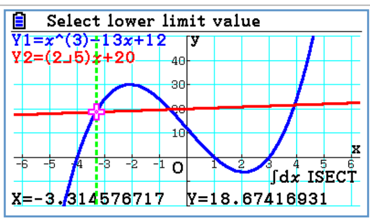


Press SHIFT and then G-Solv (F5) to open the G-Solv menu and then use ▷ (F6) to reveal more functions.

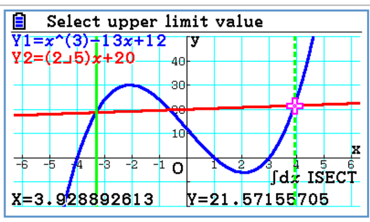
Use $\int dx$ (F3) to show the integral functions.



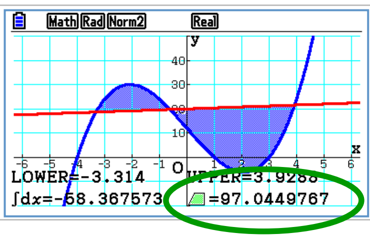
Use INTSECT (F3) to start the calculation.



The calculator will locate the left-most (visible) point of intersection between the two functions, to select it as the lower limit press EXE.



Then press ▶ ▶ to move the cursor to the right most (visible) point of intersection.



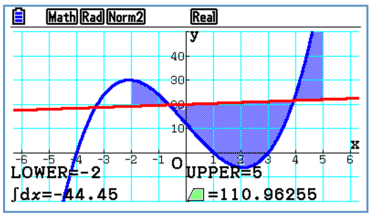
Press EXE to complete the calculation.

We can conclude that bounded area enclosed by the function $y = x^3 - 13x + 12$ and $y = \frac{2}{5}x + 20$ for $x \in \mathbb{R}$ is 97.04 square units, correct to 2 decimal places. If you are convinced there are no other points of intersection! ☺

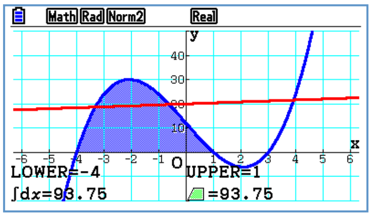
This calculator only incorporates intersection points in this calculation that have *x* co-ordinates in the visible domain.

To clear the shading from a previous calculation, while the graph is displayed, press SHIFT and then Sketch (F4) to open the Sketch menu and then use Cls (F1).

To calculate an approximate value for the area enclosed by the function $y = x^3 - 13x + 12$ and $y = \frac{2}{5}x + 20$ for $-2 \le x \le 5$, use the MIXED function.

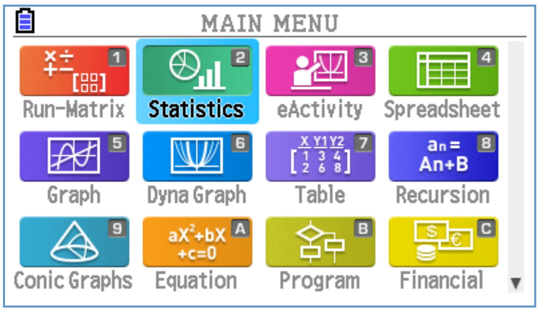


The ROOT function will calculate an approximate value for the area enclosed between a function and the x-axis between the roots (zeros / x-intercepts) of the function, without having to first calculate the roots.



Note that calculations of this type will always produce decimal approximations for the quantities being calculated.

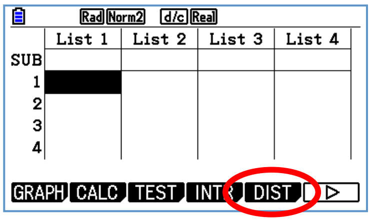
8. Probability



8.1 Binomial distribution

Y is a random variable with binomial distribution defined by n = 30 and p = 0.4.

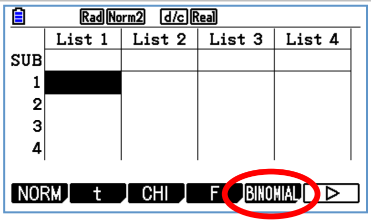
Calculate $\text{P}(Y = 10)$.



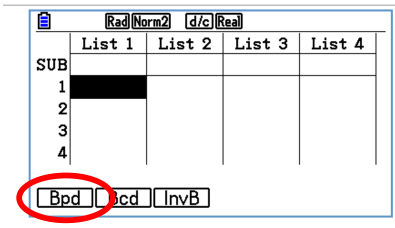
Open the 

application.

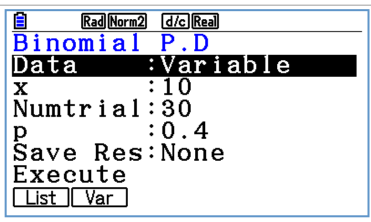
Use DIST (F5) to show the probability distribution list.



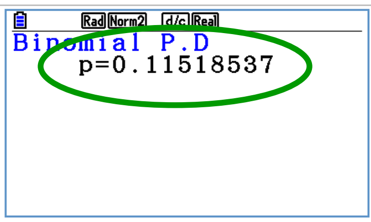
Use BINOMIAL (F5) to show the binomial distribution functions.



Use Bpd (F1) to start the calculation.



Set Data to Variable, x to 10, Numtrial to 30 and p to 0.4.

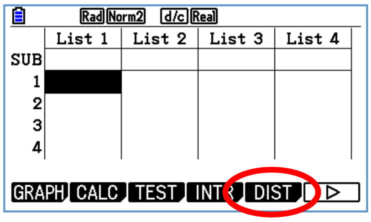


Press EXE to complete the calculation.

We can conclude that $\text{P}(Y = 10)$ = 0.12, correct to 2 decimal places.

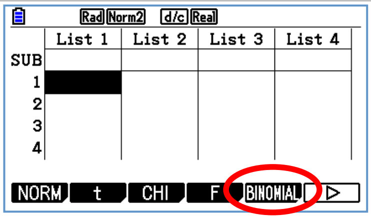
Y is a random variable with binomial distribution defined by n = 30 and p = 0.4.

Calculate $P(Y \geq 25)$.

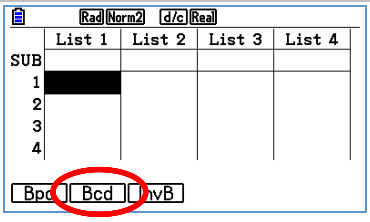


Open the Statistics application.

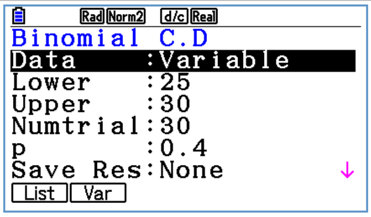
Use DIST (F5) to show the probability distribution list.



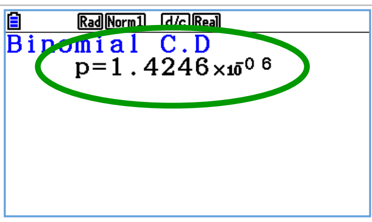
Use BINOMIAL (F5) to show the binomial distribution functions.



Use Bcd (F2) to start the calculation.



Set Data to Variable, Lower to 25, Upper to 30, Numtrial to 30 and p to 0.4.



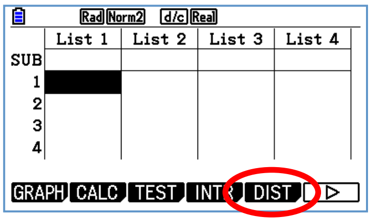
Press EXE to complete the calculation.

We can conclude that $P(Y \geq 25) = 0.00000142$, correct to 3 significant figures.
A very low chance!

8.2 Normal distribution

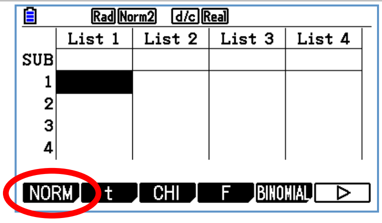
X is a random variable with normal distribution defined by $\mu = 30$ and $\sigma = 4$.

Calculate $P(X \le 32)$.

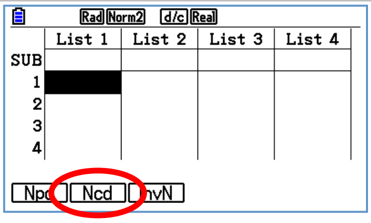


Open the Statistics application.

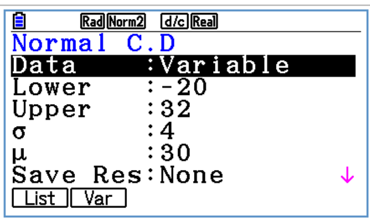
Use DIST (F5) to show the probability distribution list.



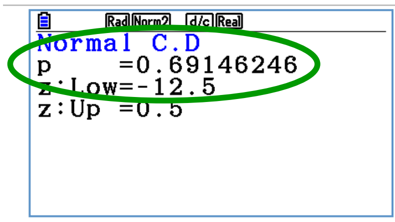
Use NORMAL (F1) to show the normal distribution functions.



Use Ncd (F2) to start the calculation.



Set Data to Variable, Lower to a number much smaller that three standard deviations under the mean, -20 in this case is suitable, Upper to 30, σ to 4 and μ to 30.



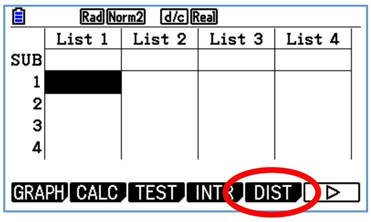
Press EXE to complete the calculation.

We can conclude that $P(X \le 32) = 0.69$, correct to 2 decimal places.

The Z-scores that correspond to the lower and upper values of X are also displayed.

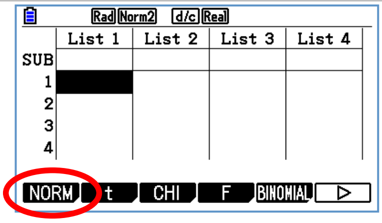
X is a random variable with normal distribution defined by $\mu = 30$ and $\sigma = 4$.

Calculate the values of x if $\mathrm{P}(X \geq x) = 0.2$.

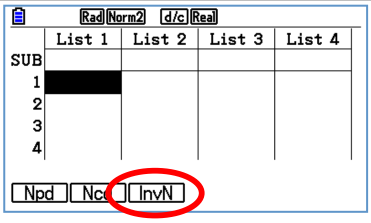


Open the  application.

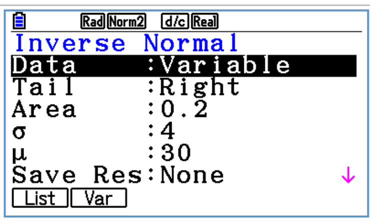
Use DIST (F5) to show the probability distribution list.



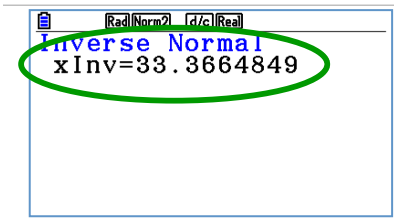
Use NORMAL (F1) to show the normal distribution functions.



Use InvN (F3) to start the calculation.



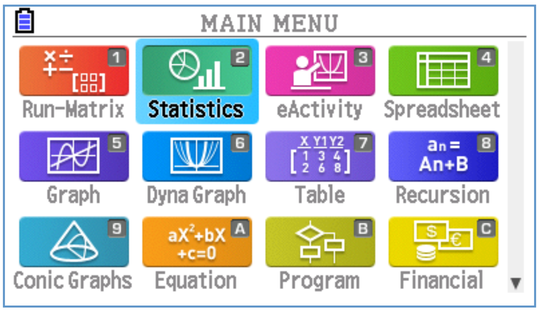
Set Data to Variable, Tail to Right, Area to 0.2, σ to 4 and μ to 30.



Press EXE to complete the calculation.

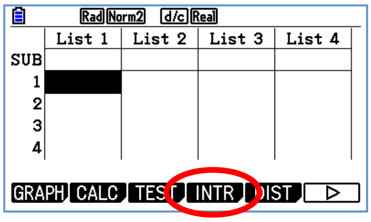
We can conclude that $\mathrm{P}(X \geq 33.37) = 0.2$, correct to 2 decimal places.

9. Confidence Intervals



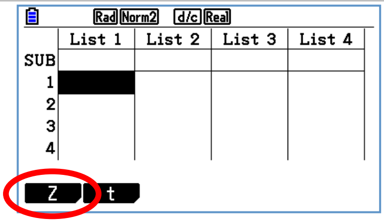
9.1 CI for the population proportion

A random sample of 350 high school students from the large city called Blenker are surveyed and asked if they support a 4-day school week. 310 voted no.
Calculate an approximate 95% confidence interval, based on the standard normal (Z) distribution, for the proportion of the population that do not support a 4-day school week.

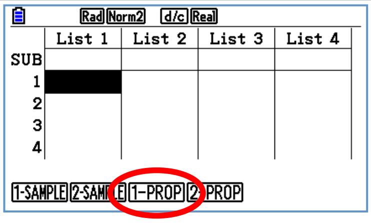


Open the Statistics application.

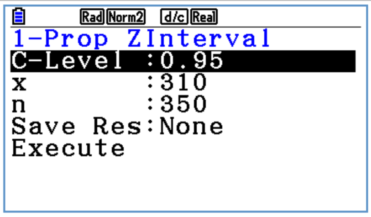
Use INTR (F4) to show the interval options.



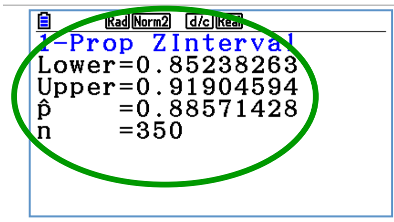
Use Z (F1) to choose an interval based on the Z-distribution.



Use 1-PROP (F3) to start the calculation.



Set C-level to 0.95, x to 310 and n to 350.



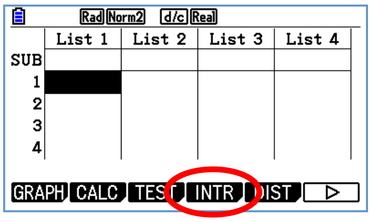
Press EXE to complete the calculation.

Thus, an approximate 95% confidence interval, based on the standard normal (Z) distribution, for the proportion of the population that do not support a 4-day school week is $0.85 \le p \le 0.92$.

The sample proportion ($\hat{p}$) is also displayed, 0.886, in this case.

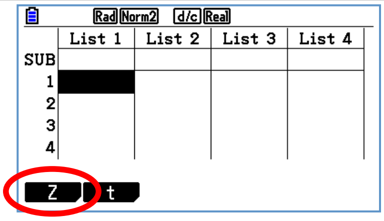
9.2 CI for the population mean

A random sample of 270 female high school students from the large city called Blenker are surveyed and asked to record their height. The average ($\bar{x}$) of the 270 recorded heights was 163.4 cm.
Calculate an approximate 95% confidence interval, based on the standard normal (*Z*) distribution, for the mean height (μ) of the population.
Assume the standard deviation (σ) of the heights of all female high school students from Blenker is 6 cm.

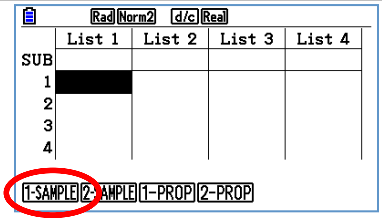


Open the Statistics application.

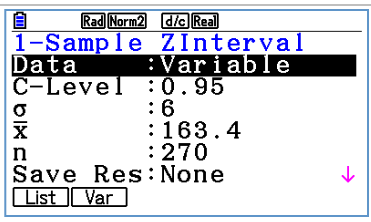
Use INTR (F4) to show the interval options.



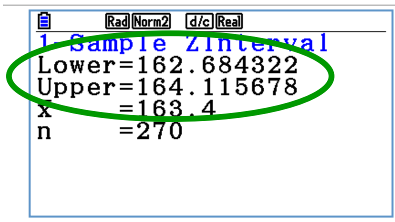
Use Z (F1) to choose an interval based on the *Z*-distribution.



Use 1-SAMPLE (F3) to start the calculation.



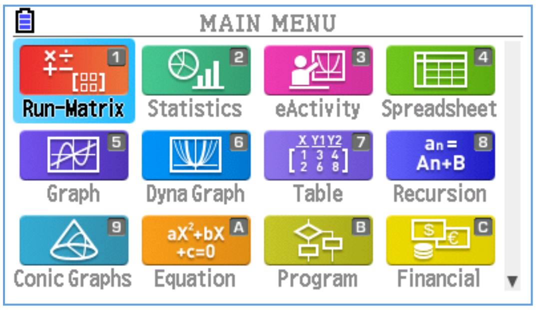
Set Data to Variable, C-level to 0.95, σ to 6, $\bar{x}$ to 163.4 and n to 270.



Press EXE to complete the calculation.

Thus, an approximate 95% confidence interval, based on the standard normal (Z) distribution, for the mean height (μ) of the population is $162.7 \le \mu \le 164.1$.

10. Matrices

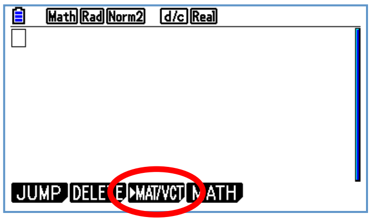


MAIN MENU
Run-Matrix
Statistics
eActivity
Spreadsheet
Graph
Dyna Graph
Table
Recursion
Conic Graphs
Equation
Program
Financial

10.1 Operating with matrices

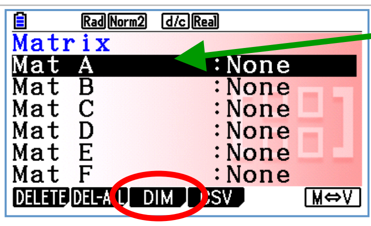
$$\mathbf{A}=\begin{bmatrix}2 & -4\\ 1 & 5\\ 3 & 1\end{bmatrix},\ \mathbf{B}=\begin{bmatrix}1 & 4 & 2\\ -2 & 5 & 3\end{bmatrix}\text{ and }\mathbf{C}=\begin{bmatrix}2 & 1 & 5\\ -4 & 1 & 0\\ 2 & 7 & 1\end{bmatrix}$$

Calculate 3**AB**.

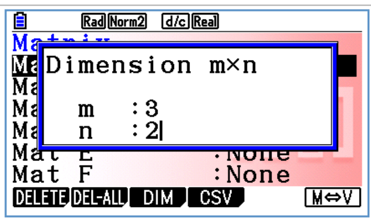


Open the  application.

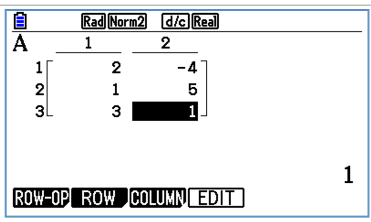
▶MAT/VCT (F3) to show the matrix options.



With Mat A selected use DIM (F3) to define the dimensions of matrix A.

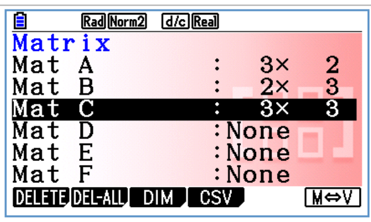


Set m to 3 and n to 2, since **A** is a 3 by 2 matrix.

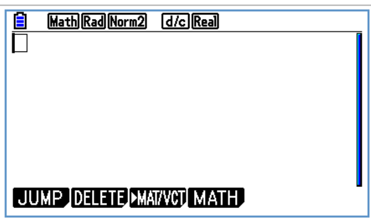


Press EXE to enter the dimensions.

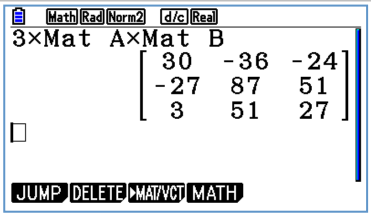
Then enter each element, pressing EXE after each one.



Press EXIT go back and define the dimensions of, and enter the elements of, matrix **B** and **C**.



Once each matrix is defined, press EXIT to return to the calculation screen.



Now enter:

3 ×

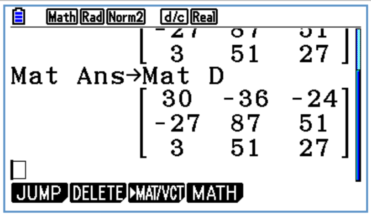
SHIFT and then Mat (2) from the keyboard then ALPHA A

×

SHIFT and then Mat (2) then ALPHA B

EXE

And the resulting 3 by 3 matrix is displayed.



To store this matrix, as **D**, for later use:

SHIFT and then Mat (2)

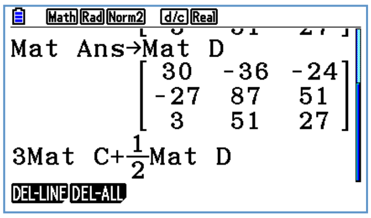
SHIFT Ans ((−))

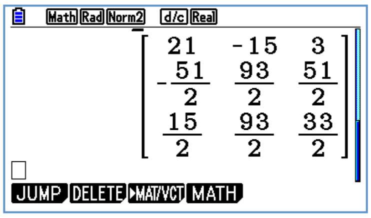
→

SHIFT and then Mat (2) then ALPHA D

EXE

Since D and C have the same dimensions, we could add together any multiple of each, for example $3\mathbf{C} + \frac{1}{2}\mathbf{D}$.

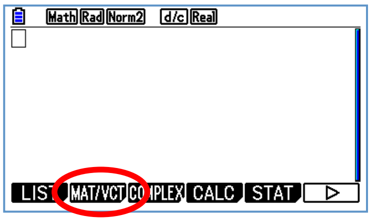




Try it, and check your result matches mine!

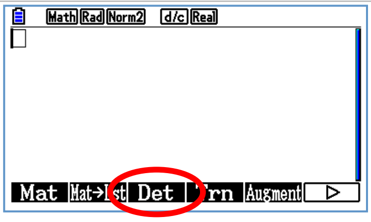
10.2 Determinant and inverse

As defined earlier, $\mathbf{C} = \begin{bmatrix} 2 & 1 & 5 \\ -4 & 1 & 0 \\ 2 & 7 & 1 \end{bmatrix}$. Find the determinant of **C** and, if it exists, $\mathbf{C}^{-1}$.

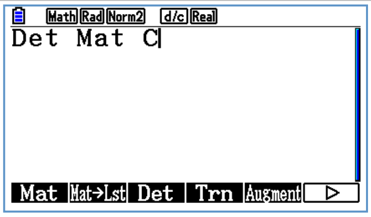


Open the 

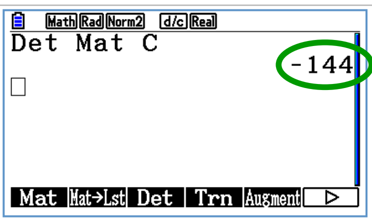
application.
Press OPTN to open the option menu.
Use MAT/VCT (F2) to show the matrix functions.



Use DET (F3) to begin the calculation.

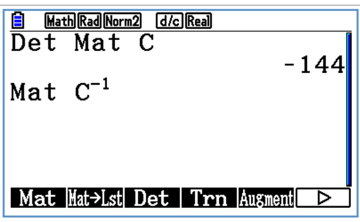


Then SHIFT and then Mat (2) then ALPHA C.

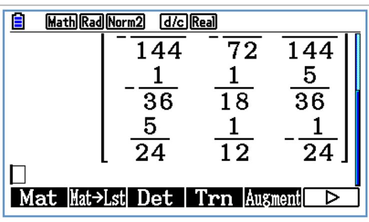


Press EXE to complete the calculation.

Thus the determinant of **C** is -144.

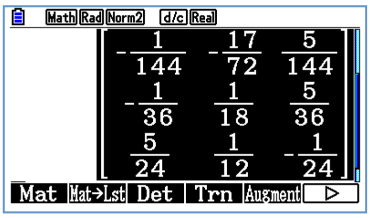


To find $\mathbf{C}^{-1}$
SHIFT and then Mat (2) then ALPHA C
^
− 1



Press EXE to complete the calculation.

Using ▲ allows you to see the whole matrix.

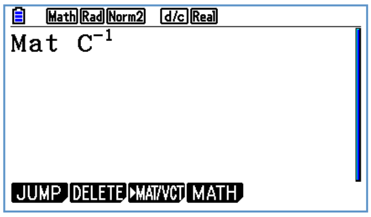


10.3 Matrix equation

As defined earlier, $\mathbf{C} = \begin{bmatrix} 2 & 1 & 5 \\ -4 & 1 & 0 \\ 2 & 7 & 1 \end{bmatrix}$.

Let $\mathbf{X} = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$ and $\mathbf{CX} = \begin{bmatrix} 2 \\ 1 \\ 2 \end{bmatrix}$.

Therefore $\mathbf{X} = \mathbf{C}^{-1} \begin{bmatrix} 2 \\ 1 \\ 2 \end{bmatrix}$. Calculate **X**.

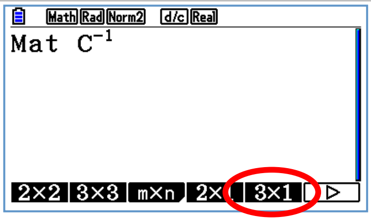


Open the Run-Matrix application. Then:

SHIFT and then Mat (2) then ALPHA C

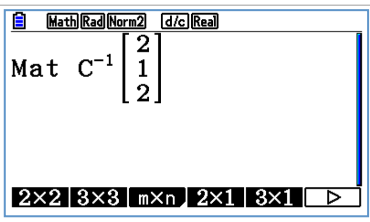
↑

− 1



There is a 'quick' method to enter a matrix if we do not want to define it. We will use the 'quick' method to enter $\begin{bmatrix} 2 \\ 1 \\ 2 \end{bmatrix}$.

Use MATH (F4) and then MAT/VCT (F1) to reveal the screen opposite.
Use 3X1 (F5) to enter a matrix template.



Then enter:

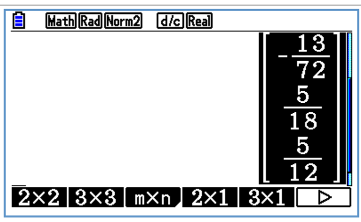
2

▼

1

▼

2 (Do not press EXE in between each element.)



Press EXE to complete the calculation.

Thus $\mathbf{X} = \begin{bmatrix} -\frac{13}{72} \\ \frac{5}{18} \\ \frac{5}{12} \end{bmatrix}$.

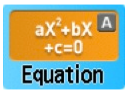
10.4 Systems of linear equations

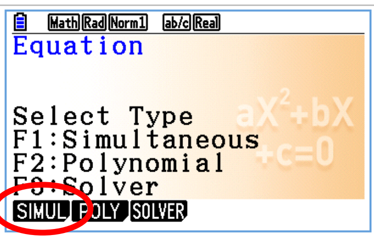
Some systems of linear equations (aka simultaneous equations) can be solved efficiently using your mind and paper and pen to document your thinking.

For example, solve $\begin{matrix} 5x+2y=7 \\ y=8-x \end{matrix}$.

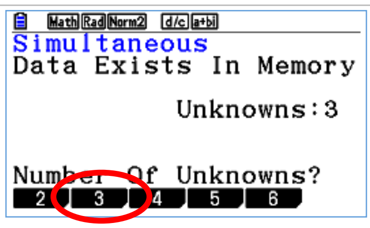
$5x+2y=7$ and $y=8-x$
$\Rightarrow 5x+2(8-x)=7$
$\Rightarrow 5x+16-2x=7$
$\Rightarrow 3x=-9$
$\Rightarrow x=-3$
$\therefore x=-3$ and $y=11$.

However, other systems, like some with three unknowns, are more efficiently solved using digital technology.

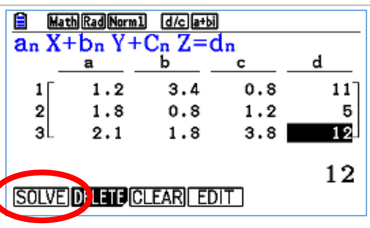
For example, to solve the system $\begin{matrix} 1.2x+3.4y+0.8z=11 \\ 1.8x+0.8y+1.2z=5 \\ 2.1x+1.8y+3.8z=12 \end{matrix}$ we could use the  application.



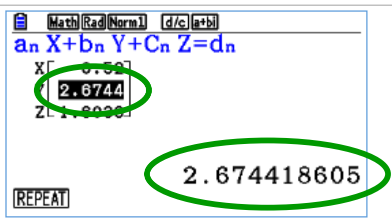
Open the SIMUL (F1) menu.



Choose 3 (F2) as this system has three variables (unknowns).



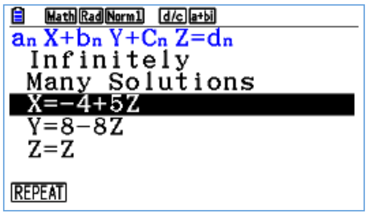
For entry purposes, each equation must be of the form $ax+by+cz=d$. Enter the coefficients of each equation into the matrix provided.
EXE between each entry.
Then SOLVE (F1).



Note that a maximum of five figures (truncated) for each value in the solution set is displayed in the table. The selected value is displayed with more figures at the bottom right of the screen. Use the cursor keys (▲, ▼) to move up and down to see each result with more figures or in exact form (if it is possible for the machine to calculate it).

This application can find solutions for systems containing from two up to six unknowns.
It cannot find solutions to systems with non-unique solutions. The application of elementary row operations to an augmented matrix can be used in such cases.

Solving the system $\begin{aligned} 3x+2y+z&=4 \\ x+y+3z&=4 \\ 5x+3y-1z&=4 \end{aligned}$ using the simultaneous mode of the Equation application gives the solution seen right.



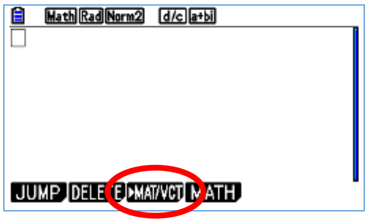
This system does not have a unique solution, but as stated, infinitely many solutions. Such a result can also be determined by applying elementary row operations to an augmented matrix in an attempt to produce reduced row echelon form.

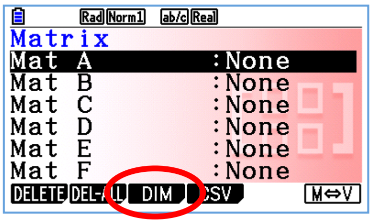
$$\left[\begin{array}{ccc|c} 3 & 2 & 1 & 4 \\ 1 & 1 & 3 & 4 \\ 5 & 3 & -1 & 4 \end{array}\right]$$

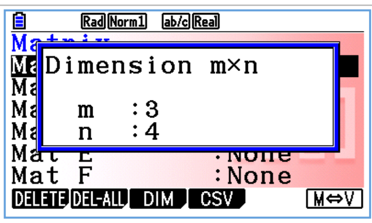
$$\left[\begin{array}{ccc|c} 3 & 2 & 1 & 4 \\ 1 & 1 & 3 & 4 \\ 0 & 2 & 16 & 16 \end{array}\right] \quad 5R_2-R_3$$

and so on.

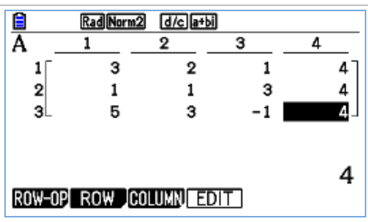
Reduced row echelon form can be reached efficiently using the Run-Matrix application. To define the matrix, open ▷MAT/VCT (F3) and then open DIM (F3).



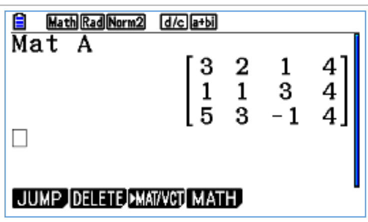




Set m and n to be 3 and 4 respectively.
EXE between each entry and
EXE to complete the definition of the dimension.

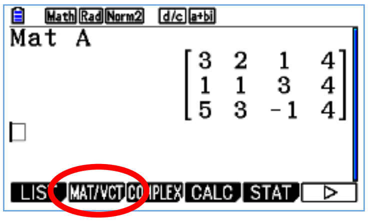


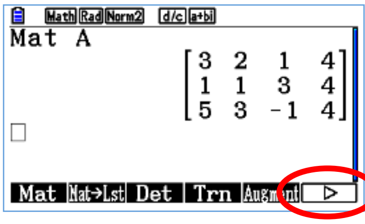
Enter the elements of the matrix,
EXE between each entry.
EXIT twice to return to the working area of this application.

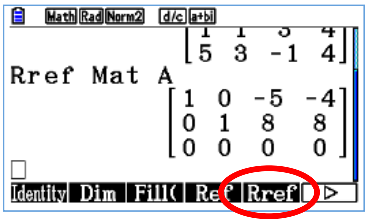


Look above the number 2 key, you will see Mat.
To display the matrix (Mat A), press (and release)
SHIFT, 2 (Mat) and then ALPHA, X,θ,T (A).
EXE to see the matrix.

To transform matrix A to reduced row echelon form press OPTN, MAT/VCT (F2), ▷ (F6) and then Rref (F5) followed by Mat A and EXE.







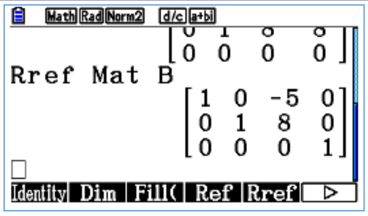
$$\left[\begin{array}{ccc|c} 1 & 0 & -5 & -4 \\ 0 & 1 & 8 & 8 \\ 0 & 0 & 0 & 0 \end{array}\right].$$

A row of zeros implies infinitely many solutions.

Let $z = t$, $z \in R$.
From R2, $y = 8 - 8t$
From R1, $z = -4 + 5t$

Thus we reach the same solution produced in the Equation application.

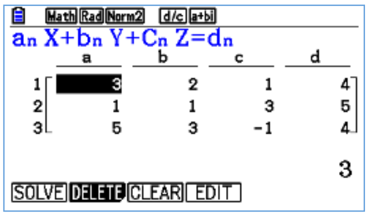
Attempting to solve the system
$$\begin{aligned} 3x+2y+z&=4 \\ x+y+3z&=5 \\ 5x+3y-1z&=4 \end{aligned}$$
gives:

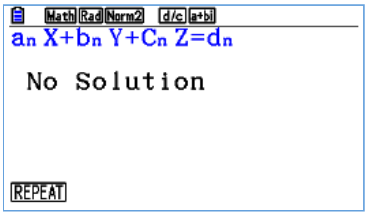


$$\left[\begin{array}{ccc|c} 1 & 0 & -5 & 0 \\ 0 & 1 & 8 & 0 \\ 0 & 0 & 0 & 1 \end{array}\right]$$

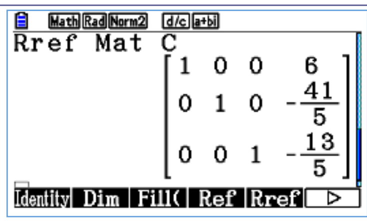
From R_3 we see $0 = 1$.
This is a contradiction, this system has no solutions.
It is said to be inconsistent.

Solving the system in the Equation application gives:





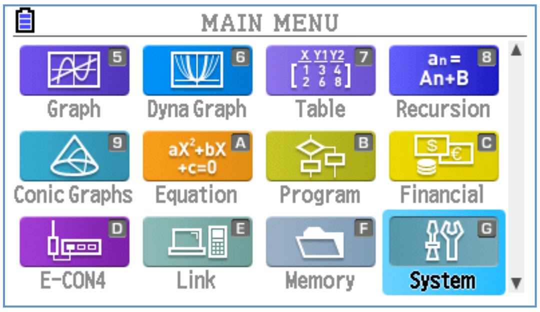
Attempting to solve the system
$$\begin{aligned} 4x+2y+z&=5 \\ 2x+y+3z&=-4 \\ 3x+3y-1z&=-4 \end{aligned}$$
gives:

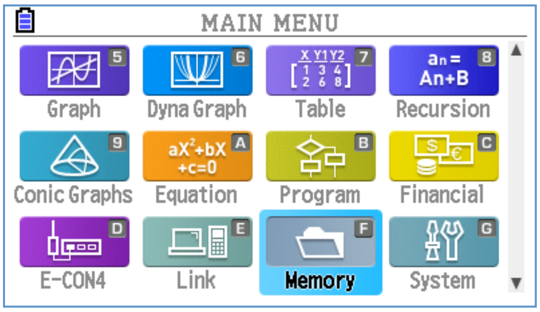


$$\left[\begin{array}{ccc|c} 1 & 0 & 0 & 6 \\ 0 & 1 & 0 & -\frac{41}{5} \\ 0 & 0 & 1 & -\frac{13}{5} \end{array}\right]$$

This system has a unique solution.
$x = 6$, $y = -\frac{41}{5}$, $z = -\frac{13}{5}$.

11. Managing my calculator



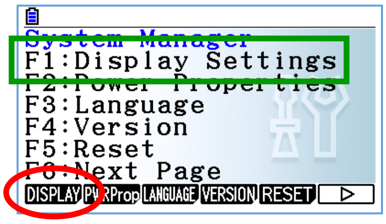


11.1 Display Settings & Power Properties

The brightness of the backlight of your calculator's screen can be altered. A continually bright backlight will result in a shorter battery life.

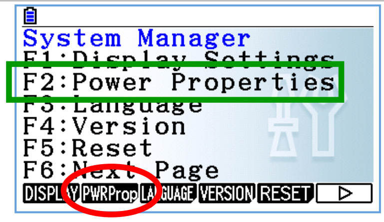
Open the  application.

Choose Display Settings by pressing DISPLAY ([F1]).



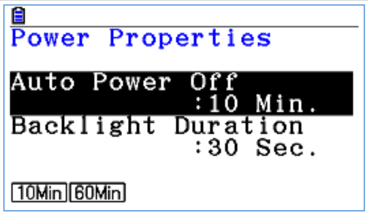
Now hold down the [◀] or [▶] key to alter the brightness of the screen to suit you.
Press [EXIT] to return to the System Manager menu.

Choose Power Properties by pressing PWRProp [F2].



Here you can make changes to the time that passes before the calculator will Power Off.

You can also effect change on the time that passes before the backlight dims.
When the backlight dims the brightness can be restored by pressing any key on the calculator.

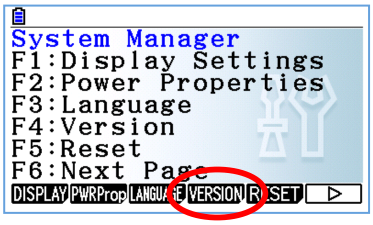


11.2 Operating System update.

This calculator's operating system is upgradeable. New releases of the operating system occur from time to time.

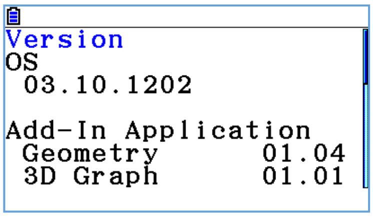
Open the  application.

Open the VERSION (F4) menu.

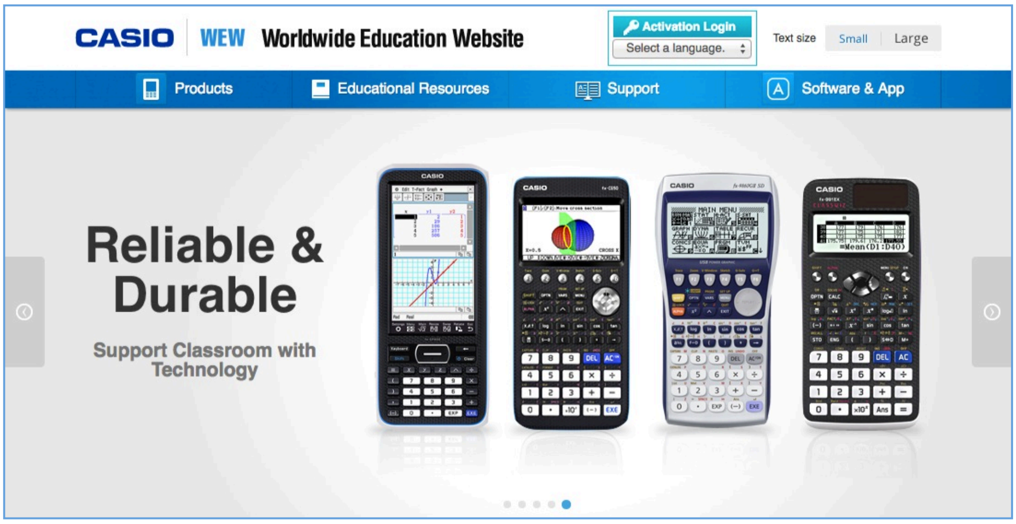


The version of the operating system (OS) currently installed on your calculator will be displayed along with the version numbers for the Add-In applications installed.

At the time of writing the current OS was OS 03.10.1202.



For information about the latest operating system please visit http://edu.casio.com
Operating system upgrades are free.



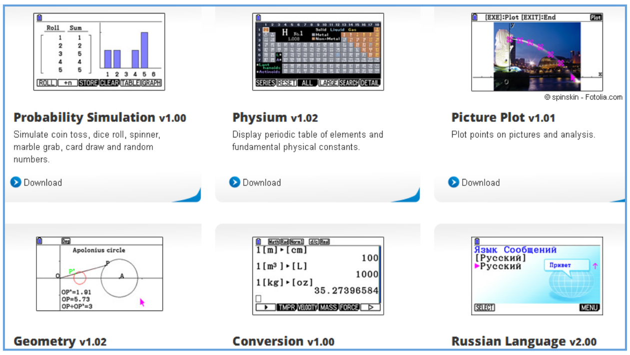
11.3 Types of memory

This calculator has two types of memory storage: Main Memory and Storage Memory.

When you define functions, draw graphs, perform calculations, solve equations and so on, the calculator is using and storing things in the Main Memory.

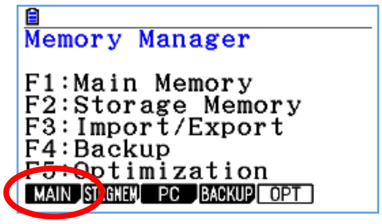
Storage Memory serves three functions. You can store data in there and copy it into the Main Memory when you need it (freeing up the Main Memory for processing), Add-In applications are stored and run from here, photos are stored here and finally eActivities are stored and run from this memory too.

You can find Add-In applications at http://edu.casio.com



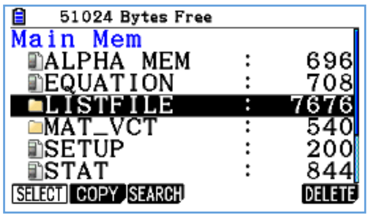
Open the 

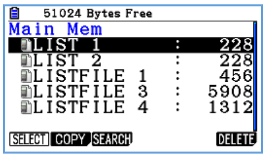
application.



Open the MAIN (F1) menu.

Notice that some words have a folder icon to their left, e.g. LISTFILE.
This indicates it is a folder that contains other files. Select LISTFILE and press EXE to see the files.





In these menus you can SELECT (F1) and COPY (F2) data to the Storage Memory.
You can then DELETE (F6) data to free up the Main Memory for working.

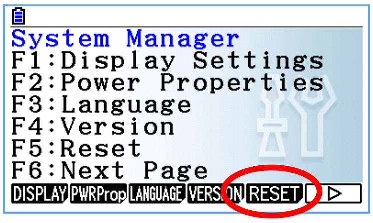
EXIT EXIT to return to the Memory Manager menu.

Storage memory is ‘flash’ memory and can be accessed on a computer via the USB port on the calculator. It works just like a USB memory stick works. Add-In applications (and other data) can be simply transferred to the calculator using this feature.

11.4 Resetting your calculator

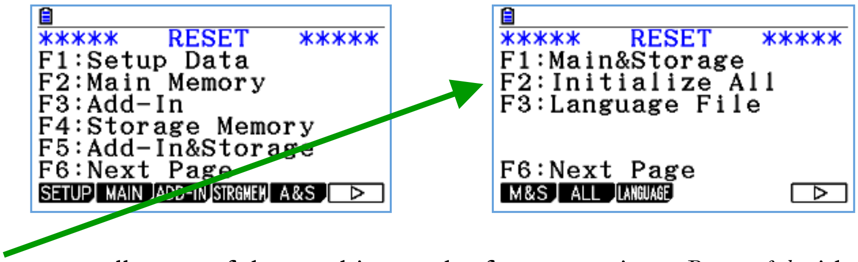
You can reset all parts, or selected parts, of your calculator's memories.

Open the  application.



Open the RESET (F5) menu.

There are a variety of different options you can choose.



Initialize All returns all parts of the machine to the factory settings. *Be careful* with this one. It will erase all data from all calculator memories.

11.5 Backing up and optimizing

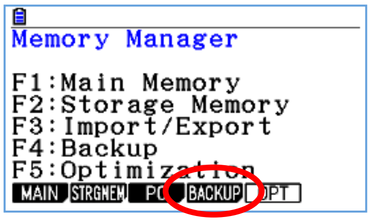
The more you use your calculator the more data you create, some of which will be saved in the calculator's memory, especially if you use programs and eActivities.

If you have data saved on your calculator you do not want to lose in the event of a malfunction, you should regularly backup your calculator.

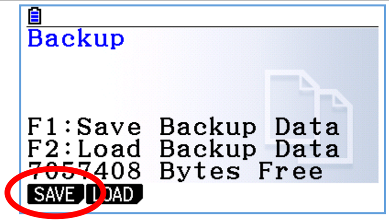
Open the 

application.

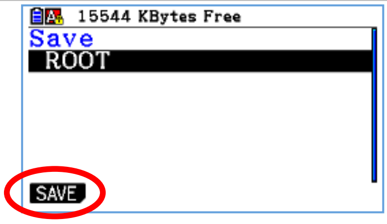
Press BACKUP (F4) to open the Backup menu.



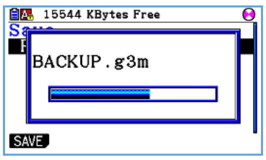
Press SAVE (F1) to start the backup process.

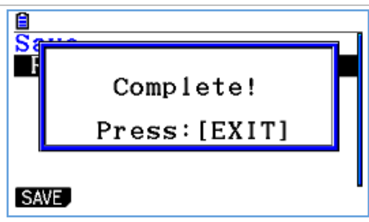


Select ROOT, which refers to the root directory of the calculator's flash memory and press SAVE (F1).



The backup process will not take too long and when completed a file named BACKUP.g3m will be stored in the root directory of the calculator's storage memory area.

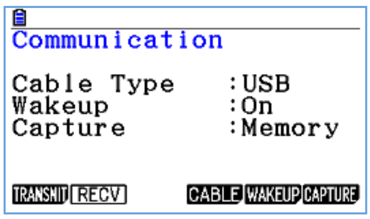




The file called BACKUP.g3m should be transferred to a computer and renamed for safe keeping.

To do this, open the 

application of your calculator and make sure the settings are as shown right.

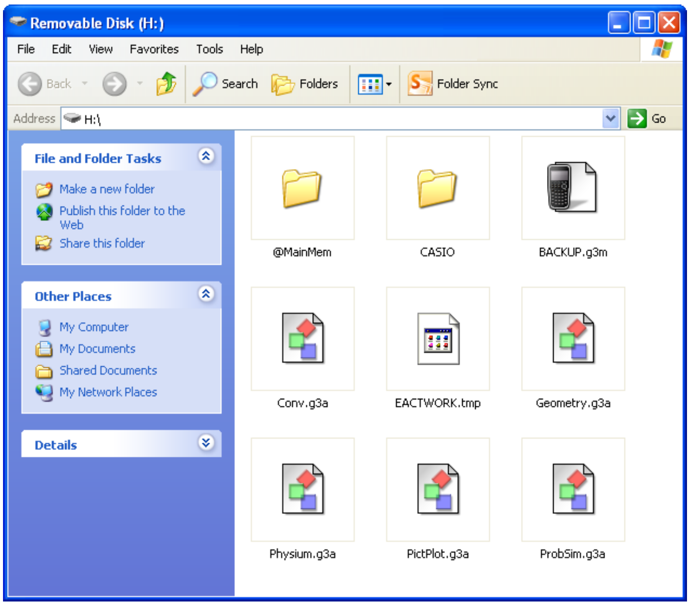


We will be communicating via the USB cable that came in the box of your calculator.

The Wakeup option needs to be On so that the calculator will automatically go into communication mode.

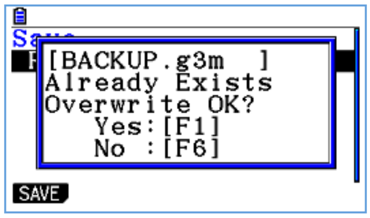
Now connect the calculator to a computer using a USB to mini-USB cable. On the screen of the calculator you will be asked to choose a connection mode – choose USB Flash (F1).

The flash memory area of your calculator will mount on the computer's desktop and you will be able to see the contents. It should look similar to that seen right.



Copy the BACKUP.g3m file onto your computer and re-name it with a name that includes a date.

If you try to back-up your calculator with a file called BACKUP.g3m in the root directory of the flash memory, the warning message seen right will be displayed.



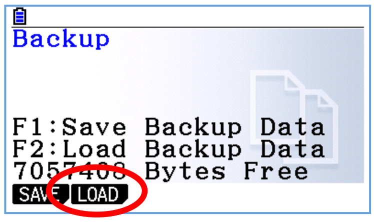
If you have transferred previous back-ups to your computer you could happily over-write it.

Putting the contents of a back-up file back into your calculator can be done as follows.

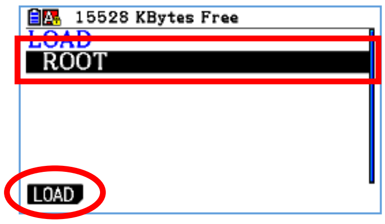
Save the appropriate back-up file into the root directory of your calculator's flash memory. **Be sure it is named BACKUP.g3m – if it is not, the calculator will not recognise it as a back-up file**.

Open the  application.

Press BACKUP (F4) to open the Backup menu.
Press LOAD (F2) to load a back-up file.



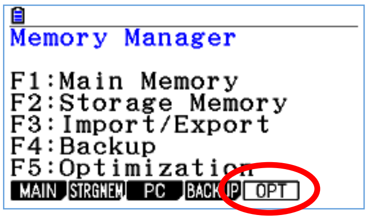
Choose ROOT and then press LOAD (F1) to start the process.



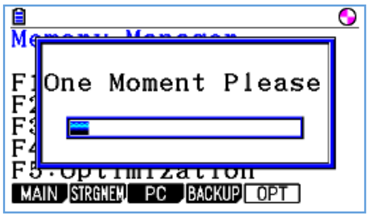
Like all computer devices, the memory of your calculator can become fragmented. To keep your calculator in good health, a ‘de-frag’, or optimise, option is provided. If important data is saved on your calculator, backup the calculator’s memory before optimising.

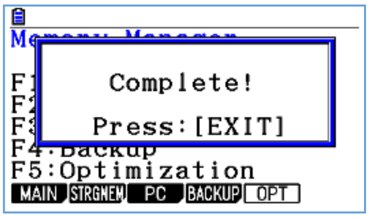
Open the  application.

Use OPT (F5) to begin the optimization process.



The process will take a minute or two to complete, depending on how much data you have stored in the calculator.





My notes

Index

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